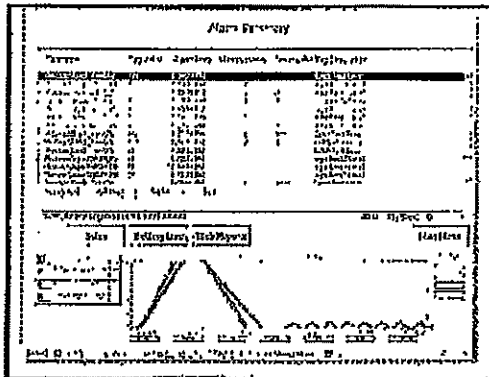




Schedule printing of graphic displays

Use a simple command to print any graphic display in the project at any time. You might want to schedule screen prints for auditing purposes or automatically print a graphic display when a particular event (such as a high-priority alarm) occurs. You can print a graphic display even if it is not running.

Manage screen real estate with display types

Manage your graphic displays at runtime by using one of three display types. The Replace display type opens a new display and automatically closes open displays using a single Display command. The On Top display type keeps a graphic display, such as a pop up display, on top of other displays already open on the screen. The Overlay display type allows multiple displays to run simultaneously, even if they overlap.

Display data values in trends

Track plant activity as it happens by dropping the ActiveX control, RSView32 TrendX, into a graphic display. TrendX provides real-time and historical trending for up to 100 tags on a single trend with extensive, flexible runtime capabilities. RSView32 also offers native trending with preconfigured objects available in the graphics library.

COMPREHENSIVE ALARMS EDITOR

RSView32 offers a complete, flexible alarm system. Display alarm messages on the screen, in an alarm log viewer, or export the DWP alarm log data to any ODBC-compliant database program.

RSView32 alarm monitoring allows you to:

- Monitor up to 40,000 tags for alarms.
- Define up to eight severity levels to distinguish alarms visually and audibly.
- Define up to eight alarm thresholds with different levels of alarm severity to indicate an alarm's importance. Attract attention to high-priority alarms with blinking colors in the alarm summary.
- Add user-defined remarks to the alarm log description field.

- Tie alarm thresholds to tags to provide dynamic threshold values that change with a process.
- Filter alarm summaries to display only those alarms you need to monitor.
- Associate a script with an alarm to provide custom handling. For example, open a display that contains instructions on how to correct the alarm condition.
- Set up global alarm monitoring. Operators can acknowledge an alarm at one station and have it recognized at all stations.
- Notify a programmable controller that RSView32 has received an alarm.

Use RSView32 Messenger, an optional software extension, to announce alarms through pagers, faxes, email, telephones, cell phones, or even locally on your computer using a sound card.

FULL-FEATURED DATA LOG EDITOR

Data logging records specific tag values under conditions defined by up to 20 different log models. Data is stored in .DWF format and can be displayed in trends, archived for future processing or analysis, and displayed or analyzed using third-party software, such as Microsoft Excel, Crystal Reports®, FoxPro®, and RSTrend™. ODBC database support lets you log RSView32 tag data to an ODBC-compliant database, such as Microsoft SQL Server, Oracle®, or Sybase®. You can still view the data graphically in a trend. You can specify a secondary path for all logged data. If the primary path becomes full or unavailable, RSView32 can automatically switch to the secondary path without losing any data. RSView32 automatically detects when the primary path is restored and reroutes the data from the secondary path back to the primary path so that you retain all of your data in one location.

SOPHISTICATED LOGIC AND CONTROL EDITOR

RSView32 offers derived tags, event control, expressions, macros, and embedded Visual Basic® for Applications. Use these powerful options to customize and automate your RSView32 projects.

Continuously calculate values with derived tags

A derived tag's value is the result of an expression. The expression can include mathematical operations, tag values from the RSView32 internal value table, IF-then-else logic, and other functions. Use derived tags to perform continuous evaluations on a tag or for any loop processing.

Trigger actions with event expressions

An event is an expression that triggers actions. You might use event detection to respond automatically to an alarm. Or as a tank approaches a specified fill level, it might warn the operator by opening a Web browser and displaying instructions from your company's Internet site.

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ROCKWELL PART# 93012SE3300

Run sequenced commands from a macro file

A macro is a series of commands stored in a file. Use the macro file menu like a command and enter it anywhere you can use an RSView32 command. Entering a macro file name runs the macro and sequentially executes all the commands in the file.

SECURITY FEATURES

Secure RSView32 at the project level

RSView32 provides 16 levels of security to safeguard your system at the project level. Assign levels of security to commands, alarms, database tags, graphic displays, and OLE with control. Assigning combinations of security levels to individuals or to groups of users allows different users access to different sets of features.

Secure RSView32 at the system level

At the system level, lock users into your RSView32 application so they cannot exit the Windows operating system during runtime. Enabling Windows security synchronizes the user account list to the user list of one domain controller, providing a means for centralizing security management and allowing users a single login. Launching RSView32 automatically logs a Windows user into RSView32. Changing the RSView32 password also changes the Windows user password.

CUSTOMIZE AND EXTEND RSVIEW32

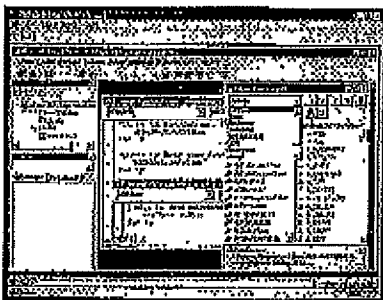
Customize projects with startup preferences

Use startup preferences to customize how a project looks and operates at runtime. Specify which graphic to display first, which window elements to display, and whether to disable or enable certain accelerator key sequences. You can also specify which subsystems to start automatically, including alarms, data logging, derived tags, and event detector.

Fully integrated VBA programming language

Microsoft Visual Basic for Applications (VBA) is fully integrated in the RSView32 core product. With the VBA integrated development environment, you can create, test, and debug VBA subroutines, and then run the subroutines from within RSView32.

By writing VBA code that interacts with the runtime Object Model of RSView32, you can manipulate RSView32 programmatically, extend its functionality, and automate processes.



OPC (OLE for Process Control)

RSView32 can function as both a native OPC client and OPC server. As an OPC server, RSView32 can serve data up to other applications. As an OPC client, RSView32 can communicate with a variety of devices and networks that cover all of your equipment, not just the Allen-Bradley devices.

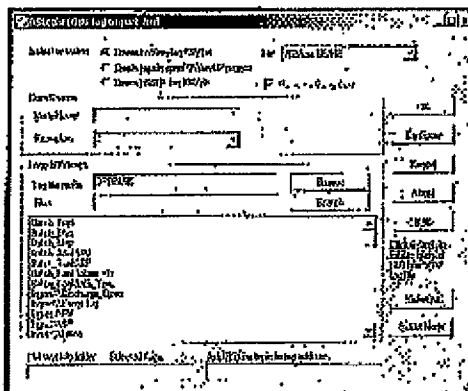
Customize RSView32 core features with Add-on Architecture

Add-on Architecture technology expands the functionality of RSView32 by integrating new software components directly into its core. Customize the RSView32 runtime set by installing only those components you need.

ADDITIONAL RSVIEW32 FEATURES

RSLogix 5000 Tag Import utility

The RSLogix 5000 Tag Import utility imports RSLogix 5000 tags into RSView32, RSView Studio and RS5ql*. In RSView32 v7.20, this utility has been enhanced to provide support for all ControlLogix, FlexLogix*, and CompactLogix* I/O modules. In addition, it provides support for up to 100,000 tags, arrays, user-defined data structures, module tags, and alias tags.



RSView LogViewer

The RSView LogViewer tool is an ActiveX control for displaying DataLog, Alarm Log, or Activity Log data in a grid format. It allows you to modify filter settings, select log type, display fields, data sort order and time span, or to indicate a specific time.

With RSView32 v7.20, the LogViewer ActiveX is installed as part of the core RSView32 tools.

Update projects online

RSView32 saves you time with runtime changes that don't require you to shut down your process. Edit graphic displays online, and the changes will take effect the next time you open the display. When you add or edit tags online, the changes take effect immediately.

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Organize tags in folders

RSView32 uses a convenient, intuitive folder structure to organize tags. For example, you might group all tags for Tank1 in one folder and tags for Tank2 in another folder. Browse for tags anywhere within RSView32 or from within VBA.

Reuse tag databases

RSView32 can reuse the same tags created in a PLC application. Simply open the tag browser and point and click to select the tags. Import an individual tag or groups of tags from an Allen-Bradley® PLC, SIM, or ControlLogix® database.

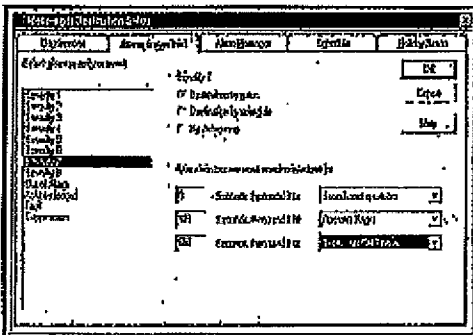
RSVIEW32 ADD-ONS

At no additional charge, you can install the following RSView32 Add-ons based on your needs:

RSView32 Messenger

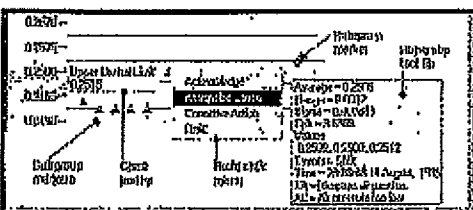
RSView32 Messenger announces alarms and simple reports through pagers, faxes, email, telephones, cell phones, or even locally on your computer using a sound card. With its scheduling capabilities, you can accommodate holidays, weekends, and business trips.

With RSView32 v7.20, Messenger has been enhanced to allow the pager setup to be modified during runtime.



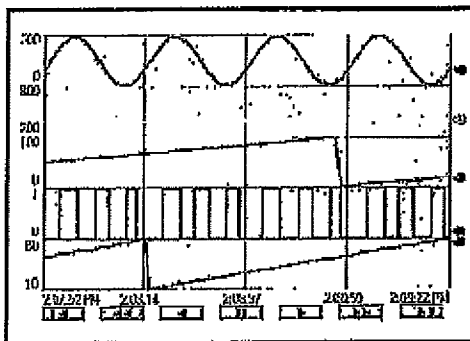
RSView32 SPC

This Add-on offers an integrated Statistical Process Control solution that provides real time SPC analysis. SPC provides statistical methods for analyzing and controlling the variation of a process. Controlling a process is essential for producing quality products.



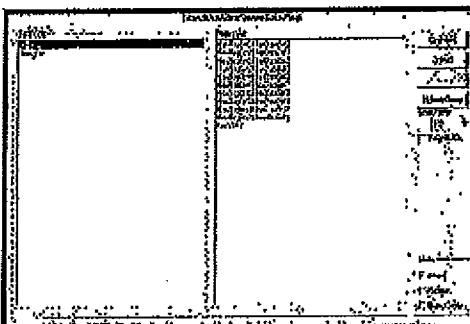
RSView32 TrendX

TrendX is an ActiveX control that integrates with RSView32 to provide real-time and historical trending from RSView32 data logs. TrendX offers extensive, flexible runtime control. Add up to 100 points on the fly, toggle between stacked and overlapping trend lines, specify unique pen configurations, and plot one variable against another. Compare data by overlaying multiple trend snapshots, click and drag to reposition overlays, and click and drag to zoom in and pan through trend data.



RSView32 RecipePro

RSView32 RecipePro provides enhanced recipe management capability that allows you to configure multiple recipe project files in each RSView32 project and easily transfer process data requests to and from your automation equipment.



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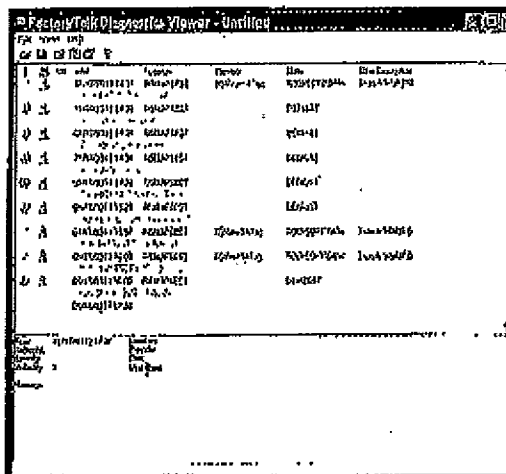
The screenshot shows a web browser window displaying the Rockwell Brewery website. The browser's address bar shows 'http://www.rockwellbrewery.com/'. The website features a dark, textured background with a large image of a building. The text 'Rockwell Brewery' is prominently displayed at the top. Below it, there is a list of products: 'Rockwell Lager', 'Rockwell Pilsner', and 'Rockwell Stout'. The website also includes a navigation menu with links like 'Home', 'About Us', 'Contact Us', and 'FAQ'. The browser window is titled 'Rockwell Brewery' and shows the standard Windows interface of the early 2000s.

FactoryTalk® is a manufacturing information platform that integrates plant-wide control systems and connects the enterprise with the production facility. RSView32 v7.20 adopts the following three FactoryTalk technologies:

RSView32 is a FactoryTalk® Live Data™ server that provides tags to FactoryTalk clients such as RSView® Supervisory Edition™ and RSWinWare™ software products.

This feature allows RSVIEW32 to log warning, error, and diagnostic messages to a system-wide FactoryTalk® Diagnostics destination. The diagnostic messages can be viewed with a FactoryTalk Diagnostics Viewer.

With RSVision 3.27.20, the old floppy disk-based activation has been replaced by the new "PartwayTalk" Activation™ system that is based on activation files generated by Rockwell Software and distributed over the Internet.



RECOMMENDED REQUIREMENTS

The hardware and software you need for RSVIEW32 depends on the demands your project places on the system. The following tables use points to rate the demands that various uses place on your system.

Use the first table to find the demand (or total profits) your project places on the system. Use the second table to determine the hardware and software you need.

ROCKWELL PART# 93012SE3300

For	If you use	R5View32
R5View32 Project	Running displays, or adding your project using R5View32 Work	Add 7 points
	Using more than 30,000 tags	Add 2 points
	Using more than 5,000 tags	Add 1 point
	Changing displays, on average, more than 5 times per minute	Add 1 point
	Using more than 200 objects in displays	Add 2 points
	Using ActiveX controls in displays	Add 2 points
Alarms	Monitoring more than 1,500 tags for alarms	Add 2 points
	Monitoring more than 300 tags for alarms	Add 1 point
Number of Active Clients	Using typically more than 5 active clients	Add 2 points
	Using at least 1 client	Add 1 point
Data Log or Historical Trends	Logging fewer than 100 tags in 1 model	Add 1 point
	Logging between 100 and 1000 tags in 1 model	Add 2 points
	Logging to more than 1 model	Add 2 points
Event Detector, Derived Tags, or Real-time Trends	Using any	Add 1 point
VBA	Using any	Add 2 points
Add-ons	Using any, for each one	Add 1 point
		Total Points:

Minimum system requirements for R5View32 based on points

For this number of points	You need:
4 or more	Pentium® II 400, 128MB RAM, Windows XP Professional* or Windows 2000 Professional** or Windows Server 2003***
6 to 7	Pentium 2 300, 128MB RAM, Windows XP Professional* or Windows 2000 Professional** or Windows Server 2003***
3 to 5	Pentium 200, 64MB RAM, Windows XP Professional* or Windows 2000 Professional** or Windows Server 2003***

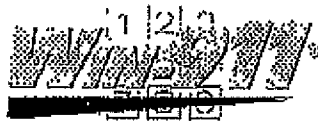
* With Service Pack 1 or later

** With Service Pack 3 or later

*** With Service Pack 1.

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SPECTER PART# WIN-911/PRO-BT



Alarm Notification Software Version 7.00



WIN-911 is real-time Alarm Notification Software that works with your existing control software or SCADA system to monitor operations and notify personnel of problem conditions. With WIN-911, your operators can concentrate on other tasks while your computer system does the monitoring.

Applications Include:

Water & Wastewater Facilities, Power Plants, Military Facilities, Automobiles, Semiconductor and Pharmaceutical Manufacturers, Bulk Drug Manufacturers & Security and Oil & Gas Monitoring.

WIN-911 can be used with pagers, cell phones, landline phones and most wireless communications.

NOTIFICATION OPTIONS

SMS Mobile-to-Mobile

To provide the most secure, reliable and timely notification option, you may now choose SMS 1-Way or SMS 2-Way text messaging. This method does not require an internet or email connection. Just select a standard GSM modem and a text messaging plan from your local wireless carrier.

SMS 1-Way is featured with all WIN-911/Basic software installations. This allows SMS Text alarm messaging to be sent to all "on duty" users with a basic cell phone. It also gives notification when alarms have been acknowledged.

SMS 2-Way is available with all WIN-911/PRO installations. This feature includes:

- Text notification on alarms
- Individual alarm acknowledgement from your cell phone
- "On Demand" list of alarms which have been acknowledged, but are still in the alarm condition
- Health Status
- 2-Way Manual text messaging available in the WIN-911 alarm monitor

SMS 2-Way also supports the powerful Mobile-911 Smart Phone applications. (See the Mobile-911 data sheet.)

Telephony

Text-to-Speech & Voice Synthesis

- Instantly create all of your required voice sound files in just minutes...DPC and Direct Connect will use the tag descriptions from the SCADA database as the default text for the tag sound.
- This version also offers the opportunity to select Dynamic Text-to-Speech Human Voice Synthesis.
- Verbalize the text from the tag values and descriptions to the local audio and telephony notification types.
- Eliminate the need for pre-recorded .wav files.

Premium Voices

This is a standard feature found on all new WIN-911/PRO systems. It offers professional sounding voices as an alternative to the Microsoft choices. Voices are available in male and female selections. The standard accent is US English. International voices such as UK English, French, and Indian are available as special order.

WIN-911

WIN-911 Reports is a standard feature with the voice telephony option and supports IFIX and Wonderware Direct Connects. (This feature is not supported with Rockwell Software products in this release.) Authorized users can call in and have access to current alarms and data values. Additionally, the user can change a data value in the SCADA database. This function is password protected and can be limited to minimum and maximum allowable values.

Dialogic Telephony Cards

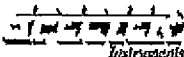
WIN-911 continues to support the world's leader in computer telephony for applications requiring robust communications and multiple incoming lines.

Voice Capable (TAPI) Modems

Lower cost solutions for single line voice connections. These devices are typically "Plug & Play" and greatly reduce installation hassles.

Wireless & Email Notification

Support for Email using SMTP servers or Alphanumeric Pagers using IAP protocols are also supported.



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SPECTER PART# WIN-911/PRO-BT

2

DATA INTERFACE OPTIONS

This connection to your SCADA Database is the most advanced in the industry. Stand alone and Distributed installations are supported.

WIN-911 Direct Connect

- This offers the most seamless and powerful connection available
- Your SCADA system determines the alarm
- WIN-911 does the remote alarm notification
- User can acknowledge the alarm in your SCADA database locally or by phone

WIN-911 Direct Connect supports Rockwell (RSView32, FactoryTalk View SE and FactoryTalk, GE Fanuc Proficy (FIX) and Wonderware InTouch - SCADA products. (See separate datasheet for FactoryTalk)

Other Connections

- **OPC:** Operating as an OPC Client, WIN-911 is compatible with any OPC server that supports Data Access Version 1.0 & 2.0. Network connections are supported
- **Microsoft DDE:** The generic DDE connection is still available for other Windows applications that can be configured as a DDE Server

SCADA Database Import

- Import your existing SCADA Database or data from OPC Servers using WIN-911's Import Browser
- Select the data tags you want to include in WIN-911 configuration
- The Database Import Utility will instantly build a WIN-911 configuration
- Simply enter your pager & phone numbers, e-mail addresses, assign duty schedules & groups
- You're done in just minutes
- *Of Rockwell Software users may want to use the new Filter Tags. You may configure "filter tags" which are collected from the Alarm Database and brought into WIN-911 for remote notification in-the-fly.*

ADDITIONAL FEATURES

Alarm Log Manager

The ability to view, sort, arrange, and print your alarm history any way you would like.

- Personal notification attempts and confirmation
- Acknowledgements, events, and error codes
- Each line item may be annotated using the "Notes" feature

WEB-911 XTools

This is a new option for WIN-911 offering a family of ActiveX controls that will allow the user to drop WIN-911 configuration modules into most SCADA displays. Each module is called an XTool. They include:

- XContact - add or edit contacts in Phone Book
- XGroup - edit the Group function
- XSchedule - view and edit all users' duty schedules
- XApply - apply changes to the WIN-911 Runtime
- XStandby and XActivate - scripting controls for hot backup systems

Security Options

WIN 911 offers many levels of optional security and scripting tools for achieving unique integration with your SCADA installation.

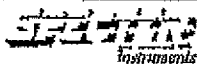
- Password & Acknowledgement Codes can control access to most functions from a caller ID to restricting changes to authorized operators
- System Health Heartbeats and Watchdogs can be setup to monitor health of both WIN-911 and the SCADA Software
- Hot Backup capabilities with scripting tools are available for the SCADA system to control which WIN-911 system is responsible for the remote alarm notification

WIN-911 Now Available As A Service

You may now choose to apply WIN-911 runtime as a Windows Service for most applications. Contact factory for minor limitations or technical information.

Audit Modifications

Track and archive modifications to your WIN-911 configuration to a special text file using the Audit Modification tool. Using this text file with encryption software will meet the 21CFR11 requirements for monitoring changes in the configuration.



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info@specterinstrumentals.com • WWW.SpecterInstruments.com • (02/2009)

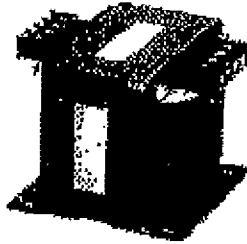
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SQUARE D PART# 9070T1000D1

Product Data Sheet

9070T1000D1

Industrial Control Transformer, 1000VA



 **SQUARE D**

by Schneider Electric

Technical Characteristics

Insulation Temperature	180 Degrees C
Application	Specifically designed to handle high inrush associated with contactors and relays for applications such as conveyor systems, paint lines, punch presses or overhead cranes
Approvals	UL Listed File Number: L61239 CSA Certified File Number: LR37655 Guide: 184-N-60 - OL Marked
Enclosure Type	Open
Terminal Type	Screw Clamp
Phase	1-Phase
Height	4.43 inches
Mounting Type	Panel
Fuse Block	None
Temperature Rise	115 Degrees C
Type	T
Rating	1000VA
Winding Material	Copper
Secondary	120V or 115V or 110V
Depth	3.04 inches
Primary	240x460V or 230x460V or 220x440V
Width	6.25 inches

Shipping and Ordering

Category	16201 - Transformers, Industrial Control, 250 - 2000 va, Type T
Discount Schedule	CPR
QTIN	09785901801724
Package Quantity	1
Weight	21.66 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Repeatability	Y
Country of Origin	MX

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D-687 JUNE 1968
CSC FILE UNCLASSED
BY JPM OBTAINED BY #1383



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WAGS ON WAGS

SQUARE D PART# 9070T1500D1**Product Data Sheet****9070T1500D1****Industrial Control Transformer, 1500VA**

Schneider Electric

Technical Characteristics

Insulation Temperature	180 Degrees C
Application	Specifically designed to handle high inrush associated with contactors and relays for applications such as conveyor systems, paint lines, punch presses or overhead cranes
Approvals	UL Listed File Number: F81239 - CSA Certified File Number: 1 R37065 Guide: 184-M-90 - CE Marked
Enclosure Type	Open
Terminal Type	Screw Clamp
Width	7.08 inches
Phase	1-Phase
Mounting Type	Panel
Fuse Block	None
Temperature Rise	115 Degrees C
Type	T
Height	6.18 inches
Rating	1500VA
Winding Material	Copper
Secondary	120V or 115V or 110V
Depth	5.81 inches
Primary	240x410V or 230x460V or 220x440V

Shipping and Ordering

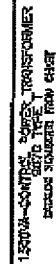
Category	16201 - Transformers, Industrial Control, 250 - 2000 va, Type T
Discount Schedule	C/P8
Article Number	785901876071
Package Quantity	1
Weight	37.17 lbs.
Availability Code	6
Reliability	Y

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ALL INFORMATION
11-23, PLE 6722
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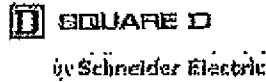


EX-105 Form

THE

SQUARE D PART# 9070TF500D1**Product Data Sheet****9070TF500D1**

Industrial Control Transformer , 500VA

**Technical Characteristics**

Insulation Temperature	100 Degrees C
Application	Develop to help customers comply with UL Standard 508 and NEC 450
Approvals	UL Listed File Number: E61230 - CSA Certified File Number: LR37055 Gukto: 164-N-90 - CE Marked
Enclosure Type	Open
Temperature Rise	115 Degrees C
Height	5.10 Inches
Phase	1-Phase
Type	IT
Fuse Block	Top Mounted
Mounting Type	Panel
Winding Material	Copper
Secondary	120V or 115V or 110V
Rating	500VA
Depth	5.40 Inches
Primary	240x480V or 230x160V or 220x140V
Terminal Type	Screw Clamp
Width	4.50 Inches
Specifications	0.41 x 1.80 inch (Class CC) Primary Fuse Holders

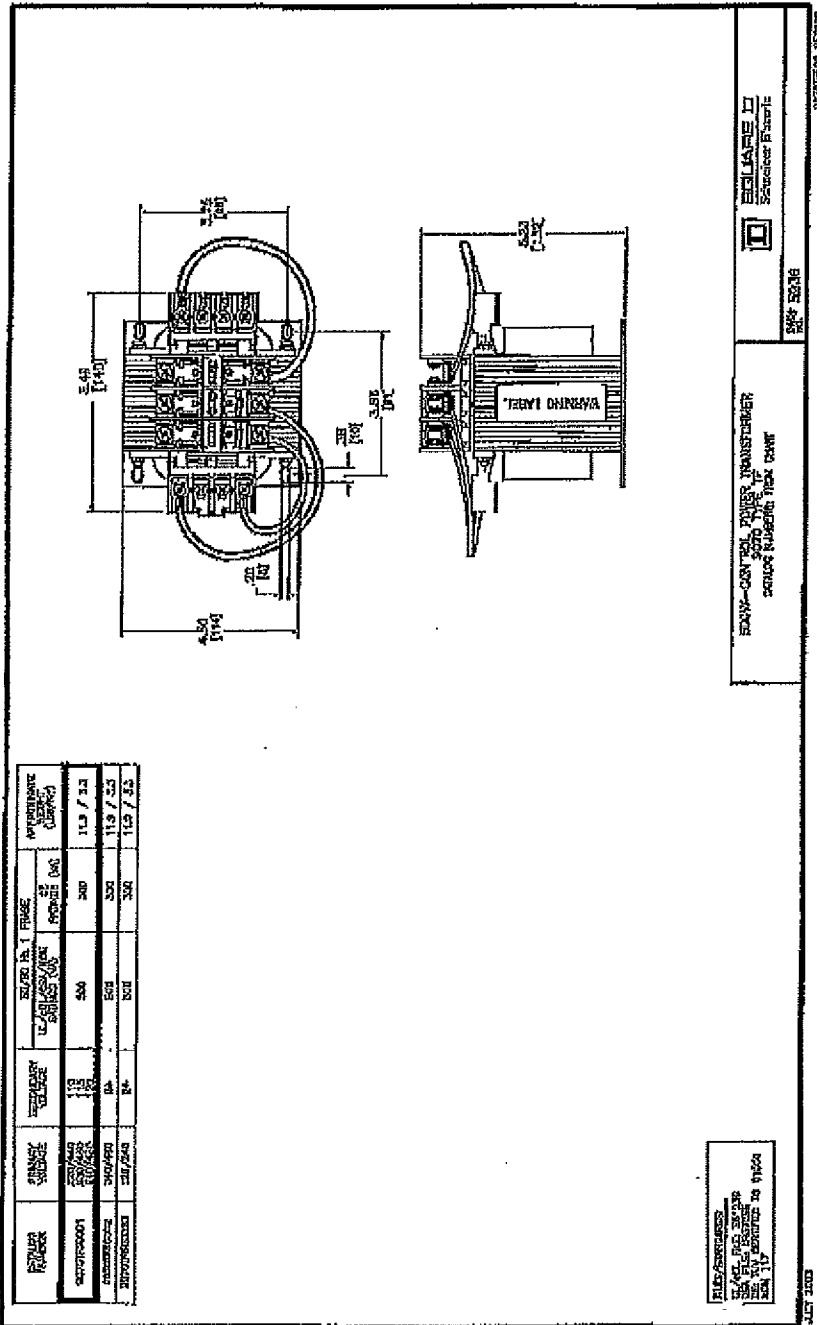
Shipping and Ordering

Category	16203 - Transformers, Industrial Control, 250 - 2000 va, Type TF
Discount Schedule	CP8
Article Number	785001004997
Package Quantity	1
Weight	12.70 lbs.
Availability Code	S
Returnability	Y

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SQUARE D PART# 9070TF500D1



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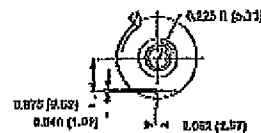
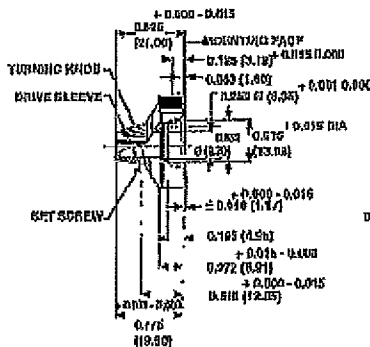
25.4mm Dia Eleven Turn Dial



- Round Vanner Single
- 1" Dia.
- 1/4" or 1/8" Shank Adaptor
- Black Chrome Finish with White Markings
- Brushed Chrome Finish with Black Markings
- Ball Chrome Finish with Black or White Markings

MECHANICAL SPECIFICATIONS	
PARAMETER	
Runout	Dial to be free running and without binds, with axis of drive sleeve perpendicular or in any position within 0.004 per inch (0.10) out of perpendicular with the mounting face
Mounting	Directly to shaft with 62 - 58 spline socket set screw. Drive sleeve not move on lower side of vertical center line with a graduated circular dial reading of 0
Nominal Size	0.75 H (1.88) x 0.12 Width (0.33) of line
Graduation Size	
Minimum	0.40 inches L (1.02cm)
Intermediate	0.4125 inches L (0.78cm)
Width	0.010 inches (0.25cm)
Weight	0.7 oz maximum (19.84gm)

OPERATIONAL SPECIFICATIONS	
Indication	Single counter type wheel and a graduated circular dial registering a total count of 10 turns
Operation	Single numeral in window (0 thru 9) indicates completed number of turns of the drive sleeve. Graduated circular dial indicates the percent of the partial turn of the drive sleeve
Transfer Point	Between 57 and 0
Rotation	
Increasing Indication	CW direction
Decreasing Indication	CCW direction
Accuracy	Zero backlash between dial and the drive sleeve
Mounting Hardware	Lock washer, internal tooth, steel, nickel plated panel nut, brass, nickel plated

[illegible]

11	1	11
MODEL	SHAFT DIAMETER AND NUMERICAL DISPLAY	FINISH AND OTHER FEATURES
	1. 1/4" Shaft (standard) 2. 1/8" Shaft adapter	11. Satin chrome, black markings 21. Black chrome, white markings 31. Brushed chrome, black markings 41. Satin chrome, white markings
Example: 11-1-11		

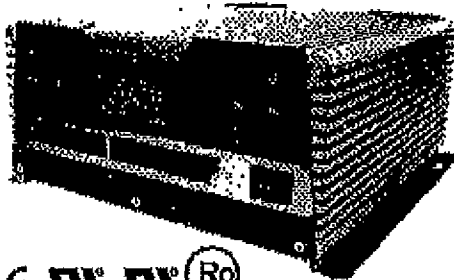
Example: $11 = 1 + 11$

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Pro-face

1341 Fanless, Diskless Industrial "Node" PC without Integrated Display

DS-134100(C)



The newest Xycom Industrial PC from Pro-face America is designed for the harsh environments required for plant floor use. This 1341 addresses the growing concern for reliability of rotating hard drives in these environments. Utilizing solid state media to store the operating system and your application, higher levels of reliability are easily obtained. In addition there are no system fans to hinder cooling when air flow is restricted by dust and debris, often found in factory environments.

Higher Performance, Lower Power

The 1341 utilizes an Intel mobile Celeron M processor while utilizing nearly half the wattage of many Pentium 4 class PCs. The Celeron M 1.3 GHz with 512 K Cache running at 400 MHz system bus provides enough processing power for many simple factory automation applications. The custom designed housing, which acts as a heatsink, coupled with the lower power usage allows the 1341 to operate in environments up to 50°C without the need for a system fan or additional cooling devices.

Full Featured in a Compact Package

The 1341 offers 4 RS-232 serial ports, 4 USB 2.0 compliant ports,

10/100 Ethernet, parallel, video, PS/2 mouse and keyboard ports, and an audio port. Even more options are available with the half-length PCI expansion slot and the two PCMCIA card slots. There also is a CompactFlash™ Type I/II slot that is utilized for the system memory to store the operating system and application(s). All this is accomplished in a compact package that is about the size of a standard package of printer paper.

Superior Video Performance

The on-board 4X AGP graphics controller defaults to 4 MB system RAM to allow resolutions up to 1280 x 1024. In addition the 1341 automatically shares up to 32 MB system RAM to allow full 32-bit color depth and 3D rendering.

- Intel® Celeron® M 1.3 GHz, 512K cache, 400 MHz system bus
- 4X AGP video controller with up to 32 MB video memory (shared with system memory)
- 512 MB DRAM
- 4 GB CompactFlash™
- 10/100 Base-T Ethernet port
- 4 USB 2.0 compliant ports
- Audio port
- 4 RS-232 Serial ports
- Video port
- Parallel port
- PS/2 mouse and keyboard ports
- 2 externally accessible PCMCIA ports
- One half-length PCI expansion slot
- 9-30 Volt regulated DC input (AC power supply sold separately)
- UL and cUL recognized
- CE approved
- RoHS Directive-compliant
- Preloaded with Windows® XP Professional (Windows 2000 Professional optional)
- 2-year warranty included

Meets High Standards

To survive on the plant floor the 1341 meets FCC, UL, cUL and European CE mark requirements for industrial automation equipment. Xycom brand Industrial PCs lead the industry in reliability, service, and support with an optional five year warranty available.

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XYCOM

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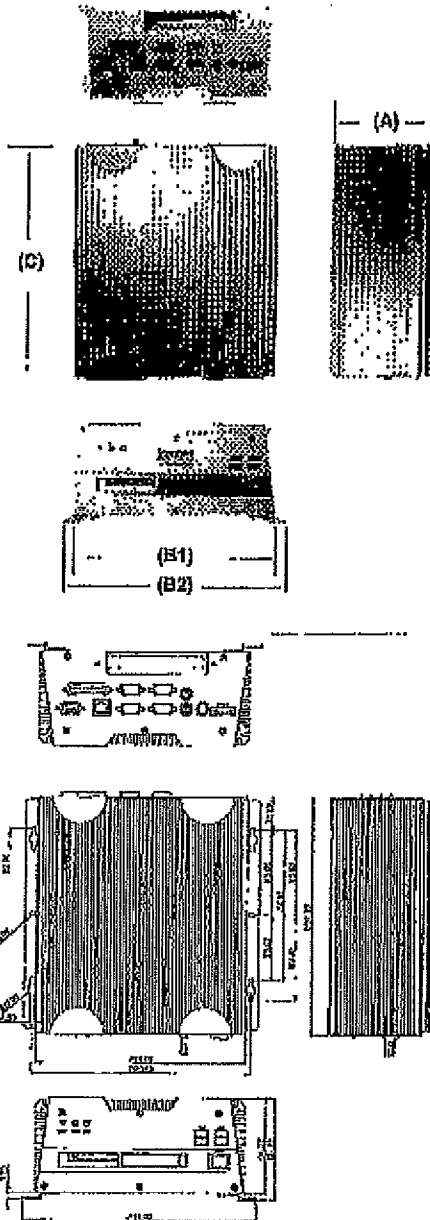
XYCOM PART# PM-090017

1341 Unit Dimensions

Model	1341
Height (A)	4.10" (104.14 mm)
Width (B1)	9.42" (214.0 mm)
Width (B2)	9.40" (239.0 mm)
Length (C)	9.60" (241.3 mm)
Weight	12.5" (5.7kg)

1341 Unit Configurations

Model	1341
Processors	Intel® Celeron® M 1.3 GHz
Preloaded OS	Windows XP Professional or Windows 2000 Professional
Expansion	One half-length PCI expansion slot



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Environmental

	Operating	Nonoperating
Thermal	0°C to 60°C	-20°C to 60°C
Humidity	20% to 80% RH, noncondensing	20% to 80% RH, noncondensing
Shock ^a	15g peak acceleration, 11 msec duration	30g peak acceleration, 11 msec duration
Vibration	.005" peak to peak displacement	.015" peak to peak displacement
5-2000 Hz	1.0g maximum acceleration	2.5g maximum acceleration

Electrical

Internal Power Supply	9-30 VDC (Regulated Input), 4.0 Amp, 30 Watts nominal power † (33 Watts nominal power when powered by optional external AC power supply (1341-PWR)) †
Optional External AC Power Supply	(1341-PWR) 100-240 VAC, 0.4 Amps, 50-60 Hz

† Nominal power is measured for a base configuration only. Any additional expansion modules will increase the input power required.

Compliance

Regulatory Compliance

- CE**
- EN55022, Class A
 - FNS1000-6-2
 - IEC60950-1
 - EN61000-3-2, Class A
 - EN61000-3-3

FCC

- 47 CFR, Part 15 Subpart B, Class A

RoHS Directive-compliant

Safety Agency Approvals

- UL**
- UL 60950-1 Recognized
- CUL**
- CSA-C22.2, 60950-1-03 Recognized

Product certification documentation available at: www.pro-faceusa.com/certifications



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XYCOM PART# PM-090017

To create an order number, follow the conventions defined by the example order numbers and product configurations.

Example Order Number

Order Number	Description
1341-1300-512-4GB-XP	1341 Industrial "Node" PC with Intel® Celeron® M 1.3 GHz, 512K cache, 400 MHz system bus, 4 GB CompactFlash, Preloaded with Windows® XP Professional (Windows 2000 Professional optional).

1341 - 1300 - 512 -

Storage Media

4GB 4 GB CompactFlash

Operating System

-XP Windows XP Professional
-2K Windows 2000 Professional

1341 Accessories

1341-PWR 100-240 Volt AC, 50-60Hz, 0.4 Amp Input, regulated 12 VDC output power supply
for use with the 1341
(Connector for direct connection to the 1341 included)

Warranty Information

The 1341 series carries a
two-year parts & labor
warranty.

Important Notice for XP configurations: Certain Microsoft® software product(s) included with this computer may use technological measures for copy protection. IN SUCH EVENT, YOU WILL NOT BE ABLE TO USE THE PRODUCT IF YOU DO NOT FULLY COMPLY WITH THE PRODUCT ACTIVATION PROCEDURES. Product activation procedures and Microsoft's privacy policy will be detailed during initial hours of the product, or upon certain reinstallation of the software product(s) or reconfigurations of this computer, or may be completed by internet or telephone (toll charges may apply).

Pro-face America
Phone: 734.429.4971
Fax: 734.429.1010
www.profaceamerica.com

Customer Service Hotline: 734.944.0482

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26 35 00 - Generator Paralleling Switchgear

for

City of Las Vegas New City Hall

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CATERPILLAR EMCP 3.S TRAINING/TECHNICAL MANUAL

CATERPILLAR Caterpillar Generator Switchgear Products
Caterpillar Automatic Transfer Switches

Caterpillar
Automated Switchgear

TRAINING / TECHNICAL MANUAL

EMCP 3.S Controller Based Switchgear

Rev 2.2

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CATERPILLAR EMCP 3.S TRAINING/TECHNICAL MANUAL

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2.0	SP	EMCP3S Controller based Systems	
2.1	DL	Minor edits and format changes	5/10/08
2.2	JDM	Edits and format changes	4/24/09

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1 Overview

Section 1.1.....	Introduction
Section 1.2.....	Definition of Terms
Section 1.3.....	System Descriptions

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1.1 Introduction

Your PowerLynx Switchgear is designed to provide you with years of dependable emergency power. Great care has been taken to ensure that your system is reliable and easy to operate.

Typically, PowerLynx Switchgear is powered by at least 2 separate DC sources. The system automatically selects the best of these sources. Failure or disconnection of any of the sources will in no way interrupt your power protection.

PowerLynx Switchgear is furnished with several levels of fault tolerance. Hardware backup has been provided to allow you to run the system manually.

This manual provides a description of the operation of the PowerLynx Switchgear and the Touch Screen operator interface. The PowerLynx Touch Screen interface is designed to provide the operator with

- Easily operated controls
- Instantly available important system information
- Current system status conditions
- A selection of system reports

The Touch Screen operates intuitively; just touch the area you're interested in and the system zooms in on it.

***Note:** All information contained herein is proprietary and/or patent pending. Copying any portion of this manual without written permission from ISQ or its licensed distributors is expressly forbidden.

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1.2 Definition of Terms

Touch Screen Processor (TSP) - Computer that drives the Touch Screen.

Touch Screen (TS) - Computer monitor with touch screen operator interface.

Hot Area - An area on the Touch Screen that, when touched, will cause something to happen.

Hot Bus Indication - A bus is indicated on the HMI as energized by the light blue color and not energized by dark blue.

Load Shed - The opening of circuit breakers to de-energize certain selected loads when the generator plant is being overloaded.

Generator Demand Priority - The removal of generators, by assigned priority, according to the building's power demands.

Human Machine Interface (HMI) - The interface between the operator and the machine. On the PowerLynx the software running on the Touch Screen TSP.

Synchronization - The matching of the voltage waveforms of two power sources.

Engine Control Switch (ECS) - Four-position selector switch that controls the generators mode of operation.

Electronic Modular Control Panel (EMCP3S) - Caterpillar developed engine/generator controller.

Synchronization Mode Selector Switch (Sync Mode) - A Three-position selector switch that controls a sources synchronization mode.

Pre-alarm - A cautionary engine or generator condition that does not cause an engine shutdown, but indicates that corrective action is required.

Shutdown Alarm - An engine or generator condition that is serious enough to cause an engine to be automatically shutdown and removed from the bus.

Master Mode Selector Switch (MMS) - Four-position selector switch that controls the operational mode of all generators, as well as utility and tiebreaker operation.

Utility Fail Test Switch (UFT) - Two-position selector switch that causes a utility(s) failure to be simulated.

CEMF - Counter Electro-Motive Force is generated from residual magnetism in the rotors of de-energized motors as they wind down.

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1.3 System Type Descriptions

1.3.1 EGP

An EGP system is defined as having 2-16 generators feeding a common generator bus. There is no utility main breaker in the switchgear and no control of a remote utility breaker in an EGP system. Distribution breakers on the common generator bus are optional. An EGP system can perform Emergency mode, No Load Test Mode and Utility Fail Test Mode/Test With Load as described in the Sequence of Operations.

- Automatic Start, Synchronize, Parallel, and Load Share on a common bus
- Main Lugs Output to feed downstream emergency distribution switchboard
- Optional Emergency Distribution CBs
- Load shed/add
- Generator priority demand
- For use with multiple downstream Automatic Transfer Switches
- Caterpillar switchgear is designed to integrate hand-in-glove with Caterpillar Automatic Transfer Switches. EGP is optionally available with direct communication to CAT ATS's to provide "fingertip" control and monitoring of all your facility ATS's from one convenient central location

1.3.2 XLM

An XLM system is defined as having one utility source and 1-16 generators feeding a common generator/load bus. This common bus is normally energized. There is no Tiebreaker between the utility breaker and the generator bus in an XLM system. There can only be one utility source in an XLM system. Distribution breakers on the common generator/load are optional. An XLM system can perform Emergency Mode, Transfer to Emergency Mode, Load Management Mode, No Load Test Mode, and Utility Fail Test Mode as described in the Sequence of Operations.

- Automatic Transfer to Emergency upon Utility failure
- Automatic Start, Synchronize, Parallel, and Load Share on a common bus
- Closed transition transfer back to Utility upon stable return of power, with soft generator unloading
- Closed transition Load Management Mode with soft loading and unloading of generator system
- Closed transition transfer to Emergency Mode to facilitate maintenance, or for storm threat avoidance, with soft loading and unloading of generator system
- Load shed/add
- Generator priority demand
- Cost effective, technically superior alternative to conventional ATS arrangement

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1.3.3 LM

LM – An LM as a generator plant system is defined as having one utility source and 1-16 generators feeding a common generator/load bus. This common bus is normally energized. There is no tiebreaker between the utility breaker and the generator along with the generator bus in an LM as a generator plant system. There can only be one utility source in an LM as a generator plant system. Distribution breakers on the common generator/load bus are optional but not typical. An LM as a generator plant system can perform Load Management Mode and No Load Test Mode as described in the Sequence of Operations. There is no Emergency Mode.

- Standardized, simple, cost effective control switchgear for local or remotely initiated starting, stopping, synchronizing, utility paralleling, load management, and distributed generation
- Available as:
 - o Base loading export
 - o Utility set-point import peak shaving

PowerLynx Technology brings the power and reliability of microprocessor technology to your generator power application. Through the use of the PowerLynx operator interface touch screen display, with easy to follow graphical presentations, the PowerLynx technology product merges the features of:

- Power Monitoring
- Switchgear Automation
- Generator Set Control
- Remote Communications

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2 Sequences of Operation

Section 2.1.....	EGP Sequence of Operation
Section 2.2.....	XLM Sequence of Operation

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2.1 EGP Sequence of Operation

A. The System Controls shall be designed and integrated with the other specified control components to provide a completely functional total system which shall automatically perform the following generally described sequence of operations:

1) AUTOMATIC/STANDBY (UTILITY) MODE

- a. The automatic transfer switches are in the normal position serving utility power to the loads.
- b. The generator mains are open.
- c. The automation is standing by to act in response to a utility failure.

2) EMERGENCY (GENERATOR) MODE

a. Utility Failure

- (1) Automatic transfer switch(es) protective relaying senses utility undervoltage condition.
- (2) A run request is sent to the generator plant.
- (3) The first generator up to voltage and frequency is closed to the bus.
- (4) The remaining generators are synchronized and paralleled to the bus as they come up to voltage and frequency.
- (5) Automatic transfer switches transfer to emergency position via their time delays and via the Load Shed Control.
- (6) The system is now in Emergency Mode.

b. Utility Restoration and Exit from Emergency Mode

- (1) Automatic transfer switch(es) protective relaying senses utility voltage within tolerance.
- (2) Following the automatic transfer switch return to normal time delay, to assure that the utility power source is stable, the automatic transfer switches individually retransfer to the normal position.
- (3) When the last automatic transfer switch has retransferred to the normal position, the generator mains are opened.
- (4) The generators are allowed to run for their programmed Cooledown period.
- (5) The system is now in Automatic/Standby (Utility) Mode.

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2.1.1 GENERATOR TEST MODE

a. Entry

1. The operator places the System Mode Selector Switch into the Gen Test position.
2. A run request is sent to the generators.
3. The first generator up to speed and voltage is closed to a dead bus.
4. The remaining generator is synchronized and paralleled to the bus when it has reached acceptable voltage and frequency.
5. The system is now running in Gen Test Mode, and the operator may manually close the load bank breaker to apply load to the generators.

b. Exit

1. The operator places the System Mode Selector Switch into the Auto position.
2. The generator mains are opened.
3. The generators are allowed to run for their programmed cooldown period.
4. The system is now in Automatic/Standby (Utility) Mode.

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2.2 XLM / XLM-T Sequence of Operation

The System Controls shall be designed and integrated with the other specified control components to provide a completely functional trial system which shall automatically perform the following generally described sequence of operations:

2.2.1 AUTOMATIC/STANDBY (UTILITY) MODE

- c. The utility main is closed serving utility power to its load bus.
- d. The emergency tie is open.
- e. The generator mains are open.
- f. The automation is standing by to act in response to a utility failure.

2.2.2 UTILITY FAILURE

EMERGENCY (GENERATOR) MODE

- g. Utility Failure (Conditional Load Shed)
 - 1. Utility protective relaying senses utility voltage or frequency out of tolerance.
 - 2. The utility main is opened.
 - 3. A run request is sent to the generator plant.
 - 4. All Non-Essential loads on failed load bus are shed.
 - 5. The first generator up to speed and voltage is closed to a dead bus.
 - 6. The emergency tie is closed.
 - 7. Essential Priority Levels will be added as a function of the on-line generator capacity by the user selected load add / shed time delays and within the user selected load add / shed limits.
 - 8. The remaining generator(s) is synchronized and paralleled to the bus when it has reached acceptable voltage and frequency.
 - 9. The system is now in Emergency Mode.
- h. Utility Restoration and Exit from Emergency Mode
 - 1. Utility protective relaying senses utility voltage and frequency within tolerance.
 - 2. Following a 30-minute time delay (which can be abbreviated by the operator) to assure that the utility power source is stable, the generators are passively synchronized and paralleled to the utility source, by closing the utility breaker.
 - 3. The generators are soft ramp unloaded until the utility source is nominally serving the entire system load.
 - 4. The emergency tie is opened when it's disconnect kW has been reached.

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5. The generators are allowed to run for their programmed cooldown period.
6. The system is now in Automatic/Standby (Utility) Mode.

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2.2.3 CLOSED TRANSITION TO EMERGENCY MODE

i. Entry

1. The operator places the System Mode Selector Switch into the Emergency position.
2. A run request is sent to the generators.
3. The generators are allowed to run for a five-minute warm-up time (which can be abbreviated by the operator).
4. The first generator up to speed and voltage is closed to a dead bus.
5. The remaining generator is synchronized and paralleled to the bus when it has reached acceptable voltage and frequency.
6. The generators are passively synchronized and paralleled to the utility source, by closing the tiebreaker.
7. The generators are then soft ramp loaded until the generators are serving nominally the entire load on the load bus and the utility main is opened.
8. The system is now running in Emergency Mode.

j. Exit from Emergency Mode

1. The operator places the System Mode Selector Switch into the Auto position.
2. Following a 30-minute time delay (which can be abbreviated by the operator) to assure that the utility power source is stable, the generators are passively synchronized and paralleled to the utility source, by closing the utility breaker.
3. The generators are soft ramp unloaded until the utility source is nominally serving the entire system load.
4. The emergency tie is opened when it's disconnect kW has been reached.
5. The generator mains are opened.
6. The generators are allowed to run for their programmed cooldown period.
7. The system is now in Automatic/Standby (Utility) Mode.

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3 Hardware Interfacing

Section 3.1..... Front Panel Hardware Operation

Section 3.2..... Control Cabinet Switches

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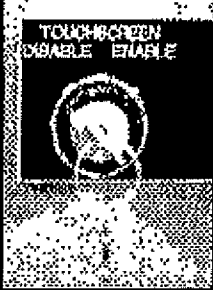
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3.1 Front Panel Hardware Operation

3.1.1 Touch Screen Enable/Disable Switch

This is a key-switch on the front panel of the Touch Screen.

Touch Screen Enable/Disable	Switch Operations
	Basic operations of the Touch Screen Enable/Disable Switch: • Disable: Removes the ability to interface with the system via the touch screen. Used when it is desired to touch the screen with out operating the system • Enable: This allows the operation of the touch screen.

3.1.2 Horn Silence

This push button is a quick way to silence the horn during alarming situations.

Horn Silence Push Button	Button Operations
	Basic operations of the Horn Silence Push Button: • This will silence the alarm horn. The system will not acknowledge the alarm!

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3.2 Control Cabinet Switches

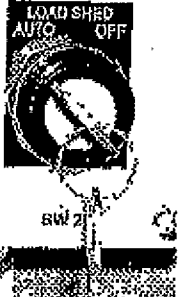
3.2.1 Instant Auto Switch

- Located inside system control section

Instant Auto Switch	Switch Operations
 SW 206	Basic operations of the Instant Auto Switch: • Spring return switch that when placed in auto takes all control switches in system to auto. • The Instant Auto will Reset all Engine Alarms, Set the ECS in Auto and will place all System Switches to their default position and finally reset all Circuit Breaker Faults. • Normal position is OFF

3.2.2 Load shed Switch

This a two position switch inside the system control section

Load Shed Switch	Switch Operations
 SW 21	Basic operations of the Load Shed Switch: • Auto: This allows the operation of the load-shed scheme of the switchgear. • Off: This will disable all load-shed/add operation or halt current load shed/add operation.

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4 HMI Interfacing

Section 4.1.....	Main Menu Operation
Section 4.2.....	Main Menu Navigation
Section 4.3.....	Main Menu Password entry
Section 4.4.....	Overview Screen Operation
Section 4.5.....	Overview Screen Navigation

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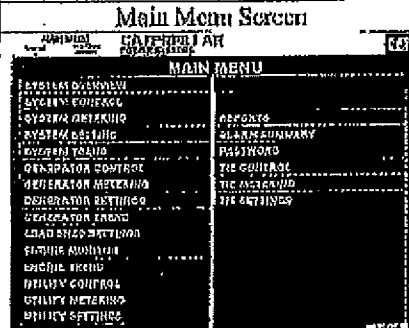
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4.1 Main Menu Operation

Main Menu Screen	Screen Operations
	Basic operations on the Main Menu Screen: Main Menu is accessed from any screen by touching the Main Menu button on the bottom "Touch Area". From here you will be able to enter all primary screens by touching the associated touch area.

4.2 Main Menu Navigation

- Pressing the "Touch Area" for the desired screen will send you to that screen. From this screen it is possible to navigate through the following Main Menu Structure.

Main Menu Navigation Structure:

System Overview
 System Control
 System Setting
 System Trend
 Generator Control
 Generator Metering
 Generator Setting
 ↳ Generator "X" Setup
 ↳ Generator "X" Protectives 1
 ↳ Generator "X" Protectives 2
 ↳ Generator "X" Circuit Breaker
 Generator Trend
 Load Shed Settings
 Engine Monitor
 Engine Trend
 Utility Control
 Utility Metering
 Utility Setting
 ↳ Utility "X" Setup
 ↳ Utility "X" Protectives
 ↳ Utility "X" Circuit Breaker
 Annunciator Menu

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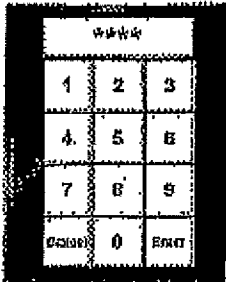
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(Continued) Main Menu Navigation Structure:

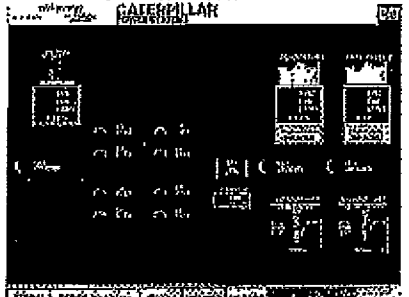
Reports
 Alarm Summary
 Tie Control
 Tie Metering
 Tie Setting
 ↳ Tie "X" Setup
 ↳ Tie "X" Protectives
 ↳ Tie "X" Circuit Breaker

4.3 Main Menu Password entry

Password Entry	Operations
	Basic operations on the Password Entry: • This pop up screen allows the Plant Engineer to enter his or her password and change system settings. • Pressing, "Cancel" or leaving the "Settings Menu" nulls the current password. • Pressing, "Enter" logs the current password, which remains in effect until the user exits any "setting screen" to any screen other than the "Main Menu" • Default password is "1234". Contact ISO to change password.

***Note:** All setting screens require to have entered a valid password entered before any parameters can be changed.

4.4 Overview Screen Operation

Overview Screen	Screen Operations
	Basic operations on the Overview Screen: The Overview Screen is accessed from the Main Menu screen by touching the System Overview button "Touch Area". From here you will be able to enter Metering, Monitoring and Control screens by touching the associated touch area or by navigating through the bottom menu.

4.5 Overview Screen Navigation

- Pressing the "Touch Area" for the desired screen will send you to that screen. Additional screens, such as to the Control, Metering, Annunciator Screens and Engine Monitoring Screens can be reached either direct when touching the "Hot Areas" on the overview screen or over the bottom Overview Menu which has the following menu structure:

Overview Screen Navigation Structure:

```

Main Menu
Control
    ↳ System Control
        ↳ Load Shed Control
        ↳ Gen Demand Control
    ↳ Utility "X" Control
    ↳ Tie "X" Control
    ↳ Generator "X" Control
Metering
    ↳ System Control
    ↳ Utility "X" Control
    ↳ Tie "X" Control
    ↳ Generator "X" Control
Annunciator
    ↳ System Annunciator
    ↳ Utility "X" Annunciator
    ↳ Tie "X" Annunciator
    ↳ Generator "X" Annunciator
Eng Monitor
    ↳ Engine "X" Monitoring
    
```

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5 System Modes

Section 5.1.....	Automatic Operation
Section 5.2.....	Load Shed
Section 5.3.....	Generator Demand Priority
Section 5.4.....	Utility Mode / Returning from Emergency Mode
Section 5.5.....	Generator No Load Test
Section 5.6.....	Generator Test With Load
Section 5.7.....	Load Management
Section 5.8.....	Utility Fail Test

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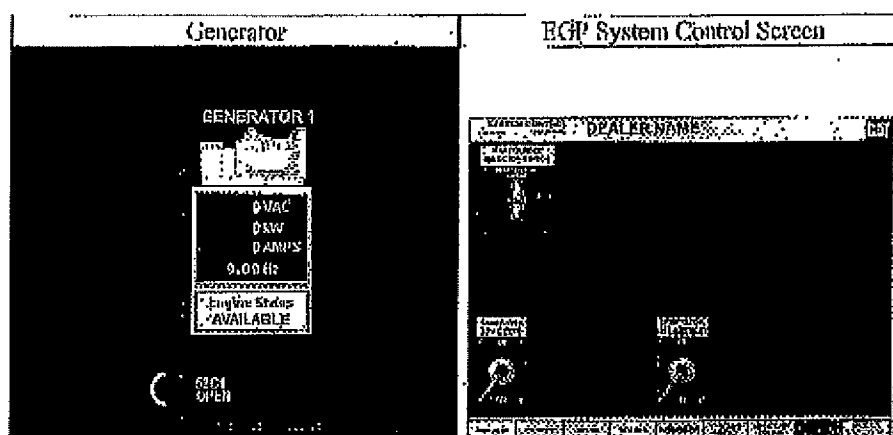
5.1 Automatic Operation

The System Controls shall be designed and integrated with the other specified control components to provide a completely functional total system which shall automatically perform the following generally described sequence of operations:

5.1.1 Standby Mode

A. RGP

- The automatic transfer switches are in the normal position serving utility power to the loads.
- The generator mains are open.
- The automation is standing by to act in response to a run request from associated Automatic Transfer Switches.



B. XLM

- The utility main breaker is closed serving utility power to the generator/loads bus.
- The generator main breakers are open.
- The automation is standing by to act in response to a utility failure.

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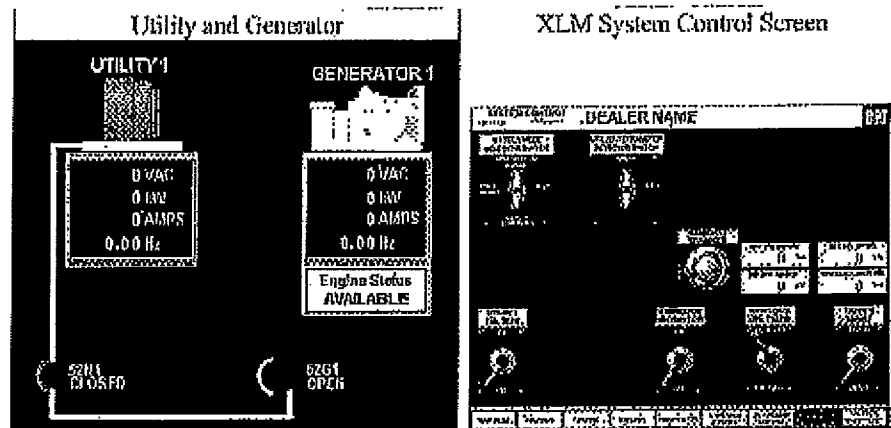
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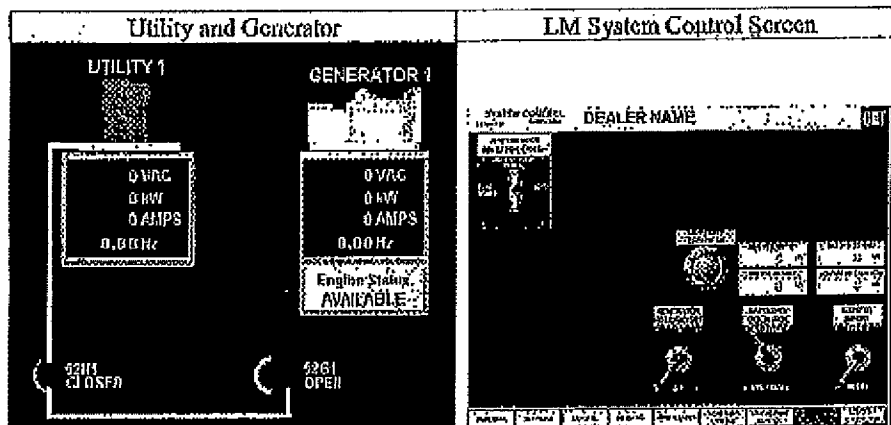
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C. LM

- The utility main breaker (Optional) is closed serving utility power to the generator/loads bus.
- The generator main breakers are open.



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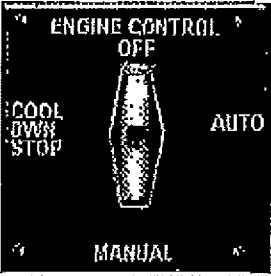
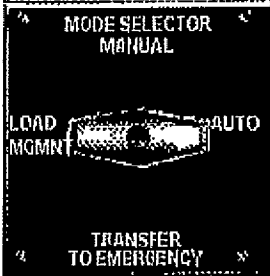
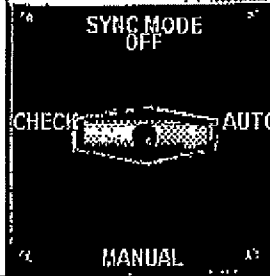
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5.1.2 Required Switch Positions

Engine Control Switch	Master Mode Select Switch	Sync Mode Switch
		
• Master Mode Selector Switch (Located on System Control Screen): Automatic • Engine Control Switch (Located on Overview Screen, Engine Control Screen): Automatic • Sync Mode Switch (Located on Engine Control Screen): Automatic		
*Note: • Transfer to Emergency is only available on XLM systems • Load Management is only available on XLM /LM systems		

5.1.3 Emergency Mode

Places where you'll find indications of the System being in Emergency.	
	
• Any Annunciator Screen will indicate the Emergency Mode • The header on all screens	

EGP

- Automatic Transfer Switches protective relaying senses utility undervoltage condition.
- A run request is sent to the generator plant.
- The first generator up to voltage and frequency is closed to the bus.
- The remaining generators are synchronized and paralleled to the bus as they come up to voltage and frequency.

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- d. Automatic transfer switches transfer to emergency position via their time delays and via the Load Shed Control.
- e. The system is now in Emergency Mode.

XLM

- a. Utility protective relaying senses utility undervoltage or frequency out of tolerance condition.
- b. The utility main breaker is opened.
- c. A run request is sent to the generator plant.
- d. The first generator up to voltage and frequency is closed to the bus.
- e. The remaining generators are synchronized and paralleled to the bus as they come up to voltage and frequency.
- f. The system is now in Emergency Mode.

LM

There is no Emergency function on LM systems.

5.2 Load Shed

A. The System Controls shall include a Load Shed Control function to control the loads served by the generator plant. The Load Shed Control shall have one Essential Load Shed Priority Level for each generator in the system plus one Non-Essential Load Shed Priority Level (which is always shed in the Emergency Mode of operation). The Load Shed Control shall provide a 4 pole, 10A, 120VAC rated, form C set of contacts for each Load Shed Priority Level to allow the control of loads external to the Emergency Generator Paralleling Switchboard. Additionally, the Load Shed Control shall control each of the distribution circuit breakers within the Emergency Generator Paralleling Switchboard, which are shown on the drawings to be electrically operated. Each electrically operated distribution circuit breaker shall be field selectable to be assigned to any of the available Load Shed Priority Levels. The following controls shall be provided for each Essential Load Shed Priority:

- 1) One - Shed Delay Timer, adjustable from 0 to 255 minutes
- 2) One - Add Delay Timer, adjustable from 0 to 255 minutes
- 3) One - Load Shed By-Pass Selector (auto/manual shed/manual add)
- 4) Three - Status Indicators to show the 3 positions of the Load Shed By-Pass Selector
- 5) Two - Status indicators to show whether the Priority Level is Added or Shed

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B. The following controls shall be provided for the Non-Essential Load Shed Priority:

- 1) One - Load Shed By-Pass Selector (auto/manual shed/manual add)
- 2) Three-Status indicators to show the 3 positions of the Load Shed By-Pass Selector
- 3) Two-Status indicators to show whether the Priority Level is Added or Shed

C. Additionally, the Load Shed Controls shall have:

- 1) One - Load Shed Control Switch (On/Off)
- 2) One - User-settable Load Shed % (as a function of on-line generator capacity)
- 3) One - User-settable Load Add % (as a function of on-line generator capacity)
- 4) One - User-settable Bus Underfrequency Setpoint and time delay
- 5) One - Bus Frequency Normal indicator
- 6) One - Bus Underfrequency Indicator

D. Conditional/Load Sensitive

- 1) Conditional Load Shed: Upon entrance into Emergency Mode of operation, the Load Shed Control shall shed all Non-Essential loads. As generators come to the bus, Non-Essential Priority Level loads shall be added based on the number of generators on line. When the first generator comes to the bus, Priority Level 1 loads shall be added; second generator, priority 2, etc. After a time delay that allows all operational generators to come to the bus, Load Shed Mode shall shift to Load Sensitive Mode. (Provided the Load Shed Switch is in ON)
- 2) Load Sensitive Load Shed: After all generators have been given sufficient time to come to the bus, load shed shall shift to "Load Sensitive" mode. The system shall compare current generator on-line capacity (in kW) to current load requirements. If surplus capacity is greater than the calculated Load Add Setpoint, after the Load Add Time Delay the next Load Shed Priority will be added. This calculation will continue until all Sheddable Loads are added, or until surplus capacity is less than the calculated Load Add Setpoint. If surplus capacity is less than the calculated Load Shed Setpoint, after the Load Shed Time Delay the next Load Shed Priority will be shed. This calculation will continue until all Sheddable Loads are shed, or until surplus capacity is greater than the calculated Load Shed Setpoint. The Load Shed Control, in its automatic shedding and adding of loads, shall not override any manual load shed/add operation.

E. Should a generator fail off-line or should loads increase, Essential Priority Level loads shall be shed as a function of the on-line generator capacity by the user selected load shed time delays and within the user selected load shed limits. The Load Shed Control, in its automatic shedding of loads, shall not override any manual load add operation.

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F. Should the load bus frequency fall below the user selected bus underfrequency, then an alarm is triggered and displayed on the system alarm summary.

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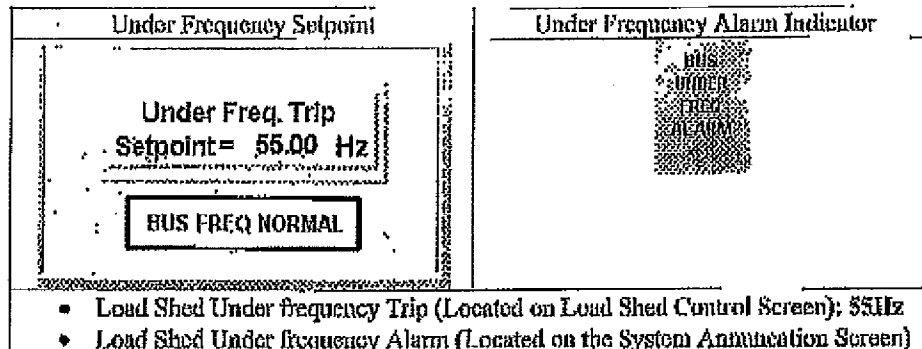
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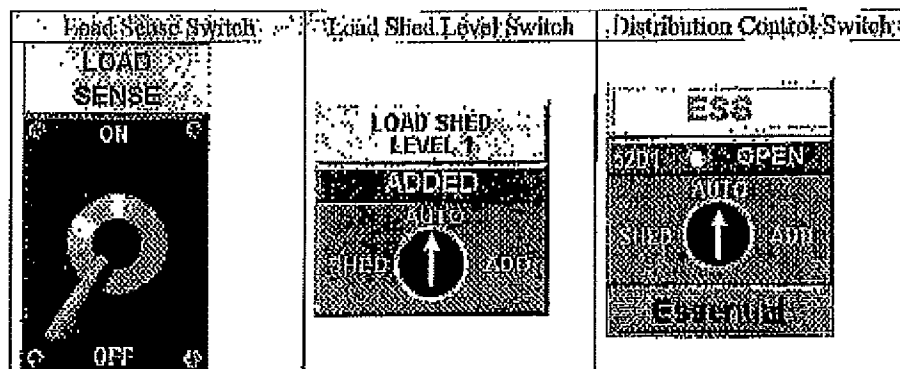
(a) How to set Load Shed Bus Under frequency and associated Alarm

- From Overview Screen
- Press the **CONTROL** button: Pop up boxes will show.
- Press the **SYSTEM** button: this will take you to "System Control Screen"
- Press the **LOAD SHED CONTROL** button: this will take you to "Load Shed Control Screen"

OR

- From Overview Screen
- Press the **MAIN MENU** button: this will take you to the "Main Menu Screen".
- Press the **SYSTEM CONTROL** button: this will take you to "System Control Screen"
- Press the **LOAD SHED CONTROL** button: this will take you to "Load Shed Control Screen"

(b) Required Switch Positions



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- Load Sense Switch (Located on Load Shed Control Screen): On
- Load Shed Level Switches (Located on Load Shed Control Screen): Auto
- Distribution Control Switches (Located on Load Shed Control Screen): Auto

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(c) How to set Load Shed Levels

Hardwire

- The Load Shed Control shall provide a 4 pole, 10A, 120VAC rated, form C set of contacts for each Load Shed Priority Level
- Each Priority can be manually added or shed from the Touch Screen

Electrically operated breakers

- Each electrically operated distribution circuit breaker shall be field selectable to be assigned to any of the available Load Shed Priority Levels

5.3 Generator Demand Priority

A. The System Controls shall include a Generator Demand Priority Control function to automatically match the on-line generator capacity to the loads to avoid unnecessary operation of all the generators when the loads are low. This allows the operator to make most efficient use of available Genset capacity. The following controls shall be provided for each generator:

- 1) One - User-settable Generator Priority Selector
- 2) One - Status Indicator for the Generator Priority Selected
- 3) Two - Status Indicator for generator On-line or Off-line

B. Additionally the Generator Demand Priority Control shall have:

- 1) One - Generator Demand Priority Control Switch (On/Off)
- 2) One - User-settable Generator Remove Differential kW
- 3) One - User-settable Generator Minimum Reserve kW
- 4) One - User-settable Generator Remove Delay
- 5) One - User-settable Generator Immediate Add Reserve kW
- 6) One - User-settable Generator Add Delay
- 7) One - User-settable Minimum Number of Generators

C. Upon entrance into Emergency or Load Management modes, all generators shall be started and paralleled to the bus. After the settable Remove Time Delay times out, generators shall be removed from the bus in descending priority order (i.e. Generator Priority #3 removed first, Generator Priority #2 removed second) when the bus load drops under the Remove Setpoint of each Generator. The remove setpoint is a function of the generator size minus a minimum reserve Setpoint as well as Remove differential

Should the generator load increase to the user selected Generator Add Setpoint (GenSize minus the Minimum Reserve Setpoint) for the duration of the user

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selected Add Delay, the next generator will be started, synchronized and paralleled to the bus. Generators shall be added to the bus in ascending priority order.

	Description
	A generator is REMOVED from the bus when the bus kW is less than the sum of the minimum reserve setpoint and the remove differential. A generator is ADDED to the bus when the bus kW is greater than the minimum reserve setpoint. Add SP = Gen Size - Min Reserve SP Remove SP = Gen Size - Min Reserve SP - Remove Differential
	Located on the Generator Demand Control Screen

D. In case that the load exceeds the current only generators capacity, the next priority generator will be started and added to the bus with no time delay.

(a) Navigation to Gen Demand

- From Overview Screen
- Press the **CONTROL** button: Pop up boxes will show.
- Press the **SYSTEM** button: this will take you to "System Control Screen"
- Press the **GEN DEMAND CONTROL** button: this will take you to "Gen Demand Control Screen"

OR

- From Overview Screen
- Press the **MAIN MENU** button: this will take you to the "Main Menu Screen".
- Press the **SYSTEM CONTROL** button: this will take you to "System Control Screen"
- Press the **GEN DEMAND CONTROL** button: this will take you to "Gen Demand Control Screen"

(b) Required Switch Positions

Switch	Switch Position
--------	-----------------

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GEN DEMAND
CONTROL



Generator Demand Control Switch:

- **On:** Enables Generator Demand to automatically control the total number of generators on the bus.
- **Off:** Disables Generator Demands automatic functions.

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(c) How to change levels

Generator Priority	Keypad	Save/Abort buttons																				
Gen 1 Priority Actual: 1	<table border="1"> <tr> <td>1</td> <td>0</td> <td>8</td> <td>Clear</td> </tr> <tr> <td>4</td> <td>7</td> <td>9</td> <td>Back</td> </tr> <tr> <td>1</td> <td>2</td> <td>3</td> <td>Exp</td> </tr> <tr> <td>.</td> <td>0</td> <td>.</td> <td>12</td> </tr> <tr> <td colspan="2">Update Field</td> <td>Download</td> <td>Cancel</td> </tr> </table>	1	0	8	Clear	4	7	9	Back	1	2	3	Exp	.	0	.	12	Update Field		Download	Cancel	SAVE ABORT
1	0	8	Clear																			
4	7	9	Back																			
1	2	3	Exp																			
.	0	.	12																			
Update Field		Download	Cancel																			
• Use touch area for generator priority. This will enable a Keypad screen which allows the Operator to enter and change generator priority request level. Press the number corresponding to the desired level. Any number higher than the total number of generators will enter the highest allowed priority level, which equals the total number of generators. Keypad: - Pressing, "Cancel" will keep the current level. - Pressing, "Download" logs the level in pop up screen - Pressing "Update Field" shows the current setting. Save/Abort buttons: - Pressing the "SAVE" button will overtake the current requested level to the actual settings. - Pressing the "ABORT" button will discard all made changes to the requested levels and restore to the actual generator priority setting.																						

5.4 Utility Mode / Returning from Emergency Mode

5.4.1 EGP

- Automatic transfer switch(es) protective relaying senses utility voltage within tolerance.
- Following the automatic transfer switch return to normal time delay, to assure that the utility power source is stable, the automatic transfer switches individually retransfer to the normal position.

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- c. When the last automatic transfer switch has retransferred to the normal position, the generator mains are opened.
- d. The generators are allowed to run for their programmed cooldown period.
- e. The system is now in Automatic/Standby (Utility) Mode.

5.4.2 XLM

- a. Utility protective relaying senses utility voltage and frequency within tolerance.
- b. Following an adjustable time delay (which can be abbreviated by the operator), to assure that the utility power source is stable; the generator plant is passively synchronized and paralleled to the utility source by closing the utility main breaker.
- c. The generator plant is soft ramp unloaded until the utility source is nominally serving the entire system load.
- d. The generator breakers are opened.
- e. The generators are allowed to run for their programmed cooldown period.
- f. The system is now in Automatic/Standby (Utility) Mode.

Utility Retransfer timer	
UTIL 1 RE-XFER TIMER	3.42 min
* Located on the System Control Screen	

5.4.3 LM

There is no Emergency function for LM systems

5.5 Generator No Load Test

Purpose/Description

- * Perform periodic testing of generators without interrupting power to downstream loads

Entrance Into No Load Test Mode

XLM/LM

- * Generator No Load Test Switch is taken to ON position.
- * All available generators are started.
- * All generators come up to voltage and frequency and remain running disconnected from the bus.
- * The system is now in No Load Test Mode.

EGP

- * Generator No Load Test Switch is taken to ON position
- * All available generators are started.

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- First generator up to voltage and frequency is closed to the bus.
- All remaining generators are synchronized and paralleled to the bus as they come up to voltage and frequency.
- The system is now in No Load Test Mode.

Exit from No Load Test Mode

XLM/LM

- Generator No Load Test Switch is taken to OFF position
- All generators are allowed to run for their programmed cooldown period.
- The system is now in Automatic Mode

BGP

- Generator No Load Test Switch is taken to OFF position
- All generator breakers are opened
- All generators are allowed to run for their programmed cooldown period.
- The system is now in Automatic Mode

Required Switch Positions

Master Mode Switch	Engine Control Switch	Sync Mode Switch
		
• Master Mode Selector Switch (Located on System Control Screen): Automatic • Engine Control Switch (Located on Overview Screen, Engine Control Screen): Automatic • Sync Mode Switch (Located on Engine Control Screen): Automatic		

To initiate Generator No load Test, touch "GENERATOR NO LOAD TEST" Switch. The switch will move from the OFF position to the ON position beginning the test.

To exit from no load test, touch "GENERATOR NO LOAD TEST" Switch. The switch will move from the ON position to the OFF position ending the test.

Generator No Load Test Switch positions

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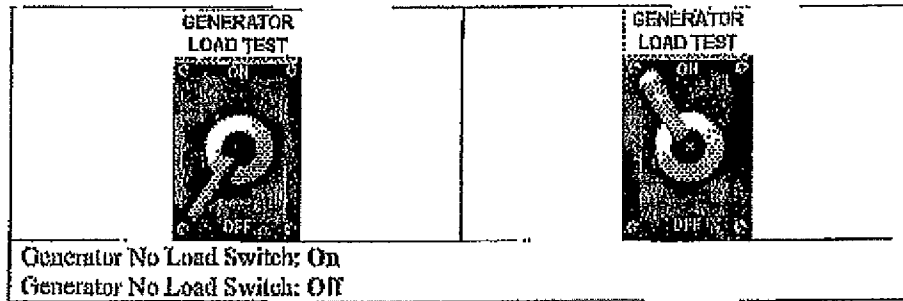
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5.6 Generator Test with Load

Purpose/Description

- Perform periodic testing of generators to include picking up all system loads

XLM/LM

- There is no Load Test function available.

EGP

- For Sequence, see Utility Fail Test Section 2.

Required Switch Positions

Master Mode Switch	Engine Control Switch	Sync Mode Switch
		
• Master Mode Selector Switch (Located on System Control Screen): Automatic • Engine Control Switch (Located on Overview Screen, Engine Control Screen): Automatic • Sync Mode Switch (Located on Engine Control Screen): Automatic		

To initiate Generator Load Test, touch "GENERATOR LOAD TEST" Switch. The switch will move for the OFF position to the ON position beginning the test

Generator Load Test Switch positions	
	
• Generator Load Switch: Off • Generator Load Switch: On	

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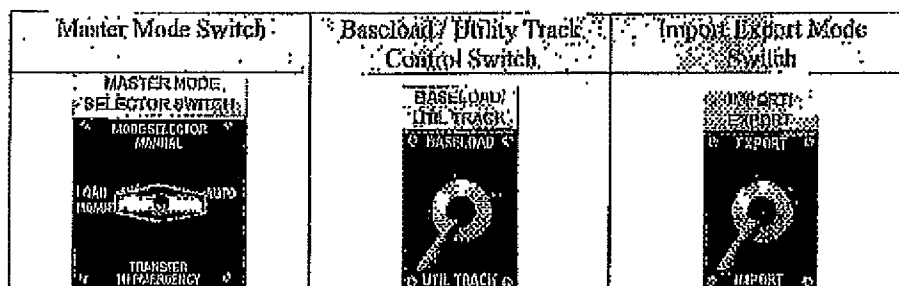
To exit from load test touch "GENERATOR LOAD TEST" Switch. The switch will move for the " " position to the " " position ending the test.

5.7 Load Management (XLM/LM only)

Purpose/Description

- A. Import Limit-Place the Import/Export toggle switch in the Import position and place the Base Load/Utility Tracking toggle switch in the Utility Tracking position. Set the Utility Import Setpoint to the desired amount of kW that you want to import through the Utility Circuit Breaker during Load Management Mode.
- B. Export Limit-Place the Import/Export toggle switch in the Export position and place the Base Load/Utility Tracking toggle switch in the Utility Tracking position. Set the Utility Export Setpoint to the desired amount of kW that you want to export through the Utility Circuit Breaker during Load Management Mode.
- C. Base Load Import-Place the Import/Export toggle switch in the Import position and place the Base Load/Utility Tracking toggle switch in the Base Load position. Set the Base Load Setpoint to the desired amount of kW that you want the generator plant to assume during Load Management Mode. The controls will not allow the generator plant to export kW through the Utility Circuit Breaker and will always maintain a nominal amount of Utility kW imported through the Utility Circuit Breaker.
- D. Base Load Export-Place the Import/Export toggle switch in the Export position and place the Base Load/Utility Tracking toggle switch in the Base Load position. Set the Base Load Setpoint to the desired amount of kW that you want the generator plant to assume during Load Management Mode. The controls will allow the generator plant to export kW through the Utility Circuit Breaker.

Required Switch Positions



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A. Import Limit

- Master Mode Selector Switch (Located on System Control Screen): Load Management
- Base load/Utility Track Switch (Located on System Control Screen): Utility Track
- Import/Export Switch (Located on System Control Screen): Import

Master Mode Switch	Baseload / Utility Track Control Switch	Import Export Mode Switch
		

B. Export Limit

- Master Mode Selector Switch (Located on System Control Screen): Load Management
- Base load/Utility Track Switch (Located on System Control Screen): Utility Track
- Import/Export Switch (Located on System Control Screen): Export

Master Mode Switch	Baseload / Utility Track Control Switch	Import Export Mode Switch
		

C. Base Load Import

- Master Mode Selector Switch (Located on System Control Screen): Load Management
- Base load/Utility Track Switch (Located on System Control Screen): Base Load
- Import/Export Switch (Located on System Control Screen): Import

Master Mode Switch	Engine Control Switch	Sync Mode Switch
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D. Base Load Export

- Master Mode Selector Switch (Located on System Control Screen): Load Management
- Base load/Utility Track Switch (Located on System Control Screen): Base Load
- Import/Export Switch (Located on System Control Screen): Export

Load Management Setpoints	Keypad																												
<table border="1"> <tr> <td>MAX UTIL IMPORT</td> <td>MAX UTIL EXPORT</td> </tr> <tr> <td> kW</td> <td> kW</td> </tr> <tr> <td>MIN UTIL IMPORT</td> <td>GENERATOR BASELOAD</td> </tr> <tr> <td> kW</td> <td> kW</td> </tr> </table>	MAX UTIL IMPORT	MAX UTIL EXPORT	kW	kW	MIN UTIL IMPORT	GENERATOR BASELOAD	kW	kW	<table border="1"> <tr> <td>7</td> <td>8</td> <td>9</td> <td>Clear</td> </tr> <tr> <td>4</td> <td>5</td> <td>6</td> <td>Back</td> </tr> <tr> <td>1</td> <td>2</td> <td>3</td> <td>Exp</td> </tr> <tr> <td>0</td> <td>.</td> <td>+/-</td> <td></td> </tr> <tr> <td>Update Field</td> <td>Download</td> <td>Cancel</td> <td></td> </tr> </table>	7	8	9	Clear	4	5	6	Back	1	2	3	Exp	0	.	+/-		Update Field	Download	Cancel	
MAX UTIL IMPORT	MAX UTIL EXPORT																												
kW	kW																												
MIN UTIL IMPORT	GENERATOR BASELOAD																												
kW	kW																												
7	8	9	Clear																										
4	5	6	Back																										
1	2	3	Exp																										
0	.	+/-																											
Update Field	Download	Cancel																											
• Max Utility Import in use during Import Operations with Utility Track • Min Utility Import in use during Import Operations with Base Load • Max Utility Export in use during Export Operations with Utility Track • Generator Base Load in use during Base Load Operation and either Export or Import	• Use touch area for kW setpoint. This will enable a pop up screen. This pop up screen allows the Operator to enter and change kW setpoint level. Press the number corresponding to the desired level. Any number higher than the Max. value will enter the highest allowed kW setpoint. • Pressing, "Cancel" will keep the current level. • Pressing, "Download" logs the level in pop up screen • Pressing "Update Field" shows the current setting.																												

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5.8 Utility Fail Test

Purpose/Description

- Perform periodic testing of system to respond to a utility outage.

Entrance into Utility Fail Test Mode

XLM

- Utility Fail Test Switch is taken to ON position.
- Voltage sensing at the utility protective relay is opened, which simulates a loss of utility.
- System enters Emergency Mode as described in 2.01.2(b)

EGP

- Utility Fail Test Switch is taken to ON position.
- A dry contact is sent to each ATS, which simulates a loss of utility within the ATS controls.
- System enters Emergency Mode as described in 2.01.2(a).

Exit from Utility Fail Test Mode

XLM

- Utility Fail Test Switch is taken to OFF position.
- Voltage sensing at the utility protective relay is restored, which simulates a return of utility power.
- System exits Emergency Mode as described in 2.01.5(b).

EGP

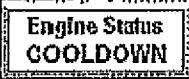
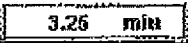
- Utility Fail Test Switch is taken to OFF position.
- A dry contact is removed from each ATS, which simulates a return of utility within the ATS controls.
- System exits Emergency Mode as described in Section 2.

6 System Pop Ups

<i>Section 6.1</i>	<i>Engine Cooldown Timers</i>
<i>Section 6.2</i>	<i>Utility Ok to Retransfer</i>
<i>Section 6.3</i>	<i>Utility Retransfer Timer</i>
<i>Section 6.4</i>	<i>Warm up Timers</i>
<i>Section 6.5</i>	<i>Transfer Imminent</i>
<i>Section 6.6</i>	<i>ATS Ok to Retransfer</i>

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6.1 Engine Cooldown Timer

Description	
	
• Located on the Overview Screen • Displays when the generator is unloading and it's respective breaker is opened or if running isolated from the bus and the operator places the switchgear BCS in the Cooldown/Stop position.	

6.2 Utility OK to Retransfer

Description	
	
• Located on the System Control Screen • This will only display when the Utility Retransfer Selector Switch is in the Manual position and the Utility Retransfer timer has expired.	

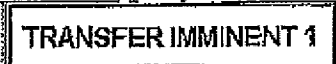
6.3 Utility Retransfer Timer

Description	
	
• Located on the System Control Screen • Displays when the system detects the utility voltage and frequency are within acceptable tolerance and no other faults exist on the utility after a faulted condition.	

6.4 Warm-up Timer

Description	
	
• Located on the ATS Control Screen • Displays when the engine plant is started while performing the following: Load Management or Close Transfer to Emergency.	

6.5 Transfer Imminent

Description	
	
• Located on the Sys Control Screen • Displays when the operator bypasses any timer by pressing the "IMMEDIATE TRANSFER" pushbutton. Indicates generator is actively synchronizing to the utility.	

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6.6 ATS OK to Retransfer

Description	
ATS OK to Retransfer	
2.25 min	
• Located on the ATS Control Screen	

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7 Master Shutdown

Section 7.1	Purposes
Section 7.2	Location of Button
Section 7.3	Operation
Section 7.4	Resetting Master Shutdown

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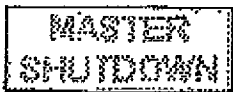
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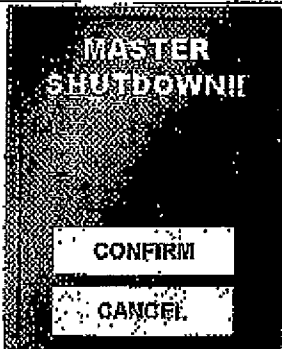
7.1 Purpose

The Master Shutdown function is available from all screens on your PowerLynx equipment. When activated, all generator breakers are opened, and all generators are shut down. If utility breakers are available, utility breakers will close following a Quick Utility Exit.

7.2 Location of Button

Master Shutdown Button	Operations
	Basic operations of the Master Shutdown Button: The Master Shutdown is located in the lower right hand corner of every screen.

7.3 Operation

Master Shutdown Popup	Screen Operations
	Basic operations of the Master Shutdown Popup: The Master Shutdown is initiated by touching the "Hot Area". A confirmation window will "pop up". From here you can "Confirm" or "Cancel" the operation.

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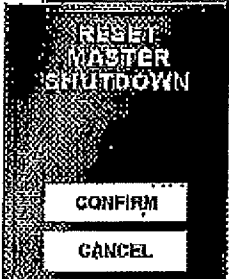
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7.4 Resetting Master Shutdown

Reset Master Shutdown Button	Operations
	Basic operations of the Reset Master Shutdown Button: Once the Master Shutdown has been initiated, a Reset Shutdown button will appear where the Master Shutdown button once was.
	This will also need to be confirmed. The confirmation window will "pop up". From here you can "Confirm" or "Cancel".

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8 System Operation

Section 8.1.....	System Control
Section 8.2.....	System Metering
Section 8.3.....	System Annunciation

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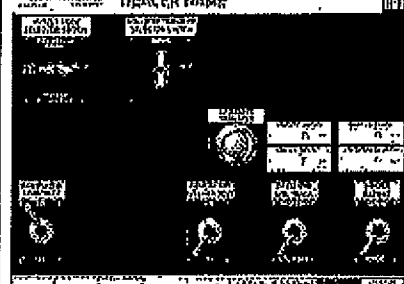
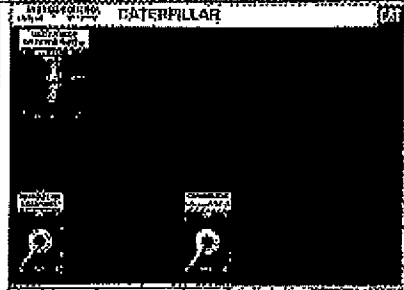
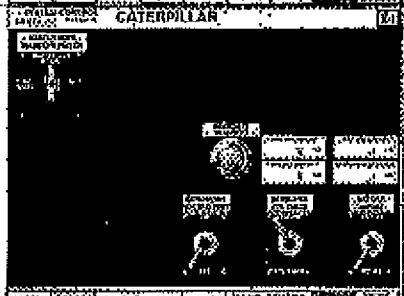
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8.1 System Control

This chapter describes typical System control screen EGP, XLM and LM system types.

System Control Screen	Screen Operations
	Basic operations on the System Control Screen: • Typical XLM • See System Operation (Section 2)
	Basic operations on the System Control Screen: • Typical EGP • See System Operation (Section 2)
	Basic operations on the System Control Screen: • Typical LM • See System Operation (Section 2)

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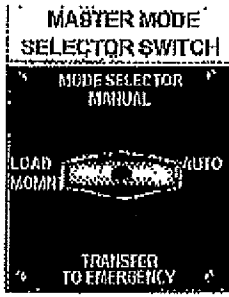
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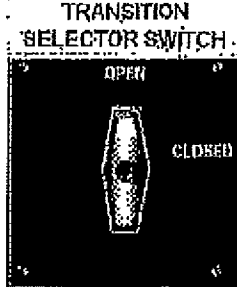
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Master Mode selector switch

Master Mode Selector Switch	Switch Operations
	Basic operations on the Master Mode Selector Switch: • Manual (EGP, XLM, LM) Removes all automatic functions for the PowerLynx system • Automatic (EGP, XLM, LM) Allows for automatic control of the PowerLynx system • Transfer to Emergency (XLM) Transfers system to generators in anticipation of utility outages • Load Management (XLM, LM) Places generators in parallel with utility to share load

Transition Selector Switch (Only available on XLM systems)

Transition Selector Switch	Switch Operations
	Basic operations on the Transition Selector Switch: • Open: This is a Break-Before-Make operation. It occurs when transferring between two good sources. The load will be interrupted while going from generators back to utility. • Closed: This is a Make-Before-Break operation between two good sources only. There will be no loss of power to the load.

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Utility Retransfer switch

Utility Retransfer Switch	Screen Operations
 The image shows a selector switch with two positions: 'MANUAL' and 'AUTO'. The switch is currently in the 'MANUAL' position.	Basic operations of the Utility Retransfer Switch: • Manual: System will wait for operator to press the Immediate Transfer Button on System Control Screen before initiating the retransfer to utility. • Auto: System will automatically transfer back to utility once retransfer timer has timed out.

Immediate Transfer push button

Immediate Transfer push button	Screen Operations
 The image shows a circular push button with the text 'IMMEDIATE TRANSFER' in the center.	Basic operations of the Immediate Transfer push button: • Pushing the Immediate Transfer button will bypass all warm-up timers and initiate automatic system operation.

Base Load/Utility Tracking

Base Load/Utility Tracking Switch	Screen Operations
 The image shows a switch with two positions: 'BASELOAD' and 'UTIL TRACK'. The switch is currently in the 'BASELOAD' position.	Basic operations of the Base Load/Utility Tracking Switch: • See Load Management

Import/Export

Import/Export Switch	Screen Operations
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Basic operations of the Import/Export Switch:

- See Load Management

Utility Fail Test

Utility Fail-Test Switch



Screen Operations

Basic operations of the Utility Fail Test Switch:

- **ON:** This will initiate a popup warning that must be confirmed to initiate a utility fail test. This will operate a normally closed relay simulating a loss of utility power to the utility protective relay.
- **OFF:** This will operate a normally closed relay simulating a return of utility power to the utility protective relay.

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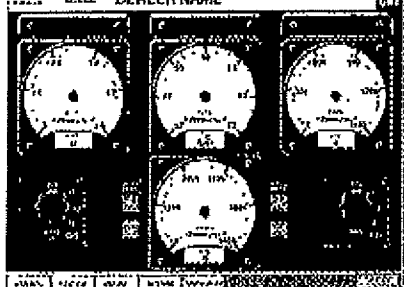
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8.2 System Metering

Generator System Metering Screen	Screen Operations
	Basic operations on the System Metering Screen: Allows for single location to view system parameters. These parameters consist only of the combined generator plant metering.

Available Indication

- Volts
- Frequency/Pf
- KW/KVAR
- Amps

Operation of Phase Selector Switch

Phase Select Switch	Switch Operations
	Single "Hot Area" is touched to select between phases: Purpose: Allows digital and analog voltage indication
Note: • Phase to neutral on Wye systems	

Frequency/ PF

Toggle Switch	Switch Operations
	Operation of toggle switch: Single "Hot Area" is touched to toggle between PF and Hz Purpose: Allows digital and analog frequency/PF indication

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KW/KVAR

Toggle Switch	Switch Operations
	Operation of toggle switch: Single "Hot Area" is touched to toggle between kW and kVAR Purpose: Allows digital and analog kW/kVAR indication

Amp meter

Amp Meter Switch	Switch Operations
	Operation of phase selector switch: Single "Hot Area" is touched to select between phases Purpose: Allows digital and analog current indication

Information other than meters

Breaker Status	Description
	Breaker Status: OPEN, CLOSED, TRIPPED The Breaker Indicators are located on the following screens: • Generator Metering Screen • Generator Control Screen • Utility Metering Screen • Utility Control Screen

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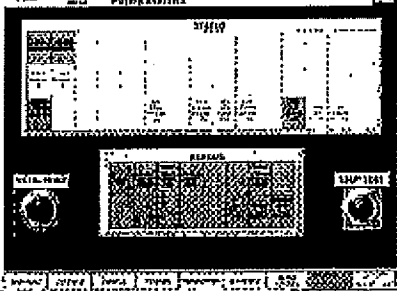
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8.3 System Annunciation

System Annunciator Screen	Screen Operations
	Basic operations on the System Annunciator Screen: - Alarm Acknowledge - Status- any light illuminated under the status area regardless of color is status only and not an alarm - System Alarms- all system alarms will be found under alarms area and horn will sound

Your PowerLynx annunciator system shows all active and not acknowledged alarms (flashing) which can be acknowledged by pressing the "ACK ALARM". This will also silence the horn. Also it shows all acknowledged alarms (solid) which will stay in this state unless the Alarm Reset Button is pressed to reset all inactive acknowledged alarms. Pressing the Reset will not remove continuously active alarms unless their origin is removed.

Annunciator Button

Annunciator Button	Button Operations
	Operation of Annunciator Button: When the operator hears the annunciator horn, he should return to the Overview screen. The button to the annunciator in alarm will flash.

CB Fail Reset Button

Circuit Breaker Reset Button	Button Operations
CB FAIL RESET 	Operation of Circuit Breaker Button: CB Fail Reset: Resets all CB Fail alarms. These breakers will not close until the CB Reset button has been pushed.

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Lamp Test Button

Lamp Test Button	Button Operations
LAMP TEST 	Operation of Lamp Test Button: When the operator presses the Lamp Test button, all of the Annunciator panels will light up. (Simulates conventional Switchgear Lamp Test)

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9 Generator Operation

Section 9.1.....	Generator Controls
Section 9.2.....	Generator Metering
Section 9.3.....	Generator Annunciation
Section 9.4.....	Engine Monitoring
Section 9.5.....	Expanded Engine Data

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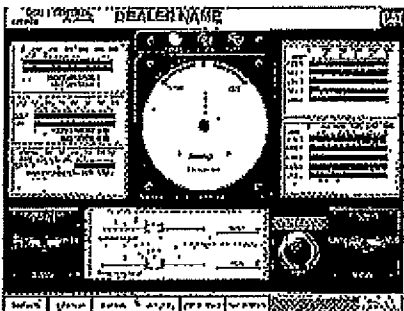
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9.1 Generator Controls

Generator Control Screen	Screen Operations
	Basic operations on the Generator Control Screen: • Generator and Bus Voltage, Frequency and Power Factor • Synchronization scope shows the phase relationship between the Bus and the Generator • Generator breaker Ampereage and power status • Touch and move slider to adjust Generator Voltage and Frequency when generator is running and breaker is open • Touch manual to enable manual Generator Operation, the push button closes the breaker when Generators are in manual mode

Switches/Buttons

- Engine Control Switch
- Sync Mode Switch
- Breaker Close Button
- Voltage / Frequency sliders

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Engine Control Switch

Definition/Purpose

- To control the mode in which the generator operates

Operation

Engine Control Switch	Switch Operations
	Basic operations on the Engine Control Switch: Auto: Allows for all automatic functions to occur via PowerLynx controls Manual: Starts the generator Cooldown Stop: Unloads generator, opens breaker, then performs Cutdown, generator is unavailable Off/Reset: Turns generator off, resets any alarms that have cleared

Touching the "Hot Area" which you want the switch to be positioned operates ECS

*Note: If system enters Emergency Mode and the ECS is in manual with the Sync Mode switch in auto the breaker will close automatically.

Sync Mode

Definition/Purpose

- To control the mode in which you want the generator to sync

Operation

Sync Mode Switch	Switch Operations
	Basic operations on the Sync Mode Switch: Auto: Allows for all automatic synchronization functions to occur via PowerLynx controls Manual: Allows for manually closing the generator breaker from control screen push button Check: Holds the generator in sync with the bus without allowing closing of the breaker Off: Will not attempt to synchronize generator(s) to a hot bus. Does not allow the generator breaker to close

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Generator Breaker Close Button

Definition/Purpose

- Allows operator to manually close the generator button in sync

Operation

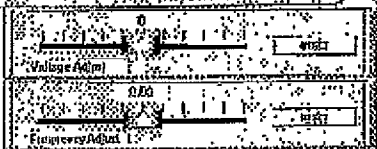
- Single "Hot Area" is touched to send signal to plc to close generator breaker

"Note: Typically the sync check relay (25) will have to meet synchronization parameters to allow breaker to close.

Required Switch Positions

Sync Mode Switch	Generator Breaker Close Button
	
▪ Sync Mode Switch Manual	

Voltage /Frequency Sliders

Sliders are located on the Generator and Utility Control Screen	
	
▪ Touching area allows for continuous fluid movement allowing operator to raise or lower voltage and frequency.	
▪ Reset button centers the slider to remove manual bias	

Definition/Purpose

- Allows for manual operation of voltage or frequency control with generator breaker OPEN

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*Note: Sliders are left at mid position to allow for full voltage and frequency range.
Also for systems with multiple engines the deviation from midpoint acts as an immediate drop that must be compensated for in automation.

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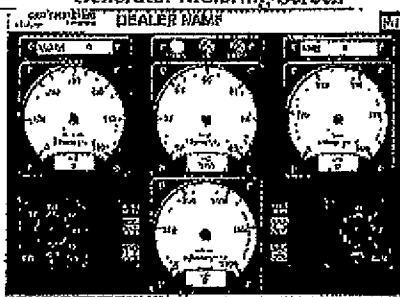
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9.2 Generator Metering

Generator Metering Screen	Screen Operations
	Basic operations on the Generator Metering Screen: Allows for single location to view each individual Generator metering

Available indication

- Volts
- Frequency/Pf
- KW/KVAR
- Amps
- Phase to neutral on Wye systems

Volts

Volts Selector Switch	Switch Operations
	Operation of phase selector switch: Single "Hot Area" is touched to select between phases Purpose: Allows digital and analog voltage indication

Frequency/ Power factor

Toggle Switch	Switch Operations
	Operation of toggle switch: Single "Hot Area" is touched to toggle between the Power factor (PF) and Frequency (Hz) Purpose: Allows digital and analog PF/Hz indication

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KW/KVAR

Toggle Switch



Switch Operations

Operation of toggle switch:
Single "Hot Area" is touched to toggle between kW and kVAR

Purpose:
Allows digital and analog kW/kVAR indication

Amp meter

Amp Selector Switch



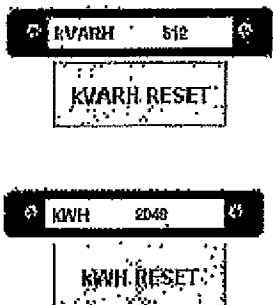
Switch Operations

Operation of phase selector switch:
Single "Hot Area" is touched to select between phases

Purpose:
Allows digital and analog current indication

Generator Energy Counters

kVARH and kWh Energy counters



Description

kVARH Energy counter and Reset:
Display the stored kVARH Energy of the Generator since the last reset. The associated kVARH RESET button will set this counter to zero

kWH Energy counter:
Display the stored kWH Energy of the Generator since the last reset. The associated kWH RESET button will set this counter to zero

Information other than meters

- Breaker Status

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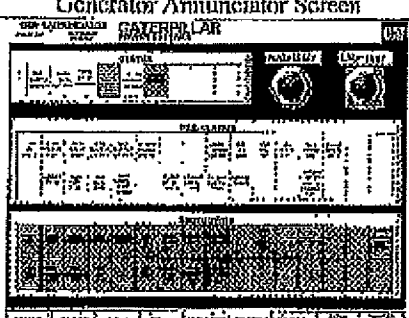
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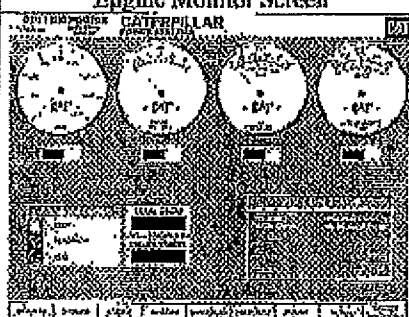
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9.3 Generator Annunciation

Generator Annunciator Screen	Screen Operations
	Basic operations on the Generator Annunciator Screen: • Lamp Test • Alarm Acknowledge • Alarm Reset • Status • Pre-Alarms • Shutdown Faults
Your Power Lynx Generator annunciator system shows all active and unacknowledged alarms (flashing) which can be acknowledged by pressing the "ACK ALARM". This will silence the horn. Also, it shows all acknowledged alarms (solid) that will stay in this state unless the Alarm Reset Button is pressed to reset all inactive acknowledged alarms. Pressing the Reset will not remove continuously active alarms unless their origin is removed.	

9.4 Engine Monitoring

Engine Monitor Screen	Screen Operations
	Basic operations on the Engine Monitor Screen: • Meters • Local Engine Control Indication Status display of the ECS position at the engine. (No control) • GEN Status Shutdown Faults Pre-alarms
Engine status is obtained directly from the generators "smart" control system (EMCP II/ EMCP III). Available information is determined by the controller type of your engine	

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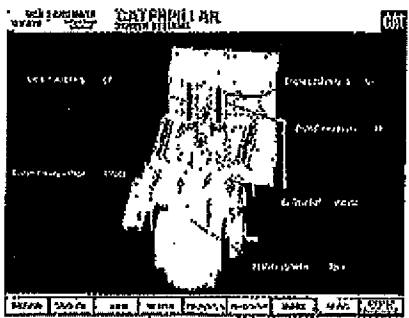
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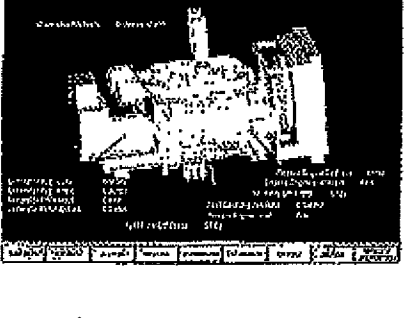
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9.5 Expanded Engine Data

Air/Cool Typical

Engine Air/Cool	Screen Operations
	Basic operations on the Engine Air/Cool Screen: • Atmospheric Pressure • Left Exhaust Temperature • Left Turbo Inlet Pressure • Boost Pressure • System Battery Voltage • Left Air Filter Differential • Engine Coolant Temperature • Right Exhaust Temperature • Right Turbo Inlet Pressure • Right Air Filter Differential • ECM Hour Meter

Oil/Fuel Typical

Engine Oil/Fuel	Screen Operations
	Basic operations on the Engine Oil/Fuel Screen: • Crankcase Pressure • Generator Average Volts • Generator Average Amps • Generator kW Output • Generator kVAR Output • Fuel Filter Differential Pressure • Fuel Consumption Rate • Percent Engine Load • Filtered Engine Oil Pressure • Filtered Engine Fuel Pressure • Oil Filter Differential Pressure

*Note: This type of Expanded Engine Data is only available on ADHM II and ADEM III Diesels. Check with your actual engine technical manual to verify applicability. A table is referenced in the appendix.

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10 Utility Operation

Section 10.1.....	Utility Controls
Section 10.2.....	Utility Metering
Section 10.3.....	Utility Annunciation

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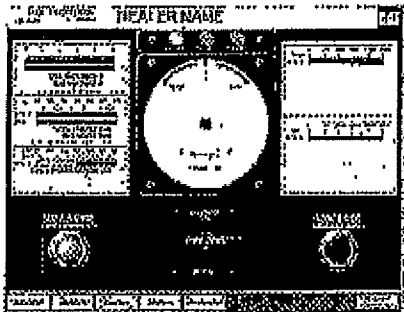
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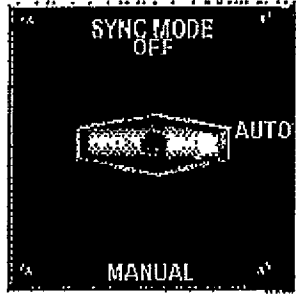
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10.1 Utility Controls

Utility Control Screen	Screen Operations
	Basic operations on the Utility Control Screen: - Utility and Bus Voltage, Frequency and Power Factor - Synchronization scope shows the phase relationship between the Bus and the Utility - Utility breaker Amperage and power status - Touch manual to enable manual Utility Operation, the Close button closes the breaker and the Open push button opens the breaker when Utility is in manual mode

Utility Sync Mode Switch

Utility Sync Switch	Switch Operations
	Basic operations on the Utility Sync Switch: Definition/Purpose - To control the mode in which you want the utility to sync Operation Touching the "Hot Area" which you want the switch to be positioned operates the Sync Mode Switch - Auto; Allows for all automatic functions to occur via PowerLynx controls - Manual; Allows for manually operating the utility breaker from control screen

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Utility Breaker Close button

Definition/Purpose

- Allows operator to manually close the utility breaker.

Operation

- Single "Hot Area" is touched to send signal to plc to close utility breaker.

Required Switch Positions

Sync Mode Switch	Utility Breaker Close Button
	
• Sync Mode Switch: Manual	

Utility Breaker Open Button

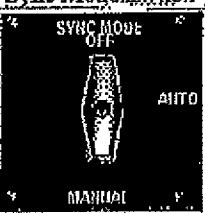
Definition/Purpose

- Allows operator to manually open the utility breaker from the touch screen

Operation

- Single "Hot Area" is touched to send signal to plc to open utility breaker

Required Switch Positions

Sync Mode Switch	Utility Breaker Open Button
	
• Sync Mode Switch: Manual	

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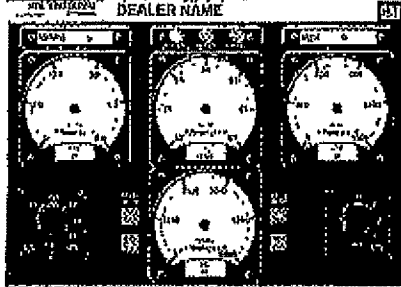
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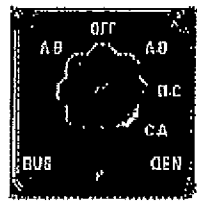
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10.2 Utility Metering

Utility Metering Screen	Screen Operations
	Basic operations on the Utility Metering Screen: Allows for single location to view single Utility parameters

Available indication

- Volts
- Frequency/Pf
- KW/KVAR
- Amps
- Phase to neutral on Wye systems
- Energy Counters

Volts Selector Switch	Volts Switch Operations
	Operation of phase selector switch Single "Hot Area" is touched to select between phases Purpose: Allows digital and analog voltage indication

Toggle Switch	Frequency/ Power factor Switch Operations
	Operation of toggle switch: Single "Hot Area" is touched to toggle between the Power factor (PF) and Frequency (Hz) Purpose: Allows digital and analog PF/Hz indication

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KW/KVAR

Toggle Switch	Switch Operations
	Operation of toggle switch: Single "Hot Area" is touched to toggle between kW and kVAR Purpose: Allows digital and analog kW/kVAR indication

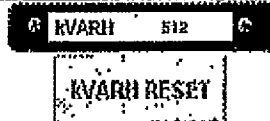
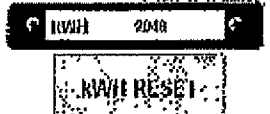
Amp meter

Amp Selector Switch	Switch Operations
	Operation of phase selector switch: Single "Hot Area" is touched to select between phases Purpose: Allows digital and analog current indication

Information other than meters

Breaker Status	Description
	Breaker Status: OPEN, CLOSED, TRIPPED The Breaker Indicators are located on the following screens: • Generator Metering Screen • Generator Control Screen • Utility Metering Screen • Utility Control Screen

Utility Energy Counters

kVARH and kWh Energy Counters	Description
	kVARH Energy counter and Reset: Display the stored kVARH Energy of the Utility since the last reset. The associated kVARH RESET button will set this counter to zero
	kWH Energy counter: Display the stored kWH Energy of the Utility since the last reset. The associated kWH RESET button will set this counter to zero

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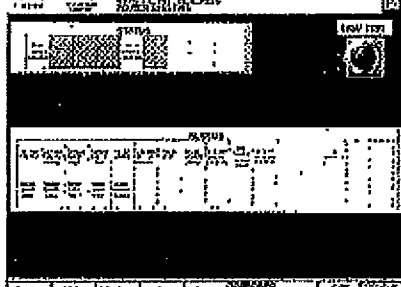
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10.3 Utility Annunciation

Utility Annunciator Screen	Screen Operations
	Basic operations on the Utility Annunciator Screen: • Lamp Test • Alarm Acknowledge • Status • Alarms

Your PowerLynx System uses ISA F3A First Out annunciator system. When multiple unacknowledged alarms are shown on the screen, pressing, "ACKNOWLEDGE," acknowledges all alarms except for the first alarm in. This remains flashing until the "ACKNOWLEDGE" button is pressed again, allowing the operator to see the original cause behind a cascade of events.

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11 Emergency Tie Operation

Section 11.1.....	Emergency Tie Controls
Section 11.2.....	Emergency Tie Metering
Section 11.3.....	Emergency Tie Annunciation

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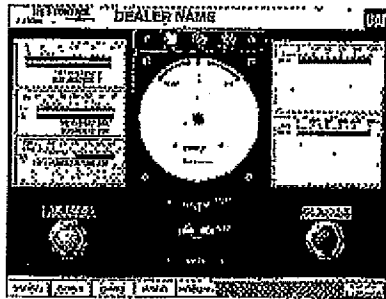
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11.1 Emergency Tie Controls

Emergency Tie Control Screen

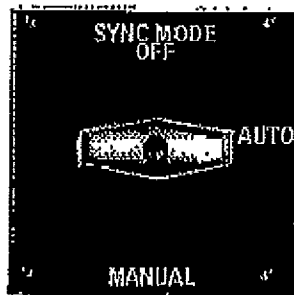


Screen Operations

Basic operations on the Emergency Tie Control Screen:

- Emergency Tie and Bus Voltage, Frequency and Power Factor
- Synchronization scope shows the phase relationship between the Bus and the Emergency Tie
- Emergency Tie breaker Amperage and power status
- Touch manual to enable manual Emergency Tie Operation, the Close button closes the breaker and the Open push button opens the breaker when Emergency Tie is in manual mode

Emergency Tie Sync Mode Switch
Emergency Tie Sync Switch



Switch Operations

Basic operations on the Emergency Tie Sync Switch:

Definition/Purpose

- To control the mode in which you want the Emergency Tie to sync

Operation

Touching the "Hot Area" which you want the switch to be positioned operates the Sync Mode Switch

- Auto: Allows for all automatic functions to occur via PowerLynx controls
- Manual: Allows for manually shutting the Emergency Tie breaker from control screen

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Emergency Tie Breaker Button

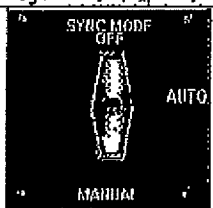
Definition/Purpose

- Allows operator to manually close the emergency tie breaker in sync

Operation

- Single "Hot Area" is touched to send signal to plc to close emergency tie breaker

Required Switch Positions

Sync Mode Switch	Emergency Tie Breaker Close Button
	
Sync Mode Switch: Manual	

Emergency Tie Breaker Open Button

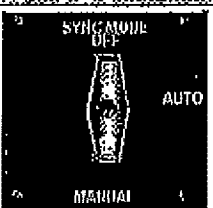
Definition/Purpose

- Allows operator to manually open the emergency tie breaker from the touch screen

Operation

- Single "Hot Area" is touched to send signal to plc to open emergency tie breaker

Required Switch Positions

Sync Mode Switch	Emergency Tie Breaker Open Button
	
Sync Mode Switch: Manual	

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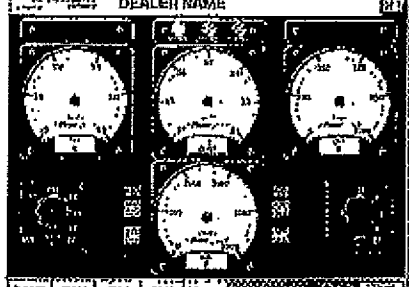
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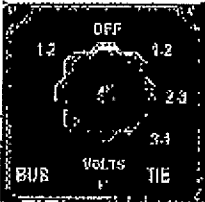
11.2 Emergency Tie Metering

Emergency Tie Metering Screen	Screen Operations
	Basic operations on the Emergency Tie Metering Screen: Allows for single location to view single Emergency Tie parameters

Available indication

- Volts
- Frequency/Pf
- KW/KVAR
- Amps
- Phase to neutral on Wye systems

Volts

Volts Selector Switch	Switch Operations
	Operation of phase selector switch: Single "Hot Area" is touched to select between phases Purpose: Allows digital and analog voltage indication

Frequency/ Pf

Toggle Switch	Switch Operations
	Operation of toggle switch: Single "Hot Area" is touched to toggle between PF and Hz Purpose: Allows digital and analog PF/Hz indication

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Toggle Switch



KW/KVAR

Switch Operations

Operation of toggle switch:
Single "Hot Area" is touched to toggle between kW and kVAR

Purpose:
Allows digital and analog kW/kVAR indication

Amp meter

Amp Selector Switch



Switch Operations

Operation of phase selector switch:
Single "Hot Area" is touched to select between phases

Purpose:
Allows digital and analog current indication

Information other than meters

Breaker Status



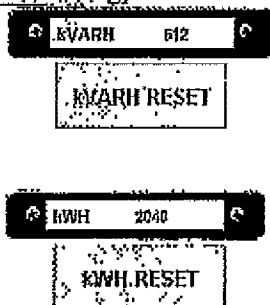
Description

Breaker Status: OPEN, CLOSED, TRIPPED
The Breaker Indicators are located on the following screens:

- Generator Metering Screen
- Generator Control Screen
- Utility Metering Screen
- Utility Control Screen

Tie Energy Counters

kVARH and kWh Energy counters



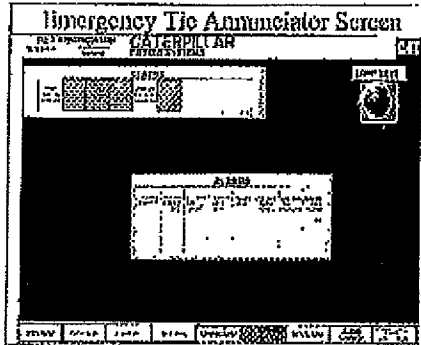
Description

kVARH Energy counter and Reset:
Display the stored kVARH Energy of the Tie since the last reset. The associated kVARH RESET button will set this counter to zero

kWH Energy counter:
Display the stored kWH Energy of the Tie since the last reset. The associated kWH RESET button will set this counter to zero

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11.3 Emergency Tie Annunciation



Screen Operations

Basic operations on the Emergency Tie Annunciator Screen:

- Lamp Test
- Alarm Acknowledge
- Status
- Alarms

Your PowerLynx System uses ISA F3A First Out annunciator system. When multiple unacknowledged alarms are shown on the screen, pressing "ACKNOWLEDGE," acknowledges all alarms except for the first alarm in. This remains flashing until the "ACKNOWLEDGE" button is pressed again, allowing the operator to see the original cause behind a cascade of events.

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12 Distribution Operation

Section 12.1.....	System Load Shed Controls
Section 12.2.....	Gas Demand Controls

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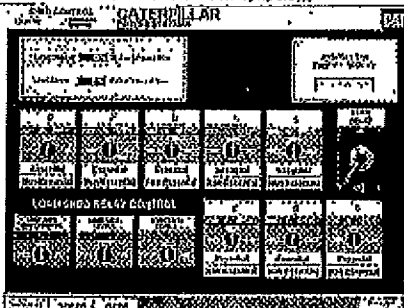
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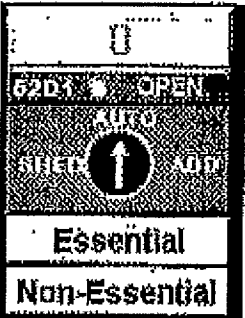
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12.1 System Load Shed Controls

Shed Control Screen	Screen Operations
	Basic operations on the Utility Setting Screen: • Load Sense Control Switch • Distribution Control Switches • Load Shed Relay/Level Control Switches

Distribution Control Switch

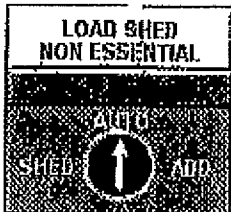
Distribution Control Switch	Screen Operations
	Basic operations on the Distribution Control Switch: Control Positions: • Add: This position will close the distribution breaker. • Shed: This position will open the distribution breaker. • Auto: This position will allow for automatic operation via the load-shed/add scheme. • Essential/ Non-Essential : Places Circuit Breaker in Essential or Non-Essential condition Breaker status is also shown on the distribution control switch. Touching the Shed level button allows the operator to select the desired load shed level.

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Distribution controls are located on the LOAD SHED control screen. This three (3) position switch also allows a load shed setting to be placed on each individual distribution breaker with electrical control.

*Note: If after 3 seconds, the breaker has not operated the PLC output will no longer pulse and the Distribution Control Switch must be reset to AUTO and then placed in the position of desired operation.

Load Shed Relay/Level Switch

Load Shed Relay/Level Switch	Screen Operations
	Basic operations on the Load Shed Level/Relay Control Switch:
	Positions
	• Add This position will close the Load Shed Relay.
	• Shed This position will open the Load Shed Relay.
	• Auto This position will allow for automatic operation via the load-shed/add scheme.

Load shed control Switch

Load Shed Control Switch positions	
	
• On: Enables all automatic load sensitive operations (section 2.01.3) provided all other load shed switches are in auto • Off: Overrides all automatic load sensitive operations	

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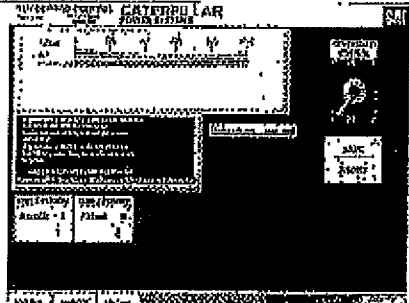
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12.2 Gen Demand Controls

Gen Demand Control Screen	Screen Operations
	Basic operations on the Gen Demand Control Screen: • Gen Demand Control Switch • Generator Demand Priority Settings

* Note: For operation description see chapter 5.3 Generator Demand Priority.

Gen Demand Control Switch

Gen Demand Control Switch positions	
	
• On: Enables all automatic functions of the Generator Demand system • Off: Overrides all automatic generator demand functions. This will have all available generators running any time there is a run request.	

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13 ATS Operation

Section 13.1.....	ATS Overview
Section 13.2.....	ATS Control
Section 13.3.....	ATS Metering
Section 13.4.....	ATS Settings

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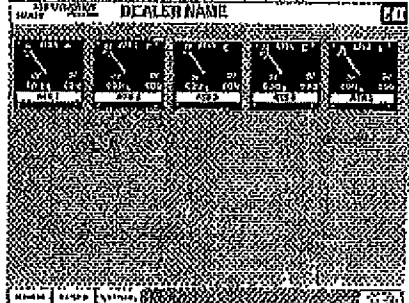
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13.1 ATS Overview

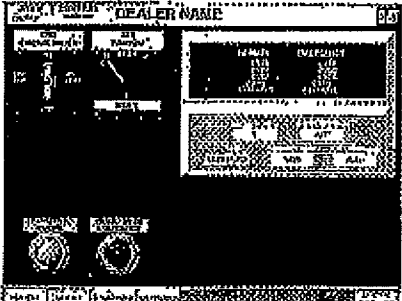
ATS Positions

ATS Overview Screen	Screen Operations
	Basic operations on the ATS Overview Screen:
	Normal
	Emergency

- Load is shown being supplied by normal (Utility) source

- Load is shown being supplied by emergency (Utility) source

13.2 ATS Control

ATS Control Screen	Screen Operations
	Basic operations on the ATS Control Screen:
	• ATS Normal Source Phase Voltage and Frequency
	• ATS Emergency Source Phase Voltage and Frequency

- ATS Position Status

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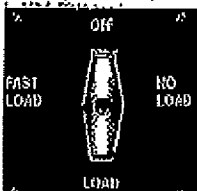
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Test Control Switch

Test Control Switch	Switch Operations
	Basic operations on the Test Control Switch: Positions • Off • Load • No Load • Fast Load

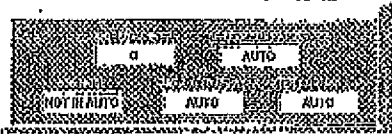
Transfer To Normal Button

Transfer To Normal Button	Operations
	Basic operations on the Transfer To Normal Button: • Press this button to transfer the ATS to normal power source by bypassing the stability time delay

Transfer to Emergency Button

Transfer To Emergency Button	Operations
	Basic operations on the Transfer To Emergency Button: • Press this button to transfer the ATS to the Emergency supply and send the system in to emergency

Indication

Indication	Operations
	Basic operations on the ATS Indications: • Number of Transfers • ATS Mode • Auto Transfer Relay • Transfer Control • Re-Transfer Control • ATS Timer Active

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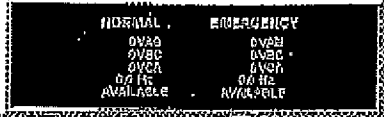
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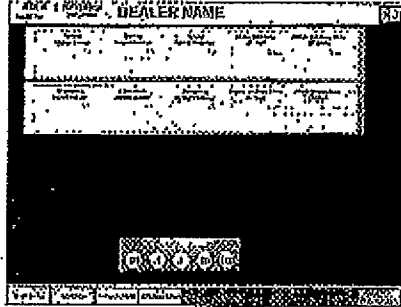
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13.3 ATS Metering

ATS Metering	Operations
 The screenshot shows a table with two columns: NORMAL and EMERGENCY. Under NORMAL, it lists OVAG, OVBC, OVCA, and DA HS. Under EMERGENCY, it lists OVAG, OVBC, OVCA, and DA HS. At the bottom of each column, it says AVAILABLE.	Basic operations on the ATS Metering (located on the ATS Control Screen): Voltage - Voltages of both the normal and emergency source are shown Frequency - Frequency of both the normal and emergency source are shown

13.4 ATS Settings

ATS Settings	Operations
 The screenshot shows a screen with a title bar 'DEALER NAME' and a list of settings including Normal Pickup Voltage, Normal Dropout Voltage, Normal Pickup Frequency, Engine Start Timer, Transfer to Emergency Timer, Emergency Pickup Voltage, Emergency Dropout Voltage, Emergency Pickup Frequency, Engine Cooldown Timer, and Transfer to Normal Timer.	Basic operations on the ATS Settings: - Normal Pickup Voltage - Normal Dropout Voltage - Normal Pickup Frequency - Engine Start Timer - Transfer to Emergency Timer - Emergency Pickup Voltage - Emergency Dropout Voltage - Emergency Pickup Frequency - Engine Cooldown Timer - Transfer to Normal Timer

*Note: Refer to your specific ATS manual for system effects of changing settings.

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14 System Setup Settings

Section 14.1 System Settings

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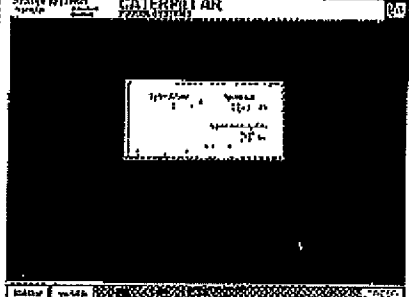
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14.1 System Settings

System Setting Screen	Screen Operations
	Basic operations on the System Setting Screen: • Voltage • Frequency • System KW Ramp Rate

Operation

System settings are normally "View Only". To change setpoint, the password must be entered.

Setting Description

System Voltage: This is the voltage rating of the generator plant. This variable is used to determine the voltage output of each generator. Adjusting this value will raise the voltage output of the generator.

System Frequency: This is the frequency rating of the generator plant. This variable is used to determine the frequency output of each generator. Adjusting this value will raise the frequency output of the generator.

System KW Ramp Rate: This is the KW rating in percent of the Generator power per second. This distinguishes how fast the system is ramping up/down when ramping in parallel in the utility.

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15 Generator Setup Settings

<i>Section 15.1</i>	<i>Generator Setup</i>
<i>Section 15.2</i>	<i>Generator Protective Settings I</i>
<i>Section 15.3</i>	<i>Generator Protective Settings II</i>
<i>Section 15.4</i>	<i>Gen Circuit Breaker Settings</i>
<i>Section 15.5</i>	<i>Gen Demand Settings</i>
<i>Section 15.6</i>	<i>Load Shed Settings</i>

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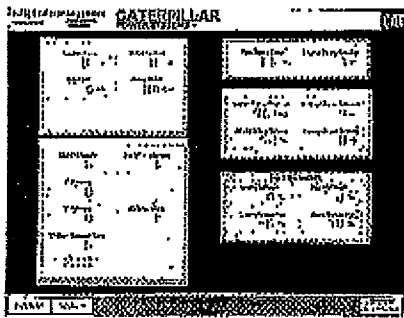
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15.1 Generator Setup

Generator Setting Screen	Screen Operations
	Basic operations on the Generator Setting Screen: • Generator Rated Voltage and Current • Generator Rated KW and kVAR • Generator Cooldown time • Generator Engine Safety Alarm delay • Speed droop Setpoint and Settings • Voltage Droop Setpoint and Settings • Generator available Voltage settings • Generator available Frequency settings • Bus and Generator VT, CT ratios

Operation

Generator settings are normally "View Only". To change setpoints, the password must be entered.

Setting Description

Rated Voltage: This is the Voltage rating of the generator. This variable is used for other setpoints which are entered in percent of this generator rated voltage.

Rated KW: This is the kW rating of the generator. This variable is used to determine the size of the unit when operating the system in parallel with other generators such that facility load is shared equally among them. Also this variable is used for other setpoints which are entered in percent of this generator rated KW.

Rated kVAR: This is the kVAR rating of the generator. This variable is used to determine the size of the unit when operating the system in parallel with other generators such that facility reactive load is shared equally among them. Also this variable is used for other setpoints which are entered in percent of this generator rated kVAR.

Cooldown: This is the time allotted for the generator to continue running once separated from the generator bus prior to the unit shutting down.

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Engine Safety Alarm: This is the time delay that the Generator protection is inhibited while the Generator is cranking and not already up to speed and voltage.

Bus VT Primary: This is the busbar primary Voltage transformer setting.

Bus VT Secondary: This is the busbar secondary Voltage transformer setting.

CT Primary: This is the Generator primary current transformer setting.

NGR CT Primary: This is the Neutral Ground Generator primary current transformer setting.

Voltage Measure Type: This sets the voltage measurement type. Following types are supported: 0 = 3phase4wire, 1 = 3phase3wire, 2=1phase2wire and 3 = 1phase3wire.

Speed Droop Setpoint: This sets the starting or threshold the Genset Target Frequency will be dropped in Hz.

Speed Droop Setpoint: This variable sets how much the Genset Target Frequency will be dropped in percent of the Genset's KW.

Lower Voltage (Gen & Bus Available): This setting is the lower variable setpoint where the generator voltage is considered to be in range. The value is entered in percentage of the generator rated voltage.

Upper Voltage (Gen & Bus Available): This setting is the upper variable setpoint where the generator voltage is considered to be out of range. The value is entered in percentage of the generator rated voltage.

Lower Frequency (Gen & Bus Available): This setting is the lower variable setpoint where the generator frequency is considered to be in range. The value is entered in percentage of the generator rated frequency.

Upper Frequency (Gen & Bus Available): This setting is the lower variable setpoint where the generator frequency is considered to be out of range. The value is entered in percentage of the generator rated frequency.

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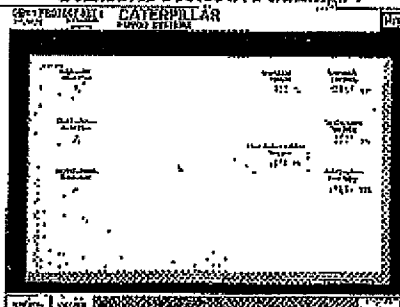
J43-281

WTUR0000450

JA 00003245

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15.2 Generator Protective Settings I

Generator Protective Settings I	Screen Operations
	Basic operations on the Generator Protective Settings I: • Reverse kW Alarm settings • Over Excitation Alarm settings • Under Excitation Alarm settings • Reverse kW Setpoint & Time Delay • Over/Under Excitation setpoint • O/U Excitation Time delays

Operation

Generator settings are normally "View Only". To change setpoints, the password must be entered.

Setting Description

Reverse kW Alarm: This is a protective function that is detected within PowerLynx, which senses direction of power flow. In paralleled sets, a flow of reverse power (i.e. power flow into the generator) above the setpoint for the allotted time delay, will activate according to the set alarm class either trigger a prealarm or trigger a shutdown alarm that will open the breaker and shutdown the generator.

Reverse kW Alarm Class: This setting is the alarm class and the taken action when this alarm is triggered. The alarm classes A-F are supported. Please refer. APPENDIX D: Alarm Classes and Actions for details.

Over/Under Excitation: This is a protective function that is detected within PowerLynx, which senses the amount of reactive power. In parallel sets above or under the setpoints of reactive power for the allotted time delay will activate according to the set alarm class either trigger a pre-alarm or trigger a shutdown alarm that will open the breaker and shutdown the generator.

Over/Under Excitation Alarm Class: This setting is the alarm class and the taken action when the Over/Under Excitation alarm is triggered. The alarm classes A-F are supported. Please refer. APPENDIX D: Alarm Classes and Actions for details.

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Reverse kW Setpoint & Reverse kW Time Delay

This is a protective function that is detected within PowerLynx, which senses direction of power flow. In paralleled sets, a flow of reverse power (i.e. power flow into the generator) above the setpoint for the allotted time delay will activate according to the set alarm class either trigger a pre-alarm or trigger a shutdown alarm that will open the breaker and shutdown the generator.

Over/Under Excitation Setpoint & Over/Under Excitation Time Delay

This is a protective function that is monitored within PowerLynx, that senses the frequency. When the generator frequency is below or above the setpoint for the allotted time delay (Under or Over Frequency Delay) will activate the trip function within PowerLynx, open the breaker and shutdown the generator.

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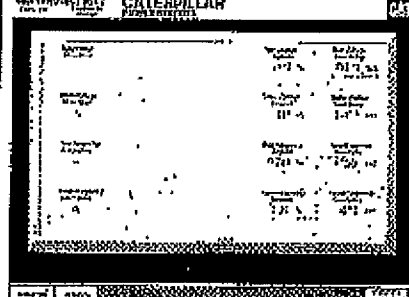
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J43-283

WTUR0000452

JA 00003247

15.3 Generator Protective Settings II

Generator Protective Settings II	Screen Operations
	Basic operations on the Generator Setting Screen: • Under Voltage Alarm settings • Over Voltage Alarm settings • Over Frequency Alarm settings • Under Frequency Alarm settings • Over Voltage Setpoint & Time Delay • Under Voltage Setpoint & Time delay • Over Frequency Setpoint & Time Delay • Under Frequency Setpoint & Time Delay

Operation

Generator settings are normally "View Only". To change setpoints, the password must be entered.

Setting Description

Under/Over Voltage & Time Delay: This is a protective function that is monitored within PowerLynx, which senses the generator voltage. When the generator voltage is below/above the setpoint for the allotted time delay (Under/Over Voltage Delay) will activate the trip function within PowerLynx, open the breaker and shutdown the generator.

Under/Over Voltage Alarm Class: This setting is the alarm class and the taken action when the Over/Under voltage alarm is triggered. The alarm classes A-F are supported. Please refer. APPENDIX D: Alarm Classes and Actions for details.

Under/Over Frequency Setpoint & Time Delay: This is a protective function that is monitored within PowerLynx, which senses the generator frequency. When the generator frequency is below/above the setpoint for the allotted time delay (Under/Over Frequency Delay) will activate the trip function within PowerLynx, open the breaker and shutdown the generator.

Under/Over Frequency Alarm Class:

This setting is the alarm class and the action when triggered for the over and under frequency alarms. The alarm classes A-F are supported. Please refer. APPENDIX D: Alarm Classes and Actions for details.

***NOTE:** PowerLynx protective settings are calibrated at the factory to adequately protect your hardware. Consult the factory before changing settings to avoid possible voidance of your warranty.

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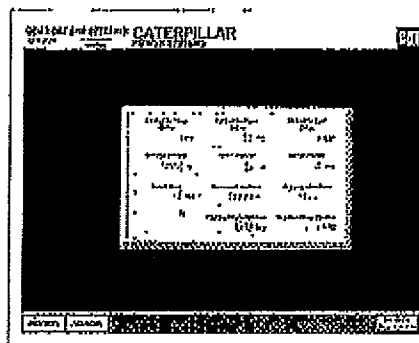
J43-284

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15.4 Gen Circuit Breaker Settings



Basic operations on the Gen Circuit Breaker Settings screen:

- *CB Fail to Close/Open Delay*
- *CB Fail to Sync Delay*
- *Voltage Window*
- *CB On/Off Impulse*
- *Phase Angle Dwell Time*
- *Negative/Positive Slew Rate*
- *Positive/Negative Phase Window*

Operation

System settings are normally "View Only". To change setpoint, the password must be entered.

Setting Description

CB Fail to Open/Close Delay: This setting is the number of milliseconds allotted to open/close the generator breaker after an open/close command was issued. When this time is expired, a fail to open/close alarm will be generated for the appropriate generator.

CB Fail to Synchronize Delay: This setting is the number of milliseconds that a synchronizing attempt will be made. When this time is expired, a fail to synchronize alarm will be generated for the appropriate generator.

Voltage Window: This setting is the voltage dead band around the targeted bus voltage ($\pm$ Bus Voltage) that the generator voltage must be within prior to issuing a command to close the breaker. It is entered in percent of the Generator rated voltage.

CB On/Off Impulse: This setting is the number of milliseconds allotted to the pulse On/Off timings on a generator breaker open or close command. The On pulse sets the time that an open/close command goes true. The Off impulse sets the time the signal stays false before going true again.

Dwell Time: This setting is the number of milliseconds that the phase angle must remain in the in the synchronizing window (Positive and Negative Phase Window) prior to issuing a command to close the breaker.

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Positive Phase Window: This setting is the number of degrees seen from the top of the Synchroscope meter (12:00) to left hand side (slow side) where the synchronizing window starts and initiates the dwell time.

Negative Phase Window: This setting is the number of degrees seen from the top of the Synchroscope meter (12:00) to right hand side (fast side) where the synchronizing window starts and initiates the dwell time.

Positive Slew Rate: This setting is the positive setpoint of the frequency dead band around the target bus frequency that the generator frequency must be within prior to issuing a command to close the breaker.

Negative Slew Rate: This setting is the negative setpoint of the frequency dead band around the target bus frequency that the generator frequency must be within prior to issuing a command to close the breaker.

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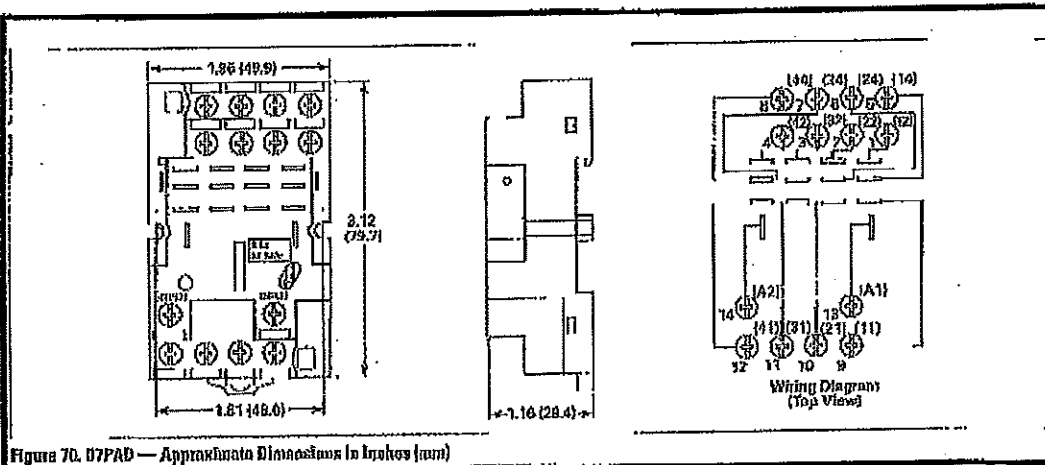
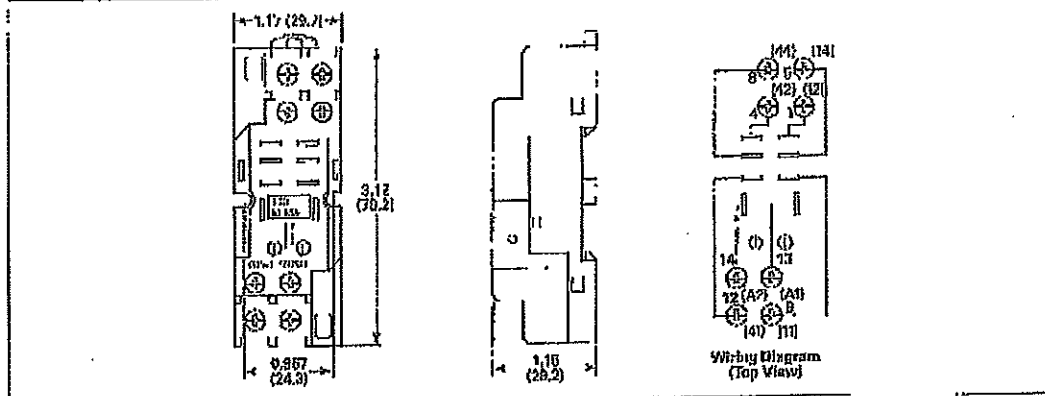
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WTUR0000455

JA 00003250

CUTLER HAMMER PART# D7PAA, D7PAD, D7PF2AT1, D7PF4AT1

Dimensions



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CUTLER HAMMER PART# D7PAA, D7PAD, D7PF2AT1, D7PF4AT1

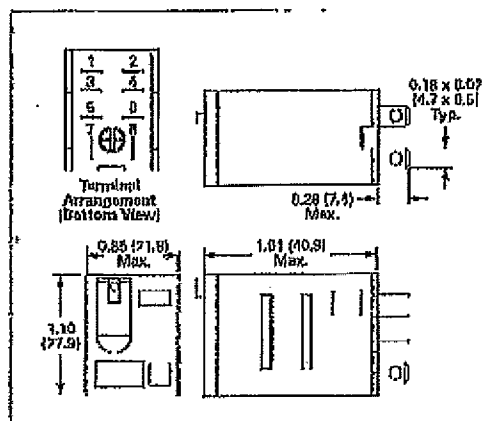


Figure 26. D7PF2 — Approximate Dimensions in inches (mm)

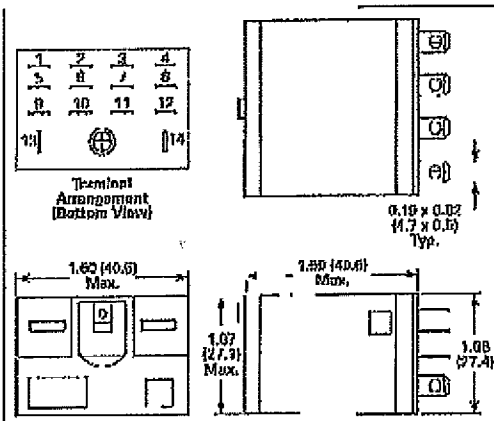


Figure 28. D7PF4 — Approximate Dimensions in inches (mm)

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CUTLER HAMMER PART# EM22H2X40, EM22H3X41, EM22H5X90

Indicating Light Units — Modular

- Standard and PresTest Types
- Plastic or Metal Operators
- Full Voltage LED Light Units or
- Full Voltage, Resistor or Transformer Incandescent Light Units
- Plastic Lenses

PresTest — This device incorporates a press-to-test feature whereby depressing the lens disconnects the light from the source being monitored and connects the lamp to a continuously energized circuit for immediate test for a faulty lamp.

Table 47-47. Indicating and PresTest Light Units — UL (NEMA) Type 3, 3B, 4, 4X, 12, 13

	Color	Indicating Light		PresTest	
		LED	Incandescent	Incandescent	
		Catalog Number	Catalog Number	Catalog Number	
Plastic Operators					
	24V AC/DC Full Voltage				
	Red	EM22H2X40	EM22H2X4	EM22T2X20	
	Green	EM22H3X41	EM22H3X4	EM22T3X20	
	White	EM22H5X90	EM22H5X4	EM22T5X20	
	Blue	EM22H6X42	EM22H6X4	EM22T6X20	
	Amber	EM22H9X95	EM22H9X4	EM22T9X20	
	120V AC Full Voltage		120V AC/DC Resistor		
	Red	EM22H2X43	EM22H2X10	EM22T2X28	
	Green	EM22H3X44	EM22H3X10	EM22T3X28	
	White	EM22H5X92	EM22H5X10	EM22T5X28	
	Blue	EM22H6X45	EM22H6X10	EM22T6X28	
	Amber	EM22H9X98	EM22H9X10	EM22T9X28	
	120V AC Transformer				
	Red	—	EM22H2X11	EM22T2X27	
	Green	—	EM22H3X11	EM22T3X27	
	White	—	EM22H5X11	EM22T5X27	
	Blue	—	EM22H6X11	EM22T6X27	
	Amber	—	EM22H9X11	EM22T9X27	
Metal Operators					
	24V AC/DC Full Voltage				
	Red	EM22H2X40	EM22H2X4	EM22T2X20	
	Green	EM22H3X41	EM22H3X4	EM22T3X20	
	White	EM22H5X90	EM22H5X4	EM22T5X20	
	Blue	EM22H6X42	EM22H6X4	EM22T6X20	
	Amber	EM22H9X95	EM22H9X4	EM22T9X20	
	120V AC Full Voltage		120V AC/DC Resistor Unit		
	Red	EM22H2X43	EM22H2X10	EM22T2X28	
	Green	EM22H3X44	EM22H3X10	EM22T3X28	
	White	EM22H5X92	EM22H5X10	EM22T5X28	
	Blue	EM22H6X45	EM22H6X10	EM22T6X28	
	Amber	EM22H9X98	EM22H9X10	EM22T9X28	
	120V AC Transformer 60/60 Hz				
	Red	EM22H2X43	EM22H2X11	EM22T2X27	
	Green	EM22H3X44	EM22H3X11	EM22T3X27	
	White	EM22H5X92	EM22H5X11	EM22T5X27	
	Blue	EM22H6X45	EM22H6X11	EM22T6X27	
	Amber	EM22H9X98	EM22H9X11	EM22T9X27	

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CUTLER HAMMER PART# EM22K53C

Key Operated Selector Switches

Note: Key removed from maintained positions only will accept a maximum of 2 contact blocks (4 circuits) with supplied 3-way mounting adapter. Optional 5-way adapter will accept a maximum of 5 contact blocks (10 circuits).

Table 47-56. Key Operated Selector Switches—UL (NEMA) Type 3, 3R, 4, 4X, 12, 13

Operating Mode M = Maintained S = Momentary				Ham Code	E22 Series Plastic Operators		E22 Series Metal Operators		Allowable Key Removal Positions (3)
Left	Center	Right	Black Bezel		Chrome Bezel	Chrome Bezel			
45° Catalog Number	45° Catalog Number	60° Catalog Number							
	2-Position								
M	—	M	2	E22KB53	E22KB53	—		1, 2	
		S	2	E22KB52	E22KB52	—		—	
—	M	M	2	E22KB55	E22KB55	EM22KB55		1, 4	
	M	S	2	E22KB54	E22KB54	EM22KB54		—	
	3-Position								
M	M	M	1	E22KB67	E22KB67	EM22KB67		1-6	
M	M	M	2	E22KB67	E22KB67	EM22KB67		1-6	
S	M	M	1	E22KB68	E22KB68	EM22KB68		1, 4	
S	M	M	2	E22KB68	E22KB68	EM22KB68		1, 4	
	S	S	1	E22KB64	E22KB64	EM22KB64		—	
S	S	S	2	E22KB64	E22KB64	EM22KB64		—	
M	M	S	1	E22KB65	E22KB65	EM22KB65		2, 4	
M	M	S	2	E22KB65	E22KB65	EM22KB65		2, 4	

① To order operator with other than standard key removal position(s), select allowable option from table below and change last (underlined) digit of listed Catalog Number using Suffix Code column. Example: E22KB300 Three Position Selector Switch with key removable from Left and Center positions.

② To order a different key and lock assembly, add suffix B7, C7, D1, E1 or F1 to the end of the Catalog Number.

Note: For Run of Panel Extensions, see Table 47-128 on Page 47-54.

Table 47-67. Key Removal Options

Key Removal Position	Code Suffix	Key Removal Position	Code Suffix	Key Removal Position	Code Suffix
Right Only	1	Center Only	4	Right, Left and Center	7
Left Only	2	Right and Center	5		
Right and Left	3	Left and Center	6		

Table 47-68. Spare Keys

Description	Reference Number Stamped on Key	Catalog Number
Standard Lock	E2239	E22KB52
Master Key	For 00000 Series Locks	E22KB55

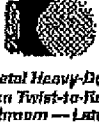
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Contact Blocks Page 47-69
Screw Colors Page 47-68
Discount Symbol 1001

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CUTLER HAMMER PART# EM22P1D

22 mm EM22 Heavy-Duty Metal - Non-Illuminated For Reference

Momentary Non-Illuminated Pushbuttons

Operator Type	Operator Color	Contact Blocks	Part Number
 FLUSH Chrome Bezel	BLACK	NO	EM22P1A
		NO-NC	EM22P1C
		2NO	EM22P1D
	RED	NO	EM22P2A
		NC	EM22P2B
		NO-NC	EM22P2C
	GREEN	2NC	EM22P2E
		NO	EM22P3A
		NO-NC	EM22P3C
	2NO	EM22P3D	
	YELLOW	NO	EM22E2A
		NC	EM22E2B
NO-NC		EM22E2C	
2NC		EM22E2E	
 EXTENDED Chrome Bezel	BLACK	NO	EM22L2A
		NC	EM22L2B
		NO-NC	EM22L2C
	RED	2NC	EM22L2E
		GREEN	NO
	NC		EM22J2B
	NO-NC		EM22J2C
	YELLOW	2NO	EM22J2D
		2NC	EM22J2E
	 40 mm Mushroom Chrome Bezel	BLACK	NO
NC			EM22L2B
NO-NC			EM22L2C
RED		2NC	EM22L2E
		GREEN	NO
NC			EM22J2B
NO-NC			EM22J2C
YELLOW		2NO	EM22J2D
		2NC	EM22J2E
 50 mm JUMBO Mushroom Chrome Bezel		BLACK	NO
	NC		EM22L2B
	NO-NC		EM22L2C
	RED	2NC	EM22L2E
		GREEN	NO
	NC		EM22J2B
	NO-NC		EM22J2C
	YELLOW	2NO	EM22J2D
		2NC	EM22J2E
	 Metal Heavy-Duty 40 mm Twist-to-Release Mushroom - Latching	BLACK	NO
NC			EM22L2B
NO-NC			EM22L2C
RED		2NC	EM22L2E
		GREEN	NO
NC			EM22J2B
NO-NC			EM22J2C
YELLOW		2NO	EM22J2D
		2NC	EM22J2E
 Metal Heavy-Duty 50 mm Jumbo Mushroom - Maintained (Latching)		BLACK	NO
	NC		EM22JL2N8B
	NO-NC		EM22JL2N8C
	RED	2NO	EM22JL2N8D
		2NC	EM22JL2N8E
	GREEN	NO	EM22JL2N8A
		NC	EM22JL2N8B
		NO-NC	EM22JL2N8C
	YELLOW	2NO	EM22JL2N8D
		2NC	EM22JL2N8E

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CUTLER HAMMER PART# EM22PP1A

EATON | Cutler-Hammer

Application Note

(Replaces Bulletin 2007)

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22 mm EM22 Heavy-Duty Metal — Alternate Action Pushbutton Flush Non-Illuminated Alternate Action Pushbuttons

Bezel Color ^a	Operator Color ^b	Contact Blocks ^c	Part Number
	BLACK	NO	EM22PP1A
		NC	EM22PP1B
		NO-NC	EM22PP1C
		2NO	EM22PP1D
		2NC	EM22PP1E
		NO	EM22PP2A
		NC	EM22PP2B
		NO-NC	EM22PP2C
		2NO	EM22PP2D
		2NC	EM22PP2E
		NO	EM22PP3A
		NC	EM22PP3B
		NO-NC	EM22PP3C
		2NO	EM22PP3D
		2NC	EM22PP3E
	YELLOW	NO	EM22PP4A
		NC	EM22PP4B
		NO-NC	EM22PP4C
		2NO	EM22PP4D
		2NC	EM22PP4E
	WHITE	NO	EM22PP5A
		NC	EM22PP5B
		NO-NC	EM22PP5C
		2NO	EM22PP5D
		2NC	EM22PP5E
		NO	EM22PP6A
		NC	EM22PP6B
		NO-NC	EM22PP6C
		2NO	EM22PP6D
		2NC	EM22PP6E
	GRAY	NO	EM22PP7A
		NC	EM22PP7B
		NO-NC	EM22PP7C
		2NO	EM22PP7D
		2NC	EM22PP7E



22 mm EM22 Heavy-Duty Metal
Flush Non-Illuminated
Alternate Action Units

^a See Figure 10, Page 4 for 22 mm Bezel List Part Numbers.

^b See Figure 10, Page 49 for Non-Illuminated Alternate Action Operator Part Numbers.

^c See Figure 0, Page 67 for Contact Block Part Numbers.

This publication contains only the most popular catalog offerings. For more options, please see Tab 47 of the Control Products Catalog, SA0312201E.

AP07/2011

For more information visit: www.eaton.com

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CUTLER HAMMER PART# EM22X61A

2 POSITION SELECTOR SWITCHES—45° THROW, NON-ILLUMINATED

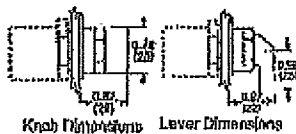
Description	Operator Action Diagram	Operator Type (BLACK)	Cam—2			
			O X—(NO)	X O—(NO) O O—(NO)	O X—(NO) O O—(NO)	O X—(NO) O O—(NO) X O—(NO)
		Knob	EM22X51A	FM22X51C	EM22X51D	EM22X51WW
		Lever	EM22X51A	EM22X51C	EM22X51D	EM22X51WW
		Knob	EM22X61A	EM22X61C	EM22X61D	EM22X61WW
		Lever	EM22X61A	EM22X61C	EM22X61D	EM22X61WW

3 POSITION SELECTOR SWITCHES—45° THROW, NON-ILLUMINATED

Description	Operator Action Diagram	Operator Type (BLACK)	Cam—1			Cam—2			Cam—3		
			X O—(NO) O O—(NO)	X O—(NO) O O—(NO)	X O—(NO) O O—(NO)	X O—(NO) O O—(NO)	X O—(NO) O O—(NO)	X O—(NO) O O—(NO)	X O—(NO) O O—(NO)	X O—(NO) O O—(NO)	X O—(NO) O O—(NO)
		Knob	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D
		Lever	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D
		Knob	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D
		Lever	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D	EM22X31D
		Knob	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D
		Lever	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D
		Knob	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D
		Lever	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D	EM22X41D

To order a selector switch with an alternate color, substitute the unlighted digit with the appropriate code from this order table below.

Color	Non-Illuminated Color Code	Illuminated Color Code
Black	1	1
Green	2	2
Yellow	4	4
White	5	5
Blue	6	6
Gray	7	7
Orange	8	8
Amber	9	9
Clear	0	0



Knob Dimensions Lever Dimensions

ILLUMINATED SELECTOR SWITCH COMPONENTS—45° THROW

Description	Positions	Operator Positions			Cam Code	Catalog Number Operator ONLY
		Left	Center	Right		
	2	M	—	S	Knob 2	EM22S2
		M	—	S	Lever 2	EM22S2
		M	M	M	Knob 2	EM22W2
		M	M	M	Lever 2	EM22W2
	3	M	M	M	Knob 1	EM22S2
		M	M	M	Lever 1	EM22S2
		M	M	M	Knob 2	EM22W2
		M	M	M	Lever 2	EM22W2
	3	S	M	M	Knob 1	EM22S2
		S	M	M	Lever 1	EM22S2
		S	M	M	Knob 2	EM22W2
		S	M	M	Lever 2	EM22W2
	3	M	M	S	Knob 1	EM22S2
		M	M	S	Lever 1	EM22S2
		M	M	S	Knob 2	EM22W2
		M	M	S	Lever 2	EM22W2

CONTACT BLOCKS

Photo	Description	Color Number	Suble Code
	1NC	F22H1	B
	1NO	E22B2	A
	1NO Early Make	E22B3	—
	1NO Early Break	E22B4	—
	1NO-1NC	E22B11	W
	2NO	E22B20	V
	1NC (Logic Level)	E22B1E	—
	1NO (Logic Level)	E22B2E	—

MISCELLANEOUS EM22 OPERATORS

	Twist-to-Lock (28mm)	EM22L1		Standard Pushbutton (Non-IL)	EM22P1
	Push-Pull (50mm, Red)	EM22P1L2		Standard Pushbutton (Illuminated)	EM22T2
	Key Operator (40mm Mushroom)	EM22C2		28mm Mushroom (Non-IL)	EM22M1

LEGEND PLATES

Dimensions (H x W) inch (mm)	Standard Aluminum 1.77x1.17 (45x30)	Junior Aluminum 1.77x1.57 (45x40)	Plastic, Self-Adhesive 0.75x0.75 (20x20)	Standard Plastic 1.77x1.17 (45x30)	Junior Plastic 1.77x1.57 (45x40)	Plastic, Gilt-Ed 0.44x1.10 (11.2x27.6)	Plastic, Junior Gilt-Ed 1.18x1.57 (47x40)
Black	E22N636	E22N136	E22N636	E22N636	E22N136	E22N636	E22N636
Red	E22N637	E22N137	E22N637	E22N637	E22N137	E22N637	E22N637
White/Silver	—	—	—	E22N636	E22N136	E22N636	E22N636
Red/Black	—	—	—	E22N637	E22N137	E22N637	E22N637

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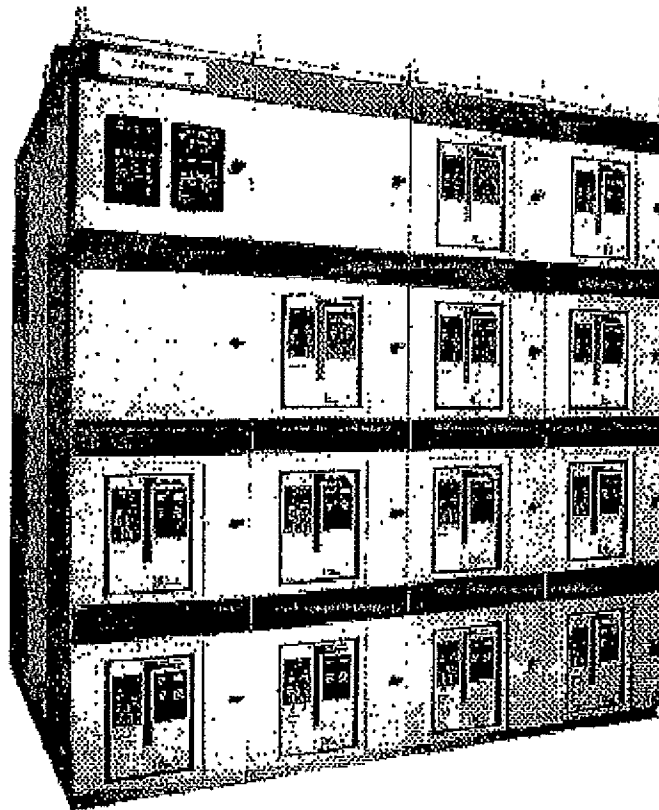
CUTLER HAMMER LV MAGNUM DS TECHNICAL DATA

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Cutler-Hammer

**Magnum™ DS Metal-Enclosed
Low Voltage Switchgear**
Technical Data

Supersedes 1001501001
pages T-48, dated April 2002.



1001501001

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Magnum DS Metal-Enclosed Low Voltage Switchgear

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Why Magnum DS Switchgear?

Factor's Choice. Cutler-Hammer Magnum DS switchgear is backed by 24 years of power circuit breaker and switchgear development that have set the industry standards for quality, reliability, maintainability and extended operating life. Magnum DS switchgear is designed to meet the changing needs of our customers by providing:

- Lower maintenance costs.
- Higher interrupting ratings.
- Higher coordination capability.
- Increased tripping sensitivity.
- Higher monitoring accuracy.
- Higher quality and reliability.
- Ease of life and monitoring and communications.

Magnum DS switchgear can meet the needs for general applications, service entrance, harsh environments, multiple source transfer, special grounding systems and many others.

Modern designed Magnum DS Metal-Enclosed Low Voltage Switchgear and Power Circuit Breakers provide:

- 100% rated, fully selective protection.
- Integral microprocessor based breaker tripping systems.
- Two-step stored-energy breaker closing.
- 100 kA short circuit bus loading standard.
- Optional 150 kA and 200 kA short circuit bus loading, without increasing current limiting fuses.
- Optional metal barriers isolate the cable compartment from the bus compartment.

Many other features for coordinated, safe, convenient, trouble-free and economical control and protection of low voltage distribution systems are also provided.

Magnum DS Switchgear conforms to the following standards: NEMA® 863 and 865, CSA®, ANSI C37.20.1, C37.61, and UL® Standard 1658 and is built in an ISO 9001 certified facility.

Maximum ratings for Magnum DS Switchgear are 800 volts ac, 6000 amperes continuous cross bus and 200,000 amperes short circuit capacity.

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Magnum DS Metal-Enclosed Low Voltage Switchgear

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Ratings

Table 1. Voltage Ratings (VAC)

System Voltage	Maximum Voltage
7200/7400	7740
480	480
340	345

Table 2. Available Bus Ratings

Circuit Breaker Ampacity	Available Bus Rating	Available Bus Rating
2500	2500	120 kA, 100 kA, 200 kA
3200	3200	
4000	4000	
5000	5000	
6000	6000	
8000	8000	
10000	10000	

Note: In addition to the available bus ratings shown above, this bus has been tested for short circuit values of 65,000 amperes for a full 60 cycles.

Standards

Magnum DS switchgear conforms to the following standards: NEMA SB3 and SB6, CSA, ANSI C37.20.1, C37.61, and UL Standard 198E.

Certifications

Magnum DS Switchgear assemblies have undergone an extensive seismic qualification program. The test program utilized ANSI standard C37.61, the Uniform Building Code (UBC) and the California Building Code (CBC) as a basis for the test program. The assemblies have been tested and qualified to exceed these requirements.

American Bureau of Shipping (ABS) certification is available for those instances where it is required.

Table 3. Ratings of Magnum DS Breakers

Breaker Type	Frame Amperes	Ratings, rms Symmetrical Amperes (60 Hz)			
		Interrupting Rating	200-240 V 480 V	600 V	800 V
MDSE-400	400	42	42	42	42
MDSE-600	600	65	65	65	65
MDSE-800	800	85	85	85	85
MDSE-1000	1000	100	100	100	100
MDSE-1200	1200	120	120	120	120
MDSE-1600	1600	160	160	160	160
MDSE-2000	2000	200	200	200	200
MDSE-2500	2500	250	250	250	250
MDSE-3200	3200	320	320	320	320
MDSE-4000	4000	400	400	400	400
MDSE-5000	5000	500	500	500	500
MDSE-6000	6000	600	600	600	600
MDSE-8000	8000	800	800	800	800
MDSE-10000	10000	1000	1000	1000	1000
MDSE-12000	12000	1200	1200	1200	1200
MDSE-16000	16000	1600	1600	1600	1600
MDSE-20000	20000	2000	2000	2000	2000
MDSE-25000	25000	2500	2500	2500	2500
MDSE-32000	32000	3200	3200	3200	3200
MDSE-40000	40000	4000	4000	4000	4000
MDSE-50000	50000	5000	5000	5000	5000
MDSE-60000	60000	6000	6000	6000	6000
MDSE-80000	80000	8000	8000	8000	8000
MDSE-100000	100000	10000	10000	10000	10000
MDSE-120000	120000	12000	12000	12000	12000
MDSE-160000	160000	16000	16000	16000	16000
MDSE-200000	200000	20000	20000	20000	20000
MDSE-250000	250000	25000	25000	25000	25000
MDSE-320000	320000	32000	32000	32000	32000
MDSE-400000	400000	40000	40000	40000	40000
MDSE-500000	500000	50000	50000	50000	50000
MDSE-600000	600000	60000	60000	60000	60000
MDSE-800000	800000	80000	80000	80000	80000
MDSE-1000000	1000000	100000	100000	100000	100000
MDSE-1200000	1200000	120000	120000	120000	120000
MDSE-1600000	1600000	160000	160000	160000	160000
MDSE-2000000	2000000	200000	200000	200000	200000
MDSE-2500000	2500000	250000	250000	250000	250000
MDSE-3200000	3200000	320000	320000	320000	320000
MDSE-4000000	4000000	400000	400000	400000	400000
MDSE-5000000	5000000	500000	500000	500000	500000
MDSE-6000000	6000000	600000	600000	600000	600000
MDSE-8000000	8000000	800000	800000	800000	800000
MDSE-10000000	10000000	1000000	1000000	1000000	1000000
MDSE-12000000	12000000	1200000	1200000	1200000	1200000
MDSE-16000000	16000000	1600000	1600000	1600000	1600000
MDSE-20000000	20000000	2000000	2000000	2000000	2000000
MDSE-25000000	25000000	2500000	2500000	2500000	2500000
MDSE-32000000	32000000	3200000	3200000	3200000	3200000
MDSE-40000000	40000000	4000000	4000000	4000000	4000000
MDSE-50000000	50000000	5000000	5000000	5000000	5000000
MDSE-60000000	60000000	6000000	6000000	6000000	6000000
MDSE-80000000	80000000	8000000	8000000	8000000	8000000
MDSE-100000000	100000000	10000000	10000000	10000000	10000000
MDSE-120000000	120000000	12000000	12000000	12000000	12000000
MDSE-160000000	160000000	16000000	16000000	16000000	16000000
MDSE-200000000	200000000	20000000	20000000	20000000	20000000
MDSE-250000000	250000000	25000000	25000000	25000000	25000000
MDSE-320000000	320000000	32000000	32000000	32000000	32000000
MDSE-400000000	400000000	40000000	40000000	40000000	40000000
MDSE-500000000	500000000	50000000	50000000	50000000	50000000
MDSE-600000000	600000000	60000000	60000000	60000000	60000000
MDSE-800000000	800000000	80000000	80000000	80000000	80000000
MDSE-1000000000	1000000000	100000000	100000000	100000000	100000000
MDSE-1200000000	1200000000	120000000	120000000	120000000	120000000
MDSE-1600000000	1600000000	160000000	160000000	160000000	160000000
MDSE-2000000000	2000000000	200000000	200000000	200000000	200000000
MDSE-2500000000	2500000000	250000000	250000000	250000000	250000000
MDSE-3200000000	3200000000	320000000	320000000	320000000	320000000
MDSE-4000000000	4000000000	400000000	400000000	400000000	400000000
MDSE-5000000000	5000000000	500000000	500000000	500000000	500000000
MDSE-6000000000	6000000000	600000000	600000000	600000000	600000000
MDSE-8000000000	8000000000	800000000	800000000	800000000	800000000
MDSE-10000000000	10000000000	1000000000	1000000000	1000000000	1000000000
MDSE-12000000000	12000000000	1200000000	1200000000	1200000000	1200000000
MDSE-16000000000	16000000000	1600000000	1600000000	1600000000	1600000000
MDSE-20000000000	20000000000	2000000000	2000000000	2000000000	2000000000
MDSE-25000000000	25000000000	2500000000	2500000000	2500000000	2500000000
MDSE-32000000000	32000000000	3200000000	3200000000	3200000000	3200000000
MDSE-40000000000	40000000000	4000000000	4000000000	4000000000	4000000000
MDSE-50000000000	50000000000	5000000000	5000000000	5000000000	5000000000
MDSE-60000000000	60000000000	6000000000	6000000000	6000000000	6000000000
MDSE-80000000000	80000000000	8000000000	8000000000	8000000000	8000000000
MDSE-100000000000	100000000000	10000000000	10000000000	10000000000	10000000000
MDSE-120000000000	120000000000	12000000000	12000000000	12000000000	12000000000
MDSE-160000000000	160000000000	16000000000	16000000000	16000000000	16000000000
MDSE-200000000000	200000000000	20000000000	20000000000	20000000000	20000000000
MDSE-250000000000	250000000000	25000000000	25000000000	25000000000	25000000000
MDSE-320000000000	320000000000	32000000000	32000000000	32000000000	32000000000
MDSE-400000000000	400000000000	40000000000	40000000000	40000000000	40000000000
MDSE-500000000000	500000000000	50000000000	50000000000	50000000000	50000000000
MDSE-600000000000	600000000000	60000000000	60000000000	60000000000	60000000000
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MDSE-1600000000000	1600000000000	160000000000	160000000000	160000000000	160000000000
MDSE-2000000000000	2000000000000	200000000000	200000000000	200000000000	200000000000
MDSE-2500000000000	2500000000000	250000000000	250000000000	250000000000	250000000000
MDSE-3200000000000	3200000000000	320000000000	320000000000	320000000000	320000000000
MDSE-4000000000000	4000000000000	400000000000	400000000000	400000000000	400000000000
MDSE-5000000000000	5000000000000	500000000000	500000000000	500000000000	500000000000
MDSE-6000000000000	6000000000000	600000000000	600000000000	600000000000	600000000000
MDSE-8000000000000	8000000000000	800000000000	800000000000	800000000000	800000000000
MDSE-10000000000000	10000000000000	1000000000000	1000000000000	1000000000000	1000000000000
MDSE-12000000000000	12000000000000	1200000000000	1200000000000	1200000000000	1200000000000
MDSE-16000000000000	16000000000000	1600000000000	1600000000000	1600000000000	1600000000000
MDSE-20000000000000	20000000000000	2000000000000	2000000000000	2000000000000	2000000000000
MDSE-25000000000000	25000000000000	2500000000000	2500000000000	2500000000000	2500000000000
MDSE-32000000000000	32000000000000	3200000000000	3200000000000	3200000000000	3200000000000
MDSE-40000000000000	40000000000000	4000000000000	4000000000000	4000000000000	4000000000000
MDSE-50000000000000	50000000000000	5000000000000	5000000000000	5000000000000	5000000000000
MDSE-60000000000000	60000000000000	6000000000000	6000000000000	6000000000000	6000000000000
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MDSE-2000000000000000	2000000000000000	200000000000000	200000000000000	200000000000000	200000000000000
MDSE-2500000000000000	2500000000000000	250000000000000	250000000000000	250000000000000	250000000000000
MDSE-3200000000000000	3200000000000000	320000000000000	320000000000000	320000000000000	320000000000000
MDSE-4000000000000000	4000000000000000	400000000000000	400000000000000	400000000000000	400000000000000
MDSE-5000000000000000	5000000000000000	500000000000000	500000000000000	500000000000000	500000000000000
MDSE-6000000000000000	6000000000000000	600000000000000	600000000000000	600000000000000	600000000000000
MDSE-8000000000000000	8000000000000000	800000000000000	800000000000000	800000000000000	800000000000000
MDSE-10000000000000000	10000000000000				

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Table 2. Single Ground Fault Pickup Settings

Installed Rating (kV) (Superior) I _N	Pickup Settings — Ground Fault Currents (Amperes) I _G						
	0.25 I _N	0.25 I _N	0.25 I _N	0.4 I _N	0.4 I _N	0.8 I _N	1.5 I _N
250	60	60	70	80	100	120	200
250	63	75	80	100	125	150	250
350	75	90	105	120	150	180	300
400	120	120	140	160	200	240	400
600	150	180	210	240	300	360	600
600	200	240	280	320	400	480	800
1000	250	300	360	420	500	600	1000
1200	300	360	420	480	600	720	1200
1500	400	480	560	640	800	960	1500
2000	500	600	700	800	1000	1200	2000
2500	600	720	840	960	1200	1400	2500
3000	720	840	1000	1200	1500	1800	3000
3200	800	960	1120	1280	1600	1920	3200
4000	1000	1200	1400	1600	2000	2400	4000
5000	1200	1440	1680	1920	2400	2880	5000
6000	1400	1680	1960	2240	2800	3360	6000

¹ Tolerances on pickup levels are ±10% of values shown in chart.
² For Testing Purposes Only: When using an external single-phase current source to test low level ground fault current settings, it is advisable to use the Auxiliary Power Module (APM), especially when the single-phase current is low, without the APM it may appear as if the trip unit does not respond until the current is well above the set value, leading the tester to believe there is an error in the trip unit when there is none. The reason this occurs is that the single-phase test current is not a good simulation of the normal three-phase current. If three-phase had been flowing, the trip unit would have performed correctly. Use the APM for correct trip unit performance when single-phase tests are made.

Table 3. Single Ground Fault Pickup Values for Secondary Injection Test Kit Superiors

Installed Rating (kV)	Superior Rating	Pickup Settings Values in Secondary Sources I _G							
		25% I _N	50% I _N	75% I _N	100% I _N	150% I _N	200% I _N	250% I _N	300% I _N
250	250	1.50	1.00	1.75	2.00	2.50	3.00	3.75	4.50
250	250	1.50	1.00	1.75	2.00	2.50	3.00	3.75	4.50
350	350	1.75	1.25	1.75	2.00	2.50	3.00	3.75	4.50
400	400	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50
600	600	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50
600	600	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50
1000	1000	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50
1000	1000	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50
1200	1200	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50
1500	1500	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50
2000	2000	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50
2500	2500	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50
3000	3000	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50
3200	3200	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50
4000	4000	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50
5000	5000	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50
6000	6000	1.25	1.00	1.75	2.00	2.50	3.00	3.75	4.50

¹ Tolerances on pickup levels are ±10% of values shown in chart.
² For Testing Purposes Only: When using an external single-phase current source to test low level ground fault current settings, it is advisable to use the Auxiliary Power Module (APM), especially when the single-phase current is low, without the APM it may appear as if the trip unit does not respond until the current is well above the set value, leading the tester to believe there is an error in the trip unit when there is none. The reason this occurs is that the single-phase test current is not a good simulation of the normal three-phase current. If three-phase had been flowing, the trip unit would have performed correctly. Use the APM for correct trip unit performance when single-phase tests are made.

11/03/2011

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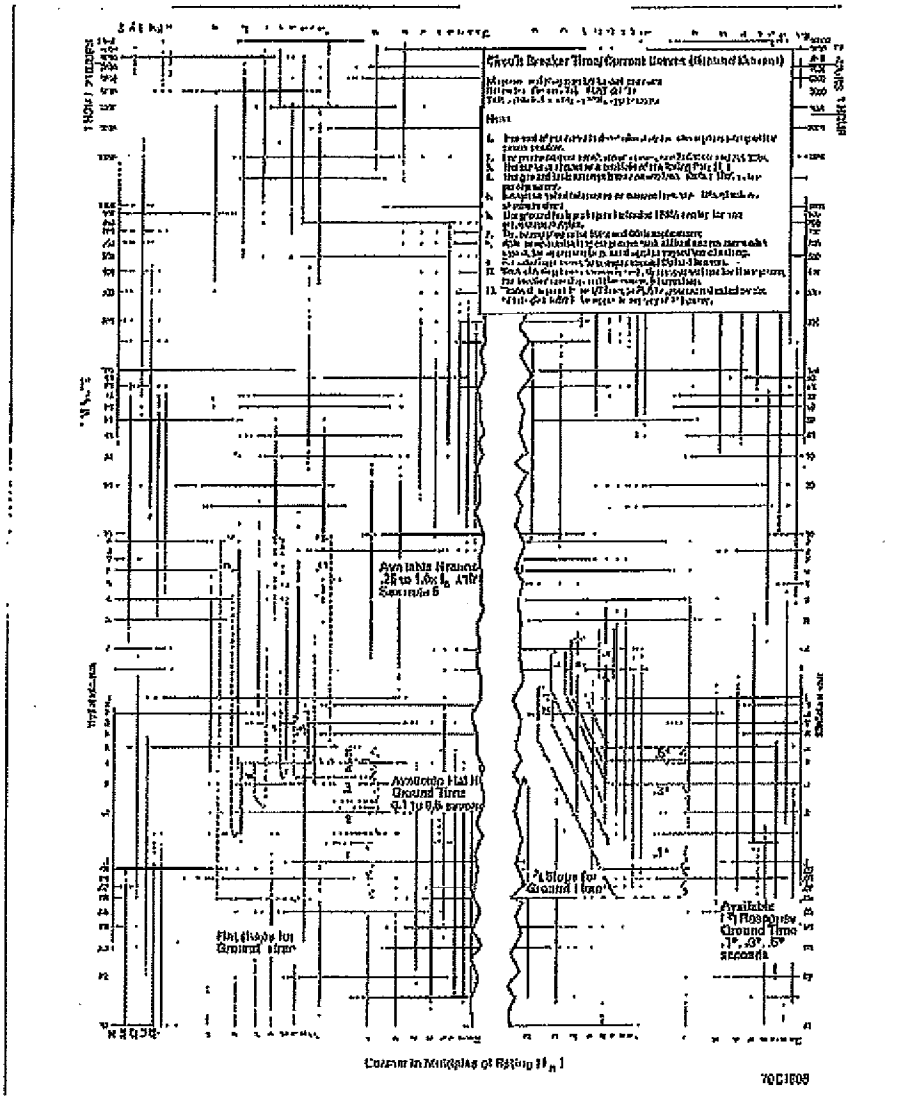
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Magnum DS Metal-Enclosed Low Voltage Switchgear

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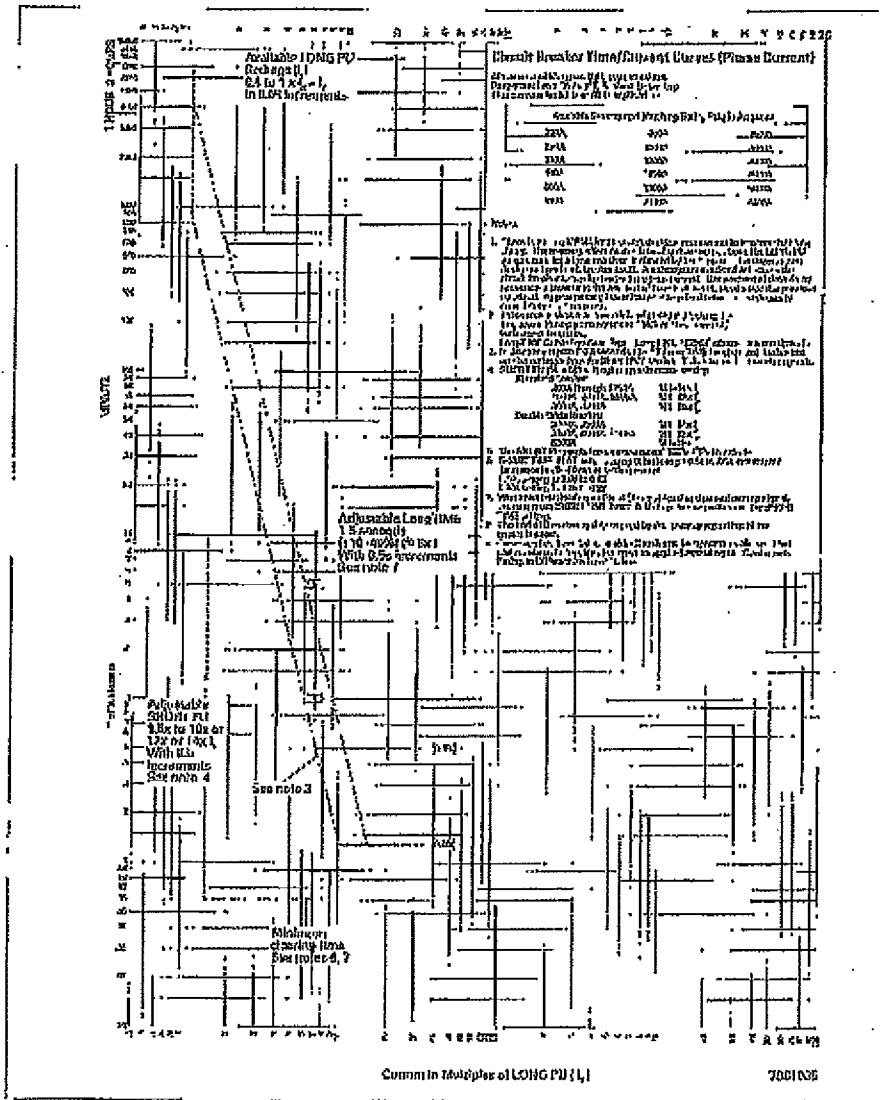


Figure 4: Magnum DS Circuit Breaker Time/Current Curves with Voltage RMS 1150/1500 — 1/2" Trip Unit
Typical Long Delay and Short Delay Time/Phase Current Characteristic Curves (2S)

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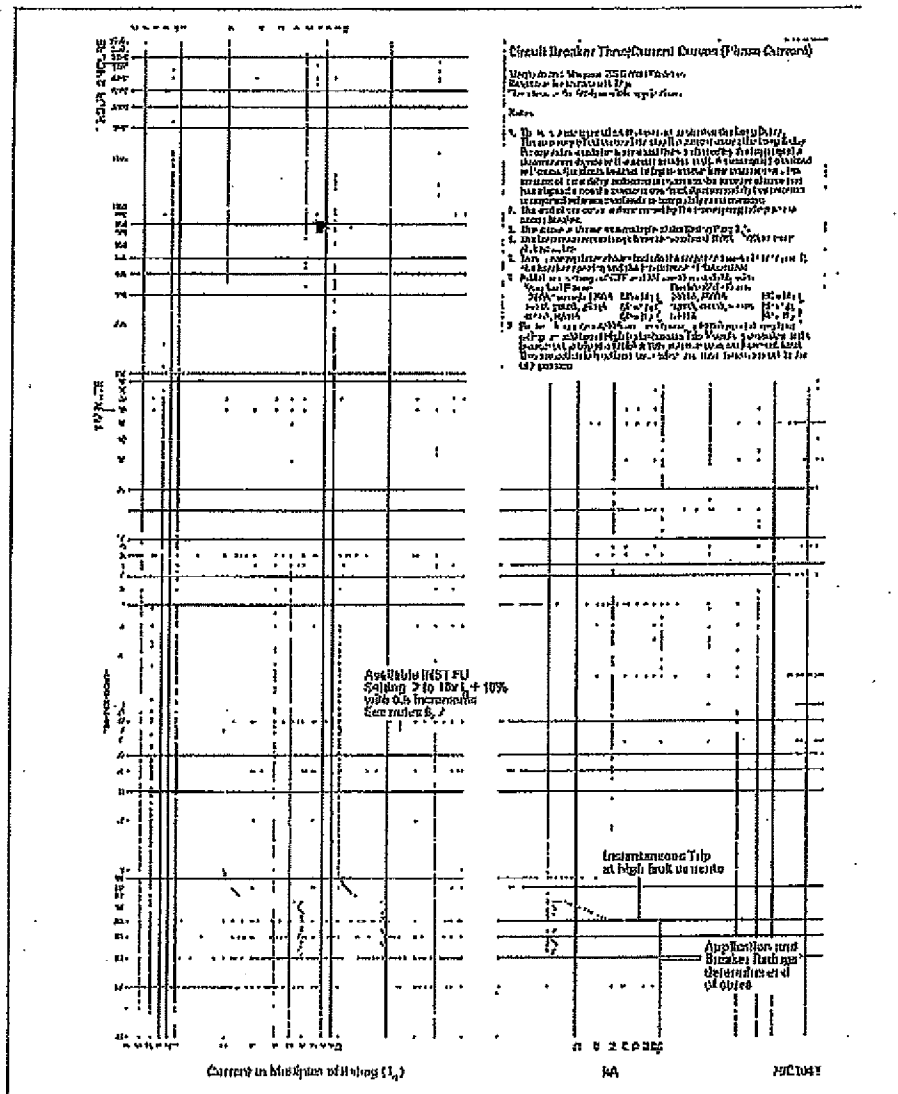


Figure 6. Magnum DS Circuit Breakers with Digital RMS 1100/1150 Trip Unit: Typical Instantaneous Time/Phase Current Characteristic Curve (I)

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Table 10, Mounting Type Current Transformers for Mounting in Circuit Breaker Compartments

ANSI Meter Accuracy Classification		Ratio		Ratio		Ratio		Ratio	
Breaker Frame Rating	Ratio	Ratio	Ratio	Ratio	Ratio	Ratio	Ratio	Ratio	Ratio
100, 1600, 2000	100/5	100/1	1.2	2.4	—	—	—	—	—
	150/5	150/1	1.2	2.4	—	—	—	—	—
	200/5	200/1	1.2	2.4	—	—	—	—	—
	250/5	250/1	0.8	1.2	2.4	—	—	—	—
	300/5	300/1	0.8	0.8	1.2	2.4	—	—	—
	400/5	400/1	0.8	0.8	1.2	1.2	2.4	—	—
	500/5	500/1	0.8	0.8	0.8	1.2	1.2	2.4	—
	600/5	600/1	0.8	0.8	0.8	1.2	1.2	1.2	—
	750/5	750/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	1000/5	1000/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	1200/5	1200/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	1500/5	1500/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	1600/5	1600/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	2000/5	2000/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	2500/5	2500/1	0.8	0.8	0.8	0.8	0.8	0.8	—
3200	1000/5	1000/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	1200/5	1200/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	1500/5	1500/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	1600/5	1600/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	2000/5	2000/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	2500/5	2500/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	3200/5	3200/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	4000/5	4000/1	0.8	0.8	0.8	0.8	0.8	0.8	—
4000	4000/5	4000/1	0.8	0.8	0.8	0.8	0.8	0.8	—
	5000/5	5000/1	0.8	0.8	0.8	0.8	0.8	0.8	—
10000	10000/5	10000/1	0.8	0.8	0.8	0.8	0.8	0.8	—
10000	10000/5	10000/1	0.8	0.8	0.8	0.8	0.8	0.8	—

Note: Current transformers with meter accuracy classifications of higher burdens are not available for relaying unless available. They will be mounted in the rear cable compartment compartment.

Voltage Transformers

Insulation Class is 600 volt dielectric, 10 kV full wave BIL. Accuracy Class is 0.5 for W and 1.2 for X burdens at 60 Hz. Thermal ratings are 150 VA at 30°C, and 110 VA at 65°C. Primary and secondary fuses are mounted on the face of the VT.

Available Standard Ratios

- 120:120
- 240:120
- 288:120
- 480:120
- 600:120

Control Power Transformers

Insulation Class is 600 volt dielectric. Primary and secondary fuses are mounted on the face of the CPT. An optional primary fuse cover is available. 1 kVA, 2 kVA, 3 kVA and 5 kVA ratings are available as standard.

Available Standard Ratios

- 208:120/240
- 240:120/240
- 480:120/240
- 600:170/240

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Application

Standards

Magnum DS circuit breakers meet or exceed all applicable requirements of ANSI Standards C37.13, C37.17, C37.50 and CSA.

System Voltage and Frequency

Magnum DS breakers are designed for operation on ac systems only, 60 Hz or 60 Hz, 600 volts maximum.

Continuous Current Ratings

Unlike transformers, generators and motors, circuit breakers are maximum-rated devices and have no built-in temporary overload current ratings. Consequently, it is vital that each application take into consideration the maximum anticipated current demand, initial and future, including temporary overloads.

The continuous rating of any Magnum DS breaker is limited to the sensor rating, or the frame size current rating, whichever is the lesser. For instance, an M36-816 1600 ampere frame breaker with 800 ampere sensors has a maximum continuous rating of 800 amperes, but the sensor breaker with 1600 ampere sensors is limited to 1600 amperes maximum.

All current ratings are based on a maximum ambient air temperature of 40°C (104°F).

Ambient Temperature

The temperature of the air surrounding the enclosure should be within the limits of: -30°C (-22°F) to +40°C (104°F).

Altitude

The breakers are applicable at their full voltage and current ratings up to a maximum altitude of 6,600 feet (2,012 m) above sea level. When installed at higher altitudes, the ratings are subject to the following correction factors in accordance with ANSI C37.50.1.

Table 11. Altitude Derating Factors

Altitude Feet	Altitude Meters	Voltage Correction	Current Derivation
0,000	2,012	1.000	1.000
2,000	2,134	0.989	0.989
4,000	2,256	0.978	0.978
6,000	2,378	0.968	0.968
8,000	2,499	0.958	0.958
10,000	2,621	0.948	0.948
12,000	2,743	0.938	0.938
14,000	2,865	0.928	0.928
16,000	2,987	0.918	0.918
18,000	3,109	0.908	0.908
20,000	3,231	0.898	0.898
22,000	3,353	0.888	0.888
24,000	3,475	0.878	0.878
26,000	3,597	0.868	0.868

Unusual Environmental and Operating Conditions

Special attention should be given to applications subject to the following conditions:

1. Damaging or hazardous fumes, vapors, etc.

For such conditions, it is generally recommended that the switchgear be installed in a clean, dry room, with filtered and/or pressurized clean air. This method permits the use of standard indoor switchgear and avoids the derating effect of non-ventilated enclosures.

2. Excessive or abrasive dust.

For such conditions, it is generally recommended that the switchgear be installed in a clean, dry room, with filtered and/or pressurized clean air. This method permits the use of standard indoor switchgear and avoids the derating effect of non-ventilated enclosures.

3. Salt spray, excessive moisture, dripping, etc.

Dry shields in equipment rooms and space heaters in indoor switchgear, or outdoor weather-proof enclosures, may be indicated, depending upon the severity of the conditions.

4. Excessively high or low ambient temperatures.

For ambient temperatures exceeding 40°C, and based on a standard temperature rise of 65°C, the continuous current ratings of breaker frame sizes, and also fuses, current transformers, etc., will be subject to a derating factor calculated from the following formula:

$$I_{\text{derated}} = I_{\text{rated}} \times \frac{40 - T_{\text{actual}}}{40 - T_{\text{standard}}}$$

* 40°C (104°F) Standard Ambient

Circuit breakers are not adversely affected by very low ambient temperatures, particularly when energized and carrying load currents. The standard space heaters in weatherproof switchgear will raise the temperature slightly and prevent condensation.

Electrical components such as relays and instruments, however, must be applied within the manufacturer's specified limits.

5. Exposure to Seismic Shock.

Magnum DS switchgear and breakers have been certified for applications through ULG Type 4 and for the California Building Code. Assembly modifications may be required, so such conditions must be specified.

6. Abnormally high frequency of operation.

In line with above, a lesser number of operations between servicing, and more frequent replacement of parts, may be indicated.

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Application (Continued)

Unit Substations

Most Magnum DS Switchgear Assemblies are configured as unit substations.

A Unit Substation, as referred to in this publication, is defined as a compact metal assembly consisting of 3 phase transformers with high voltage incoming line sections and an assembly of low voltage distribution sections, with the following parameters:

- Transformer kVA — 112.5 through 3750
- Low Voltage — 208, 240, 480 or 600V

Unit Substations may be indoor or outdoor, with a selection of high-voltage incoming sections, a choice of transformer types and an arrangement of Magnum DS Switchgear to suit the application.

Why Unit Substations?

Unit substations follow the system concept of locating transformers as close as practicable to areas of load concentration at utilization voltages, thus minimizing the lengths of secondary distribution cables and buses. This concept provides several key advantages, such as:

- Reduced power losses.
- Improved voltage regulation.
- Improved service continuity.
- Reduced likelihood of faults.
- Increased flexibility.
- Minimized installation expense.
- Availability of non-flammable types of transformers eliminates necessity of vaults.
- Efficient space utilization.

Advantages of Magnum DS Unit Substations

- Complete coordination, both mechanical and electrical.
- Extreme flexibility with wide choice of components and ratings to meet exact application requirements.
- Optimum safety to operators.
- Modern design.
- Meets all applicable ANSI, IEEE, NEMA and UL standards.

Transition Sections

All indoor Unit Substations utilizing liquid filled transformers require an 12-inch (305 mm) or 22-inch (559 mm) wide transition section. The center line location of the low voltage throat is based upon the depth of the Magnum DS assembly.

In many indoor applications, it is desirable to minimize floor space by eliminating the need for a transformer transition section. For these situations, Magnum DS switchgear is designed to accommodate close coupling to dry-type transformers if their low voltage terminations conform to a specific vertically oriented arrangement. This configuration may be provided if:

- (1) additional space is not required for auxiliary devices such as ground ing conductors, instrumentation, etc;
- (2) no sequence ground fault is not applied on main breakers;
- (3) compression on assemblies with no main breaker do not utilize "A" or "B" position feeder breakers;
- (4) adequate conduit space is available for any top exit cable connections in this section.

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Application (Continued)

Types of Systems

A. Simple Radial

- Simplest and least costly.
- Easy to coordinate.

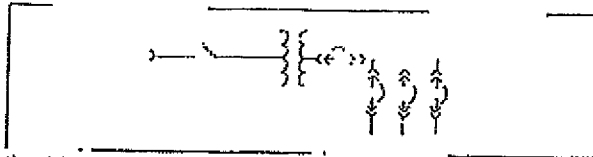


Figure 8. Simple Radial

B. Primary Selective Radial

Similar to simple radial, with the added advantage of spare primary incoming cable circuit. By switching to spare circuit, duration of outage from cable failure is limited.

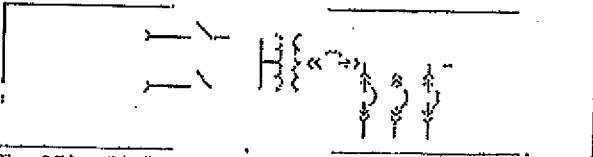


Figure 9. Primary Selective Radial

C. Secondary Selective

Normally operates as two electrically independent unit substations, with the breaker (B) open, and with approximately half of total load on each bus. In case of failure of either primary incoming circuit, only one bus is affected, and opening main breaker (M) on dead bus and closing the breaker (B) can promptly restore service. This operation can be made automatic, with duration of outage on either bus limited to a few seconds.

Since the transformers are not continuously paralleled, secondary fault currents and breaker application are similar to those on radial unit substations.

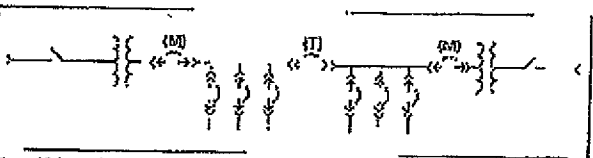


Figure 10. Secondary Selective

If required, and equipped with the appropriate relaying, either transformer can be removed from service and isolated with no interruption of service on either bus, by first closing the tie breaker and then opening the associated main breaker.

Service continuity and restoration capacity can be further improved by substituting selector type primary switches, shown above in B.

D. Spot Network

The transformers are paralleled through network protection. In case of primary voltage failure, the usual spot protector automatically opens. The other protector remains closed, and there is no "dead time" on the bus, even momentarily. When primary voltage is restored, the protector automatically checks for synchronization and recloses.

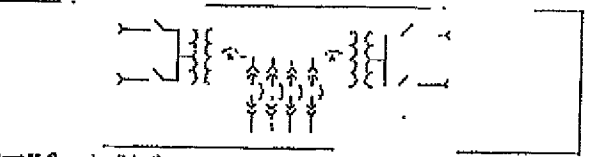


Figure 11. Secondary Selective

- Secondary voltage regulation is improved by paralleled transformers.
- Secondary fault capability is increased by paralleled transformers, and the feeder breaker breaking rating must be selected accordingly.

- Primary switches are usually selector or duplex type, so that transformers can be transferred to alternate live sources, thus shortening duration of outages.

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Application (Continued)

System Application

Most Magnum DS Switchgear is fed from power busbars. To facilitate minimum breaker sizing, Table 12 lists the calculated secondary short circuit currents and applicable main secondary and feeder breakers for various transformer sizes and voltages.

The short circuit currents are calculated by dividing the transformer base (100%) rated amperes by the sum of the transformer and primary system impedances, expressed in "per unit." The transformer impedance percentages are standard for most secondary unit substation transformers. The primary impedance is obtained by dividing the transformer base (100%) kVA by the primary short circuit kVA. The motor contributions to the short circuit currents are unlimited as approximately 4 times the motor load amperes, which in turn are based upon 50% of the total load for 208V system voltages and 100% for all other voltages.

High transformer impedances and/or lower percentages of motor loads will reduce the short circuit currents correspondingly. Supply voltage transformer winding and temperature ratings will not increase the short circuit currents, provided the motor loads are not increased.

The tables do not apply for 3-phase banks of single-phase distribution transformers, which usually have impedances of 2% to 3% or even lower. The short circuit currents must be recalculated for all such applications, and the breakers selected accordingly.

Transformer Main Secondary Breakers

Transformer secondary breakers are required or recommended for one or more of the following purposes:

1. To provide a one stop means of removing all load from the transformer.
2. To provide transformer overload protection in the absence of an individual primary breaker, and/or when primary fuses are used.
3. To provide the fastest clearing of a short circuit in the secondary main bus.
4. To provide a local disconnecting means, in the absence of a local primary switch or breaker, for maintenance purposes.
5. For automatic or manual transfer of loads to alternate sources, as in double ended secondary selective unit substations.
6. For simplifying key interlocking with primary interrupter switches.
7. To satisfy N.E.C. service entrance requirements when more than six feeder breakers are required.

Main secondary breakers, as selected in Table 12, have adequate interrupting ratings, but not necessarily adequate continuous current ratings. They should be able to carry continuously not only the multiplied maximum continuous output of the transformer but also any temporary overloads.

For a fully selective system, instantaneous protection on main breakers should be selected, as they typically cannot be coordinated with downstream devices.

Maximum capabilities of transformers of various types, in terms of kVA and secondary current, are given in Table 12. It will be noted that the maximum ratings will often require the substitution of larger frame main breakers than those listed in the tables. Even if a self-cooled transformer only is considered, it should be remembered that with ratings of 750 kVA and higher, provision for the future addition of cooling fans is automatically included. It is recommended that the main breaker have sufficient capacity for the future fan-cooled ratings, plus an allowance for overloads, if possible, particularly since load growth cannot always be predicted.

The same considerations should be given to the main bus capacities and main current transformer ratios.

Bus Sectionalizing (Tie) Breakers

The minimum recommended continuous current rating of bus sectionalizing or tie breakers, as used in double-ended secondary selective unit substations, or for connecting two single-ended substations, is one half that of the associated main breakers. The interrupting rating should be at least equal to that of the feeder breakers. It is common practice to select the tie breaker of the next frame size below that of the main breakers. However, many users and engineers prefer that the tie breaker be identical to and interchangeable with the main breakers, so that under normal conditions it will be available as a spare main breaker.

In general, the tie breaker, like the main breaker, trip unit should have its instantaneous tripping delayed.

Automatic Transfer Schemes

Often loads are fed from multiple sources, most often a primary source and an alternate source. In cases where the power source is required to transfer between the normal and alternate source automatically, a transfer system must be utilized. Of course, electrically separated main breakers are necessary to accomplish this transfer.

Suggested transfer logic, description and features for such a transfer are given in the following paragraphs. Certain loads or plant processes may dictate a different scheme.

Dual Source, No Tie, Open Transition

The logic of the transfer system functions via a microprocessor. The set points are field adjustable without the use of special tools.

A digital readout displays each option as it is functioning. Readings display actual line-to-line voltage, line frequency and timers. When timers are functioning, the microprocessor displays the time remaining to next. All set points can be re-programmed from the front of the logic panel when the transfer system is in the program mode. A test pushbutton is included as part of the microprocessor. The microprocessor is compatible with a Cutler-Hammer PowerNet™ communications system.

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The transfer system includes the following features:

1. Time delay normal to alternate, adjustable.
2. Time delay alternate to normal, adjustable.
3. Time delay neutral.
4. LEDs to indicate normal and alternate position.
5. LEDs marked "Source 1" and "Source 2" to indicate that respective source voltages are available.
6. LEDs to show which source is preferred.
7. LED to show the last energized.
8. Horizontal transfer information via the front panel.
9. Two position selector switch permitting two (2) modes of transfer system operation: **AUTO** (standard automatic operation), **MANUAL** (disconnect logic and allows manual operation of the main breakers with interlocking).

When the alternate source is an auxiliary generator, the following features are also provided:

1. Adjustable time delay engine start.
2. Adjustable time delay engine cool off.
3. Engine start contact.
4. Frequency/voltage relay for alternate source, frequency adjustable from 45 to 60 Hz and voltage fixed at 80% pickup, 70% dropout.
5. Delayed transition time delay, adjustable from 0 to 120 seconds, to allow disconnection of the load during transfer in either direction to prevent excessive inrush currents due to out-of-phase switching of large inductive loads.
6. Plant exciter.

Sequence of Operation

1. The transfer system shall automatically transfer its load circuit to an emergency or alternate power supply upon failure of its normal or preferred source.
2. Upon loss of phase to phase voltage of the normal source to 80% of nominal, and after a time delay, adjustable from 0.5 to 10 seconds, to override momentary dips and/or outages, a 10 ampere, 24V dc contact shall close to initiate starting of the emergency or standby source power plant. Transfer to the alternate source shall take place immediately upon attainment of 80% of rated voltage and frequency of that source. For schemes not involving engine generator sets as the alternate source, transfer shall occur after an adjustable time delay of 1 to 60 seconds to override momentary dips and outages.
3. When the normal source has been restored to 80% of rated voltage, and after a time delay, adjustable from 0.5 to 30 minutes (to ensure the integrity of the normal power source), the load shall be returned to the normal source.
4. A time delay, adjustable from 0.5 to 30 minutes, shall delay shutdown of the emergency or standby power source after retransfer to allow the generator to run unloaded for cooldown, after which the generator shall be automatically shut down.
5. If the emergency or standby power should fail while carrying the load, transfer to the normal power supply shall be made automatically upon restoration of the normal source to satisfactory conditions.

Dual Source, With Tie, Open Transition (Closed Transition)

The logic of the transfer system functions via a microprocessor. The set points are field adjustable without the use of special tools.

The transfer system displays status as it is functioning. When timers are functioning, the system displays the timer counting down. All time delays can be set from the front of the equipment using a timer setting screen on the display.

The transfer system includes the following features:

1. Time delay to transfer on loss of Source 1, adjustable.
2. Time delay to transfer on loss of Source 2, adjustable.
3. Time delay re-transfer to Source 1, adjustable.
4. Time delay re-transfer to Source 2, adjustable.
5. Time delay manual (main and tie open), adjustable.
6. Multi-fig Main and tie on system display.
7. Main and tie breaker status shown on system display. (Open, closed, tripped, out of call)
8. Headout on system display marked "Source 1" and "Source 2" to indicate that respective source voltages are available.
9. Automatic/manual mode selector.
10. Pushbutton for manual breaker control on system display.
11. Alarm information via the system display (loss of source, breaker trip).
12. [Open/Closed transition mode select pushbutton on system display.]

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Sequence of Operation Automatic Mode

- Under normal conditions the main breaker are closed and the tie breaker is open.
- Upon phase loss or loss of phase to phase voltage of either utility source to between 80% and 100% of nominal, and after a time delay, adjustable from 1 – 60 seconds to override momentary dips and outages the transfer system will open the affected main breaker and close the tie breaker.
- When normal voltage has been restored after a time delay, adjustable from 10 – 600 seconds to ensure the integrity of the source, the transfer system will verify the two sources are in sync via a sync check relay (26), close the affected main breaker and open the tie breaker. (closed transition retransfer)
- If Source 2 should fail while carrying the load, transfer to Source 1 shall be made instantaneously upon restoration of Source 1 to satisfactory conditions.
- If both sources should fail simultaneously no action is taken.
- If the main or tie breakers trip due to a fault the transfer system will be reset to manual mode and manual operation of that breaker will be prevented until its overcurrent trip switch is reset.

Manual Mode

- Breakers may be opened and closed using control switches or pushbuttons on the transfer system display while in manual mode. Interlocking is in place to prevent the closing of both mains and the tie simultaneously.
- (Breakers may be opened and closed using control switches or pushbuttons on the transfer system display while in manual mode. While in open transition mode, interlocking is in place to prevent the closing of both mains and the tie simultaneously. If closed transition mode is selected all three breakers may be closed for an adjustable time delay (5 – 60 seconds). The operator may open the desired breaker via its push button or the system will open the tie breaker after the time delay has expired.)

Generator Breakers

In most applications where generators are connected through breakers to the secondary bus, they are used as emergency standby sources only, and are not synchronized or paralleled with the utility substation transformers. Under these conditions, the interrupting rating of the generator breaker will be based solely on the generator kVA and sub-transient reactance. This reactance varies with the generator type and size, from a minimum of approximately 8% for a 2-pole 3600 rpm turbine driven generator to 25% or more for a medium or slow speed engine type generator. Thus the feeder breakers selected for the unit substation will usually be adequate for a standby generator of the same kVA on the transformer.

Most generators have a 2-hour 25% overload rating, and the generator breaker must be adequate for this overload current. Selective type long and short delay trip protection only is usually recommended for coordination with the feeder breakers, with the long delay elements set at 125% to 150% of the maximum generator current rating for generator protection.

In the case of two or more paralleled generators, with individual reverse power relays (device 32) are recommended for protection of the prime movers, particularly piston type engines. For larger generators requiring a Magnum MDS-632 or larger, voltage-sensitive type overcurrent relays (device 51V) are recommended.

Feeder Breakers - General

Circuit breakers for feeder circuit protection may be manually or electrically operated, with long and short delay or long delay and instantaneous type trip devices, and trip settings, as required for the specific design and load requirements.

Feeder breakers as selected in Table 12 have adequate interrupting ratings, and are assumed to have adequate continuous current ratings for maximum load demands.

General purpose feeder breakers, such as for lighting circuits, are usually equipped with long delay and instantaneous trip devices, with the long delay pickup set for the maximum load demand in the circuit. Where arc fault protection is required, the instantaneous trip setting should be as low as practicable consistent with inrush requirements.

Motor Starting Feeder Breakers

These breakers are usually electrically operated, with long delay and instantaneous tripping characteristics for motor running, locked rotor and fault protection. The breaker sensing relay should be chosen so that the long delay pickup can be set at 175% of motor full load current for motors with a 1.15 service factor, or at 115% for all other motors. Considerations are recommended for this application when there are a number of daily operations involved.

When system short circuits are less than 10 times the motor full load current, the motor breaker tripping characteristics should include a short delay characteristic for ground fault protection.

Group Motor Feeder Breakers

Typical loads for such circuits are motor control centers. The feeder breakers may be either manually or electrically operated as preferred, and are usually equipped with long and short delay trip protection only for coordination with the individual motor circuit devices. The minimum long delay pickup setting should be 115% of the running current of the largest motor in the group, plus the sum of the running currents of all other motors.

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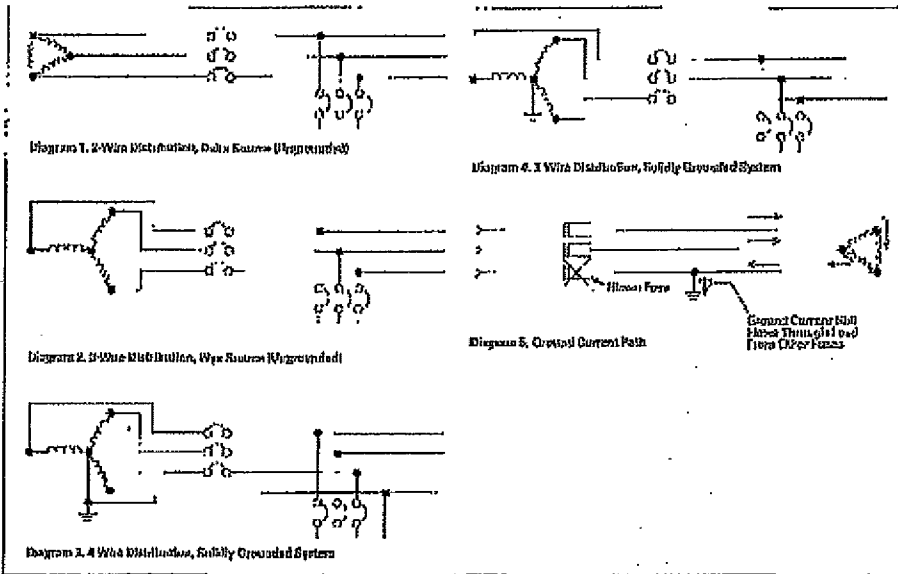


Figure 12. Distribution Systems

Ground Fault

Distribution Systems

The power distribution in 3-phase low voltage systems can be 3- or 4-wire distribution. The 3-wire distribution can be served from either delta or wye sources, but the 4-wire distribution is obtained from wye solidly grounded sources only. Diagram 1 in Figure 12 shows 3-wire distribution with delta source and Diagram 2 in Figure 12 shows 3-wire distribution with wye source. It is significant on Diagram 2 in Figure 12, that the wye connection of a transformer secondary does not necessarily mean 4-wire distribution in switchgear. This is worthwhile to note because 4-wire distribution in switchgear is frequently assumed when the transformer secondary is wye connected. The low voltage system in 3-phase 4-wire distribution only if a fourth wire is carried through the switchgear, the transformer neutral is solidly grounded, and single-phase loads are connected to feeder breakers. This fourth wire is the neutral bus. The neutral bus is connected to

the neutral of the wye connected transformer secondary as shown on Diagram 3 in Figure 12.

Three- or 4-wire sources can be grounded or ungrounded in service. Generally, where the source is delta connected it is ungrounded, but in some very rare cases it is grounded at one corner of the delta, or at some other point. When the source is wye connected it can be grounded or ungrounded, and when grounded, the grounding is at the neutral. When low voltage systems are grounded they are generally solidly grounded; however, occasionally the grounding is through a resistor. Three- and 4-wire solidly grounded systems are shown on Diagrams 3 and 4 in Figure 12. Most installations are solidly grounded. Solidly grounded systems have the advantage of being the easiest to maintain, yet have the potential for producing extremely high fault levels.

When feeding critical facilities, or continuous industrial processes, it is sometimes preferable to allow

the system to continue operating when a phase conductor goes to ground. There are two methods of accommodating this application; the source transformer may either be left ungrounded or high resistance grounded. If the correct system conditions of inductance and capacitance manifests themselves, arcing ground on ungrounded systems can produce excessive line-to-ground voltages, which in turn can lead to insulation breakdown in other devices. This condition is known as ferroresonance. The high resistance grounded system does not suffer from this potential phenomenon. Regardless of which system is selected, both require the application of an appropriate maintenance ground detection method. Upon grounding of one of the phase conductors, the detection device starts operation of the circuit breaker. Personnel should be aware that ground faults can die and reappear, and before a second ground occurs on another phase.

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Since ungrounded and resistance grounded systems produce unlimited ground currents, no damage occurs to the grounded equipment. These ground currents are also too low for detection by integral trip and ground elements, therefore serve no ground (fault) tripping function. If applied on these systems, ground fault elements on these types of systems can, however, provide supplemental protection. If a second ground occurs on another phase, and exceeds the ground element pickup setting, the ground element can cause an immediate short delay trip.

Ungrounded or resistance grounded systems can not be applied on 4-wire systems. Even if supplied from a 4-wire source, no line-to-neutral loads may be served. These applications are limited to 3-wire distribution systems only.

Need for Ground Fault Protection

If the magnitude of all ground currents would be large enough to operate the short delay or instantaneous elements of the phase overcurrent trip devices, there would be no need for separate ground fault protection on solidly grounded systems. Unfortunately, because low magnitude ground currents are quite common, this is not the case. Low level ground currents can exist if the ground in the winding of a motor or a transformer, or if it is a high impedance ground. Low level ground currents may also be due to an arcing type ground. The arcing type grounds are the source of the most severe damages to electrical equipment. The lower limit of the arcing ground currents is unpredictable and the magnitude may be considerably below the setting of the breaker phase overcurrent trip device. It is for this reason that the National Electrical Code, and UL, require ground fault protection for all service disconnect breakers rated 1000 amperes and greater, applied on systems with greater than 150 volts line-to-ground.

Since the breaker phase overcurrent trip devices cannot provide sensitive enough protection against low magnitude ground faults, there is a need for an additional protective device. This additional device is not to operate on normal overloads and it is to be sensitive and fast enough to protect against low magnitude grounds. It is also important that this additional ground protecting device be simple and reliable. If the Magnum DS breaker solid-state tripping system including an optional "ground element"

is selected, good ground fault protection will be ensured.

The Ground Element

The ground element of the solid-state trip unit is in addition to the usual phase protection. The ground element has adjustable pickup with calibrated marks as shown in Tables 8 and 9 and adjustable time delay. The input current to the trip unit can be provided by:

- Residual connection of phase sensors, with the residual circuit connected to the ground element terminals.** This is the Magnum DS Low Voltage Switchgear standard ground protection system for 2-wire systems. On 4-wire systems, standard ground fault protection includes a fourth "neutral sensor." It is connected to vectorially subtract from the residual current of the phase sensors, its only function is to sense neutral currents. It does not sense ground current. These systems produce pickup values as shown in Table 8.
- External ground sensing current transformers connected to the ground element terminals.** This means that the external ground sensor will trip the breaker whenever its secondary output current exceeds the values shown in Table 9. Tripping is independent of phase currents. The lower the CT ratio, the more sensitive the ground fault protection.

Ground Fault Protection Application and Coordination

In all power systems, continuity of service is very important. For reliable service continuity, selective tripping is applied between main, tie, and feeder breakers, and downstream protecting devices, for phase-to-phase faults. Similar selective tripping is desirable when breakers trip on grounds. The application of ground protection only to main breakers may ensure good ground protection. However, it will not provide good service continuity because the main breaker will trip on grounds that should have been cleared by feeder breakers, or proper protection and for good service continuity, main, tie and feeder breakers all should be equipped with ground fault protection.

In view of the above, it is evident that properly applied ground protection requires ground elements as far down the system to the loads as practical. For best results, downstream molded case breakers should have individual

ground protection. This would result in excellent ground protection because ground elements of Magnum DS and downstream breakers having similar tripping characteristics can be coordinated.

Depending on the sensitivity of the ground fault protection method applied, coordination between Magnum DS breaker ground elements and downstream branch circuit fuses is sometimes impractical. This is due to the basic fact that the blowing of one phase fuse will not clear a ground on a 3-phase system. The other 2-phase fuses will let the load "single phase," and also continue to feed the ground through the load, as shown in Diagram 5 in Figure 12.

High Resistance Grounding

Where continuity of service is a high priority, high resistance grounding can add the safety of a grounded system while maintaining the cost of service interruptions due to grounds. The concept is a shunt circuit provide a path for ground current via a resistance that limits the current magnitude, and monitor to determine when an abnormal condition exists.

The ground current path is provided at the point where the service begins, by placing resistance in the connection from system neutral to ground. Control equipment continuously measures ground current. A relay detects when the current exceeds a predetermined level. An alarm alerts building personnel that a ground exists. The system has built in fault tripping means to assist in finding the source of the ground. An integral transformer provides control power from the primary source.

800 Volt (Maximum) Delta Systems

To add high resistance grounding to an ungrounded delta connected system, a neutral point must be created. Three single-phase transformers can be interconnected in a delta or wye broken delta configuration to provide such a neutral point. The transformers and grounding resistance are chosen to limit the ground current to a maximum value of 5 amperes.

Note: The neutral point may not be used to serve phase-to-neutral loads. Also, this technique may be applied to a wye-connected source when the neutral point is not conveniently accessible from the service entrance location.

(continued)

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600/247 Volt (Maximum) Wye Systems
To add high resistance grounding to a wye-connected system, resistors are placed in series with the neutral-to-ground connection of the power source. The resistors are chosen to limit the current to a maximum value of 5 amperes.

Note: For 1993 NEC 250.5b, Exception No. 5, these neutral links may not be connected to a system where the neutral is resistance-grounded.

Ground Current Detection

Any time a system is energized, a small ground current called the "capacitive charging current" will be observed. For low voltage (600V and below) systems, this naturally-occurring current is typically 1 ampere or less.

When one phase becomes grounded, additional current above the capacitive level will flow. As all ground current must flow through the grounding resistor/grounding transformer assembly, an ammeter in this circuit will read the total amount of ground current. By placing a current sensing relay in series with the ammeter, the current relay can be adjusted to pick up at a level in excess of the capacitive charging current, thus indicating the abnormal condition.

Alternatively, an optional voltmeter-relay can be connected across the grounding resistors. The voltage across the resistors is proportional to the amount of ground current. The voltmeter-relay's pickup adjustment is set above the capacitive charging current, to the desired detection level.

In both current and voltage detection methods, the ground current ammeter provides a direct reading of the total, actual ground current present in the system at that time. It will be helpful to periodically note the ammeter's reading; a trend towards higher values may indicate the need for equipment maintenance, and hence reduce the occurrence of unplanned shutdowns.

Indication and Alarm Circuits

When a fault is detected, an adjustable time delay is provided to suppress transients. When the time delay has been exceeded, the green "normal" light will turn off, the red "ground fault" light will turn on, and the ground alarm contacts will transfer. If equipped with the optional alarm horn, it will sound.

When the fault is cleared, the current/voltage relay will reset. If the reset control is set on "push," the lights will return to "normal" or, "ground fault" off, and the ground alarm contacts will re-transfer. If the reset control is set on "manual," the lights and relay contacts will remain latched until the operator turns the reset control to "reset." The lights and ground alarm contacts will then return to normal. The system can be reset only if the fault has been cleared.

During a fault, the optional alarm horn can be silenced at any time by using the "alarm silence" pushbutton. It will not re-sound until either the system is reset, or the re-alarm timer expires. The re-alarm timer is activated by the "alarm silence" control. If the horn has been silenced but the fault has not been cleared, the timer will run. It has a range of 2-48 hours. When the timer times out, the horn will re-sound, alerting maintenance personnel that the fault has not been cleared.

Test Circuit

A test circuit is provided to allow the user to quickly determine that the system is working properly. The test circuit will operate only under normal conditions—it will not allow testing if the system is sensing a fault. A separate grounding resistor is provided, connected to a relay operated by the "test" position of the cable selector switch. The relay's contact grounds Phase B through the test resistor, causing ground current to flow. The system then reacts as it would under actual system ground conditions: lights transfer, alarm contacts transfer and the (optional) horn sounds.

Pulser Circuit

The pulser circuit offers a convenient means to locate the faulted feeder and trace the fault to its origin. The pulser is available any time a fault has been detected. An adjustable recycle timer controls the pulse intervals. The "pulser" light flashes on and off, corresponding to the on/off cycles of the pulser contact. The pulser contact switches a bank of resistors on and off, thus allowing a momentary increase in the ground current (approximately 5 to 6 amperes current pulses above the ground current).

Locating a Ground Fault

The current pulses can be noted with a clamp on ammeter when the ammeter is placed around the cables or conduit feeding the fault. The operator tests each conduit or set of cables until the pulsing current is noted. By moving the ammeter along the conduit, or checking the conduit periodically along its length, the fault can be traced to its origin. The fault may be located at the point where the pulsing current drops off or stops.

If little or no change in the pulsing current is noted along the entire length of a cable, then the fault may be in the connected load. If the load is a panel board, distribution substation or motor control center, repeat the process of checking all outgoing cable groups to find the faulted feeder. If the fault is not found in an outgoing feeder, the fault may be internal to that equipment.

NOTE: It may not be possible to precisely locate faults within a conduit. The ground current may distribute many components, depending on the number of cables per phase, number of conductors per feeder, and the number and positions of each ground point along the conduit. The resulting currents may be too small to allow detection, or may take a path that the ammeter cannot trace. An important note to keep in mind is that while the pulser can greatly aid in locating a fault, there may be certain conditions under which the pulser cannot be easily traced, and other test procedures (using ohm, high-potential, etc.) may be needed.

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Sequence of Operation

Normal

- Green "normal" light on.
- Red "ground fault" light off.
- White "pulse" light off.
- System control switch in "normal" position.
- Reset control switch in either "auto" or "manual."

Test

Turn and hold the system control switch in the "test" position. Thus it will be grounded via the test resistor. The ground current will activate the sensing circuit, causing the green "normal" light to turn off and the red "ground fault" light to turn on. The pulse will be activated as well. The white "pulse" light will turn on and off as the pulse conductor closes and opens. The ground current circuit will display the total ground current, including the incremental pulse current. When ready, return the system control switch to "normal." The pulse will stop. If the reset control is in the "manual" position, turn it to "reset" to reset the fault sensing circuit. The red "ground fault" light will turn off, and the green "normal" light will turn on. Test mode is not available if the system is detecting a ground. The sensing circuit will disable the test circuit.

Ground Fault

When the sensing circuit detects a fault, the green "normal" light will turn off and the red "ground fault" light will turn on. The ground current ammeter will indicate the total ground current. To use the pulse, turn the system control switch to "pulse." The pulse conductor will cycle on and off as control led by the recycle timer relay. Use the clamp-on ammeter to locate the faulted feeder. Open the feeder and clear the fault. If the reset control switch is in the "manual" position, turn it to "reset" to reset the sensing circuit. (If reset control is in "auto," it will reset itself.) When ready to restore service to the load, change the feeder. Return the system control to "normal."

Zone Selective Interlocking (ZSI)

By definition, a selectively coordinated system is one where by adjusting trip unit pickup and time delay settings, the circuit breaker closest to the fault trips first. The upstream breaker serves two functions:

1. Back-up protection to the downstream breaker.
2. Protection of the conductors between the upstream and downstream breakers. These elements are provided for on Digitrip™ trip units.

For faults that occur on the conductors between the upstream and downstream breakers it is highly desirable for the upstream breaker to trip with no time delay. This is the feature provided by zone selective interlocking. Digitrip trip units may be specified to utilize this option.

Zone selective interlocking is a communication signal between trip units applied on upstream and downstream breakers. Each trip unit must be applied as if zone selective interlocking were not employed, and set for selective coordination.

During fault conditions, each trip unit that senses the fault sends a restraining signal to all upstream trip units. This restraining signal results in causing the upstream trip to continue timing as it is set. In the absence of a restraining signal, the trip unit trips the associated breaker with no intentional time delay, minimizing damage to the fault point. This restraining signal is a very low level. To minimize the potential for induced noise, and to provide a low impedance interface between trip units, special twisted pair conductors are utilized for interconnection. For this reason, zone selective interlocking must be specified.

Ground fault and short delay pickup on Digitrip Trip Units may be specified with zone selective interlocking. Since most system faults start as arcing ground faults, zone selective interlocking on ground fault pickup only is usually adequate. Zone selective interlocking on short delay pickup may be utilized where no ground fault protection is provided.

Zone selective interlocking may be applied as a type of time differential protection. It must be recognized, however, that one must accept the minimum pickup of the trip unit for sensitivity.

- It must also be recognized that not all systems may be equipped with zone selective interlocking. Systems containing multiple sources, or where the direction of power flow varies, require special configurations, or may not be suitable for this feature. Digitrip zone interlocking has been tested with up to three levels with up to 20 trip units per level.

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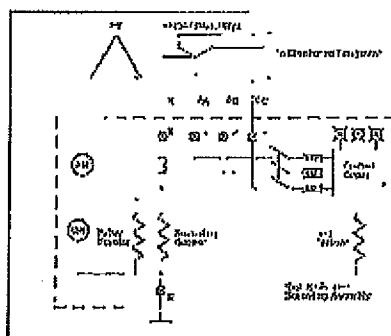


Figure 12. 4-Wire System — Fault Detection via Current Relay

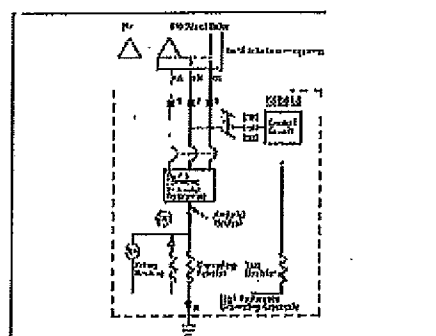


Figure 13. 3-Wire System — Zig-Zag Grounding Transformer Fault Detection via Voltmeter Relay

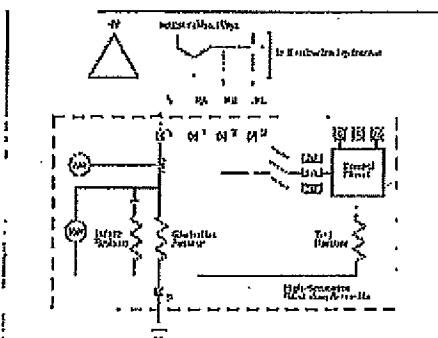


Figure 14. 4-Wire System — Fault Detection via Voltmeter Relay

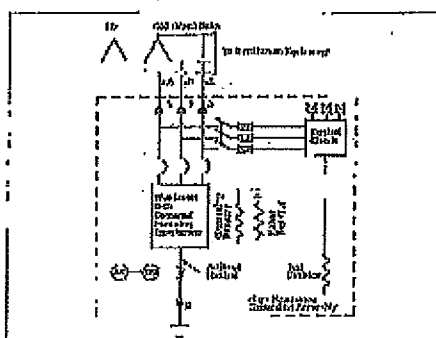


Figure 17. 3-Wire System — Wye-Broken Delta Grounding Transformer Fault Detection via Current Relay

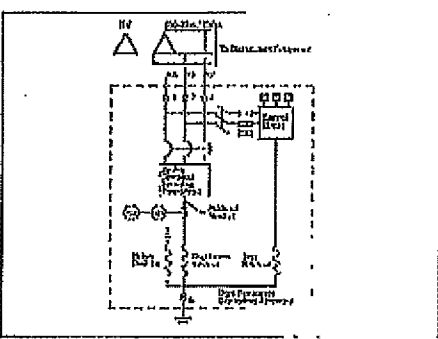


Figure 15. 3-Wire System — Zig-Zag Grounding Transformer Fault Detection via Current Relay

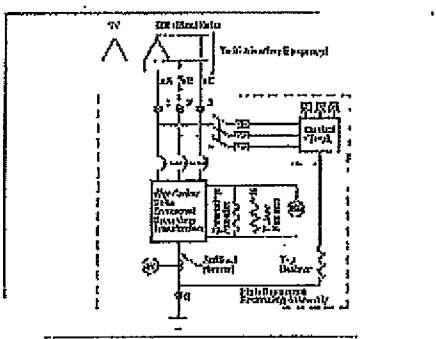


Figure 16. 3-Wire System — Wye-Broken Delta Grounding Transformer Fault Detection via Voltmeter Relay

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Table 12. Guidelines for Ground Fault Protection

System	Advantages	Disadvantages	Equipment Available for Protection			Notes
			Main Breaker	In Breaker	Feeder Breaker	
Ungrounded (3-Wire)	Minimum disturbance to equipment and property. Systems for the majority of grounds will be limited to capacitive charging current of the system. Can operate with the first ground until it is removed during a regular shut down. Low cost. No protective pickup for an ungrounded system will trip until ground cleared.	When ground detector shows that a ground exists, correction must be taken in the shortest possible time. However, external overvoltages that this system is not always possible. Therefore, these systems tend to operate with one phase grounded through the first impedance ground. A high impedance ground on another part of the system would result in low values of current, which would not operate a breaker phase trip, and could produce fire damage. High voltages from arcing grounds are possible.	Long type ground detector or ground detecting unit with an ungrounded voltage transformer. If voltage is low, a ground alarm relay can be added for remote or local warning. 3 wire residual protection, after main pickup, has a second time delay. See Figures 19, 22 and 24 on Pages 26 and 27.	3 wire residual protection, after main pickup, has a second time delay. See Figures 22 and 24 on Pages 27.	3 wire protection, including pickup, a 22 second time delay. See Figures 19, 22 and 24 on Pages 26 and 27.	2b
Single Grounded	20	20	Standard residual ground protection for single source system, and 200% ground. See Figure 23 on Page 26, for multiple ground sources. Minimum pickup is 50 percent time delay.	Ground 3 wire or 4 wire system residual fault protection. Minimum pickup. 0.33 second time delay. See Figure 27 on Page 27.	Ground 3 wire or 4 wire system residual fault protection. Minimum pickup. 0.22 second time delay for main equipment current transformer fault into 1 rly unit. See Figures 19, 20 and 24 on Pages 26 and 27.	This is the most common configuration in use today. As long as it is not necessary to coordinate with phase detectors down the line, it will give very good results with feeder protection.
High Resistance Grounded (3-Wire)	Ground fault current is limited. Unsymmetrical can result in high voltage during arcing grounds, and this is softened by high resistance grounding. Can operate with the first ground until it is removed during a regular shutdown.	Very sensitive detector is required to detect the limited fault current. When the ground detector shows that a ground exists, corrective action must be taken at the earliest possible shutdown. However, overvoltages and other that this system is not always possible. Therefore, these systems tend to operate with one phase grounded through the first impedance ground. A high impedance ground on another part of the system would result in low values of current, which would not operate a breaker phase trip, and could produce fire damage. Higher than recommended.	Same as for ungrounded except ground voltage alarm relay is replaced across grounding resistor, or can run relay across reactor and ground.	Same as for ungrounded.	Same as for ungrounded.	Same as for ungrounded. This system is most effective when supplied with a pickup option.

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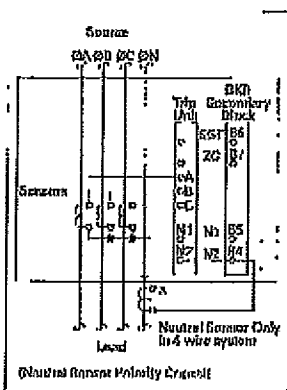


Figure 19. Realized Main and Feeder Breaker

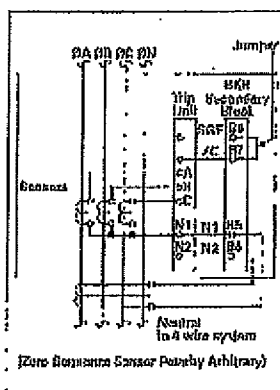


Figure 20. Zero Sequence Feeder Breaker

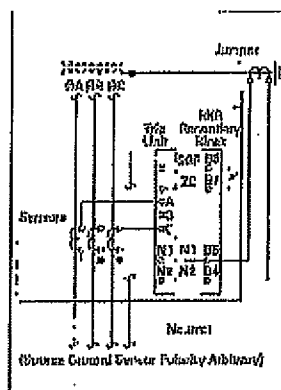


Figure 21. Source Neutral Main Breaker

3. Apply in 4-wire systems for Main Breaker only when no other grounded conductors are connected to the system.
Note: For double ended secondary unit substations, grounded fault protection should be as illustrated in Figure 19 and Figure 20; however, for this type of application, the Cutler-Hammer business should be consulted for the correct full line solution to be used.
The application becomes either complex if single phase to neutral breakers being served.

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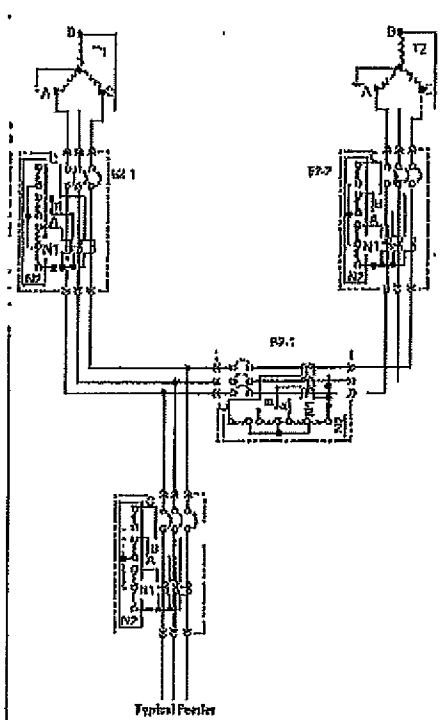


Figure 22. 3-Wire Double-Ended Unit Substation

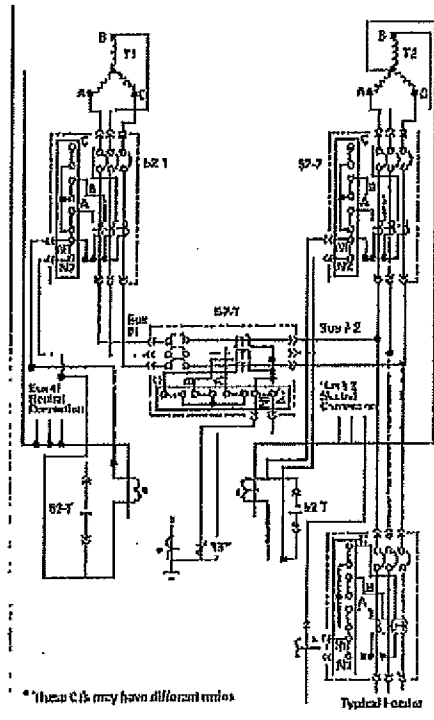


Figure 23. 4-Wire Double-Ended Unit Substation

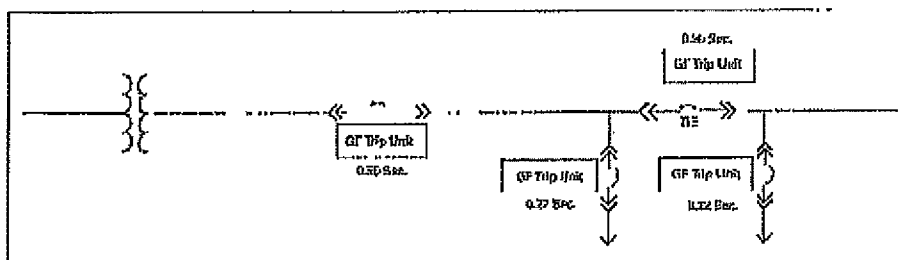


Figure 24. Continued Ground Fault Pickup Ratings

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Table 13. Application of Magnum DS Power Circuit Breakers with Standard Three-Phase Transformers — Mold Filled and Ventilated Dry Types

Transformer Base (100% Rating)	Anywhere	Maximum Short Circuit kVA Available from Primary System	Secondary Short Circuit Currents on Symmetrical Faults		Applicable Size Breakers for Selective Trip Systems		
Anywhere Anywhere	Anywhere	Anywhere	Through Transformer Only	Motor Contribution	Combined	Main Breaker Short Delay Trip	Feeder Breaker Short Delay Trip
240 Volts Three-Phase — 50% Motor Load							
300 5.0%	203	50,000 100,000 150,000 250,000 500,000 Unlimited	14,800 19,700 15,000 16,300 16,200 14,700	7700	16,500 17,400 17,400 18,000 18,200 18,400	MDS-615	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
400 6.0%	1389	50,000 100,000 150,000 250,000 500,000 Unlimited	21,100 28,700 21,700 25,700 27,200 27,000	2500	26,000 28,000 28,000 29,200 30,000 30,500	MDS-615	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
750 6.75%	2052	50,000 100,000 150,000 250,000 500,000 Unlimited	28,700 32,000 23,900 34,400 36,700 36,700	4200	32,500 36,700 37,500 38,500 39,400 40,400	MDS-615	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
1600 6.75%	2773	50,000 100,000 150,000 250,000 500,000 Unlimited	31,500 41,200 43,300 45,000 46,700 46,300	10000	41,800 48,500 49,500 50,500 51,100 53,500	MDS-615	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
240 Volts Three-Phase — 100% Motor Load							
300 10.0%	777	50,000 100,000 150,000 250,000 500,000 Unlimited	12,900 15,600 13,400 14,100 14,300 14,400	2500	11,600 14,500 18,800 17,500 17,200 17,200	MDS-415	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
600 5.0%	1202	50,000 100,000 150,000 250,000 500,000 Unlimited	20,000 21,000 22,500 24,100 24,600 24,100	4500	24,500 29,000 27,000 27,500 28,400 28,500	MDS-415	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
750 5.75%	1003	50,000 100,000 150,000 250,000 500,000 Unlimited	24,000 24,000 25,800 26,900 28,800 28,400	7700	32,100 33,000 33,100 34,000 34,800 35,000	MDS-615	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
1600 10.0%	2002	50,000 100,000 150,000 250,000 500,000 Unlimited	31,000 35,000 37,400 39,100 40,400 41,800	3000	40,000 45,000 47,100 48,700 50,000 51,400	MDS-615	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400

† At transformer 600-50000 and 1600.

†† Not longer have the same breaker may be required for 1500V type and/or 10000 or 10000 (1000) transformer.

Black Transformer Secondary Amps Rating

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Table 13, Application of Magnum DS Power Circuit Breakers with Standard Three-Phase Transformers - Field Mounted Metal-Enclosed Dry Types (Continued)

Transformer Base (100% Rating)	Amperes ⁽¹⁾	Maximum Short Circuit MVA Available from Primary System	Secondary Short Circuit Current from System (Peak Amperes)	Through Transformer Only	Motor Contribution	Combined	Minimum Size Breakers for Selective Trip Systems	Feeder Breaker Short Delay Trip	Feeder Breaker Instantaneous Trip
480 Volts Three-Phase — 100% Motor Load									
7500 5.0%	600	60,000 100,000 180,000 750,000 600,000 Unlimited	10,000 10,000 11,300 11,300 11,300 12,000	2400		12,400 13,300 13,300 14,300 14,300 15,400	MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03	MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03	MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03
7500 8.75%	800	60,000 100,000 180,000 750,000 600,000 Unlimited	17,400 17,400 19,400 19,400 19,400 20,500	3600		19,000 17,400 19,400 20,500 20,500 21,600	MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03	MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03	MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03 MDS-100-03
15000 5.75%	1200	60,000 100,000 140,000 240,000 600,000 Unlimited	15,500 17,400 18,400 19,400 20,500 21,600	4800		20,300 22,500 24,400 24,400 25,500 26,700	MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03	MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03	MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03
15000 8.75%	1600	140,000 100,000 150,000 230,000 600,000 Unlimited	20,100 24,800 26,700 28,400 29,500 31,400	7200		27,300 32,100 33,000 35,000 37,000 38,000	MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03	MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03	MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03
22500 5.75%	2400	80,000 100,000 150,000 250,000 600,000 Unlimited	24,300 31,600 34,800 38,000 39,100 41,800	8500		32,800 40,600 43,000 45,200 46,200 49,000	MDS-432-03 MDS-432-03 MDS-432-03 MDS-432-03 MDS-432-03 MDS-432-03	MDS-432-03 MDS-432-03 MDS-432-03 MDS-432-03 MDS-432-03 MDS-432-03	MDS-432-03 MDS-432-03 MDS-432-03 MDS-432-03 MDS-432-03 MDS-432-03
22500 8.75%	3200	140,000 100,000 150,000 250,000 600,000 Unlimited	24,300 31,600 34,800 38,000 39,100 41,800	12000		46,000 48,800 55,500 58,000 60,100 64,000	MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03	MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03	MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03
30000 5.75%	3600	60,000 100,000 150,000 250,000 600,000 Unlimited	30,700 41,800 46,000 51,900 52,000 55,000	14000		61,700 65,200 66,000 70,500 70,600 74,000	MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03	MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03	MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03 MDS-615-03
37500 8.75%	4800	140,000 100,000 150,000 250,000 600,000 Unlimited	34,000 47,500 58,700 62,200 62,300 66,000	18000		82,000 88,000 97,700 102,200 102,300 107,000	MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03	MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03	MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03 MDS-1020-03

⁽¹⁾ At transformer secondary rating.

⁽²⁾ Next lower figure also made by user may be required for 55°C rise and/or limited up-cooled (FAT) conditions.
Check Transformer Secondary Ampere Rating.

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Application (Continued)

Table 13. Application of Magnum DS Power Circuit Breakers with Standard Three-Phase Transformers — Pad-Mounted and Ventilated Dry Types (Continued)

Transformer Base kVA Rating	Ampacity ¹	Short-Circuit Current kVA Available from Primary System	Through Transformer Fault	Motor Contributions	Contributed	Minimum Size Breakers for Selective Trip Systems	Feeder Breaker Instantaneous Trip
kVA and Percent Impedance						Main Breaker Short Delay Trip	Feeder Breaker Short Delay Trip
500 Volt Three-Phase — 100% Motor Load							
600 5.5%	481	15,000 100,000 100,000 200,000 500,000 Unlimited	8,000 8,700 9,000 9,700 10,000 0.000	1500	8,500 10,500 10,500 11,000 11,000 11,500	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
750 5.75%	722	50,000 100,000 100,000 200,000 500,000 Unlimited	10,000 11,100 11,000 11,900 12,000 12,000	2200	12,500 14,000 14,000 14,000 14,000 14,000	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
1000 5.75%	802	50,000 100,000 100,000 200,000 500,000 Unlimited	12,400 14,000 14,000 15,000 15,000 15,000	3000	15,000 16,200 16,200 16,200 16,200 16,200	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
1500 5.75%	1113	50,000 100,000 100,000 200,000 500,000 Unlimited	15,000 16,000 16,000 17,000 17,000 17,000	5800	22,000 25,000 25,000 25,000 25,000 25,000	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
2000 5.75%	1324	50,000 100,000 100,000 200,000 500,000 Unlimited	19,000 20,000 20,000 21,000 21,000 21,000	1700	27,000 28,500 28,500 28,500 28,500 28,500	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
2500 5.75%	1535	50,000 100,000 100,000 200,000 500,000 Unlimited	22,400 23,000 23,000 24,000 24,000 24,000	3000	34,000 34,000 34,000 34,000 34,000 34,000	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
3000 5.75%	1746	50,000 100,000 100,000 200,000 500,000 Unlimited	24,000 24,000 24,000 25,000 25,000 25,000	11500	40,000 40,000 40,000 40,000 40,000 40,000	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400
3750 5.75%	2057	50,000 100,000 100,000 200,000 500,000 Unlimited	27,000 28,000 28,000 29,000 29,000 29,000	14400	41,000 42,000 42,000 42,000 42,000 42,000	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400	MDS-400 MDS-400 MDS-400 MDS-400 MDS-400 MDS-400

¹ All transformers are 60 Hz.

² Next larger feeder size may be required for 1500 V and/or forced air cooled (FAC) transformers.
Check Transformer Secondary Ampere Rating.

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Application (Continued)

Breaker Arrangements

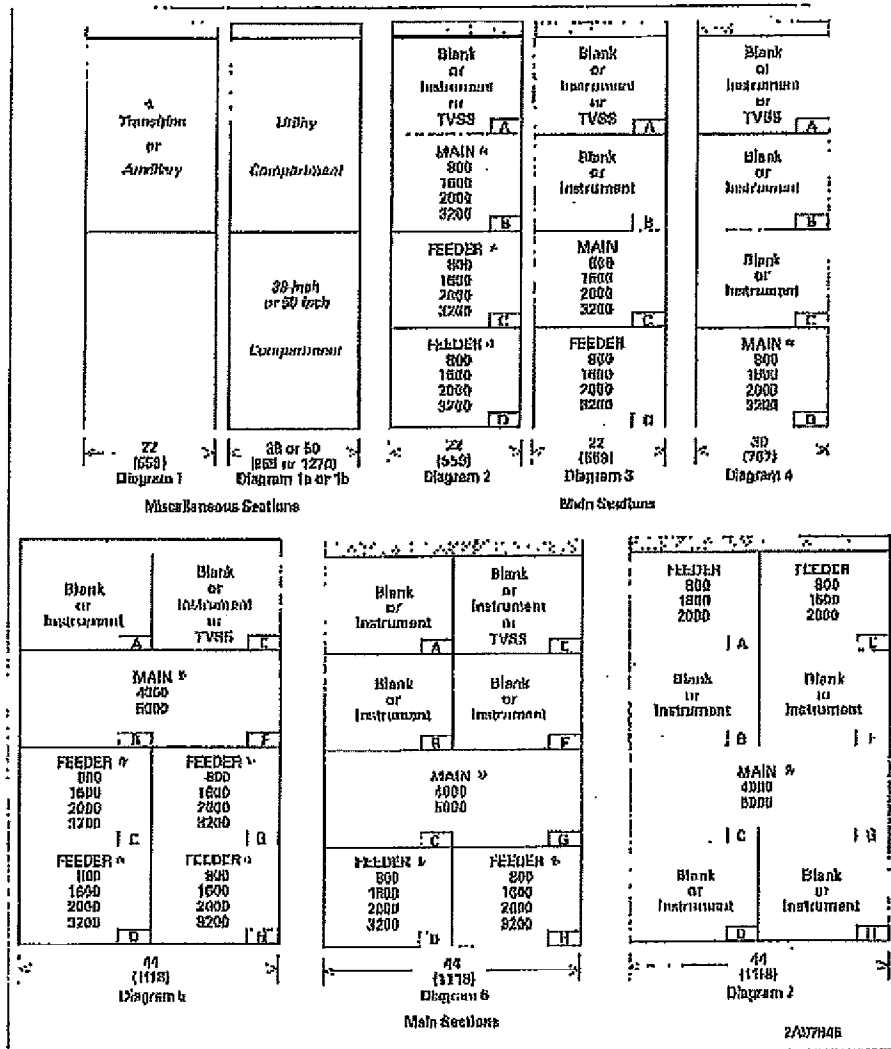


Figure 25. Breaker Arrangements

See Page 25 for footnotes.

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Application (Continued)

Breaker Arrangements (continued)

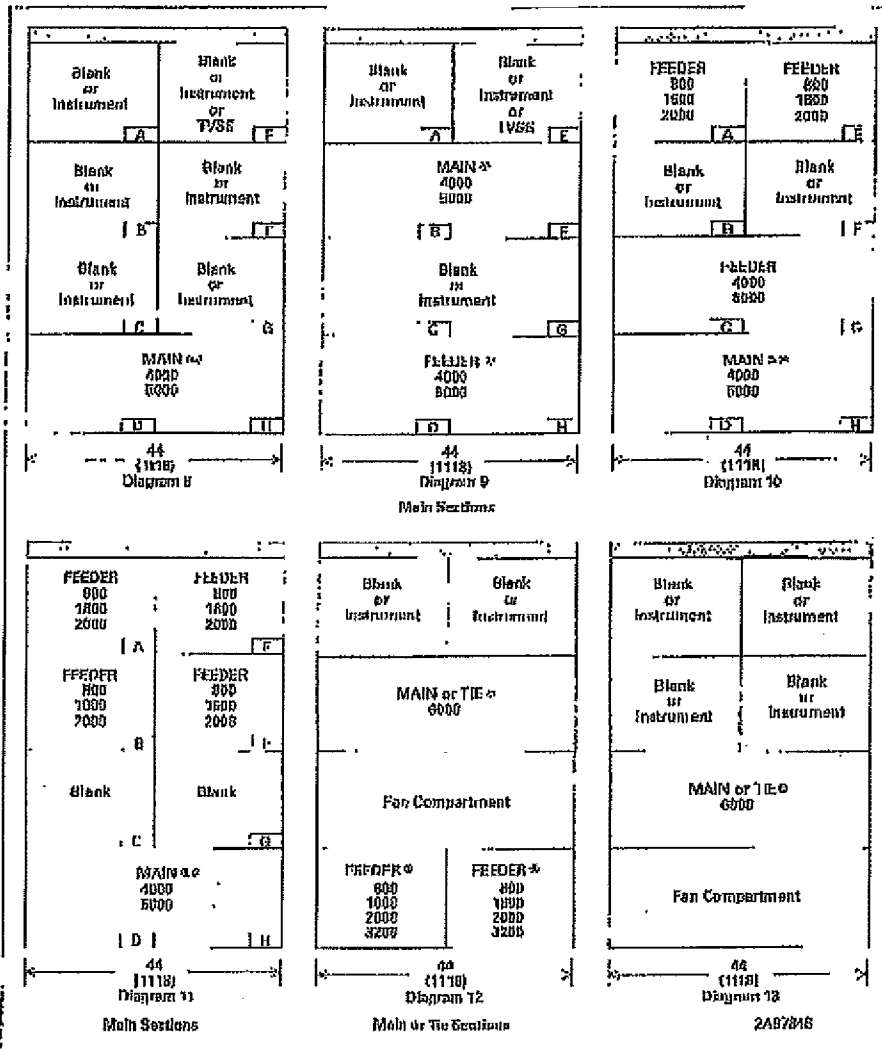


Figure 23. Breaker Arrangements (continued)

See Page 35 for footnotes.

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Application (Continued)

Breaker Arrangements (Continued)

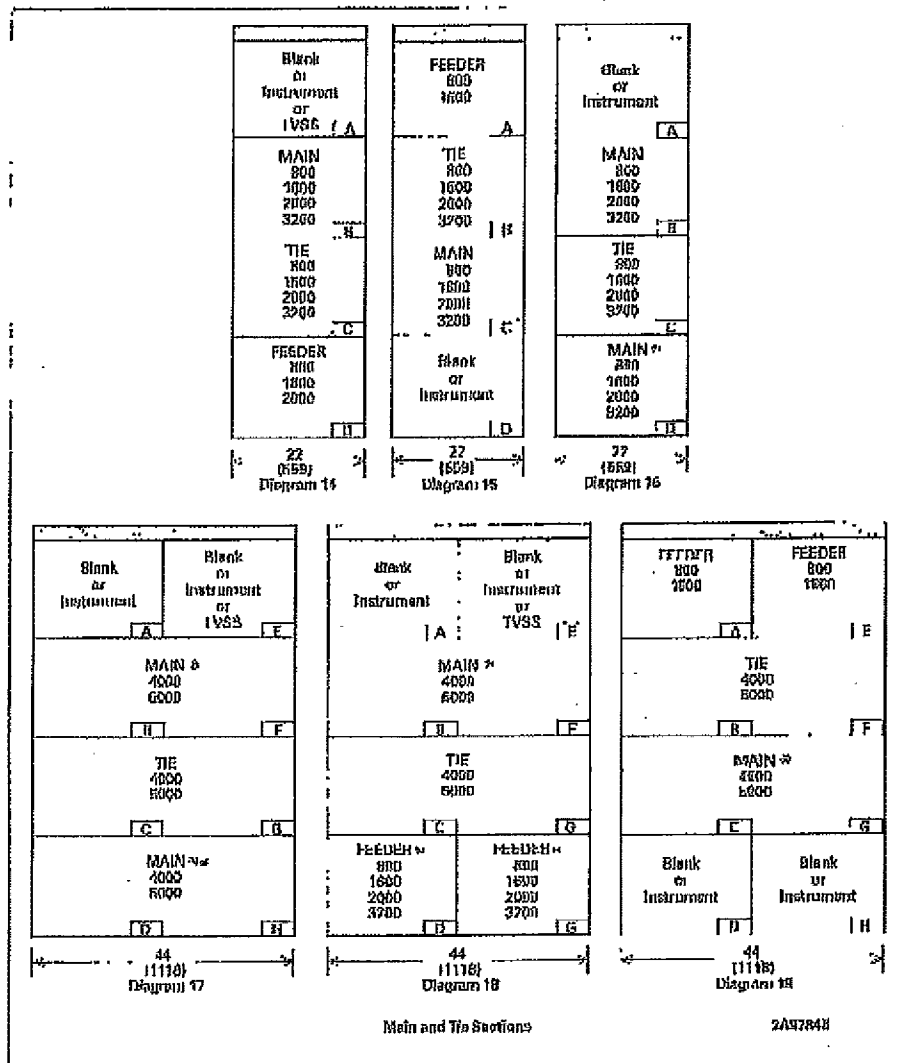


Figure 25. Breaker Arrangements (continued)

See Page 35 for footnotes.

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Application (Continued)

Breaker Arrangements (continued)

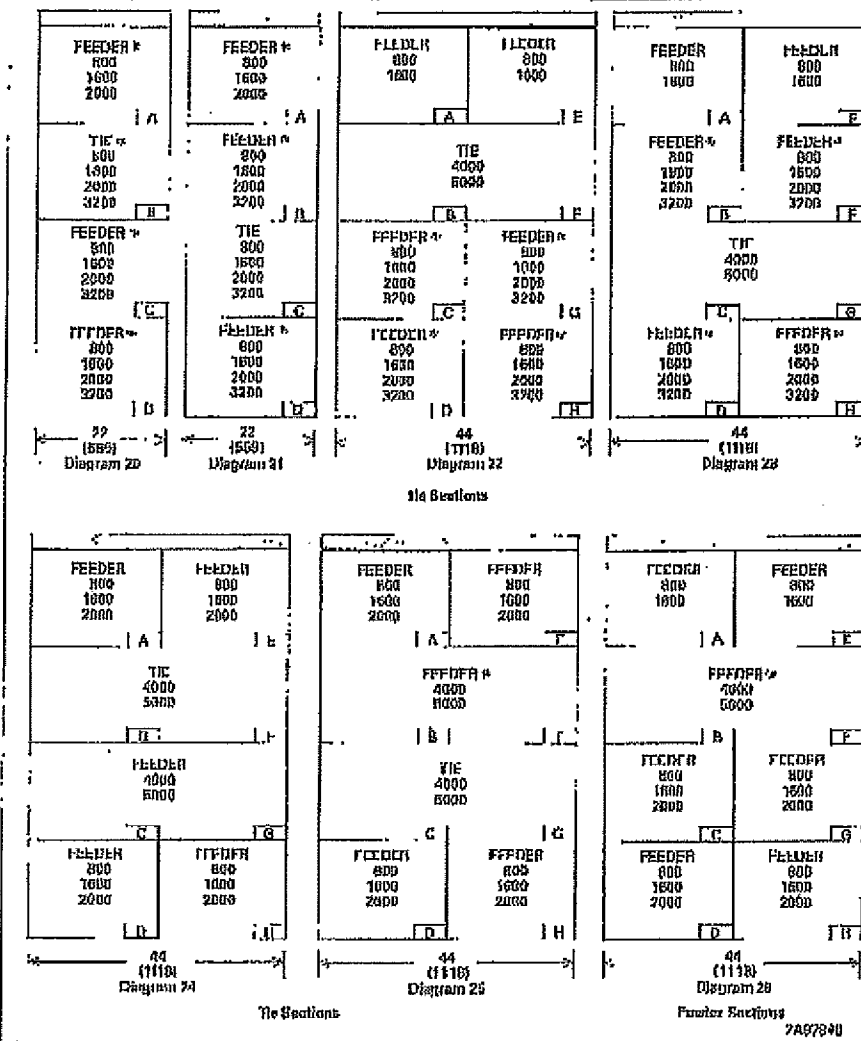


Figure 25. Breaker Arrangements (continued)

See Page 35 for footnotes.

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Application (Continued)

Breaker Arrangements for 3.5's

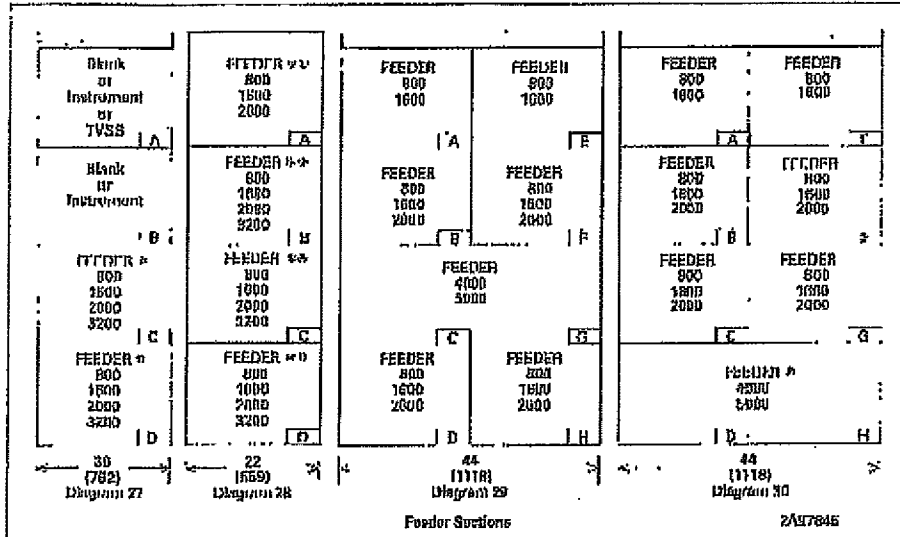


Figure 25. Breaker Arrangements (continued)

Breaker Arrangement Footnotes

1. Maximum (standard) indoor shipping condition width for 6 vertical sections of 120 inches (3048 mm), while never to exceed. Maximum (standard) outdoor shipping width is 84 inches (2133 mm) including side doors, any transformer connections, etc.
2. All vertical sections are 82 inches (2083 mm) high plus 4 inches (102 mm) for vent lines and non removable lifting eyes. When a top of gear breaker door is used, height is 80 inches (2032 mm) high.
3. When bus doors and the bus structure are required, the depth of the bus may increase and vertical stacking may be affected. Refer to the Cutler-Hammer handbook.
4. Vertical section bus is sized per main bus bar maximum rating or by ANSI C2/30.7 section 2.4.1.1 (Table 1) to a maximum of 5000 ampere.

5. Any compartment can be a blank or 22-inch (559 mm) wide (standard) configuration with the following exceptions: A 44-inch (1118 mm) wide instrument compartment must be adjacent to another 44-inch (1118 mm) wide compartment or the only 44-inch (1118 mm) wide compartment in the enclosure.
6. Confirm that there is sufficient (vertical) space for all layout configurations.
7. A transition section is required descending to a non-enclosed dry-type transformer or auxiliary and oil-filling devices are to be located in a transition section or there is a bus pump breaker required or there is a main sequence ground fault required.
8. A maximum of 12 3200 ampere breakers are permitted per 22-inch (559 mm) width of enclosure, one of which must be a main or tie. A 3200 ampere frame breaker cannot be mounted in the same enclosure with a 2400 ampere main or tie. For a 3200 ampere frame breaker mounted in the same enclosure with a 2400 or 1600 ampere main or tie, contact the Cutler-Hammer business.
9. Ground mounted main breakers are not permitted in the "D" position.

10. Except for the Cutler-Hammer busways for 2000 ampere busway breakers in the compartment.
11. A maximum of 12 2000 ampere breakers per 22-inch (559 mm) width of enclosure. If there are multiple positions "A," "B," and "D" must be used.
12. If you have 4 wire position and service entrance replacement, busway connection or cable connection, the bus or cables must enter from the top.
13. Service entrance option is not available with feeder breakers mounted in the structure.
14. If you have 4 wire service entrance replacement, busway connection or cable connection, the bus or cables must enter from the bottom.
15. Busway or cable entrance must be 100% top up.
16. "B" and "D" position breakers must be reverse fed.
17. Subject to your elevation drawing if the equipment is to be attached to the breaker.

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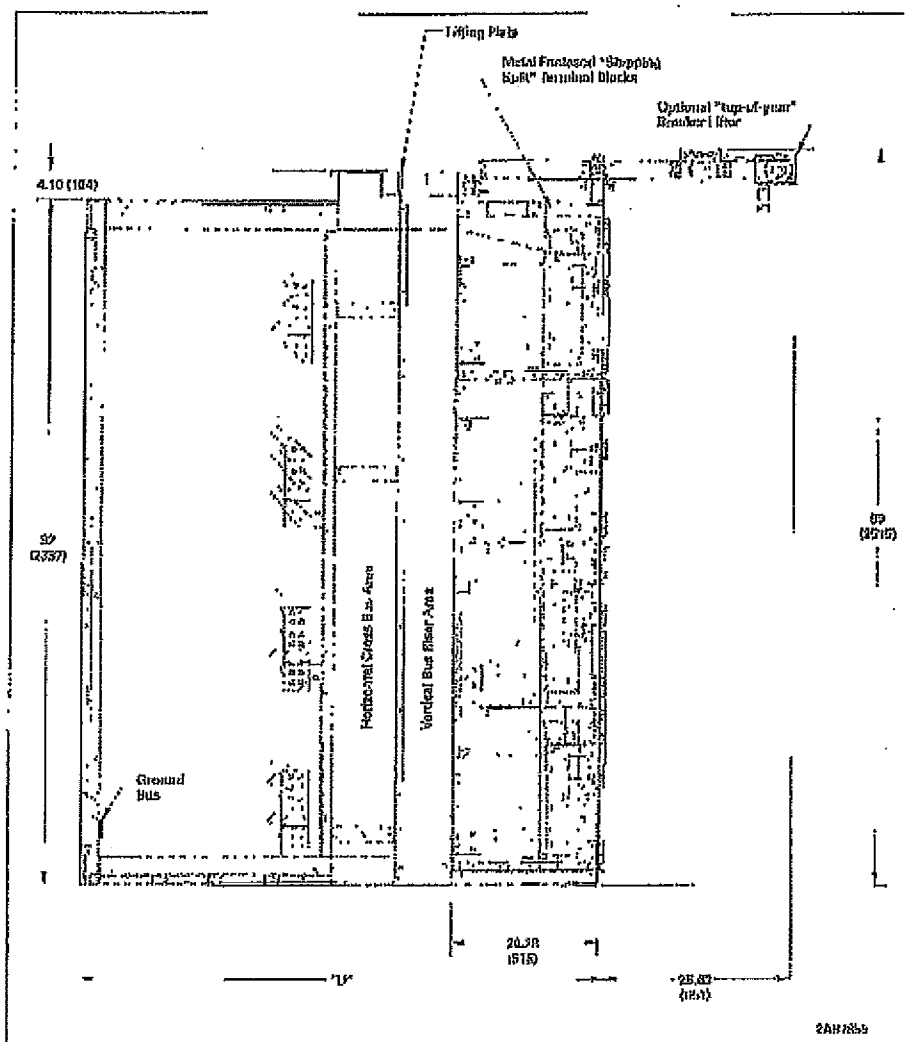


Figure 2A. Section View of Typical Structure - Dimensions in inches (mm)

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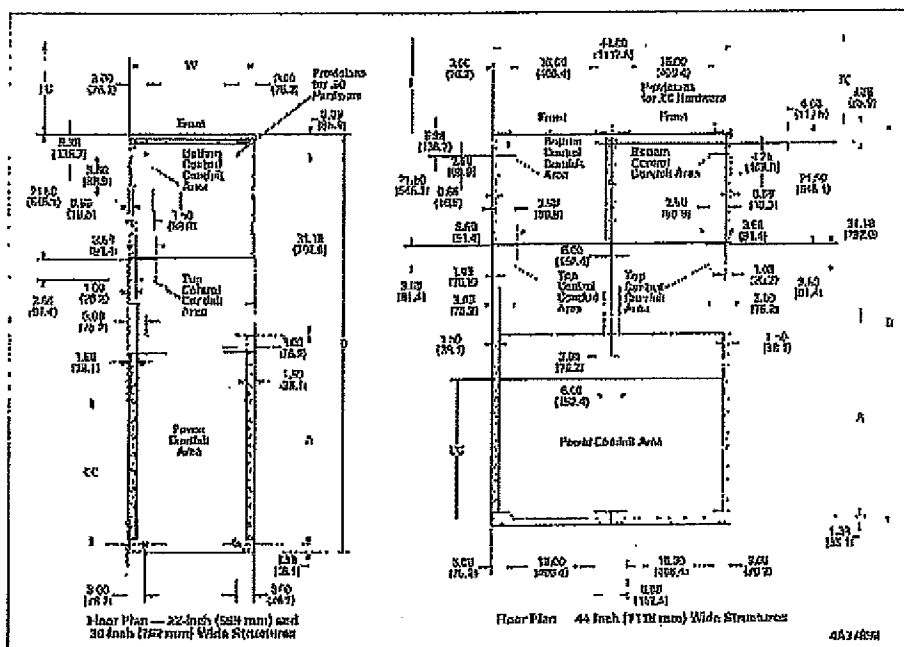


Figure 27. Floor Plans—Dimensions in inches (mm)

Table 10. Dimensions in inches (mm)

FE-10	W	H	A	CE-10	Recommended Number of Power Poles (Maximum)	FE-10
35 (914.4)	22 (559.1)	84 (1371.0) 80 (1524.0) 68 (1676.4) 58 (1473.2) 48 (1219.2) 38 (965.1)	18 (457.2) 20 (508.0) 22 (558.8) 24 (609.6) 26 (660.4) 28 (711.2)	7.8 (198.1) 13.3 (337.8) 10.3 (261.7) 26.3 (667.6) 31.3 (794.0) 37.3 (947.9)	8 8 12 12 16 21	8 8 12 12 16 21
28 (711.4)	20 (508.0)	84 (1371.0) 80 (1524.0) 68 (1676.4) 58 (1473.2) 48 (1219.2) 38 (965.1)	18 (457.2) 20 (508.0) 22 (558.8) 24 (609.6) 26 (660.4) 28 (711.2)	7.8 (198.1) 13.3 (337.8) 10.3 (261.7) 26.3 (667.6) 31.3 (794.0) 37.3 (947.9)	4 8 12 16 20 24	4 8 12 16 20 24
25 (635.0)	18 (457.2)	84 (1371.0) 80 (1524.0) 68 (1676.4) 58 (1473.2) 48 (1219.2) 38 (965.1)	18 (457.2) 20 (508.0) 22 (558.8) 24 (609.6) 26 (660.4) 28 (711.2)	7.8 (198.1) 13.3 (337.8) 10.3 (261.7) 26.3 (667.6) 31.3 (794.0) 37.3 (947.9)	4 8 12 16 20 24	4 8 12 16 20 24

- 1. TC is the recommended front clearance for breaker removal with top-of-switchgear-mounted breaker. If a portable breaker is to be used, allow at least 64 inches (1626 mm) of clear space.
- 2. Breaker not shown with 1.25 inches (31.75 mm) of clear space.
- 3. Hot hole location for removing the switchgear element when required. Floor channels are included.
- 4. When a non-suspension ground fault (GFI) is required on the side of the cable, it is located within 10 inches (254 mm) of the cable.
- 5. For availability for bus duct connection, specify the Cutler-Hammer bus duct.
- 6. Sub-panel 2 inches (50.8 mm) minimum in power cable area, 1 inch (25.4 mm) minimum in control wiring area.

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Application (Continued)

Center of Gravity Location

For seismic calculations, the following dimensions should be used to locate the center of gravity for indoor Magnum DS Switchgear.

Table 15. Center of Gravity Location

Axis	Position
X (Center)	60 inches (1524 mm)
Y (48-in.-High)	Center of Lineup
Z (From the Front)	20 inches (508 mm)

Table 16. Heat Loss Data¹

Estimated Heat Loss Per Breaker (Watts)		
Breaker Range	Fixed Mounting	Drawout Mounting
150	181	150
1500	350	320
2000	172	214
3200	358	719
4000	377	749
5000	408	1000
6000	4	6

¹ For lower than maximum load currents, heat loss may be calculated by reducing the full load loss by the following:

$$W_L = I_L^2 R_L^2 W_{FL}$$

Where:

- W_L = Load Watts
- W_{FL} = Full Load Watts
- I_L = Actual Load Current
- I_{FL} = Full Load Current

² Consult the Cutler Hammer business.

Table 17. Estimated Heat Loss (Watts)

Breaker	Vertical Bus	Ground Bus
2000	410	228
3200	1523	1153
4000	1867	1150
5000	2110	838
6000	9	1285
8000	—	0
10,000	—	0

¹ For lower than maximum load currents, heat loss may be calculated by reducing the full load loss by the following:

$$W_L = I_L^2 R_L^2 W_{FL}$$

Where:

- W_L = Load Watts
- W_{FL} = Full Load Watts
- I_L = Actual Load Current
- I_{FL} = Full Load Current

² Consult the Cutler Hammer business.

Table 18. Magnum DS Indoor Switchgear Structure Approximate Weights (Less Breakers)

Structure Type (Notes 1 and 2)	Structure Depth in inches (mm)					
	60 (1524.0)	66 (1678.4)	72 (1828.8)	78 (1981.2)	84 (2133.6)	90 (2286.0)
22 (558.8)	1750	1307	1350	1400	1450	1500
30 (762.0)	(458)	(500)	(612)	(640)	(680)	(800)
30 (762.0)	1770	1770	1840	1900	1950	2000
30 (762.0)	(772)	(800)	(832)	(860)	(890)	(920)
34 (863.6)	2000	2000	2700	2800	2900	3000
34 (863.6)	(1130)	(1130)	(1220)	(1271)	(1317)	(1362)
42 (1066.8)	850	1000	1050	1100	1150	1200
42 (1066.8)	(421)	(650)	(677)	(693)	(722)	(749)
42 (1066.8)	435	500	520	550	570	600
42 (1066.8)	(216)	(254)	(267)	(280)	(288)	(305)
42 (1066.8)	830	1000	1050	1100	1150	1200
42 (1066.8)	(421)	(650)	(677)	(693)	(722)	(749)
50 (1269.6)	1500	1625	1650	1675	1700	1725
50 (1269.6)	(725)	(773)	(773)	(773)	(773)	(773)
50 (1269.6)	1600	1675	1700	1725	1750	1775
50 (1269.6)	(773)	(773)	(773)	(773)	(773)	(773)

Table 19. Magnum DS Breaker Weights—Lbs (Kgs) *

Breaker	Fixed	Drawout
M15-400	110 (50)	120 (55)
M15-600	110 (50)	120 (55)
M15-800	120 (55)	140 (65)
M15-1000	120 (55)	140 (65)
M15-1200	120 (55)	140 (65)
M15-1400	120 (55)	140 (65)
M15-1600	120 (55)	140 (65)
M15-1800	120 (55)	140 (65)
M15-2000	120 (55)	140 (65)
M15-2200	120 (55)	140 (65)
M15-2400	120 (55)	140 (65)
M15-2600	120 (55)	140 (65)
M15-2800	120 (55)	140 (65)
M15-3000	120 (55)	140 (65)
M15-3200	120 (55)	140 (65)
M15-3400	120 (55)	140 (65)
M15-3600	120 (55)	140 (65)
M15-3800	120 (55)	140 (65)
M15-4000	120 (55)	140 (65)
M15-4200	120 (55)	140 (65)
M15-4400	120 (55)	140 (65)
M15-4600	120 (55)	140 (65)
M15-4800	120 (55)	140 (65)
M15-5000	120 (55)	140 (65)
M15-5200	120 (55)	140 (65)
M15-5400	120 (55)	140 (65)
M15-5600	120 (55)	140 (65)
M15-5800	120 (55)	140 (65)
M15-6000	120 (55)	140 (65)
M15-6200	120 (55)	140 (65)
M15-6400	120 (55)	140 (65)
M15-6600	120 (55)	140 (65)
M15-6800	120 (55)	140 (65)
M15-7000	120 (55)	140 (65)
M15-7200	120 (55)	140 (65)
M15-7400	120 (55)	140 (65)
M15-7600	120 (55)	140 (65)
M15-7800	120 (55)	140 (65)
M15-8000	120 (55)	140 (65)
M15-8200	120 (55)	140 (65)
M15-8400	120 (55)	140 (65)
M15-8600	120 (55)	140 (65)
M15-8800	120 (55)	140 (65)
M15-9000	120 (55)	140 (65)
M15-9200	120 (55)	140 (65)
M15-9400	120 (55)	140 (65)
M15-9600	120 (55)	140 (65)
M15-9800	120 (55)	140 (65)
M15-10000	120 (55)	140 (65)

* Manually or electrically operated. For approximate impact weight, add 50% of breaker weight.

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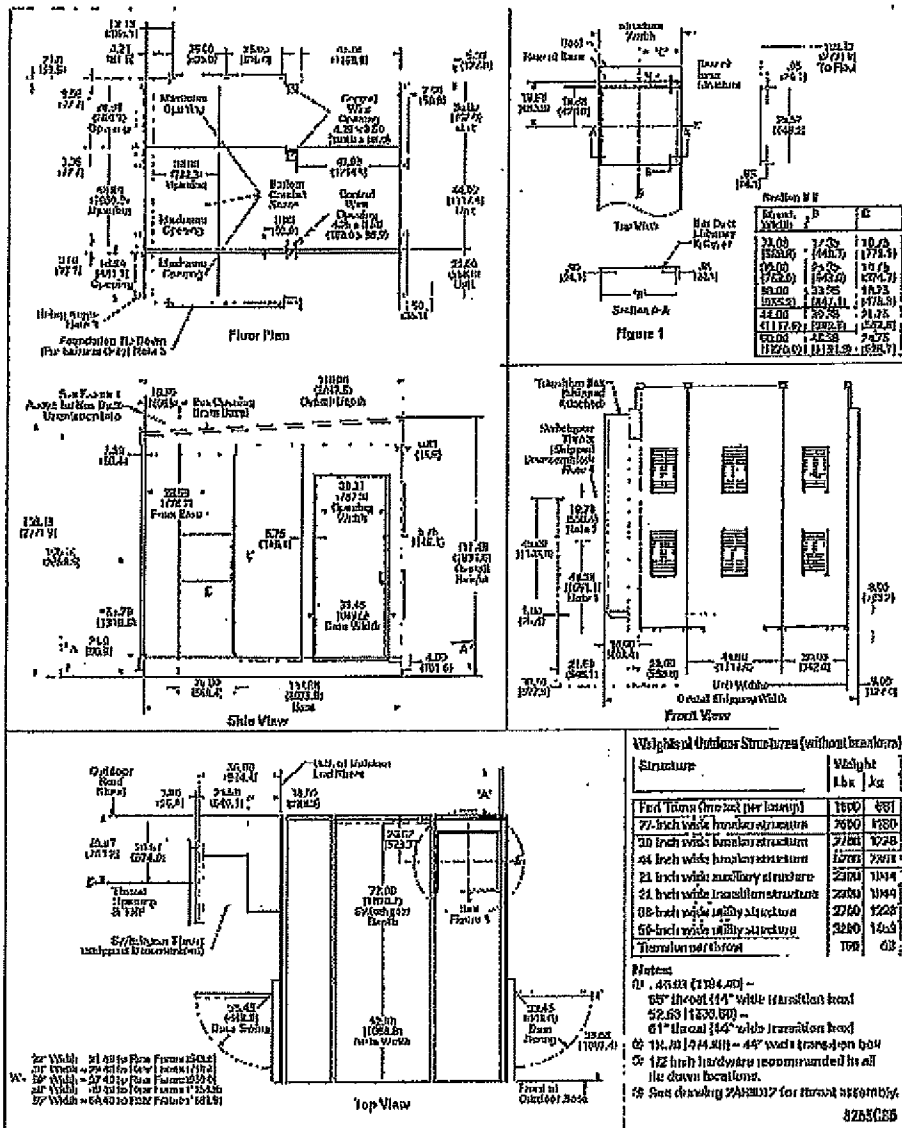


Figure 2A, Outdoor Structure Dimensions in inches (mm)

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Features

Structure

Standard Finish

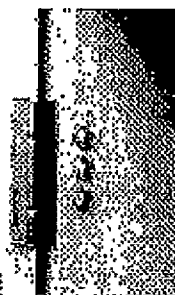
Gray paint finish (AMT 55) using a modern computerized automatic and continuously monitored electrostatic powder coating. This computerized monitored system includes spray de-grime and clean, spray primer, iron phosphate spray coating, epoxy resin, non-chemical seal, oven drying, electrostatic powder spray paint coating and oven curing.

Integral Base

The rugged formed base greatly increases the rigidity of the enclosure and reduces the possibility of damage during the installation of the equipment and is suitable for rolling, locking and handling. A lifting angle is permanently welded into the bus compartment structure for increased strength.

Heavy Duty Door Hinges

Each breaker door is mounted with hinge pins. Removal of the door is easily accomplished by just lifting the hinge pin. This allows easy access to the breaker internal compartment for inspection and maintenance.



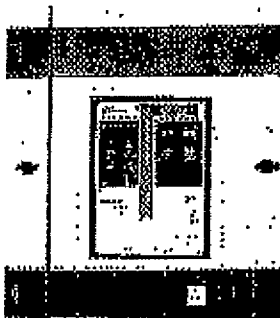
Heavy Duty Hinge Pins

Door Cover/Flaps

In Magnum DS Switchgear standard rear covers with captive hardware are the bolt-on type. They are split into two sections to facilitate handling during removal and installation. Optional rear doors are also available.

Through the Door Design

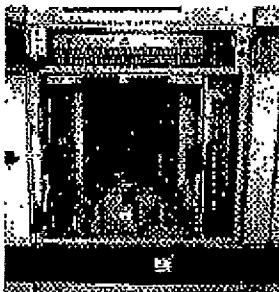
The following functions may be performed without the need to open the circuit breaker door: levering the breaker between positions, operate manual charging system and view the spring charge status flag, close and open breaker, view and adjust trip unit and read the breaker rolling namplate.



Through-the-Door Design

Front Accessible

When the door is open or removed, each breaker compartment provides front access to isolated, vented busways, primary disconnects, rail circuit transformers and other breaker compartment accessories for ease of field wiring and trouble shooting field connections.



Breaker Cell

Four Position Drawout

Breakers can be in connected, test, disconnected or removed position. The breaker compartment door can be closed in the connected, test and disconnected positions.

Closing Spring Automatic Discharge

Mechanical interlocking automatically discharges the closing springs when the breaker is removed from the compartment.

Optional Safety Shutters

Positive safety shutters which isolate the breaker compartments to the main bus when the breaker is withdrawn from the cell is an option offered for additional safety beyond our standard design. Insulating covers ("boots") are furnished on live main stationary disconnecting contacts in compartments equipped for future breakers.

Breaker Inspection

When withdrawn on the rails, breaker is completely accessible for visual inspection; tilting is not necessary. The rails are permanent parts of every breaker compartment.

Interference interlocks are supplied on breakers and in compartments where the compartments are of the same physical size to ensure no incorrect breaker cannot be inserted.

Key Interlock (Switchgear Mounted)

Breaker can be stored in compartment, and completely removed for maintenance or for use as a spare without disturbing the interlock. No modification of the breaker required. This mechanism holds the breaker mechanically trip-free to prevent electrical or manual closing. An additional simple cylinder breaker mounted key interlock is also available as an option.

Optional Mechanical Interlock

Available between adjacent breakers.

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CUTLER HAMMER LV MAGNUM DS TECHNICAL DATA

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Features (Continued)

Bus

Bus and Connections

Vertical and cross bus ratings in Magnum DS Switchgear are based on a UL and ANSI standard temperature rise of 65°C above a maximum ambient air temperature of 40°C.

Bus Ampacity

Vertical and cross bus ratings in Magnum DS are 2000, 3200, 4000, and 6000 amperes. In addition, 5000, 6000 and 10,000 ampere cross bus ratings are available.

Bus Wiring

Unique vertical bus configuration provides an optional industry leading short circuit withstand rating of 200,000 amperes without the need for pre-arcing current limiting fuses. Standard wiring is 100,000 amperes. The "U" shaped bar is the heart of the Magnum DS vertical bus. This configuration provides a much higher mechanical strength. To further demonstrate the strength and rigidity of this bus system, it has been verified through testing to withstand 85,000 amperes short circuit for a full 60 cycles.

Silver Plating

Bolted, silver-plated copper main buses are standard. The plating is over the entire length of the bar, not just at the joints. Optional tin plated copper buses are available.

Bus Joints

All joints are bolted and secured with Belleville-type spring washers for maximum joint integrity. These washers reduce the potential of joint hardware loosening during the change of joint temperature associated with variations of the loads.

Full Neutral

For 4-wire applications, the neutral bus is rated 100% of main bus rating as a standard, up to a maximum ampere rating of 6000 amperes.

Ground

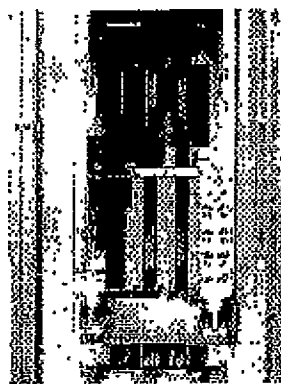
A ground bus is furnished the full length of the switchgear assembly and is fitted with terminals for purchaser's connections.

Glass Reinforced Polyester and Ultramid® Stand-Off Insulation System

Glass reinforced polyester has been used on both low and medium voltage switchgear for decades. By combining this industry proven material with Ultramid insulation, a total system providing exceptional mechanical and dielectric withstand strength, as well as high resistance to heat, flame, and moisture, is produced. Substantial testing to demonstrate mechanical effects of heating and cooling on the mechanical and dielectric properties of this system proven to provide superior performance for decades of trouble-free operation.

Optional Conductor Insulation Covering

For applications requiring additional bus protection in harsh environments, Magnum DS Switchgear is designed for the addition of optional conductor insulation covering. In addition to providing full UL air clearance without insulation. This material is applied during the assembly of the bus and covers all vertical and horizontal phase bus bars. Removable boots provide access to service-to-earthing bus joints for inspection and maintenance purposes.



Optional Insulated Bus

Barriers

Optional grounded metal barriers isolate the main bus and connections from the cable compartment providing added safety to the workers while reducing the potential of objects falling into the bus compartment.

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Wiring

Cable Compartment

The cable compartment gives ample room for terminating the power cables. Removable top roof sheets allow for easy conduit bulk installation. The floor of the cable compartment is open to allow cable entry from under ground duct banks. Optional floor plates are available.

Optional grounded metal barriers isolate the main bus and connections from the cable compartment, as well as optional barriers to separate adjacent cable compartments.

In addition to cable, Power-A-Way Busway (not recommended) bus duct can be terminated in the compartment.

Lug Pad

The lugs are located on the breaker run-backs to accommodate lug orientations at a 45° angle to reduce the bending radius of the cable needed for making the connections, thus reducing installation and maintenance time. Mechanical screw type lugs are standard. Optional NEMA 2 hole compression lugs are available as an option.

Control Wireway

An isolated vertical wireway is provided for routing of factory and field wiring in each switchgear section. Breaker secondary terminal blocks are mounted as standard above each circuit breaker. The terminal blocks are rated 30 amperes and will accept five wire, ring or spade terminals for wire size ranges of #22 to #14. Extended loops are punched in side sheets of the vertical wireway to allow routing of customer control wiring without the use of adhesive wire anchors.

For applications involving excessive wiring, or nonstandard terminal blocks, terminal blocks are mounted on the rear frame with the power cables where they are readily accessible for wire-to-wire connections and inspection.



Control Wireway

Control Wire

Standard wire is Type SIS insulated stranded copper, extra flexible No. 18 AWG minimum.

Control Wire Marking

Each wire is imprinted with ink coded under ultraviolet light for durability and for easy identification by the user. The enhanced solvent resistance and durability of the aerospace grade UV cure ink has been tested for severe environments. The imprinting is made periodically along the length of the wire, with the ends being imprinted more frequently. The point of origin, wire designation and point of destination are imprinted in the following format: `<origin zone>wire name/destination zone>`. Each device has a uniquely designated zone. "A" indicates the direction of the wire origin and "D" indicates the direction of the wire destination. As an option, wire marking can be made utilizing sleeve type or heat shrink sleeve type.

Secondary Terminal Compartment Door

The customer's secondary terminal connections are located behind a separate door providing access to these connections without the need to open the breaker compartment door.

Short Circuiting Terminal Blocks

One provided for each set of instrumentation or relaying application current transformers.

Shipping Split Connection

At each shipping split, the control connections are made with plug in terminal blocks rated 600 volts, 30 amperes. The terminal blocks interlock mechanically without removing the live or load connections. This method of making the shipping split control connections increases the speed of installation and reduces the potential of incorrect connections.

Control Wire Marking

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Instrumentation/Metering

Flexibility

Magnum DS Switchgear allows for a variety of metering options:

- Analog switchboard type meters such as ammeters, voltmeters, wattmeters, power factor, etc.
- Electronic power metering such as the IQ family of Analyzers, DI-4000, etc.
- Instrument door mounted meters. For feeder circuit instrumentation, 2% accuracy ammeters and ammeters for switches can be mounted on the existing switch compartment door. This improves the breaker compartment doors. The ammeters and switches are immediately associated with definite breaker circuits. Other devices, such as control pushbuttons, breaker control switches, indicating lights, and test switches can be mounted on these panels, within space limitations.

Voltage Transformers

Voltage transformers are rated 10 kV BIL and are protected by both primary and secondary fuses. The primary fuses are of the current limiting type.

Current Transformers

Current transformers for metering and instrumentation are mounted in the breaker compartments and are front accessible. Secondary wiring between the current transformer and the standard shunting terminal block is color-coded for ease of identification.

Control Power Transformers

Control transformers are provided when required for the control of circuit breakers, space heaters, and/or transformer fans. Like voltage transformers, they are protected by current limiting primary fuses. Non-current limiting fuses are used on the secondary side to protect branch circuits.

Instrumentation — Door Mounted

Secondary Terminal Compartment Door Devices, such as control pushbuttons, breaker control switches, indicating lights, and test switches can be mounted on these panels, within space limitations. The ammeters and switches are immediately associated with definite breaker circuits.

Instrument Compartment Door Devices, such as electronic power metering and analog switchboard type meters that do not fit on the secondary terminal compartment door, are mounted on the instrument compartment door or on the panel of a blank cell.



Devices Mounted on Secondary Terminal Compartment Door



Devices Mounted on Instrument Compartment Door

Accessories and Options

Switchgear Accessories

Standard accessories furnished with each Magnum DS Switchgear assembly include:

- One breaker lowering track.
- Insulating covers or "boots" are furnished on the main stationary disconnector contacts in compartment main aisles for future breakers.
- Removable cover to block opening in the door when the breaker is temporarily removed from its compartment.

Optional Accessories

- Traveling type circuit breaker lifter, roll mounted on top of switchgear.
- Full running portable circuit breaker lifter and transfer truck with manual lifting mechanism. This requires approximately 24 inch (2134 mm) deep front aisle space.
- Test cabinet for electrically operated breakers, with pushbuttons, control coils and receptacles, for separate mounting.
- Portable test kit for secondary injection testing and verification of trip coils. Utilizes standard 120 volt, 15 ampere, single-phase, 60 Hz supply, available from any outlet.
- Additional removable cover to block opening in the door when breaker is temporarily removed from its compartment.
- Removable insulating boots over power cable lug adapters.



Optional Switchgear Mounted Lifter

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Features (Continued)

Breaker

Contacts

The Magnum DS has silver tungsten moving contacts and silver graphite stationary contacts. The contacts provide a long-wearing, low resistance joint. The contacts are protected from arcing damage even after repeated interruptions by the "hard-toe" action which causes the integral arcing contacts to ride before the main contacts part. The arcing contacts then part last, striking the air away from the main contacts.

The main contacts are of the butt type and are composed of a multiplicity of fingers to give many points of contact without alignment being critical.



Magnum DS High-Voltage Contacts
(Arc Chutes Removed)

Stored-Energy Mechanism

A cam-type closing mechanism closes the breaker. It receives its energy from a spring that can be charged by a manual handle on the front of the breaker or by a universal electric motor.

Release of the stored energy is accomplished by manually depressing a button on the front of the breaker or electrically energizing a releasing solenoid.

Arc Chute

There are three basic ways of extinguishing an arc: lengthening the arc path; cooling by gas blast or conduction; deionizing or physically removing the conduction particles from the arc path.

The DE-ION® principle is incorporated in all Magnum DS circuit breakers. This makes possible faster arc extinction for a given contact travel, ensures positive interruption and minimum contact burning.

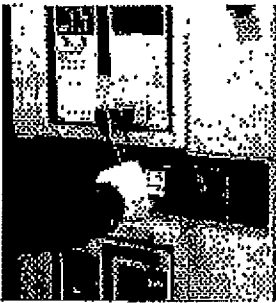
Levering Mechanism

The worm gear levering mechanism is self-contained on the breaker frame element and engages with the breaker compartment. A removable crank is used to lever the breaker between the connected, test and disconnected positions.

Mechanical interlocking is arranged so that levering cannot be accomplished unless the breaker is in the opened position.

Protection During Levering Operation

When levering the breaker between the connected, test and disconnected positions, the operator is protected from contact with live parts by the breaker door.



Levering Magnum DS Breaker

Two-Step Stored-Energy Closing follows the sequence required to charge and close the breaker.

1. The breaker closing springs are charged either through the manual-charging handle or by the optional charging motor. The breaker is mechanically interlocked to prevent closing of the breaker until the closing springs are fully charged.
2. With the closing springs fully charged, the breaker can then be closed by pressing the manual close pushbutton on the breaker, or by the optional spring release coil through a remote electrical signal.

This means that the energy required to open the breaker is always restored following a closing operation.

"Stored energy" in energy hold is waiting, ready to open or close the breaker within five cycles or less. The unique cam and spring design provides necessary energy for a single close-open sequence as well as the energy for multiple charge-close-open-close-open as this possible sequence; charge close-recharge-open-close-open.

The closing springs are interlocked with the breaker locking mechanism to insure the closing springs are fully charged before the breaker can be removed from the compartment.

Manually Operated Breakers

Manually operated breakers are equipped with a manual charging handle to charge the closing springs. Manual closing and tripping pushbuttons are utilized to operate the breaker. Remote closing and tripping can be accomplished by installing optional electric spring release and shunt trip coils (see Table 4 for available control voltages, currents and motor-operated spring charging times). The breaker closing springs must be charged manually, then remote closing and tripping signals can be sent to the breaker.

Electrically Operated Breakers

Electrically operated breakers are equipped with a spring charging motor and electrically operated spring release and shunt trip coils (see Table 4 for available control voltages, currents and motor-operated spring charging times). The breaker manual charging handle can be used to charge the closing springs when power is not available to the charging motor.

Provisions for Padlocking

All breakers include provision for padlocking open to prevent electrical or manual closing. This padlocking pin secures the breaker in the connected, test or disconnected position by preventing levering of the breaker.

Ease of Inspection and Maintenance

Magnum DS breakers are designed for maximum accessibility and the utmost ease of inspection and maintenance.

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Features (Continued)

Breaker

Magnum DS Switchgear — Trip Units

Digital RMS Trip Unit

The Digital RMS trip unit features a dependent curve that is depicted in the next page by a line shaded area of the trip curve. The dependent curve affords better protection flexibility. Additionally, all of the trip units have, as standard, thermal memory, 60/60 Hz operation, and thermal cut protection at 50°C.

Also, the 520M trip units have a large display window and 2% metering accuracy.

Digital RMS Integral Microprocessor-Based Breaker Overcurrent Trip Systems
Provides maximum reliability with trip time meeting as standard, gives excellent repeatability, and requires minimum maintenance. No external control source is required for its protective functions.

Trip Functions

Magnum DS trip units provide the maximum in flexibility and are available in the following configurations: LSI, LSI-G, LSI-A (ground fault alarm only). In each case, either the short delay or instantaneous trip (both) functions may be defeated. This reduces the need for spare breaker inventories and provides maximum utilization of interchangeable breakers.

Change in Trip Rating

The overcurrent trip pickup range is established by a combination of trip unit rating plug and limiting current window setting on the breaker.

Optional Breaker Attachments and Accessories

- A. Shunt trip on manually operated breakers, for any standard control voltage.
- B. Auxiliary contacts on manually or electrically operated breakers. Maximum of 6 normally open and 6 normally closed contacts (5 normally closed contacts on electrically operated breakers) are available on any breaker, manually or electrically operated. The contact rating is 10 amperes.

C. Compartment position switch, 4 or 8 Form C contacts, actuated by movement of drawout breaker from the connected position. Most common uses are for disconnect trip remote control circuits of electrically operated breaker, and for bypassing "U" interlocking auxiliary contacts when breaker is withdrawn from the connected position.

D. Undervoltage trip (see and see available). Acts to trip the breaker when the coil voltage is insufficient to restrain a spring-loaded core. The dropout point is within 30 to 60 percent of the nominal coil voltage and is not adjustable.

F. Overcurrent trip switch (OTS). A latching type switch with two independent Form C contacts. Operates only when the trip unit trips the breaker. It may be used for alarm and/or interlocking circuits. Resetting is done by a push-button on the breaker faceplate.

F. Electric close on manually operated breakers, for any standard control voltage. Breaker can be closed by remote control switch or pushbutton after the closing spring is manually charged.

G. Explosion cover.

H. Breaker mounted key interlock.

I. Second shunt trip coil in place of UVR coil.

TOPSIDE

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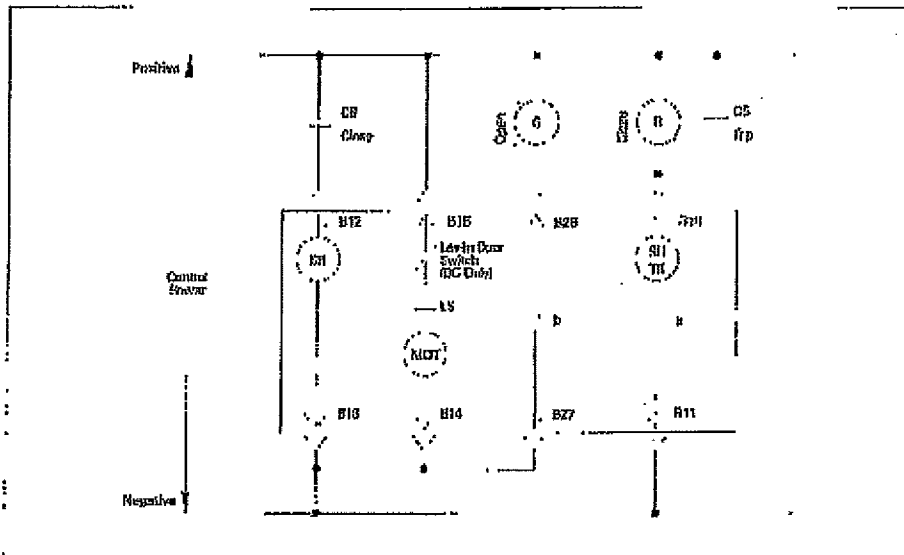


Figure 22. Typical Control Diagram for Magnum DS Electrically Operated Breaker

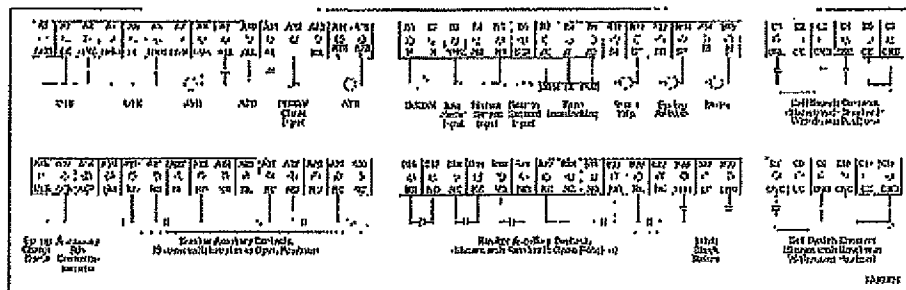


Figure 20. Magnum DS Switchgear Cell Secondary Contact Configuration

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Magnum DS Metal-Enclosed Low Voltage Switchgear

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Typical Specification

General

Magnum DS indoor low voltage metal-enclosed switchgear shall consist of a stationary structure assembly and one or more removable Magnum DS power circuit breakers complete with disconnecting devices and other necessary accessories. The switch gear shall be suitable for 601 volt maximum service and shall withstand a 220KV dielectric test in accordance with ANSI standards. It shall be designed, manufactured and tested in accordance with the latest applicable standards of IEEE, NEMA, ANSI, UL and CSA. Documentation of design testing shall be third party certified.

Secondary Structure

Each steel unit forming part of the stationary assembly shall be a self-contained housing having one or more individual breaker or instrument compartments, and a rear compartment for the buses and outgoing cable connections.

Frying slots shall be provided on the base of the structure for ease of positioning in equipment rooms.

A rigid integral steel base shall be provided for each section, which will allow movement of shipping groups directly on rollers without the need for a separate skid.

Each circuit breaker compartment shall be equipped with primary and secondary contacts, drawout extension rails, stationary latching mechanism pins, and required instrument current transformers. A formed steel dust, supported on concealed lingers with removable pins, shall be provided for each circuit breaker compartment. Access to the integral circuit breaker control panel, including the trip unit, shall be provided without the need to open the breaker compartment door. Closed-door spring latching and latching operations shall also be accomplished without the need to open the breaker compartment door.

The top of the unit shall be enclosed with removable steel sheets, which include necessary hooded ventilation openings. A separate removable access panel shall be provided for drilling of control conduit holes. A metal walkway with removable covers shall be provided for utility-type wiring. Pull-apart type terminal blocks shall also be provided for rigid, horizontal, shipping unit assembly. A metal-enclosed vertical walkway shall be

provided for routing of field installed control wiring.

The structure shall be so designed that future additions may readily be made at any time. The steel structure shall be thoroughly cleaned and pick plated prior to the application of the ANSI No. 87 finish.

A white, laminated, plastic engraved circuit designation nomenclature shall be provided on each circuit breaker door.

Buses and Connections

Each breaker circuit shall include the necessary three phase copper bus and connections between the source bus and one set of circuit breaker studs. NEMA 7-hole cable lugs, attached to a heavy-duty copper extension for the outgoing cables, shall be provided on the other set of circuit breaker studs. The buses and connections shall consist of high-conductivity (silver-plated) or plated copper bar mounted on heavy-duty supports, and having bolted joints. All bolted bus joints shall utilize Belleville type spring washers to maintain maximum joint integrity through continuous thermal cycling. The bus system shall be suitable for applications on power systems requiring a (100) (150) (200) kA short circuit withstand rating without upstream current limiting fuses.

Terminal blocks with integral-type barriers shall be provided for circuit breaker secondary circuits. The terminal blocks shall be front accessible through a hinged access panel above each circuit breaker.

All control wiring shall be securely fastened to the switchgear assembly without the use of adhesive wire supports. A dedicated wiring path shall be provided for purchaser's installed control wiring. Non-adhesive anchors shall also be provided for anchoring of purchaser's installed wiring.

Disconnecting Devices

The stationary part of the primary disconnecting devices for each circuit breaker shall consist of a set of contacts extending through a glass polyester insulating base. Buses and outgoing cable terminals shall be directly connected to them. The corresponding moving contacts shall consist of a set of contact fingers suitably spaced on the circuit breaker shaft. For ease of inspection and maintenance, contact fingers shall not be a permanent part of the stationary structure. In the "connected" position, these contacts shall form a current-

carrying bridge. The assembly shall provide a multitude of silver-to-silver high-pressure point contacts. High uniform pressure on each finger shall be maintained by springs. The entire assembly shall be full floating and shall provide ample flexibility between the stationary and moving elements. Contact engagement shall be maintained only in the "connected" position.

The secondary disconnecting devices shall consist of floating fingers mounted on the stationary unit and automatically engages contacts located at the front of the compartment. The secondary disconnecting contacts shall be silver plated to ensure permanence of contact. Contact engagement shall be maintained in the "connected" and "test" positions.

Removable Element

The removable element shall consist of a Magnum DS power circuit breaker equipped with the necessary disconnecting contacts and interlocks for drawout applications. The removable element shall have four position features and shall permit closing the compartment door with the breaker in the "connected," "test," and "disconnect" positions.

Power Circuit Breakers

The circuit breaker shall be Magnum DS, operating on the DE-IGN arc interruption principle. These breakers shall incorporate specially designed circuit interrupting devices that provide high interrupting efficiency and minimize the formation of arc flame and gases.

The primary contacts shall have an easily accessible wear indicator to indicate main contact erosion. The breaker closing time shall be no more than three cycles. Each breaker shall have three windows in the front cover to offer clear indication of trip and close electrical accessories mounted in the breaker. The breaker shall be equipped with "DE-IGN" arc chutes which effectively enclose the arcing contacts and confine the arc to reduce the disturbance caused by short circuit interruption. Each breaker shall be equipped with a position indicator, mechanically connected to the circuit breaker mechanism.

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Typical Specification (Continued)

Each breaker shall be equipped with a microprocessor-based, true rms sensing trip device. The adjustments shall be:

- Long delay pickup between 40% and 100% of the trip rating
- Long delay time between 2 and 24 seconds at 6 times trip rating
- Short delay pickup between 7 and 10 times long delay trip setting, short delay time between 0.1 and 0.5 seconds at 2.5 times short delay pickup. Short delay protection shall be defeatable, but only if instantaneous protection is activated. Both "I₁" and "I₂" protection shall be provided. (Optional) Zone Selective Interlocking Trip Units and necessary wiring within the switchgear shall be provided for each breaker indicated on the drawings.
- Instantaneous pickup between 2 and 12 times trip rating. Instantaneous protection shall be defeatable, but only if short delay protection is activated.
- (Optional) Ground fault pickup approximately 25% of sensor rating, and ground fault time between 0.1 and 0.5 seconds. Both "GFI" and "GFI" protection shall be provided. Pickup shall not exceed 1200A, regardless of circuit breaker maximum continuous rating. Ground fault shall be field adjustable for residual, zero sequence or average ground protection. Selectability shall be made in the circuit breaker control unit, not on the drawout element, to preserve the flexibility of interchangeability between power circuit breakers. (Optional) Zone Selective Interlocking Trip Units and

necessary wiring within the switchgear shall be provided for each breaker indicated on the drawings.

It shall be possible to test and verify the time and current characteristics and trip circuit by means of a portable plug in test device.

Both electrically operated and manually operated breakers shall have stored energy tripping mechanism. The device to release the breaker shall be by means of a mechanical push-button, which insures positive contact of the closing operation.

General

The switchgear assembly and circuit breakers shall be suitable for and certified to meet all applicable voltage requirements of (UBC) (The California Building Code) for 480V application. Guidelines for the installation, consistent with these requirements, shall be provided by the switchgear manufacturer and be based upon actual testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, (insert the following for UL: a peak of 0.78g, and a ZPA of 0.38g), (insert the following for IEC: a peak of 1.0g, and a ZPA of 0.45g). The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 30 Hz.

Factory Assembly and Tests

The switchgear shall be completely assembled, wired, adjusted and tested at the factory. After assembly, the complete switchgear control and instrumentation circuits shall be tested for operation under simulated service conditions to ensure the accuracy of the wiring and the functioning of the equipment.

The main circuits shall be given a dielectric test of 2200 volts for five minutes between live parts and ground and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one minute, or 1000 volts for one hour, between live parts and ground.

Note: An approval sketch and single line diagram should accompany the written specification.

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NEMA is the registered trademark and service mark of the National Electrical Manufacturers Association.

National Electrical Code and NEC are registered trademarks of the National Fire Protection Association, Quincy, Mass.

ISO is the registered trademark and sole property of the International Organization for Standardization.

Uniform Building Code (UBC) is a trademark of the International Conference of Building Officials (ICBO).

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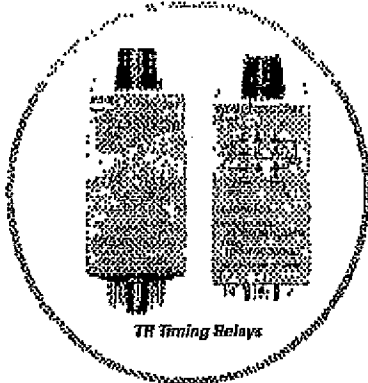
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CUTLER HAMMER PART# TRNB24AD

TR Series



Product Description

The upgraded TR Series Timing Relays are designed to meet most timing requirements by offering more flexibility in range of input voltage, timing range and functionality. Use a rotary switch to choose from 20 selectable time ranges from 0.1 second to 600 hours. We offer both a power triggered and signal triggered model each with expanded operation modes. There is a green LED to indicate when power is ON and an orange LED when output is ON.

Features

- 20 time ranges and 10 timing functions
- Time delays from 0.1 sec to 600 hrs.
- Space-saving, compact package
- High repeat accuracy of $\pm 0.2\%$
- LED indication
- Standard 8- or 11-Pin and 11-blade termination
- 2 Form C DPDT delayed output contacts
- 10A Contact Rating

Standards and Certifications



Technical Data and Specifications

Table 70. Contact Ratings

Item	Specification
Contact Configuration	2 Form C, DPDT (Delayed Output)
Alternate Voltage/Current	240V AC, 80V DC/10A
Max. Permissible Operating Frequency	1800 cycles per hour
Rated Load -- Resistive Inductive Horsepower Rating	10A, 240V AC/80V DC 7A, 240V AC/30V DC 1/8 hp 120V AC, 1/8 hp 240V AC
Life -- Electrical Mechanical	500,000 operations minimum (resistive) 50,000,000 operations minimum

Table 71. General Specifications

Item	Specification
Operation Type	Solid State CMOS Circuit
Time Range	0.1 sec to 600 hours
Function Delays	2 (IE60004-1)
Overvoltage Category	III (IE60064-1)
Rated Operational Voltage -- 240AC 24AC 12DC	100-240V AC (IE60011-1) 24V AC (UL6080 Hz)/24V DC 12V DC
Voltage Tolerances -- 240AC 24AC 12DC	85-264V AC (IE60011-1) 20.4-26.4V AC (UL6080 Hz)/21.6-26.4V DC 10.8-13.2V DC
Input OFF Voltage	Rated Voltage x 10% Minimum
Ambient Operating Temperature	-4 to 149°F (-20 to 55°C)
Hazel Life	100 mS maximum
Repeat Error	$\pm 0.2\%$, ± 20 mS
Voltage Error	$\pm 0.2\%$, ± 20 mS
Temperature Error	$\pm 0.2\%$, ± 20 mS
Settling Error	$\pm 10\%$ maximum
Insulation Resistance	100M ohm minimum (500V DC)
Dielectric Strength	Between power and output terminals Between contacts of different poles Between contacts of same pole
Vibration Resistance	10-561 Hz amplitude 0.5 mm; 2 hrs in each of 3 axes
Shock Resistance	Operating extremes
Damage Levels	TRNB, TRFB
Power Consumption (Approx.)	240AC 120V AC/60Hz 240V AC/60Hz 24AC (AC/DC) 12DC
Dimensions	TRNB, TRFB
Weight	TRNB, TRFB

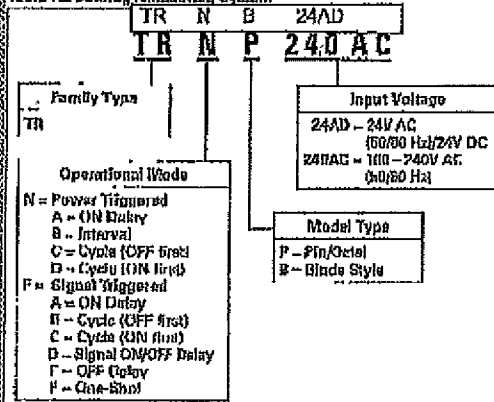
For the value of the error against a preset value, whichever value is larger should apply.

CATERPILLAR

CUTLER HAMMER PART# TRNB24AD

Catalog Numbering System

Table 78. Catalog Numbering System



Product Selection

When Ordering Specify

- Catalog Number of Timing Relay

Table 79. TB Plug-In Timing Relays

Cell Voltage	Order		Blade
	Catalog Number		Catalog Number
Power Triggered			
24V AC/DC	TRNP24AC		TRNB24AD
100 - 240V AC	TRNP240AC		TRNB240AC
Signal Triggered			
24V AC/DC	TRFP24AD		TRFB24AD
100 - 240V AC	TRFP240AC		TRFB240AC

CATERPILLAR®

CUTLER HAMMER PART# TRNB24AD

Operation

TRNP, TRNB

A: ON-Delay (Power Start)

Set timer for desired delay, apply power to coil. Contacts transfer after preset time has elapsed, and remain in transferred position until timer is reset. Reset occurs with removal of power.

Item	Terminal No.	Operation
Power	(1) 2-7 (2) A-B	
Delayed Contact	(1) 1-4, 5-8 (NC) (2) 1-7, 8-9 (NO)	
Indicator	PWR OUT	
Set Time		

B: Interval (Power Start)

Set timer for desired delay, apply power to coil. Contacts transfer immediately, and return to original position after preset time has elapsed. Reset occurs with removal of power.

Item	Terminal No.	Operation
Power	(1) 2-7 (2) A-B	
Delayed Contact	(1) 1-4, 5-8 (NC) (2) 1-7, 8-9 (NO)	
Indicator	PWR OUT	
Set Time		

C: Cycle 1 (Power Start, ON-First)

Set timer for desired delay, apply power to coil. First transfer of contacts occurs after preset delay has elapsed, after the next elapse of preset delay contacts return to original position. The timer may cycle between on and off as long as power is applied (Duty Ratio 1:1).

Item	Terminal No.	Operation
Power	(1) 2-7 (2) A-B	
Delayed Contact	(1) 1-4, 5-8 (NC) (2) 1-7, 8-9 (NO)	
Indicator	PWR OUT	
Set Time		

D: Cycle 3 (Power Start, ON First)

Functions in same manner as Mode C, with the exception that first transfer of contacts occurs as soon as power is applied. This ratio is 1:1. Time On - Time Off.

Item	Terminal No.	Operation
Power	(1) 2-7 (2) A-B	
Delayed Contact	(1) 1-4, 5-8 (NC) (2) 1-7, 8-9 (NO)	
Indicator	PWR OUT	
Set Time		

Notes: T=Set Time, T₁=Greater Than Set Time,
1=TRNP, 2=TRNB, 1A=TRFP, 1B=TRFB

Internal Connections

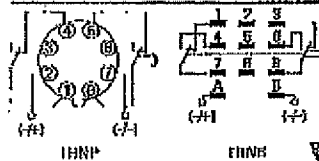


Figure 99, Operational Figures (1 of 2)

CATERPILLAR

CUTLER HAMMER PART# TRNB24AD

Accessories

Table B0. Sockets for Use with TR Timers — Standard Pack of 10

Timing Relay	Terminal Style	Catalog Number	
TRNP	14-16 Gage	D2PA2	
TRPB	14-16 Gage	D3PAS	
TRPB, TRPB	0.187" solid/OC terminals (Mata style)	D6PA2	

Dimensions

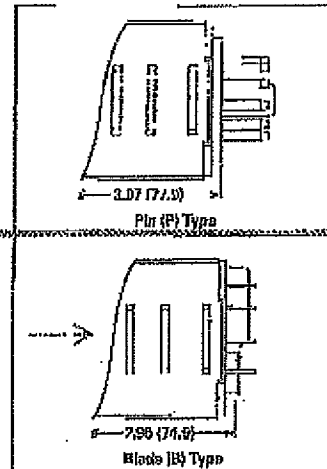


Figure 190. Approximate Dimensions in Inches (mm)

CATERPILLAR®

EATON PART# EM22LP2VB

EATON

March 2008

Pushbuttons & Indicating Lights 22.5 mm Heavy-Duty Watertight/Dirttight

E22 and EM22 Series, Twist-to-Release, Push-Pull and Key Release Components

Twist-to-Release, Push-Pull and Key Release Components

Table 47-46, Maintained Contact Mushroom Head Operators, Non-Illuminated UL (NEMA) Type 3, 3R, 4, 4X, 12, 18

Will Accept Maximum of 2 Contact Blocks (4 Circuits) When Used with Supplied 3-Way Adapter.			E22 Series — Plastic Operators		EM22 Series — Metal Operators		
			Color	Black Base Catalog Number	Chrome Base Catalog Number	Color	Chrome Base Catalog Number
Twist-to-Release — 29 mm Diameter Button (Push to Latch — Twist to Release)							
			Black	E22MLB1		Black	EM22ML1
			Red	E22MLB2		Red	EM22ML2
			Green	E22MLB3		Green	EM22ML3
			Yellow	E22MLB4		Yellow	EM22ML4
			Blue	E22MLB5		Blue	EM22ML5
Twist-to-Release — 40 mm Diameter Button (Push to Latch — Twist to Release)							
			Black	E22LLB1		Black	EM22LL1
			Red	E22LLB2		Red	EM22LL2
			Green	E22LLB3		Green	EM22LL3
			Yellow	E22LLB4		Yellow	EM22LL4
			Blue	E22LLB5		Blue	EM22LL5
Push-Pull — 40 mm Diameter Button (Push to Latch — Pull to Release)							
			Black	E22LPB1		Black	EM22LP1
			Red	E22LPB2		Red	EM22LP2
			Green	E22LPB3		Green	EM22LP3
			Yellow	E22LPB4		Yellow	EM22LP4
			Blue	E22LPB5		Blue	EM22LP5
Push-Pull — 60 mm Diameter Button (Push to Latch — Pull to Release)							
			Black	E22JPLB1		Black	EM22JPL1
			Red	E22JPLB2		Red	EM22JPL2
			Green	E22JPLB3		Green	EM22JPL3
			Yellow	E22JPLB4		Yellow	EM22JPL4
			Blue	E22JPLB5		Blue	EM22JPL5
			Red (Metal)	E22JLB2		Red (Metal)	EM22JLB2
Red (Metal) EMERGENCY STOP							
				E22JLB2NB			EM22JLB2NB
Key Release — 40 mm Diameter Button (Push to Latch — Turn Key to Release) Q5							
			Black	E22GB1		Black	EM22GB1
			Red	E22GB2		Red	EM22GB2
			Green	E22GB3		Green	EM22GB3

* For hybrid plates, use overmold plates, Catalog Numbers E22VA1, VA2 or VA3 listed on Page 47-74.

* To order a different key and lock assembly, add suffix B1, C1, D1, E1 or F1 to the end of the Catalog Number.

Notes: For Row of Panel Extensions, see Table 47-128 on Page 47-84.

CATERPILLAR



March 2008

Pushbuttons & Indicating Lights 22.5 mm Heavy-Duty Watertight/Oiltight

E22 and EM22 Series, Twist-to-Release, Push-Pull and Key Release Components

Twist-to-Release, Push-Pull and Key Release Components

Table 47-46, Maintained Contact Mushroom Head Operators, Non-Illuminated • UL (NEMA) Types 3, 3B, 4, 4X, 12, 13

Will Accept Maximum of 2 Contact Blocks (4 Circuits) When Used with Supplied 3-Way Adapter			E22 Series — Plastic Operators			EM22 Series — Metal Operators		
			Color	Black Bezel Catalog Number	Chrome Bezel Catalog Number	Color	Chrome Bezel Catalog Number	
			Twist-to-Release — 28 mm Diameter Button (Push to Latch — Twist to Release)					
			Black	E22MLB1	E22ML1	Black	EM22ML1	
			Red	E22MLB2	E22ML2	Red	EM22ML2	
			Green	E22MLB3	E22ML3	Green	EM22ML3	
			Yellow	E22MLB4	E22ML4	Yellow	EM22ML4	
			Blue	E22MLB5	E22ML5	Blue	EM22ML5	
			Twist-to-Release — 40 mm Diameter Button (Push to Latch — Twist to Release)					
			Black	E22LLB1	E22LL1	Black	EM22LL1	
			Red	E22LLB2	E22LL2	Red	EM22LL2	
			Green	E22LLB3	E22LL3	Green	EM22LL3	
			Yellow	E22LLB4	E22LL4	Yellow	EM22LL4	
			Blue	E22LLB5	E22LL5	Blue	EM22LL5	
			Push-Pull — 40 mm Diameter Button (Push to Latch — Pull to Release)					
			Black	E22LPB1	E22LP1	Black	EM22LP1	
			Red	E22LPB2	E22LP2	Red	EM22LP2	
			Green	E22LPB3	E22LP3	Green	EM22LP3	
			Yellow	E22LPB4	E22LP4	Yellow	EM22LP4	
			Blue	E22LPB5	E22LP5	Blue	EM22LP5	
			Push-Pull — 60 mm Diameter Button (Push to Latch — Pull to Release)					
			Black	E22JPLB1	E22JPL1	Black	EM22JPL1	
			Red	E22JPLB2	E22JPL2	Red	EM22JPL2	
			Green	E22JPLB3	E22JPL3	Green	EM22JPL3	
			Yellow	E22JPLB4	E22JPL4	Yellow	EM22JPL4	
			Blue	E22JPLB5	E22JPL5	Blue	EM22JPL5	
			Red (Metal)	E22JLB2	E22JL2	Red (Metal)	EM22JLB2	
			Red (Metal)	EMERGENCY STOP				
				E22JLB2NB	E22JL2NB		EM22JLB2NB	
			Key Release — 40 mm Diameter Button (Push to Latch — Turn Key to Release) (30°)					
			Black	E22GB1	E22G1	Black	EM22GB1	
			Red	E22GB2	E22G2	Red	EM22GB2	
			Green	E22GB3	E22G3	Green	EM22GB3	

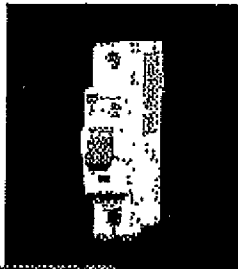
For legend plates and overlock plates, Catalog Numbers E22VA1, VA2 or VA3 listed on Page 47-74.

To order a different key and lock assembly, add suffix B1, C1, D1, E1 or F1 to the end of the Catalog Number.

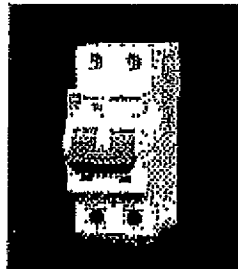
Note: For Base of Panel Installation, see Table 47-128 on Page 47-84.

CATERPILLAR

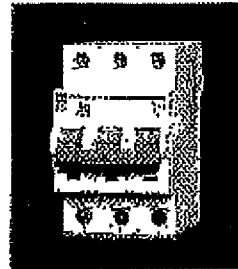
EATON PART# WMS1D40



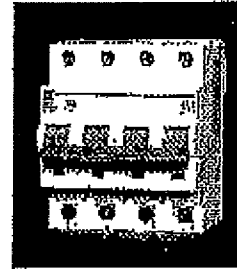
Single Pole



Double Pole



Triple Pole



Four Pole

Features

- Short Circuit Capacity: IEC 898, IEC 947-2
UL1077, CSA 236
- Voltage: 277/480Y Vac, 240/416 Vac
- Rating: 0.5 to 60 Amperes
- Poles: 1, 2, 3 and 4
- Module Width: 0.71 inches (18 mm)
- Magnetic Range: Curve B - 3 (I_n) to 5 (I_n)
Curve C - 5 (I_n) to 10 (I_n)
Curve D - 10 (I_n) to 20 (I_n)
- Connection Type: Cable, Ring Tong, Busbar (Fork & Pin)
- Cable Size: 14 to 6 AWG,
1 mm² to 25 mm²
- IP Rating: IP20
- Operating Temp: -5°C to 160°C
- Rated Insulation Voltage (U_i): 500 V
- Mounting: DIN RAIL 35 mm
- Handle Color: RAL7005 Gray
- Marking: CE, VDE, etc.
- UL File Number: E162898
- Weight Unpacked oz.(kg): 1P 2P 3P 4P
6 12.3 18.5 24.5
(.017) (.34) (.52) (.69)
- Carton Quantities 12 6 4 3

Short Circuit Capacity

Table 1 - IEC Ratings

Rating (A)	Curve	Voltage	Short Circuit Capacity (A)	
			IEC 898, I _{cn}	IEC 947-2, I _{cu}
0.5 to 5	C, D	240/416 V~	10,000	10,000
6 to 40	B, C, D	240/416 Vac	10,000	10,000
50 to 60	B, C	240/416 Vac	10,000	10,000

Table 2 - UL/CSA Ratings

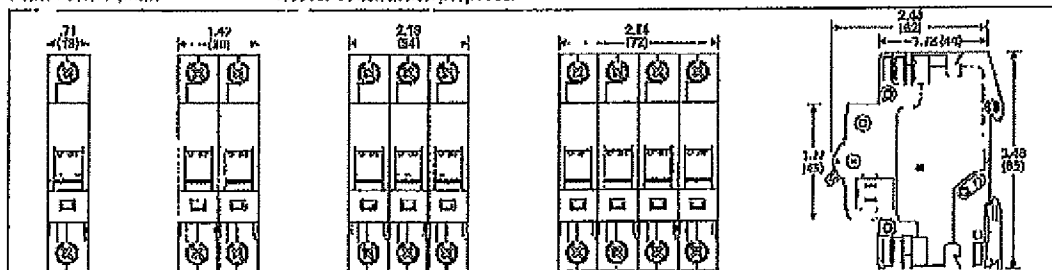
Rating (A)	Poles	Curve	Voltage	Short Circuit Capacity (A)	
				UL1077, I _{cu}	CSA 236, I _{cu}
6 to 60	1	B	120	10,000	10,000
0.5 to 60	1	C, D	120	10,000	10,000
6 to 60	2, 3, 4	B	240	10,000	10,000
0.5 to 60	2, 3, 4	C, D	240	10,000	10,000
6 to 40	1	B	277	6,000	6,000
0.5 to 60	1	C, D	277	6,000	6,000
6 to 60	2, 3, 4	B	480	5,000	5,000
0.5 to 60	2, 3, 4	C, D	480	5,000	5,000

Table 3 - DC Ratings

Rating (A)	Poles	Curve	Voltage	Short Circuit Capacity (A)	
				UL1077, I _{cu}	CSA 236, I _{cu}
0.5 to 63	1	B, C, D	65 Vdc	10,000	10,000
0.5 to 63	2	B, C, D	130 Vdc	10,000	10,000

Dimensions (mm)

Not for construction purposes.



CATERPILLAR

EATON PART# WMS1D40

400 Amp Single Pole

Rating (A)	Single Pole			Rating (A)	Double Pole		
	B Curve 3 to 5 I _n	C Curve 5 to 10 I _n	D Curve 10 to 20 I _n		B Curve 3 to 5 I _n	C Curve 5 to 10 I _n	D Curve 10 to 20 I _n
0.5	-	WMS1C00	WMS1D00	0.5	-	WMS2C00	WMS2D00
1	-	WMS1C01	WMS1D01	1	-	WMS2C01	WMS2D01
2	-	WMS1C02	WMS1D02	2	-	WMS2C02	WMS2D02
3	-	WMS1C03	WMS1D03	3	-	WMS2C03	WMS2D03
4	-	WMS1C04	WMS1D04	4	-	WMS2C04	WMS2D04
5	-	WMS1C05	WMS1D05	5	-	WMS2C05	WMS2D05
6	WMS1B06	WMS1C06	WMS1D06	6	WMS2B06	WMS2C06	WMS2D06
7	WMS1B07	WMS1C07	WMS1D07	7	WMS2B07	WMS2C07	WMS2D07
8	WMS1B08	WMS1C08	WMS1D08	8	WMS2B08	WMS2C08	WMS2D08
10	WMS1B10	WMS1C10	WMS1D10	10	WMS2B10	WMS2C10	WMS2D10
13	WMS1B13	WMS1C13	WMS1D13	13	WMS2B13	WMS2C13	WMS2D13
15	WMS1B15	WMS1C15	WMS1D15	15	WMS2B15	WMS2C15	WMS2D15
16	WMS1B16	WMS1C16	WMS1D16	16	WMS2B16	WMS2C16	WMS2D16
20	WMS1B20	WMS1C20	WMS1D20	20	WMS2B20	WMS2C20	WMS2D20
25	WMS1B25	WMS1C25	WMS1D25	25	WMS2B25	WMS2C25	WMS2D25
30	WMS1B30	WMS1C30	WMS1D30	30	WMS2B30	WMS2C30	WMS2D30
32	WMS1B32	WMS1C32	WMS1D32	32	WMS2B32	WMS2C32	WMS2D32
40	WMS1B40	WMS1C40	WMS1D40	40	WMS2B40	WMS2C40	WMS2D40
50	WMS1B50	WMS1C50	-	50	WMS2B50	WMS2C50	-
60	WMS1B60	WMS1C60	-	60	WMS2B60	WMS2C60	-

Rating (A)	Triple Pole			Rating (A)	Four Pole		
	B Curve 3 to 5 I _n	C Curve 5 to 10 I _n	D Curve 10 to 20 I _n		B Curve 3 to 5 I _n	C Curve 5 to 10 I _n	D Curve 10 to 20 I _n
0.5	-	WMS3C00	WMS3D00	0.5	-	WMS4C00	WMS4D00
1	-	WMS3C01	WMS3D01	1	-	WMS4C01	WMS4D01
2	-	WMS3C02	WMS3D02	2	-	WMS4C02	WMS4D02
3	-	WMS3C03	WMS3D03	3	-	WMS4C03	WMS4D03
4	-	WMS3C04	WMS3D04	4	-	WMS4C04	WMS4D04
5	-	WMS3C05	WMS3D05	5	-	WMS4C05	WMS4D05
6	WMS3B06	WMS3C06	WMS3D06	6	WMS4B06	WMS4C06	WMS4D06
7	WMS3B07	WMS3C07	WMS3D07	7	WMS4B07	WMS4C07	WMS4D07
8	WMS3B08	WMS3C08	WMS3D08	8	WMS4B08	WMS4C08	WMS4D08
10	WMS3B10	WMS3C10	WMS3D10	10	WMS4B10	WMS4C10	WMS4D10
13	WMS3B13	WMS3C13	WMS3D13	13	WMS4B13	WMS4C13	WMS4D13
15	WMS3B15	WMS3C15	WMS3D15	15	WMS4B15	WMS4C15	WMS4D15
16	WMS3B16	WMS3C16	WMS3D16	16	WMS4B16	WMS4C16	WMS4D16
20	WMS3B20	WMS3C20	WMS3D20	20	WMS4B20	WMS4C20	WMS4D20
25	WMS3B25	WMS3C25	WMS3D25	25	WMS4B25	WMS4C25	WMS4D25
30	WMS3B30	WMS3C30	WMS3D30	30	WMS4B30	WMS4C30	WMS4D30
32	WMS3B32	WMS3C32	WMS3D32	32	WMS4B32	WMS4C32	WMS4D32
40	WMS3B40	WMS3C40	WMS3D40	40	WMS4B40	WMS4C40	WMS4D40
50	WMS3B50	WMS3C50	-	50	WMS4B50	WMS4C50	-
60	WMS3B60	WMS3C60	-	60	WMS4B60	WMS4C60	-

Accessories

Shunt Trip

Voltage	Module Width	Catalog Reference
110/220 Vac	1	WST220A
240/415 Vac	1	WST415A
12/48 Vdc	1	WST48D

Auxiliary Switch

No. Contacts	Module Width	Catalog Reference
1A/1B	1/2	WAX1A1B

Description	Catalog Reference
Padlocking Attachment Padlock Key Ring Tong Interphase Barrier	WPLK WPKLY WRTIFB

Do not connect when using Ring Tong Connection.
At 10 phases per pole.

Under Voltage Release

Voltage	Module Width	Catalog Reference
240 Vac	1	WUVR240A
48 Vdc	1	WUVR48D

Alarm Switch

No. Contacts	Module Width	Catalog Reference
1A/1B	1/2	WAL1A1B

Description	Catalog Reference
Identification Labels	WIDL

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CATERPILLAR

ELECTROSWITCH PART# 2424E

APPLICATION SPECIFIC SWITCHES SERIES 24 AND SERIES 31 ROTARY SWITCHES

POWER-FACT OR-Switch

3-phase, two current transformers,
one or two current coils
Depth Behind Panel 2.4"
Handle: Round, Removable
Engaging and jumping as shown

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Order #
Series 24 - 2422C includes HP 100-2714
Series 31 - 3122C includes HP 310-2714

SYNCHRONIZING-Switch

Machine-to-line with buslocks
Depth Behind Panel 2.9"
Handle: Round, Removable
Engaging and jumping as shown

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Order #
Series 24 - 2424E includes HP 110-2517

MOTOR CONTROL-Switch, Governor or Rheostat

Split-Field motor
Depth Behind Panel 2.6"
Handle: Round, Removable
Engaging and jumping as shown

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Order #
Series 24 - 2421B includes HP 105-2822
Series 31 - 3121B includes HP 310-2822

TEMPERATURE METER- Transfer Switch

Transfer 3 two wires to three coils,
with "T15" and "T11"
Depth Behind Panel 2.6"
Handle: Round, Removable
Engaging and jumping as shown

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Order #
Series 24 - 2432C includes HP 100-3110
Series 31 - 3132C includes HP 310-3110

CIRCUIT BREAKER- Trip Switch

Double-pole single-throw contacts
normally open
Depth Behind Panel 2.6"
Handle: Round, Removable
Engaging and jumping as shown

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Order #
Series 24 - 2438D includes HP 100-3110

CIRCUIT BREAKER- Control Switches

Depth Behind Panel 2.6"
Handle: Round, Removable
Engaging and jumping as shown

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Order #
Series 24 - 2438D includes HP 100-3110

CIRCUIT BREAKER-Control Switches

Depth Behind Panel 2.4"
Handle: Round, Removable
Engaging and jumping as shown

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Order #
Series 24 - 2443D includes HP 100-2623

Operates two breakers
Depth Behind Panel 2.4"
Handle: Round, Removable
Engaging and jumping as shown

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Order #
Series 24 - 2443D includes HP 100-2623

Depth Behind Panel 4.3"
Handle: Round, Removable
Engaging and jumping as shown

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Order #
Series 24 - 2442L includes HP 100-2623

ElectroSwitch • 180 King Avenue • Weymouth, MA 02188 • TEL: (781) 335-5700 • FAX: (781) 335-4253 • www.electroswitch.com

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ELECTROSWITCH PART# 74902QF



ELECTROSWITCH
SWITCHES & RELAYS

(781) 335-5200

info@electroswitch.com

SERIES 24

INSTRUMENT AND CONTROL SWITCHES

Features

- Double-Sided, Double-Wiping, Knife-Type Rotary Contacts
- Silver Contact Surfaces for Long, Reliable Life
- Terminal Screws – Easy Installation
- Four-Hole Mount



Control Switch Special Features

- Spring Return to Normal (Vertical) Position

Instrument Switch Special Features

- Make-Before-Break (Shorting Contacts)
- Common Input Tap Switch Arrangement – Sequentially Connected to Several Lines Using the Same Switching Deck
- Positive Positioning, Maintained Action Detent Mechanism

Electrical Specifications

Interrupt Ratings

- 15A/120VAC
- 4A/600VAC
- 7.5A/240VAC
- Overload Current (50 operations): 30A/125VAC Resistive
- Voltage Breakdown: 1200V rms minimum
- Insulation Resistance: 100 Megohms minimum
- Contacts Resistance: 10 milliohms maximum

Mechanical Specifications

Sections	1 to 30
Poles	1 to 60
Positions	8; Adjustable Stops for 2-8 Position Rotation
Contacts	Break-Before-Make (Non-Shorting); Make-Before-Break (Shorting)
Action	45° Positive Detent Indexing
Mounting	4-Hole
Panel Thickness	3/16" Max, Standard
Rotor Contacts	Silver Plated Phosphor-bronze, Double Grip
Stationary Contacts	Silver Plated Copper, w/Integral Screw Type Terminals
Construction	Contacts Enclosed in Molded-phenolic Disks

Approvals • UL File No. E1B174 • CSA File #LR20743

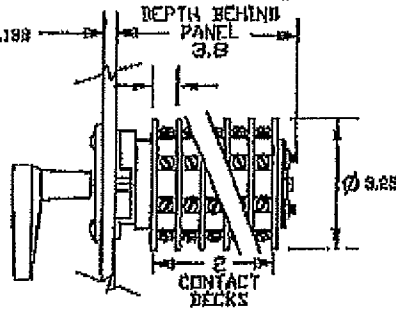
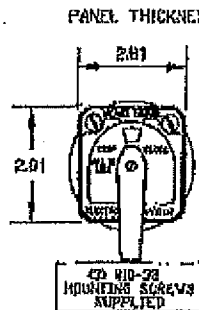
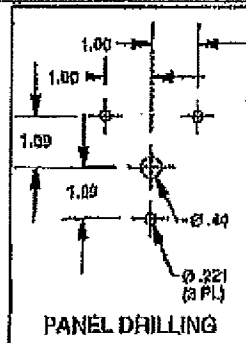
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ELECTROSWITCH PART# 74902QF



ELECTROSWITCH
UNIT OF ELECTRO SWITCH CORP.
LYNN, MASSACHUSETTS 01901
TEL: 617/325-3800 FAX: 617/325-4853

SERIES 24 CONTROL SWITCH

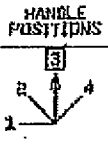


AL
20A-120VAC
15A-240VAC
FILE NO. 1A-125VAC
E18174 1A-250VAC

CS
20A-600VAC res
15A-600VAC ind
2A-125VDC
RHP-24C/480VAC

4-8-32 30HD TERMINAL SCREWS SUPPLIED IN-ASSEMBLED

TITLE: BREAKER CONTROL		POSITION				
DECK	CONTACTS	POSITION				
		TRIP	TRIP	TRIP	TRIP	TRIP
1	11 01-110 10	X				
2	27 01-110 28	X				
3	22 01-110 23					X

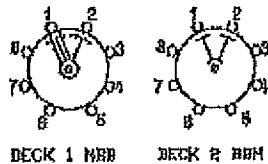


**ACTION: SPRING RETURN TO POS. 3
PULL TO LOCK IN POSITION 1**

11	12	13	14	15	16	17	18
21	22	23	24	25	26	27	28

JUMPERS AND TERMINALS SUPPLIED AS SHOWN

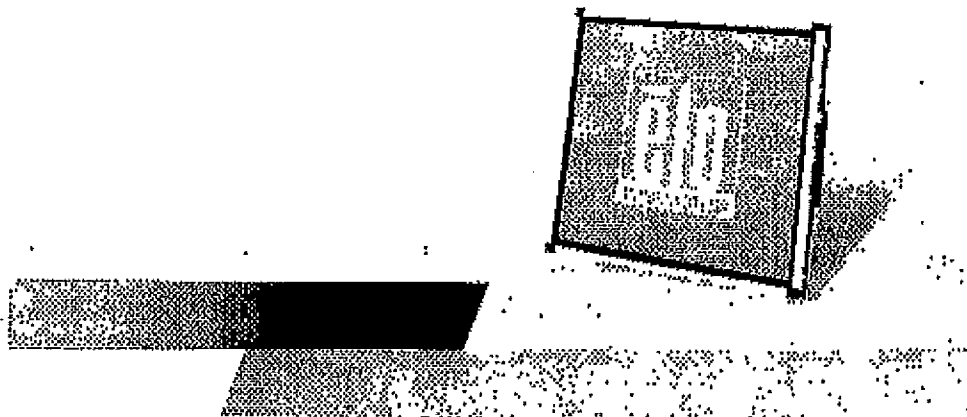
**NAMEPLATE
CODE 19C-3833**



MADE BY: WCK DATE: 09-08-05
APPR BY: WCK DATE: 09-08-05

REV: 0
SHEET 1 OF 1

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1939L 19" LCD Open-Frame Touchmonitor

High-quality panel and choice of touch technology in a compact form factor

The Elo TouchSystems 1939L 19" LCD open-frame touchmonitor delivers a cost-effective touch solution for OEM's and systems integrators, and complements the expanding family of Elo touch solutions for applications in the retail self-service and gaming/entertainment markets. This compact touchmonitor is "designed for touch" with proven Elo expertise and reliability built in, not added later by altering an existing monitor.

The 1939L features a brilliant wide-viewing-angle panel to instantly grab and hold the users' attention, whether they are checking out retail goods with a self service kiosk or playing games in a casino or arcade. Because the enclosure is controlled by specifications and tooling, Elo open-frame touchmonitors have a history of product availability—important for continuity through all phases of project rollouts and when servicing. The 1939L also features a unique, injection-molded minibox with a virtually invisible watertight seal, making it well-suited for the rigors of public use.

Narrow borders, multiple mounting options and a dual serial/USB touch interface add to the versatility of the 1939L. Worldwide agency approvals, as set forth on the back side of the spec sheet, cover the entire monitor that is designed, built and supported by a true single source supplier.

Benefits

- Bright, high contrast display with wide-viewing angle to attract and hold users' attention
- Choice of Elo touch technologies
- "Designed for touch" from the ground up: includes a protective minibox for sealing against liquids
- Slim and compact outer dimensions
- Enclosure controlled by Elo specifications
- Multiple mounting options
- Dual serial and USB connectivity
- Worldwide agency approvals
- Three year standard warranty
- Designed, built, and supported by Elo

Applications

- Casino and amusement games
- Information kiosks
- Self service
- Industrial process control

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ELO PART# 19-24VDC-ISO-VI

1939L 19" LCD Open-Frame Touchmonitor Specifications

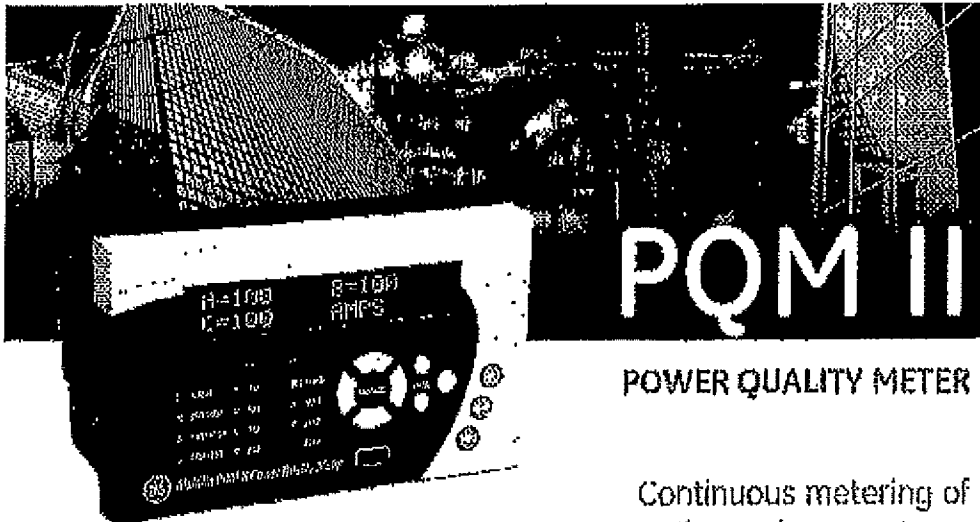
Case/Bezel color	Steel/black
Display type	Active matrix TFT LCD
Display size	19.0" diagonal
Active screen area	Horizontal/vertical 14.6" (375 mm)/11.9" (302 mm)
Monitor dimensions	Width: 16.3" (415 mm) Height: 14.3" (363 mm) Depth: 2.0" (51 mm)
Optimal (native) resolution	768 x 1024
Other supported resolutions	1280 x 1024 60 Hz, 1280 x 960 60 Hz, 1280 x 800 60 Hz, 1024 x 768 60 Hz, 1024 x 768 85 Hz (Sun), 632 x 624 75 Hz (Mac), 800 x 600 36, 60, 72, 75 Hz, 120 x 400 70 Hz, 720 x 360 70 Hz, 640 x 480 60, 72, 75 Hz, 640 x 480 65 Hz (Mac)
Colors	16.7 million colors
Brightness (typical)	LCD panel: 250 cd/m ² with AccuTouch: 200 cd/m ² with Accusafe Pulse Recognition: 250 cd/m ² with Carroll Touch: 230 cd/m ² with Intelli Touch: 240 cd/m ² with SecureTouch: 230 cd/m ² with Surface Capacitive: 212 cd/m ²
Response time (typical)	20 msec (combined rise/fall)
Viewing angle (typical at CR>10)	Horizontal (left/right) 89°/89° Vertical (up/down) 89°/89°
Contrast ratio	1000:1
Input video format	RGB analog
Input sync format	Separate H & V sync, composite sync, and sync on green
Input video signal connector	Mini D Sub 15-pin VGA type
Scanning frequency	Horizontal/vertical 48.5 kHz/48.5 Hz
Power dissipation	Monitor only 46 W (max.) Monitor and power brick 50 W (max.)
Power supply	External AC to DC power brick is provided
Input voltage requirement	Monitor input: +12VDC ± 4%, 3.2A (typical), 5.8A (maximum) AC to DC power brick input 100-240 VAC, 50/60 Hz
Temperature	Operating/storage 0°C to 40°C/-20°C to 60°C
Humidity (non condensing)	Operating/storage 20% to 80%/10% to 98%
Mean time between failures (MTBF)	10,000 hours demonstrated
Backlight lamp life (typical)	50,000 hours to half brightness
Weight (approx.)	Actual/shipping 5.2 kg (11.5 lbs)/7.8 kg (17.1 lbs)
Other Features	Digital on-screen display (OSD); Fully RoHS compliant; Patent pending bezel rest and patented touch technology
Mounting options	75 mm and 100 mm VESA mounting; rear mount with or without bezel mounting brackets (included)
User's controls	OSD buttons: menu, left, right, select, power; OSD: contrast, brightness, H/V position, RGB (color temp), clock, phase, recall, language (English, German, Spanish, Japanese, French); OSD disable/enable, power disable/enable; optional remote OSD
Warranty	Touchmonitor: 3 years
Touch interface	Serial and USB
Agency certifications	UL, cUL, SILMCO, CN, TÜV-T, CE/FCC/VCCI/C/C-TICK (Class B)



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PQM II

POWER QUALITY METER

Continuous metering of
three-phase systems

KEY BENEFITS

- Power quality monitoring with waveform capture and historical data logging
- Easy to program and use with keyboard and large illuminated 40 character display
- Multiple communication ports for integration with DCS and SCADA systems
- Supports DNP 3.0 and Modbus protocols
- Digital and analog I/Os for control and alarms
- Voltage disturbance recording capability for electrical sag and swell events

APPLICATIONS

- Metering of distribution feeders, transformers, generators, capacitor banks and motors
- Commercial, industrial, utility
- Flexible control for demand load shedding, power factor, etc.
- Medium and low voltage systems

FEATURES

Monitoring and Metering

- Ia Ib Ic In
- Va Vb Vc Vab Vbc Vca
- VI unbalance
- True PF Crest and K factor
- Hz W var VA
- Wh varh VWh W Crest
- Demand AW var VA
- Harmonic analysis through 63rd with THD and TIF
- Event recorder - 150 events
- Waveform capture
- Data logger 99,000 events
- Voltage Disturbance Recorder (VDR) - 500 events

Communications

- Local RS232 serial port 11,200 to 19,200 baud
- Two (two) RS485 serial ports with Modbus and DNP 3.0 protocol
- Ethernet connectivity provided by MultiNet
- EnerVision™ software is provided for setup and monitoring functions
- Federal plot-in modem capabilities

Protection & Control

- Load shedding
- Power factor control
- Pulse input totalizing

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Introduction

GE Multilin has set a new standard in metering technology with the introduction of the PQM II. This meter designed to the latest industry specifications, provides accurate and reliable three phase power metering with an optional Ethernet and fiber communications module in a small and modern package. The PQM II can be used for a variety of applications including metering of distribution feeders, transformers, generators and motors.

Robust Metering and Power Quality Capabilities in One Package

The PQM II is an ideal choice when continuous monitoring of a three phase system is required. It provides metering for current, voltage, real and reactive power, energy use, cost of power, power factor and frequency. Waveform capture and Voltage Disturbance Recorder continuously monitors power quality. Programmable relays and 4 assignable output relays allow control functions to be added for specific applications.

Communications Made Easy

Integrate process, instrumentation and electrical requirements in a plant automation system by connecting PQM II meters to a DCS or SCADA system. Meter provides multiple communication ports. It can provide data simultaneously to multiple masters such as SCADA, DCS, BMS etc. Meter supports both Modbus and DNP 3.0 protocol. A computer running "EnerVista" software can change system setpoints, monitor values, status and alarms. Continuous monitoring minimizes process downtime by immediately identifying potential problems due to faults or changes.

Industry leading software makes setup simple

The PQM II comes complete with EnerVista™ GE Multilin's suite of software tools for managing the entire lifecycle implementation of the PQM II. EnerVista™ controls all of the tools for setting up and configuring your PQM II in minutes via RS232, RS485, external modem or Ethernet LAN.

Ethernet capability

With the optional Multilin module, users can add Ethernet capability to their meter. Multilin is an Ethernet communications module that allows connection of up to 32 Modbus devices, providing Modbus TCP/IP communications for these devices over Ethernet. This allows connection to fiber optic LAN and WAN systems for remote access to data on the PQM II.

Standard Features

The PQM II provides continuous monitoring of a three-phase system. It provides metering of current, voltage, real and reactive power, energy use, cost of power, power factor and frequency. Ethernet communications are available through the optional Multilin module.

Metering

PQM II is a true RMS meter with 0.2% accuracy for voltage and currents. The PQM II provides advanced features for monitoring and analysis which include:

- Ia Ib Ic In
- Va Vb Vc Vab Vbc Vca
- V Unbalance
- True PF crest and K factor

- Hz W var VA
- Wh with VAh W cost
- Demand A W var VA

Keypad and illuminated 40 character display provides local setup settings and monitoring of values and status.

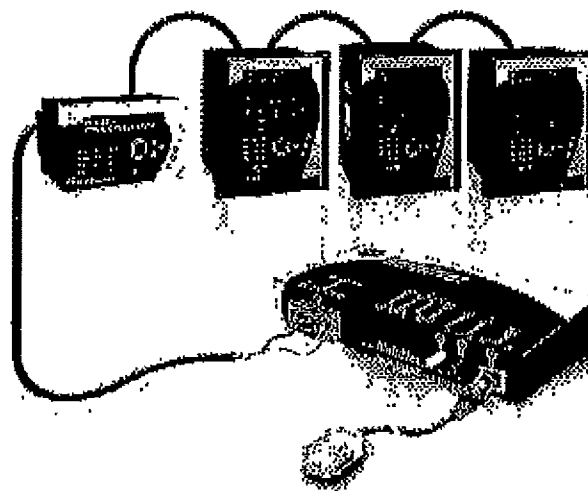
Mounting Versatility

PQM II panel mount with display, offers an easy local interface. Standard models have RS485 communications for programming and monitoring. Users can replace expensive additional devices by adding the CONTROL, TRANSDUCER and POWER analysis options to the PQM II as required.

Alarms

Any of the assignable outputs may be used to trigger an alarm for specific applications. Simple alarm messages provide easy notification.

CONDITION	APPLICATION
overcurrent	motor/transformer
undercurrent	pumps/compressors
neutral current	industrial motor/ce
unbalanced current	motor
overvoltage	equipment protection
undervoltage	motor/transformer
phase unbalance	pumps/compressors
overfrequency	generators
underfrequency	load shedding
power factor	capacitor banks
switch input	process control



Connect up to 32 Modbus devices in your Ethernet network

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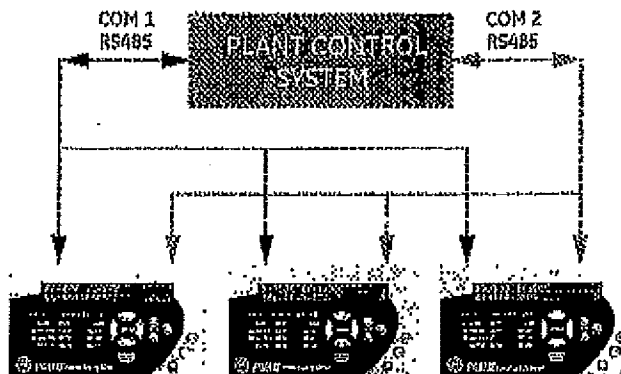
Communications

Interpret process, instrumentation and electrical requirements in a plant automation system by connecting PQM II meters to a DCS or SCADA system. Initially PQM II meters can be used as stand-alone units. Open architecture allows connection to other Modbus® compatible devices on the same communication link. At a later stage PQM II can be integrated in a complete plant wide system for overall process monitoring and control.

The standard PQM II comes complete with a rear RS485 and front RS232 port. RS232 port can be used for data collection, printing reports or problem analysis without disturbing the main RS485 communication interface of rear. The standard meter provides:

- RS485 Modbus® 1,200 or 19,200-bps
- DNP 3.0 Level 2 Protocol
- Mini H-V SCADA system component
- Measure actual values
- Read status
- Issue control commands
- Load all setpoints from a file
- Change individual setpoints

A computer running Inverista® software can change system setpoints, monitor values, status and alarms. Continuous monitoring minimizes process downtime by immediately identifying potential problems due to faults or changes.



Redundancy in data security systems is provided by the 2nd RS485 screen port.



Connect two 4 to 20 mA transmitters for process variable measurement and control.

Future Expansion

The PQM II uses non-volatile flash memory for firmware storage. This allows future product upgrades to be loaded via the serial port. Upgrades can also be downloaded from the GE Multilin website.

Options

There are a variety of options available to the user, allowing a range of custom configurations.

Transducer

Four Analog Outputs: Four isolated analog outputs can be used to replace eight analog transducers. Output signals can be selected from any of the measured parameters for direct interface to a PLC or other devices.

Analog Input: PQM II meters can accept two analog inputs from external devices. Meter can be programmed to activate a control relay based on analog input from transducers (temperature, level etc.)

Communications

Second Rear Comm Port: An additional rear RS485 comm port is provided for simultaneous monitoring by process, instrument, electrical or maintenance personnel.

Control

Three output relays and four inputs allow measured parameters from the standard PQM II to be combined with setpoints and ZOs for control applications. With the control option, three output relays and four switch inputs are added along with programmable setpoints to make a mini RTU. Output relays can also be controlled via the communication port or assigned to different setpoints for custom programming to accommodate many applications such as:

- Undercurrent alarm for pumps
- Over and undervoltage for generators
- Unbalance alarm for rotating machines
- Run level power factor for capacitor bank switching
- Under frequency demand output for load shedding resulting in power cost savings
- kWh, kvarh and kVAh pulse output for PLC interface

Power Analysis

Data Logger/Trending: Trending is useful as a troubleshooting aid when a problem is detected. Measured values can be selected and plotted with a programmable sampling rate to suit the time interval of interest. The generated chart recorder screen can be printed or

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GE PART# PQMII-T20-C-A

usually is other programs for report writing.

Harmonic Analysis: Non-linear loads such as variable speed drives, computers and electronic ballasts can cause harmonics which may lead to problems such as reference breaker tripping, in-phase interference, transformer, capacitor or motor overheating. Harmonic analysis can be used for fault diagnosis such as detecting undesirable neutral wiring, need for a harmonic rated transformer, or effectiveness of harmonic filters. Details of the harmonic spectrum are useful and available with the power analysis option.

Voltage Disturbance Recorder (VDR): The Voltage Disturbance Recorder (VDR) function adds to the PQM II the ability to monitor and record sag and swell disturbances. It can record up to 500 sag/swell events for all voltages simultaneously.

Waveform Capture: Voltage and current waveforms can be captured and displayed on a PC using the LiveView™ program supplied with the PQM II or using third party software. Extensive print or plot data from SCR switching may be clues for taking corrective action.

Event Recorder/Alarms: Setpoint trippers, input and output events can be stored in a 150 event record and time and date stamped by the internal clock. This is useful for diagnosing problems and system activity. Minimum and maximum values are also continuously updated and timestamped.

Trace Memory: The PQM II can be configured to record a maximum of 30 cycles of data on all voltage and current inputs based on overvoltage, undervoltage, overcurrent or switch input state change.

SmartView™ Software

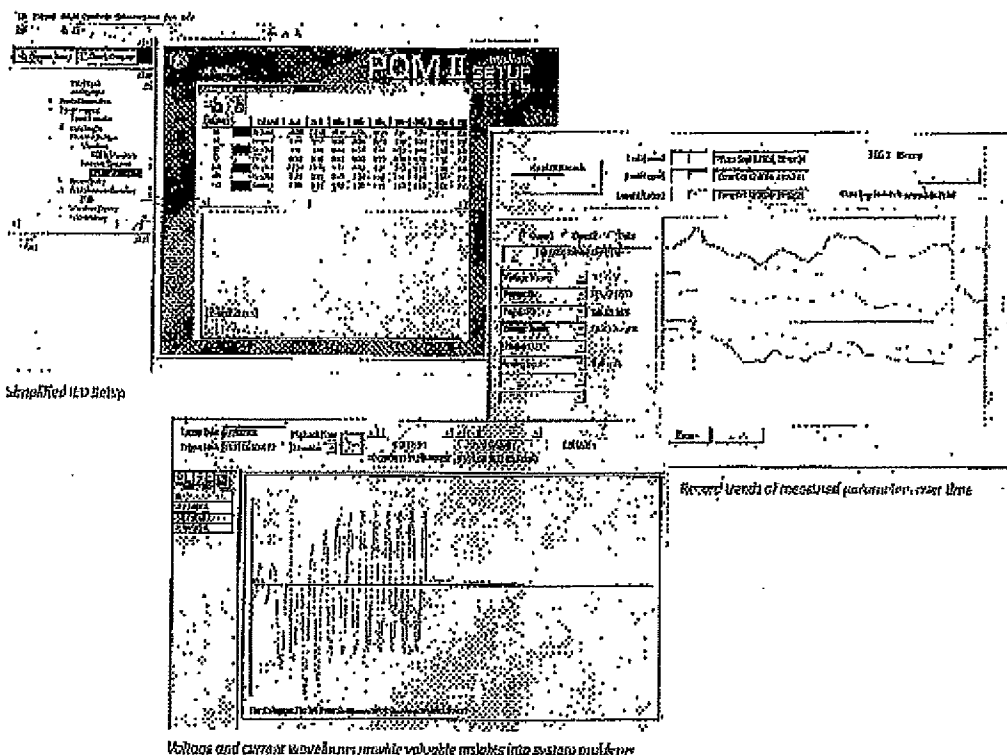
EnerVista™ Launchpad

EnerVista™ Launchpad is a powerful software package that provides users with all of the setup and analysis tools needed for configuring and measuring GE Multilin products. Launchpad allows configuration of devices in real-time by communicating using RS232, RS485, Ethernet, or modem connections.

The intuitive user interface makes it simple to make adjustments, read metered values, monitor status and evaluate power quality. Powerful troubleshooting features make it easy to retrieve and view voltage & current waveforms and harmonic analysis. This vital information can help provide early warning of problems and prevent equipment damage or production breaker tripping.

EnerVista Launchpad PQM II Setup and Analysis

PQM II setup program contains many tools and reports that simplify device configuration and allow viewing of power system events.



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GE PART# PQMII-T20-C-A

Included in EverVista is a document archiving and management system that archives critical documentation is up to date and available when needed by automatically creating for and downloading new versions of manuals, applications notes, specifications, and service bulletins.

Viewpoint Monitoring

Viewpoint Monitoring is a single to use, full-featured monitoring and data recording software package for remote systems. Viewpoint Monitoring provides a complete HMI package that instantly puts critical real-time device data on your PC through pre-configured graphical screens with the following functionality:

- Plug & Play Device Monitoring
- System On-Line Monitoring & Control

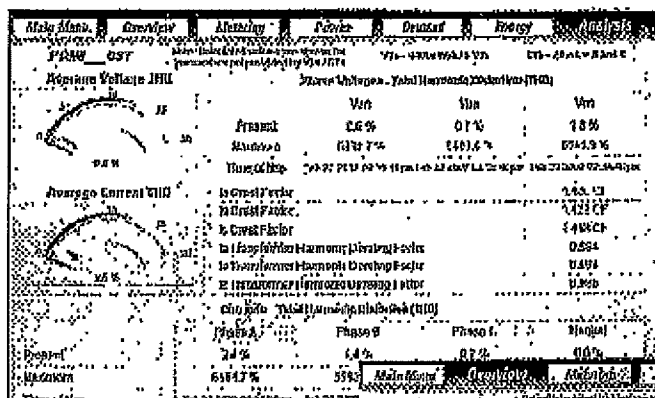
- Apparatus Alarm Screens
- Trending Reports
- Automatic Event Retrieval
- Automatic Waveform Retrieval

EverVista™ Integrator

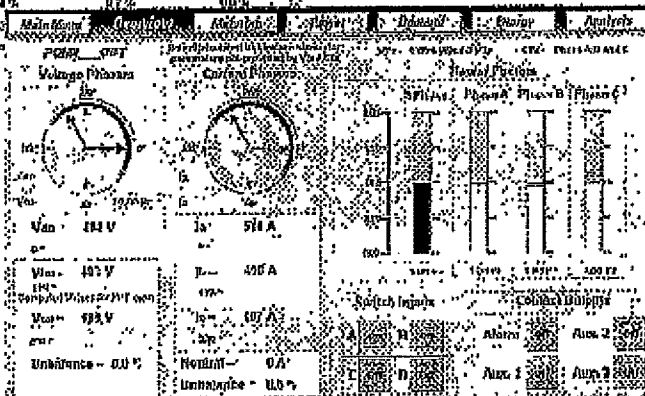
EverVista™ Integrator is a toolkit that allows seamless integration of GE Multilin devices into new or existing automation systems by sending GE device data to HMI, DCS, and SCADA systems. Included in EverVista Integrator is:

- OPC/DDE Server
- GE Multilin Drivers
- Automatic Event Retrieval
- Automatic Waveform Retrieval

EverVista Viewpoint Monitoring Plug-and-Play Screens



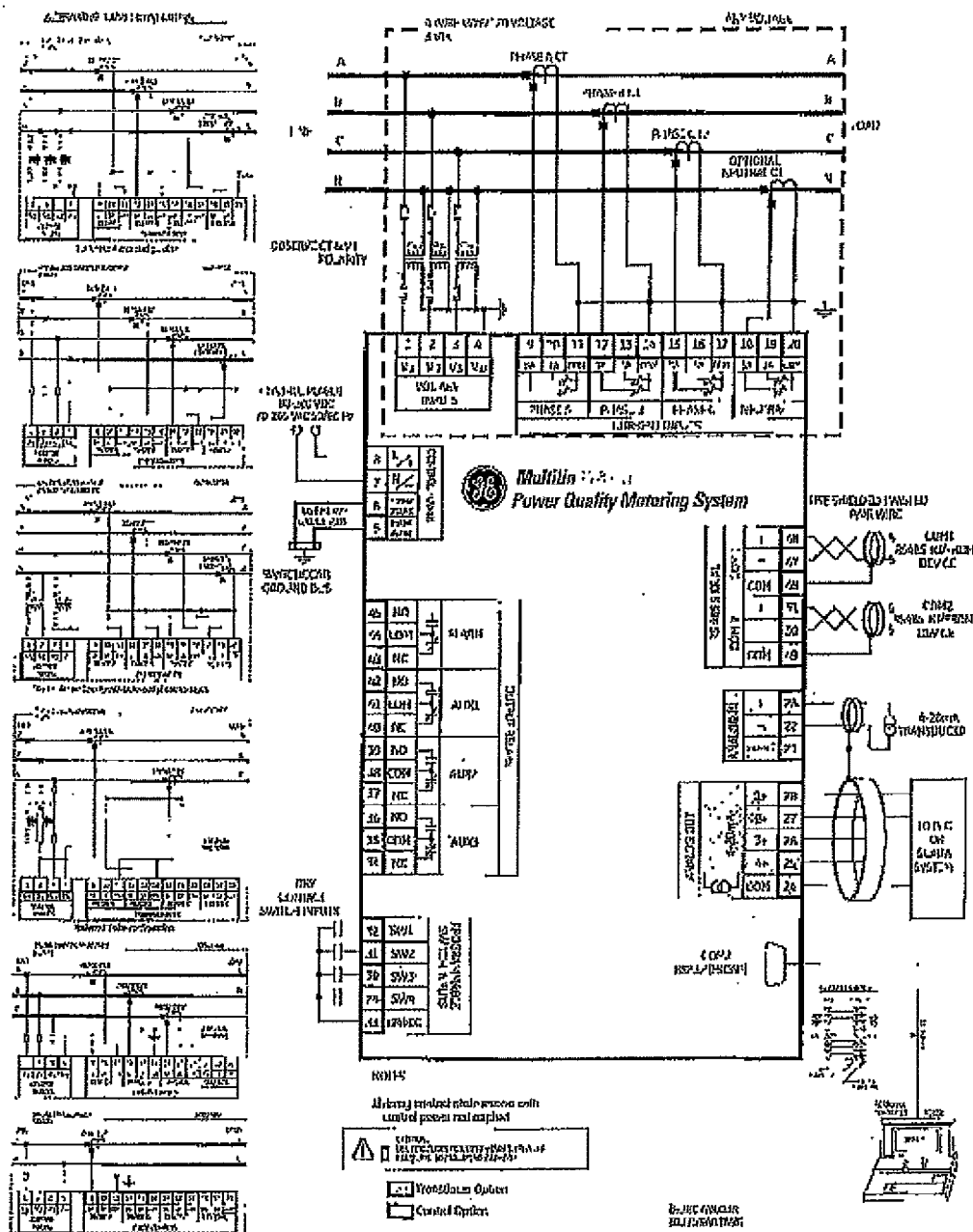
Viewpoint Monitoring PQMII analysis screen for detailed power quality information



Viewpoint Monitoring PQMII real time monitoring screen for detailed device status

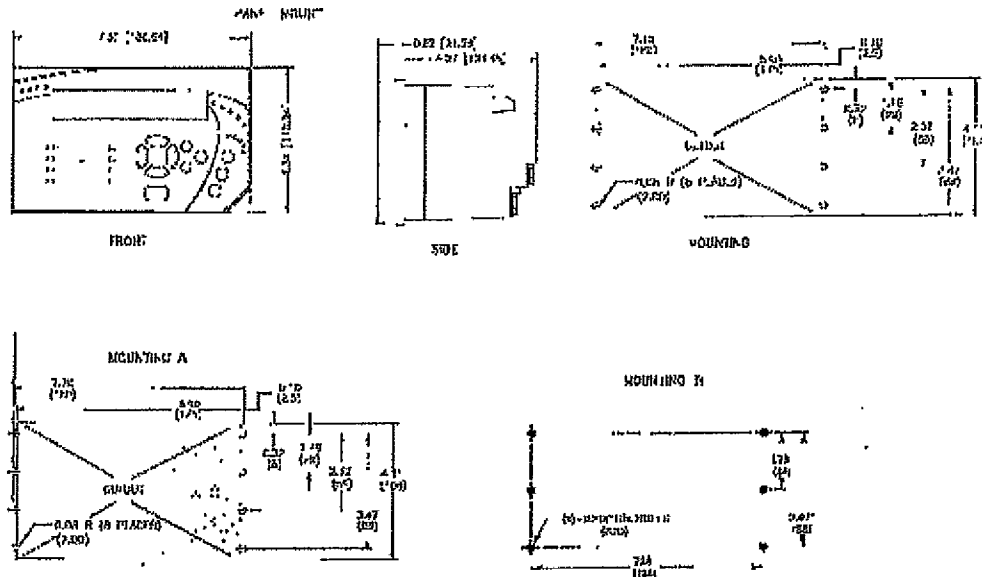
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Typical Wiring



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PQM II Dimensions



Ordering

PQM II	*	*	*	Description
PQM II				Base unit with display, all current/voltage/power measurements, 1 RS485 communication port, 1 RS232 communication port
T20				Temperature option; 4 isolated analog outputs 0-20 mA and 4-20 mA, 2-wire/4-wire; 4 isolated digital outputs 0-20 mA and 4-20 mA, 2-wire/4-wire
TX				Transducer option; 4 isolated analog outputs 0-20 mA, 2-wire/4-wire; 4 isolated digital outputs 0-20 mA and 4-20 mA, 2-wire/4-wire
C				Control option; 4 isolated analog outputs 0-20 mA, 2-wire/4-wire; 4 isolated digital outputs 0-20 mA and 4-20 mA, 2-wire/4-wire
A				Power analysis option; harmonic analysis, triggered frame memory, voltage sag/swell, event, record data logger, voltage disturbance recorder (VDR)

Modifications:	Control Power:
1000-201	20-60 VDC/20-45 WDC
1000-202	20-60 VDC/20-45 WDC
1000-203	20-60 VDC/20-45 WDC
1000-204	20-60 VDC/20-45 WDC
1000-205	20-60 VDC/20-45 WDC

Accessories for the PQM II:

- Multilink II Ethernet Modem: ML1600-II-A2-A2
- Multilink II Ethernet Modem: ML1600-II-A2-A2
- Viewpoint Monitoring: VM2

Visit www.GEMultilin.com/PQMII to:

- View Guideform Specifications
- Download the Instruction Manual
- Review applications notes and support documents
- Buy a PQM II online

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MARATHON™

From the World Leader in VRLA Battery Technology

Designed for durability in Telecommunications and Electric Utility applications, the GNB TOP Terminal MARATHON™ series provides high performance and reliability in long duration discharge applications. The MARATHON™ family of batteries highlights another example of GNB's extensive experience and world wide leadership in VRLA technology.

"Designed in" Quality Manufacturing

Quality manufacturing processes for the MARATHON™ series batteries incorporate the industry's most advanced technologies including: an automated helium leak detection system, a computer controlled "fill by weight" acid filler, and a temperature controlled water bath formation process. Each and every unit is capacity tested.

High Performance MARATHON™ Series Features

- Standard Reinforced polypropylene container and cover
- Optional flame-retardant reinforced container and cover compliant with UL94 V 0, 20% L.O.I.
- Integrated flash-arrester ultrasonically welded into cover.
- Patented "Diamond Side-Wall" design to maintain structural integrity in higher operating temperatures
- Heat sealed case-to-cover bond to ensure a leak proof seal
- High-Compression Absorbent Glass Mat (AGM) technology for greater than 99% recombination efficiency
- High-purity calcium, silver, lead positive plate design for maximum service float life; 10 year design life @ 25°C (77°F)
- Heavy duty copper alloy terminals for ease of assembly and reduced maintenance
- Reliable one-way, self-revealing safety vents
- Multicell design for faster installation and reduced maintenance
- Horizontal or vertical operation
- Removable carry handles for ease of installation

Applications

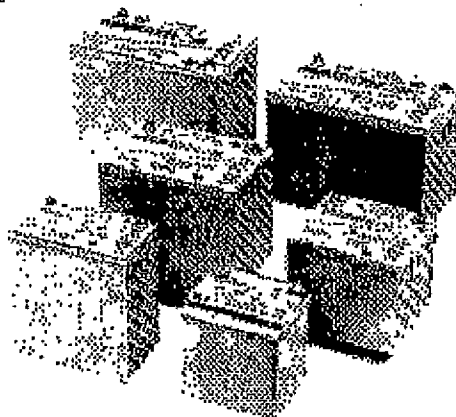
MARATHON™ series batteries incorporate GNB's advanced VRLA technology designed for long life and high performance in:

Telecommunications

- Distributed Power
- PCS
- Cellular
- Broadband

Electric Utility

- Switchgear Control Power
- Communications



UL Recognized Component

CATERPILLAR

GNE MARATHON PART# M12V40

MARATHON™

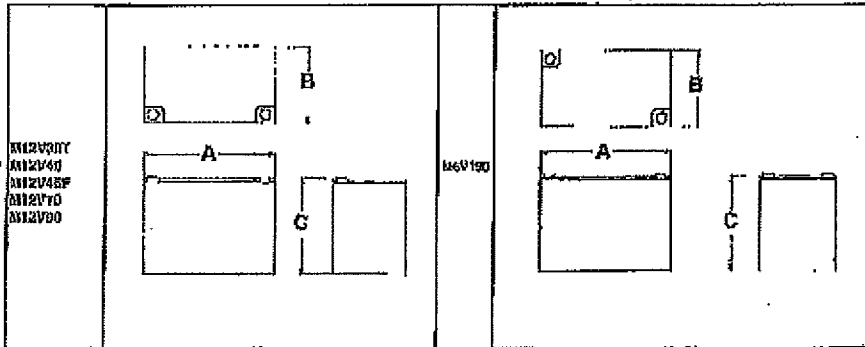
MARATHON™ Specifications

Model Number	Voltage	Capacity (Ah)		Nominal Dimensions						Nominal Weight	
		5 Hr To 1.75 VFC @ 25°C	10 Hr To 1.60 VFC @ 25°C	Inches			Millimeters			Lbs.	Kg.
				A	B	C	A	B	C		
M12V30T ^a	12	28	28	8.75	6.13	6.60	171	150	175	24	10.7
M12V40	12	40	37	7.91	6.63	7.01	198	167	178	30	17.0
M12V45F ^a	12	45	45	8.68	4.78	5.68	220	121	245	30	17.5
M12V70	12	72	71	10.25	6.85	8.80	260	174	224	61	27.0
M12V90	12	90	89	12.03	6.85	8.80	302	174	224	72	32.0
M16V180	6	180	180	12.05	6.85	8.80	302	174	224	74	33.5

^a Bolt, washer, and nut assembly height by 0.63 in. (16 mm)

^b Add suffix "F" to model number for flange reinforced version OPTION

^c Available in flange reinforced version ONLY



MARATHON™ Electrical Data

Model Number	Short Circuit Current (Amps)	Internal Resistance (mOhms)
M12V30T	1570	7.7
M12V40	2341	5.9
M12V45F	2162	6.4
M12V70	3277	3.7
M12V90	3769	3.7
M16V180	5343	1.0

Float Voltage & Charging

Constant Voltage charging is recommended

Recommended float voltage: 2.27 VPC @ 25°C (77°F)

Float Voltage Range: 2.25 to 2.30 VPC @ 25°C (77°F)

Equalize Voltage: 2.25 VPC for 24 hours

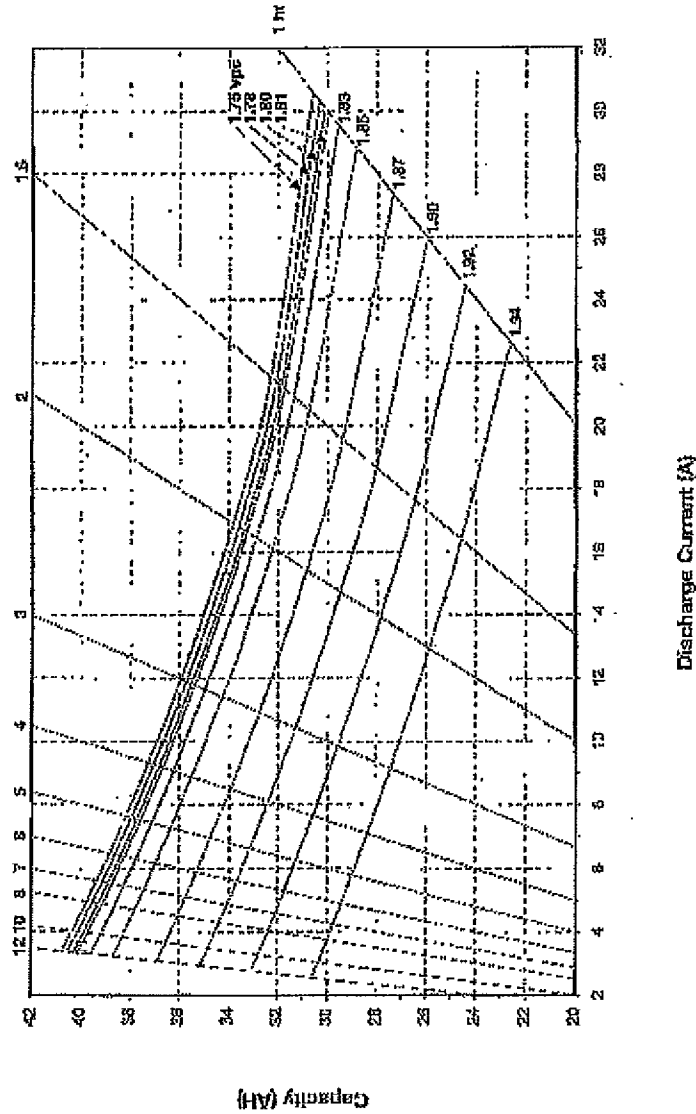
Note: Design margin specifications subject to change without notice. If you have a question, please contact your local GNE representative for assistance.

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GNB MARATHON PART# M12V40

MARATHON™

M12V40(F) - Performance Curves Amperes @ 25°C (77°F)



CATERPILLAR®

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CONFIDENTIAL

J43-118

WTUR0000287

JA 00003082



Single-Door Type 12 and 13 Wall-Mount Enclosures

WALL-MOUNT
ENCLOSURES
Bulletin
A12



Application

For use in housing electrical and electronic controls, instruments, components, and associated wiring, these enclosures incorporate flanged doors that provide convenient access. Designed for indoor use, they protect components from dust, dirt, oil, and water.

ՀԱՅԴՏՄԱՆՈՒՄ

- Enclosure bodies are either 14 or 16 gauge steel. All doors are 14 gauge steel.
- Seams continuously welded and ground smooth; no holes or knockouts.
- External wall-mounting brackets are 14 gauge steel.
- Return flanges around blower sides of shroud and all sides of enclosure having meshed blower and exhaust louvers.
- Door closures are quick and easy to operate.
- Removable heavy gauge reinforcement mesh pin.
- Used as a template for painting.
- One product is high-impact thermoplastic.
- Color studs provided for mounting optional panels.
- Blending polyester on door.
- Optional panels are 12 gauge steel.

Finish

White birds with ANSI 61 gray marbled finish over phosphorized surfaces. Optimum panels have white or conductive finish.

Industry Standards

LI 508A, File No. 461997: Type 12 and 13
NEMA/EMAC: Type 12 and 13
JIC standard EGP-1-1967 (14 gage only)
CSA, File No. 4218A: Type 12
IEC 60529, IP65

Abstract

for the discussion of the

- Blower Fanlong
- Clean Kit (AL14)
- Drive Snap Kit (AD5TOPK)
- Drive Shield Kit
- Electric Hinges
- Electric Motorlocks
- Enclosure Stabilizers
- External Data Pocket
- Gas Cooling Products
- Fast Operating Clamp Assembly (AF491755)
- Huor Stand Kit
- Folding Shelf
- INTERFACES Data Interface Ports
- Keyboard Kit (KCB24)
- Latch Kits and Lock Kit
- Lighting Kit
- Panel Support Kit
- Pinkey (see cable)
- Rack Mounting Angle Kit
- Swing-Out Panel Kit (ANADK)
- Terminal Block Kit Assembly
- Touch-Up Paint (ATPPY61)
- Windows Kit

Modification Services Program:

You can customize this product to your unique requirements by specifying from these options:

- Enclosure height, width, depth
- Over 100 standard finish colors and textures
- Holes and openings in body, doors, subpanels
- Tapped holes, fasteners in enclosure or subpanel
- Finishing
- Doors
- Subpanels
- Structural changes
- Environmental control (heaters, fans, filters)
- Windows
- Standard accessories

To order, contact your local Hollman sales representative.

NOTE: In applications above modifications outside the slope of the bifurcation curves (points) located your Hoffman index representative

Standard Sizes Single-Door Type 12 and Type 13 Enclosures

Tasklog Number	A x B x C (m, mm)	Body Mass (kg)	Female Ontogeny Number	Female Juvenile Female Ontogeny Number	Female Size O X (cm)	Female Size W x E (mm)	F (cm)	F (mm)	Number of Clutches	Data Points
A1224181F	12.24 x 24.06 x 6.00 (325 x 610 x 163)	15	A12P24	A12P24R	6.00 x 24.00	272 x 553	1.00	74	7	Small
A1612611F	13.34 x 12.40 x 6.00 (408 x 595 x 152)	15	A16P12	A16P11R	6.20 x 12.40	331 x 579	1.25	72	8	Small
A1616011F	10.40 x 9.10 x 6.00 (406 x 406 x 152)	15	A16P16	A16P16R	5.10 x 12.60	330 x 330	1.00	71	2	Small
A1426001F	16.28 x 23.00 x 6.60 (406 x 504 x 164)	14	A14P14	A14P14R	1.10 x 13.00	432 x 530	3.00	70	9	Small
A2023051F	20.00 x 12.00 x 6.00 (500 x 393 x 152)	16	A20P12	A20P12G	1.60 x 12.00	430 x 530	1.25	32	2	Small
A2177001F	20.00 x 11.00 x 7.00 (378 x 408 x 162)	18	A20P16	A20P16R	37.00 x 13.00	432 x 430	0.60	76	9	Small
A2123001F	20.00 x 10.00 x 6.00 (438 x 500 x 152)	16	A20P20	A20P20R	1.10 x 11.00	432 x 432	0.50	79	2	Small
A2024001F	20.00 x 12.00 x 7.00 (500 x 400 x 152)	18	A20P20	A20P20R	21.00 x 11.00	432 x 432	3.00	70	2	Small

1

Subjects in phonon without noise

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CATERPILLAR

WALL-MOUNT
ENCLOSURES
Bulletin
A12

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JA 00003084

HOFFMAN PART# A303608LP



Single-Door Type 12 and 13 Wall-Mount Enclosures

WALL-MOUNT
ENCLOSURES
Industrie
A12

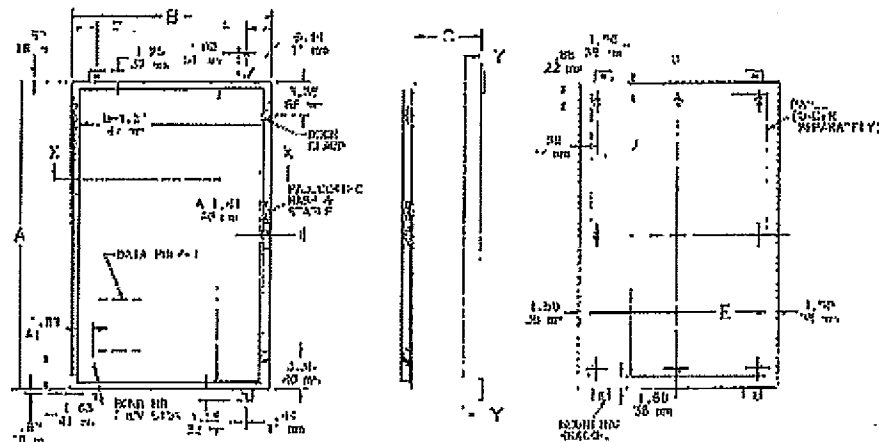
Standard Size Single-Door Type 12 and Type 13 Enclosures (Cont.)

Enclosure Symbol	A x B x C (in.)	Door Height	Panel Material	Enclosure Panel Material	Panel Size H x W (in.)	Panel Size H x W (mm)	Panel Size H x W (in.)	Panel Size H x W (mm)	Number of Mounts	Door Material
A303608LP	61.00 x 21.00 x 21.00 (1549 x 533 x 533)	14	A303608	A303608	37.00 x 21.00	939 x 533	37.00	21.00	3	Large
A303608LP	61.00 x 21.00 x 21.00 (1549 x 533 x 533)	14	A303608	A303608	37.00 x 21.00	939 x 533	37.00	21.00	3	Large

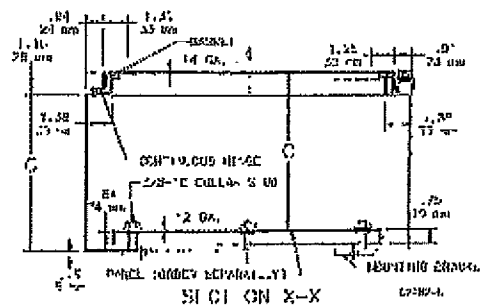
*Small: 5.00 x 6.00 in. (127 x 152 mm).

For more details, see separate drawing of enclosure, enclosure, and enclosure panels are available for your use.

NOTE: Enclosure panels are made of steel or aluminum. Panels are made of steel or aluminum. Panels are made of steel or aluminum.



SECTION Y-Y



SECTION X-X

Industrial
Enclosures

10/10/2000 Chicago, Illinois

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Spec-00288 Rev. A 6/10/01

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J43-121

WTUR0000290

JA 00003085

Intel

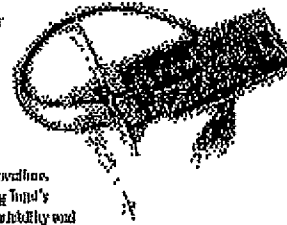
Intel® PRO/1000 MT Dual Port Server Adapter

Two Gigabit Copper Server Connections in a Single PCI Slot

The Intelligent Way to Connect

Conserve valuable PCI slot space in servers, eliminate server bottlenecks and migrate existing Category-5 networks to Gigabit Ethernet easily and cost-effectively with the Intel® PRO/1000 MT Dual Port Server Adapter. Featuring flexible auto negotiating 10/100/1000 Mbps performance, the Intel PRO/1000 MT Dual Port Server Adapter is designed to seamlessly adapt to any existing network.

Enhance server performance further by featuring full port connections. Migration is easy with other Intel® PRO Server Adapters using Intel's universal server driver software to achieve multi-Gigabit scalability and redundant failover capability. A compact form factor and negligible low-profile bracket allow this dual port Gigabit adapter to fit in even high-density, rack-mounted 1U and 2U servers. With a flexible design that fits almost any type of PCI bus, the standards-based management features and wide network operating system support help to ensure extensive compatibility with the latest server and networking environments.



Easy installation for 10/100/1000 migration and existing CAT-5 cabling

• Multi-Gigabit scalability and increased uptime through advanced server features

• Optional low-profile bracket and standard 1U and 2U server rack-mounted servers

Intel PRO
Network Connections

Features	Benefits
VERSATILE COMPATIBILITY	
Support for IPv4/IPv6	Enables widespread deployment
Intel® High-Speed Ethernet	Complete driver suite for Gigabit Ethernet reduces installation complexity
Backward Compatibility with previous generations of Intel PRO/1000 Network Adapters	Requires support ports and simplifies installation and maintenance
Supports 64- or 32-bit PCI-X and PCI Express buses	Flexibility with existing adapters works in a variety of host types
Remote Management Support (RMM, RS, SMP/DM)	Reduces support costs with remote management based on industry-wide standards
IEEE 802.3ab Compatibility	Supports Gigabit Ethernet industry-wide networking standard
NEW FEATURES IN THE INTEL PRO/1000 MT DUAL PORT SERVER ADAPTER	
Intel® 82549 Gigabit Controller	Enables two Gigabit connections in a single adapter, delivering increased bandwidth for slot-constrained servers and providing high performance, reliability, and low power use in a single, integrated, dual port Gigabit Ethernet controller chip
Full height and low-profile, server-only brackets included with quick install	Compatible with full-height and low-profile PCI slots—the standard, full-height bracket can be easily removed and replaced by the shorter, low-profile bracket for rack servers at high-density 1U and 2U servers that feature low-profile PCI slots
Interrupt Moderation	Minimizes interrupt performance with significantly reducing CPU utilization
Advanced Error Diagnostics	Optimally tests and reports network problems (errors, error rate, cable length) and automatically reconfigures for cable features (cross over cables, wrong pin configuration)
Large Send Offload/ TCP Segmentation Offload	Compatible with Large Send Offload features of Microsoft Windows® Server 2003, 2000 and XP which enables the speed performance with low CPU utilization
Extended Advanced Server Features	Intel® ANS software increases uptime with redundant, mirrored connections and enables bandwidth by balancing network load across multiple server connections, High-Speed Select Pack, Redundant and Load Balancing Capabilities to load unavailability and further increases uptime

CATERPILLAR

INTEL PART# PWLA8492MT

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Unusable records not Category-5 cable releases

All or certain speeds or some by declared COT 5 withing withup to only cable
7/1/2007

Compatible with Fast Ethernet

□ **Get low bid on costs and return to work**

Auto-tuning, self-configuring 10/100/1000 Mbps performance

Excludes only those in-kind resources readily and transparently—admittedly still subjectively—verifiable. The measure is used to support a faster spend, but will—unlike the use of cash—be subject to audit and lower economic

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### VLAARDINGEN KIPPE RACK

## COMPANY PRINCIPLES

Consider these Inter products in your sales and marketing plan today!

- [illegible]

**NOT FOR REPRODUCTION**

Typical and proven manufacturing after Intel® processors and their various peripherals. Specifically we seek for Intel® P4/D2/Atom/Duo/Conroe/Wellington and your Intel® PC, server or mobile PCT platform. We have a list of preferred suppliers, which are in the World Wide Web for your reference and list of various Intel® products for your reference.

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## UNZURE:DOCUMENTS

For the latest product information, visit us at [www.Veeva.com](http://www.Veeva.com).  
 1-800-441-4411, ext. 4411 or [info@veeva.com](mailto:info@veeva.com)

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ନିମ୍ନଲିଖିତ ପ୍ରଶ୍ନ ଗୁଡ଼ିକର ସଠିକ୍ ଉତ୍ତର ଚୟନ କରନ୍ତୁ।

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**All signs removed**

**CATERPILLAR<sup>®</sup>**

# ITI PART# 3P668L-102,-122,-162,-401,-501,-801



Instrument Transformers, Inc.

Authorized GE Multilin



## Current Transformer

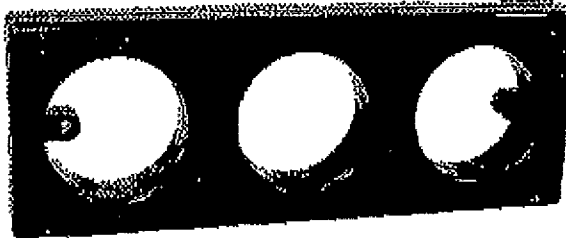
Model 3P668L 3P668L

Window Diameter 3.60"

ITI FIELD/TEST AGENCY APPROVAL



Not intended to be used for purposes other than those specified in the listing. See UL 1000 for details.



### APPLICATION:

3 phase metering and motor overload protection.

### FREQUENCY:

50-400 Hz.

### INSULATION LEVEL:

600 Volts, 10 kV BIL full wave.

Terminals are brass studs No. 8-32 with one flatwasher and regular nut.

Leads (4) are 12 gauge, 24" long.

Approximate weight 7.5 lbs.

| **CATALOG<br>NUMBER | CURRENT<br>RATIO | ANSI METERING CLASS AT 60HZ |      |      |      |      |  | SECONDARY<br>WINDING<br>RESISTANCE<br>(OHMS @ 75°C) |
|---------------------|------------------|-----------------------------|------|------|------|------|--|-----------------------------------------------------|
|                     |                  | B0.1                        | B0.2 | B0.5 | B0.9 | B1.8 |  |                                                     |
| 3P668-251           | 250.5 *          | 0.6                         | 1.2  | 2.4  | —    | —    |  | 0.058                                               |
| 3P668-401           | 400.5 *          | 0.6                         | 0.6  | 1.2  | 1.4  | —    |  | 0.070                                               |
| 3P668-401           | 400.5 *          | 0.3                         | 0.6  | 1.2  | 1.2  | —    |  | 0.085                                               |
| 3P668-501           | 500.5 *          | 0.5                         | 0.3  | 0.6  | 1.2  | —    |  | 0.116                                               |
| 3P668-501           | 500.5 *          | 0.3                         | 0.3  | 0.6  | 1.2  | —    |  | 0.133                                               |
| 3P668-751           | 750.5 *          | 0.3                         | 0.3  | 0.3  | 0.6  | 1.2  |  | 0.175                                               |
| 3P668-801           | 800.5 *          | 0.3                         | 0.3  | 0.3  | 0.6  | 1.2  |  | 0.190                                               |
| 3P668-102           | 1000.5 *         | 0.3                         | 0.3  | 0.3  | 0.6  | 0.6  |  | 0.278                                               |
| 3P668-122           | 1200.5 *         | 0.3                         | 0.3  | 0.6  | 1.2  | 1.2  |  | 0.385                                               |
| 3P668-162           | 1600.5 *         | 0.3                         | 0.3  | 0.3  | 0.6  | 1.2  |  | 0.508                                               |
| 3P668-202           | 2000.5 *         | 0.3                         | 0.3  | 0.3  | 0.3  | 0.6  |  | 0.662                                               |

\*\* (OHMS @ 75°C) TYPICAL

Approved for use in Canada by the Canadian Standards Association (CSA) No. 14-06-101

CATERPILLAR

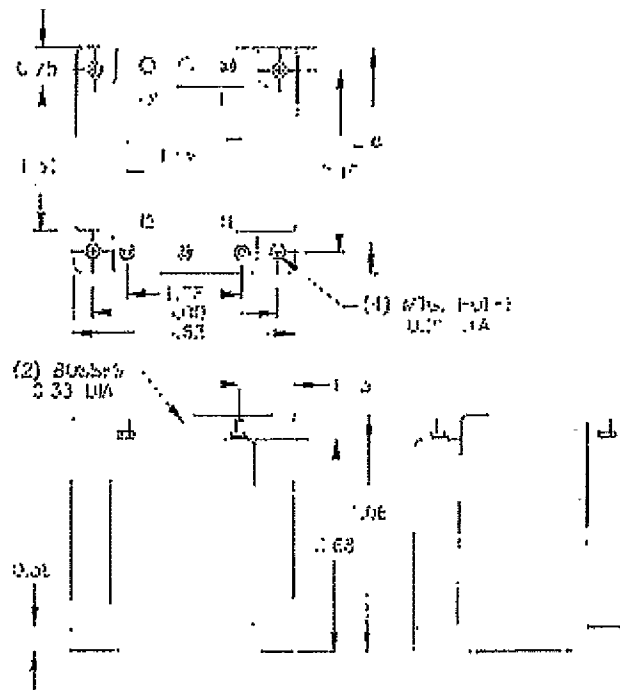
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JA 00003089



## Model 468

- The core and cast assembly is enclosed in a thermoplastic shell and filled with resin.
- These transformers are designed for operation line-to-line. They may also be operated line-to-ground or line to neutral at reduced voltage voltage, (80% of rated volts)
- It is desirable to use a GFI breaker in the secondary to protect the transformer.
- With two exceptions these transformers are ANSI C47.13 group 1. Those marked \* are group 2.
- Models 450-300, 400-100, 450-415 designed specifically for 50Hz operation are available with reduced performance. Consult factory for details.
- Each transformer has two plastic terminal cover,



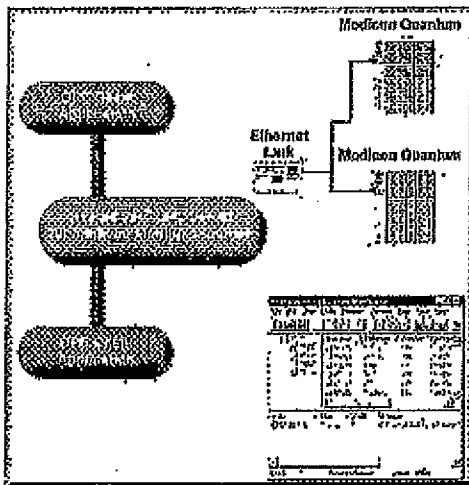
**CATERPILLAR®**

## KEPWARE PART# OPC-MDBUS-NA00

### Modbus Ethernet OPC Server

#### Overview

KePware's 32 bit Modbus Ethernet device driver works in conjunction with our OPC Server KEPServerEX, to provide data exchange between OPC clients and Modbus Ethernet protocol compliant PLCs. KePware's implementation of Modbus Ethernet supports master and slave operations simultaneously. The slave mode allows the server to receive data by exception from other Modbus Ethernet devices. KEPServerEX automatically optimizes your data acquisition based on client demand. Data integrity is ensured with our extensive error handling.



The Modbus Ethernet driver now offers direct integration with Modicon Concept and ProWORX programming packages. If you are using either of these packages you will be able to directly import the tags used in your PLC application directly into KEPServerEX. This time saving step makes all of the relevant PLC data available to your OPC client applications instantly.

This driver is part of the Modicon Modbus Communications Suite. Purchasing either the Modbus RTU serial, Modbus RTU Slave serial, Modbus ASCII serial, Modbus Plus SABB, or the Modbus Ethernet TCP driver entitles you to all five drivers.

#### Supported Devices:

| Device          | Note                                                                                                                       |
|-----------------|----------------------------------------------------------------------------------------------------------------------------|
| Modbus Ethernet | n/a                                                                                                                        |
| Mailbox         | Consult your Modicon Documentation on the MSTR instruction for sending unsolicited requests to the Modbus Ethernet driver. |
| Huerta PGM      | n/a                                                                                                                        |
| Roxar RRM       | n/a                                                                                                                        |

#### Features:

##### Specific Features

- Automatic Tag Database Generation.

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## KEPWARE PART# OPC-MDBUS-NA00

- Supports Multiple PLCs via IP addressing.
- Supports Modicon Ethernet to Modbus Plus bridging.
- Supports Multiple or Single socket usage for better gateway resource management.
- Supports Tag Import from Concept and ProWORX programming packages.
- Supports Memory Accesses to 65535.
- Hex Addressing Support (0-FFFF).
- User Definable Read Block Sizes.
- Adjustable Address Base ( 0 or 1 ).
- Word Order Swapping for Floating Point and Longs.
- Oxco: Output Coils, 1xxxx - Input Coils, 3xxxx - Internal Registers, 4xxxx - Holding Registers.
- All data types and arrays are supported.

### General Features

#### General

- Multi-threaded design ensures optimum performance
- Supports up to 16 concurrent serial port and PC card configurations
- Full Time On line operation allows on the fly changes
- Build Diagnostic system with protocol display
- OPC Diagnostic feature provides a real-time and historical view of OPC events that occur between any OPC client and the server.
- Modem support included on all Serial port drivers
- CSV file import and export of Server tags for easy configuration on large projects
- Supports running as a Windows service
- Supports direct scaling of device data which allows raw device data to be converted to engineering units for OPC client applications
- Online full time
- Includes a built in User Manager that allows complete control over what types of functionality each individual user can access
- Allows the user to specifically select a NIC card for use with any Ethernet driver or serial driver running in Ethernet Emulation mode.

#### OPC

- Supports OPC 1.0 Data Access Specifications
- Supports OPC 2.05a Data Access Specifications
- Supports OPC 2.0 Data Access Specifications
- Includes OPC 2.0 Automation Interface and comprehensive Visual Basic examples

#### DDP

- AdvancedDDP supports RSView32 and Simplicity
- FastDDP and SoftLink Support Wonderware FactorySuite 2000
- CF-Text supports all DDE aware applications
- NetDDE supports shared network access to device data

### Required Software and Hardware

#### Supported Operating Systems

- Windows NT
- Windows 2000
- Windows Server 2003

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## KEPWARE PART# OPC-MDBUS-NA00

- Windows XP

### PC Hardware

#### Minimum

- 400 Mhz Pentium CPU
- 128 Megs of RAM
- 100 Megs of Free Hard Drive Space

#### Recommended

- 600 Mhz Pentium CPU
- 512 Megs of RAM
- 100 Megs of Free Hard Drive Space

### Hardware Requirements

- For Device and Hardware Requirements see the Devices table.

### Communications Protocol:

- Modbus Ethernet

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# KEPWARE PART# OPC-UCNPS-NADL



Automation's Best Friend | U-CON datasheet

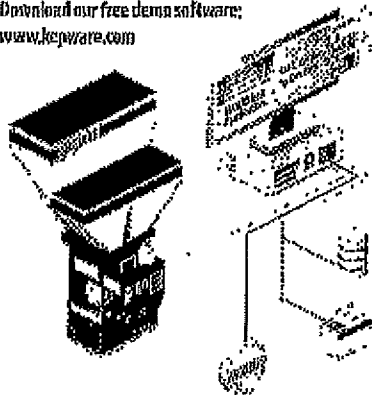
Kepware Technologies Automation's Best Friend 1-888-Kepware sales@kepware.com www.kepware.com

## User-Configurable Driver + OPC / DDE server

Download our free demo software: [www.kepware.com](http://www.kepware.com)

Our User-Configurable driver by Kepware enables you to quickly and easily develop communication's drivers for new PLCs, serial or Ethernet devices. The U-CONs Foundation Edition uses a menu-driven interface, which allows the configuration of read & write transactions (data packets) to establish runtime communication with the device. These transaction sets are uploaded as tags to our reliable and field-proven OPC/DDE server. Typically users create transaction profiles for their specific device but the Magnum III Advanced Kepware has worked closely with Magnum Foundation to provide a pre-configured profile for use with their controllers.

Download our free demo software:  
[www.kepware.com](http://www.kepware.com)



### Product Description Product ID #

U-CON Protocol Server OPC UCNPS NADL

or choose U-CON as a plug-in to KPServerEX

U-CON driver for KPServerEX OPC UCNPS NADL

For connectivity to Magnum controllers

Kepware provides a free U-CON profile for use with our User-Configurable driver/server products. Please contact us to obtain the .opj project file.

### Support:

1-800-775-1666

1-888-Kepware extension 211

support@kepware.com

### Sales:

1-800-775-1666

1-888-Kepware extension 228

sales@kepware.com

Please visit [www.kepware.com](http://www.kepware.com) for complete product listing

## Performance & Ease of Use:

- Kepware OPC servers are proven with HM, SCADA, HMI, and custom applications like Visual Basic, Visual Basic .NET, Excel, etc.
- Software includes Simulator driver and demo unit and source code
- License purchase includes 2 years of phone & unlimited email support
- No device or tag limits with licensed U-CON products
- Free product help files, user manual, FAQs, and serviceability guides

## Application Connectivity:

### OPC Data Access:

1.0a, 2.0, 2.05a, 3.0

### Additional Formats:

CF\_Text (DDE), Advanced DDE

FUD interface for HX; FastDDE & SubLink for Wonderware



## Which U-CON license do you need?

The U-CON Protocol Server is based upon the same technology found in our industry leading KPServerEX. The OPC/DDE server features are identical between U-CON Protocol Server and KPServerEX, but U-CON is used in applications where only configurable connectivity is needed. KPServerEX on the other hand is a single OPC server interface with multiple "plug-in" drivers for numerous additional connectivity to Allen Bradley, GE, Mitsubishi, Modicon/Modbus, Siemens, Yokogawa and more. So choose the U-CON plug-in for KPServerEX when you also need other types of connectivity supported through a single OPC server interface.

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# MALLORY PART # SC628P

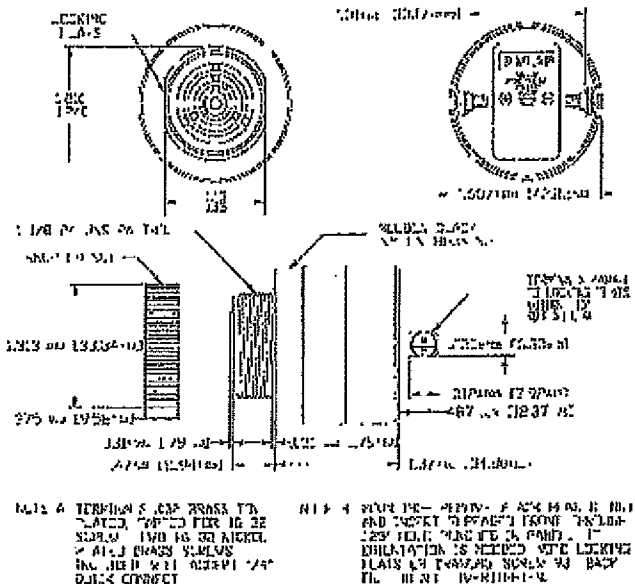
**MALLORY**

## Specifications:

|                         |                                   |
|-------------------------|-----------------------------------|
| Sound level Category    | Medium Sound Level                |
| Mode of Operation       | Fast Pulse                        |
| Mounting                | Panel (see note B)                |
| Voltage Rating          | 6 to 28 Vdc                       |
| Frequency               | 2900 Hz 1500 Hz                   |
| Loudness (Min. Voltage) | 68 dB(A) min. @ 2 FT and 6 Vdc    |
| Loudness (Max Voltage)  | 80 dB(A) min. @ 2 FT and 28 Vdc   |
| Current Draw            | 4 mA Max @ 6 Vdc                  |
| Current Draw            | 16 mA Max @ 28 Vdc                |
| Min. Pulse Rate         | 2 @ 6 VDC                         |
| Max. Pulse Rate         | 10 @ 28 VDC                       |
| Duty Cycle %            | 50 (Approx)                       |
| Storage Temperature     | -40°C to +85°C                    |
| Operating Temperature   | -30°C to +65°C                    |
| Weight (Typical)        | 1.5 oz (42 g)                     |
| Housing                 | 6/6 Nylon, Color Black            |
| Options                 | For other options contact factory |

## Dimensions: Inches (mm)

UL Recognized 



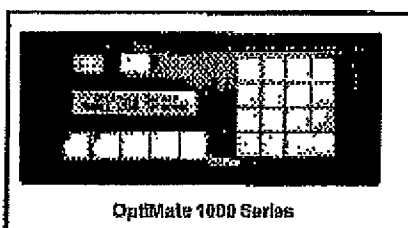
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# Nematron

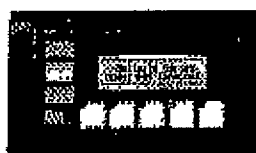
For more information or to request a quote, visit us online at [www.nematron.com](http://www.nematron.com)

## OptiMate® Series

Intelligent Operator Interface Peripherals for Control & I/O



OptiMate 1000 Series



OptiMate 600 Series



OptiMate 400 Series

### Overview

Nematron has sixteen operator interface terminals in the OptiMate Series. All of the terminals are compatible with the major brands of PLC's. The OptiMate Series is also compatible with computer or microprocessor based applications using the OptiMate Hex protocol.

All of the operator terminals are low cost, high performance, man/machine interface modules with a broad range of input and display capabilities. The OptiMate product line is the most cost-effective solution in control & I/O on the market today.

OptiMate modules are compatible with any computer that has either an RS232 or RS422 port. They are also compatible with many major PLC's (see PLC Compatibility Chart on page 2).

### Hazardous Locations Approvals

All OptiMate operator panels are available in models that are UL Class I, Division 2, Groups A, B, C, and D certified for use in hazardous conditions (see ordering information on page 4).

### Broad Compatibility

OptiMate operator panels are compatible with most major brands of PLCs, as well as PC or microprocessor-based applications using the OptiMate Hex protocol.

### Compatible PLC brands include:

- |                    |              |
|--------------------|--------------|
| * Allen Bradley    | * Mitsubishi |
| * AutomationDirect | * Modbus     |
| * Enteltron        | * Mexicon    |
| * GE Fanuc         | * Omron      |
| * IDEC             | * Siemens    |
| * Keyence          | * Toshiba    |
| * Koyo             |              |

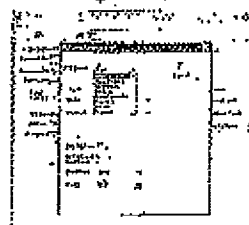
See PLC Accessory Cables on page 3.

### Easy-to-Use Software for OptiMate Panel Configuration

OM-WINEDIT is a graphical, user-friendly software program that runs on any Windows-compatible computer. It is available to configure any OptiMate panel system, or define all system parameters.



OM-WINEDIT can be downloaded from the Nematron.com website at no charge. It can also be purchased on CD-ROM and comes with OM-ACBL-1 and OM-CCBL cables to connect the PC and operator panels.



Our Configuration Editor, OM-WINEDIT is designed specifically for custom configuration of our equipment, allowing you maximum flexibility in customizing the way your panels will operate.

NEMATRON CORPORATION • 5849 Interfac Drive, Ann Arbor, MI 48103 • 1.800.NEMATRON (686-2876)

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# OPTIMATE PART# OM1124 & OM9001

## OptiMate Product Guide

### 1000 Series



**OM1124 Annunciator Panel**  
Eighteen LED pairs  
with 24 I/O light bars



**OM1212 Button/Lamp Panel**  
12 LED light bars and 12 pushbutton  
240s



**OM1224 Pushbutton Panel**  
24 pushbutton pads  
ready for custom labels



**OM1312 Setpoint Panel**  
Three 4-digit numeric displays  
and 12 numeric light bars



**OM1500 Operator Terminal**  
2x20 char. LCD with 100 msg.  
capacity base LCD light bars,  
16 pushbuttons, and 16 numeric



**OM1510 Operator Terminal**  
All the features of the OM1500,  
plus a configurable menu tree

### 600 Series



**OM609 Control Panel**  
8xLED light bars and  
four pushbutton pads



**OM618 Operator Panel**  
4-digit numeric display  
four numeric light bars,  
four LED light bars,  
four pushbutton pads



**OM620 Operator Panel**  
2x20 char. LCD with  
100 message capacity,  
configurable numeric light  
bars, pushbutton pads



**OM640 Operator Panel**  
4x20 char. LCD with  
400 message capacity,  
three LED light bars,  
four pushbutton pads

### 400 Series



**OM408**  
Indicator/Display Panel  
Six LED light bars and  
four pushbutton pads



**OM415**  
Setpoint/Display Panel  
One 4-digit numeric display  
and six numeric light bars



**OM414**  
Setpoint/Display Panel  
One 4-digit numeric display  
and six numeric light bars

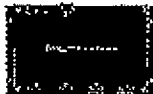


**OM420**  
2-Line Operator Panel  
2x20 char. LCD with 100 msg.  
capacity and four pushbutton pads



**OM440**  
4-Line Operator Panel  
4x20 char. LCD with  
400 message capacity

### OM9001 Communications Master



The OM9001 Communications Master provides an interface between your PLC and up to 31 connected OptiMate panels (1000 Series or 600 Series). The OM9001 communicates readily to the PLC, transferring register data in both directions, and consequently manages operations through the OptiMate panels. The Communications Master can be configured via the OptiMate Communications Master menu tree of your industry-standard PLC protocols. Baud rate, parity and character length specifications are interactively selectable to enable communications. Once configured, the OM9001 will continuously transfer data between all modules and the PLC to read and write the appropriate data registers. The OM9001 and the OptiMate panels take care of the rest.

### PLC Compatibility Chart

**How to Order:** Use the PLC Compatibility Chart below to determine the letter to append to the model number that you are ordering. Examples: To purchase an OM640 for use with an AB PLC, then the model number to order would be OM640C. For use with a Modbus PLC then it would be OM640H. A "-" indicates that the model is incompatible with the corresponding PLC.

| PLC Brand        | 400 Series | 600 Series | 1000 Series | OM9001 |
|------------------|------------|------------|-------------|--------|
| Allen Bradley    | G          | G          | A           | A      |
| AutomationDirect | B          | G          | A           | A      |
| Phoenix          | J          | J          | B           | -      |
| CE Fanuc         | -          | -          | A           | A      |
| DEC              | -          | -          | B           | -      |
| Keyence          | H          | H          | -           | -      |
| Mitsubishi       | I          | I          | B           | -      |
| Modbus           | H          | H          | A           | A      |
| Omron            | -          | -          | A           | A      |
| Toshiba          | -          | -          | A           | A      |
| OptiMate I/O     | GJHL       | GJHL       | AB          | -      |

www.nematron.com

2

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# OPTIMATE PART# OM1124 & OM9001

## OptiMate Accessories

**Configuration Cables - All Cables are 6 ft. long unless stated otherwise.**

|           |                                                                                 |
|-----------|---------------------------------------------------------------------------------|
| OM-ACBL-1 | Connects Indicon 900 or 1000 series panels and a PLC. (Also used with A/B PLCs) |
| OM-CCBL   | Connects between 400 series panels and PC                                       |

**PLC Communication Cables - All Cables are 6 ft. long unless stated otherwise.**

### Allen Bradley PLCs

|           |                                                                                       |
|-----------|---------------------------------------------------------------------------------------|
| OM-ACBL-1 | Connects any 900 or 1000 series OptiMate panel to an Allen Bradley SLC 500 or 600 PLC |
| OM-ACBL-2 | Connects any 900 or 1000 series OptiMate panel to an Allen Bradley Micrologix PLC     |
| OM-ACBL-3 | Connects any 400 series OptiMate panel to an Allen Bradley SLC 500 or 600             |
| OM-ACBL-4 | Connects any 400 series OptiMate panel to an Allen Bradley Micrologix PLC             |

### GE Fanuc PLCs

|           |                                                                            |
|-----------|----------------------------------------------------------------------------|
| OM-SCBL-1 | Connects any 1000 series OptiMate panel to GE Fanuc S11 Micro or 90/30 PLC |
|-----------|----------------------------------------------------------------------------|

### Koyo PLCs

|           |                                       |
|-----------|---------------------------------------|
| OM-KCBL-1 | OptiMate 400 series panel to Koyo PLC |
| OM-KCBL   | OptiMate 600 series panel to Koyo CPU |

### Koyo (Autonationaldirect.com) PLCs

|           |                                                                                                  |
|-----------|--------------------------------------------------------------------------------------------------|
| OM-2CBL   | OptiMate 600 or 1000 series to DL105, DL205, D3-3W or D4-45U CPU. 15 pin 'Y' shell to RJ12 Jack. |
| OM-2CBL-1 | OptiMate 600 or 1000 series to DL205 in-line port. 15 pin 'Y' shell to 15 pin 'Y' shell.         |
| OM-2CBL-2 | OptiMate 400 series to DL105, DL105, DL205, DL25U in SH450 CPU. RJ12 to RJ12.                    |
| OM-3CBL   | OptiMate 600 or 1000 series to DL340 CPU. 15 pin 'Y' shell to RJ11                               |
| OM-3CBL-1 | OptiMate 400 series to DL340 CPU. RJ12 to RJ11                                                   |
| OM-4CBL-1 | Connects 600 or 1000 series panel to DL405 CPU. 15 pin 'Y' shell to 15 pin 'Y' shell             |
| OM-4CBL-2 | Connects 600 or 1000 series panel to DL405 or DL350 CPU. 15 pin 'Y' shell to 25 pin 'Y' shell    |
| OM-4CBL-3 | Connects 400 series panel to DL405 CPU. RJ12 to 15 pin 'Y' shell                                 |

### Modicon PLCs

|           |                                             |
|-----------|---------------------------------------------|
| OM-MCBL-1 | OptiMate 600 or 1000 series to Modicon PLCs |
| OM-MCBL-2 | OptiMate 400 series to Modicon RJ45         |

## Power Supplies

|          |                                                                                                                                                                                                      |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OM-PS1   | Wall plug power supply for 1000 series, 1000 series panels. 24VDC (unregulated) @ 1A output.                                                                                                         |
| OM-PS400 | Wall plug power supply for 400 series panels. 5V @ 250mA with center negative. Required for configuration and for connection to PLCs that do not have a 5VDC connection on their communication port. |

## Light Bar Kits

|           |                             |
|-----------|-----------------------------|
| OM-GREEN  | 4-Pack of Green Light Bars  |
| OM-RED    | 4-Pack of Red Light Bars    |
| OM-YELLOW | 4-Pack of Yellow Light Bars |

## Connector Kits

|           |                                                                                                           |
|-----------|-----------------------------------------------------------------------------------------------------------|
| OM-CON-1  | Package of 4 ribbon cable connectors OM9001 to OptiMate connector.                                        |
| OM-CON-2  | Package of 4 solder type 15 pin (male) 'Y' shell connectors for OM9001 to OptiMate connector.             |
| OM-CON-3  | Package of 2, 15 pin 'Y' shell to 4 pin terminal block connectors for 600 or 1000 series H4422 connector. |
| OM-PS-CON | Package of 4 terminal plugs for power connection to 600 or 1000 series panels.                            |

## Configuration Software

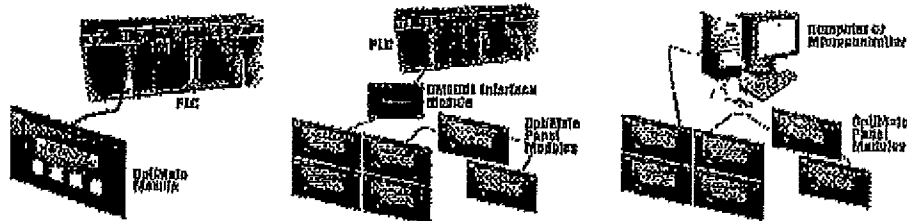
|            |                                                                                                                                                                                                         |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OM-WINEDIT | OptiMate panel configuration software on CD-ROM. Works with OM-ACBL-1 and OM-CCBL cables to connect the PC and operator panels. Software can be downloaded separately at no charge from Newtronics.com. |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

www.newtronics.com

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# Nematron

## Configuration Options



### PLC Stand Alone

Optimate modules plug directly into most PLCs. A simple RS232 cable connection allows you to interface and control the Optimate module via PLC data registers and ladder logic. To do this the operator terminal uses a bank of mapped PLC registers. Complete operator interface is performed using the PLC registers for display message selection, data entry, function key interface and indicator light control. The Optimate module continuously accesses these PLC registers and performs operations under ladder logic control on a real-time basis.

PLCs are slave devices on their standard communications ports. This means that a panel attached to the standard port must control the transfer of information by reading and writing the PLC registers. Optimate modules will perform this communications for most major PLC protocols.

### PLC Multi Modules

Larger systems involving operator panels can be configured using an OM9001 Communications Master and multiple 800 and 1600 series panels. This configuration uses an RS422 link with up to 31 modules installed on the communications cable. The OM9001 Communication translates data between the PLC and the individual Optimate modules. Modules can be located together to form custom modules or they can be distributed anywhere within 4000 feet.

The OM9001 Communications Master provides a transparent interface between the PLC and a group of Optimate modules. The communication interface between modules requires only four wires. The OM-WinEdit software program is used to configure both the OM9001 and the connected panels.

This modular approach to custom applications provides a nearly limitless number of possibilities.

### Microprocessor Based Systems

Optimate modules can also interface directly to most computers or microcontrollers using the Optimate Hex protocol. In a microprocessor based system, the host microprocessor is the system master. The Optimate modules are slave devices that respond to commands from the host. The Optimate Hex protocol is used to develop a program that allows the user to directly control Optimate module operation and retrieve operator inputs. A serial port is required and the modules communicate over either RS232 for a single panel configuration or RS422 for multiple panel configurations.

With RS422 communications modules can be located together to form custom modules or they can be distributed anywhere within 4000 feet.

## Ordering Information

### Ordering Optimate Panels with Class I, Div 2

To order Optimate panels with Class I, Div 2 approvals for hazardous locations, simply replace the "M" in the product number with an "H". For example, an OM406 and OM1612 would be ordered as OH406 and OH1612. The "X" represents the label designation of the brand of PLC required in your application. See PLC Compatibility Chart on the bottom of page 2.

Nematron and Optimate brand products are available worldwide through our network of factory-authorized distributors. For distributor contact information in your area, please visit our website at [www.nematron.com](http://www.nematron.com) and submit a Request for Quote or call Nematron's Customer Care Center at your nearest regional sales office. OM-WINEDIT software can be downloaded free of charge from the Nematron website.

### Contact Information

**US and Canadian Office -** Nematron Corporation  
8840 Interface Drive  
Ann Arbor, MI 48108 USA  
Tel: 1.734.294.2000  
Fax: 1.734.294.8174  
Email: [info@nematron.com](mailto:info@nematron.com)

**International Office -** Nematron Europe Ltd  
17A Somerset House, Hutton Court  
Watlington, Hampshire PO7 7SG UK  
Tel: +44 (0)23 8225 8888  
Fax: +44 (0) 23 8225 8001  
Email: [sales@nematron.eu](mailto:sales@nematron.eu)

For more information or to request a quote, visit us online at [www.nematron.com](http://www.nematron.com)

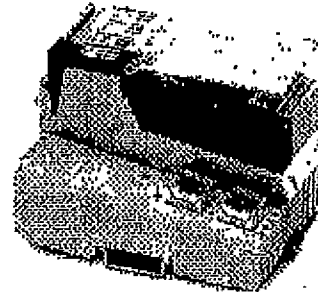
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**CATERPILLAR**



# IL ETH BK DI8 DO4 2TX-PAC

Order No.: 2703981



Modbus/RTU (UDP) bus coupler, 8 inputs, 24 V DC, 4 outputs, 24 V DC, 500 mA, complete with I/O connectors

Modbus/RTU (UDP)

## Commercial data

EAN 4046356041157  
 Pack 1 pos.  
 Customs tariff 85369091  
 Weight/Piece 0.8537 KG  
 Catalog page information Page 250 (AX-2000)

## Product notes

WEEE/RoHS-compliant since:  
 11/27/2007



<http://www.download.phoenixcontact.com>  
 Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation. The General Terms and Conditions of Use apply to Internet downloads.

## Product description

The bus coupler for the Modbus/RTU (UDP) protocol has 4 digital outputs and 8 digital inputs. This package contains all the necessary inline connectors for connecting the supply and the I/Os.

The inline terminals can be labeled using pull-out labeling fields. The fields have insert cards that can be labeled individually to suit the application. Additionally, there is the ZBF-M-6... Zack marker strip for labeling the terminal points.



# PHOENIX PART# 2703981

IL ETH BK DI8 DO4 2TX-PAC Order No.: 2703981

## Technical data

### Interface

|                    |                                                                |
|--------------------|----------------------------------------------------------------|
| Fieldbus system    | LoKobus                                                        |
| Name               | Inline local bus                                               |
| Type of connection | Inline data jumper                                             |
| Transmission speed | 500 kBit/s, 2 MBit/s (Automatic detection, no combined system) |
| Fieldbus system    | Modbus/TCP (UDP)                                               |
| Name               | Modbus/TCP (UDP)                                               |
| Type of connection | RJ45 socket, autoconfiguration                                 |
| Transmission speed | 10/100 MBit/s                                                  |
| Name               | Supply                                                         |
| Type of connection | 8 pos. inline connector                                        |

### Digital inputs

|                                |                                      |
|--------------------------------|--------------------------------------|
| Input name                     | Digital inputs                       |
| Description of the input       | HN 61 131-2 type 1                   |
| Type of connection             | Inline connectors                    |
| Connection method              | 2, 3-wire                            |
| Number of inputs               | 8                                    |
| Protective circuitry           | Polarity protection Suppressor diode |
| Input voltage                  | 24 V DC                              |
| Input voltage range "1" signal | 15 V DC ... 30 V DC                  |

### Digital outputs

|                                                    |                                                            |
|----------------------------------------------------|------------------------------------------------------------|
| Output name                                        | Digital outputs                                            |
| Type of connection                                 | Inline connectors                                          |
| Connection method                                  | 2, 3-wire                                                  |
| Number of outputs                                  | 4                                                          |
| Maximum output current per channel                 | 500 mA                                                     |
| Protective circuitry                               | Short circuit and overload protection Free running circuit |
| Output voltage                                     | 24 V DC -1 V (At nominal current)                          |
| Nominal output voltage                             | 24 V DC                                                    |
| Maximum output current per module / terminal block | 2 A                                                        |
| Maximum output current per module                  | 2 A                                                        |
| Nominal load, inductive                            | 12 VA                                                      |

**CATERPILLAR**

# PHOENIX PART# 2703981

IL ETH BK DI8 DO4 2TX-PAC Order No.: 2703981

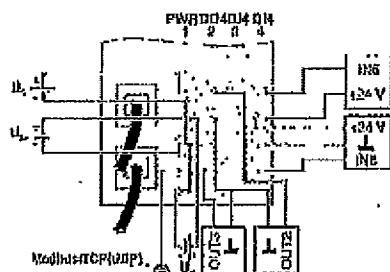
|                                            |                                                                                                                                                               |
|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nominal load, lamp                         | 12 W                                                                                                                                                          |
| Nominal load, ohmic                        | 12 W                                                                                                                                                          |
| <b>Power supply for module electronics</b> |                                                                                                                                                               |
| Supply voltage                             | 24 V DC                                                                                                                                                       |
| Range of supply voltages                   | 19.2 V DC ... 30 V DC                                                                                                                                         |
| Supply current                             | 70 mA                                                                                                                                                         |
| <b>General data</b>                        |                                                                                                                                                               |
| Width                                      | 80 mm                                                                                                                                                         |
| Height                                     | 119.8 mm                                                                                                                                                      |
| Depth                                      | 71.5 mm                                                                                                                                                       |
| Note on dimensions                         | Specifications with male connectors                                                                                                                           |
| Weight                                     | 375 g                                                                                                                                                         |
| Note on weight specifications              | With male connectors                                                                                                                                          |
| Ambient temperature (operation)            | -25 °C ... 55 °C                                                                                                                                              |
| Ambient temperature (storage/transport)    | -45 °C ... 55 °C                                                                                                                                              |
| Permissible humidity (operation)           | 10 % ... 85 % (As per EN 61131-2)                                                                                                                             |
| Permissible humidity (storage/transport)   | 10 % ... 85 % (As per EN 61131-2)                                                                                                                             |
| Air pressure (operation)                   | 70 kPa ... 106 kPa (up to 3000 m above sea level)                                                                                                             |
| Air pressure (storage/transport)           | 70 kPa ... 106 kPa (up to 3000 m above sea level)                                                                                                             |
| Degree of protection                       | IP20                                                                                                                                                          |
| Mechanical tests                           | Vibration resistance in acc. with IEC 60068-2-6 g<br>Shock test in acc. with IEC 60068-2-27 Operation: 25 g, 11 ms<br>duration, semi-sinusoidal shock impulse |
| Mounting type                              | DIN rail                                                                                                                                                      |
| <b>Inline potential routing</b>            |                                                                                                                                                               |
| Communications voltage $U_c$               | 7.5 V DC $\pm 5\%$                                                                                                                                            |
| Power supply for $U_c$                     | Max. 0.8 A DC                                                                                                                                                 |
| Supply for module circuit $U_m$            | 24 V DC -15% / +20% (in acc. with EN 61131-2)                                                                                                                 |
| Power supply for $U_m$                     | Max. 8 A DC (Sum of $U_c$ + $U_m$ )                                                                                                                           |
| Segment power supply voltage $U_s$         | 24 V DC -15% / +20% (in acc. with EN 61131-2)                                                                                                                 |
| Power supply for $U_s$                     | Max. 8 A DC (Sum of $U_c$ + $U_s$ )                                                                                                                           |
| Current consumption from $U_s$             | Max. 2 A                                                                                                                                                      |
| I/O supply voltage $U_{IO}$                | 24 V DC -15% / +20%                                                                                                                                           |
| Power supply for $U_{IO}$                  | Max. 0.5 A DC (observe derating)                                                                                                                              |

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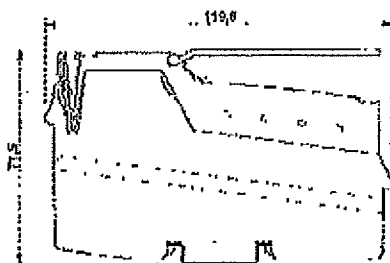
IL ETH BK D18 DO4 2TX-PAC Order No.: 2703981

Drawings

Connection diagram



Dimensioned drawing

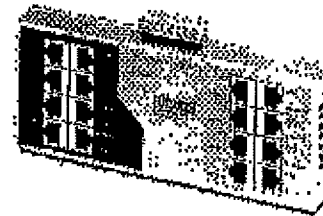


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## FL SWITCH SF 16TX

Order No.: 2832849



Ethernet Switch, 16 TP RJ45 ports, automatic detection of data transmission rate of 10 or 100 Mbit/s (RJ45), autocrossing function

### Commercial data

|                          |                    |
|--------------------------|--------------------|
| EAN                      | 4017918052211      |
| Pack                     | 1 pcs.             |
| Customs tariff           | 85176200           |
| Weight/Piece             | 0.598 KG           |
| Catalog page information | Page 108 (AX-2009) |

### Product notes

WEEE/RoHS-compliant since:  
08/03/2007



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### Technical data

#### Interfaces

|                      |                                               |
|----------------------|-----------------------------------------------|
| Interface            | Ethernet (RJ45)                               |
| No. of ports         | 16 RJ45 ports                                 |
| Type of connection   | RJ45 socket, autonegotiation and autocrossing |
| Transmission physics | Ethernet II RJ45 twisted pair                 |

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**PHOENIX PART# 2832849**

FL SWITCH SF 16TX Order No.: 2832849

|                                         |                                                                                                |
|-----------------------------------------|------------------------------------------------------------------------------------------------|
| Transmission speed                      | 10/100 MB/s (RJ45)                                                                             |
| Transmission length                     | 100 m (per segment)                                                                            |
| Signal LEDs                             | Data receive, link status                                                                      |
| Interface                               | Potential-free signaling contact                                                               |
| Type of connection                      | Plug-in/screw connection via COMBICON                                                          |
| <b>Function</b>                         |                                                                                                |
| Basic functionality                     | Unmanaged switch / autonegotiation, complies with IEEE 802.3, store and forward switching mode |
| Status and diagnostics displays         | LEDs: $U_{+}$ , $U_{-}$ (redundant voltage supply), link and activity per port                 |
| <b>Network extension parameters</b>     |                                                                                                |
| Cascading depth                         | Network, line and star structures any                                                          |
| Maximum conductor length (twisted pair) | 100 m                                                                                          |
| <b>Supply voltage</b>                   |                                                                                                |
| Supply voltage                          | 24 V DC                                                                                        |
| Residual ripple                         | 3.6 V <sub>ac</sub> (within the permitted voltage range)                                       |
| Range of supply voltages                | 18.6 V DC ... 30.2 V DC                                                                        |
| Typical current consumption             | Typ. 300 mA                                                                                    |
| Max. current consumption                | Typ.                                                                                           |
| <b>General data</b>                     |                                                                                                |
| Weight                                  | 360 g                                                                                          |
| Width                                   | 205 mm                                                                                         |
| Height                                  | 84.3 mm                                                                                        |
| Depth                                   | 30 mm                                                                                          |
| Degree of protection                    | IP20 in acc. with DIN 40050/IEC 60529                                                          |
| Ambient temperature (operation)         | 0 °C ... 55 °C                                                                                 |
| Ambient temperature (storage/transport) | -20 °C ... 70 °C                                                                               |
| Permissible humidity (operation)        | 20 % ... 85 % (non-condensing)                                                                 |
| Housing material                        | Aluminum                                                                                       |
| Electromagnetic compatibility           | Conformance with EMC directive 89/330/EEC                                                      |
| Emitted interference                    | EN 61000-6-4                                                                                   |
| Immunity to interference                | EN 61000-6-2:2005                                                                              |

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**FL SWITCH SF 16TX** Order No.: 2832849

**Conformity with EMC directives**

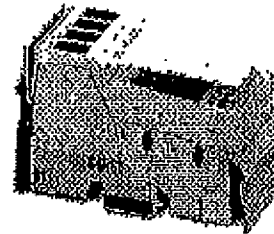
|                                 |                                                    |
|---------------------------------|----------------------------------------------------|
| Developed in acc. with standard | IEC 61000-0-2                                      |
| Test standard                   | IEC 61000-4-2 (ESD)                                |
| Test result                     | Criterion B                                        |
| Test standard                   | IEC 61000-4-3 (Immunity to radiated interference)  |
| Test result                     | Criterion A                                        |
| Test standard                   | IEC 61000-4-4 (burst)                              |
| Test result                     | Criterion B                                        |
| Test standard                   | IEC 61000-4-5 (surge)                              |
| Test result                     | Criterion B                                        |
| Test standard                   | IEC 61000-4-6 (immunity to conducted interference) |
| Test result                     | Criterion A                                        |
| Test standard                   | IEC 61000-4-8 (immunity to magnetic fields)        |
| Test result                     | Criterion A                                        |
| Test standard                   | EN 55022 (emitted interference)                    |
| Test result                     | Criterion A                                        |

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# IB IL 24 DI 16-ME

Order No.: 2897156



Inline digital input terminal, inline ME version (machine edition)  
complete with accessories (connector and labeling field), 16 inputs, 24  
V DC, 2, 3-conductor connection method

## Commercial data

EAN 4048358148207  
Pack 4 pcs.  
Customs tariff 85380001  
Weight/Volume 0.11348 kg  
Catalog page information Page 292 (IX-2008)

## Product notes

WEEE/ROHS-compliant since:  
11/18/2008



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## Technical data

### Interface

Fieldbus system INTERBUS  
Name Local bus  
Type of connection Inline data jumper  
Transmission rate 600 kBit/s

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Jun 9, 2009

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# PHOENIX PART# 2897156

IB IL 24 DI 16-ME Order No.: 2897156

|                                          |                                                   |
|------------------------------------------|---------------------------------------------------|
| Transmission physical                    | Copper                                            |
| Digital inputs                           |                                                   |
| Input name                               | Digital inputs                                    |
| Description of the input                 | EN 6131-2 type 1                                  |
| Type of connection                       | Spring-cage connection                            |
| Connection method                        | 3-conductor                                       |
| Number of inputs                         | 16                                                |
| Typical response time                    | < 1 ms                                            |
| Protective circuitry                     | Short circuit and overload protection             |
| Input voltage                            | 24 V DC (via voltage jumper)                      |
| Input voltage range "0" signal           | -3 V DC ... 5 V                                   |
| Input voltage range "1" signal           | 15 V DC ... 30 V DC                               |
| Power supply for module electronics      |                                                   |
| Supply voltage                           | 24 V DC (via voltage jumper)                      |
| Range of supply voltages                 | 19.2 V DC ... 30 V DC                             |
| Communication voltage U <sub>L</sub>     | 7.5 V (via voltage jumper)                        |
| Current consumption                      | Max. 80 mA (from the local bus)                   |
| General data                             |                                                   |
| Width                                    | 46.8 mm                                           |
| Height                                   | 119.8 mm                                          |
| Depth                                    | 71.5 mm                                           |
| Notes on dimensions                      | Housing dimensions                                |
| Weight                                   | 122 g                                             |
| Notes on weight specifications           | Without plug                                      |
| Ambient temperature (operation)          | -25 °C ... 65 °C                                  |
| Ambient temperature (storage/transport)  | -25 °C ... 85 °C                                  |
| Permissible humidity (operation)         | 10 % ... 95 % (According to DIN EN 6131-2)        |
| Permissible humidity (storage/transport) | 10 % ... 98 % (According to DIN EN 6131-2)        |
| Air pressure (operation)                 | 70 hPa ... 105 hPa (up to 3000 m above sea level) |
| Air pressure (storage/transport)         | 70 hPa ... 105 hPa (up to 3000 m above sea level) |
| Degree of protection                     | IP20                                              |
| Class of protection                      | Class 3 as per VDE 0100, IFC 0440                 |

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Jan B. 2009

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# PHOENIX PART# 2897156

IB IL 24 DI 16-ME Order No.: 2897156

|                                     |                                                                                                                                                                                                                                                                                                          |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test condition                      | 5 V supply, incoming remote bus/7.5 V supply (bus logics) 500 V AC 50 Hz 1 min<br>5 V supply, outgoing remote bus/7.5 V supply (bus logics) 500 V AC 50 Hz 1 min<br>7.5 V supply (bus logics)/24 V supply (I/O) 500 V AC 50 Hz 1 min<br>24 V supply (I/O) / functional earth ground 500 V AC 50 Hz 1 min |
| Mounting type                       | DIN rail                                                                                                                                                                                                                                                                                                 |
| In-line potential routing           |                                                                                                                                                                                                                                                                                                          |
| Communication voltage $U_c$         | 7.5 VDC                                                                                                                                                                                                                                                                                                  |
| Current consumption from $U_c$      | Max. 60 mA                                                                                                                                                                                                                                                                                               |
| Current consumption from $U_{IL}$   | 0 A DC                                                                                                                                                                                                                                                                                                   |
| Segment power supply voltage $U_s$  | 24 V DC (nominal value)                                                                                                                                                                                                                                                                                  |
| Current consumption from $U_s$      | Max. 4 A                                                                                                                                                                                                                                                                                                 |
| Current consumption from $U_{DATA}$ | 0 A DC                                                                                                                                                                                                                                                                                                   |

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Jun 9, 2008

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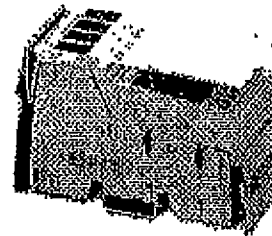
# PHOENIX PART# 2897253



Extract from the online  
catalog

## IB IL 24 DO 16-ME

Order No.: 2897253



<http://eshop.phoenixcontact.de/phoenix/treeView/Detail.do?UID=2897253>

Inline digital output terminal, inline ME version (machine edition)  
complete with accessories (connector and labeling field), 16 outputs,  
24 VDC, 600 mA, 2-3-conductor connection method

### Commercial data

|                          |                    |
|--------------------------|--------------------|
| EAN                      | 4046356140191      |
| Pack                     | 4 pcs.             |
| Customs tariff           | 85369091           |
| Weight/Piece             | 0.1692 KG          |
| Catalog page information | Page 282 (AX-3109) |

### Product notes

WEEE/RoHS-compliant since:  
11/13/2006



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### Technical data

#### Interface

|                    |                    |
|--------------------|--------------------|
| Modbus system      | INTERBUS           |
| Ratio              | Local bus          |
| Type of connection | Inline data jumper |
| Transmission rate  | 500 kbaud          |

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# PHOENIX PART# 2897253

IR II 24 DO 16-ME Order No.: 2897253

<http://shop.phoenixcontact.de/phoenixtreeViewClick.do?UII=2897253>

|                                          |                                                          |
|------------------------------------------|----------------------------------------------------------|
| Transmission physics                     | Copper                                                   |
| Digital outputs                          |                                                          |
| Output name                              | Digital outputs                                          |
| Type of connection                       | Spring-cage connection                                   |
| Connection method                        | 2, 3 wire                                                |
| Number of outputs                        | 16                                                       |
| Maximum output current per channel       | 500 mA                                                   |
| Protective sensitivity                   | Overload protection, short circuit protection of outputs |
| Output voltage                           | 24 V DC ( $U_n \pm 1 V$ )                                |
| Nominal output voltage                   | 24 V DC (voltage difference at $I_{out} \leq 1 A$ )      |
| Maximum output current per module        | 8 A                                                      |
| Nominal load, inductive                  | 12 W                                                     |
| Nominal load, lamp                       | 12 W                                                     |
| Nominal load, ohmic                      | 12 VA                                                    |
| Power supply for module electronics      |                                                          |
| Supply voltage                           | 24 V DC (nominal value)                                  |
| Range of supply voltages                 | 18.2 V DC ... 30 V DC                                    |
| Supply current                           | 80 mA                                                    |
| Communications voltage $U_c$             | 7.5 V (via voltage jumper)                               |
| Current consumption                      | Max. 80 mA (from the input bus)                          |
| Power consumption                        | Max. 0.675 W                                             |
| General data                             |                                                          |
| Width                                    | 48.8 mm                                                  |
| Height                                   | 110.8 mm                                                 |
| Depth                                    | 71.5 mm                                                  |
| Notes on dimensions                      | Housing dimensions                                       |
| Weight                                   | 130 g                                                    |
| Notes on weight specifications           | Without plug                                             |
| Ambient temperature (operation)          | -25 °C ... 55 °C                                         |
| Ambient temperature (storage/transport)  | -25 °C ... 85 °C                                         |
| Permissible humidity (operation)         | 10 % ... 95 % (According to DIN EN 61131-2)              |
| Permissible humidity (storage/transport) | 10 % ... 95 % (According to DIN EN 61131-2)              |
| Air pressure (operation)                 | 70 kPa ... 105 kPa (up to 3000 m above sea level)        |
| Air pressure (storage/transport)         | 70 kPa ... 105 kPa (up to 3000 m above sea level)        |

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Jan 8, 2010

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# PHOENIX PART# 2897253

ID IL 24 DO 16-ME Order No.: 2897253

<http://www.phoenixcontact.de/phoenix/treeViewClick.do?UID=2897253>

|                                   |                                                                                                                                                                                                                                                                                                       |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Degree of protection              | IP20                                                                                                                                                                                                                                                                                                  |
| Class of protection               | Class 3 as per VDE 0100, IEC 01440                                                                                                                                                                                                                                                                    |
| Test handling                     | 5 V supply, incoming remote bus/1.5 V supply (bus logic) 500 V AC 50 Hz 1 min<br>5 V supply, outgoing remote bus/1.5 V supply (bus logic) 500 V AC 50 Hz 1 min<br>1.5 V supply (bus logic)/24 V supply (I/O) 500 V AC 50 Hz 1 min<br>24 V supply (I/O) / functional earth ground 500 V AC 50 Hz 1 min |
| Diagnostic messages               | Short circuit overload of the digital output (can message in the diagnostic code (bus) and display (2 Hz) via the LED (D) on the module                                                                                                                                                               |
| Mounting type                     | DIN rail                                                                                                                                                                                                                                                                                              |
| Inline potential routing          |                                                                                                                                                                                                                                                                                                       |
| Communications voltage $U_L$      | 1.5 V DC                                                                                                                                                                                                                                                                                              |
| Current consumption from $U_L$    | Max. 90 mA                                                                                                                                                                                                                                                                                            |
| Supply power supply voltage $U_E$ | 24 V DC (nominal value)                                                                                                                                                                                                                                                                               |
| Current consumption from $U_E$    | Max. 0 A                                                                                                                                                                                                                                                                                              |

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## PHOENIX PART# 2897253

JB IL 24 DO 16-ME Order No.: 2897253  
<http://eshop.phoenixcontact.de/phoenix/treeViewCn3.do?CID=2897253>

### Address

PHOENIX CONTACT Inc., USA  
686 Filling Mill Road  
Middletown, PA 17057, USA  
Phone (800) 888 7388  
Fax (717) 844-1626  
<http://www.phoenixcontact.com>



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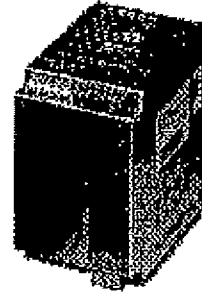
Page 414  
Jun 8, 2008

## CATERPILLAR



# QUINT-PS-100-240AC/24DC/10

Order No.: 2938604



DIN rail power supply unit 24 V DC/10 A, primary switched-mode, 1-phase

## Commercial data

|                          |                    |
|--------------------------|--------------------|
| PAN                      | 4017918890537      |
| Pack                     | 1 pcs.             |
| Customs tariff           | 85044081           |
| Weight/Piece             | 1.5057 KG          |
| Catalog page information | Page 481 (IF-2007) |

## Product notes

WEEE/RoHS-compliant since:  
04/19/2006



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## Product description

QUINT POWER is the high-capacity DC current supply of 80 - 960 watts for universal use worldwide. This is ensured by the wide-range input, one and three-phase versions as well as an international approval package that has yet to be matched. QUINT POWER stands for guaranteed supply: Generously dimensioned capacitors guarantee a mains buffering of more than 20 ms under full load. All three-phase devices provide the full output power, even in the event of a continuous phase failure. The Power Boost power reserve easily starts loads with high inrush currents and ensures that fuses are reliably triggered. A preventive function monitoring diagnoses improper operating states and minimizes downtime in your system. Remote monitoring is provided by an active transistor switching output and a floating relay contact. All devices are protected against idling and short circuits and are available with a regulated and adjustable output voltage of 12, 24 and 48 volts DC with output currents of 2.5, 5, 10, 20, 30 and 40 A. The comprehensive range of

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**PHOENIX PART# 2938604****QUINT-PS-100-240AC/24DC/10 Order No.: 2938604**

products is rounded off by power supplies for use in the Ex zone 2, uninterruptible solutions, AS-I power supplies and a Quint diode.

**Technical data****Input data**

|                              |                                                       |
|------------------------------|-------------------------------------------------------|
| Nominal input voltage        | 100 V AC ... 240 V AC                                 |
| AC input voltage range       | 85 V AC ... 264 V AC                                  |
| DC input voltage range       | 80 V DC ... 350 V DC                                  |
| AC frequency range           | 45 Hz ... 65 Hz                                       |
| DC frequency range           | 0 Hz                                                  |
| Current consumption          | Approx. 2.34 A (120 V AC)<br>Approx. 1.2 A (230 V AC) |
| Nominal power consumption    | 240 W                                                 |
| Inrush surge current         | < 16 A (typical)                                      |
| Power failure bypass         | > 80 ms (120 V AC)<br>> 60 ms (230 V AC)              |
| Input fuse                   | 6.3 A (slow-blow, internal)                           |
| Recommended backup fuse      | 10 A<br>16 A (characteristic B)                       |
| Name of protection           | Transient surge protection                            |
| Protective circuit/component | Variator                                              |

**Output data**

|                                      |                                                                                                                                            |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Nominal output voltage               | 24 V DC $\pm 1\%$                                                                                                                          |
| Setting range of the output voltage  | 22.5 V DC ... 28.5 V DC                                                                                                                    |
| Output current                       | 10 A (up to 60 °C)<br>15 A (with POWER BOOST)                                                                                              |
| Connection in parallel               | Yes, for redundancy and increased capacity                                                                                                 |
| Connection in series                 | Yes                                                                                                                                        |
| Max. capacitive load                 | Unlimited                                                                                                                                  |
| Current limitation                   | on. $I_{peak} = 15$ A (for short circuit)                                                                                                  |
| Control deviation                    | < 1 % (change in load, static 10% ... 80%)<br>< 2 % (change in load, dynamic 10% ... 80%)<br>< 0.1 % (change in input voltage $\pm 10\%$ ) |
| Residual ripple                      | < 10 mVPP (with nominal values)                                                                                                            |
| Peak switching voltages nominal load | < 60 mVPP (20 MHz)                                                                                                                         |
| Maximum power dissipation idling     | 2 W                                                                                                                                        |

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# PHOENIX PART# 2938604

QUINT-PS-100-240AC/24DC/10 Order No.: 2938604

Power loss nominal load max.

24 W

## General data

|                                                                                                                                  |                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Width                                                                                                                            | 85 mm                                                                      |
| Height                                                                                                                           | 130 mm                                                                     |
| Depth                                                                                                                            | 125 mm                                                                     |
| Weight                                                                                                                           | 1,3 kg                                                                     |
| Operating voltage display                                                                                                        | LED green                                                                  |
| Efficiency                                                                                                                       | > 91 %                                                                     |
| Insulation voltage input/output                                                                                                  | 4 kV AC (type test)<br>2 kV AC (routine test)                              |
| Degree of protection                                                                                                             | IP20                                                                       |
| Class of protection                                                                                                              | I, with PE connection                                                      |
| MTBF                                                                                                                             | > 500 000 h in acc. with IEC 61709 (SN29500)                               |
| Ambient temperature (operation)                                                                                                  | -25 °C ... 70 °C (> 60 °C derating)                                        |
| Ambient temperature (storage/transport)                                                                                          | -40 °C ... 85 °C                                                           |
| Max. permissible relative humidity (operation)                                                                                   | 85 % (at 25 °C, no condensation)                                           |
| Mounting position                                                                                                                | Horizontal DIN rail NS 35, EN 60715                                        |
| Assembly instructions                                                                                                            | Can be aligned: Horizontal 0 cm, vertical 5 cm                             |
| Electromagnetic compatibility                                                                                                    | Conformance with EMC directive 89/336/EEC                                  |
| Emitted interference                                                                                                             | EN 60984-2                                                                 |
| Immunity to interference                                                                                                         | EN 61000-6-2                                                               |
| Standard - Electrical equipment of machines                                                                                      | EN 60204                                                                   |
| Standard - Safety of transformers                                                                                                | EN 61558-2-17                                                              |
| Standard - Electrical safety                                                                                                     | EN 60950/VDE 0805 (SELV)                                                   |
| Standard - Shipbuilding                                                                                                          | German Lloyd, ABS                                                          |
| Standard - Electronic equipment for use in electrical power installations and their assembly into electrical power installations | EN 50178/VDE 0160 (PELV)                                                   |
| Standard - Safe isolation                                                                                                        | DIN VDE 0100-410<br>DIN VDE 0106-1010<br>DIN 57100-410<br>DIN VDE 0106-101 |
| Standard - Protection against electric shock                                                                                     | DIN 57100-410                                                              |
| Standard - Protection against shock currents, basic requirements for protective separation in electrical equipment               | DIN VDE 0106-101                                                           |
| Standard - Limitation of mains harmonic currents                                                                                 | EN 61000-3-2                                                               |
| Standard - Equipment safety                                                                                                      | GS (tested safely)                                                         |

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# PHOENIX PART# 2938604

QUINT-PS-100-240AC/24DC/10 Order No.: 2938604

|                                        |                                                                                                                       |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Certification                          | CB Scheme                                                                                                             |
| UL approvals                           | UL/C-UL Recognized UL 60950<br>UL/C-UL Listed UL 508<br>UL/C-UL Listed UL 1804 Class 1, Division 2, Groups A, B, C, D |
| Surge voltage category                 | III                                                                                                                   |
| <b>Connection data, input</b>          |                                                                                                                       |
| Type of connection                     | Pluggable screw connection                                                                                            |
| Conductor cross section solid min.     | 0.2 mm <sup>2</sup>                                                                                                   |
| Conductor cross section solid max.     | 2.5 mm <sup>2</sup>                                                                                                   |
| Conductor cross section stranded min.  | 0.2 mm <sup>2</sup>                                                                                                   |
| Conductor cross section stranded max.  | 2.5 mm <sup>2</sup>                                                                                                   |
| Conductor cross section AWG/kcmil min. | 24                                                                                                                    |
| Conductor cross section AWG/kcmil max. | 12                                                                                                                    |
| Stripping length                       | 7 mm                                                                                                                  |
| Screw thread                           | M3                                                                                                                    |
| <b>Connection data, output</b>         |                                                                                                                       |
| Type of connection                     | Pluggable screw connection                                                                                            |
| Conductor cross section solid min.     | 0.2 mm <sup>2</sup>                                                                                                   |
| Conductor cross section solid max.     | 2.5 mm <sup>2</sup>                                                                                                   |
| Conductor cross section stranded min.  | 0.2 mm <sup>2</sup>                                                                                                   |
| Conductor cross section stranded max.  | 2.5 mm <sup>2</sup>                                                                                                   |
| Conductor cross section AWG/kcmil min. | 24                                                                                                                    |
| Conductor cross section AWG/kcmil max. | 12                                                                                                                    |
| Stripping length                       | 7 mm                                                                                                                  |
| <b>Signaling</b>                       |                                                                                                                       |
| Output name                            | DC OK active                                                                                                          |
| Output description                     | $U_{out} > 0.9 \times U_N$ 1 ligh signal                                                                              |
| Maximum switching voltage              | ≤ 24 V                                                                                                                |
| Output voltage                         | ± 24 V DC (signal)                                                                                                    |
| Maximum inrush current                 | ≤ 40 mA                                                                                                               |
| Continuous load current                | < 40 mA                                                                                                               |
| Status display                         | "DC OK" LED green                                                                                                     |
| Note on status display                 | $U_{OUT} < 0.9 \times U_N$ : LED flashing                                                                             |
| Conductor cross section solid min.     | 0.2 mm <sup>2</sup>                                                                                                   |

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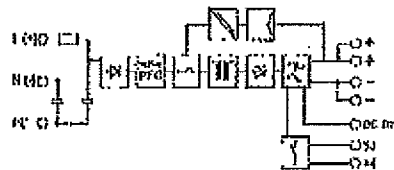
# PHOENIX PART# 2938604

QUINT-PS-100-240AC/24DC/10 Order No.: 2938604

|                                        |                                                            |
|----------------------------------------|------------------------------------------------------------|
| Conductor cross section solid max.     | 2.5 mm <sup>2</sup>                                        |
| Conductor cross section stranded min.  | 0.2 mm <sup>2</sup>                                        |
| Conductor cross section stranded max.  | 2.5 mm <sup>2</sup>                                        |
| Conductor cross section AWG/kcmil min. | 24                                                         |
| Conductor cross section AWG/kcmil max. | 12                                                         |
| Tightening torque, min.                | 0.5 Nm                                                     |
| Tightening torque max.                 | 0.6 Nm                                                     |
| Screw thread                           | M3                                                         |
| Output name                            | DC OK floating                                             |
| Output description                     | Relay contact, $U_{out} > 0.9 \times U_N$ ; Contact closed |
| Maximum switching voltage              | < 30 V AC/DC                                               |
| Maximum inrush current                 | ≤ 1 A                                                      |
| Continuous load current                | < 1 A                                                      |
| Status display                         | "DC OK" LED green                                          |

## Drawings

### Block diagram



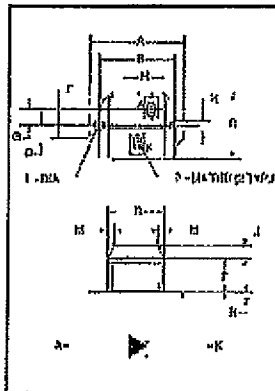
CATERPILLAR

# POWEREX PART# CS241210

**POWEREX**

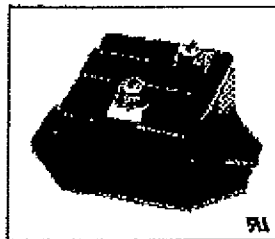
Powerex, Inc., 200 Hills Street, Youngwood, Pennsylvania 15097-1800 (724) 828-7272

**Fast Recovery Single Diode Modules**  
100 Amperes/600-1200 Volts



Outline Drawing

| Dimension | Inches      | Millimeters |
|-----------|-------------|-------------|
| A         | 2.087       | 53          |
| B         | 1.705±0.008 | 43.31±0.2   |
| C         | 1.417       | 36          |
| D         | 1.289       | 33          |
| E         | 0.865       | 22          |
| F         | 0.551       | 14          |
| G         | 0.354       | 9           |
| H         | 0.315       | 8           |
| J         | 0.275       | 7           |
| K         | 0.247       | 6.3         |
| L         | 0.217 Dia   | Dia 5.5     |
| M         | 0.138       | 3.5         |
| N         | 0.118       | 3           |
| P         | M Molds     | M4          |



**CS241210**  
Fast Recovery Single Diode Modules  
100 Amperes/600-1200 Volts

## Description:

Powerex Fast Recovery Single Diode Modules are designed for use in applications requiring fast switching. The modules are isolated for easy mounting with either components on common heatinks. POW R BLOCK™ has been tested and recognized by Underwriters Laboratories (UL) as Power Switching Semiconductors.

## Features:

- ☐ Isolated Mounting
- ☐ Planar Chips
- ☐ UL Recognized **RA**

## Applications:

- ☐ Inverters
- ☐ Choppers
- ☐ Switching Power Supplies
- ☐ Free Wheeling

## Ordering Information:

Select the complete eight digit module part number you desire from the table below.

Example: CS241210 is a 1200 Volt, 100 Ampere Fast Recovery Single Diode Module.

| Type | Voltage Volts (V <sub>RRM</sub> ) | Current Rating Amperes (A <sub>RRM</sub> ) |
|------|-----------------------------------|--------------------------------------------|
| CS24 | 12                                | 10                                         |

**CATERPILLAR**

# POWEREX PART# CS241210



Powerex, Inc., 200 Hills Street, Youngwood, Pennsylvania 15667-1809 (724) 825-7272

CS241210

Fast Recovery Single Diode Modules  
160 Ampere/200 1700 Volts

## Absolute Maximum Ratings

| Characteristic                                                               | Symbol      |
|------------------------------------------------------------------------------|-------------|
| Peak Reverse Blocking Voltage                                                | $V_{RRM}$   |
| Threshold Peak Reverse Blocking Voltage (Non-Repetitive), $t < 1 \text{ ms}$ | $V_{RRM}$   |
| DC Reverse Blocking Voltage                                                  | $V_{R(DC)}$ |
| DC Current, $T_C = 25^\circ\text{C}$                                         | $I_F(DC)$   |
| Peak One-Cycle Surge (Non-Repetitive) On-State Current (50Hz)                | $I_{FSM}$   |
| Peak One-Cycle Surge (Non-Repetitive) On-State Current (50Hz)                | $I_{FSM}$   |
| (21 Hot Loading), 6.3 milliseconds                                           | $I_2$       |
| Storage Temperature                                                          | $T_{STG}$   |
| Operating Temperature                                                        | $T_J$       |
| Maximum Mounting Torque M3 Mounting Screw                                    | —           |
| Maximum Mounting Torque M4 Terminal Screw                                    | —           |
| Module Weight (Typical)                                                      | —           |
| V Isolation                                                                  | $V_{RMS}$   |

| CS241210   | Units            |
|------------|------------------|
| 1200       | Volts            |
| 1250       | Volts            |
| 900        | Volts            |
| 100        | Amps             |
| 2000       | Amps             |
| 1820       | Amps             |
| 10700      | Amps             |
| 40 to 125  | $^\circ\text{C}$ |
| -40 to 125 | $^\circ\text{C}$ |
| 17         | in.-lb.          |
| 12         | in.-lb.          |
| 80         | grams            |
| 2500       | Volts            |

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# POWEREX PART# CS241210



Powerex, Inc., 200 Hills Street, Youngwood, Pennsylvania 15097-1800 (724) 828-7272

CS241210  
Fast Recovery Single Diode Modules  
100 Amperes/600-1200 Vols

Electrical and Thermal Characteristics,  $T_J = 25^\circ\text{C}$  unless otherwise specified

| Characteristics                             | Symbol            | Test Conditions                                                                                               | CS241210 | Units                        |
|---------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------|----------|------------------------------|
| Blocking State Maximums                     |                   |                                                                                                               |          |                              |
| Reverse Leakage Current, Peak               | $I_{RRM}$         | $T_J = 150^\circ\text{C}$ , $V_{RRM} = \text{Rated}$                                                          | 20       | nA                           |
| Conducting State Maximums                   |                   |                                                                                                               |          |                              |
| Peak On-State Voltage                       | $V_{FEM}$         | $I_F = 100\text{A}$                                                                                           | 1.5      | Volts                        |
| Switching Minimums                          |                   |                                                                                                               |          |                              |
| Reverse Recovery Time                       | $t_{rr}$          | $I_{FM} = 100\text{A}$ , $T_J = 150^\circ\text{C}$<br>$dI/dt = 200\text{A}/\mu\text{s}$ , $V_R = 1/2 V_{RRM}$ | 0.5      | $\mu\text{s}$                |
| Reverse Recovery Charge                     | $Q_{rr}$          | $I_{FM} = 100\text{A}$ , $T_J = 150^\circ\text{C}$<br>$dI/dt = 200\text{A}/\mu\text{s}$ , $V_R = 1/2 V_{RRM}$ | 50       | $\mu\text{C}$                |
| Thermal maximums                            |                   |                                                                                                               |          |                              |
| Typical Resistance, Junction to Case        | $R_{\theta(j-c)}$ | Per Module                                                                                                    | 0.5      | $^\circ\text{C}/\text{Watt}$ |
| Thermal Resistance, Case-to-Sink (Soldered) | $R_{\theta(c-s)}$ | Per Module                                                                                                    | 0.15     | $^\circ\text{C}/\text{Watt}$ |

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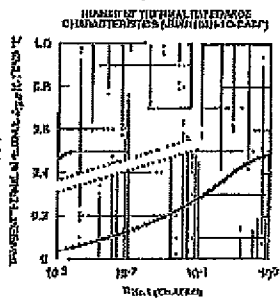
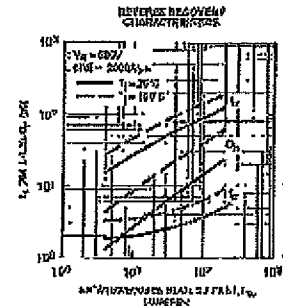
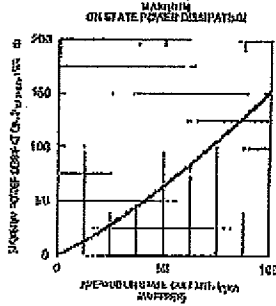
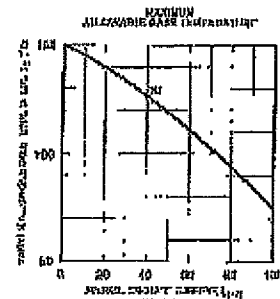
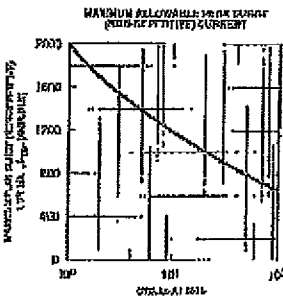
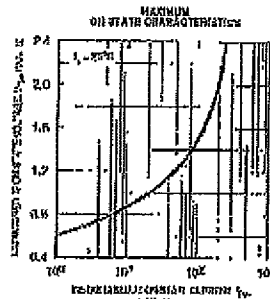
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# POWEREX PART# CS241210

**POWEREX**

Powerex, Inc., 200 Hills Street, Youngstown, Pennsylvania 15807-1800 (724) 845-7272

CS241210  
Dual SCR POW-R-SLOK™ Modules  
100 Amps/600-1200 Volts



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## RSVIEW32 v7.20

### OVERVIEW

RSView32™ is an integrated, component-based HMI software product for industrial automation, process control, and supervisory monitoring. It enables operators to interact with automation machines and processes while providing a flexible, easy-to-use design environment for control engineers to create, test, and deploy HMI solutions for real-world applications.



RSView32 is an open system that allows plant floor data to be shared with other manufacturing systems throughout the enterprise. This provides a vital link to real time manufacturing information for the enterprise to achieve process optimization and increase productivity. Designed for Microsoft® Windows® environments, RSView32 integrates easily with the Rockwell Software integrated product line, Microsoft products, and other third-party offerings.

You can extend your RSView32 applications with the RSView32 Active Display System™, a client/server option that allows you to interact with your RSView32 applications remotely — across either a Local Area Network or the Internet.

RSView32 products include:

- **RSView32 Works** — includes both the development and runtime software to create, test, and run RSView32 applications.
- **RSView32 Runtime** — includes the runtime software to deploy and run RSView32 applications.

Additional RSView32 products:

- **RSView32 Active Display System** — a client/server application that extends the reach of your HMI application to virtually any computer on a network. (See VV32AD-TD001B-EN-E)
- **RSView32 WebServer** — allows anyone with a valid RSView32 user account to connect to an RSView32 project over the Internet. (See VVDSRV-TD001B-RS-1)
- **RSView32 MessengerPro** — provides additional Messenger features that allow you to dial in using a regular phone line to hear and respond to status and run RSView32 commands or macros.

### FEATURES

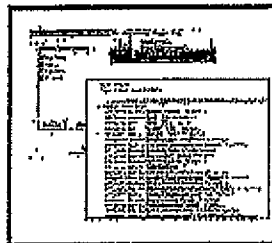
Get started quickly with RSView32's point-and-click access to its options and many of its functions. An intuitive folder system makes it easy to organize project files. To switch between the development and runtime systems, you simply click the tabs in the convenient Project Manager. It's quick and easy to change your project on the fly during runtime.

### POWERFUL GRAPHICS EDITOR

Design high-level graphics for even the most complex application using the RSView32 drawing environment. You can also use graphic files from other drawing software, such as AutoCAD®, CorelDRAW®, and Photoshop®. And you can add animations to vector-based graphic objects.

#### Graphic Import/Export Wizard

The new Graphics Import/Export Wizard in RSView32 v7.20 lets you export complete graphic displays as XML (Extensible Markup Language) files. You can edit the elements and attributes you need for your graphic displays using an external programming tool or



XML editor and then import the file back into RSView32 to modify the existing graphic objects or create a new display.

**CATERPILLAR®**

## Customize the look of graphic displays

RSView32 offers a full set of display setup features, including background color, highlight color, input field text and fill colors, scaling, window size and position, security code, and startup and shutdown commands. You can also set default values so that all graphic displays in a project share similar characteristics.

Use any of the standard Windows colors for objects in graphic displays, or create your own custom colors. To draw an operator's attention to an object at runtime, animate the object to change color as its value changes, using up to 16 different color options.

## Copy and paste animations

After attaching animation to an object, copy the animation and paste it onto another object. If the object has more than one type of animation, all animation is copied and pasted with a single click.

## Edit objects and properties as a group

To edit a common property of several objects (for example, their color, size, or orientation), group the objects together and then change all of them with just one click.

## Simulate runtime with the click of a button

During development, quickly test the animations in a graphic display by clicking a button on the toolbar. RSView32 immediately simulates run mode from within the graphics editor without starting the runtime software. To continue editing, simply click another toolbar button.

## Represent multiple machines with a single graphic display

When you create the graphic objects in a display, assign tag placeholders to the objects instead of tag names, and assign a parameter file to the graphic display. A parameter file defines the tags that the graphic display uses at runtime. To change the tags associated with all of the objects on a graphic display at runtime, simply change the parameter file. A single graphic display can handle information for many similar sources — so you have fewer graphic displays to create, edit, save, and update.

## Build commands by pointing and clicking

You don't have to remember complicated command names and syntax; the command wizard in RSView32 steps you through the process with lists, prompts, and check boxes. To run commands quickly during either development or runtime, use the built-in command line.

## Enter input with an on-screen keyboard

The on-screen keyboard allows operators of touch-screen terminals to enter input without a keyboard attached to the terminal. When the on-screen keyboard is enabled for a graphic display, a keypad opens when the operator selects an input field. If the operator selects a text input field, a full QWERTY keypad opens. If the operator selects a numeric input field, a numeric keypad opens.

## Continuously update hidden graphics

Even when hidden from view, displays can remain actively running or collecting data at the configured scan rate. For example, use this feature to keep an ActhruX™ control running continuously or to update real-time trend data, even if the graphic display is closed.

## Continuously update input fields

To help you track a tag's value, configure an input field to update continuously with its current value, while pausing when you enter values manually.

## Resize objects and graphic displays

RSView32 automatically scales objects on a graphic display to fit the runtime screen resolution. This eliminates the need for configuring separate graphic displays for different display resolutions.

## Document objects with pop-up tool tips

Assist runtime operators by adding pop-up tool tips to buttons and other touch-control objects.

## Animate objects with changing colors

Edit a common property of several objects (for example, their color, size, or orientation) by grouping the objects and then changing all of the properties with just one click.

## Animate motion by clicking and dragging

With Object Smart Path™, animate an object's range of motion by simply dragging the object from its starting point to its final position. RSView32 automatically calculates the pixel offset and moves the object through the range at runtime, eliminating counting pixels, taking measurements, and trial and error.

## Simplify tag replacement by using parameter files

When you create the graphic objects in a display, assign tag placeholders to the objects instead of tag names, and assign a parameter file to the graphic display. A parameter file defines the tags that the graphic display uses at runtime. To change the tags associated with all of the objects on a graphic display at runtime, simply change the parameter file. A single graphic display can handle information for many similar sources — so you have fewer graphic displays to create, edit, save, and update.

## Replace tag names and character strings quickly

Like tag substitution lets you quickly replace the tag names or placeholders, comments, macros, file names, or command parameters associated with all currently selected graphic objects. This timesaving feature allows you to change quickly a large number of tag names or other character strings associated with multiple objects without editing each object individually.

**CATERPILLAR**

1                                   **IN THE SUPREME COURT OF THE STATE OF NEVADA**

2  
3  
4   CASHMAN EQUIPMENT COMPANY,  
5   a Nevada corporation,

6                                   Appellant,

7   vs.

8  
9   WEST EDNA ASSOCIATES, LTD., dba  
10   MOJAVE ELECTRIC, a Nevada  
11   corporation; WESTERN SURETY  
12   COMPANY, a surety; THE WHITING  
13   TURNER CONTRACTING  
14   COMPANY, a Maryland corporation;  
15   FIDELITY AND DEPOSIT COMPANY  
16   OF MARYLAND, a surety;  
17   TRAVELERS CASUALTY AND  
18   SURETY COMPANY OF AMERICA, a  
19   surety; QH LAS VEGAS LLC, a foreign  
20   limited liability company; PQ LAS  
21   VEGAS, LLC, a foreign limited liability  
22   company; L W T I C SUCCESSOR LLC,  
23   an unknown limited liability company;  
24   FC/LW VEGAS, a foreign limited  
25   liability company;

26                                   Respondents.

                                  Electronically Filed  
**Case No: 66452** Jun 17 2015 01:03 p.m.  
**Case No: 61715** Tracie K. Lindeman  
**Case No: 65819** Clerk of Supreme Court

District Court Case Nos.:   **A642583 &**  
                                                          **A653029**

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| 38 | Defendants’ Motion for Summary Judgment of Surety Payment and License Bond Claims                                                                                                                                | 08/30/2012 | 2   | JA000467-98  |
| 39 | Opposition to Cashman’s Motion for Reconsideration of Order Granting in Part Counter-claimants’ Motion for Preliminary Injunction to Procure Codes or Alternatively Motion for Clarification and Request for OST | 09/07/2012 | 2-3 | JA000499-609 |

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| 97 | Reply to Cashman's Opposition to Motion for Relief Pursuant to NRCP 60(b) and Motion for Attorneys' Fees and Costs Pursuant to NRS Ch. 108 | 04/23/2014 | 31    | JA0007694-7707 |
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| 75  | Order<br>Rescheduling<br>Pretrial/Calendar<br>Call                                                                                                | 04/17/2013 | 10 | JA0002388-89 |
| 18  | Order Setting Civil<br>Non-Jury Trial,<br>Pre-Trial/Calendar<br>Call                                                                              | 02/21/2012 | 1  | JA000145-46  |
| 32  | Order Setting Civil<br>Non-Jury Trial,<br>Pre-Trial/Calendar<br>Call                                                                              | 08/06/2012 | 2  | JA000405-06  |

|    |    |                                                                                                                                                                                                |            |          |                    |
|----|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------|--------------------|
| 1  | 84 | Order Setting Civil<br>Non-Jury Trial,<br>Pre-Trial/Calendar<br>Call                                                                                                                           | 09/06/2013 | 10       | JA0002488-90       |
| 2  |    |                                                                                                                                                                                                |            |          |                    |
| 3  |    |                                                                                                                                                                                                |            |          |                    |
| 4  | 88 | Order Setting Civil<br>Non-Jury Trial,<br>Pre-Trial/Calendar<br>Call                                                                                                                           | 10/1/2013  | 11       | JA0002503-05       |
| 5  |    |                                                                                                                                                                                                |            |          |                    |
| 6  |    |                                                                                                                                                                                                |            |          |                    |
| 7  |    |                                                                                                                                                                                                |            |          |                    |
| 8  | 90 | Plaintiff's Trial<br>Brief                                                                                                                                                                     | 01/16/2014 | 11       | JA0002534-59       |
| 9  |    |                                                                                                                                                                                                |            |          |                    |
| 10 | 66 | QH Las Vegas,<br>LLC, PQ Las<br>Vegas, LLC,<br>LWTIC Successor,<br>LLC, and FC/LW<br>Vegas Motion to<br>Dismiss, or in the<br>alternative, Motion<br>for Summary<br>Judgment                   | 02/07/2013 | 5-6      | JA0001241-<br>1355 |
| 11 |    |                                                                                                                                                                                                |            |          |                    |
| 12 |    |                                                                                                                                                                                                |            |          |                    |
| 13 |    |                                                                                                                                                                                                |            |          |                    |
| 14 |    |                                                                                                                                                                                                |            |          |                    |
| 15 |    |                                                                                                                                                                                                |            |          |                    |
| 16 |    |                                                                                                                                                                                                |            |          |                    |
| 17 |    |                                                                                                                                                                                                |            |          |                    |
| 18 | 74 | QH Las Vegas,<br>LLC, PQ Las<br>Vegas, LLC,<br>LWTIC Successor,<br>LLC, and FC/LW<br>Vegas Reply to<br>their Motion to<br>Dismiss, or in the<br>alternative, Motion<br>for Summary<br>Judgment | 04/05/2013 | 9-<br>10 | JA0002102-<br>2387 |
| 19 |    |                                                                                                                                                                                                |            |          |                    |
| 20 |    |                                                                                                                                                                                                |            |          |                    |
| 21 |    |                                                                                                                                                                                                |            |          |                    |
| 22 |    |                                                                                                                                                                                                |            |          |                    |
| 23 |    |                                                                                                                                                                                                |            |          |                    |
| 24 |    |                                                                                                                                                                                                |            |          |                    |
| 25 |    |                                                                                                                                                                                                |            |          |                    |
| 26 | 81 | QH Las Vegas, PQ<br>Las Vegas, LWITC<br>Successor and<br>FC/LW Vegas'                                                                                                                          | 06/11/2013 | 10       | JA0002441-61       |
| 27 |    |                                                                                                                                                                                                |            |          |                    |
| 28 |    |                                                                                                                                                                                                |            |          |                    |

|     |                                                                                                                                             |            |    |                |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------|------------|----|----------------|
|     | Answer to Fourth Amended Complaint                                                                                                          |            |    |                |
| 59  | Reply in Support of Motion to Amend Complaint                                                                                               | 12/17/2012 | 5  | JA0001127-48   |
| 31  | Reply to Cashman's Opposition to Motion for Injunctive Relief or Writ of Possession                                                         | 07/31/2012 | 2  | JA000398-404   |
| 97  | Reply to Cashman's Opposition to Motion for Relief Pursuant to NRCPP 60(b) and Motion for Attorneys' Fees and Costs Pursuant to NRS Ch. 108 | 04/23/2014 | 31 | JA0007694-7707 |
| 56  | Reply to Cashman's Opposition to Motion to Expunge or Reduce Mechanic's Lien                                                                | 11/02/2012 | 5  | JA0001102-11   |
| 15  | Scheduling Order                                                                                                                            | 01/31/2012 | 1  | JA000126-28    |
| 4   | Second Amended Complaint                                                                                                                    | 09/30/2011 | 1  | JA00034-50     |
| 113 | Stipulation and Order for                                                                                                                   | 05/08/2015 | 32 | JA0007834-36   |

|    |                                                                                                                                      |            |   |                |
|----|--------------------------------------------------------------------------------------------------------------------------------------|------------|---|----------------|
|    | Dismissal of Defendants Fidelity and Deposit Company of Maryland and Travelers Casualty and Surety Company of America with Prejudice |            |   |                |
| 73 | Supplement to Cashman's Supplement to its Countermotion for Summary Judgment on its Payment Bond and Mechanic's Lien Claims          | 04/05/2013 | 9 | JA0002095-2101 |
| 24 | Third Amended Complaint                                                                                                              | 05/24/2012 | 2 | JA000276-94    |
| 36 | Transcript of Proceedings for August 3, 2012                                                                                         | 08/22/2012 | 2 | JA000423-38    |
| 62 | Transcript of Proceedings for November 9, 2012                                                                                       | 01/11/2013 | 5 | JA0001173-1203 |