

**Caterpillar C32 1000kW Diesel Generator Set
Presented by:**



TABLE OF CONTENTS

	PAGE
BILL OF MATERIAL	3-7
SECTION 1: MANUFACTURER DATA SHEETS	9-117
DIESEL GENERATOR SET	10-16
SYSTEMS DATA	17-18
PERFORMANCE DATA	19-26
GENERATOR DATA	27-33
CIRCUIT BREAKERS	34-68
JACKET WATER	69-72
BATTERY CHARGER	73-79
BATTERIES	80-81
ADEM 4 ENGINE CONTROLLER	82-84
EXCIATION MODULE	85-89
INTEGRATED VOLTAGE REGULATOR	90-94
EMCP 4.2	95-98
EMCP LOCAL ANNUNCIATOR	99-100
REMOTE ANNUNCIATOR	101-102
RS-485 CABLE	103
DIGITAL INPUT/OUTPUT (I/O) MODULE	104-107
EMCP MONITORING SOFTWARE	108-109
CATERPILLAR WARRANTY STATEMENT	110-111
GENERATOR EMISSIONS	112-117
IBC CERTIFICATION	118-120
SECTION 2: CUSTOM SOUND ENCLOSURE & FUEL TANK DATA SHEETS	121-135
SECTION 3: GENERATOR DRAWINGS	136-147

BILL OF MATERIALS

**CATERPILLAR MODEL C32 DIESEL STANDBY GENERATOR SET.
RATED 1000 kW, WITH FAN, 60 HZ, 3 PH, 277/480V AT 1800 RPM.**

CUSTOM SOUND ATTENUATED ENCLOSURE 85 DBA @ 23 FEET

Outer Skin, 14 Ga. Galvannealed Steel
Roof Skin, 14 Ga. Galvannealed Steel
Interior Stiffeners, 14 Ga. Galvannealed Steel
Acoustical Pack 4# Per Cubic Foot Mineral Wool
Protective Liner , 2 Mil Mylar
Interior Perforated Liner, 22 Ga. Galvanized, Perforated Steel
Base Frame, C6 Channel A-36 Carbon Steel
Enclosure, 4X4 Square Tubing
Roof mounted critical grade muffler
Vibration spring isolators mounted between genset rail and enclosure base.
Inlet weather louvers with birdscreen (galvannealed)
Inlet & discharge vertical baffle panels (galvannealed)
Discharge elbow with birdscreen (galvannealed construction)
Two (2) double access service doors 72" W x 78" H
Two (2) single access service doors 48" W x 78" H
Door hardware to include:
- Handles and Hinges - Refrigerator style stainless steel
- neoprene gasket single sealed around the door perimeters
- bolting hardware stainless steel
Gasket between enclosure and the base tank
One (1) engine exhaust opening with stainless steel weather cap
Two (2) roof mounted muffler support channels
Rain lips over all doors
Four (4) lifting eyes

CUSTOM ENCLOSURE – ELECTRICAL OPTIONS

Ground Fault Relay (M6C & Neutral Transformer)
Four (4) Fluorescent light fixtures
Two (2) Three way Switches
Two (2) 20 amp GFI duplex receptacles
One (1) 100 amp MB, 120/240 AC, single phase, 60 Hz control panel
housed in a NEMA-3r box with breakers. All conduit will be rigid with EMT connections

CUSTOM 4,000 GAL UL-142 BASE TANK- 48 HOUR

E&CA Model SCGBT4000, 4000 gallon capacity SECONDARY CONTAINMENT (DOUBLE WALL)
GENERATOR BASE TANK with the following standard features:
Heavy gauge steel construction 1" x ½" NPT removable fuel supply dip tube

Primary Tank, 1" NPT fuel return
10 Gage steel top
12 Gage steel bottom, sides, ends, and baffles

1" NPT exterior drain
Tank baffles to increase structural strength and to cool fuel

Outer Tank
7 Gage steel channel sides
10 Gage steel bottom, and ends
2" NPT fill connection
1½" NPT level gage
2" NPT normal vent inner tank
Emergency vent 8" NPT inner tank
Emergency vent 8" NPT outer tank
black

Inner tank pressure tested to 3 psi
Outer tank pressure tested to 3 psi
Four sided complete base enclosure

Exterior - E&CA gray enamel or optional gloss

Including the following features:

ULD - Tank Built To UL-142OPT-UL - This Tank Requires The UL Label

229F - Secondary Containment Vent/Fill/Alarm Package Including One 2" NPT Locking Fill Cap, One Low Level Float Switch, One Leak Detector Float Switch, One 2" NPT Normal Vent Cap Cap, And Two 8" NPT Emergency Vent Caps

650 - Fuel Fitting Containment Area, 2 ½" Raised Receiver To Contain Potential Fuel Overflow

544B - High Fuel Level Float Switch With Conduit Box, Contacts Rated 20 VA, 0.16 Amps

544B - High High Fuel Level Float Switch With Conduit Box, Contacts Rated 20 VA, 0.16 Amps

326A - Remote Fill Panel, NEMA-3R Enclosure For Remote Mounting. Contains Low Fuel Level Light, High Fuel Level Light, And Critical High Fuel Level Light. At Low Fuel Level, Light Only Operates. At High Fuel Level, Light Illuminates And Alarm Horn Activates. At Critical High Fuel Level, Light Illuminates And Alarm Horn Activates, With Relay Contacts For Optional Solenoid Valve To Close Allowing No More Fuel To Enter Tank. Includes Alarm Horn With Silent Switch, And On-Off Switch. Does Not Include Float Switches

653B - Overflow Prevention Valve, 4" Connection with 2" fuel connection,

682 - Supportive Cross Members, 6" W6-25, \$85.00 Per Foot

610A - Top Mounted Vibration Isolator Pad, \$99.00 Per Pad

510 - Stub up Area

CATERPILLAR FEATURES

EPA STATIONARY EMERGENCY

UL 2200 LISTED PACKAGE GEN SET

IBC CERTIFICATION

ENGINE

Standby = 1000 kW

Engine = C32.

Cooling System = ATAAC, Radiator = AB27.5 CT (0.625).

Radiator Ambient = Maximum 53C(127F), 300M(984ft) @ Standby Rating.

Generator Argt = 432-6120, Frame = 1402, No. of Bearings = 1.

Generator Winding = RW, No. of Leads = 6, Pitch = .667.

Generator Winding: RW (standard)

Gen Temp Rise: Standby = 125C, Prime = 105C, Continuous = 80C.

Permanent Magnet Excitation

Lube System: 68L oil pan is standard.

GENERATORS AND GENERATOR ATTACHMENTS

3 phase brushless, salient pole.

Integrated Voltage Regulator (IVR) - IVR includes reactive droop capability, 3 phase voltage sensing, PF control, maximum excitation limiter and line-loss compensation.

6 lead

Winding temperature detectors

Random wound

Permanent Magnet Excitation

NEMA Class H insulation, Class H temperature rise at 40C ambient (125C standby).

Reactive droop.

Bus bar connections, top center mounted.

60 Hz models: NEMA standard hole pattern.

STARTING/CHARGING SYSTEM

Installed battery charger – 10A

Includes low voltage, ac failure alarm outputs, dc ammeter and voltmeter

24-volt electric starting motor.

Charging alternator 45a.

24 volt battery set – dry

Filled with acid during commissioning

P/N 9X9720 (2), 1000 cca, 140 amp-hrs

Jacket water heater

240 vac, 60 hz, single phase, 9kw

208 vac, 60 hz, single phase, 6.75kw

Meets requirements of nfpa 110 when used in 0c (32f)

Minimum air temperature with 134 m/min (440 fpm)

Maximum air flow.

Generator space heater

Provides heating for condensation control.

AIR INLET SYSTEM

Air cleaner single element

CONTROL SYSTEM (RIGHT SIDE)

EMCP 4.2 CONTROLS

Run/Auto/Stop Control

Speed Adjust

Voltage Adjust

Engine Cycle Crank

Emergency Stop Pushbutton

24 Volt Dc Operation

Environmental Sealed Front Face

Text Alarm/Event Descriptions

True Rms Ac Metering, 3 Phase,

Digital Indication For:

Rpm

Dc Volts
Operating Hours
Oil Pressure (Psi, Kpa Or Bar)
Coolant Temperature
Volts (L-L) & (L-N), Frequency (Hz)
Amps (Per Phase & Avg)
Pf (Per Phase And Avg)
Kw (Per Phase, Avg And %)
Kva (Per Phase, Avg And %)
Kvar (Per Phase, Avg And %)
Kw-Hr (Total)
Kvar-Hr (Total)
Warning/Shutdown With Common Led Indication For:
Low Oil Pressure
High/Low Coolant Temp
Overspeed
Estop
Fail To Start (Overcrank)
Low Coolant Level
Programmable Protective Relaying Functions:
Generator Phase Sequence
Over/Under Voltage (27/59)
Over/Under Frequency (81 O/U)
Reverse Power (Kw) (32)
Revese Reactive Power (Kvar) (32rv)
Overcurrent (50/51)

COMMUNICATIONS

Local Pc Monitoring
Customer Data Link (Modbus Rtu)
Accessory Module Data Link
Serial Communication Module Data Link
6 Programmable Digital Inputs
4 Programmable Relay Outputs (Form A)
2 Programmable Relay Outputs (Form C)
2 Programmable Digital Outputs
I/O Module, 12 Digital Inputs, 8 Form C Relays

LOCAL ANNUNCIATOR

REMOTE SERIAL ANNUNCIATOR

COOLING SYSTEM

ATAAC
Radiator Sized To 50 Degrees C (122 Degrees F)
Coolant Drain Line with valve terminated on edge of base
Fan And Belt Guards Drive

Coolant Level Sensor
Cat Extended Life Coolant

EXHAUST SYSTEM

Exhaust manifold – dry
8 in round flange outlet

FUEL SYSTEM

Primary fuel filter with water separator
Secondary fuel filters
Fuel cooler
Fuel priming pump

CIRCUIT BREAKER– GENERATOR – RIGHT SIDE MOUNTING

1600 AMP, 3 POLE, UL-100% RATED CIRCUIT BREAKERS
LSI-P 5.0P TRIP UNIT
R-frame model, molded case circuit breaker with auxiliary contacts, shunt trip
And load take-off bus. Breakers are manually operated
Adjustable range between 1.0 to 0.4 of the breaker setting.
Right side mounted
LSI-P Long-Time, Short-Time, Instantaneous,
Skirting/shroud for **bottom entry**

GOVERNING SYSTEM

ADEM A4

LUBE SYSTEM

Lubricating oil
Gear type lube oil pump
Integral oil cooler
Oil filter, filler and dipstick
Oil drain lines and valve
Fumes disposal – open crankcase ventilation routed to front of package

MOUNTING SYSTEM

Rails – engine/generator/radiator mounting
Vibration isolators installed between rail and enclosure base

SECTION 1
MANUFACTURER DATA SHEETS

Caterpillar is leading the power generation marketplace with Power Solutions engineered to deliver unmatched flexibility, expandability, reliability, and cost-effectiveness.



Specifications

Generator Set Specifications	
Minimum Rating	830 ekW (910 kVA)
Maximum Rating	1000 ekW (1250 kVA)
Voltage	220 to 4160
Frequency	50 or 60 Hz
Speed	1500 or 1800 RPM

Generator Set Configurations	
Emissions/Fuel Strategy	Low Fuel Consumption, Low Emissions, EPA Certified for Stationary Emergency Application (Emits Equivalent U.S. EPA Tier 2 Nonroad Standards)

Engine Specifications		
Engine Model	C32 TA, V-12, 4-Stroke Water-Cooled Diesel	
Bore	145 mm	5.71 in
Displacement	32.1 L	1958.86 in ³
Stroke	162 mm	6.38 in
Compression Ratio	15.0:1	
Aspiration	TA	
Governor Type	Adem™ A4	
Fuel System	MEUI	

Benefits And Features

Cat Diesel Engine

- Reliable, rugged, durable design
- Field-proven in thousands of applications worldwide
- Four-stroke-cycle diesel engine combines consistent performance and excellent fuel economy with minimum weight

Generator

- Matched to the performance and output characteristics of Cat engines
- Industry leading mechanical and electrical design
- Industry leading motor starting capabilities
- High Efficiency

Cat EMCP Control Panel

The EMCP controller features the reliability and durability you have come to expect from your Cat equipment. EMCP4 is a scalable control platform designed to ensure reliable generator set operation, providing extensive information about power output and engine operation. EMCP4 systems can be further customized to meet your needs through programming and expansion modules.

Seismic Certification

- Seismic Certification available.
- Anchoring details are site specific, and are dependent on many factors such as generator set size, weight, and concrete strength.
- IBC Certification requires that the anchoring system used is reviewed and approved by a Professional Engineer
- Seismic Certification per Applicable Building Codes: IBC 2000, IBC 2003, IBC 2006, IBC 2009, CBC 2007, CBC 2010
- Pre-approved by OSHPD and carries an OSP-0321-10 for use in healthcare projects in California

Standard Equipment

Air Inlet

- Air Cleaner

Cooling

- Package mounted radiator

Exhaust

- Exhaust flange outlet

Fuel

- Primary fuel filter with integral water separator
- Secondary fuel filter
- Fuel priming pump

Generator

- Matched to the performance and output characteristics of Cat engines
- Load adjustment module provides engine relief upon load impact and improves load acceptance and recovery time
- IP23 Protection

Power Termination

- Bus Bar

Control Panel

- EMCP 4 Genset Controller

General

- Paint - Caterpillar Yellow except rails and radiators gloss black

Optional Equipment

Exhaust

- Exhaust mufflers

Generator

- Excitation: Permanent Magnet Excited (PM) [] Internally Excited (IE)
- Anti-condensation heater



Power Termination

- Circuit breakers, UL listed

Control Panels

- EMCP (4.2) ()
- Digital I/O module
- Remote monitoring software

Mounting

- IBC isolators

Starting/Charging

- Battery chargers
- Batteries
- Jacket water heater
- Charging alternator

General

- The following options are based on regional and product configuration:
- Seismic Certification per applicable building codes: IBC 2000, IBC 2003, IBC 2006, IBC 2009, CBC 2007
- UL 2200 package
-
-
- Enclosures: sound attenuated, weather protective
-
-
- sub-base UL listed dual wall fuel tanks

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C32 ACERT
 1000 ekW/ 1250 kVA/ 60 Hz/ 1800 rpm/ 480 V/ 0.8 Power Factor

Rating Type: STANDBY

Emissions: EPA Certified for Stationary Emergency
 Application (Emits Equivalent U.S. EPA Tier 2 Nonroad
 Standards)

C32 ACERT
 1000 ekW/ 1250 kVA
 60 Hz/ 1800 rpm/ 480 V



Image shown may not reflect actual configuration

Metric English

Package Performance		
Genset Power Rating with Fan @ 0.8 Power Factor	1000 ekW	
Genset Power Rating	1250 kVA	
Aftercooler (Separate Circuit)	N/A	N/A

Fuel Consumption		
100% Load with Fan	272.1 L/hr	71.9 gal/hr
75% Load with Fan	213.4 L/hr	56.4 gal/hr
50% Load with Fan	144.7 L/hr	38.2 gal/hr
25% Load with Fan	82.6 L/hr	21.8 gal/hr

Cooling System ¹		
Engine Coolant Capacity	55.0 L	14.5 gal

Inlet Air		
Combustion Air Inlet Flow Rate	87.6 m ³ /min	3094.1 cfm
Max. Allowable Combustion Air Inlet Temp	48 ° C	118 ° F

Exhaust System		
Exhaust Stack Gas Temperature	476.4 ° C	889.5 ° F
Exhaust Gas Flow Rate	228.4 m ³ /min	8065.3 cfm
Exhaust System Backpressure (Maximum Allowable)	10.0 kPa	40.0 in. water



C32 ACERT
1000 ekW/ 1250 kVA/ 60 Hz/ 1800 rpm/ 480 V/ 0.8 Power Factor

Rating Type: STANDBY

Emissions: EPA Certified for Stationary Emergency Application (Emits Equivalent U.S. EPA Tier 2 Nonroad Standards)

Heat Rejection		
Heat Rejection to Jacket Water	352 kW	20033 Btu/min
Heat Rejection to Exhaust (Total)	1024 kW	58206 Btu/min
Heat Rejection to Aftercooler	288 kW	16385 Btu/min
Heat Rejection to Atmosphere from Engine	127 kW	7238 Btu/min
Heat Rejection to Atmosphere from Generator	55 kW	3122 Btu/min

Alternator²	
Motor Starting Capability @ 30% Voltage Dip	2734 skVA
Current	1504 amps
Frame Size	1402
Excitation	PM
Temperature Rise	125 ° C

DEFINITIONS AND CONDITIONS

1. For ambient and altitude capabilities consult your Cat dealer. Air flow restriction (system) is added to existing restriction from factory.
2. UL 2200 Listed packages may have oversized generators with a different temperature rise and motor starting characteristics. Generator temperature rise is based on a 40° C ambient per NEMA MG1-32.
3. Emissions data measurement procedures are consistent with those described in EPA CFR 40 Part 89, Subpart D & E and ISO8178-1 for measuring HC, CO, PM, NOx. Data shown is based on steady state operating conditions of 77° F, 28.42 in HG and number 2 diesel fuel with 35° API and LHV of 18,390 btu/lb. The nominal emissions data shown is subject to instrumentation, measurement, facility and engine to engine variations. Emissions data is based on 100% load and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle.



C32 ACERT
1000 ekW/ 1250 kVA/ 60 Hz/ 1800 rpm/ 480 V/ 0.8 Power Factor

Rating Type: STANDBY

**Emissions: EPA Certified for Stationary Emergency
Application (Emits Equivalent U.S. EPA Tier 2 Nonroad
Standards)**

Applicable Codes and Standards:

AS1359, CSA C22.2 No100-04, UL142, UL489, UL869, UL2200,
NFPA37, NFPA70, NFPA99, NFPA110, IBC, IEC60034-1, ISO3046, ISO8528,
NEMA MG1-22, NEMA MG1-33, 72/23/EEC, 98/37/EC, 2004/108/EC

Note: Codes may not be available in all model configurations. Please consult your local Cat Dealer representative for availability.

STANDBY: Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year.

Ratings are based on SAE J1349 standard conditions. These ratings also apply at ISO3046 standard conditions

Fuel Rates are based on fuel oil of 35° API [16° C (60° F)] gravity having an LHV of 42 780 kJ/kg (18,390 Btu/lb) when used at 29° C (85° F) and weighing 838.9 g/liter (7.001 lbs/U.S. gal.). Additional ratings may be available for specific customer requirements, contact your Cat representative for details. For information regarding Low Sulfur fuel and Biodiesel capability, please consult your Cat dealer.

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AIR INTAKE SYSTEM		
<i>THE INSTALLED SYSTEM MUST COMPLY WITH THE SYSTEM LIMITS BELOW FOR ALL EMISSIONS CERTIFIED ENGINES TO ASSURE REGULATORY COMPLIANCE.</i>		
MAXIMUM ALLOWABLE INTAKE RESTRICTION WITH CLEAN ELEMENT	15	IN-H20
MAXIMUM ALLOWABLE INTAKE RESTRICTION WITH DIRTY ELEMENT	25	IN-H20
MAXIMUM PRESSURE DROP FROM COMPRESSOR OUTLET TO MANIFOLD INLET (OR MIXER INLET FOR EGR)	4.4	IN-HG
MAXIMUM TURBO INLET AIR TEMPERATURE	122	DEG F
MAXIMUM AIR FILTER INLET AIR TEMPERATURE	122	DEG F
MAXIMUM ALLOWABLE STATIC WEIGHT ON AIR INLET	0	LB
MAXIMUM ALLOWABLE STATIC BENDING MOMENT ON AIR INLET	0	LB-FT
MAXIMUM ALLOWABLE STATIC WEIGHT ON TURBO OUTLET CONNECTION	0	LB
MAXIMUM ALLOWABLE STATIC BENDING MOMENT ON TURBO OUTLET CONNECTION	0	LB-FT
COOLING SYSTEM		
ENGINE ONLY COOLANT CAPACITY	14.5	GAL
MAXIMUM ALLOWABLE JACKET WATER OUTLET TEMPERATURE	210	DEG F
REGULATOR LOCATION FOR JW CIRCUIT	OUTLET	
MAXIMUM UNINTERRUPTED FILL RATE	5.0	G/MIN
MINIMUM ALLOWABLE COOLANT LOSS (PERCENTAGE OF TOTAL)	12	PERCENT
COOLANT LOSS-MAXIMUM PERCENTAGE OF PUMP PRESSURE RISE LOSS	10	PERCENT
ENGINE SPEC SYSTEM		
CYLINDER ARRANGEMENT	VEE	
NUMBER OF CYLINDERS	12	
CYLINDER BORE DIAMETER	5.7	IN
PISTON STROKE	6.4	IN
TOTAL CYLINDER DISPLACEMENT	1959	CU IN
STANDARD CRANKSHAFT ROTATION FROM FLYWHEEL END	CCW	
STANDARD CYLINDER FIRING ORDER	1-10-9-6-5-12-11-4-3-8-7-2	
NUMBER 1 CYLINDER LOCATION	RIGHT FRONT	
STROKES/COMBUSTION CYCLE	4	
EXHAUST SYSTEM		
<i>THE INSTALLED SYSTEM MUST COMPLY WITH THE SYSTEM LIMITS BELOW FOR ALL EMISSIONS CERTIFIED ENGINES TO ASSURE REGULATORY COMPLIANCE.</i>		
MAXIMUM ALLOWABLE SYSTEM BACK PRESSURE	40	IN-H20
MANIFOLD TYPE	DRY	
MAXIMUM ALLOWABLE STATIC WEIGHT ON EXHAUST CONNECTION	110.2	LB
MAXIMUM ALLOWABLE STATIC BENDING MOMENT ON EXHAUST CONNECTION	0	LB-FT
FUEL SYSTEM		
MAXIMUM FUEL FLOW FROM TRANSFER PUMP TO ENGINE	221.9	G/HR
MAXIMUM ALLOWABLE FUEL SUPPLY LINE RESTRICTION	-8.9	IN-HG
MAXIMUM ALLOWABLE FUEL TEMPERATURE AT TRANSFER PUMP INLET	149	DEG F
MAXIMUM FUEL FLOW TO RETURN LINE FROM ENGINE	190.2	G/HR
MAXIMUM ALLOWABLE FUEL RETURN LINE RESTRICTION	10.2	IN-HG
NORMAL FUEL PRESSURE IN A CLEAN SYSTEM	90.9	PSI
FUEL SYSTEM TYPE	EUI	
MAXIMUM TRANSFER PUMP PRIMING LIFT WITHOUT PRIMING PUMP	12.1	FT
LUBE SYSTEM		

CRANKCASE VENTILATION TYPE	TO ATM	
MOUNTING SYSTEM		
CENTER OF GRAVITY LOCATION - X DIMENSION - FROM REAR FACE OF BLOCK - (REFERENCE TM7077)	23.0	IN
CENTER OF GRAVITY LOCATION - Y DIMENSION - FROM CENTERLINE OF CRANKSHAFT - (REFERENCE TM7077)	11.5	IN
CENTER OF GRAVITY LOCATION - Z DIMENSION - FROM CENTERLINE OF CRANKSHAFT - (REFERENCE TM7077)	0	IN
DRY WEIGHT - ENGINE ONLY (REFERENCE VALUE)	6462	LB
STARTING SYSTEM		
MINIMUM CRANKING SPEED REQUIRED FOR START-RPM	100	
LOWEST AMBIENT START TEMPERATURE WITHOUT AIDS	32	DEG F

SALES MODEL:	C32	COMBUSTION:	DI
ENGINE POWER (BHP):	1,474	ENGINE SPEED (RPM):	1,800
GEN POWER WITH FAN (EKW):	1,000.0	HERTZ:	60
COMPRESSION RATIO:	15.0	FAN POWER (HP):	56.3
RATING LEVEL:	STANDBY	ADDITIONAL PARASITICS (HP):	1.3
PUMP QUANTITY:	1	ASPIRATION:	TA
FUEL TYPE:	DIESEL	AFTERCOOLER TYPE:	ATAAC
MANIFOLD TYPE:	DRY	AFTERCOOLER CIRCUIT TYPE:	JW+OC, ATAAC
GOVERNOR TYPE:	ADEM4	INLET MANIFOLD AIR TEMP (F):	120
ELECTRONICS TYPE:	ADEM4	JACKET WATER TEMP (F):	210.2
IGNITION TYPE:	CI	TURBO CONFIGURATION:	PARALLEL
INJECTOR TYPE:	EUI	TURBO QUANTITY:	2
REF EXH STACK DIAMETER (IN):	8	TURBOCHARGER MODEL:	GTB45518BS-52T-1.37
MAX OPERATING ALTITUDE (FT):	997	CERTIFICATION YEAR:	2007
		PISTON SPD @ RATED ENG SPD (FT/MIN):	1,913.4

INDUSTRY	SUB INDUSTRY	APPLICATION
OIL AND GAS	LAND PRODUCTION	PACKAGED GENSET
ELECTRIC POWER	STANDARD	PACKAGED GENSET

General Performance Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
EKW	%	BHP	PSI	LB/BHP-HR	GAL/HR	IN-HG	DEG F	DEG F	IN-HG	DEG F
1,000.0	100	1,474	331	0.342	71.9	70.3	118.2	1,209.3	58.1	889.5
900.0	90	1,330	299	0.341	64.7	64.0	111.0	1,150.9	51.9	855.4
800.0	80	1,187	267	0.349	59.2	60.4	106.5	1,116.3	48.6	832.2
750.0	75	1,116	251	0.354	56.4	57.9	103.8	1,100.0	46.6	821.0
700.0	70	1,046	235	0.354	52.9	53.7	99.5	1,077.6	43.2	810.0
600.0	60	905	203	0.353	45.7	43.7	90.1	1,025.8	35.3	788.8
500.0	50	765	172	0.350	38.2	32.9	80.8	964.8	27.0	768.5
400.0	40	628	141	0.351	31.5	23.9	74.7	895.9	20.5	731.2
300.0	30	490	110	0.357	25.0	15.7	70.4	812.1	15.1	676.7
250.0	25	420	94	0.363	21.8	12.0	68.9	764.0	12.7	643.0
200.0	20	350	79	0.374	18.7	8.7	67.9	708.9	10.6	601.8
100.0	10	206	46	0.425	12.5	4.5	67.5	569.8	7.8	489.0

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	WET INLET AIR VOL FLOW RATE	ENGINE OUTLET WET EXH GAS VOL FLOW RATE	WET INLET AIR MASS FLOW RATE	WET EXH GAS MASS FLOW RATE	WET EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)	DRY EXH VOL FLOW RATE (32 DEG F AND 29.9 IN HG)
EKW	%	BHP	IN-HG	DEG F	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
1,000.0	100	1,474	76	422.1	3,094.1	8,065.3	13,465.4	13,968.9	2,939.2	2,688.4
900.0	90	1,330	69	391.5	2,939.0	7,417.0	12,749.0	13,202.3	2,773.0	2,544.8
800.0	80	1,187	65	375.1	2,856.2	7,051.1	12,358.8	12,773.3	2,683.6	2,472.3
750.0	75	1,116	63	363.9	2,783.7	6,813.1	12,021.7	12,415.6	2,615.7	2,413.9
700.0	70	1,046	58	343.3	2,639.5	6,395.9	11,355.9	11,723.5	2,476.8	2,288.3
600.0	60	905	48	302.6	2,355.5	5,576.9	10,061.2	10,377.6	2,196.4	2,033.1
500.0	50	765	37	262.3	2,076.5	4,775.6	8,810.4	9,077.6	1,911.9	1,773.0
400.0	40	628	27	223.0	1,805.8	4,001.6	7,595.0	7,814.6	1,652.1	1,535.9
300.0	30	490	18	183.7	1,537.6	3,237.7	6,435.6	6,610.0	1,400.8	1,306.8
250.0	25	420	14	163.9	1,403.3	2,856.8	5,874.1	6,026.7	1,273.8	1,190.9
200.0	20	350	11	146.2	1,286.2	2,507.0	5,386.7	5,517.7	1,161.2	1,089.1
100.0	10	206	6	122.6	1,147.6	1,981.6	4,797.2	4,885.1	1,027.0	974.3

Heat Rejection Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHAUST RECOVERY TO 350F	FROM OIL COOLER	FROM AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIG HEAT VALUE ENERGY
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
1,000.0	100	1,474	20,033	7,238	58,206	31,961	8,218	16,385	62,497	154,292	164,
900.0	90	1,330	18,378	6,464	52,445	28,178	7,400	14,318	56,390	138,929	147,
800.0	80	1,187	16,891	5,941	48,853	25,916	6,766	13,293	50,345	127,034	135,
750.0	75	1,116	16,127	6,236	46,672	24,565	6,445	12,521	47,342	121,002	128,
700.0	70	1,046	15,231	6,920	43,437	22,625	6,051	11,086	44,338	113,600	121,
600.0	60	905	13,439	6,738	37,282	19,058	5,220	8,561	38,371	97,997	104,
500.0	50	765	11,741	5,267	31,535	15,862	4,369	6,404	32,440	82,034	87,3
400.0	40	628	10,827	4,384	25,642	12,387	3,599	4,511	26,618	67,572	71,9
300.0	30	490	9,885	3,711	19,869	8,929	2,858	2,920	20,779	53,663	57,1
250.0	25	420	9,298	3,442	17,092	7,276	2,495	2,235	17,832	46,843	49,8
200.0	20	350	8,559	3,149	14,473	5,698	2,136	1,689	14,848	40,103	42,7
100.0	10	206	6,645	2,319	9,873	2,744	1,432	1,058	8,742	26,884	28,6

Emissions Data

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN ENGINE POWER	EKW	1,000.0	750.0	500.0	250.0	100.0
PERCENT LOAD	BHP	1,474	1,116	765	420	206
	%	100	75	50	25	10
TOTAL NOX (AS NO2)	G/HR	8,726	5,093	3,335	2,252	1,328
TOTAL CO	G/HR	356	235	501	819	1,263
TOTAL HC	G/HR	37	104	99	75	153
PART MATTER	G/HR	51.8	39.2	67.6	105.5	83.2
TOTAL NOX (AS NO2)	(CORR 5% O2) MG/NM3	2,841.8	2,105.6	2,041.6	2,429.4	2,417.2
TOTAL CO	(CORR 5% O2) MG/NM3	116.1	93.7	305.5	894.8	2,570.4
TOTAL HC	(CORR 5% O2) MG/NM3	10.3	37.8	52.6	69.6	283.1
PART MATTER	(CORR 5% O2) MG/NM3	14.1	13.5	35.5	106.1	135.6
TOTAL NOX (AS NO2)	(CORR 5% O2) PPM	1,384	1,026	994	1,183	1,177
TOTAL CO	(CORR 5% O2) PPM	93	75	244	716	2,056
TOTAL HC	(CORR 5% O2) PPM	19	71	98	130	528

TOTAL NOX (AS NO2)	G/HP-HR	5.97	4.59	4.38	5.37	6.45
TOTAL CO	G/HP-HR	0.24	0.21	0.66	1.95	6.14
TOTAL HC	G/HP-HR	0.03	0.09	0.13	0.18	0.74
PART MATTER	G/HP-HR	0.04	0.04	0.09	0.25	0.40
TOTAL NOX (AS NO2)	LB/HR	19.24	11.23	7.35	4.96	2.93
TOTAL CO	LB/HR	0.79	0.52	1.10	1.81	2.78
TOTAL HC	LB/HR	0.08	0.23	0.22	0.17	0.34
PART MATTER	LB/HR	0.11	0.09	0.15	0.23	0.18

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN ENGINE POWER		EKW	1,000.0	750.0	500.0	250.0	100.0
PERCENT LOAD		BHP	1,474	1,116	765	420	206
		%	100	75	50	25	10
TOTAL NOX (AS NO2)		G/HR	7,212	4,209	2,756	1,861	1,097
TOTAL CO		G/HR	191	126	268	438	676
TOTAL HC		G/HR	19	55	52	40	81
TOTAL CO2		KG/HR	721	564	380	217	124
PART MATTER		G/HR	26.6	20.1	34.7	54.1	42.7
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,348.6	1,740.1	1,687.3	2,007.8	1,997.7
TOTAL CO	(CORR 5% O2)	MG/NM3	62.1	50.1	163.4	478.5	1,374.6
TOTAL HC	(CORR 5% O2)	MG/NM3	5.5	20.0	27.8	36.8	149.8
PART MATTER	(CORR 5% O2)	MG/NM3	7.2	6.9	18.2	54.4	69.5
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,144	848	822	978	973
TOTAL CO	(CORR 5% O2)	PPM	50	40	131	383	1,100
TOTAL HC	(CORR 5% O2)	PPM	10	37	52	69	280
TOTAL NOX (AS NO2)		G/HP-HR	4.93	3.79	3.62	4.43	5.33
TOTAL CO		G/HP-HR	0.13	0.11	0.35	1.04	3.28
TOTAL HC		G/HP-HR	0.01	0.05	0.07	0.09	0.39
PART MATTER		G/HP-HR	0.02	0.02	0.05	0.13	0.21
TOTAL NOX (AS NO2)		LB/HR	15.90	9.28	6.08	4.10	2.42
TOTAL CO		LB/HR	0.42	0.28	0.59	0.97	1.49
TOTAL HC		LB/HR	0.04	0.12	0.12	0.09	0.18
TOTAL CO2		LB/HR	1,589	1,244	839	478	273
PART MATTER		LB/HR	0.06	0.04	0.08	0.12	0.09
OXYGEN IN EXH		%	10.1	11.5	12.2	13.5	15.7
DRY SMOKE OPACITY		%	0.7	0.7	1.4	3.0	2.2
BOSCH SMOKE NUMBER			0.18	0.16	0.58	1.31	0.99

Regulatory Information

EPA TIER 2

2006 - 2010

GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 89 SUBPART D AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-ROAD REGULATIONS.

Locality	Agency	Regulation	Tier/Stage	Max Limits - G/BKW - HR
U.S. (INCL CALIF)	EPA	NON-ROAD	TIER 2	CO: 3.5 NOx + HC: 6.4 PM: 0.20

EPA EMERGENCY STATIONARY

2011 - ----

GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE EMERGENCY STATIONARY REGULATIONS.

Locality	Agency	Regulation	Tier/Stage	Max Limits - G/BKW - HR
U.S. (INCL CALIF)	EPA	STATIONARY	EMERGENCY STATIONARY	CO: 3.5 NOx + HC: 6.4 PM: 0.20

Altitude Derate Data

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

AMBIENT OPERATING TEMP (F)	50	60	70	80	90	100	110	120	130	NORMAL
ALTITUDE (FT)										
0	1,474	1,474	1,474	1,474	1,474	1,468	1,442	1,417	1,393	1,474
1,000	1,474	1,474	1,474	1,466	1,439	1,413	1,388	1,365	1,341	1,474
2,000	1,474	1,465	1,437	1,411	1,385	1,360	1,337	1,313	1,291	1,434
3,000	1,438	1,410	1,383	1,358	1,333	1,309	1,286	1,264	1,242	1,389
4,000	1,383	1,356	1,331	1,306	1,282	1,259	1,237	1,216	1,195	1,345
5,000	1,330	1,304	1,280	1,256	1,233	1,211	1,190	1,169	1,149	1,302
6,000	1,278	1,254	1,230	1,207	1,185	1,164	1,144	1,124	1,105	1,260
7,000	1,228	1,205	1,182	1,160	1,139	1,119	1,099	1,080	1,062	1,220
8,000	1,180	1,157	1,135	1,114	1,094	1,074	1,056	1,037	1,020	1,180
9,000	1,133	1,111	1,090	1,070	1,050	1,032	1,014	996	979	1,141
10,000	1,087	1,066	1,046	1,027	1,008	990	973	956	940	1,103
11,000	1,043	1,023	1,004	985	967	950	933	917	902	1,066
12,000	1,001	981	963	945	928	911	895	880	865	1,029
13,000	959	941	923	906	889	873	858	843	829	994
14,000	919	901	884	868	852	837	822	808	794	959
15,000	880	863	847	831	816	802	788	774	761	926

Selected Model

Engine: C32 **Generator Frame:** 1402 **Genset Rating (kW):** 1000.0 **Line Voltage:** 480
Fuel: Diesel **Generator Arrangement:** 4326120 **Genset Rating (kVA):** 1250.0 **Phase Voltage:** 277
Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 1503.5
Duty: STANDBY **Connection:** SERIES STAR **Application:** EPG **Status:** Current

Version: 41205 /41596 /41282 /9708

Spec Information

Generator Specification			Generator Efficiency		
Frame: 1402	Type: SR5	No. of Bearings: 1	Per Unit Load	kW	Efficiency %
Winding Type: RANDOM WOUND			0.25	250.0	92.2
Flywheel: 18.0			0.5	500.0	94.6
Connection: SERIES STAR			0.75	750.0	94.9
Housing: 0			1.0	1000.0	94.8
Phases: 3					
No. of Leads: 6					
Poles: 4					
Wires per Lead: 4					
Sync Speed: 1800					
Generator Pitch: 0.6667					

Reactances	Per Unit	Ohms
SUBTRANSIENT - DIRECT AXIS X' _d	0.1573	0.0290
SUBTRANSIENT - QUADRATURE AXIS X'' _q	0.1861	0.0343
TRANSIENT - SATURATED X' _d	0.2799	0.0516
SYNCHRONOUS - DIRECT AXIS X _d	3.9453	0.7272
SYNCHRONOUS - QUADRATURE AXIS X _q	2.3698	0.4368
NEGATIVE SEQUENCE X ₂	0.1725	0.0318
ZERO SEQUENCE X ₀	0.0374	0.0069

Time Constants	Seconds
OPEN CIRCUIT TRANSIENT - DIRECT AXIS T' _{d0}	2.5090
SHORT CIRCUIT TRANSIENT - DIRECT AXIS T' _d	0.1800
OPEN CIRCUIT SUBTRANSIENT - DIRECT AXIS T'' _{d0}	0.0320
SHORT CIRCUIT SUBTRANSIENT - DIRECT AXIS T'' _d	0.0180
OPEN CIRCUIT SUBTRANSIENT - QUADRATURE AXIS T'' _{q0}	0.2290
SHORT CIRCUIT SUBTRANSIENT - QUADRATURE AXIS T'' _q	0.0180
EXCITER TIME CONSTANT T _e	0.0600
ARMATURE SHORT CIRCUIT T _a	0.0270

Short Circuit Ratio: 0.31 Stator Resistance = 0.0042 Ohms Field Resistance = 0.39 Ohms

Voltage Regulation		Generator Excitation		
Voltage level adjustment: +/-	5.0%	No Load	Full Load, (rated) pf	
Voltage regulation, steady state: +/-	0.5%		Series	Parallel
Voltage regulation with 3% speed change: +/-	0.5%	Excitation voltage:	10.12 Volts	54.56 Volts Volts
Waveform deviation line - line, no load: less than	2.0%	Excitation current	0.92 Amps	4.08 Amps Amps
Telephone influence factor: less than	50			

Selected Model

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Generator Mechanical Information

Center of Gravity		
Dimension X	-581.5 mm	-22.9 IN.
Dimension Y	0.0 mm	0.0 IN.
Dimension Z	0.0 mm	0.0 IN.

- "X" is measured from driven end of generator and parallel to rotor. Towards engine fan is positive. See General Information for details
- "Y" is measured vertically from rotor center line. Up is positive.
- "Z" is measured to left and right of rotor center line. To the right is positive.

Generator WT = 2200 kg * Rotor WT = 854 kg * Stator WT = 1346 kg
4,850 LB 1,883 LB 2,967 LB

Rotor Balance = 0.0508 mm deflection PTP
Overspeed Capacity = 125% of synchronous speed

Generator Torsional Data

J1 = Coupling and Fan **J2 = Rotor** **J3 = Exciter End**

TOTAL J = J1 + J2 + J3

K1 = Shaft Stiffness between J1 + J2 (Diameter 1) **K2 = Shaft Stiffness between J2 + J3 (Diameter 2)**

J1	K1	Min Shaft Dia 1	J2	K2	Min Shaft Dia 2	J3
0.0 LB IN. s ²	0.0 MLB IN./rad	6.7 IN.	127.5 LB IN. s ²	128.3 MLB IN./rad	5.5 IN.	7.1 LB IN. s ²
0.0 N m s ²	0.0 MN m/rad	170.0 mm	14.4 N m s ²	14.5 MN m/rad	140.0 mm	0.8 N m s ²
			Total J			
			134.5 LB IN. s ²			
			15.2 N m s ²			

Selected Model

Engine: C32 **Generator Frame:** 1402 **Genset Rating (kW):** 1000.0 **Line Voltage:** 480
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Version: 41205 /41596 /41282 /9708

Generator Cooling Requirements - Temperature - Insulation Data	
Cooling Requirements:	Temperature Data: (Ambient 40 °C)
Heat Dissipated: 54.9 kW	Stator Rise: 125.0 °C
Air Flow: 132.0 m ³ /min	Rotor Rise: 125.0 °C
Insulation Class: H	
Insulation Reg. as shipped: 100.0 MΩ minimum at 40 °C	

Thermal Limits of Generator	
Frequency:	60 Hz
Line to Line Voltage:	480 Volts
B BR 80/40	1040.0 kVA
F BR -105/40	1183.0 kVA
H BR - 125/40	1300.0 kVA
F PR - 130/40	1300.0 kVA
H PR - 150/40	1378.0 kVA
H PR27 - 163/27	1430.0 kVA

Selected Model

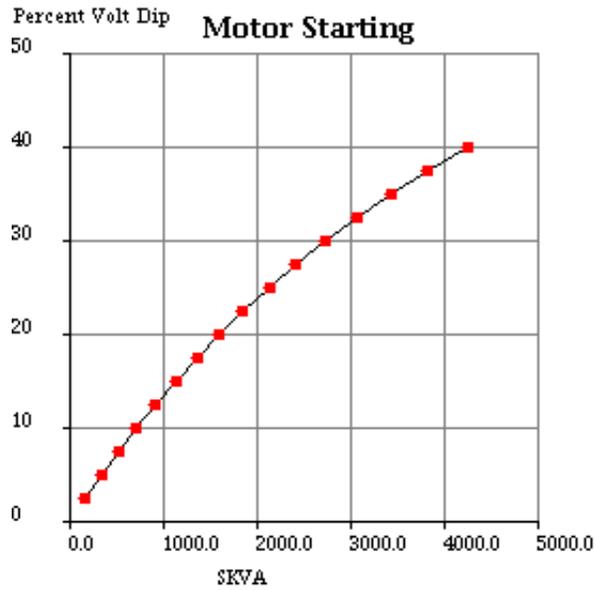
Engine: C32 **Generator Frame:** 1402 **Genset Rating (kW):** 1000.0 **Line Voltage:** 480
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Version: 41205 /41596 /41282 /9708

Starting Capability & Current Decrement

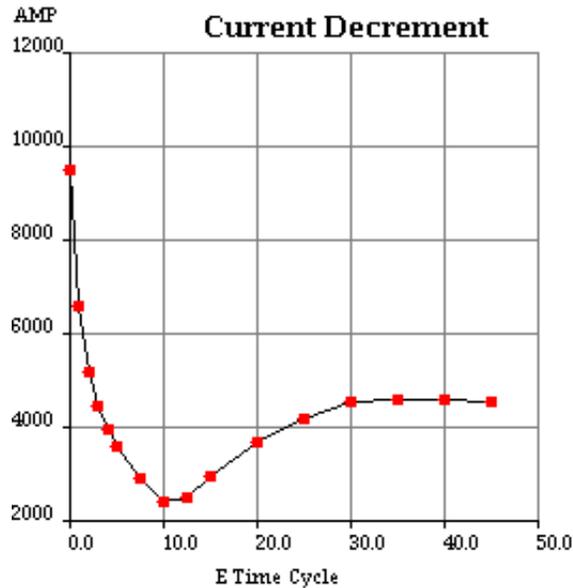
Motor Starting Capability (0.4 pf)

SKVA	Percent Volt Dip
164	2.5
336	5.0
517	7.5
709	10.0
911	12.5
1,126	15.0
1,353	17.5
1,595	20.0
1,852	22.5
2,126	25.0
2,419	27.5
2,734	30.0
3,071	32.5
3,435	35.0
3,827	37.5
4,252	40.0



Current Decrement Data

E Time Cycle	AMP
0.0	9,500
1.0	6,590
2.0	5,197
3.0	4,441
4.0	3,956
5.0	3,595
7.5	2,921
10.0	2,411
12.5	2,490
15.0	2,943
20.0	3,680
25.0	4,187
30.0	4,523
35.0	4,592
40.0	4,576
45.0	4,554



Instantaneous 3 Phase Fault Current: 9500 Amps

Instantaneous Line - Line Fault Current: 7854 Amps

Instantaneous Line - Neutral Fault Current: 12227 Amps

Selected Model

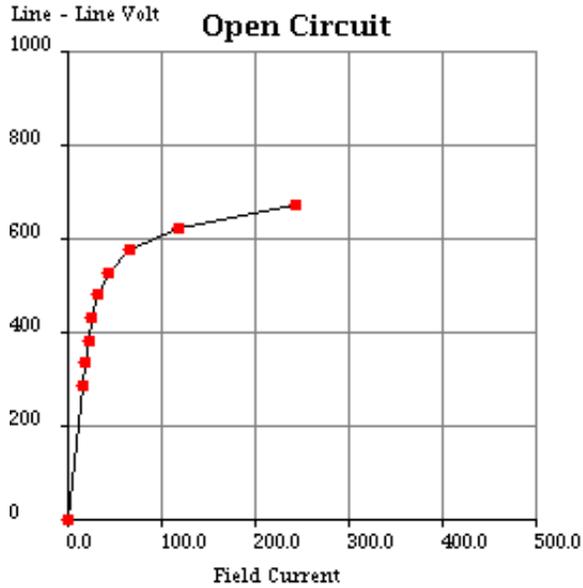
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Fuel: Diesel	Generator Arrangement: 4326120	Genset Rating (kVA): 1250.0	Phase Voltage: 277
Frequency: 60	Excitation Type: Permanent Magnet	Pwr. Factor: 0.8	Rated Current: 1503.5
Duty: STANDBY	Connection: SERIES STAR	Application: EPG	Status: Current

Version: 41205 /41596 /41282 /9708

Generator Output Characteristic Curves

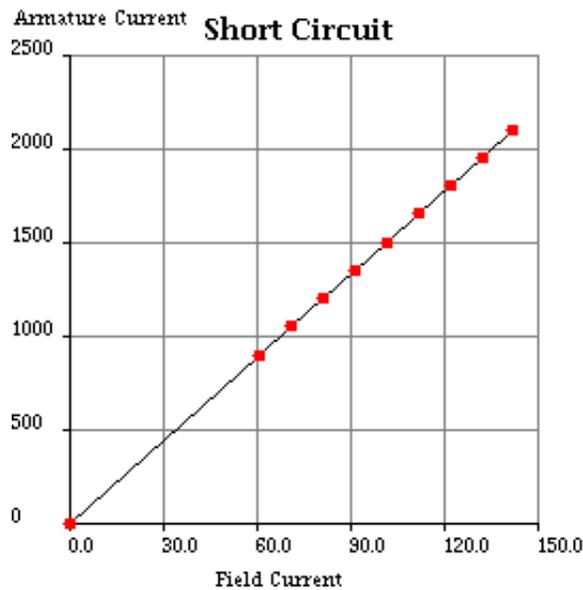
Open Circuit Curve

Field Current	Line - Line Volt
0.0	0
15.6	288
18.4	336
21.6	384
25.7	432
31.8	480
42.9	528
66.2	576
118.9	624
242.2	672



Short Circuit Curve

Field Current	Armature Current
0.0	0
60.9	902
71.1	1,052
81.2	1,203
91.4	1,353
101.5	1,504
111.7	1,654
121.8	1,804
132.0	1,955
142.1	2,105



Selected Model

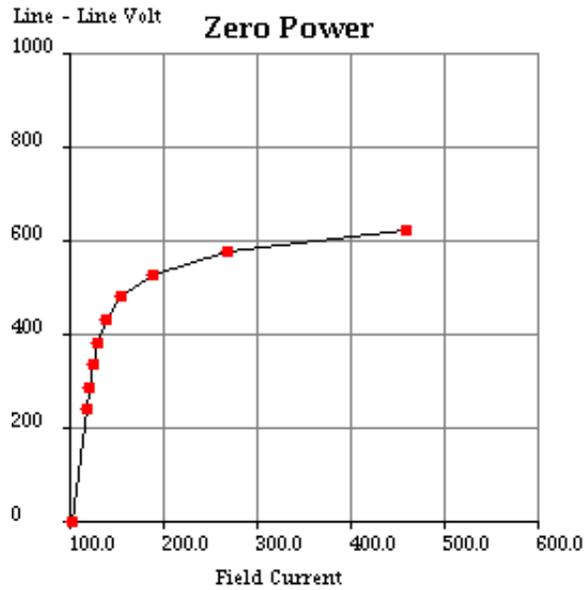
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Fuel: Diesel **Generator Arrangement:** 4326120 **Genset Rating (kVA):** 1250.0 **Phase Voltage:** 277
Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 1503.5
Duty: STANDBY **Connection:** SERIES STAR **Application:** EPG **Status:** Current

Version: 41205 /41596 /41282 /9708

Generator Output Characteristic Curves

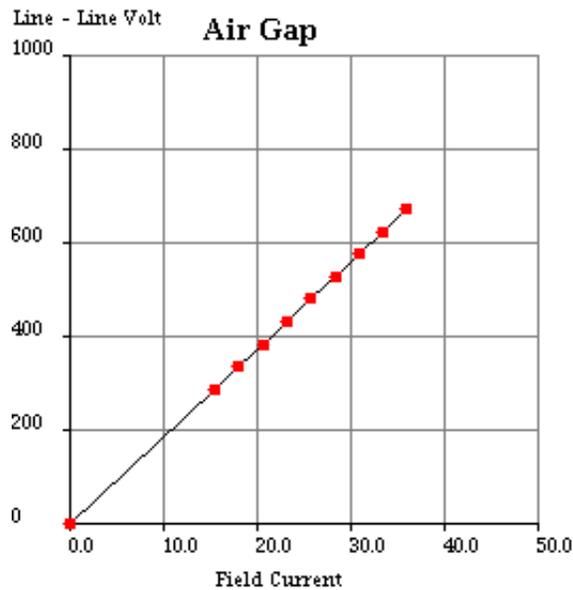
Zero Power Factor Curve

Field Current	Line - Line Volt
101.5	0
118.1	240
121.2	288
124.7	336
129.6	384
137.7	432
153.5	480
188.2	528
268.3	576
458.2	624



Air Gap Curve

Field Current	Line - Line Volt
0.0	0
15.4	288
18.0	336
20.6	384
23.1	432
25.7	480
28.3	528
30.9	576
33.4	624
36.0	672



Selected Model

Engine: C32 **Generator Frame:** 1402 **Genset Rating (kW):** 1000.0 **Line Voltage:** 480
Fuel: Diesel **Generator Arrangement:** 4326120 **Genset Rating (kVA):** 1250.0 **Phase Voltage:** 277
Frequency: 60 **Excitation Type:** Permanent Magnet **Pwr. Factor:** 0.8 **Rated Current:** 1503.5
Duty: STANDBY **Connection:** SERIES STAR **Application:** EPG **Status:** Current

Version: 41205 /41596 /41282 /9708



C27/C32/C175/C3500 MOLDED CASE CIRCUIT BREAKERS

R-Frame

1600A-2500A (UL), 1600A-3200A (IEC)

P-Frame

800A-1200A (UL), 800A-1600A (IEC)

NSJ

400A-600A (UL), 400A-630A (IEC)

FEATURES

- Moisture and fungus protection
- Clear indication of breaker status
- Reinforced insulation
- Shunt trip
- Auxiliary contacts
- Load side extension bars
- 80% Rated – P&R Frame (UL) Upgradeable to 100%
- 100% Rated – NSJ (IEC)
- Maintenance-free operation
- Exceptional characteristics under short-circuit conditions
- Adjustable trip settings

CONFORMITY WITH INTERNATIONAL STANDARDS

The P&R Frames plus the NSJ Circuit Breakers have been designed to comply with the international standard IEC 60947-2 as well as with these other major standards:

P&R – FRAMEs

UL 489

CSA 22.2 No 5.1

Federal Specification W-C-375B/GEN

NEMA AB1

NMX J-266

UTE, VDE, BS, CEI, UNE

NSJ

Federal Specification W-C-375B/GEN

NEMA AB1

UTE, VDE, BS, CEI, UNE

Additionally, the P&R Frames plus NSJ Circuit Breakers have been approved for Marine application by American Bureau of Shipping, Registro Italiano Navale, Germanischer Lloyd, and Det Norske Veritas.

STANDARD FEATURES

RATINGS

UL-CSA

- R-Frame Rating: 3200 Amps (max) IEC
- P-Frame Rating: 1600 Amps (max) IEC

SHUNT TRIP

The shunt trip provides a means of tripping the circuit breaker electronically. Shunt trip ratings are as follows:

Voltage: 24 VDC

Coil Burden (Holding/Inrush): 4.5/200 VA

Power Consumption: 4.5 VA

AUXILIARY CONTACTS

The auxiliary contacts provide a means of remote circuit breaker position indication and consist of one (1) Form C Contact (1 Normally open and 1 Normally closed contact) with the following current ratings:

6A @ 240-480 VAC, 50/60 Hz

CUSTOMER CABLE CONNECTIONS

Connection options include bus, cable I-Line for installation flexibility.

TRIP UNITS

All circuit breakers come equipped with True RMS Current Sensing. The trip units for each of the circuit breaker ratings sample the current waveform to provide true RMS protection through the 15th harmonic. This true RMS sensing gives accurate values for the magnitude of a nonsinusoidal waveform. Therefore, the heating effects of harmonically distorted waveforms are accurately evaluated. The trip system comes equipped with a set of current transformers (CTs) to sense current, a trip unit to evaluate the current, and a tripping solenoid to trip the circuit breaker. Additionally, each trip unit comes equipped with Active Thermal Imaging which is active 20 minutes before and after tripping.

The P&R Frame circuit breakers come equipped with basic trip unit (LI), which includes the following features:

- Long-Time setting – adjustable dial settings from 0.4 – 1.0 x sensor rating (In)
- Long-Time Delay – adjustable
- Instantaneous setting – adjustable dial settings from 1.5 – 12 x sensor rating (In)
- Neutral protection (four-pole breakers)
- Type A Rating Plug

CIRCUIT BREAKER CHARACTERISTICS

UL-IEC/CSA Breakers		P-Frame	
Number of Poles		3 & 4	
Rated Current (Amps)		800/ 1200A (UL) 800/ 1600A (IEC)	
Voltage Rating (VAC)		600 UL/ 690 IEC	
Interrupting Rating (UL) (60 Hz) – kA RMS	240 V	65	
	480 V	35	
	600 V	18	
IEC 60947-2 Rating (50/60 Hz) – kA RMS	I _{cu}	240 V	50
		380/415 V	35
	I _{cs}	240 V	25
		380/415 V	20

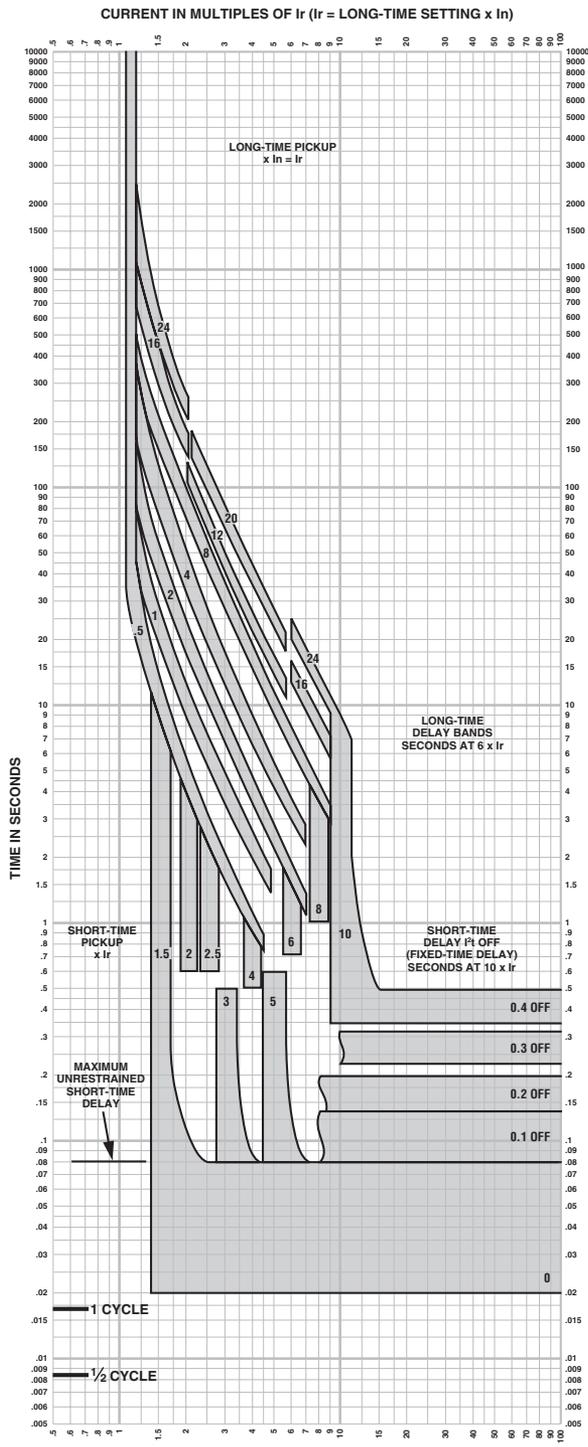
UL-IEC/CSA Breakers		NSJ-Frame	
Number of Poles		3 & 4	
Rated Current (Amps)		400/ 600A (UL) 400/ 630A (IEC)	
Voltage Rating (VAC)		600 UL/ 690 IEC	
Interrupting Rating (UL) (60 Hz) – kA RMS	240 V	65	
	480 V	35	
	600 V	18	
IEC 60947-2 Rating (50/60 Hz) – kA RMS	I _{cu}	240 V	85
		380/415 V	45
	I _{cs}	240 V	85
		380/415 V	45

UL-IEC/CSA Breakers		R-Frame	
Number of Poles		3 & 4	
Rated Current (Amps)		1600/ 2500A (UL) 1600/ 3200A (IEC)	
Voltage Rating (VAC)		600 UL/ 690 IEC	
Interrupting Rating (UL) (60 Hz) – kA RMS	240 V	65	
	480 V	35	
	600 V	18	
IEC 60947-2 Rating (50/60 Hz) – kA RMS	I _{cu}	240 V	50
		380/415 V	35
	I _{cs}	240 V	25
		380/415 V	20

CIRCUIT BREAKERS



Genset Model	Frame Rating (Amps) FRAME	Cat Part Number -Ckt Bkr-	No. Poles	UL/IEC spec	MICROLOGIC TRIP (LSI) Long-time + Short-time + Instantaneous Protection (UL Listed, IEC Rated)	MICROLOGIC TRIP (LSI) Long-time + Short-time + Instantaneous Equipment Ground-fault Protection (UL Listed, IEC Rated)	ADDS LSO, MO, LSIG, MO	Shunt Trip	Aux Contacts w/ Switches: -Connected -Disconnected	Customer Side -Lug- -Bus-
C32 3508 3512 3516	R-FRAME 1600A	244-9780	3	UL/IEC 80%	5.0A		LSI	24VDC @ 4.5/200VA	240-480 6A 600 3A <u>DC</u> 125 0.8A 250 0.3A	Load Take-off Bus: 3-Pole: Each has 4 Bolt Hole pattern evenly spaced on centers 1.75" (44.5). Dia of holes 0.57" (14.5) (Meets NEMA Standard CC1)
	R-FRAME 1600A	244-9781	3	UL/IEC 80%		6.0A	LSIG			
	R-FRAME 1600A	244-9782	3	UL/IEC 80%		6.0H	LSIG-H MODBUS			
	R-FRAME 1600A	244-9783	3	UL/IEC 80%		6.0P	LSIG-P MODBUS			
	R-FRAME 1600A	244-9990	3	UL/IEC 80%	5.0P		LSI-P MODBUS			
	R-FRAME 1600A	244-9864	3	UL/IEC 100%	5.0A		LSI			
	R-FRAME 1600A	244-9865	3	UL/IEC 100%		6.0A	LSIG	24VDC @ 4.5/200VA	240-480 6A 600 3A <u>DC</u> 125 0.8A 250 0.3A	Load Take-off Bus: 3-Pole: Each has 4 Bolt Hole pattern evenly spaced on centers 1.75" (44.5). Dia of holes 0.57" (14.5) (Meets NEMA Standard CC1)
	R-FRAME 1600A	244-9866	3	UL/IEC 100%		6.0H	LSIG-H MODBUS			
	R-FRAME 1600A	244-9867	3	UL/IEC 100%		6.0P	LSIG-P MODBUS			
	R-FRAME 1600A	244-9991	3	UL/IEC 100%	5.0P		LSI-P MODBUS			
P-FRAME 1600A	244-9772	3	IEC	5.0A		LSI & EO	24VDC @ 4.5/200VA	240-480 6A 600 3A <u>DC</u> 125 0.8A 250 0.3A	Load Take-off Bus: 3-Pole: Each has 4 Bolt Hole pattern evenly spaced on centers 1.75" (44.5). Dia of holes 0.57" (14.5) (Meets NEMA Standard CC1)	
P-FRAME 1600A	244-9773	3	IEC		6.0A	LSIG & EO				
P-FRAME 1600A	244-9775	3	IEC		6.0P	LSIG-P EO & MODBUS				
P-FRAME 1600A	244-9776	3	IEC	5.0A		LSI				
P-FRAME 1600A	244-9777	3	IEC		6.0A	LSIG				
P-FRAME 1600A	244-9779	3	IEC		6.0P	LSIG-P MODBUS				



**MICROLOGIC® 5.0/6.0 A/P/H TRIP UNIT
CHARACTERISTIC TRIP CURVE NO. 613-4**

Long-time Pickup and Delay
Short-time Pickup and I²t OFF Delay

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30° C to +60° C ambient temperature.

Notes:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately 20 minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the interrupting rating of the circuit breaker.
3. With zone-selective interlocking on, short-time delay utilized and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
4. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
5. For a withstand circuit breaker, instantaneous can be turned OFF. See 613-7 for instantaneous trip curve. See 613-10 for instantaneous override values.
6. Overload indicator illuminates at 100%.

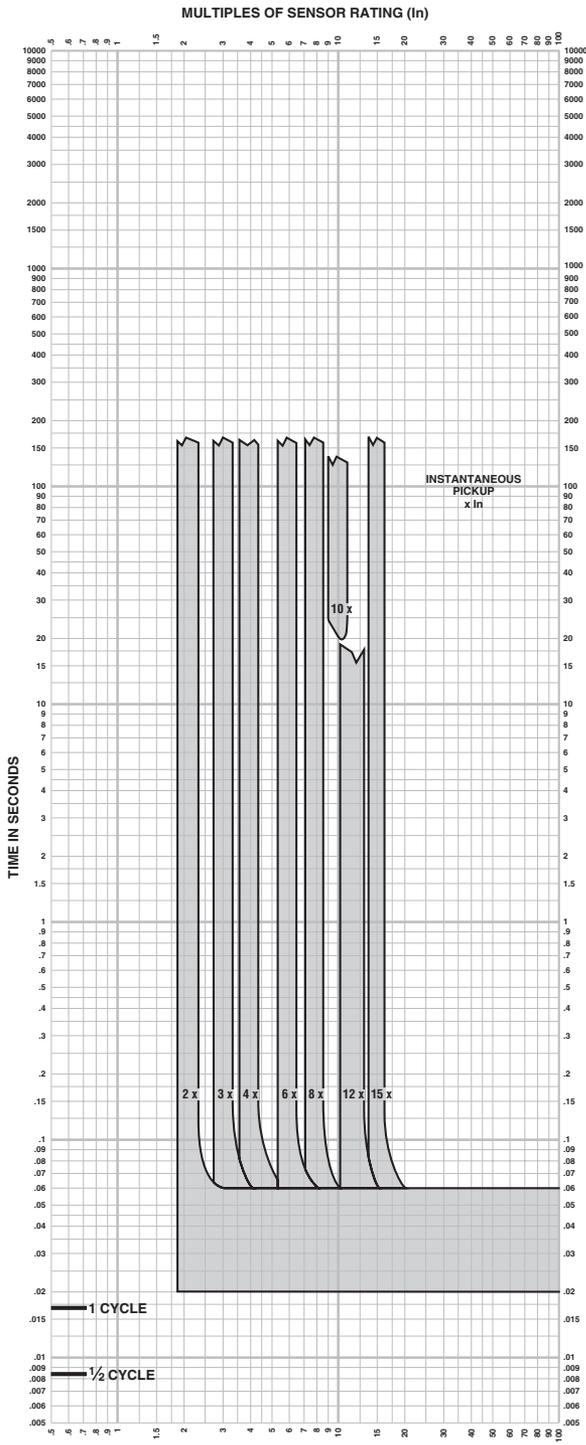
- Merlin Gerin
- Modicon
- Square D
- Telemecanique
- Federal Pioneer
- Federal Pacific

CURRENT IN MULTIPLES OF Ir
(Ir = LONG-TIME SETTING x In)



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Curve No. 0613TC0004
December 2000
Drawing No. 613-4



**MICROLOGIC® 5.0/6.0 A/P/H TRIP UNIT
CHARACTERISTIC TRIP CURVE NO. 613-7**

Instantaneous Pickup
2x-15x and OFF

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30° to +60° C ambient temperature.

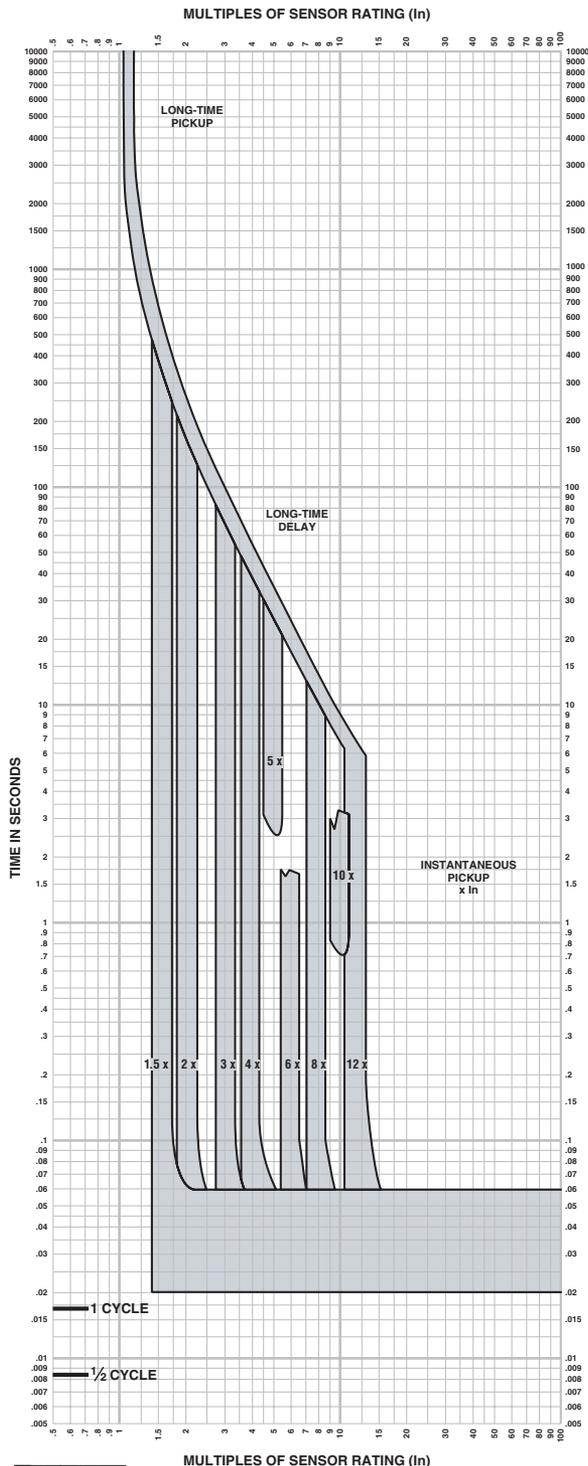
Notes:

1. The end of the curve is determined by the interrupting rating of the circuit breaker.
2. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
3. The instantaneous region of the trip curve shows maximum total clearing times. Actual clearing times in this region can vary depending on the circuit breaker mechanism design and other factors. The actual clearing time can be considerably faster than indicated. Contact your local Sales Office for additional information.
4. For a withstand circuit breaker, instantaneous can be turned OFF. See 613-7 for instantaneous trip curve. See 613-10 for instantaneous override values.
5. See 613-4 and 613-5 for long-time pickup, long-time delay, short-time pickup, and short-time delay trip curves.

- Merlin Gerin
 - Modicon
 - Square D
 - Telemecanique
 - Federal Pioneer
 - Federal Pacific
- Schneider Electric brands



Curve No. 0613TC007
December 2000
Drawing No. B48095-613-07



**ELECTRONIC TRIP 1.01
CHARACTERISTIC TRIP CURVE NO. 613-12**

Long-time Pickup and Fixed Delay
Instantaneous Pickup
1.5x-12x

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30° C to +60° C ambient temperature.

Instantaneous override values are given on 613-10.

Notes:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately 20 minutes is required between overloads to completely reset thermal-imaging.
2. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.

- Merlin Gerin
 - Modicon
 - Square D
 - Telemecanique
 - Federal Pioneer
 - Federal Pacific
- Schneider Electric Brands



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Curve No. 0613TC0612
December 2000
Drawing No. B48095-613-12

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PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers

Catalog
0612CT0101 R07/13
2013
Class 0612

R FRAME



CONTENTS

Description	Page
General Information	7
Electronic Trip Systems	22
PowerPact M-Frame Molded Case Circuit Breakers	38
PowerPact P-Frame Molded Case Circuit Breakers	41
PowerPact R-Frame Circuit Breakers	52
Compact NS630b–NS1600 Circuit Breakers	61
Compact NS1600b–NS3200 Circuit Breaker	66
Accessories	69
P-Frame Cradles and Cradle Accessories	93
Dimensional Drawings	99
Trip Curves	136
Catalog Numbers	150



by Schneider Electric

Section 1—General Information

Introduction

PowerPact™ M-frame, P-frame and R-frame and Compact™ NS630b–NS3200 electronic trip molded case circuit breakers are designed to protect electrical systems from damage caused by overloads, short circuits, and ground faults. All circuit breakers are designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent. Electronic trip molded case circuit breakers use an electronic trip system to signal the circuit breaker to open automatically.

The PowerPact M-frame (800 A frame size), P-frame (1200 A frame size) and R-frame (3000 A frame size) circuit breakers are dual rated to UL489 and IEC 60947-2. The Compact NS630b–NS1600 (1600 A frame size) and NS1600b–NS3200 (3200 A frame) circuit breakers are rated to IEC 60947-2 only.

M-frame molded case circuit breakers are equipped with a basic ET1.0 electronic trip system, which has a fixed long-time (overload) setting and an adjustable instantaneous (short-circuit) trip setting. P-frame, R-frame and NS630b–NS3200 molded case circuit breakers are available with either a basic ET 1.0I electronic trip system or with a more advanced Micrologic™ trip system. Electronic trip motor circuit protectors (trip system ET 1.0M), which trip on short circuit only, and automatic molded case switches, which trip at a predetermined self-protection level only, are also available for special applications. All of these circuit breakers are available labeled as Square D™ or Schneider Electric™ (formerly Merlin Gerin™, Federal Pioneer™, or Federal Pacific™).

For information on other Square D brand PowerPact molded case circuit breakers, see the Class 611 catalog PowerPact H-, J-, and L-Frame Circuit Breakers.

Features and Benefits

M-frame, P-frame, R-frame and NS630b–NS3200 electronic trip circuit breakers:

- Provide overload and short-circuit protection
- Are true RMS sensing devices
- Provide means to manually disconnect power to the circuit
- Provide enhanced coordination by their adjustability
- Provide high interrupting ratings and withstand ratings

Circuit breakers with Micrologic trip units can also:

- Provide integral equipment ground-fault protection or alarm
- Provide communications
- Provide power monitoring
- Provide protective relaying functions
- Provide zone-selective interlocking (ZSI), which can reduce damage in the event of a fault

PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers

Section 1—General Information

Specifications

Electronic trip molded case circuit breakers have a molded case made of a glass-reinforced insulating material (thermal set composite resin) that provides high dielectric strength. These circuit breakers:

- Are available in either dual-rated Underwriters Laboratory® (UL®) / International Electrotechnical Commission® (IEC®) or IEC-only constructions
- Are also Canadian Standard Association® (CSA®) and Association of the Electrical Sector® (ANCE®) certified (dual-rated UL/IEC circuit breakers only)
- Are manufactured in unit-mount, I-Line™ and drawout (P-frame and NS630b–NS1600) constructions
- Are available with either type ET or Micrologic electronic tripping systems
- Provide optional power monitoring, communications, protective relaying, integral ground-fault protection for equipment and zone-selective interlocking functions
- Share common tripping of all poles
- Can be mounted and operated in any position
- Are equipped with an externally-accessible test port for use with hand-held and full-function test sets
- Are available in motor circuit protector and automatic molded case switch constructions
- Can be reverse connected, without restrictive LINE and LOAD markings
- Meet the requirements of National Electrical Code® (NEC®) Sections 240.6 by providing a means to seal the rating plug and trip unit adjustments

Codes and Standards

M-, P- and R-frame, and NS630b–NS3200 electronic trip circuit breakers and switches are manufactured and tested in accordance with the following standards:

Table 1: Standards

M-Frame, P-Frame and R-Frame Circuit Breakers	P- and R-Frame Switches	NS630b–NS3200 Circuit Breakers	NS630b–NS3200 Switches
UL 489 ¹ IEC Standard 60947-2 CSA C22.2 No 5 Federal Specification W-C-375B/GEN NEMA AB1 NMX J-266 UTE, VDE, BS, CEI, UNE, CCC	UL 489 ² IEC Standard 60947-3 CSA C22.2 No 5 Federal Specification W-C-375B/GEN NEMA AB1 NMX J-266 UTE, VDE, BS, CEI, UNE	IEC Standard 60947-2 Federal Specification W-C-375B/GEN NEMA AB1 UTE, VDE, BS, CEI, UNE	IEC Standard 60947-3 Federal Specification W-C-375B/GEN NEMA AB1 UTE, VDE, BS, CEI, UNE

¹ PowerPact M-frame circuit breaker is in UL File E10027.
PowerPact P-frame circuit breaker is in UL File E63335.
PowerPact R-frame circuit breaker is in UL File E10027.

² PowerPact P-frame switch is in UL File E103740.
PowerPact R-frame switch is in UL File E33117.

Circuit breakers should be applied according to guidelines detailed in the NEC and other local wiring codes.

Circuit Breaker Ratings

Interrupting Rating

The interrupting rating is the highest current at rated voltage the circuit breaker is designed to safely interrupt under standard test conditions. Circuit breakers must be selected with interrupting ratings equal to or greater than the available short-circuit current at the point where the circuit breaker is applied to the system (unless it is a branch device in a series rated combination). Interrupting ratings are shown on the front of the circuit breaker. For grounded B phase interrupting ratings, see Data Bulletin 2700DB0202.

Table 2: UL/IEC Circuit Breaker Interrupting Ratings

Circuit Breaker ¹	UL/CSA Rating (60 Hz)				IEC 60947-2 Rating (50/60 Hz)			
	3 Phase			Grounded B Phase (1Ø-3Ø)	240 Vac		380/415 Vac	
	240 Vac	480 Vac	600 Vac		240 Vac 2P	Icu	Ics	Icu
MG	65 kA	35 kA	18 kA	65 kA	50 kA	25 kA	35 kA	20 kA
MJ	100 kA	65 kA	25 kA	65 kA	65 kA	35 kA	50 kA	25 kA
PG	65 kA	35 kA	18 kA	65 kA	50 kA	25 kA	35 kA	20 kA
PJ	100 kA	65 kA	25 kA	65 kA	65 kA	35 kA	50 kA	25 kA
PK	65 kA	50 kA	50 kA	65 kA	50 kA	25 kA	50 kA	25 kA
PL	125 kA	100 kA	25 kA	65 kA	125 kA	65 kA	85 kA	45 kA
RG	65 kA	35 kA	18 kA	35 kA	50 kA	25 kA	35 kA	20 kA
RJ	100 kA	65 kA	25 kA	100 kA	65 kA	35 kA	50 kA	25 kA
RK	65 kA	65 kA	65 kA	65 kA	85 kA	65 kA	70 kA	55 kA
RL	125 kA	100 kA	50 kA	125 kA	125 kA	65 kA	85 kA	45 kA

¹ The K interrupting rating is recommended for applications having high inrush and/or non-linear loads such as large motors, transformers, motors with soft starts, etc.

Table 3: IEC Only Circuit Breaker Interrupting Ratings (50/60 Hz)

Circuit Breaker	Interrupting Rating	220/240 Vac		380/415 Vac		440 Vac		500/525 Vac		660/690 Vac	
		Icu	Ics	Icu	Ics	Icu	Ics	Icu	Ics	Icu	Ics
Electrically Operated											
NS630b–NS1600	N Interrupting Rating	50 kA	37 kA	50 kA	37 kA	50 kA	37 kA	40 kA	30 kA	30 kA	22 kA
NS630b–NS1600	H Interrupting Rating	70 kA	35 kA	70 kA	35 kA	65 kA	32 kA	50 kA	25 kA	42 kA	21 kA
NS630b–NS1000	L Interrupting Rating	150 kA	150 kA	150 kA	150 kA	130 kA	130 kA	100 kA	100 kA	—	—
Manually Operated											
NS630b–NS1600	N Interrupting Rating	85 kA	50 kA	50 kA	50 kA	50 kA	50 kA	40 kA	40 kA	30 kA	30 kA
NS630b–NS1600	H Interrupting Rating	85 kA	52 kA	70 kA	52 kA	65 kA	48 kA	50 kA	37 kA	42 kA	31 kA
NS630b–NS1000	L Interrupting Rating	150 kA	150 kA	150 kA	150 kA	130 kA	130 kA	100 kA	100 kA	—	—
NS630b–NS800	R Interrupting Rating	200 kA	200 kA	200 kA	200 kA	200 kA	200 kA	100 kA	100 kA	75 kA	75 kA
NS1600b–NS3200	N Interrupting Rating	85 kA	65 kA	70 kA	52 kA	65 kA	65 kA	65 kA	65 kA	65 kA	65 kA
NS1600b–NS3200	H Interrupting Rating	125 kA	94 kA	85 kA	64 kA	85 kA	64 kA	—	—	—	—

PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers

Section 1—General Information

Extreme Atmospheric Conditions

PowerPact circuit breakers have successfully passed the tests defined below for extreme atmospheric conditions.

Dry cold and dry heat:

- IEC 68-2-1—Dry cold at -67°F (-55°C)
- IEC 68-2-2—Dry heat at 185°F (+85°C)

Damp heat (tropicalization)

- IEC 68-2-30—Damp heat (temperature 131°F (55°C) and relative humidity of 95%, condensing)
- IEC 68-2-52 level 2—Salt mist

The materials used in the PowerPact circuit breakers will not support the growth of fungus and mold.

Vibration

PowerPact circuit breakers meet IEC 60068-2-6 Standards for vibration.

- 2 to 13.2 Hz and amplitude 0.039 in. (1 mm)
- 13.2 to 100 Hz constant acceleration

Storage Temperature

Circuit breakers with trip units without LCD displays may be stored in the original packaging at temperatures between -58°F (-50°C) and 185°F (85°C). For circuit breakers with trip units with LCD displays, this range is -40°F (-40°C) to 185°F (85°C).

Trip System

The trip system causes the circuit breaker to open automatically under overload, short-circuit or equipment ground-fault conditions. Electronic trip circuit breakers give the customer more versatility to achieve coordination with features such as adjustable instantaneous pickup and high withstand ratings.

The type ET and the Micrologic trip systems consist of current sensors, a microprocessor-based trip unit, and a tripping coil. The tripping coil is a flux transfer solenoid that requires no external power source. All type ET and Micrologic protective functions are completely fault powered.

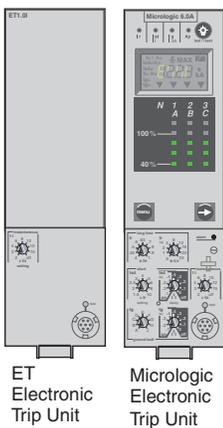
Micrologic Trip System

Features found in Micrologic™ electronic trip circuit breakers, such as universally interchangeable rating plugs, adjustable long-time pickups and 100% ratings also provide capacity for future growth.

The integral equipment ground-fault sensing capabilities available with Micrologic trip systems mean that there are fewer parts and pieces to purchase, mount and wire. These capabilities include integral ground-fault protection for equipment, which causes the circuit breaker to trip when a ground fault is detected, as well as integral ground-fault alarm, which does not trip the circuit breaker but sends an alarm when a ground fault is detected.

Certain Micrologic trip systems also offer the customer true power management system solutions through communication. These trip units can communicate with other circuit breakers in the system and also with a power monitoring system. Communication is by Modbus® and does not require proprietary software.

Communication between trip units allows zone-selective interlocking (ZSI) between circuit breakers at different levels in the system. ZSI reduces faultstress by allowing the upstream circuit breaker closest to the fault to ignore its preset delay time and trip without any intentional delay on a short circuit or ground fault. For more information on ZSI, see data bulletin *Reducing Fault Stress with Zone-Selective Interlocking*.



PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers

Section 1—General Information

Unit-Mount Circuit Breakers

Unit-mount M-frame, P-frame, R-frame and NS630b–NS3200 circuit breakers are individually-mounted using supplied mounting screws. The four mounting screws are inserted through mounting holes molded into the circuit breaker case and threaded into the circuit breaker mounting enclosure. To properly support the circuit breaker, all four mounting screws must be used.

Unit-mount M-frame, P-frame and NS630b–NS1250 circuit breakers can be ordered with mechanical line and load side lugs. The standard lugs can be removed for the installation of compression-type lugs or bus connections. All lugs are UL Listed for their proper application and marked for use with aluminum and copper (Al/Cu) or copper only (Cu) conductors. Lugs suitable for copper and aluminum conductors are made of tin-plated aluminum. Lugs suitable for use with copper conductors only are made of copper.

See individual frame sections for frame-specific connection information.



M-Frame Unit-Mount



P-Frame Unit-Mount



Electrically Operated
P-Frame Unit-Mount



R-Frame Unit-Mount



I-Line™ Circuit Breakers

M-frame circuit breakers through 800 A and P-frame and R-frame circuit breakers through 1200 A are available in I-Line construction for easy installation and removal in I-Line panelboards and switchboards. I-Line circuit breakers use “blow-on” type line side connectors. In case of a short circuit, increased magnetic flux causes the plug-on connectors of the circuit breaker to tighten their grasp on the panelboard or switchboard bus bars. The I-Line connectors and circuit breaker mounting bracket are integral parts of I-Line circuit breakers and cannot be removed or replaced. I-Line circuit breakers come with mechanical load side lugs.



M-Frame I-Line



P-Frame I-Line



R-Frame I-Line

Drawout Circuit Breakers

P-frame manually-operated circuit breakers and switches are also available in drawout construction. The drawout assembly mechanism allows the circuit breaker to be racked in four positions (connected, test, disconnect or withdrawn).

P-frame cradles are ordered separately and are available with factory and field-installed accessories. See Section 9—P-Frame Cradles and Cradle Accessories for details.



P-Frame Drawout

PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers
Section 1—General Information

Catalog Numbering System

The M-frame, P-frame, R-frame and NS630b–NS3200 circuit breakers and cradles follow a “smart” catalog numbering system. The following tables are intended as a tool to decipher existing catalog numbers. **They are not intended for use in building catalog numbers, as some combinations may not be available.** To build a catalog number, please see the *Digest*, the *Product Selector* or contact the local field office.

M-Frame, P-Frame and R-Frame Circuit Breaker Catalog Numbers

NOTE: Not all options are available on all frames.

Table 10: Catalog Number for M-, P- and R-Frame (UL/IEC Dual-Rated) Circuit Breakers

Field Position	Field Description	Options	Description
1	Brand Name	(blank)	Square D
		N	Schneider Electric (Formerly Merlin Gerin brand)
2	Circuit Breaker Frame	M	800 A Max.
		P	1200 A Max.
		R	3000 A Max.
3	Interrupting Rating	G	35 kA @ 480 Vac
		J	65 kA @ 480 Vac
		K	P-Frame: 50 kA @ 600 Vac R-Frame: 65 kA @ 600 Vac
		L	100 kA @ 480 Vac
4	Connection	F	No Lugs
		L	Lugs on Both Ends
		M	Lugs on I/ON End
		P	Lugs on O/OFF End
		A	I-Line
		D	Drawout (Not Available on M and R Frames)
5	Poles	2	2P
		3	3P
		4	4P
6	Voltage Rating	4	480 V
		6	600 V
7–9	Ampere Rating	###	Circuit Breaker Rating (120 = 1200 A)
		000	Automatic Switch Value
10	Standard or 100% Rated	(none)	Standard Rated
		C	100% rated

Continued on next page

800 AMP,
1600 AMP

PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers
Section 1—General Information

Table 10: Catalog Number for M-, P- and R-Frame (UL/IEC Dual-Rated) Circuit Breakers

Field Position	Field Description	Options	Description
11–14	Circuit Breaker Trip System	(none)	ET1.0 (M-Frame)
		(none)	ET1.0I (P-Frame, R-Frame)
		U31	Micrologic™ 3.0 Trip Unit
		U33	Micrologic 5.0 Trip Unit
		U41	Micrologic 3.0A Trip Unit
		U43	Micrologic 5.0A Trip Unit
		U44	Micrologic 6.0A Trip Unit
		U63	Micrologic 5.0P Trip Unit
		U64	Micrologic 6.0P Trip Unit
		U73	Micrologic 5.0H Trip Unit
		U74	Micrologic 6.0H Trip Unit
		Automatic Switch Trip System ¹	S60
	S80		800 A ²
	S10		1000 A ²
	S12		1200 A
	S16		1600 A
	S20		2000 A
	S25		2500 A
	S30		3000 A
	Motor Circuit Protector Trip System	M68	1200–10000 A ²
M69		1500–10000 A ²	
M70		1800–10000 A ²	
15	Rating Plug	A–H	See Table 75
16-17	Modbus® Communication	E1	Modbus BCM
18	I-Line™ Phasing	See <i>Digest, Product Selector</i>	

For Factory-Installed Accessories, See *Product Selector*

¹ For more information on P-frame switches, see page 47. For more information on R-frame switches, see page 58.

² Not available on R-frame.

PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers

Section 2—Electronic Trip Systems

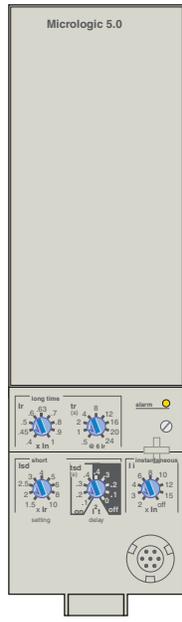
Table 16: Micrologic™ Trip Unit Features (continued)

Feature	Micrologic Trip Unit (X = Standard Feature O = Available Option)										
	Standard			Ammeter				Power		Harmonics	
	2.0	3.0	5.0	2.0A	3.0A	5.0A	6.0A	5.0P	6.0P	5.0H	6.0H
LED for Long-Time Pick-Up	X	X	X	X	X	X	X	X	X	X	X
LED for Trip Indication				X	X	X	X	X	X	X	X
Digital Ammeter				X	X	X	X	X	X	X	X
Zone-Selective Interlocking ³				X		X	X	X	X	X	X
Communications				O	O	O	O	X	X	X	X
LCD Dot Matrix Display								X	X	X	X
Advanced User Interface								X	X	X	X
Protective Relay Functions								X	X	X	X
Neutral Protection ¹								X	X	X	X
Contact Wear Indication								X	X	X	X
Incremental Fine Tuning of Settings								X	X	X	X
Selectable Long-Time Delay Bands								X	X	X	X
Power Measurement								X	X	X	X
Power Quality Measurements										X	X
Waveform Capture										X	X

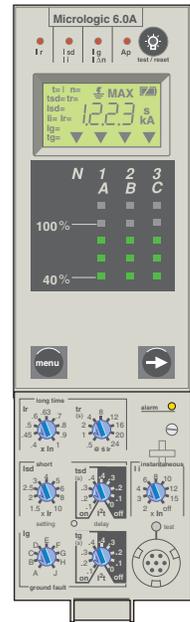
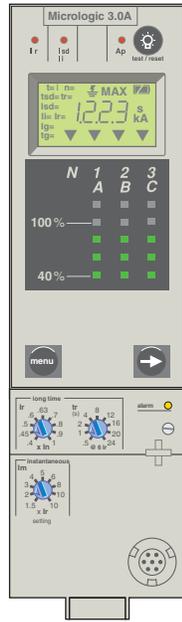
¹ 3Ø, 4W circuits require either a neutral current transformer or a 4-pole breaker.

² Requires M6C Programmable Contact Module.

³ Not available for 2.0A trip units as upstream devices.

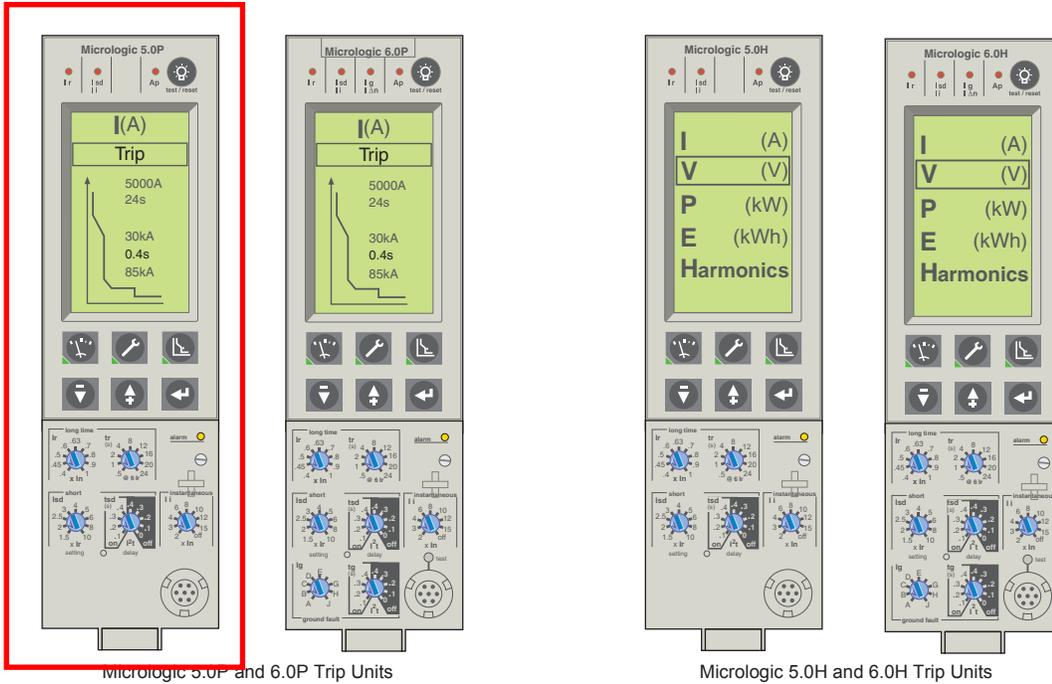


Micrologic 3.0 and 5.0 Basic Trip Units



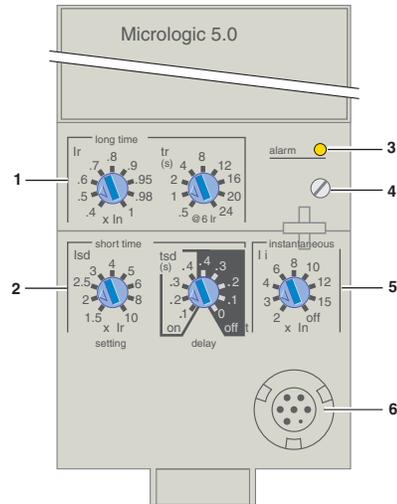
Micrologic 3.0A, 5.0A and 6.0A Trip Units

PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers Section 2—Electronic Trip Systems

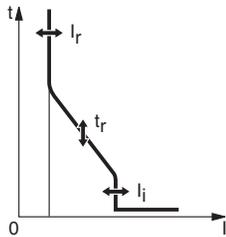


Micrologic 5.0P and 6.0P Trip Units

Micrologic 5.0H and 6.0H Trip Units



- 1—Long-time current setting and tripping delay
- 2—Short-time pickup and tripping delay
- 3—Overload signal (LED)
- 4—Long-time rating plug screw
- 5—Instantaneous pickup
- 6—Test connector



Micrologic™ 2.0, 3.0 and 5.0 Basic Trip Units

The Micrologic 2.0, 3.0, and 5.0 basic trip units protect power circuits.

Protection Settings

Protection thresholds and delays are set using the rotary switches. A full-range of long-time settings are available via field-installable adjustable rating plugs.

- Overload protection
 - True RMS long-time protection
 - Thermal imaging: Active thermal imaging before and after tripping
- Short-circuit protection
 - Short-time RMS
 - Selection of I^2t type (ON or OFF) for short-time delay
- Instantaneous protection
- Neutral protection on four-pole circuit breakers

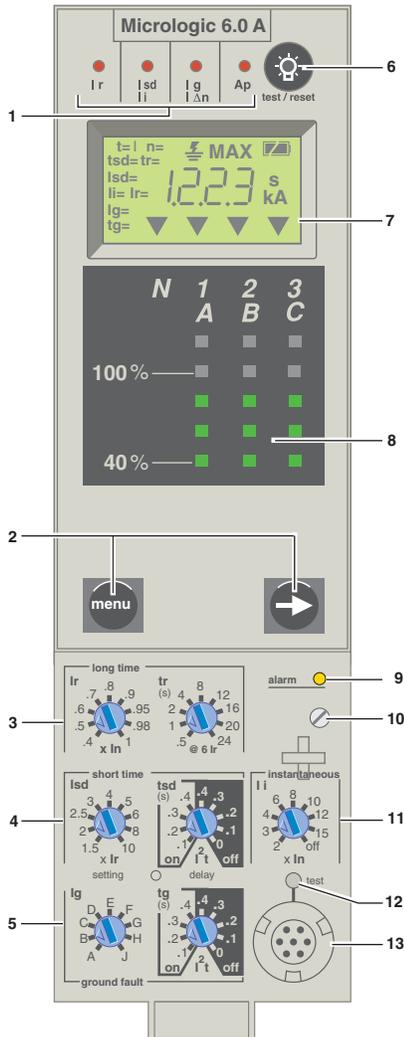
Table 17: Micrologic 2.0 and 3.0 Basic Trip Unit Settings

	Current setting (A)	2.0:	0.40	0.50	0.60	0.70	0.80	0.90	0.95	0.98	1.00
	Tripping between 1.05 and 1.20 x I_r	3.0:	0.40	0.45	0.50	0.60	0.63	0.70	0.80	0.90	1.00
			Other ranges are available by changing rating plug								
Long-time Protection	Maximum Time Delay (s)	t_r at 1.5 x I_r	12.5	25	50	100	200	300	400	500	600
	Accuracy: 0 to -20%	t_r at 6 x I_r	0.5	1	2	4	8	12	16	20	24
		t_r at 7.2 x I_r	0.34	0.69	1.38	2.7	5.5	8.3	11	13.8	16.6
	Thermal Imaging		20 minutes before or after tripping								
Short-time Protection	Current Setting (A)										
	Accuracy: ±10% No delay	$I_{sd} = I_r \times \dots$	2.0:	1.5	2	2.5	3	4	5	6	8

PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers

Section 3—Electronic Trip Systems

Micrologic™ 2.0A, 3.0A, 5.0A and 6.0A Trip Units with Ammeter



- 1—Indication of tripping cause
- 2—Navigation buttons
- 3—Long-time current setting and tripping delay
- 4—Short-time pickup and tripping delay
- 5—Ground-fault pickup and tripping delay
- 6—Test lamp and reset
- 7—Digital display
- 8—Three-phase bar graph and ammeter
- 9—Overload signal (LED)
- 10—Long-time rating plug screw
- 11—Instantaneous pickup
- 12—Electronic push-to-trip
- 13—Test connector

Micrologic A trip units protect power circuits and provide current measurements, overload protection, and short-circuit protection. In addition, the 6.0A trip units also provide ground-fault protection for equipment.

Protection Settings

Protection thresholds and delays are set using the rotary switches. The selected values are momentarily displayed in amperes and in seconds. A full-range of long-time settings are available via the field-installable rating plug:

- Overload protection (true RMS long-time protection)
- Thermal imaging (active thermal imaging before and after tripping)
- Short-circuit protection:
 - Short-time RMS
 - I^2t ON or OFF for short-time delay
- Instantaneous protection
- Ground-fault protection for equipment:
 - Residual ground-fault protection for equipment
 - Source ground-return ground-fault protection for equipment
 - Modified differential ground-fault protection (MDGF) for equipment
- Neutral protection on four-pole circuit breakers
- ZSI: Zone-selective interlocking:
 - ZSI terminal block may be used to interconnect a number of trip units to provide total discrimination for short-time and equipment ground-fault protection, without delay for tripping).
 - Not available for 3.0A trip units or for 2.0A trip units installed as upstream devices.

Ammeter Measurements

Micrologic A trip units measure the true RMS value of currents. They provide continuous current measurement from 0.2 to 20 x I_n with an accuracy of 1.5% (including sensors). No auxiliary source is needed where $I > 0.2 \times I_n$. The optional external power supply (24 Vdc) makes it possible to display currents where $I < 0.2 \times I_n$ and to store values of the interrupted current.

A digital LCD screen continuously displays the most heavily loaded phase (I_{max}) or displays the I_A , I_B , I_C , I_g , and (on 4P circuit breakers only) I_N stored current and setting values by successively pressing the navigation button.

Communication Network

In conjunction with an optional communication network, the trip unit transmits the following parameters:

- Setting values
- All ammeter measurements
- Tripping causes

PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers

Section 3—Electronic Trip Systems

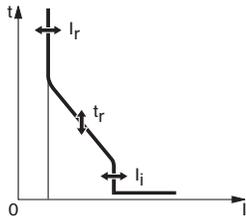


Table 22: Micrologic 2.0A and 3.0A Trip Unit Settings

Long-Time Protection	Current Setting (A)		2.0A: 0.40 0.50 0.60 0.70 0.80 0.90 0.95 0.98 1.00
	Tripping Between 1.05 and 1.20 x I _r	I _r = I _n x...	3.0A: 0.40 0.45 0.50 0.60 0.63 0.70 0.80 0.90 1.00
	Other Ranges are Available by Changing Rating Plug		
	Maximum Time Delay (s) Accuracy: 0–20%	t _r at 1.5 x I _r	12.5 25 50 100 200 300 400 500 600
	t _r at 6 x I _r	0.5 1 2 4 8 12 16 20 24	
	t _r at 7.2 x I _r	0.34 0.69 1.38 2.7 5.5 8.3 11 13.8 16.6	
Thermal Imaging		20 Minutes Before or After Tripping	
Short-Time Protection	Current Setting (A) Accuracy: ±10%, No delay	I _{sd} = I _r x...	2.0A: 1.5 2 2.5 3 4 5 6 8 10
Instantaneous Protection	Current Setting (A) Accuracy: ±10%	I _i = I _n x...	3.0A: 1.5 2 3 4 5 6 8 10 12

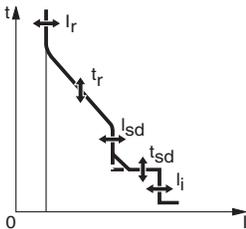


Table 23: Micrologic 5.0A and 6.0A Trip Unit Settings

Long-Time Protection	Current Setting (A)		IEC: 0.40 0.50 0.60 0.70 0.80 0.90 0.95 0.98 1.00
	Tripping Between 1.05 and 1.20 x I _r	I _r = I _n x...	UL: 0.40 0.45 0.50 0.60 0.63 0.70 0.80 0.90 1.00
	Other ranges are available by changing rating plug		
	Maximum Time Delay (s) Accuracy: 0–20%	t _r at 1.5 x I _r	12.5 25 50 100 200 300 400 500 600
	t _r at 6 x I _r	0.5 1 2 4 8 12 16 20 24	
	t _r at 7.2 x I _r	0.34 0.69 1.38 2.7 5.5 8.3 11 13.8 16.6	
Thermal Imaging		20 minutes before or after tripping	
	Current Setting (A) Accuracy: ±10%	I _{sd} = I _r x...	1.5 2 2.5 3 4 5 6 8 10
Short-Time Protection	Maximum Time Delay (s) at 10 x I _r	Settings	I ² t OFF 0 0.1 0.2 0.3 0.4
			I ² t ON 0.1 0.2 0.3 0.4
		t _{sd}	Min. trip time (ms) 20 80 140 230 350
			Max. trip time (ms) 80 140 200 320 500
Instantaneous Protection	Current Setting (A) Accuracy: ±10%	I _i = I _n x...	2 3 4 6 8 10 12 15 off

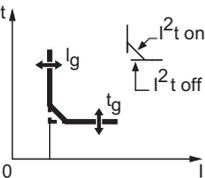


Table 24: Micrologic 6.0A Trip Unit Ground-Fault Settings

Ground-Fault Pickup (A) Accuracy: ±10%	I _g = I _n x...	A B C D E F G H J
	I _n ≤ 400 A	0.3 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
	400 A < I _n ≤ 1200 A	0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
	I _n > 1200 A	500 640 720 800 880 960 1040 1120 1200
Maximum Time Delay (s) at 1 x I _g	Settings	I ² t OFF 0 0.1 0.2 0.3 0.4
		I ² t ON 0.1 0.2 0.3 0.4
	t _g	Minimum Trip Time (ms) 20 80 140 230 350
		Maximum Trip Time (ms) 80 140 200 320 500

External Power Supplies for Micrologic Trip Units

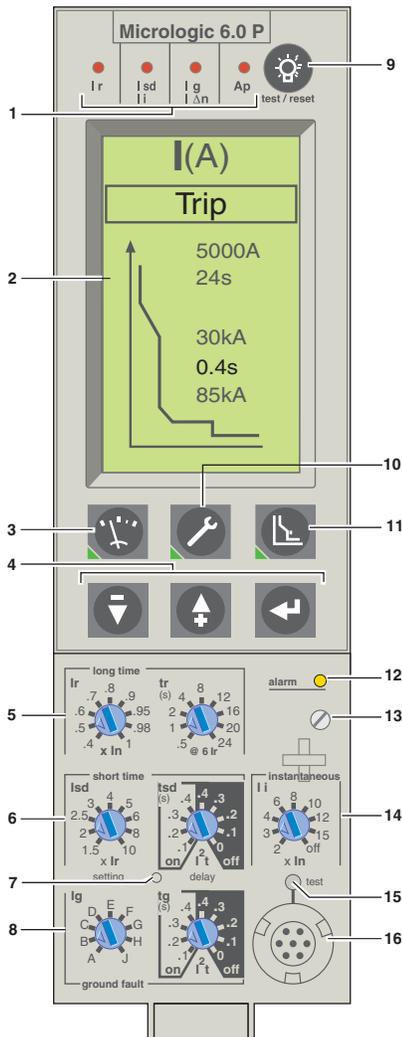
Current-based protection functions require no auxiliary power source.

Table 25: Micrologic A Use of External 24 Vdc Power Supply

Function	Without 24 Vdc Power Supply at F1 and F2	With 24 Vdc Power Supply at F1 and F2	
Fault Protection for LSIG Functions	Yes	Yes	
LED Trip Indication	Yes	Yes	
Ammeter and bar graph displays	Yes	Yes	
Trip Setting and Max. Current Readings Can Be Accessed on the Display by Using Navigation Buttons	Yes, If Current Flow on One Phase is Equal To or Greater Than:	Yes	
	Sensor Plug Value (I _n)		Minimum Ground-fault Pickup
	100–250 A		30% of sensor rating
	400–1200 A		20% of sensor rating
Ground-Fault Push-to-Trip Button Works for Testing Ground Fault ¹	1600–6300 A	500 A	
Modbus® Communications (Optional)	No	Yes, with separate 24 Vdc power supply for the circuit breaker communication module	
Back-lit Display	No	Yes	

¹ Ground fault Push-to-trip button will also be functional if hand-held test kit or full-function test kit is powering the trip unit.

Micrologic™ 5.0P and 6.0P Trip Units with Power Metering



- 1—Indication of tripping cause
- 2—High resolution screen
- 3—Measurement display
- 4—Navigation buttons
- 5—Long-time current setting and tripping delay
- 6—Short-time pickup and tripping delay
- 7—Hole for settings lockout pin
- 8—Ground-fault pickup and tripping delay
- 9—Test lamp and indication reset
- 10—Maintenance indicators
- 11—Protection settings
- 12—Overload signal (LED)
- 13—Long-time rating plug screw
- 14—Instantaneous pickup
- 15—Electronic push-to-trip
- 16—Test connector

Micrologic P trip units provide power metering and extended protection in addition to the adjustable protection functions of the Micrologic A trip unit.

Protection Settings

The adjustable protection functions of the 5.0P and 6.0P trip units are identical to those of Micrologic A trip unit (overloads, short circuits, equipment ground-fault protection; see page 27). These units also feature:

- Fine adjustment
Within the range below the rotary switch setting, fine adjustments of pickups/delays in steps of 1 A/s (except for short-time and ground-fault) are possible on the keypad or remotely by the communication network.
- Inverse definite minimum time lag (IDMTL) setting.
Coordination with fuse-type or medium-voltage protection systems is optimized by adjusting the long-time delay curve around $6 \times I_r$ axis. This setting ensures better coordination with certain loads.
- Neutral protection
On three-pole circuit breakers, neutral protection may be set using the keypad or remotely using the communication network to one of four positions: OFF, $1/2N$ ($1/2 \times I_n$), $1N$ ($1 \times I_n$), or $1.6N$ ($2 \times I_n$).

NOTE: Neutral protection is disabled if long-time curve is set to one of the IDMTL protection settings.

Configuring Alarms and Other Protection Functions

When the cover is closed, the keypad may no longer be used to change the protection settings, but it still provides access to the displays for measurements, histories, indicators, etc. Depending on the thresholds and time delays set, the Micrologic P trip unit monitors current, voltage, power, frequency, and phase sequence. Each threshold overrun may be signalled remotely via the communication network.

Each threshold overrun may be combined with tripping (protection) or an indication carried out by an optional M6C programmable contact (alarm), or both (protection and alarm).

Maintenance Record

The maintenance record can be consulted using the full-function test kit or remotely via the communication network. It can be used as an aid in troubleshooting and to assist scheduling for device maintenance operations.

Recorded indications include:

- Highest current measured
- Operation counter (cumulative total and total since last reset)
- Number of test kit connections
- Number of trips in operating mode

Load Shedding and Reconnection Parameters

Load shedding and reconnection parameters can be set according to the power or the current flowing through the circuit breaker. Load shedding is carried out by a remote computer via the communication network or by an M6C programmable contact.

PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers

Section 2—Electronic Trip Systems

Indication Option Via Programmable Contacts

The M6C programmable contact may be used to signal threshold overruns or status changes. It can be programmed using the keypad on the Micrologic P trip unit or remotely using the communication network. The contact is required to obtain data from the protective relay functions on Type P and Type H trip units.

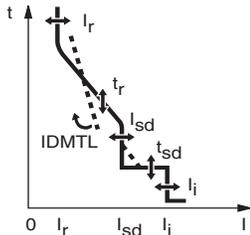


Table 23: Micrologic 5.0P and 6.0P Trip Unit Settings

Long-Time (RMS) Protection	Current Setting (A)	$I_r = I_n \times \dots$	IEC	0.40	0.50	0.60	0.70	0.80	0.90	0.95	0.98	1.00
	Tripping Between 1.05 and 1.20 x I_r	$I_r = I_n \times \dots$	UL	0.40	0.45	0.50	0.60	0.63	0.70	0.80	0.90	1.00
				Other Ranges are Available by Changing Rating Plug								
	Maximum Time Delay (s)	t_r at 1.5 x I_r		12.5	25	50	100	200	300	400	500	600
	Accuracy: 0 to -20%	t_r at 6 x I_r		0.5	1	2	4	8	12	16	20	24
		t_r at 7.2 x I_r		0.34	0.69	1.38	2.7	5.5	8.3	11	13.8	16.6
IDMTL Setting	Curve slope		SIT	VIT	EIT	HV Fuse DT						
Thermal Imaging	20 Minutes Before or After Tripping											
Short-Time (RMS) Protection	Current Setting (A)	$I_{sd} = I_r \times \dots$		1.5	2	2.5	3	4	5	6	8	10
	Accuracy: ±10%											
	Settings	I^2t OFF		0	0.1	0.2	0.3	0.4				
	Maximum Time Delay (s) at 10 x I_r	I^2t ON		0.1	0.2	0.3	0.4					
	t_{sd}	Min. Trip Time (ms)	20	80	140	230	350					
		Max. Trip Time (ms)	80	140	200	320	500					
Instantaneous Protection	Current Setting (A)	$I_i = I_N \times \dots$		2	3	4	6	8	10	12	15	off
	Accuracy: ±10%											

Table 24: Micrologic 6.0P Trip Unit Ground-Fault Settings

Ground-Fault Pickup (A)	Accuracy: ±10%	$I_g = I_n \times \dots$	A	B	C	D	E	F	G	H	J
		$I_n \leq 400$ A	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
		400 A < $I_n \leq 1200$ A	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
		$I_n > 1200$ A	500	640	720	800	880	960	1040	1120	1200
Maximum Time Delay (s) at 1 x I_g	Settings	I^2t OFF	0	0.1	0.2	0.3	0.4				
		I^2t ON	0.1	0.2	0.3	0.4					
		Min. Trip Time (ms)	20	80	140	230	350				
		t_g	Max. Trip Time (ms)	80	140	200	320	500			

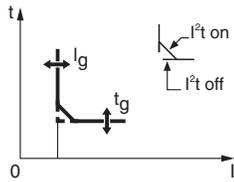


Table 25: Micrologic 5.0P and 6.0P Trip Unit Settings for Protection Functions

		Threshold	Time Delay
Current	Current Imbalance	0.05 to 0.6 x I_{max}	1 to 40 s
	Maximum Current	I_{max} : I_A, I_B, I_C, I_N, I_g	15 to 1500 s
	Voltage Imbalance	0.02 to 0.3 x V_n	1 to 40 s
Voltage	Minimum Voltage	V_{min}	100 to 725 V (Phase Total)
	Maximum Voltage	V_{max}	100 to 1200 V (Between Phases)
Power	Maximum Power	P_{max}	5 to 500 kW
	Reverse Power	P_r	0.02 to 0.2 x P_n
Frequency	Minimum Frequency	F_{min}	45 to 65 Hz
	Maximum Frequency	F_{max}	45 to 540 Hz
Phase	Sequence	$\Delta\emptyset$	$\emptyset A-\emptyset B-\emptyset C$ or $\emptyset A-\emptyset C-\emptyset B$
			Instantaneous

Table 26: Micrologic 5.0P and 6.0P Trip Unit Settings for Current and Power Load-Shedding

		Pickup	Drop-out		
		Threshold	Time Delay	Threshold	Time Delay
Current	I	0.5 to 1.0 x I_r Per Phase	20% to 80% x t_r	0.3 to 1.0 x I_r per phase	10 to 600 s
Power	P	200 kW to 10 MW	10 to 3600 s	100 kW to 10 MW	10 to 3600 s

Micrologic P trip units are designed to be used with an external 24 Vdc power supply. Current-based protection functions require no auxiliary power source.

PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers Section 2—Electronic Trip Systems

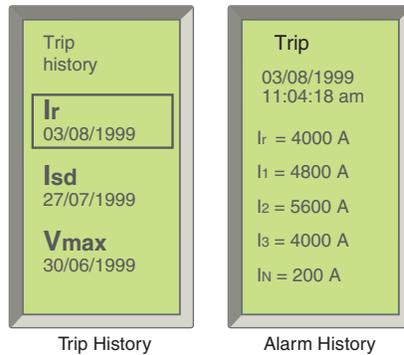
Table 27: Micrologic P Use of External 24 Vdc Power Supply

Function	Without 24 Vdc Power Supply at F1 and F2	With 24 Vdc Power Supply at F1 and F2
Fault Protection for LSIG Functions	Yes	Yes
LED Trip Indication	Yes	Yes
LCD Display and Backlight are Functional	Yes ¹	Yes
Ground-Fault Push-to-Trip Button Works for Testing Ground Fault ²	Yes ¹	Yes
Metering, Monitoring, and History Logs are Functional	Yes ¹	Yes
Communications Between Trip Unit and M2C and M6C Programmable Contact Modules	No	Yes
Operation of M6C Programmable Contact Module	No	Yes, with separate 24 Vdc power supply for the module
Modbus® Communications	No	Yes, with separate 24 Vdc power supply for the circuit breaker communication module

¹ If circuit breaker has 100 Vac or more between two phases or phase to neutral and is bottom fed or closed in a top fed application.
² Ground-fault push-to-trip button will also be functional if hand-held test kit or full-function test kit is powering the trip unit.

Tripping and Alarm Histories

The last ten trips and ten alarms are recorded in two separate history files that can be displayed on the screen (sample displays are shown).



The following information is contained in these files:

Trip History

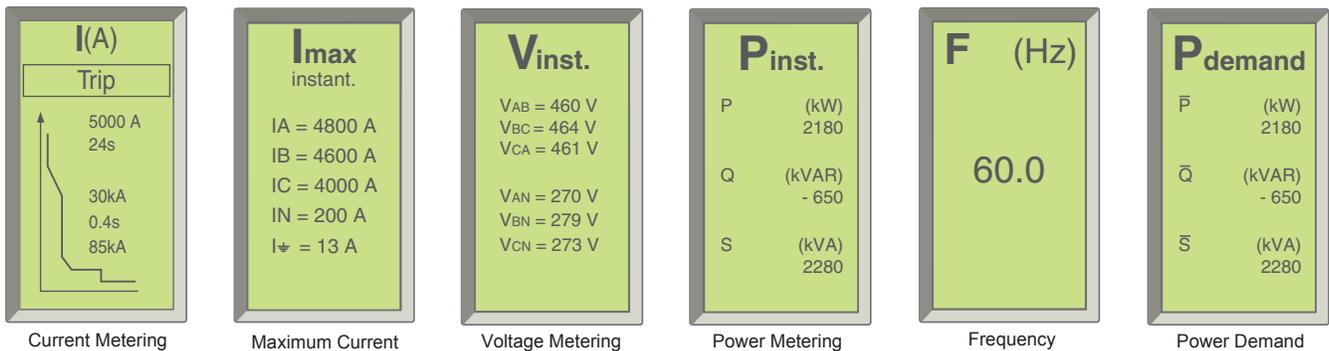
- Type of fault
- Date and time of fault
- Interrupted current

Alarm History

- Type of alarm
- Date and time of alarm
- Values measured at time of alarm

Metering

The Micrologic P trip unit calculates in real time the electrical values V, A, W, VAR, VA, Wh, VARh, VAh, Hz, power factor and crest factor. It also calculates demand current and power over an adjustable time period.



PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers

Section 2—Electronic Trip Systems

Real-Time Metering

The value displayed on the screen is refreshed every second. Minimum and maximum measurement values are stored in memory.

Table 28: Real-Time Metering

Type of Measurement		Unit of Measurement	Measurement Source
Current	I_{RMS}	A	$\emptyset A, \emptyset B, \emptyset C$ or N
	$I_{AVERAGE}$	A	$(\emptyset A + \emptyset B + \emptyset C) / 3$
	$I_{PEAK}/\sqrt{2}$	A	$\emptyset A, \emptyset B, \emptyset C$ or N
Voltage	V_{RMS}	V	$(\emptyset A-\emptyset B), (\emptyset B-\emptyset C)$ and $(\emptyset C-\emptyset A)$
	V_{RMS}	V	$(\emptyset A-N), (\emptyset B-N)$ and $(\emptyset C-N)$
	$\Delta V_{IMBALANCE}$	%	V_{RMS}
Power	P, Q and S	W, VAR, VA	Total
	EP, EQ and ES	Wh, VARh, VAh	Total
	Power factor		Total
Frequency	F	Hz	50/60

Demand Metering

The demand is calculated over a fixed or sliding time window that can be programmed from five to sixty minutes. Depending on the contract signed with the power supplier, specific programming makes it possible to avoid or minimize the cost of overrunning the subscribed power. Maximum demand values are systematically stored and time stamped.

Table 29: Demand Metering

Type of Measurement		Unit of Measurement	Measurement Source
Current	I_{DEMAND}	A	$\emptyset A, \emptyset B, \emptyset C$ or N
Power	P, Q and S_{DEMAND}	W, VAR, VA	Total

Communication Network

The communication network may be used to:

- Remotely read parameters for the protection functions.
- Transmit all the measurements and calculated values.
- Signal the causes of tripping and alarms.
- Consult the history files and the maintenance indicator record.

In addition, an event log of the last 100 events and a maintenance record, which is stored in the trip unit memory but not available locally, may be accessed via the communication network.

This Modbus® communication system is compatible with the Powerlogic™ System Manager™ software (SMS).

Event Log

The event log may be accessed by a remote computer via the communication network. All events are time stamped and include:

- Trips
- Beginning and end of alarms
- Modifications to settings and parameters
- Loss of time
- Test kit connections
- Counter resets
- System faults (thermal self-protection, major fault and minor fault alarms)

Table 87: Full-Function Test Kit Catalog Numbers

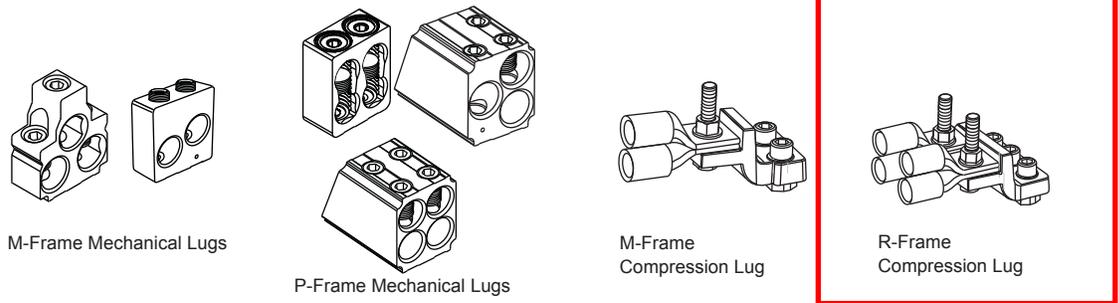
Device	Cat. No.
Full-function Test Kit	S33595
Seven-pin Test Cable (for Connection Between Test Kit and Trip Unit) ¹	S48907
230 Vac Filtered Power Cord ¹	S48856
120 Vac Filtered Power Cord ¹	S48855

¹ Included in the test kit. Kit for replacement only.

Circuit Breaker Terminations

Mechanical, Compression, and Distribution Lugs

The M-frame, P-frame and NS630b–NS1250 circuit breakers have mechanical lugs standard on both ends of the unit-mounted circuit breakers. The M-frame and P-frame I-Line™ circuit breakers have mechanical lugs standard on the O/OFF end only. These lugs are suitable for use with copper or aluminum wire. Rear connectors, compression lugs and distribution lugs are available for special applications.



P-frame and NS630b–NS1600 circuit breakers are also available in drawout construction. See Section 8 for drawout cradle details.

The R-frame and NS1600b–NS3200 circuit breakers have terminal pads only (no lugs) for bus connections on both ends. Terminal pads are required for the use of lugs on R-frame circuit breakers, lugs are not available for NS1600b–NS3200 circuit breakers. See the section on R-frame and NS1600b–NS3200 circuit breakers for information on terminal pad requirements. R-frame I-Line circuit breakers have mechanical lugs standard on the O/OFF end only (AL1200R53K).

Copper mechanical lugs are available for use with copper wire only. These lugs can be factory installed by adding an LC suffix to the circuit breaker catalog number for standard copper lugs and LD suffix for high-amp copper lugs (M-frame, P-frame and NS630b–NS1250 ≤ 800 A circuit breakers only). See the Digest or product selector or contact the field office for more information.

I-Line™ Jaw Configurations

Standard 3P I-Line circuit breakers are supplied with an ABC phase jaw connection. In applications where the jaw configuration must be reversed, specify a CBA jaw configuration by adding the digit 6 to the phasing position of the circuit breaker catalog number.

I-Line 2P circuit breakers are available in AC or CA phasing. Add the digit of the desired phasing to the phasing position of the circuit breaker catalog number.

Table 88: I-Line Phase Options

Phase Option Number	Phase Connections
1	AB
2	AC
3	BA
4	BC
5	CA
6	CB

PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers

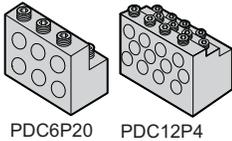
Section 8—Accessories

Table 86: I-Line Phase Options

Phase Option Number	Phase Connections
Standard 6	ABC CBA

Power Distribution Connectors

Power distribution connectors (PDCs) are available for M-frame, P-frame and NS630b–NS1250 unit-mount circuit breakers as field-installable kits. They can be used for multiple load wire connections on one circuit breaker. Each is UL Listed for copper wire only. Power distribution connectors are for use on the O/OFF end of the circuit breaker only, and the O/OFF end must be connected to the load. PDCs are for use in UL508 applications only.



PDC6P20 PDC12P4

Control Wire Terminations

Mechanical lug kits are available with provisions for control wire terminations. The control wire is crimped to a standard ring-type wire crimp terminal (not included) and secured to the lug using the #6-32 screw included in the kit. These lugs are UL and CSA Recognized as a circuit breaker component.

These lugs are available factory installed or as field-installable kits. For factory-installed control wire terminations, add the suffix from the table below in the lug option field of the catalog number.

Table 87: Control Wire Termination

Termination Code	Control Wire Location	Control Wire Suffix
L	Both ends	LW
M	ON end only	LU
P	OFF end only	LV

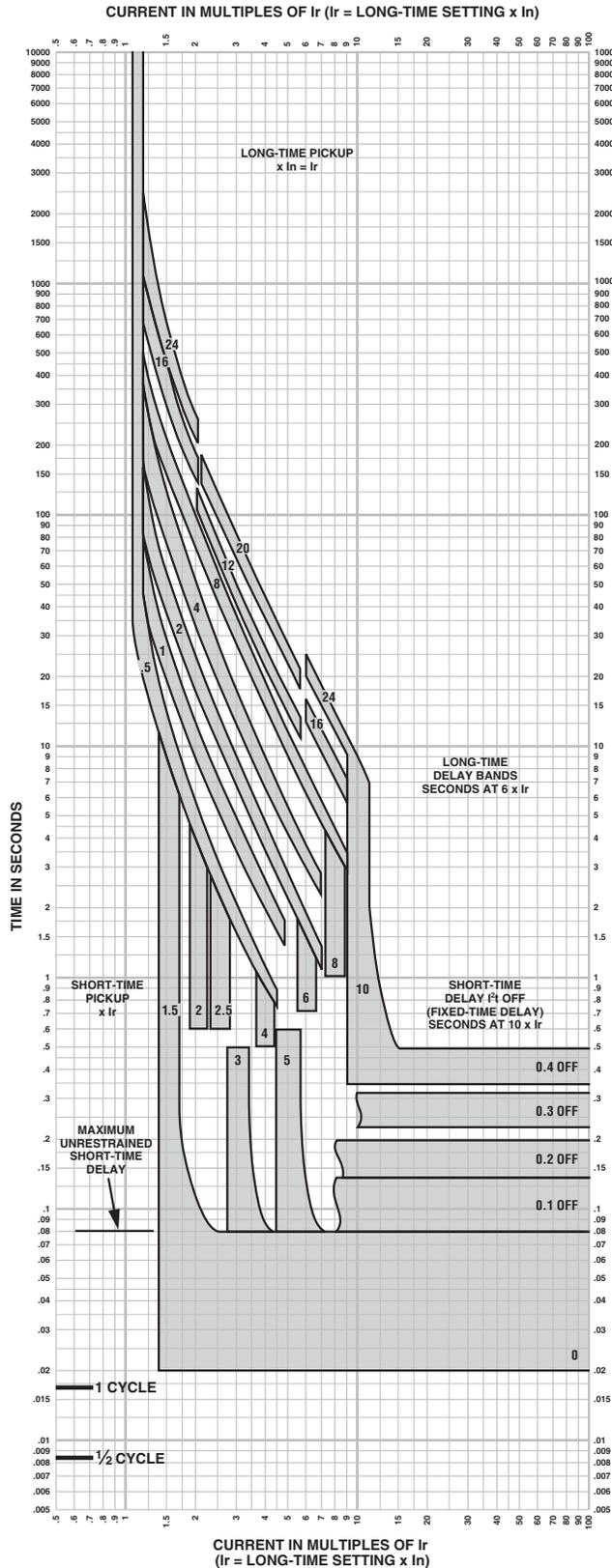
Table 88: Lug Kits

Lug Type	Catalog Number	Used On	Circuit Breaker Type	Lugs Per Kit ¹	Max. Amp. Rating	Conductors/Lug	
						No.	Range
Aluminum Mechanical Lug ²	AL800M23K	M-Frame, P-Frame ≤ 800 A, NS630b–NS800	Unit-Mount, I-Line	3, 4	800	3	3/0 AWG–500 kcmil (95–250 mm ²)
	AL800P6K	M-Frame, P-Frame ≤ 800 A ³ , NS630b–NS800	Unit-Mount, I-Line	3, 4	800	2	3/0 AWG–600 kcmil (95–300 mm ²)
	AL800P7K	M-Frame, P-Frame ≤ 800 A ³ , NS630b–NS800	Unit-Mount, I-Line	3	770	2	3/0 AWG–750 kcmil (95–400 mm ²); Compact AL 750 kcmil (400 mm ²) only
	AL1200P24K	M-Frame, P-Frame > 800 A, optional for ≤ 800 A, NS630b–NS1200	Unit-mount, I-Line	1	1200	4	3/0 AWG–500 kcmil (95–250 mm ²)
	AL1200P25K	P-Frame > 800 A, optional for ≤ 800 A, NS630b–NS1200	Unit-Mount	3, 4	1200	4	3/0 AWG–500 kcmil (95–250 mm ²)
	AL1200R53K	R-Frame, NS1600b–NS3200	I-Line	1	1200	4	3/0 AWG–600 kcmil (95–300 mm ²)
	AL1200P6KU	P-Frame > 800 A, optional for ≤ 800 A, NS630b–NS1200	Unit-Mount	3	1200	3	350-600 kcmil (185-300 mm ²)
	AL1200P7KU	P-Frame ≤ 800 A ³ , NS630b–NS800	Unit-Mount	3	1155	3	3/0 AWG–750 kcmil (95–400 mm ²); Compact AL 750 kcmil only
	AL2500RK	R-Frame, NS1600b–NS3200	Unit-Mount	2	2500	1	1/0 AWG–750 kcmil (50–400 mm ²)

Continued on next page

LSI 5.0P
PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers
Section 11—Trip Curves

Micrologic 5.0/6.0 P-Frame, R-Frame and NS630b–NS3200 A/P/H Trip Unit Characteristic Trip Curve



Micrologic 5.0/6.0 A/P/H Trip Units

Long-Time Pickup and Delay
Short-Time Pickup and I²t OFF
Delay

Characteristic Trip Curve No. 613-4

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

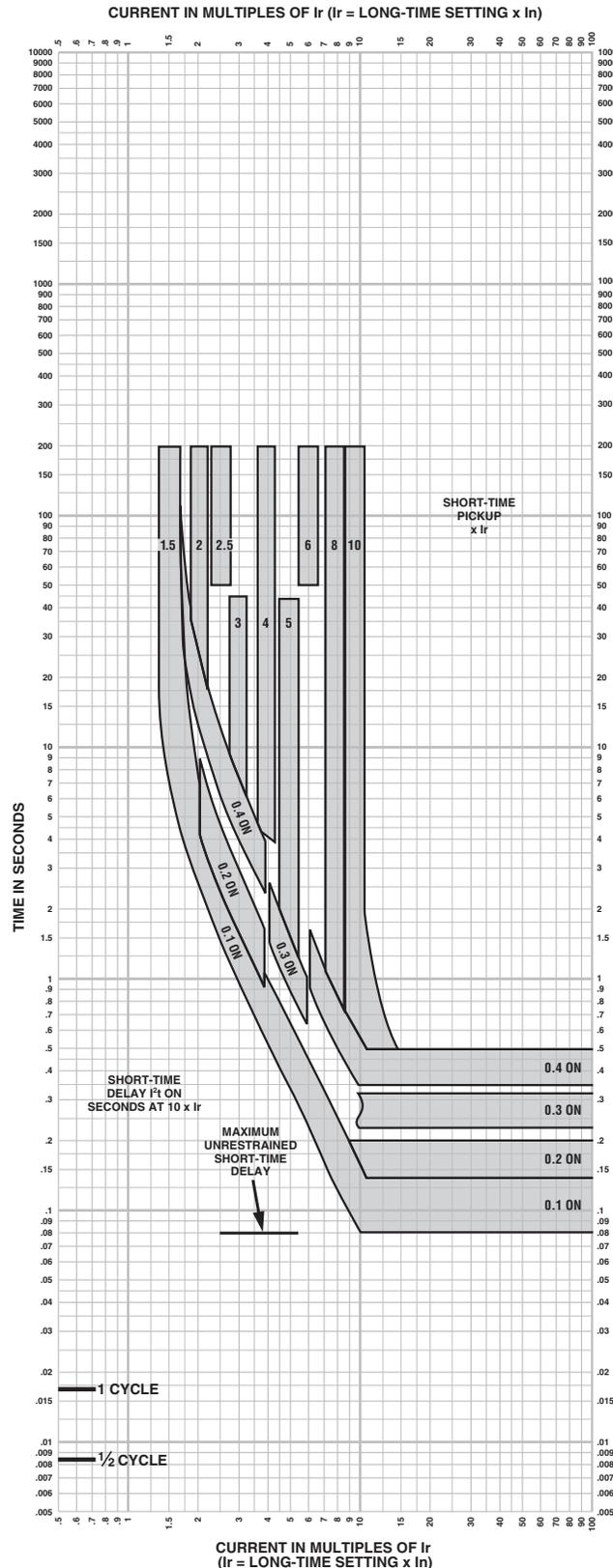
Notes:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately twenty minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the interrupting rating of the circuit breaker.
3. With zone-selective interlocking ON, short-time delay utilized, and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
4. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
5. For a withstand circuit breaker, instantaneous can be turned OFF. See trip curve 613-7 on page 143 for instantaneous trip curve. See table on page 147 for instantaneous override values.
6. Overload indicator illuminates at 100%.

Curve No. 0613TC0004
 Drawing No. B48095-613-04

LSI 5.0P
PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers
Section 11—Trip Curves

Micrologic 5.0/6.0 P-Frame, R-Frame and NS630b–NS3200 A/P/H Trip Units Characteristic Trip Curve



Micrologic 5.0/6.0 A/P/H Trip Units
Short-Time Pickup and I^2t ON Delay
Characteristic Trip Curve No. 613-5

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to $+60^{\circ}\text{C}$ (-22°F to $+140^{\circ}\text{F}$) ambient temperature.

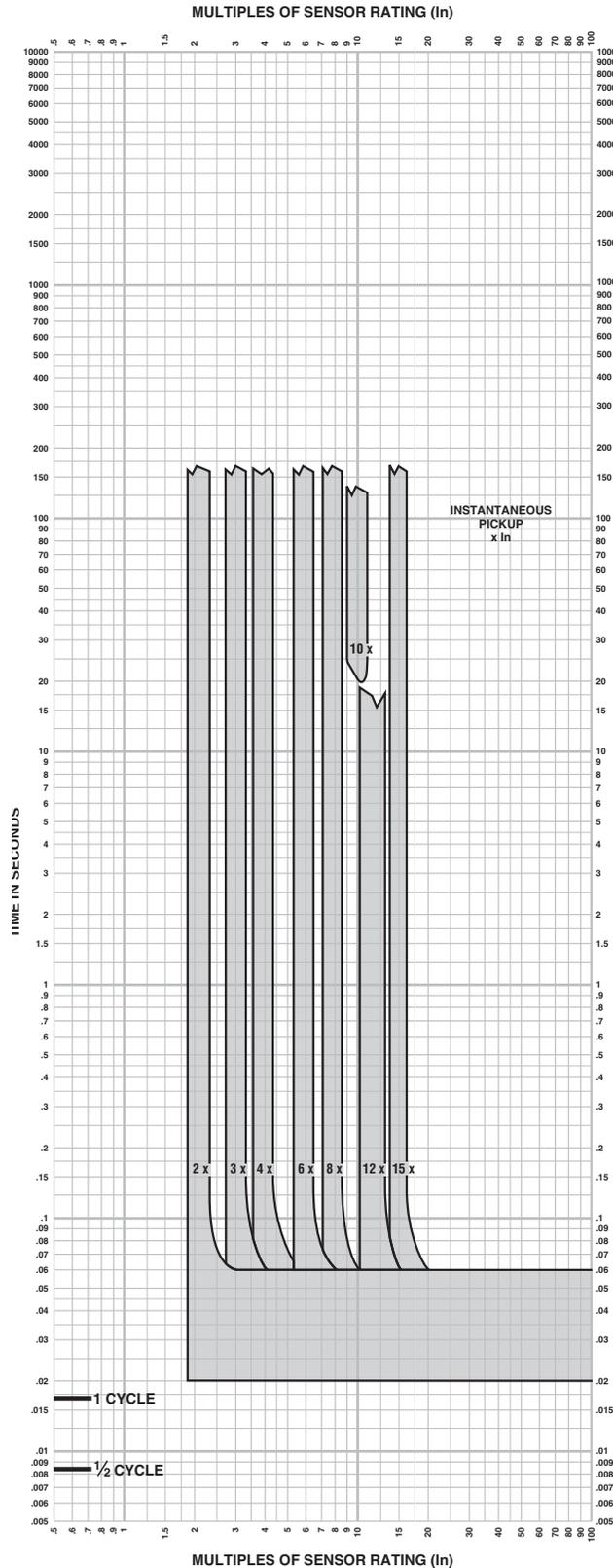
Notes:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately twenty minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the interrupting rating of the circuit breaker.
3. With zone-selective interlocking ON, short-time delay utilized, and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
4. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of current.
5. For withstand circuit breaker, instantaneous can be turned OFF. See trip curve 613-7 on page 143 for instantaneous trip curve. See table on page 147 for instantaneous override values.
6. See Trip Curve 613-4 on page 141 for long-time pickup and delay trip curve.

Curve No. 0613TC0005
 Drawing No. B48095-613-05

LSI 5.0P
PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers
Section 11—Trip Curves

Micrologic 5.0/6.0 P-Frame, R-Frame and NS630b–NS3200 A/P/H Trip Units Characteristic Trip Curve



Micrologic 5.0/6.0 Trip Units

Instantaneous Pickup, 2X to 15X and OFF

Characteristic Trip Curve No. 613-7

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

Notes:

1. The end of the curve is determined by the interrupting rating of the circuit breaker.
2. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of current.
3. The instantaneous region of the trip curve shows maximum total clearing times. Actual clearing times in this region can vary depending on the circuit breaker mechanism design and other factors. The actual clearing time can be considerably faster than indicated. Contact your local sales office for additional information.
4. For a withstand circuit breaker, instantaneous can be turned OFF. See trip curve 613-7 on page 143 for the instantaneous trip curve. See table on page 147 for the instantaneous override values.
5. See trip curve 613-4 on page 141 and trip curve 613-5 on page 142 for long-time pickup, long-time delay, short-time pickup and short-time delay trip curves.

Curve No. 0613TC0007
 Drawing No. B48095-613-07

PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers
Section 9—Accessories

Table 68: Field/Factory-Installed Accessories

Accessory	M-Frame Manually-Operated Circuit Breakers		P-Frame and NS630b–NS1600				R-Frame and NS1600b–NS3200 Circuit Breakers		Page No.
	Field Installable	Factory Installed	Manually-Operated Circuit Breakers		Electrically- Operated Circuit Breakers		Field Installable	Factory Installed	
			Field Installable	Factory Installed	Field Installable	Factory Installed			
Shunt Trip (MX)	Y	Y	Y	Y	Y	Y	Y	Y	102
Undervoltage Trip (MX)	Y	Y	Y	Y	Y	Y	Y	Y	103
Adjustable Time Delay Module for Undervoltage Trip	Y	N	Y	N	Y	N	Y	N	104
Auxiliary Switch (OF)	Y	Y	Y	Y	Y	Y	Y	Y	104
Alarm Switch (SD)	Y	Y	Y	Y	N/A	N/A	Y	Y	104
Overcurrent Trip Switch (SDE)	N	N	Y	Y	Y	Y	Y	Y	104
Spring-Charging Motor	N/A	N/A	N/A	N/A	Y	Y	N/A	N/A	106
Trip Unit Replacement Covers	N	N	Y	N	Y	N	Y	N	107
Neutral Current Transformer	N	N/A	Y	N	Y	N	Y	N	108
Ground-Fault Interface Module	N	N/A	Y	Y	Y	Y	Y	Y	108
External Sensor for SGR or MDGF Protection	N	N/A	Y	Y	Y	Y	Y	Y	108
Sensor Plugs	N	N	Y	Y	Y	Y	Y	Y	109
Rating Plugs	N	N	Y	Y	Y	Y	Y	Y	109
M2C and M6C Programmable Contacts	N/A	N/A	Y	Y	Y	Y	Y	Y	110
Circuit Breaker Communication Module	N/A	N/A	Y	Y	Y	Y	Y	Y	110
Restraint Interface Module	N/A	N/A	Y	N	Y	N	Y	N	112
External Power Supply Module	N	N/A	Y	Y	Y	Y	Y	Y	112
External Battery Backup Module	N	N/A	Y	Y	Y	Y	Y	Y	112
Hand-Held Test Kit	N	N/A	Y	Y	Y	Y	Y	Y	113
Full-Function Test Kit	Y	N/A	Y	Y	Y	Y	Y	Y	113
Mechanical Lug	Y	Y	Y	Y	Y	Y	Y	Y	114
Compression Lug	Y	Y	Y	Y	Y	Y	Y	Y	114
Terminal Pad	Y	Y	Y	Y	Y	Y	Y	Y	114
I-Line Jaws	Y	Y	Y	Y	Y	Y	Y	Y	114
Power Distribution Connectors	Y	Y	Y	Y	Y	Y	Y	Y	115
Control Wire Terminations	Y	Y	Y	Y	Y	Y	Y	Y	115
Phase Barriers	Y	N	Y	N	Y	N	Y	N	117
Electric Joint Compound	Y	Y	Y	Y	Y	Y	Y	Y	117
Door-Mounted Operating Mechanism	Y	Y	Y	Y	Y	Y	N/A	N/A	117
Rotary Handle	N/A	N/A	N	Y	N/A	N/A	N/A	N/A	118
Replacement Handles	Y	Y	Y	Y	Y	Y	Y	Y	118
Long Handle Extension	Y	Y	Y	Y	N/A	N/A	N/A	N/A	118
Accessory Cover Door Escutcheons	Y	N	Y	N	Y	N	Y	N	118
Padlock Attachment	Y	Y	Y	Y	Y	Y	Y	Y	118
Keylock	N	Y	N	Y	N	Y	N	Y	118
Keylock Provision	N	Y	N	Y	N	Y	N	Y	118
Sub-Feed Lugs	Y	Y	Y	Y	Y	Y	Y	Y	119

Y = Yes
N = No
N/A = Not Available

Electrical Accessories

Maximum Wire Length

Maximum Wire Length—The inrush currents for these devices are approximately 200 VA. When low supply voltages (12, 24 or 48 V) are used, the maximum allowable wire length is dependent on the voltage and the wire size.

Table 69: Maximum Wire Length¹

Device	Percent of Source Voltage	Source Voltage					
		12 Vdc		24 Vdc		48 Vdc	
Wire Size		14 AWG (2.08 mm ²)	16 AWG (1.31 mm ²)	14 AWG (2.08 mm ²)	16 AWG (1.31 mm ²)	14 AWG (2.08 mm ²)	16 AWG (1.31 mm ²)
UVR (MN)	100%	—	—	159 ft (48.5 m)	100 ft (30.5 m)	765 ft (233.2 m)	472 ft (143.9 m)
	85%	—	—	44 ft (13.4 m)	29 ft (8.8 m)	205 ft (62.5 m)	129 ft (39.3 m)
Shunt Trip (MX) and Shunt Close (XF)	100%	57 ft (17.4 m)	34 ft (10.4 m)	314 ft (95.7 m)	200 ft (61.0 m)	1503 ft (457.8 m)	944 ft (287.7 m)
	85%	27 ft (8.2 m)	17 ft (5.2 m)	205 ft (62.5 m)	126 ft (38.4 m)	957 ft (291.7 m)	601 ft (183.2 m)

¹ The length shown in the table is for each of the two supply wires.

Shunt Trip (MX1) and Shunt Close (XF)



Shunt Trip (MX1) and Shunt Close (XF)

Shunt Trip (MX1): When energized, the shunt trip instantaneously opens the circuit breaker. The shunt trip may be energized continuously or intermittently.

Shunt Close (XF): Remotely closes the circuit breaker if the spring mechanism is charged. The shunt close may be energized continuously or intermittently. This accessory is for electrically-operated P-frame circuit breaker only.

Communication versions of the MX1 and XF are available for direct connection via the circuit breaker communication module (BCM).

Table 70: Shunt Trip and Shunt Close Characteristics

Characteristics		MX1	XF	Min	Max
Voltage Ratings (V _n)	Vac 50/60 Hz	24 Vac		17 Vac	26 Vac
		48 Vac		34 Vac	52 Vac
		120 Vac		60 Vac	132 Vac
		240 Vac		168 Vac	264 Vac
		277 Vac		194 Vac	304 Vac
		380 Vac		266 Vac	418 Vac
	Vdc	480 Vac		336 Vac	528 Vac
		12 Vdc		8 Vdc	13 Vdc
		24 Vdc		17 Vdc	26 Vdc
		48 Vdc		34 Vdc	52 Vdc
		125 Vdc		88 Vdc	137 Vdc
		250 Vdc		175 Vdc	275 Vdc
Operating Threshold		0.7 to 1.1 V _n	0.85 to 1.1 V _n		
Power Consumption (VA or W)	Steady-State/Inrush	4.5/200			
Circuit Breaker Response Time at V _n ¹		50 ms ±10	70 ms ±10 (NW ≤ 4000 A)		
			80 ms ±10 (NW > 4000 A)		
			55 ms (NT)		

¹ Shunt trip (MX1) and shunt close (XF) circuits must be energized for minimum of 200 ms.



Neutral Current Transformer (CT)

Current transformers are available for applications requiring ground-fault protection on three-phase, four-wire systems or for neutral protection and metering. Neutral current transformers are not required on non-ground-fault circuit breakers, or on three-phase, three-wire systems. The rating of the external neutral current transformer must be compatible with the rating of the circuit breaker.

Table 79: Neutral Current Transformer Catalog Numbers

Circuit Breaker	Sensor	Cat. No.
P-Frame	250	S33575
	400–1600	S33576
R-Frame	250	S48916
	400–1600	S34036
	2000	S48896
	2500	S48182
All	All	NCTWIRING¹
12-pin Trip Unit Connector		S33100

¹ Included with NCT.

NOTE: These neutral current transformers cannot be used for SGR (Source Ground-Return) or MDGF (Modified Differential Ground Fault) applications.



Ground-Fault Interface Module

The ground-fault interface module (P-frame, R-frame and NS630b–NS3200 circuit breakers only) is used to sum the current flow in three-phase, four-wire systems and multiple-sourced systems, using one or more specially-designed external current sensors to measure current flow. The ground-fault interface module is commonly used in two applications:

- For a ground-source return ground-fault sensing (SGR) system
- For a modified differential ground-fault (MDGF) system

More complex systems are possible, for information about these, contact a field sales representative.

Order kit number **S48891**.

External Sensor for SGR or MDGF Protections

For use on 400 A sensor or higher.

In SGR applications, an external sensor is installed around the connection of the transformer neutral point to ground. Its secondary is connected to the Micrologic™ 6.0A, 6.0P or 6.0H trip units.

In MDGF applications, a sensor is installed on each phase and neutral conductor. The sensors for each circuit breaker are connected to an interface module. These, in turn, connect to the Micrologic 6.0A, 6.0P or 6.0H trip units.

Order kit number **S33579**.



PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers

Section 9—Accessories

Sensor Plugs



Sensor plugs are used to set the current rating (I_n) of the PowerPact P- and R-frame circuit breakers.

Beginning in January 2007 (date code 07011), the sensor plugs are field-replaceable, down to 50% of the original rating. Mechanical keying in the circuit breaker prevents changing a rating plug to a higher rating than the original factory-installed sensor plug.

Table 80: Sensor Plugs

Circuit Breaker	Original Circuit Breaker Amperage	Sensor Plug Range	Sensor Plug Catalog No.
UL P-Frame	250 A	250 A	S47052
	400 A	400 A	S47053
	600 A	600 A	S48823
	800 A	600–800 A	S33092
	1000 A	600–1000 A	S33093
	1200 A	600–1200 A	S48824
IEC P-Frame	630 A	630 A	S33091
	800 A	600–800 A	S33092
	1000 A	600–1000 A	S33093
	1250 A	600–1250 A	S33094
	1600 A	600–1600 A	S33095
UL R-Frame	600 A	600 A	S48823
	800 A	600–800 A	S33092
	1000 A	600–1000 A	S33093
	1200 A	600–1200 A	S48824
	1600 A	800–1600 A	S33095
	2000 A	1000–2000 A	S33982
	2500 A	1200–2500 A	S33983
IEC R-Frame	1600 A	1600 A	S33095
	2000 A	1600–2000 A	S33982
	2500 A	1600–2500 A	S33983
	3200 A	1600–3200 A	S33984

Rating Plugs

Interchangeable rating plugs are available to limit the long-time threshold setting range for greater versatility.



Table 81: Rating Plug Settings

Rating Plug	Switch Settings $I_r = I_n \times \dots$										Cat. No.
For P-Frame and R-Frame Circuit Breakers	Type A	0.4	0.45	0.5	0.6	0.63	0.7	0.8	0.9	1	S48818
	Type B	0.4	0.44	0.5	0.56	0.63	0.75	0.88	0.95	1	S48819
	Type C	0.42	0.50	0.53	0.58	0.67	0.75	0.83	0.95	1	S48820
	Type D	0.4	0.48	0.64	0.7	0.8	0.9	0.93	0.95	1	S48836
	Type E	0.6	0.7	0.75	0.8	0.85	0.9	0.93	0.95	1	S48837
	Type F	0.84	0.86	0.88	0.9	0.92	0.94	0.96	0.98	1	S48838
	Type G	0.66	0.68	0.7	0.72	0.74	0.76	0.78	0.8	0.82	S48839
	Type H	0.48	0.5	0.52	0.54	0.56	0.58	0.6	0.62	0.64	S48840
For NS630b–NS3200 Circuit Breakers	Type R ¹	0.4	0.5	0.6	0.7	0.8	0.9	0.95	0.98	1	S33542
	Type S	0.4	0.45	0.5	0.55	0.6	0.65	0.7	0.75	0.8	S33543
	Type T	0.8	0.82	0.85	0.88	0.9	0.92	0.95	0.98	1	S33544
	Type P (Off Plug)	No Long-Time Protection.									

PowerPact™ M-, P- and R-Frame, and Compact™ NS630b–NS3200 Circuit Breakers

Section 9—Accessories

Modbus Circuit Breaker Communication Module (BCM-ULP)



The circuit breaker communication module is independent of the trip unit. Installed on the circuit breaker, behind the trip unit, it receives and transmits information on the communication network. An optical link is used for communication with the Micrologic A, P, and H trip units. Power requirements are 30 mA, 24 Vdc.

NOTE: The power supply for the circuit breaker communication module must be separate and isolated from the power supply for the trip unit.

The following may be connected to this module:

- A set of dedicated switches which read the status of the circuit breaker.
- A set of “actuators” (MX shunt trip or motor mechanism) to control the circuit breaker.

Table 82: Circuit Breaker Communication Module Characteristics

Circuit Breaker Identification	Circuit Breaker and Trip Unit				
	A	P	H		
ID Code, Address Size, Rating, Performance Type of Trip Unit Type of Long-Time Rating Plug					
On/Off Indication Fault Trip					
Opening/Closing					
Settings	Reading of Settings on Rotary Switches	X	X	X	
	Fine Settings in the Range Imposed by the Rotary Switches		X	X	
	Setting of Protection and Alarms		X	X	
	Customized Alarm Programming			X	
Operating and Maintenance Aids	Reading of Protection and Alarms	Standard	X	X	
		Set	X	X	
		Customized		X	
	Reading of Measurements	Current	X	X	X
		Voltages, Frequency, Power, etc.		X	X
		Power Quality: Fundamentals and Harmonics			X
	Waveform Capture			X	
	Histories	History of Trips and Alarms ¹		X	X
		Log of Trips and Alarms			X
	Indicators	Contact Wear, Counters, Etc.		X	X
Maintenance Record				X	

¹ Up to 10 trips and 10 alarms.

Table 83: Trip Unit Field-Installable Accessories

Description	Factory-Installed Cat. No. Suffix	Field-Installable Kit Cat. No.						
		P-Frame				R-Frame		
		Unit Mount	I-Line™	Motor Operated	Drawout	With Rotary Handle	Unit Mount	I-Line
Circuit Breaker Communication Module (BCM) (Modbus)	E1	S64205		S64207	S64206	S64205		
Two Programmable Contacts Module (M2C)	V	S64273						
Six Programmable Contacts Module (M6C)	W	S64204			S64202	S64204	S64201	
External Voltage Sensing (EVS)	YV	S64203		S64210	S64209	S64210	S64208	
Trip Unit Battery for Trip Indicator Lights	—	S33593						
12-pin Trip Unit Connector for P- and R-Frame Circuit Breakers	—	S33100						

M2C and M6C Programmable Contacts



The M2C and M6C contacts are used with the Micrologic P and H control units, and indicate the type of fault and instantaneous or delayed threshold overruns (i.e: trip unit protection pickup, current/voltage unbalance, under/over voltage, reverse power, phase rotation, under/over frequency, and load shedding). The M2C has two programmable contacts while the M6C has six. They require an external 24 Vdc power supply (100 mA consumption).

NOTE: The M2C and M6C may use the same 24 V power supply as the trip unit. The M2C, M6C and trip unit power supply must be separate and isolated from the power supply used for the BCM/CCM.

M6C contacts are programmed via the control unit using a keypad or via a supervisory station with the COM communication option. They may be programmed:

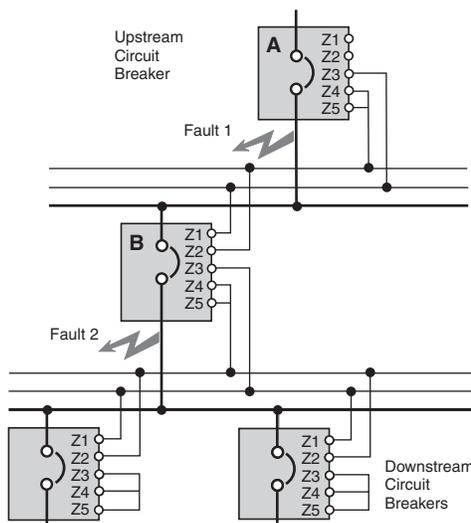
- With instantaneous return to the initial state
- Without return to the initial state
- With return to the initial state following a delay

Table 84: Characteristics for M2C and M6C Programmable Contacts

Minimum Load		100 mA/24 V
Breaking Capacity at a Power Factor (p.f.) of 0.7	240 Vac	5 A
	380 Vac	3 A
	24 Vdc	1.8 A
	48 Vdc	1.5 A
	125 Vdc	0.4 A
	250 Vdc	0.15 A

Zone-Selective Interlocking (ZSI)

Table 85:

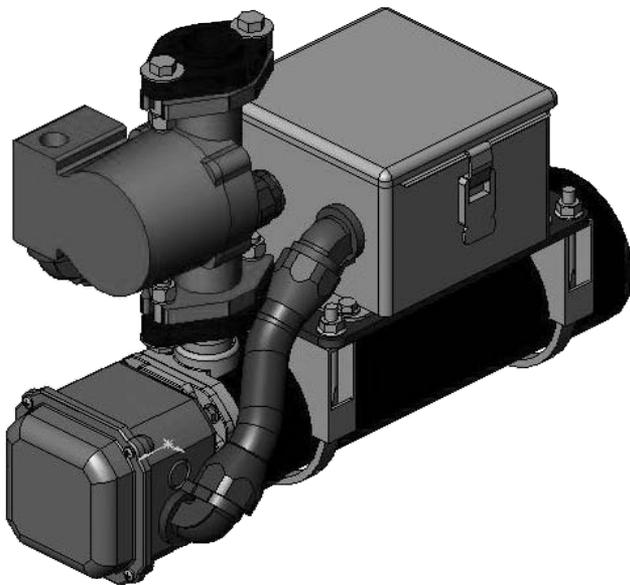


ZSI is used to reduce the stress on electrical distribution equipment during fault conditions by reducing the time it takes to clear the fault, while maintaining system coordination between overcurrent protective devices.

During a short-circuit or ground-fault condition on a ZSI system, the device directly ahead of the fault sends a signal upstream via control wiring to restrain upstream circuit breakers from tripping and then trips with no intentional time delay to clear the fault. Upstream devices which receive a restraint signal obey their short-time and/or ground-fault delay settings to maintain coordination in other areas of the system. Upstream devices that do not receive a restraint signal trip with no intentional time delay.

- Fault 1—The upstream circuit breaker (A) will clear the fault with no intentional delay, regardless of its time-delay setting.
- Fault 2—Circuit breaker (B) will inform upstream circuit breaker (A) that it is clearing the fault. This will prevent circuit breaker (A) from tripping instantaneously. Circuit breaker (A) will trip at the end of its time delay setting if the fault is not cleared during this time.

ZSI requires trip settings be coordinated so a downstream circuit breaker will trip before an upstream circuit breaker under overload, short-circuit or ground-fault conditions. Effective coordination requires a system coordination study. See data bulletin 0100DB0501, *Short Circuit Coordination for Low-Voltage Circuit Breakers*.



C32 JACKET WATER HEATER

With Circulating Pump

This is a factory-installed jacket water heater for increased cold-starting capability. The system includes heater, isolation valves, circulation pump, hoses and generator space heater relay.

FEATURES

FACTORY INSTALLED

- Completed with hoses, circulating pump, and isolation valves
- Base frame mounting minimizes engine induced vibration
- Automatically disconnected when engine is running via the generator space heater relay
- Thermostat is factory pre-set to 49° C (120° F)
- A control box with the element, pump, and thermostat pre-wired for ease of installation
- Heavy-duty (0.25" steel) mounting brackets
- Control box has a contactor to cycle the heater elements on and off per the heater thermostat
- Uniform heating over entire cooling system
- Reduced temperature at outlet extends hose and coolant life
- Longer heating element life
- Available with CE or UL/CSA compliant packages

SPECIFICATIONS

Unit Specifications	Design Voltage	
	220	240
Rating	9 kW	9 kW
Frequency	50/60	50/60
Phase	1	1
Amps	41	37
Flow Rate	32 L/min (10 gpm)	32 L/min (10 gpm)
Circulation Pump Rating	95W	95W
Control Voltage	24 VDC	24 VDC
Adjustable Thermostat	21.1°-98.8° C (70°-210° F)	21.1°-98.8° C (70°-210° F)
Shipping Weight	16.3 kg (36 lb)	16.3 kg (36 lb)

ATTACHMENTS C32 JACKET WATER HEATER WITH CIRCULATING PUMP



DESCRIPTION

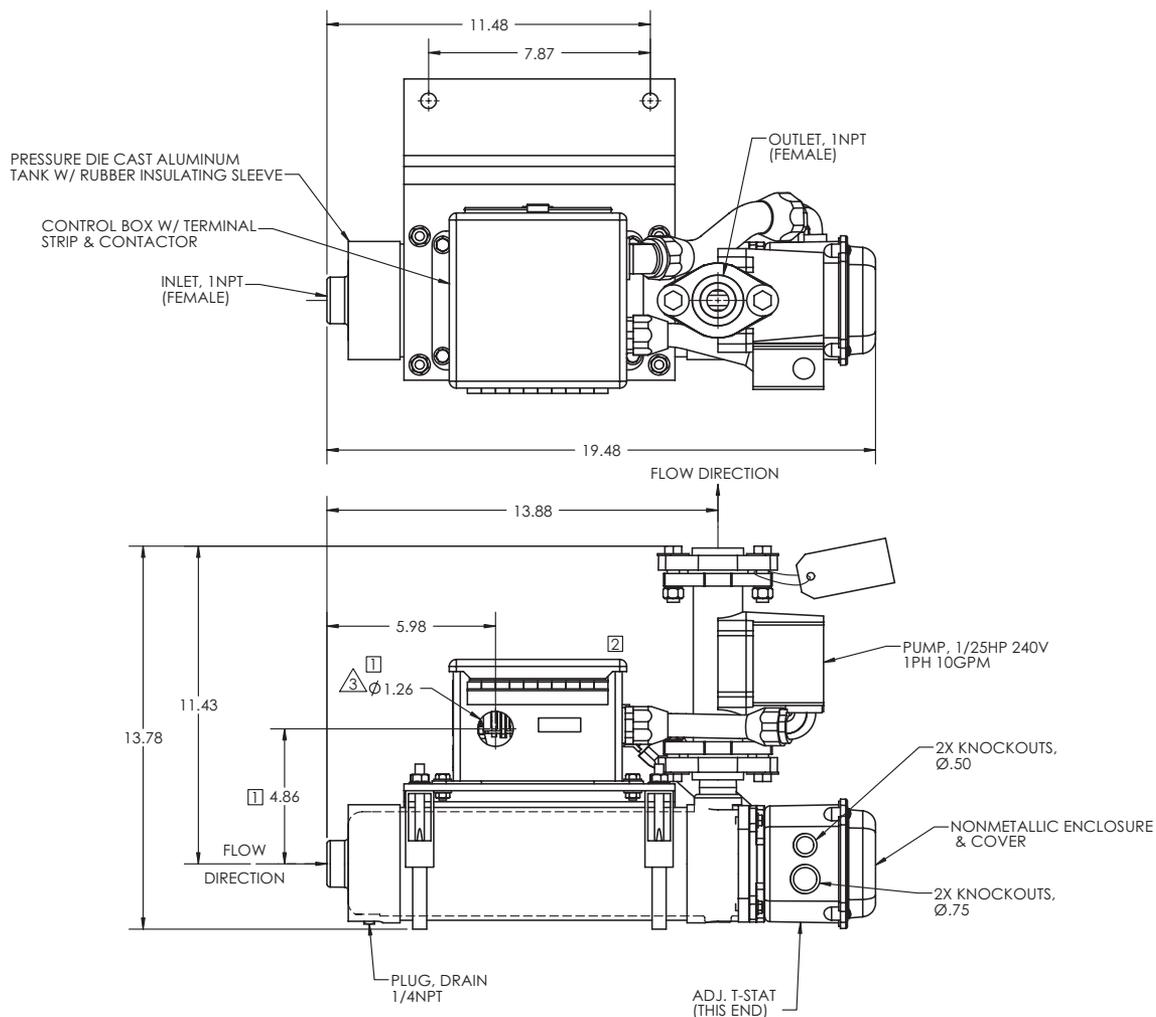
HEATER DESIGN DESCRIPTION

The jacket water heater package is designed to efficiently pre-heat the C32 engine by heating and circulating the engine's coolant. The forced coolant circulation allows the design to operate at a higher wattage and efficiency than standard thermal siphon tank heaters (tank heaters). This design results in the following benefits:

- Reduction of the maximum coolant temperatures associated with tank heater design.
- Increase life of heater hoses, engine seals, and heating elements.
- Improve heat transfer efficiency from elements to engine coolant.
- More uniform engine temperature distribution.
- Application of a thermostat with a reduced thermal differential.
- Lower customer utility costs and increased heater reliability.
- Heater thermostat's setpoint is preset from the factory.

HEATER OPERATION/WIRING

A 10-gallon per minute pump is located at the heater outlet to pull the coolant through the heater. An adjustable thermostat probe is located inside the heater tank near the inlet of the heater and responds to the temperature of the coolant entering the tank. The figure below shows the general heater design.



ATTACHMENTS C32 JACKET WATER HEATER WITH CIRCULATING PUMP



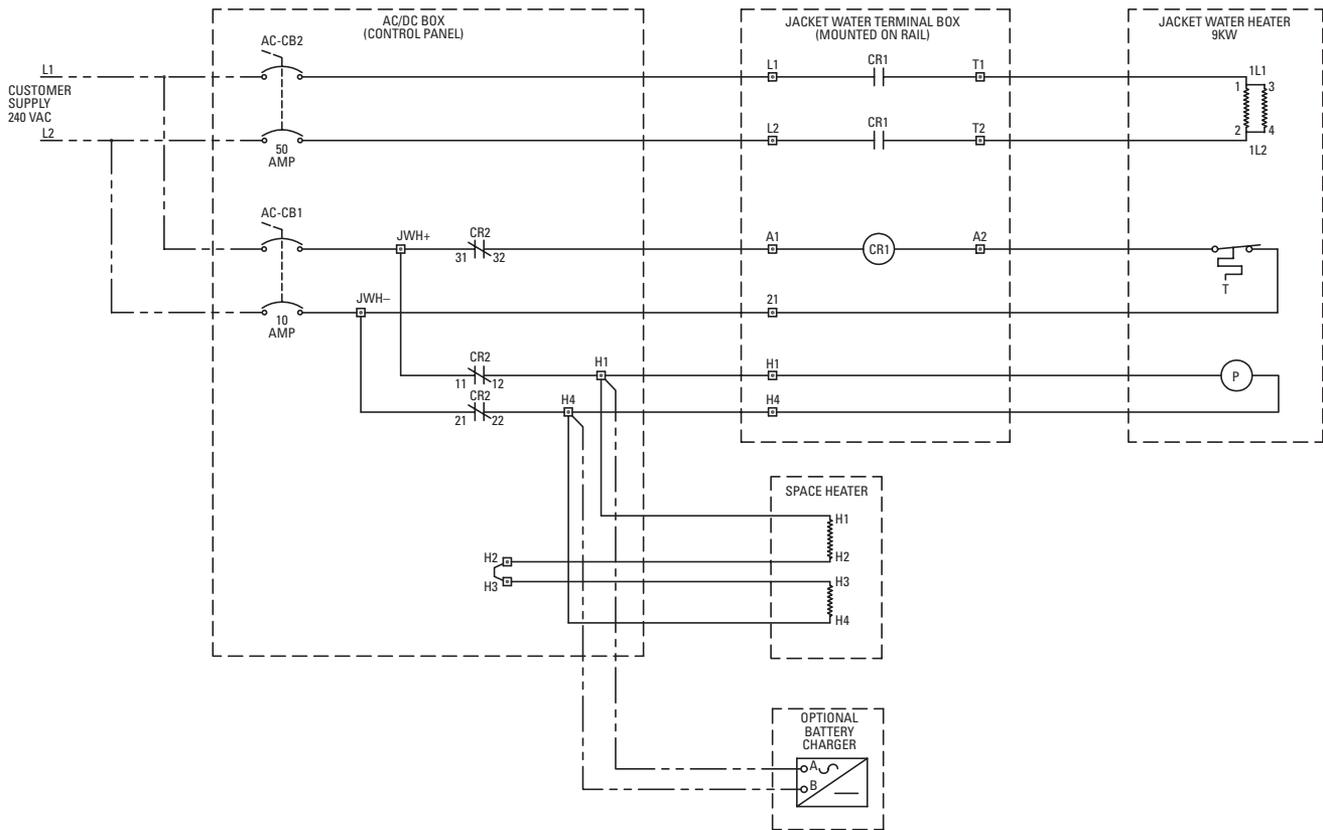
DESCRIPTION (continued)

ADJUSTABLE THERMOSTAT SETPOINT

Due to the high amperage associated with the 9 kW heater, the thermostat is wired such that it opens and closes a contactor that controls the heating elements. To maintain uniform engine temperature while the engine is not operating, the system pump requires either a 220 or a 240 VAC supply and must run continuously independent of heater thermostat. The pump and heating elements are de-energized whenever the engine starts.

The figures below show the wiring diagram for the engine jacket water heater systems.

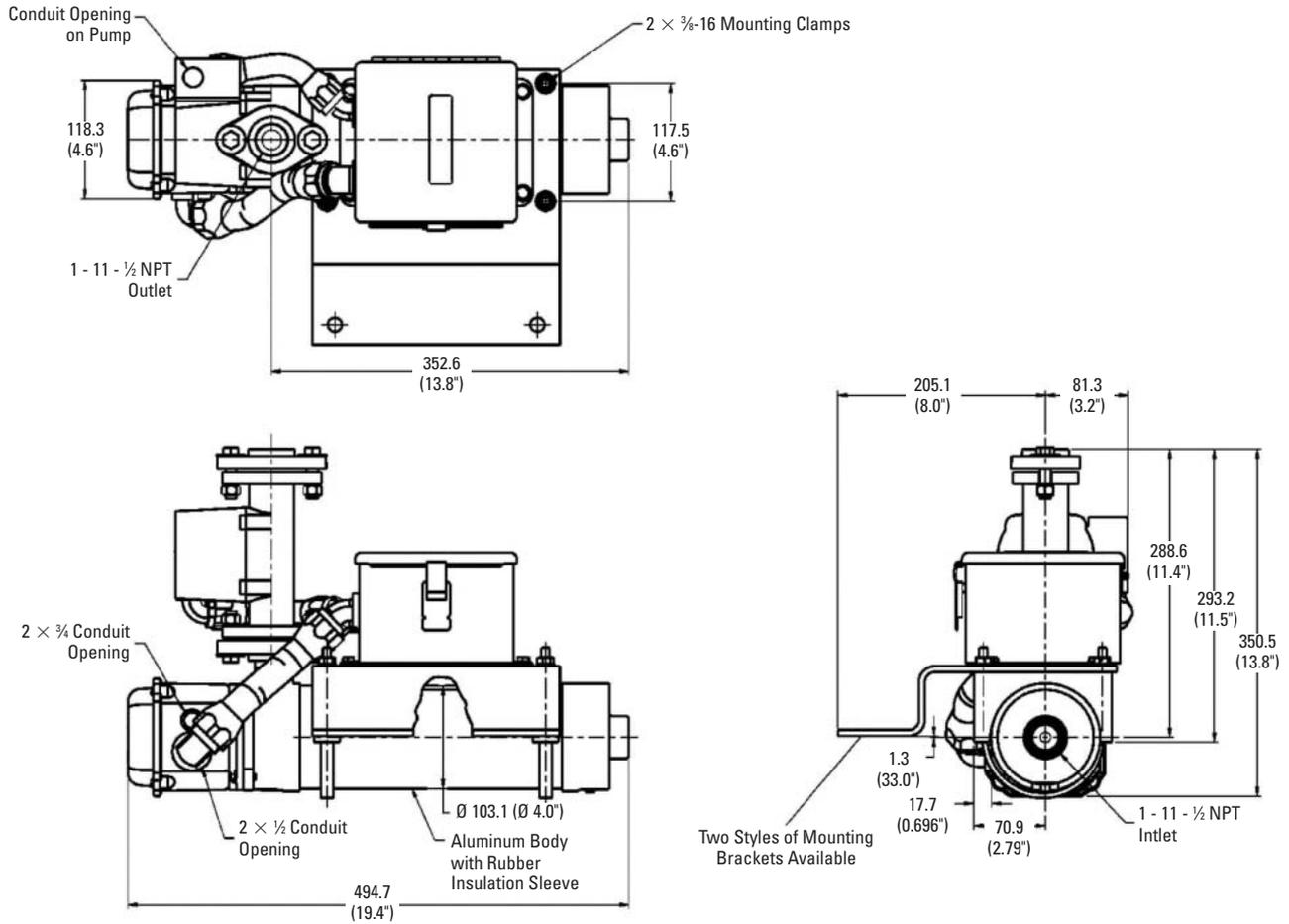
WIRING DIAGRAM



ATTACHMENTS C32 JACKET WATER HEATER WITH CIRCULATING PUMP



JACKET WATER HEATER GROUP GENERAL DIMENSION



Package Dimensions		
Length	494.7 mm	19.4 in
Width	195 mm	7.68 in
Height	350.5 mm	13.8 in
Shipping Weight	16.3 kg	36.0 lb

Note: Unless otherwise specified;
all dimensions are for reference.
(Drawing # 273-3766, 274-4541).

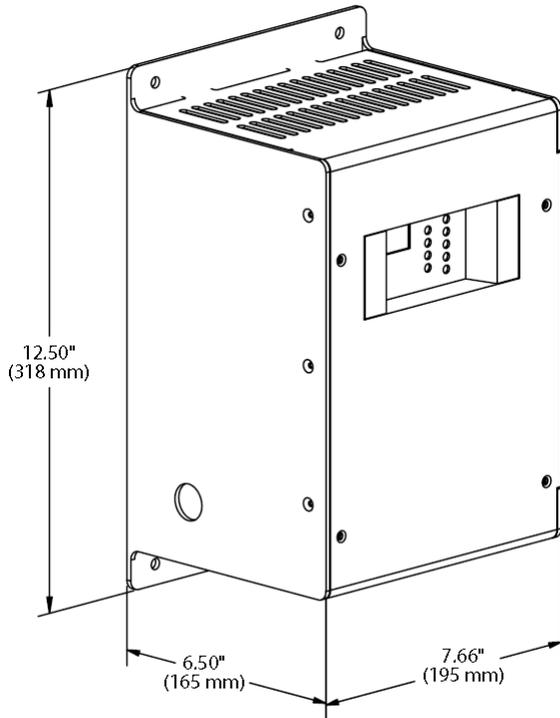


Image Shown may not Reflect Actual Package

UL 10 AMP BATTERY CHARGER

This battery charger offers accurate, automatic charging of lead-acid and nickel cadmium batteries. The output voltage automatically adjusts to changing input, load, battery and ambient conditions. This prevents battery over-charging and consequent loss of battery electrolyte.

Standard features include AC line compensation, precision voltage regulation, current limiting, automatic 2-rate charging, voltmeter and ammeter, temperature compensation and UL Listing.

The user interface is easy to understand with digital metering, NFPA 110 alarms and a battery fault alarm.

SPECIFICATION

Input Supply	110-120 V 208-240 V
AC and DC Fuses	2 input and 2 output)
Output voltage	24V
Frequency	50/60 Hz
Operating temperature	-20°C (-4°F) to +60°C (140°F)

Housing constructed of rustproof anodized aluminum.

STANDARDS

- C-UL listed to UL 1236
- NFPA 70, NFPA 110
- CSA 22.2 No 107 certified
- UL 1564
- CE DOC to EN 60335
- IBC Seismic Certification

FEATURES

- Electronically current limited at 105% of rated output
- Alarm system
- Digital Display
- Lightning and voltage transient protection
- Protection of connected equipment against load dump protection
- Constant voltage, current limited, 4-rate automatic equalization
- IP 20 housing
- AC isolated from DC
- Temperature Compensation
 - On board temperature sensor with remote port
- Auto AC line compensation
- Output regulated by sensed battery voltage

NRG

Intelligent Engine Start Battery Charger



The Smart Choice for Mission-Critical Engine Starting

- Fast, accurate, mission-critical charging – gives best starting reliability
- 4-rate, temperature-compensated output – offers longest battery life
- Replace nearly any charger – without planning ahead
- Industry-first battery-fault alarm – helps dispatch service early
- Lasting reliability – field MTBF > 1 million hours with industry-best warranty
- IBC seismic certification – meets latest building codes, no installation delays
- Optional OSHPD pre-approval – already approved for California hospital projects



NRG Battery Charger Benefits and Features



Failure to start due to battery problems is the leading cause of inoperable engine generator sets.

SENS NRG battery charger maximizes starting system reliability while slashing genset servicing costs:

One NRG replaces almost any charger without extra site visits. Installers can select or change at any time 120, 208 or 240 volts AC input, 12 or 24-volt battery and output settings optimized for nearly any lead-acid or nickel cadmium battery.

Easy to understand user interface provides state-of-the-art system status – including digital metering, NFPA 110 alarms and a battery fault alarm that can send service personnel to the site before failure to start.

Batteries charged by NRG give higher performance and last longer. In uncontrolled environments precision charging by SENS increases battery life and watering intervals 400% or more.

NRG meets all relevant industry standards – including UL, NFPA 110 and CE. Seismic Certification per International Building Code (IBC) 2000, 2003, 2006. All units are C-UL listed. 50/60 Hz units add CE marking to UL agency marks.

EnerGenius reliability technology built into every charger includes:

- All-electronic operation with generous component de-rating
- Disconnected/reversed/incorrect voltage battery alarm and protection
- Protection of connected equipment against load dump transients
- Widest temperature rating, and overtemperature protection
- Superior lightning and voltage transient protection
- Demonstrated field MTBF > 1 million hours
- Standard 3-year warranty (10 years magnetics and power semiconductors) and available 10-year complete warranty with reimbursement of field service costs

Earn the best return on your charger investment – choose SENS NRG

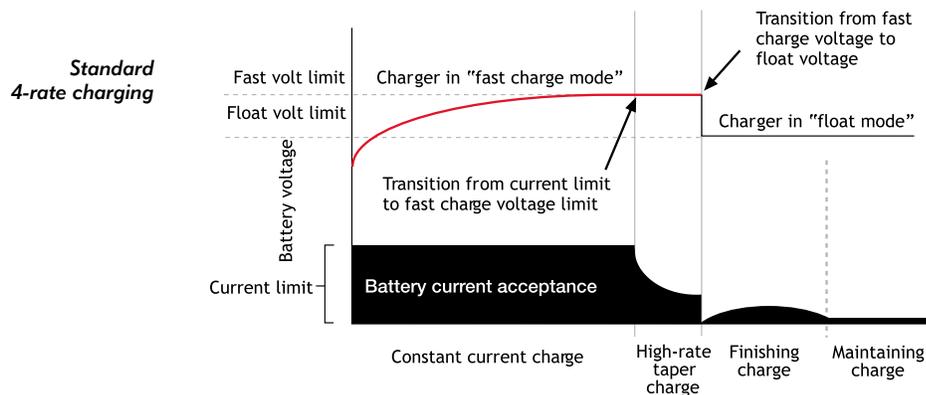
NRG Specifications

AC Input

Voltage	110-120/208-240 VAC, $\pm 10\%$, single phase, field selectable
Input current	10A charger: 6.6/3.3 amps maximum 20A charger: 12.6/6.3 amps maximum
Frequency	60 Hz $\pm 5\%$ standard; 50/60 Hz $\pm 5\%$ optional
Input protection	1-pole fuse, soft-start, transient suppression

Charger Output

Nominal voltage ratings	12 or 24 volt nominal
Optional voltage rating	12/24 volt, field selectable
Battery settings	Six discrete battery voltage programs - Low or high S.G. flooded - Low or high S.G. VRLA - Nickel cadmium 9, 10, 18, 19 or 20 cells
Regulation	$\pm 0.5\%$ (1/2%) line and load regulation
Current	10 or 20 amps nominal
Electronic current limit	105% rated output typical – no crank disconnect required
Charge characteristic	Constant voltage, current limited, 4-rate automatic equalization
Temperature compensation	Enable or disable anytime, remote sensor optional
Output protection	Current limit, 1-pole fuse, transient suppression



User Interface, Indication and Alarms

Digital meter	Automatic meter alternately displays output volts, amps ¹
Accuracy	$\pm 2\%$ volts, $\pm 5\%$ amps
Alarms	LED and Form C contact(s) per table:



Front panel status display

Alarm System Functions

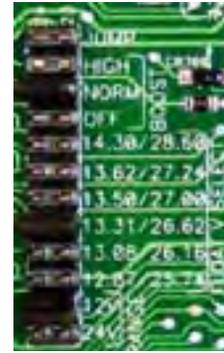
Alarm code "C" (meets requirements of NFPA 110)	
AC good	LED
Float mode	LED
Fast charge	LED
Temp comp active	LED
AC fail	LED and Form C contact ²
Low battery volts	LED and Form C contact ²
High battery volts	LED and Form C contact ²
Charger fail	LED and Form C contact ²
Battery fault ³	LED and Form C contact ²

- Three-position jumper allows user to select from three display settings: alternating volts / amps (normal), constant volts, or constant amps
- Contacts rated 2A @ 30 VDC resistive
- Battery fault alarm indicates these fault conditions:
 - Battery disconnected - Battery polarity reversed - Mismatched charger battery voltage - Open or high resistance charger to battery connection
 - Open battery cell or excessive internal resistance

Controls

AC input voltage select
Optional 12/24-volt output select
Battery program select
Meter display select
Fast charger enable/disable
Temp compensation enable
Remote temp comp enable

Field-selectable switch
Field-selectable two-position jumper
Field-selectable six-position jumper
Field-selectable three-position jumper
Field-selectable two-position jumper
Standard. Can be disabled or re-enabled in the field
Connect optional remote sensor to temp comp port



Simple field adjustments

Environmental

Operating temperature
Over temperature protection
Humidity
Vibration (10A unit)
Transient immunity
Seismic Certification

-20C to +60C, meets full specification to +45C
Gradual current reduction to maintain safe power device temperature
5% to 95%, non-condensing
UL 991 Class B (2G sinusoidal)
ANSI/IEEE C62.41, Cat. B, EN50082-2 heavy industrial, EN 61000-6-2
IBC 2000, 2003, 2006, 2009 Maximum S_{ds} of 2.28 g, Optional OSHPD pre-approval

Agency Standards

Safety

Agency marking

EMC

NFPA standards
Optional agency compliance

C-UL listed to UL 1236 (required for UL 2200 gensets), UL Category BBGQ,
CSA standard 22.2 no. 107.2-M89
CE: 50/60 Hz units DOC to EN 60335
60 Hz: C-UL-US listed
50/60 Hz: C-UL-US listed plus CE marked
Emissions: FCC Part 15, Class B; EN 50081-2
Immunity: EN 61000-6-2
NFPA 70, NFPA 110. (NFPA 110 requires Alarms "C")
OSHPD pre-approval

Construction

Housing/configuration
Dimensions
Printed circuit card
Cooling
Protection degree
Damage prevention
Electrical connections

Material: Non-corroding aluminum. C-UL listed enclosure.
See Drawings and Dimensions page for details
Surface mount technology, conformal coated
Natural convection
Listed housing: NEMA-1 (IP20). Optional IP21 drip shield. Optional NEMA 3R enclosure
Fully recessed display and controls
Compression terminal blocks

Warranty

Standard warranty

Optional warranty

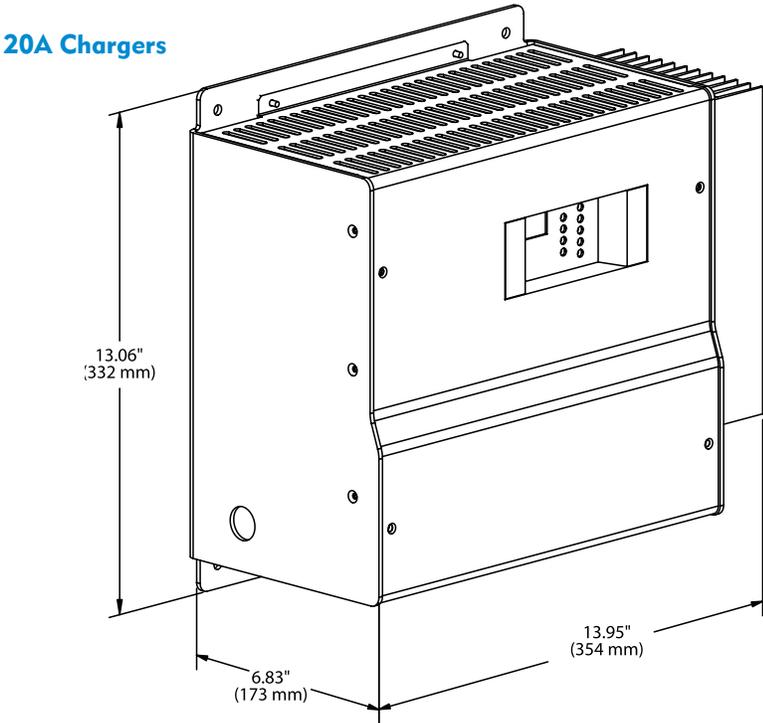
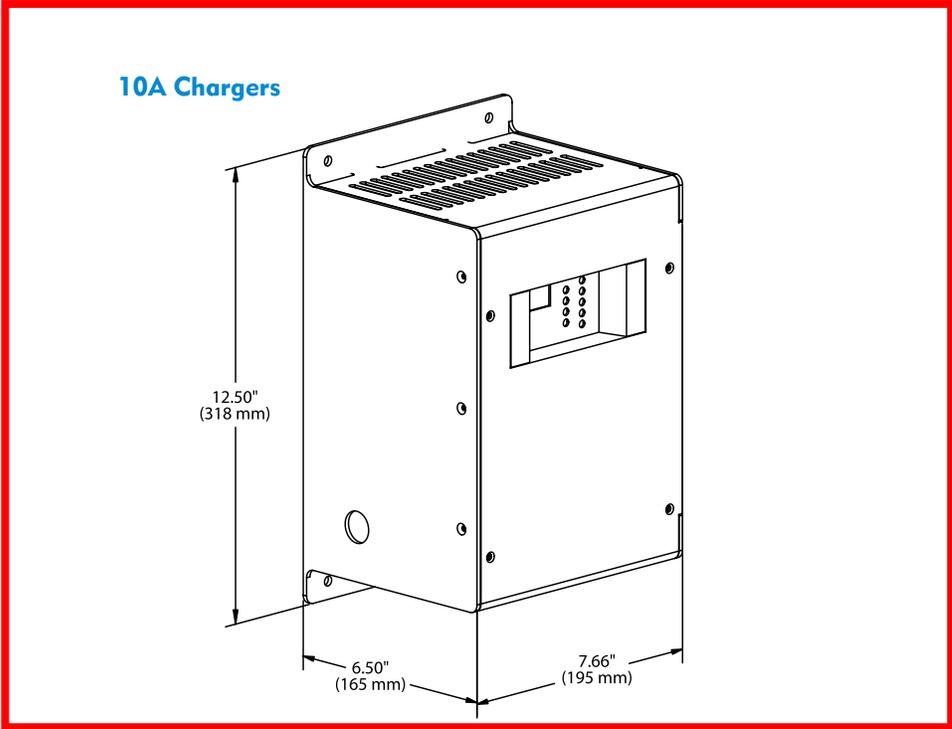
Three year parts and labor warranty (10 years magnetics and power semiconductors) from date of shipment
If specified at time of order, warranty coverage can be increased to reimburse customer's documented field service costs up to the original charger price or increased to 5 or 10 years with field service cost reimbursement. Contact the factory for full details

Optional features

Input
Remote temp comp sensor
Drip shield meets s/b (IP21)
NEMA 3R housing
Field service warranty

Input frequency, 50/60 Hz
Recommended where battery and charger are in different locations
Protects from dripping water
Enables outdoor installation (remote temp sensor recommended)
Reimbursement of customer field service expenses up to charger price for 3, 5, or 10 years

Drawings and Dimensions



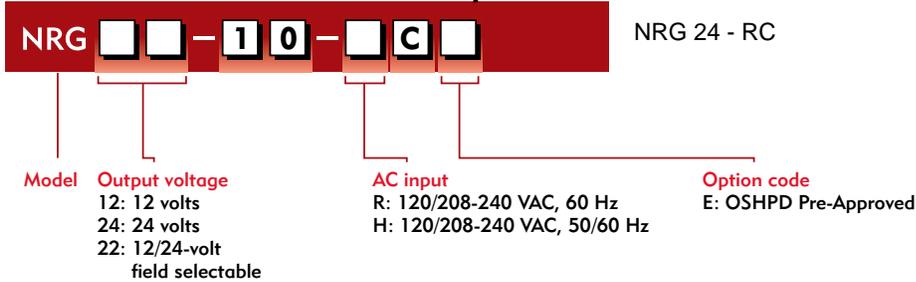
Housing Dimensions Table

Amps	Width	Depth	Height
10	7.66" (195 mm)	6.50" (165 mm)	12.50" (318 mm)
20	13.95" (354 mm)	6.83" (173 mm)	13.06" (332 mm)

NRG Ordering Information					
Output volts	Output amps	Model	NFPA 110 Alarms	Lbs/Kg	Shipping Lbs/Kg
12	10	NRG12-10-RC	Yes	23 / 10.4	25 / 11.4
24	10	NRG24-10-RC	Yes	23 / 10.4	25 / 11.4
12/24	10	NRG22-10-RC	Yes	23 / 10.4	25 / 11.4
12	20	NRG12-20-RC	Yes	39 / 17.7	43 / 19.5
24	20	NRG24-20-RC	Yes	42 / 19.1	46 / 20.9
12/24	20	NRG22-20-RC	Yes	42 / 19.1	46 / 20.9

All models offer field-selectable input 120/208-240 volts. 60 Hz input is standard with C-UL listing. Optional 50/60 Hz input includes C-UL listing and adds CE mark.

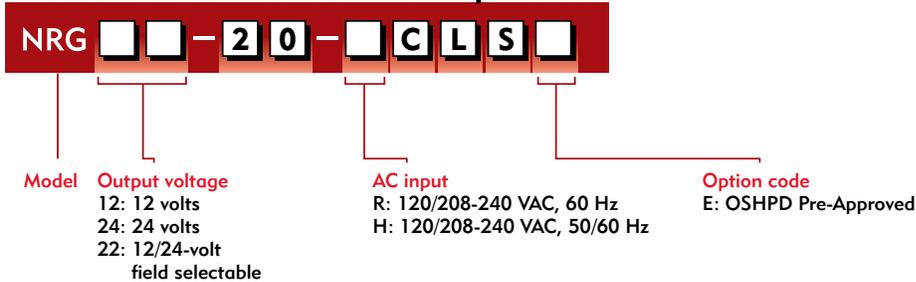
Model Number Breakout - 10 Amp Models



All NRG models are C-UL Listed to UL1236

All NRG models provide LEDs and Form C contacts to meet NFPA 110

Model Number Breakout - 20 Amp Models



The Smart Choice for Mission-Critical Engine Starting

Additional Information

Contact SENS or your local sales representative for additional specification, engineering and installation information. Check the SENS web site for latest available data. Specification is subject to change without notice.



Contact Information

For information and service on any SENS product, please contact us at:
 Sales 1.866.736.7872 • 303.678.7500 • Fax 303.678.7504
 www.sens-usa.com • info@sens-usa.com
 1840 Industrial Circle, Longmont, CO 80501 USA



World's Toughest Batteries



Premium High Output—Maximum Vibration Resistance

- Vibration Resistance...five times the Industry Standard
- Exclusive “flat top” BCI group 4D & 8D batteries are Maintenance Free and have the industries highest cold cranking amps (CCA)
- Popular BCI group 31 Maintenance Free batteries with industry leading cold cranking amps...up to 1000 (CCA), for electric power, machine or on-highway truck and bus applications. Deep cycle models are available for truck, marine or recreational usage

Specifications for Cat Premium High Output Batteries-Available Worldwide

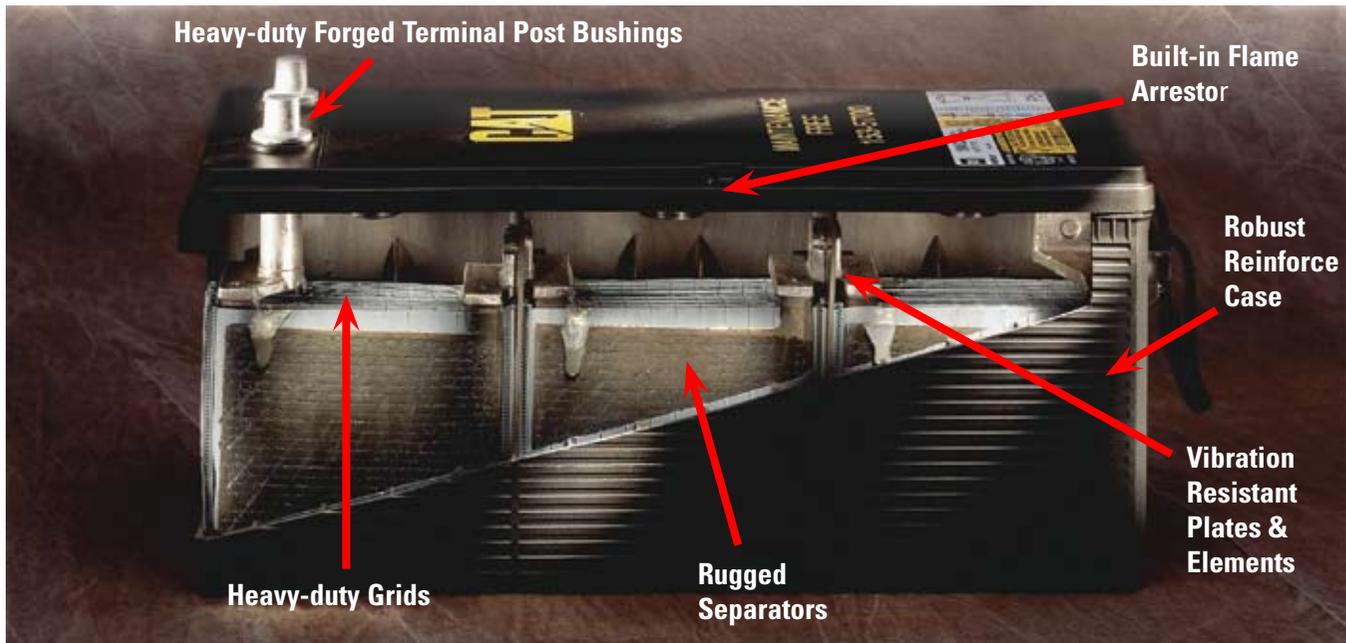
BCI Group Size	Part No.	Cold Cranking Amps*	Reserve Capacity Minutes'	Volts	Amp Hr. Capacity @ 20 Hrs.	Construction	Add Water Maintenance Check Hours	BCI Overall Dimensions			Nominal Weight		
								Length In (mm)	Width In (mm)	Height In (mm)	Wet Lb (kg)	Dry Lb (kg)	Nominal Acid to Fill Qt (liter)
8D	153-5720	1500	465	12	210	C	MF	20.47 (520)	10.8 (275)	9.76 (248)	132 (60)	—	—
8D	101-4000	1400	400	12	190	LAC+	1000	20.7 (526.5)	10.96 (278)	9.76 (248)	132 (60)	86 (39)	18.0 (17.0)
4D	153-5710	1400	425	12	200	C	MF	20.47 (520)	8.58 (218)	9.76 (248)	119 (54)	—	—
4D	153-5700	1125	305	12	145	C	MF	20.47 (520)	8.58 (218)	9.76 (248)	101 (46)	—	—
4D	9X-9730	1300	400	12	190	LAC+	1000	20.75 (527)	8.58 (218)	9.76 (248)	119 (54)	81 (37)	14.8 (14.0)
(2) → 4D	9X-9720	1000	275	12	140	LAC+	1000	20.75 (527)	8.58 (218)	9.76 (248)	101 (46)	59 (27)	15.9 (15.0)
31	175-4390	1000	180	12	90	C/S	MFA	12.9 (328.4)	6.74 (171.2)	9.29 (236)	60 (27)	—	—
31	175-4370	825	190	12	100	C/S***	MFA	12.9 (328.4)	6.74 (171.2)	9.29 (236)	60 (27)	—	—
31	175-4360	710	185	12	100	C/S***	MFA	12.9 (328.4)	6.74 (171.2)	9.29 (236)	60 (27)	—	—
31	250-0480	710	185	12	100	C/SDT***	MF	12.9 (328.4)	6.74 (171.2)	9.29 (236)	60 (27)	—	—
31	115-2422	1000	170	12	90	C SAE	MFA	12.9 (328.4)	6.74 (171.2)	9.46 (240.3)	60 (27)	—	—
31	115-2421	950	170	12	90	C SAE +	MFA	12.9 (328.4)	6.74 (171.2)	9.46 (240.3)	60 (27)	44 (20)	6.6 (6.2)
31	9X-3404	950	165	12	100	C SAE	MF	13 (330.2)	6.77 (172)	9.46 (240.3)	58 (26)	—	—
31	3T-5760	750	165	12	100	C SAE	MF	13 (330.2)	6.77 (172)	9.46 (240.3)	55 (25)	—	—
24	153-5656	650	110	12	52	SC	MF	10.98 (278.9)	6.85 (174)	9.0 (229.1)	39 (18)	—	—
65	230-6368	880	140	12	80	SC	MF	11.9 (303.4)	7.5 (190.8)	7.5 (191.4)	45.5 (21)	—	—
74	153-5660	650	110	12	52	SC*	MF	10.98 (278.9)	7.0 (178.2)	8.15 (206.9)	39 (18)	—	—
58	175-4280	500	70	12	35	SC	MF	9.96 (253.1)	7.2 (182.5)	6.9 (176)	31 (14)	—	—
2	153-5690	765	210	6	90	LAC+	1000	10.24 (260)	6.8 (173)	8.72 (221.6)	37 (17)	22 (10)	4.8 (4.5)

Construction Notes:

LAC = Low Maintenance, Hybrid Construction
 C=Calcium Lead Alloy Grid Design
 MF=Maintenance Free
 MFA=Maintenance Free with Accessible Vent Caps
 S = Stud Terminals
 + = Shipped Dry Only
 * = Side Terminals
 ** = Starting and Deep Cycle Battery
 *** = Deep Cycle and Starting Battery
 " = For 30 seconds at 0° F (-18° C)
 ' = Minimum of 25 amp output at 80° F (27° C)
 SAE = Uses SAE Posts
 SDT = Dual, Top mounted Terminals, Stud and SAE Post,
 Marine Deep Cycle/Starting Battery
 SC=Silver (Ag) Calcium Alloy Grids for resistance to high underhood temperatures

Rugged Design—Built Tough—Reliable Starting

- Positive and negative plates are anchored to container bottom and locked at the top of cell element for maximum vibration resistance.
- Heavy-duty forged terminal post bushings provide maximum strength and resistance to acid seepage.
- Hefty full-frame grids, no sharp edges, optimum acid/paste combination provides better charge acceptance after deep discharge.
- Manifold vented cover with built-in Flame Arrestor...a safety feature that directs corrosive gases away from the battery and hold-downs.
- Thick, robust container resists rugged treatment typical of heavy-duty commercial use. Embossed part number & descriptors for easy serviceability.



Robust Components = Long Life + Reliable Starts

- Heavy-duty forged terminal post bushings provide maximum strength and resistance to acid seepage that causes corrosion and black posts. Thicker internal terminal posts provide lower electrical resistance and higher cold cranking amp output.
- Rugged microporous polyethylene envelope separators protect against “shorts” and vibration damage. Deep Cycle batteries utilize double insulated Glass mat separators for longer cycling life.
- Maintenance Free batteries utilize calcium lead alloy on both positive and negative plates that reduces gassing and water consumption. Automotive batteries have Silver (Ag) Calcium Alloy Grids for resistance to high underhood temperatures.
- Heavy-duty, full frame battery grids with no sharp edges. An optimum acid/paste combination provides better charge acceptance after a deep discharge.
- Positive and Negative plates are anchored to the container bottom and the cell element is locked at the top for maximum vibration resistance. Straps are thicker, heavier and cast (not welded) into the plates.
- Manifold vented cover with built-in Flame Arrestor... a safety feature that directs corrosive gases away from the battery and hold-downs.
- Robust reinforced case provides extra strength in all temperature extremes. Brickwork design on sides reduces chance of punctures and case flexing. Embossed part number and descriptors for easy serviceability.

CAT® DEALERS DEFINE WORLD-CLASS PRODUCT SUPPORT.

We offer you the right parts and service solutions, when and where you need them.

The Cat Dealer network of highly trained experts can help you maximize your equipment investment.



ADEM™ A4 Engine Controller

The ADEM™ A4 is the main Electronic Control Module (ECM) used on select diesel engines. The ADEM A4 provides a higher degree of control over a large number of combustion variables. The ADEM A4 is designed to control/interface Electronic Unit Injector (EUI) equipped engines. The ADEM A4 engine system is composed of the ADEM A4 ECM, control software, sensors, actuators, fuel injectors, and interface to the generator system. The prime benefit of an ADEM A4 engine system is to better control and maintain the particulate emissions, both steady state and transient, while improving engine performance



FEATURES

RELIABLE, DURABLE

All ADEM A4 controllers are designed to survive the harshest environments.

- Environmentally sealed, die-cast aluminum housing isolates and protects electronic components from moisture and dirt contamination.
- Rigorous vibration testing ensures product reliability and durability.
- Accuracy maintained from -40°C to 85°C
- Electrical noise immunity to 100 volts/meter
- Internal circuits are designed to withstand shorts to +battery and -battery.

SIMPLE SERVICING

Each ADEM A4 system works in combination with the Cat® ET service tool software to keep the engine operating at peak performance.

- Displays measured parameters
- Retrieves active and logged event code documenting abnormal system operation
- Performs calibrations and diagnostic tests
- Supports flash programming of new software into the ADEM A4 ECM

SELF DIAGNOSTICS

Each ADEM A4 ECM has a full compliment of diagnostics. The ECM can detect faults in the electrical system and report those faults to the service technician for quick repair.

- Self-diagnostic capability pinpoints operational problems in need of attention.

ADVANCED FEATURES

- Enhanced performance from fuel injection timing and limiting
- Adjustable monitoring of vital engine parameters
- Programmable speed acceleration ramp rate
- Data link interfaces

DESCRIPTION

The ECM is housed in an environmentally sealed casting. All wiring connections to the ECM are made using two sealed connectors: a single seventy-pin connector and a single one hundred twenty-pin connector.

ENGINE SPEED GOVERNING

Desired engine speed is calculated by the ECM and held within ± 0.2 Hz for isochronous and droop mode. The ECM accounts for droop that is requested. The proper amount of fuel is sent to the injectors due to these calculations. The ECM also employs cooldown/shutdown strategies, acceleration delays on startup, acceleration ramp times and speed reference.

FUEL LIMITING

Warm and cold fuel-air ratio control limits are controlled by the ECM. Electronic monitoring system derates, torque limit, and cranking limit, programmable torque scaling, and cold cylinder cutout mode are standard features.

FUEL INJECTION TIMING

Master timing for injection is controlled by the ECM control. Temperature dependencies are accounted for in the fuel injection calculations.

ELECTRONIC MONITORING

Electronic monitoring of vital engine parameters can be programmed. Warning, derate, and shutdown event conditions may be customized by the user.

INFORMATION MANAGEMENT

The ECM stores information to assist with electronic troubleshooting. Active and logged diagnostic codes, active events, logged events, fuel consumption, engine hours, and instantaneous totals aid service technicians when diagnosing electronic faults and scheduling preventive maintenance.

CALIBRATIONS

Engine performance is optimized through injection timing. Auto/manual sensor calibrations are standard features.

ON-BOARD SYSTEM TESTS

System tests are available to assist in electronic troubleshooting. These tests include: injector activation, injector cutout, and override of control outputs.

DATA LINK INTERFACES

The ADEM A4 communicates with the EMCP via a dedicated communication network.

ELECTRONIC SENSING

The following sensing is available on the ADEM A4: oil pressure, fuel pressure, fuel temperature, atmospheric pressure, air inlet temperature, turbo outlet pressure, engine coolant temperature, engine speed, throttle position, exhaust temperature, oil filter pressure differential, fuel filter pressure differential, air filter pressure differential and crankcase pressure.

ENGINE CONTROLLER



SPECIFICATIONS

Impervious to:

salt spray, fuel, oil and oil additives, coolant, spray cleaners, chlorinated solvents, hydrogen sulfide and methane gas, and dust

Input and output protection

all inputs and outputs are protected against short circuits to + battery and -battery

Input voltage range (24 VDC nominal)

18 to 32 VDC

Mounting

engine mounted

Reverse polarity protected

Shock, withstands 20 g

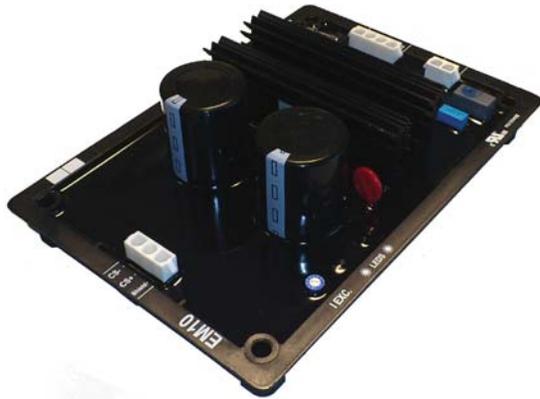
Temperature range

Operating: -40°C to 85°C (-40°F to 185°F)
Storage: -50°C to 120°C (-58°F to 248°F)

Vibration

withstands 8.0 g @ 24 to 2 kHz

EXCITATION MODULE



EM10

The EM10 Excitation Module is a power electronics component designed to provide excitation current to the generator that is controlled by the Integrated Voltage Regulator (IVR) feature in the EMCP 4 controls.

Caterpillar is leading the power generation marketplace with power solutions engineered to deliver unmatched flexibility, expandability, reliability and cost-effectiveness.

FEATURES

- Over-excitation protection – limit can be adjusted via a potentiometer (IEXC.)
- Green status LED indicating unit is powered on
- Red status LED indicating excitation current limiting (flashing) or shutdown (solid)

When used with EMCP 4.3/4.4 and IVR-compatible EMCP 4.1/4.2 controllers, the Integrated Voltage Regulator system offers:

- Automatic Voltage Regulation (AVR)
- Programmable stability settings
- Soft start control with an adjustable time setting in AVR control mode
- Dual Slope Under Frequency (Volts / Hz) regulation
- Three-phase or single-phase generator voltage (RMS) sensing/regulation in AVR mode

EMCP 4.3/4.4 and IVR-compatible EMCP 4.2 controllers also offer:

- Power Factor Regulation (PF)
- Generator paralleling with reactive droop compensation
- Line drop compensation

WORLDWIDE PRODUCT SUPPORT

- Worldwide parts availability through the Cat® dealer network
- Over 1,800 dealer branch stores operating in 200 countries
- The best product support record in the industry
- Cat dealers provide extensive post sale support including maintenance and repair agreements

COMPLETE SYSTEM INTEGRATION

Fully designed and factory tested to work seamlessly with Cat generators using Self Excitation (SE), Internal Excitation (IE) or Permanent Magnet (PMG) excitation systems and EMCP controls.

EXCITATION MODULE – EM10



SPECIFICATIONS

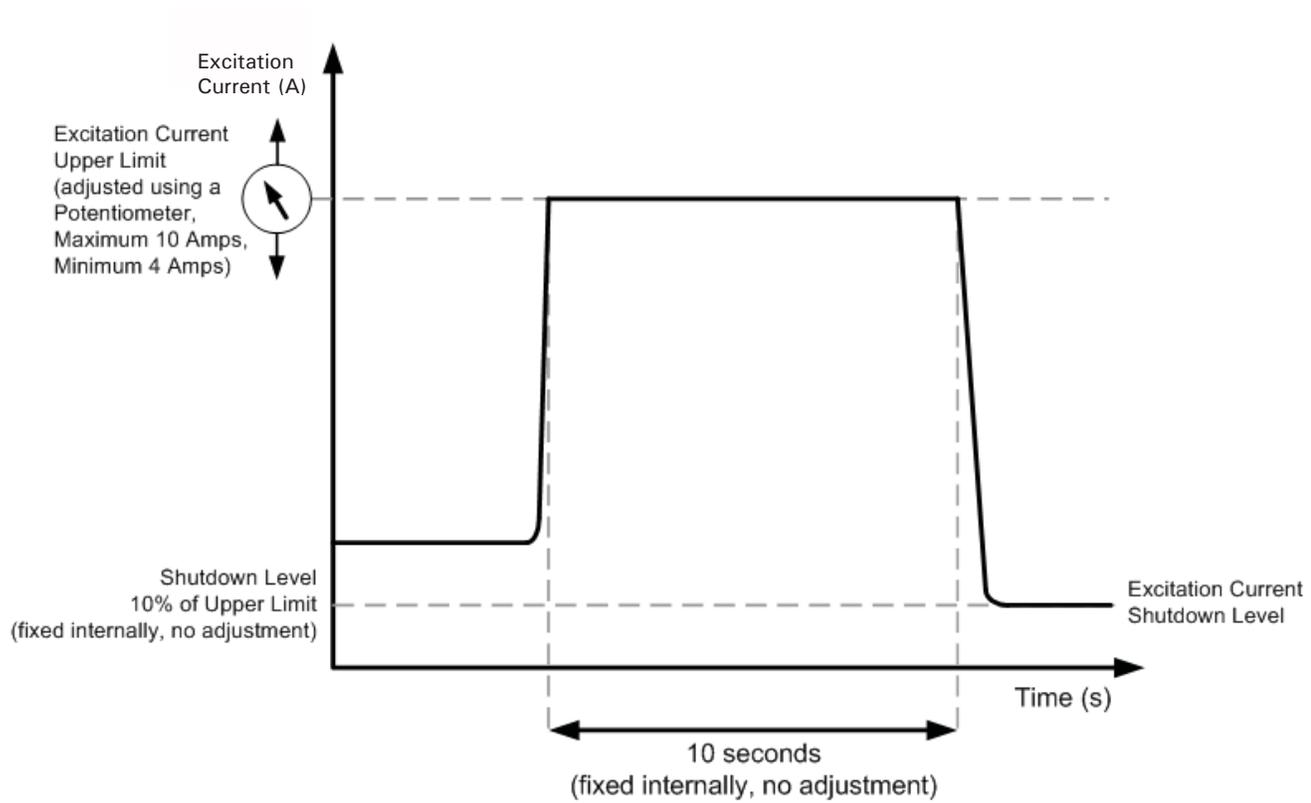
ELECTRICAL	
Generator Excitation Types	Self Excitation / Internal Excitation / Permanent Magnet (PMG)
Max. Continuous Field Current Output	6 Amps
Max. Forcing Field Current Output	10 Amps
Max. AC Voltage Input (X1:X2, Z1:Z2)	180 Vrms
ENVIRONMENTAL	
Operating Temperature Range	-40 °C (-40 °F) to +70 °C (+158 °F)
Storage Temperature Range	-40 °C (-40 °F) to +85 °C (+185 °F)
Relative Humidity Tolerance	95% non-condensing humidity
Salt Spray	5% salt (NaCl) solution for 120 hrs
Vibration	4.5 G-rms, 24-2000 Hz in 3 orthogonal planes
Electromagnetic Compatibility	RF Immunity (Radiated & Conducted) RF Emissions (Radiated & Conducted) Electrical Transients
Weight	770 g ± 30 g
Power Consumption (at Max. Continuous Rating)	<450 VA
CONFORMITY	
UL	UL Recognized (U.S. and Canada) File No. E334232
CE Integration Certificate	In conformity with the applicable requirements of the following Standards: EN 50178 EN 60204-1 EN 61000-6-2 EN 61000-6-4

EXCITATION MODULE – EM10



OVER-EXCITATION PROTECTION

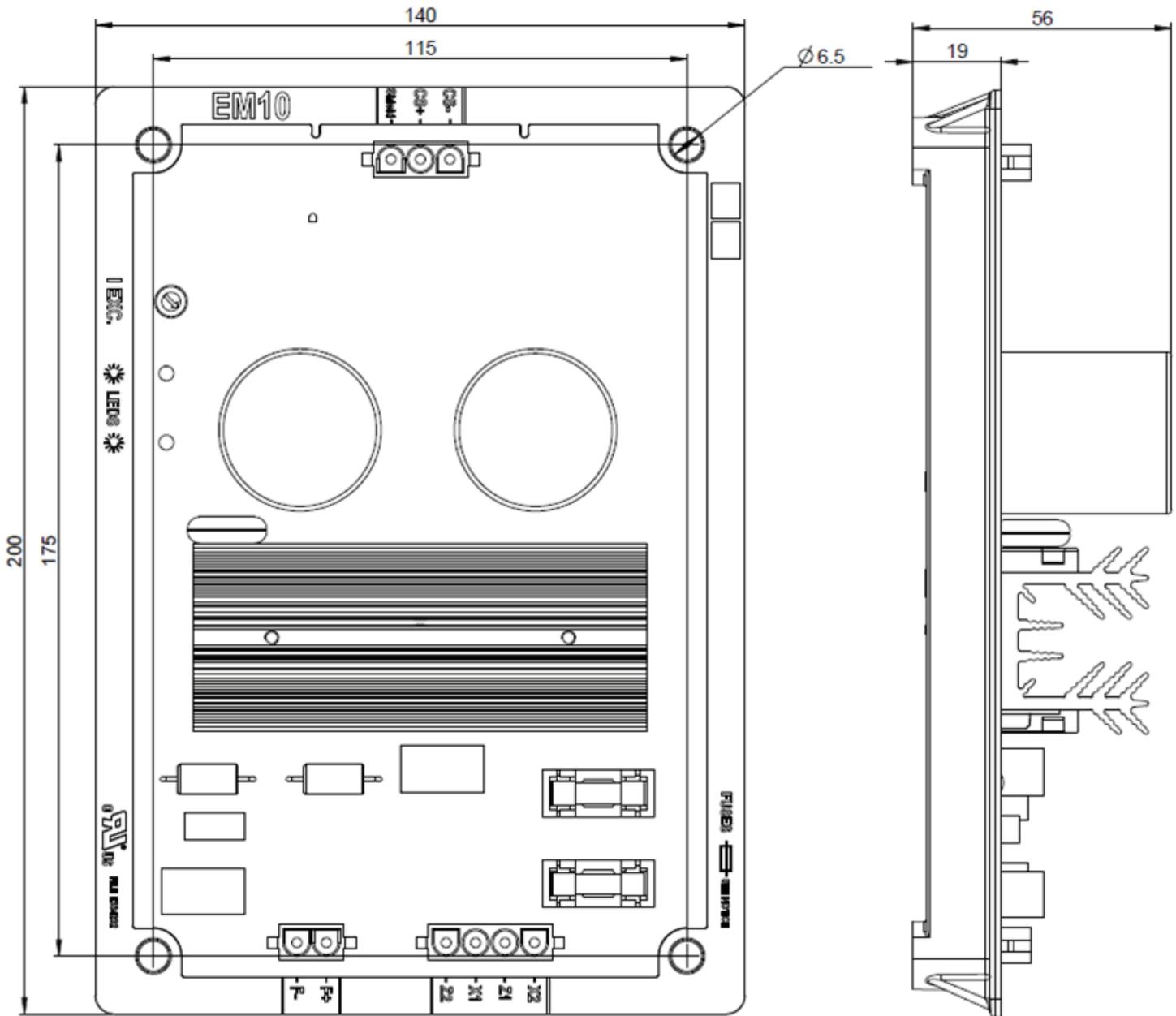
- If a short-circuit fault occurs at the generator terminals, the EM10 will allow the excitation current to rise to the upper limit value set by the adjustment potentiometer (max. 10 Amps).
- The excitation current will be clamped at the upper limit value for 10 seconds (fixed internally).
- After 10 seconds, the excitation current is reduced to a value of 10% of the potentiometer setting.



EXCITATION MODULE – EM10



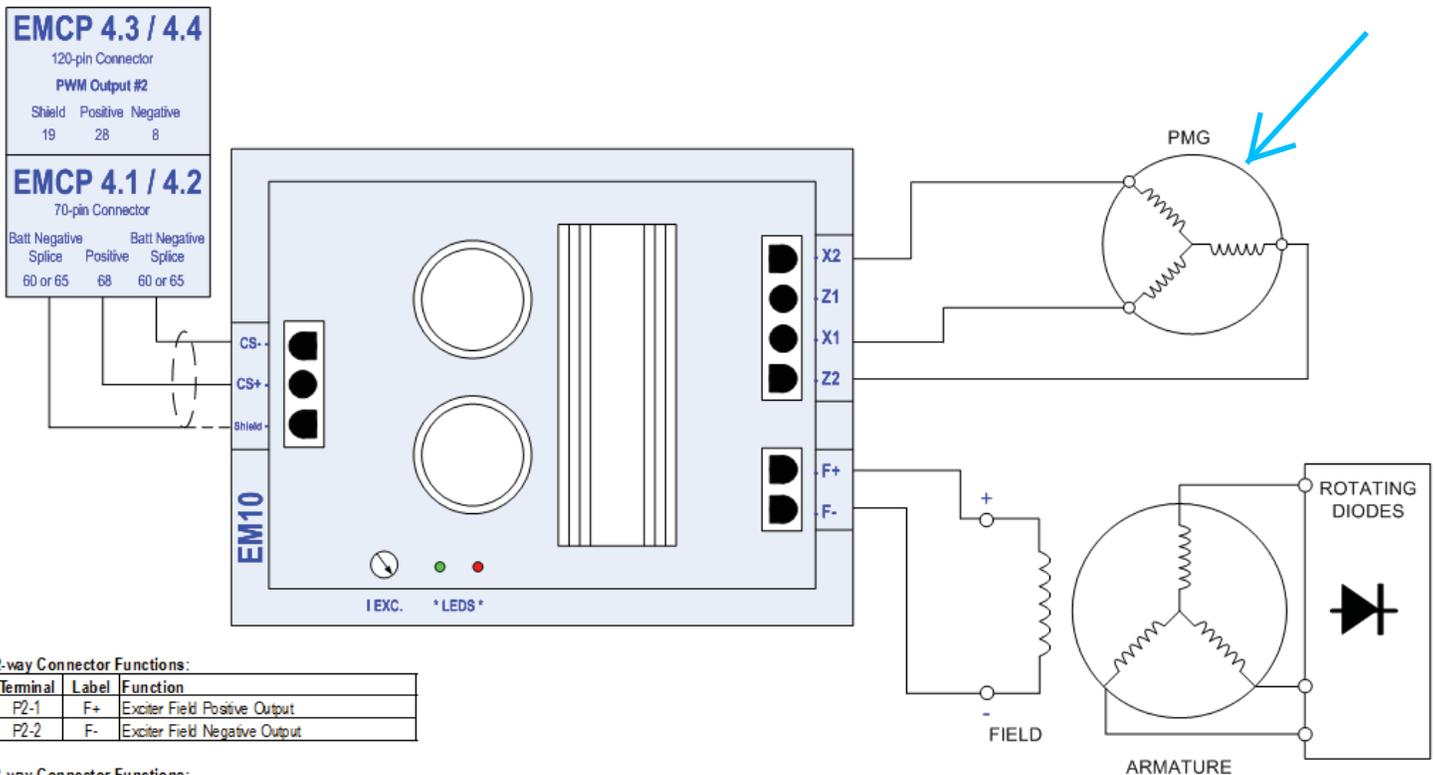
OUTLINE DRAWING (Dimensions in mm)



EXCITATION MODULE – EM10



EXAMPLE CONNECTION DIAGRAM (Permanent Magnet Excitation)



2-way Connector Functions:

Terminal	Label	Function
P2-1	F+	Exciter Field Positive Output
P2-2	F-	Exciter Field Negative Output

3-way Connector Functions:

Terminal	Label	Function
P3-1	Shield	Excitation Command Shield
P3-2	CS+	Excitation Command Positive Input
P3-3	CS-	Excitation Command Negative Input

4-way Connector Functions (PMG Excitation):

Terminal	Label	Function
P4-1	X2	Excitation Power Supply Input (PMG Phase B)
P4-2	Z1	Not Connected
P4-3	X1	Excitation Power Supply Input (PMG Phase A)
P4-4	Z2	Excitation Power Supply Input (PMG Phase C)

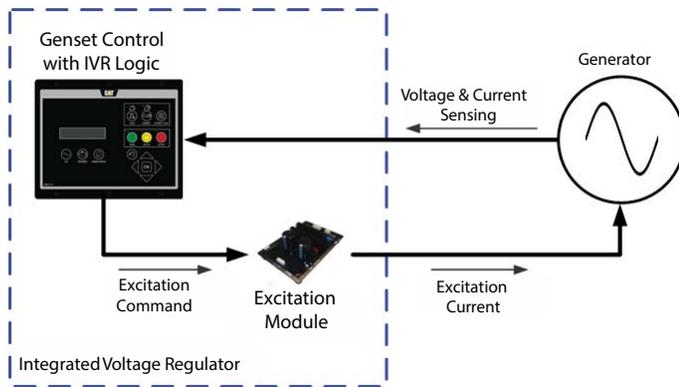
4-way Connector Functions (Self-Excitation):

Terminal	Label	Function
P4-1	X2	Excitation Power Supply Input (single-phase)
P4-2	Z1	Not Connected
P4-3	X1	Excitation Power Supply Input (single-phase)
P4-4	Z2	Not Connected

4-way Connector Functions (Internal Excitation):

Terminal	Label	Function
P4-1	X2	Excitation Power Supply Input (Aux Winding 1 - Positive)
P4-2	Z1	Excitation Power Supply Input (Aux Winding 2 - Positive)
P4-3	X1	Excitation Power Supply Input (Aux Winding 1 - Negative)
P4-4	Z2	Excitation Power Supply Input (Aux Winding 2 - Negative)

INTEGRATED VOLTAGE REGULATOR



INTEGRATED VOLTAGE REGULATOR

The Integrated Voltage Regulator (IVR) is designed to provide robust, precise closed-loop control of the generator voltage, optimized transient performance and industry leading feature specification.

Caterpillar is leading the power generation marketplace with power solutions engineered to deliver unmatched flexibility, expandability, reliability and cost-effectiveness.

FEATURES

When used with an Excitation Module, EMCP 4.3/4.4 and IVR-compatible EMCP 4.1/4.2 controllers offer:

- Automatic Voltage Regulation (AVR)
- Programmable stability settings
- Soft start control with an adjustable time setting in AVR control mode
- Dual Slope, Configurable Under Frequency (Volts/Hz) regulation
- Three-phase or single-phase generator voltage (RMS) sensing/regulation in AVR mode
- Setpoint adjustment from the EMCP display or Cat® ET ServiceTool
- IVR Operating Status and Voltage Bias Overview screens to provide an enhanced level of user interface
- Integrated Voltage Regulator event monitoring

EMCP 4.3/4.4 and IVR-compatible EMCP 4.2 controllers also offer:

- Power Factor Regulation (PF)
- Reactive Droop compensation
- Line drop compensation

WORLDWIDE PRODUCT SUPPORT

- Worldwide parts availability through the Cat dealer network
- Over 1,800 dealer branch stores operating in 200 countries
- The best product support record in the industry
- Cat dealers provide extensive post sale support including maintenance and repair agreements

COMPLETE SYSTEM INTEGRATION

Fully designed and factory tested to work seamlessly with Cat generators using Self Excitation (SE), Internal Excitation (IE) or Permanent Magnet (PMG) excitation systems and EMCP controls.

INTEGRATED VOLTAGE REGULATOR



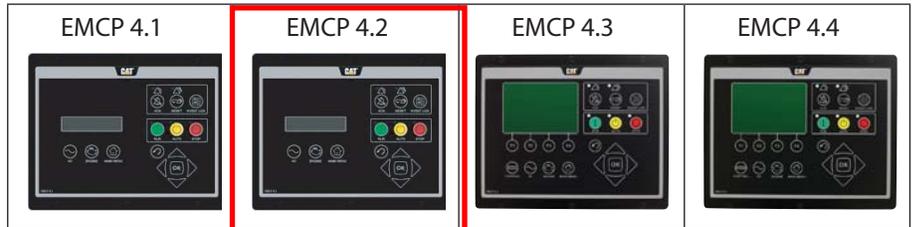
INTEGRATED VOLTAGE REGULATOR FEATURE SPECIFICATION

	EMCP 4.1	EMCP 4.2	EMCP 4.3	EMCP 4.4
				
SPECIFICATIONS				
No Load to Full Load Regulation	±0.5%	±0.25%	±0.25%	±0.25%
Configurable Volts / Hz Characteristic	•	•	•	•
Configurable Knee Frequency	•	•	•	•
Regulator Response Time	10 ms	10 ms	5 ms	5 ms
Single and Three Phase Sensing	•	•	•	•
Voltage Adjustment Range (Configurable up to)	± 30%	± 30%	± 30%	± 30%
CONTROL				
Dual Slope Configurable Volts / Hz Characteristic	•	•	•	•
Excitation Enable / Disable Selection	•	•	•	•
Line Loss (I ² R) Compensation	–	•	•	•
Reactive Droop Compensation	–	•	•	•
Power Factor Control Mode	–	•	•	•
PROTECTION / ALARMS				
Generator Overvoltage	•	•	•	•
Generator Undervoltage	•	•	•	•
Over Excitation	•	•	•	•
Loss of Sensing	•	•	•	•
Generator Reverse VARs	–	•	•	•
Event Log	•	•	•	•
METERING				
EMCP AC Metering	•	•	•	•
EMCP Power Metering	–	•	•	•
Excitation Command Percentage	•	•	•	•
Operating Mode Status Indication	•	•	•	•

INTEGRATED VOLTAGE REGULATOR



INTEGRATED VOLTAGE REGULATOR FEATURE SPECIFICATION (continued)



VOLTAGE ADJUSTMENT				
EMCP 4 Display Voltage Bias	•	•	•	•
Digital Input (Raise / Lower) Voltage Bias ¹	•	•	•	•
Potentiometer Voltage Bias ¹	•	•	•	•
Analog Voltage Bias – Voltage Range ¹	0V to 5V	0V to 5V	-10V to +10V	-10V to +10V
Analog Voltage Bias – Current Range ¹	–	–	0mA to 20mA	0mA to 20mA
Analog Voltage Bias – PWM Range ¹	–	–	0% to 100%	0% to 100%
SCADA (Modbus) Voltage Bias	–	•	•	•

¹Requires an available input on the EMCP 4.

INTEGRATED VOLTAGE REGULATOR

EXCITATION MODULE SPECIFICATION



The Integrated Voltage Regulator consists of an EMCP 4 interfacing with an Excitation Module. There are a range of Excitation Modules available to match Cat generator sets.

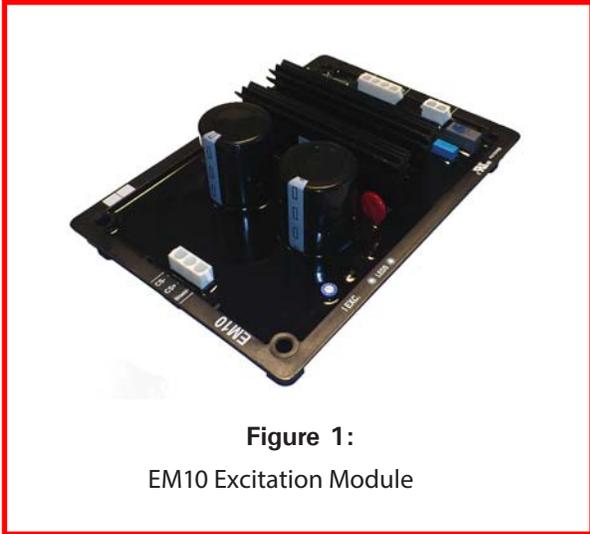


Figure 1:
EM10 Excitation Module



Figure 2:
EM15 Excitation Module

EXCITATION MODULE TECHNICAL SPECIFICATION

	EM10	EM15
Compatible Generator Excitation Types	Self Excitation (SE) Internal Excitation (IE) Permanent Magnet (PMG)	
Nominal Field Current Output	6 Amps	7 Amps
Maximum (forcing) Field Current Output	10 Amps	15 Amps
Maximum AC Voltage Input	180 Vrms	240 Vrms

For more information on the Excitation Module refer to the component spec sheet.

INTEGRATED VOLTAGE REGULATOR



EMCP 4 DISPLAY

EXAMPLE SCREENS – EMCP 4.1/4.2

VOLTS / Hz	
TARGET VOLT	480 V
EXCITATION CMD	4.5 %

Figure 3: IVR Overview Screen

VOLTAGE BIAS OVERVIEW	
MANUAL	10.0%
ANALOG	2.0%

DROOP	-2.0%
TOTAL	10.0%

Figure 4: Voltage Bias Overview Screens

EXAMPLE SCREENS – EMCP 4.3/4.4

IVR OVERVIEW			
OPERATING MODE:			
VOLTS / Hz			
TARGET VOLTAGE	480 V		
EXCITATION COMMAND	4.5 %		
COMPENSATION	DROOP		
GENSET			PAGE DOWN

Figure 5: IVR Overview Screen

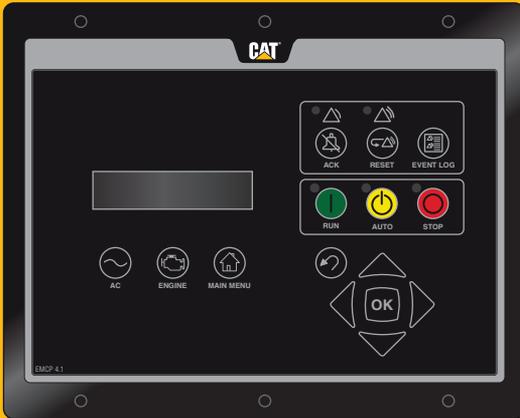
VOLTAGE BIAS OVERVIEW			
ACTIVE VOLTAGE BIASING:			
MANUAL	10.0%		
ANALOG INPUT	2.0%		
DROOP	-2.0%		
TOTAL BIAS	10.0%		
GENSET		PAGE UP	

Figure 6: Voltage Bias Overview Screen

EMCP 4.1/4.2

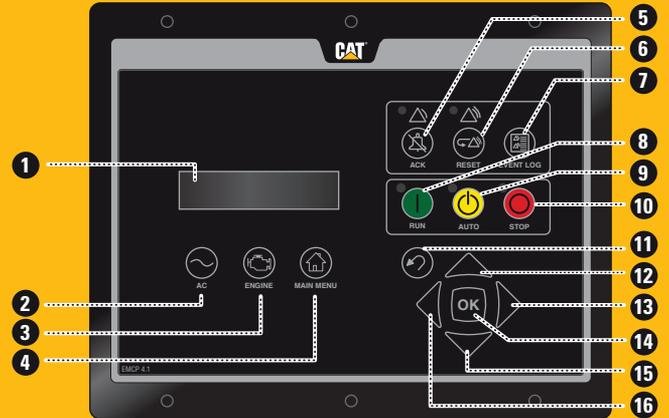
Quick Start Guide

5



Return to RUN / STOP / AUTO as required

OVERVIEW



- | | |
|---|----------------------|
| 1. Display Screen | 9. Auto Key |
| 2. AC Overview Key | 10. Stop Key |
| 3. Engine Overview Key | 11. Escape Key |
| 4. Main Menu/Home Key | 12. Scroll Up Key |
| 5. Alarm Acknowledge/Silence Key with Yellow Warning Lamp | 13. Scroll Right Key |
| 6. Event Reset Key with Red Shutdown Lamp | 14. OK Key |
| 7. Event Log Key | 15. Scroll Down Key |
| 8. Run Key | 16. Scroll Left Key |

To START



Press RUN Key
RUN

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EMCP 4.1/4.2 Advanced Feature Summary

This document will provide a high level summary of some of the advanced features found in the EMCP 4.1 & 4.2 controllers. This is not intended to be a complete list of features nor replace the A&I guide and service manuals, but rather to serve as a quick reference to certain features and functions that could be overlooked.

Security

Like the EMCP 3, EMCP 4 includes multiple security levels that can be set in the field to prevent unauthorized access operate the generator set. The EMCP 4 is equipped with five security levels: Level 0 (accessible by anyone), level 1 & 2 (password at controller), level 3 (factory password), and service tool, which required Cat ET to change. See Section 6: Security in the A&I guide for more information.

Physical Run/Auto/Stop Switch

In some installations, it is required that there be a physical switch, often a key switch, to place the generator set controller into a specific mode of operation, such as AUTO. The digital inputs on the EMCP 4.1 or 4.2 controllers can be configured to accept a switched input. See Section 8: Digital Inputs in the A&I guide for more information.

Analog Inputs

The EMCP 4.1 and 4.2 support three analog inputs. For mechanical engines, the first two analog sensors are factory programmed for monitoring oil pressure and water temperature. For electronic engines with the ADEM controller, all three are available for customer use. The inputs can be programmed for either a 0-5 volt sensor or a 5-2000 ohm resistive sender and can monitor a wide range of parameters, such as oil temperature, fuel level, urea level, or customer defined parameter. See Section 9: Analog Inputs in the A&I guide for more information.

Outputs

The EMCP 4.1/4.2 support relay outputs capable of 2A at 30 VDC. The EMCP 4.2 also supports two programmable discrete sinking outputs. These outputs can be configured for a number of conditions, including generator set mode of operation (run/auto/stop), not in auto, crank alert, engine started, common warning, common shutdown and programmable kW relay trip (EMCP 4.2 only). See

Section 10: Outputs in the A&I guide for more information.

Modifiable text strings

Modifiable text strings give the customer the ability to customize an event name of a custom event. For example, if the building fire detection system were wired into the genset, a custom event called "Building Fire Detected" could be programmed into the EMCP controller, and would appear on the display and be recorded in the event log. See Section 11: Modifiable Text Strings in the A&I guide for more information.

Programmable Cycle Timer (EMCP 4.2 only)

The programmable cycle timer allows the operator to program up to seven independent times in a week when a generator set will run. When activated, the generator will start and run for the pre-programmed time. See Section 13: Programmable Cycle Timer in the A&I guide for more information.

Reduced Power Mode

Like EMCP 3, EMCP 4 is equipped with a reduced power mode feature that puts the EMCP controller into a state where the power consumption is reduced. This will extend the amount of time the generator set can sit between runs before the controller drains the batteries. See Section 14: Reduced Power Mode in the A&I guide for more information.

Programmable kW Relay (EMCP 4.2 only)

The EMCP 4.2 controller has two programmable kW relay functions that can be programmed to activate when the generator set kW exceed a customer defined threshold, and activate an available EMCP 4.2 output. See Section 15: Programmable kW Relay in the A&I guide for more information.

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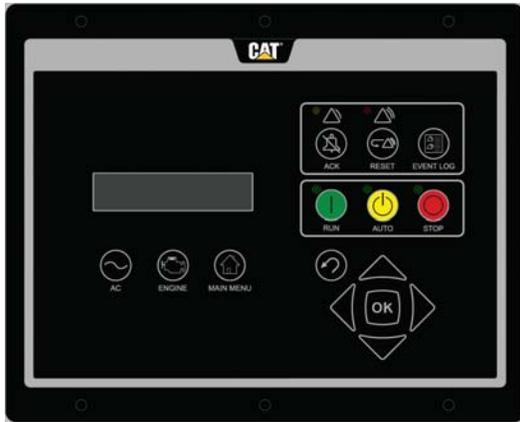


Image shown may not reflect actual package

EMCP 4.2 GENERATOR SET CONTROLLER

Caterpillar is leading the power generation market place with power solutions engineered to deliver unmatched performance, reliability, durability and cost-effectiveness.

FEATURES

GENERAL DESCRIPTION

The Cat[®] EMCP 4.2 offers fully featured power metering, protective relaying and engine and generator control and monitoring. Engine and generator controls, diagnostics, and operating information are accessible via the control panel keypads; diagnostics from the EMCP 4 optional modules can be viewed and reset through the EMCP 4.2.

FULL RANGE OF ATTACHMENTS

- Wide range of system expansion attachments, designed specifically to work with the EMCP 4.
- Flexible packaging options for easy and cost effective installation.

WORLD WIDE PRODUCT SUPPORT

- Cat dealers provide extensive pre and post sale support.
- Cat dealers have over 1,600 dealer branch stores operating in 200 countries.

FEATURES

- A 33 x 132 pixel, 3.8 inch, graphical display denotes text alarm/event descriptions, set points, engine and generator monitoring, and is visible in all lighting conditions.
- Textual display with support for 28 languages, including character languages such as Arabic, Chinese, and Japanese.
- Advanced engine monitoring is available on systems with an electronic engine control module.
- Integration with the Cat Digital Voltage Regulator (CDVR) provides enhanced system performance.
- Fully featured power metering, protective relaying, engine and generator parameter viewing, and expanded AC metering are all integrated into this controller.

- Real-time clock allows for date and time stamping of diagnostics and events in the control's logs as well as service maintenance reminders based on engine operating hours or calendar days.
- Up to 40 diagnostic events are stored in the non-volatile memory.
- Ability to view and reset diagnostics on EMCP 4 optional modules via the control panel removes the need for a separate service tool for troubleshooting.
- Set points and software stored in non-volatile memory, preventing loss during a power outage.
- Reduced power mode offers a low power state to minimize battery power requirements.
- Three levels of security allow for configurable operator privileges.
- Selectable units
 - Temperature: °C or °F
 - Pressure: psi, kPa, bar
 - Fuel Consumption: Gal/hr or Liter/hr

STANDARDS

- UL Recognized
- CSA C22.2 No.100,14, 94
- Complies with all necessary standards for CE Certification
 - 98/37/EC Machinery Directive
 - BS EN 60204-1 Safety of Machinery
 - 89/336/EEC EMC Directive
 - BS EN 50081-1 Emissions Standard
 - BS EN 50082-2 Immunity Standard
 - 73/23/EEC Low Voltage Directive
 - EN 50178 LVD Standard
- IEC529, IEC60034-5, IEC61131-3
- MIL STND 461

EMCP 4.2 GENERATOR SET CONTROLLER

STANDARD FEATURES

Generator Monitoring	<ul style="list-style-type: none"> • Voltage (L-L, L-N) • Current (Phase) • Average Volt, Amp, Frequency • kW, kVAr, kVA (Average, Phase, %) • Power Factor (Average, Phase) • kW-hr, kVAr-hr (total) • Excitation voltage and current (with CDVR) • Generator stator and bearing temp (with optional module)
Generator Protection	<ul style="list-style-type: none"> • Generator phase sequence • Over/Under voltage (27/59) • Over/Under frequency (81 O/U) • Reverse Power (kW) (32) • Reverse Reactive Power (kVAr) (32RV) • Overcurrent (50/51)
Engine Monitoring	<ul style="list-style-type: none"> • Coolant temperature • Oil pressure • Engine speed (RPM) • Battery voltage • Run hours • Crank attempt and successful start counter • Enhanced engine monitoring (with electronic engines)
Engine Protection	<ul style="list-style-type: none"> • Control switch not in auto (alarm) • High coolant temp (alarm and shutdown) • Low coolant temp (alarm) • Low coolant level (alarm) • High engine oil temp (alarm and shutdown) • Low, high, and weak battery voltage • Overspeed • Overcrank
Control	<ul style="list-style-type: none"> • Run / Auto / Stop control • Speed and voltage adjust • Local and remote emergency stop • Remote start/stop • Cycle crank
Inputs & Outputs	<ul style="list-style-type: none"> • Two dedicated digital inputs • Six programmable digital inputs • Six programmable form A dry contacts • Two programmable form C dry contacts • Two digital outputs
Communications	<ul style="list-style-type: none"> • Primary and accessory CAN data links • RS-485 annunciator data link • Modbus RTU (RS-485 Half duplex)
Language Support	<p>Arabic, Bulgarian, Chinese, Czech, Danish, Dutch, English, Estonian, Finnish, French, German, Greek, Hungarian, Icelandic, Italian, Latvian, Lithuanian, Japanese, Norwegian, Polish, Portuguese, Romanian, Russian, Slovak, Slovene, Spanish, Swedish, Turkish</p>
Environmental	<ul style="list-style-type: none"> • Control module operating temperature: -40°C to 70°C • Display operating temperature: -20°C to 70°C • Humidity: 100% condensing 30°C to 60°C • Storage temperature: -40°C to 85°C • Vibration: Random profile, 24-1000 Hz, 4.3G rms

EMCP 4 CAN ANNUNCIATOR

The EMCP 4 CAN annunciator serves to display generator set system alarm conditions and status indications. The annunciator has been designed for use on the EMCP 4 accessory communication network for local applications, but may be used for either local or remote applications, providing customers with enhanced site flexibility.

In local applications, the annunciator may be mounted on the package generator set with the EMCP 4 Controller to provide a complete package-mounted monitoring solution.

The annunciator may also be mounted separate from the generator set to provide remote indication of system operating and alarm conditions.

The EMCP 4 annunciator is configurable to the standards of NFPA 99/110 for emergency standby generator systems.



FEATURES

- The EMCP 4 annunciator provides sixteen (16) individual points of annunciation, with two (2) LED's included for each point.
- An additional pair of LED's provides status indication of the accessory communication network.
- Includes alarm horn with lamp test and alarm acknowledge pushbuttons.
- Configurable using standard Cat® Service Tool
- Configurable to NFPA 99/110 requirements for local and remote annunciation on emergency standby generator systems.
- Provides custom label kit including software for customer's specific alarms and arrangement
- Designed and tested to meet stringent impulse shock and operating vibration requirements
- Uses high quality shielded twisted-pair cable for robust remote communications
- Graphic symbols are provided next to each pair to indicate various alarms and events
- The annunciator can be mounted either locally, on the package generator set, or remotely (up to 240 m (800 ft)).
- Provides superior visibility of the LED's in direct sunlight

SPECIFICATIONS

Technical Data

Electrical

Battery Voltage Functional Range: 9 to 32 VDC

Power Consumption

Maximum: ≈ 12 watt at 24 VDC

Standby: ≈ 5 watt at 24 VDC

Control Power: 12-24 VDC

Communication: Accessory Data Link

Single, 6-pin Connector

Alarm

Sound Level 80 db

PHYSICAL

Weight

2.5 lb or ≈ 1.13 kg

ENVIRONMENTAL

Operating Temperature

-40° C to 70° C

-40° F to 158° F

Storage Temperature

-50° C to 70° C

-58° F to 158° F

Relative Humidity

90%

CERTIFICATIONS



UL Recognized

LED COLOR SCHEME

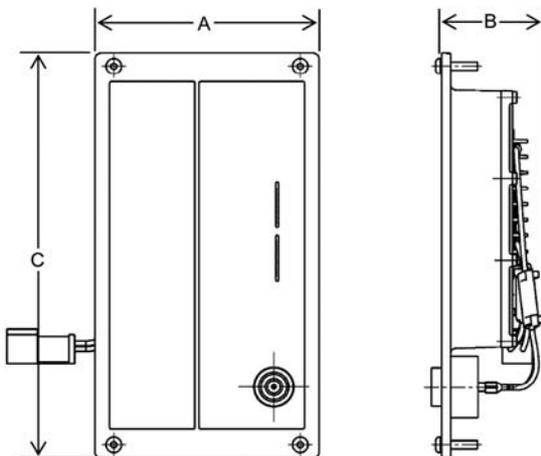
Each pair of LED's on the annunciator consists of two of three colors: green, yellow and red, which allows for custom configuration of status, warning and shutdown conditions.

The available colors and combinations are:

Row	LED 1	LED 2
1	Red	Yellow
2	Red	Yellow
3	Red	Yellow
4	Red	Yellow
5	Red	Yellow
6	Red	Green
7	Red	Yellow
8	Red	Yellow
9	Red	Yellow
10	Red	Yellow
11	Red	Yellow
12	Red	Yellow
13	Green	Yellow
14	Green	Yellow
15	Red	Green
16	Red	Yellow

STANDARD LED CONFIGURATION

- Emergency stop shutdown
- Overcrank shutdown
- Low coolant temperature warning
- High coolant temperature warning/shutdown
- Low oil pressure warning/shutdown
- Overspeed warning/shutdown
- Low coolant level warning/shutdown
- Low fuel level warning/shutdown
- EPS supplying load status
- Control switch not in auto warning
- High battery voltage warning/shutdown
- Low battery voltage warning/shutdown
- BATT charger AC failure warning/shutdown
- Low cranking voltage
- Engine running
- Tier 4 SCR



Annunciator Dimensions		
A	158 mm	6.22 in
B	60 mm	2.37 in
C	288 mm	11.34 in

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EMCP 4 RS-485 ANNUNCIATOR

The EMCP 4 RS-485 annunciator serves to display generator set system alarm conditions and status indications. The annunciator has been designed for use on the EMCP 4 RS-485 annunciator data link for remote applications, providing customers with enhanced site flexibility.

The EMCP 4 annunciator is configurable to the standards of NFPA 99/110 for emergency standby generator systems.



FEATURES

- The EMCP 4 annunciator provides sixteen (16) individual points of annunciation, with two (2) LED's included for each point.
- An additional pair of LED's provides status indication of the RS-485 communication network.
- Includes alarm horn with lamp test and alarm acknowledge pushbuttons.
- Configurable to NFPA 99/110 requirements for local and remote annunciation on emergency standby generator systems.
- Provides custom label kit including software for customer's specific alarms and arrangement
- Designed and tested to meet stringent impulse shock and operating vibration requirements
- Uses high quality shielded twisted-triad cable for robust remote communications
- Graphic symbols are provided next to each pair to indicate various alarms and events
- The annunciator can be mounted remotely up to 1200 m (4,000 ft).
- Provides superior visibility of the LED's in direct sunlight

SPECIFICATIONS

Technical Data

Electrical

Battery Voltage Functional Range: 9 to 32 VDC

Power Consumption

Maximum: \approx 12 watt at 24 VDC

Standby: \approx 5 watt at 24 VDC

Control Power: 12-24 VDC

Communication: RS-485

Single, 8-pin Connector

Alarm

Sound Level 80 db

PHYSICAL

Weight

2.5 lb or \approx 1.13 kg

ENVIRONMENTAL

Operating Temperature

-40° C to 70° C

-40° F to 158° F

Storage Temperature

-50° C to 70° C

-58° F to 158° F

Relative Humidity

90%

CERTIFICATIONS



UL Recognized

LED COLOR SCHEME

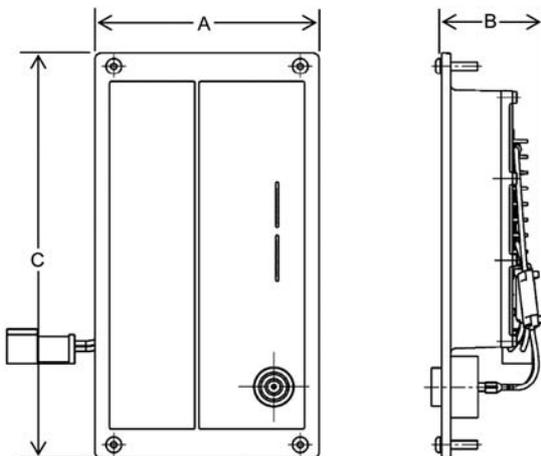
Each pair of LED's on the annunciator consists of two of three colors: green, yellow and red, which allows for custom configuration of status, warning and shutdown conditions.

The available colors and combinations are:

Row	LED 1	LED 2
1	Red	Yellow
2	Red	Yellow
3	Red	Yellow
4	Red	Yellow
5	Red	Yellow
6	Red	Green
7	Red	Yellow
8	Red	Yellow
9	Red	Yellow
10	Red	Yellow
11	Red	Yellow
12	Red	Yellow
13	Green	Yellow
14	Green	Yellow
15	Red	Green
16	Red	Yellow

STANDARD LED CONFIGURATION

- Emergency stop shutdown
- Overcrank shutdown
- Low coolant temperature warning
- High coolant temperature warning/shutdown
- Low oil pressure warning/shutdown
- Overspeed warning/shutdown
- Low coolant level warning/shutdown
- Low fuel level warning/shutdown
- EPS supplying load status
- Control switch not in auto warning
- High battery voltage warning/shutdown
- Low battery voltage warning/shutdown
- BATT charger AC failure warning/shutdown
- Low cranking voltage
- Engine running
- Tier 4 SCR



Annunciator Dimensions		
A	158 mm	6.22 in
B	60 mm	2.37 in
C	288 mm	11.34 in

Information contained in this publication may be considered confidential.

Discretion is recommended when distributing.

Materials and specifications are subject to change without notice.

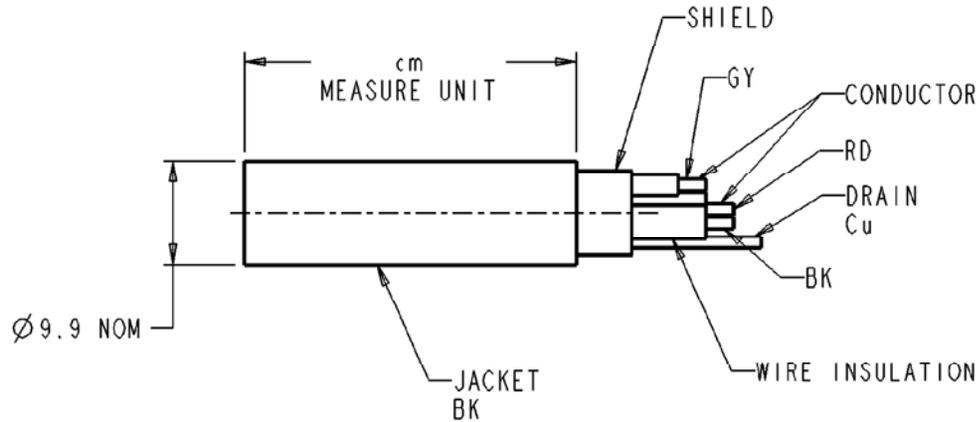
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www.Cat-ElectricPower.com

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METRIC

379-1796



- CABLE----- 3 CONDUCTOR W/ DRAIN AND SHIELD
- CONDUCTOR----- BK AND RD CONDUCTORS ARE TWISTED
- WIRE INSULATION----- 18 GA (COPPER 16 X 30 STRAND)
- JACKET----- POLYETHYLENE
- DRAIN----- THERMOPLASTIC ELASTOMERS
- SHIELD----- 18 GA COPPER 16 X 30
- MINIMUM BEND RADIUS--- ALUMINUM FOIL
- OPERATING TEMP RANGE-- 35
- IMPEDANCE----- -40°C TO +80°C
- CAPACITANCE----- 120±10 Ω
- VOLTAGE----- 11±10% pf/FT
- CERTIFICATION----- 600 V
- UL/CANADIAN STANDARD ASSOCIATION

NOTE A: NORTHWIRE INC
FAWMI83-155

NOTE B: ASTM B3, ASTM B33, ASTM B172

INTENDED USE FOR THIS CABLE IS
RS485 COMMUNICATION

DIM. W/O TOL ARE REF

M A T L	A	APPD PART	
	B	IE1541F WROUGHT MATL	
H T R			
		IE4246B ELEK SUBSTANCES	
		IE2722F DRAWING	
		IE2442J APPROVAL	
		IE2442A APPROVAL	
		IE0507C IDENT	
		IE0198R LETTERS	
		IE0013Y CONFIDENTIALITY	
	N O T E		IE0011 INTPR & TOL
		Caterpillar: Confidential Yellow	
PROD. <input checked="" type="checkbox"/> OTHER			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN mm		VERSION PRIMARY X	
DIMENSIONS W/O TOL ARE BASIC		TYPE SECONDARY	
THIRD ANGLE PROJECTION		SHEET 1 OF 1	
		DWG CONTROL A544	
CATERPILLAR			
THE INFORMATION HEREON IS THE PROPERTY OF CATERPILLAR INC. AND/OR ITS SUBSIDIARIES. WITHOUT WRITTEN PERMISSION, ANY COPYING, TRANSMITTAL TO OTHERS, AND ANY USE EXCEPT THAT FOR WHICH IT IS LOANED, IS PROHIBITED			
CABLE-BULK (ELECTRICAL)			
(RS485)			
379-1796		VER CHG B	
		- 00	



DIGITAL INPUT/ OUTPUT (I/O) MODULE

GENERAL DESCRIPTION

The Cat® Digital Input/Output (I/O) module serves to provide expandable Input and Output capability for your package generator set. The Digital I/O Module is capable of reading 12 digital inputs and setting eight (8) relay outputs.

The Cat Service Tool (ET) is used to configure the Digital I/O module, while all monitored Input and Output status conditions are viewable on the EMCP 4 control panel.

The Digital I/O Module can be Package or Remote mounted (up to 800 feet) and features rugged packaging and watertight Deutsch IPD connectors.

These features all add to the sense of value and dependability that comes with your purchase of Cat products.

OPERATOR INTERFACE

- All Digital I/O status conditions are available for viewing with the EMCP 4.2, 4.3 & 4.4 Controllers.

FEATURES/BENEFITS

- Capable of reading twelve (12) digital inputs and setting eight (8) relay outputs.
- CAN communication network eliminates the need for multiple relays, which translates to less wiring and fewer opportunities for mechanical failures.
- Remote customer communications are supported by MODBUS protocol (via EMCP 4.2 or higher), which easily interfaces with existing plant systems and equipment.
- Set points are stored in nonvolatile memory, preventing loss during a power outage.

COMMUNICATION

- Single, standard 40-pin connector
- CAN Accessory Data Link
- MODBUS RS-485 (Customer Communication) via the EMCP 4.2 or higher controllers

GENERAL SPECIFICATIONS

- Reads twelve (12) digital inputs and sets eight (8) Form C relay outputs rated for rated resistive loads of:
 - 2A @ 30 VDC for Normally Closed (NC) relays
 - 2A @ 125 VAC for Normally Closed (NC) relays
 - 2A @ 30 VDC for Normally Open (NO) relays
 - 2A @ 125 VAC for Normally Open (NO) relays

GENERAL SPECIFICATIONS (CONT'D)

- Encapsulated in a rugged aluminum housing with watertight connectors (IP67 rating)
- Suitable for moist, high shock and vibration environments
- Modules are designed for package mounting on power generator sets or remotely, up to 800 ft.
- Configuration is accomplished with Cat ET Service Tool.
- Multiple Digital I/O modules can be used on a CAN communications network.
- Protected against 95% humidity non-condensing, 30° C to 60° C.
- Operating temperature range of -40° C to 85° C (-40° F to 185° F) – for ambient temperatures exceeding 85° C, the temperature scanner may deviate in accuracy an additional $\pm 1^\circ$ C.
- Storable temperature range is -50° C to +120° C.
- Designed to meet relevant European standards for EMI/RFI/Immunity without the use of external filtering.
- Maximum level of current draw of 400 mA + 50 mA per energized relay @ 12 VDC
- Isolation voltage: 4000 VAC (RMS), 50/60 Hz for 1 min. between coil and contacts, 750 VAC, 50/60 Hz for 1 min. between contacts of the same polarity
- System throughput: All channels are scanned in 100 mSec.
- Input level characteristics:
 - Low-Level input voltage: 0 to 0.8V
 - High-Level input voltage: 3.75 to 24V
 - Inputs have internal pull-up resistors.
- Inputs that generate a warning message auto-reset whenever the input returns to non-active state.

- Inputs that generate a shutdown message continue to broadcast that message until the input returns to non-active state and a reset message is received from the EMCP 4.2, 4.3 or 4.4.
- Each output is configured to activate based upon the message that is received on the accessory and can be configured to activate on Alarm, Shutdown or Diagnostic condition – or a combination of all three.
- Optical isolation is provided for the CAN line
- Retains current date and time relative to synchronization every 24 hours (or upon boot up) with equipment system time via an explicit command from the EMCP 4.2 or higher – synchronization time is accurate to within 1 sec.
- Monitored parameters and diagnostics as well as setpoints are customizable to customer specification
- Module operates normally with loss of communication link, retaining configured values in non-volatile memory.
- Remains energized during engine cranking.

Digital I/O Module Configuration Parameters:

The Digital I/O Module is configurable to display the following parameters for each of the available Inputs:

- Active State (Active High or Active Low)
- Input Time Delay (0-120 seconds).

DIGITAL INPUT/ OUTPUT (I/O) MODULE

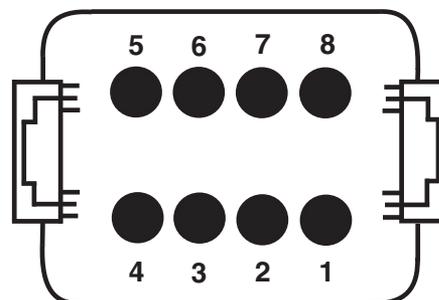


Available Inputs/Outputs:

The Digital I/O Module is configured to accept inputs for the following conditions, with the listed condition displayed at the EMCP 4 controller:

Description	Input	Output
Fuel Level Secondary Tank	X	X
Starting Air Pressure		X
Fuel Pressure		X
Fuel Filter Differential Pressure		X
Fuel Level (Primary Tank)	X	X
Engine Oil Level		X
Oil Filter Differential Pressure		X
Engine Oil Pressure		X
Crankcase Pressure		X
Air Filter Differential Pressure		X
Engine Coolant Temperature		X
Engine Coolant Level	X	X
Extinguisher System Pressure	X	X
Battery Voltage		X
Ambient Air Temperature		X
Inlet Air Temperature		X
Exhaust Temperature		X
Fuel Temperature		X
Engine Oil Temperature		X
Engine Overspeed		X
Emergency Stop Shutdown		X
Gen. Bearing Temperature #1		X
Gen. Winding Temperature (1-3)		X
Ruptured Fuel Basin-Primary Tank	X	X
Engine Failure to Start Shutdown		X
Generator Frequency		X
Generator Voltage		X
Generator Reactive Power (VAR)		X
Generator AC Current		X
Generator Reverse Power (kW)		X
Voltage Regulator Failure		X
Service Interval Warning		X
Air Shutoff Damper Close	X	X
Gen. Supplying Load	X	X
Battery Charger Failure	X	X
Gen. Breaker Closed	X	X
Utility Breaker Closed	X	X
Engine in Cooldown		X
Generator Control Not in Auto		X
Unexpected Engine Shutdown		X
User Defined Input (1-12)	X	

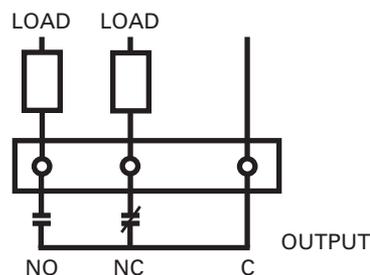
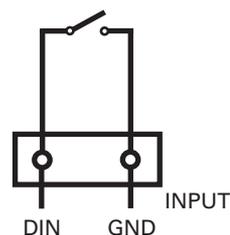
TYPICAL CONNECTIONS – POWER AND CAN BUS:



FRONT VIEW
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DT13-08PA

- 1 = PWR+
- 2 = CAN-H
- 3 = CAN-L
- 4 = PWR-
- 5 = SHIELD
- 6,7,8 = NOT USED

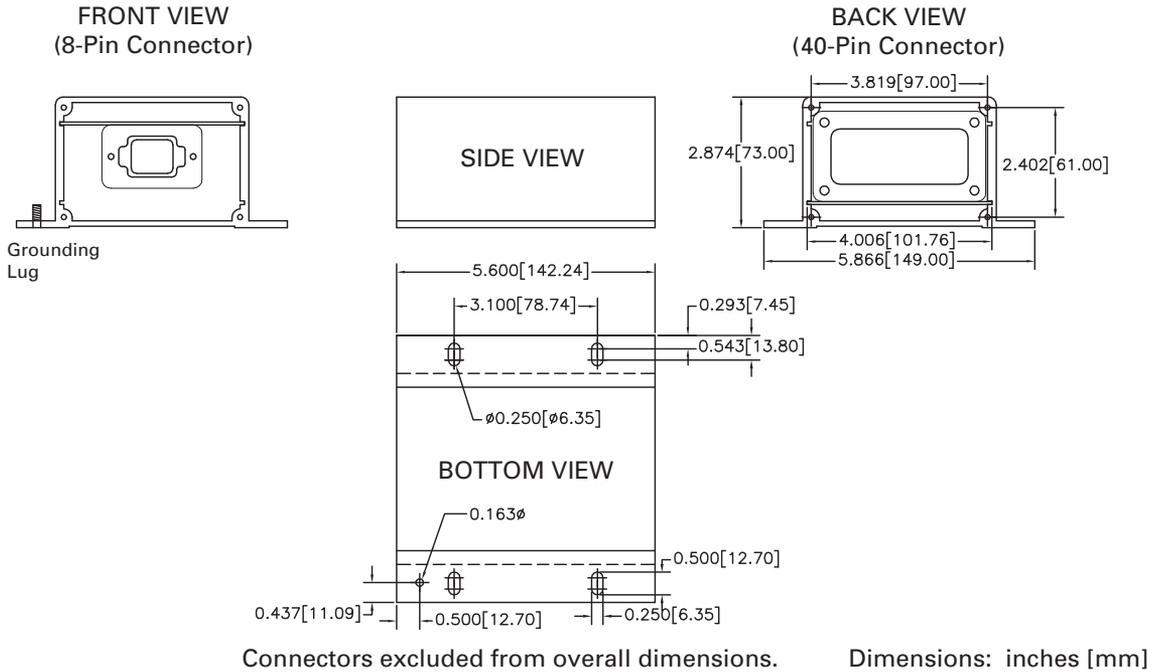
TYPICAL CONNECTIONS – DIGITAL I/O MODULE:



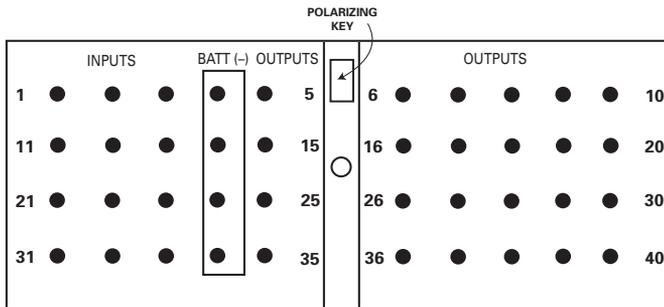
DIGITAL INPUT/ OUTPUT (I/O) MODULE



DIMENSIONS

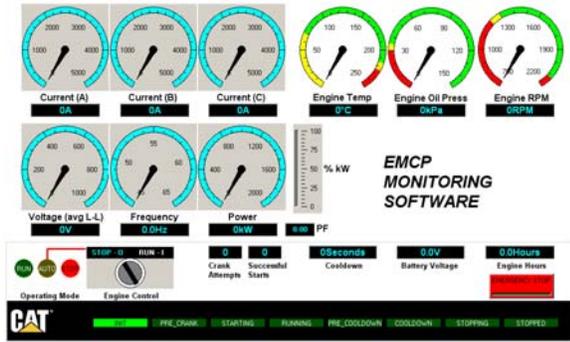


FRONT VIEW OF
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DRC13-40PB



NO - Normally Open
NC - Normally Closed
C - Common

INPUTS	Pin	OUTPUTS	Pin
DIN1	1	NC_1	5
DIN2	11	C_1	6
DIN3	21	NO_1	7
DIN4	31	NC_2	15
DIN5	2	C_2	16
DIN6	12	NO_2	17
DIN7	22	NC_3	25
DIN8	32	C_3	26
DIN9	3	NO_3	27
DIN10	13	NC_4	35
DIN11	23	C_4	36
DIN12	33	NO_4	37
BATT (-)	4	NC_5	8
BATT (-)	14	C_5	9
BATT (-)	24	NO_5	10
BATT (-)	34	NC_6	18
		C_6	19
		NO_6	20
		NC_7	28
		C_7	29
		NO_7	30
		NC_8	38
		C_8	39
		NO_8	40



EMCP MONITORING SOFTWARE

Image Shown may not reflect actual package

GENERAL DESCRIPTION

The EMCP Monitoring Software Package is a PC based program which allows the user to monitor and control up to 16 of the following: EMCP 3.2, 3.3, 4.2, 4.3 or 4.4 generator set controller, Automatic Transfer Switch (ATS) MX150, MX250, ATC 800 and Cat Flywheel Uninterruptible Power Supply (UPS).

FEATURES

GRAPHICAL MONITORING AND CONTROL

The EMCP Remote Monitoring Software offers an easy to use graphical interface for real time data monitoring and control for up to 16 Caterpillar devices. Standard screens for monitoring and control have been developed, and the user has the full flexibility to customize the software to meet their specific site requirements.

The System Overview screen displays a graphical summary of the Modbus network, and displays the status and key data for all connected devices.

In addition to the System Overview screen, the following monitoring and control screens are available:

- Generator Set
- Automatic Transfer Switch (ATS)
- Uninterruptible Power Supply (UPS)

DATA LOGGING

Any parameter that can be viewed on the Modbus network can also be logged. The EMCP Monitoring Software allows the user to define when data logging should start. This can be initiated manually by the user, automatically on receipt of remote start signal, or automatically at a specific time and date. The data is saved in a CSV (comma-separated variable) format for use by an external application such as Microsoft Excel.

DATA LOGGING – PRE-ALARM

A second data logging feature is provided for troubleshooting assistance in the event of an alarm or shutdown. When enabled, data will be logged from a configurable list of parameters for a period of time before an event occurs.

NETWORK VIEW – EVENT VIEWING AND LOGGING

The Network View shows all devices on the Modbus network and the alarm status of each, at one glance.

The Event Log Viewer makes it easy to monitor and log individual EMCP events.

Alarms are displayed in real-time, with the option to log them to a file or view events from an existing file.

DATA GRAPHING

The Data Graphing function allows for the display of user-defined parameters on the screen in a graphical format. Up to six graphs can be independently configured, with each graph having up to six parameters displayed.

GRID DATA VIEW

The Grid Data View offers a tabular view of the data available from the various components on the Modbus network.

SECURITY

The EMCP Monitoring Software offers three levels of security to control the level of access to view and control the equipment, and to modify the monitoring software.

DYNAMIC DATE EXCHANGE (DDE) LINK

The EMCP Monitoring software includes a dynamic data exchange (DDE) server, that allows any parameters monitored by the software to be passed to other applications, such as Microsoft Excel.

COMMUNICATION

- Direct connection to PC with RS485 to RS232 converter (270-0476 or equivalent) using Modbus RTU protocol
- Direct connection to PC with Ethernet using Modbus TCP protocol.
- Remote connection via modem (274-1979 or equivalent)

PC REQUIREMENTS

- Windows® XP, Vista and Windows 7
- 2 GB RAM
- 500 MB hard drive space (minimum required to install)
- Minimum 500 MB hard drive space for data logging (recommended)
- Minimum resolution 1280 x 1024 (recommended)



South Coast Air Quality Management District

21865 Copley Drive, Diamond Bar, CA 91765-4178
(909) 396-2000 • www.aqmd.gov

December 23, 2014

Mr. Bob Shepherd
Caterpillar, Inc./Quinn Power Systems/Johnson Power Systems
P.O. Box 227044
Los Angeles, CA 90022-0744

Dear Mr. Shepherd:

The South Coast Air Quality Management District (SCAQMD) has extended to December 31, 2015 the Certified Equipment Permits (CEPs) for the stationary emergency internal combustion (IC) engine models listed in the attached table. However, please be reminded that many of these certified diesel-fueled IC engines may not meet Rule 1470 requirements if installed near a sensitive receptor or near school grounds and, therefore, may require an aftertreatment system such as a diesel particulate filter in the exhaust stream.

Please note that the SCAQMD does not endorse or warrant any specific equipment or manufacturer. Modification of the equipment listed here will void this certification.

If you have additional questions or need further clarification on the CEP program, please feel free to contact Rizaldy Calungcagin at (909) 396-2315 or at rcalungcagin@aqmd.gov.

Sincerely,

A handwritten signature in blue ink that reads "David De Boer".

David De Boer
Program Supervisor
Area Sources



South Coast Air Quality Management District

21865 Copley Drive, Diamond Bar, CA 91765-4178
(909) 396-2000 • www.aqmd.gov

CATERPILLAR, INC./QUINN POWER SYSTEMS/ JOHNSON POWER SYSTEMS

Certified ICE-Emergency Generators

Engine Mfg.	Model	Engine Rating	Application No.
Caterpillar	3516C DITA (2000 KWe)	2937 BHP	449979
Caterpillar	3512C DITA	2206 BHP	449987
Caterpillar	C-15 (400 KWe)	619 BHP	452052
Caterpillar	C-32 (1000 KWe)	1502 BHP	452094
Caterpillar	C-32 (900 KWe)	1357 BHP	452095
Caterpillar	C-18 (600 KWe)	900 BHP	453933
Caterpillar	C-18 (550 KWe)	839 BHP	453934
Caterpillar	C-9 (250 KWe)	398 BHP	455162
Caterpillar	C-9 (300 KWe)	480 BHP	455163
Caterpillar	C-27 (750 KWe)	1141 BHP	457437
Caterpillar	C-6.6 (125 KWe)	217 BHP	457438
Caterpillar	C-6.6 (150 KWe)	230 BHP	457439
Perkins	1106D-E66TAG4	274 BHP	457877
Caterpillar	C-27 (650 KWe)	998 BHP	459146
Caterpillar	C-27 (700 KWe)	1069 BHP	461016
Caterpillar	C-6.6 (175 KWe)	274 BHP	472638
Caterpillar	C4.4 (100 KWe)	156.8 BHP	482670
Caterpillar	C4.4 (60/80 KWe)	130 BHP	482673
Caterpillar	C9 (200 Kwe)	374 BHP	514974
Caterpillar	C4.4	99.9 BHP	544534
Caterpillar	C15 (500 KWe)	762 BHP	554729
Caterpillar	C15 (550 KWe)	839 BHP	554730
Caterpillar	C27 (800 KWe)	1214 BHP	554731
Caterpillar	3516C (2500 KWe)	3634 BHP	554732
Caterpillar	C175 (3000 KWe)	4423 BHP	554733
Caterpillar	C15 (350 KWe)	546 BHP	554734
Caterpillar	C15 (450 KWe)	691 BHP	554735
Caterpillar	C7.1	315 BHP	567863



**CERTIFIED EQUIPMENT PERMIT
(NOT A PERMIT CONSTRUCT OR OPERATE)**

ID 096810

**Legal Owner
or Operator:**

QUINN POWER SYSTEMS ASSOCIATES/JOHNSON POWER SYSTEMS
P.O. BOX 227044
LOS ANGELES, CA 90022-0744
ATTN: PAUL WASKEWICS

Equipment Location: SAME AS ABOVE

The equipment described below and as shown on the approved plans and specifications are subject to the special condition or conditions listed.

Equipment Description

INTERNAL COMBUSTION ENGINE, CATERPILLAR, 12 CYLINDER, TURBOCHARGED/AFTERCOOLED, MODEL C-32, 1502 BHP, DIESEL-FUELED, DRIVING AN EMERGENCY ELECTRICAL GENERATOR.

Manufacturer Condition:

1. **THIS CERTIFIED EQUIPMENT PERMIT (CEP) IS NOT A PERMIT TO CONSTRUCT OR OPERATE.** THE PERSON CONSTRUCTING, INSTALLING OR OPERATING THE EQUIPMENT AT EACH SPECIFIC SITE SHALL OBTAIN ALL NECESSARY PERMIT(S) TO CONSTRUCT AND PERMIT(S) TO OPERATE AND COMPLY WITH ANY OTHER DISTRICT RULES AND REGULATIONS INCLUDING THE REQUIREMENTS OF REGULATION XIII.

End User Conditions:

1. OPERATION OF THIS EQUIPMENT SHALL BE CONDUCTED IN ACCORDANCE WITH ALL DATA AND SPECIFICATIONS SUBMITTED WITH THE APPLICATION UNDER WHICH THIS PERMIT IS ISSUED UNLESS OTHERWISE NOTED BELOW.
2. THIS EQUIPMENT SHALL BE PROPERLY MAINTAINED AND KEPT IN GOOD OPERATING CONDITIONS AT ALL TIMES.
3. A NON-RESETTABLE TOTALIZING TIMER SHALL BE INSTALLED AND MAINTAINED TO INDICATE THE ENGINE ELAPSED OPERATING TIME.
4. AN ENGINE OPERATING LOG SHALL BE KEPT AND MAINTAINED ON FILE TO RECORD WHEN THIS ENGINE IS STARTED MANUALLY. THE LOG SHALL LIST THE DATE OF OPERATION, THE TIMER READING IN HOURS AT THE BEGINNING AND END OF OPERATION, AND THE REASON FOR OPERATION FOR A MINIMUM OF THREE YEARS FROM THE DATE OF ENTRY AND MADE AVAILABLE TO DISTRICT PERSONNEL UPON REQUEST. THE TOTAL HOURS OF OPERATION (INCLUDING HOURS FOR MANUAL AND AUTOMATIC OPERATION) SHALL BE RECORDED SOMETIME DURING THE FIRST 15 DAYS OF JANUARY OF EACH YEAR.

ORIGINAL



**CERTIFIED EQUIPMENT PERMIT
(NOT A PERMIT CONSTRUCT OR OPERATE)**

5. THIS ENGINE SHALL NOT OPERATE MORE THAN 200 HOURS IN ANY ONE YEAR, WHICH INCLUDES NO MORE THAN 50 HOURS IN ANY ONE YEAR FOR MAINTENANCE AND TESTING PURPOSES.
6. THE OPERATOR SHALL NOT PURCHASE ANY DIESEL FUEL UNLESS THE FUEL IS LOW SULFUR DIESEL FOR WHICH THE SULFUR CONTENT DOES NOT EXCEED 15 PPM BY WEIGHT. EFFECTIVE JANUARY 1, 2006, THE OPERATOR SHALL ONLY USE DIESEL FUEL WITH A SULFUR CONTENT THAT DOES NOT EXCEED 15 PPM BY WEIGHT, UNLESS THE OPERATOR DEMONSTRATES IN WRITING TO THE EXECUTIVE OFFICER THAT SPECIFIC ADDITIONAL TIME IS NECESSARY.
7. OPERATION BEYOND THE 50 HOURS PER YEAR ALLOTTED FOR ENGINE MAINTENANCE AND TESTING SHALL BE ALLOWED ONLY IN THE EVENT OF A LOSS OF GRID POWER OR UP TO 30 MINUTES PRIOR TO A ROTATING OUTAGE, PROVIDED THAT: (A) THE UTILITY DISTRIBUTION COMPANY HAS ORDERED ROTATING OUTAGES IN THE CONTROL AREA WHERE THE ENGINE IS LOCATED OR HAS INDICATED THAT IT EXPECTS TO ISSUE SUCH AN ORDER AT A CERTAIN TIME; AND (B) THE ENGINE IS LOCATED IN A UTILITY SERVICE BLOCK THAT IS SUBJECT TO THE ROTATING OUTAGE. ENGINE OPERATION SHALL BE TERMINATED IMMEDIATELY AFTER THE UTILITY DISTRIBUTION COMPANY ADVISES THAT A ROTATING OUTAGE IS NO LONGER IMMINENT OR IN EFFECT.
8. THIS ENGINE SHALL BE A US EPA CERTIFIED, NON-ROAD COMPRESSION-IGNITION ENGINE, AS EVIDENCED BY THE MANUFACTURER'S ENGINE TAG.

Please notify Raman Patel at 909/396-2466 when SCAQMD information packets are needed or if you have any questions concerning the Certification/Registration Program.

This Certified Equipment Permit is based on the plans, specifications, and data submitted as it pertains to the release of air contaminants and control measures to reduce air contaminants. No approval or opinion concerning safety and other factors in design, construction or operation of the equipment is expressed or implied.

This Certified Equipment Permit will become invalid if this application is cancelled. THIS PERMIT SHALL EXPIRE ON DECEMBER 31, 2010 unless an extension is granted by the Executive Officer.

By 

RAMAN C. PATEL, P.E.
Senior Air Quality Engineer

ORIGINAL

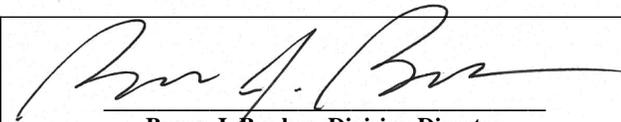


UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2015 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT OF 1990

OFFICE OF TRANSPORTATION
AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: Caterpillar Inc.
(U.S. Manufacturer or Importer)
Certificate Number: FCPXL32.0NZS-006

Effective Date:
07/01/2014
Expiration Date:
12/31/2015


Byron J. Bunker, Division Director
Compliance Division

Issue Date:
07/01/2014
Revision Date:
N/A

Model Year: 2015
Manufacturer Type: Original Engine Manufacturer
Engine Family: FCPXL32.0NZS

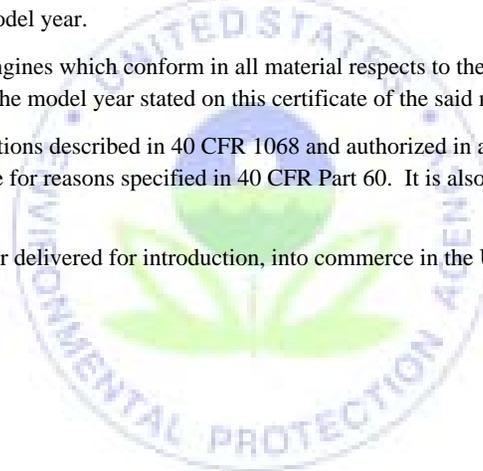
Mobile/Stationary Indicator: Stationary
Emissions Power Category: 560<kW<=2237
Fuel Type: Diesel
After Treatment Devices: No After Treatment Devices Installed
Non-after Treatment Devices: Electronic Control, Engine Design Modification

Pursuant to Section 111 and Section 213 of the Clean Air Act (42 U.S.C. sections 7411 and 7547) and 40 CFR Part 60, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following engines, by engine family, more fully described in the documentation required by 40 CFR Part 60 and produced in the stated model year.

This certificate of conformity covers only those new compression-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 60 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 60.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 60. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 60.

This certificate does not cover engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.



**Caterpillar Emergency Engines
SCAQMD CEP List
November 15, 2014**

			EPA Engine Certification (2014) (g/bhp-hr)						SCAQMD Data (2014) (g/bhp-hr)				
Model	Generator kW	HP	Family Name	HC	NOx	NMHC + NOx	CO	PM	HC	NOx	NMHC + NOx	CO	PM
C-32	900	1357	ECPXL32.0NZS	0.07	3.75	3.80	0.82	0.08	0.11	3.75		0.41	0.058
C-32	1000	1502	ECPXL32.0NZS	0.07	3.75	3.80	0.82	0.08	0.1	3.76		0.34	0.052



THE VMC GROUP
The Power of Together™



CERTIFICATE OF COMPLIANCE

SEISMIC DESIGN OF NONSTRUCTURAL COMPONENTS AND SYSTEMS



Certification No.

VMA-45800-07C (REVISION 2)

Expiration Date: 11/30/2015

Certification Parameters:

The nonstructural products (mechanical and/or electrical components) listed on this certificate are CERTIFIED¹ FOR SEISMIC APPLICATIONS in accordance with the following building code² releases.

IBC 2000, IBC 2003, IBC 2006, IBC 2009, IBC 2012

The following model designations, options, and accessories are included in this certification. Reference report number **VMA-45800-07** as issued by The VMC Group for a complete list of certified models, included accessories/options, and certified installation methods.

Cat® Diesel Engine Generator Set

The above referenced equipment is **APPROVED** for seismic application when properly installed,³ used as intended, and contains a Seismic Certification Label referencing this Certificate of Compliance⁴. As limited by the tabulated values, below grade, grade, and roof-level installations, installations in essential facilities, for life safety applications, and/or of equipment containing hazardous contents are permitted and included in this certification with an Equipment Importance Factor assigned as $I_p=1.5$.

Certified Seismic Design Levels	
C27 $S_{DS} \leq 2.20$	C27 $S_{DS} \leq 0.73$
C32 $S_{DS} \leq 2.10$	C32 $S_{DS} \leq 0.70$
$z/h \leq 0.0$ (Equipment at Grade)	$z/h \leq 1.0$ (Equipment on Roof)
Soil Classes A, B, C, D, Seismic Risk Category I, II, III, IV, and Seismic Design Categories A, B, C, D, E, and F are all covered under this certification, limited by the S_{DS} value stated above.	

Certified Seismic Installation Methods	
Rigid mounting from unit base to rigid structure	External isolation mounting from unit base to rigid structure

Shake Test of Active and Energized Components, Non-Active Components, and Equipment Structure:

C27

Qualified by successful seismic shake table testing at the nationally recognized University of California San Diego Charles Lee Powell Structural Research Laboratories Seismic Response Modification Device (SRMD) Test Facility and at Trentec under the witness of the Certified Seismic Qualification Agency, The VMC Group. Testing was conducted in accordance with ICC-ES AC-156 to envelope the required response spectrum (RRS) of maximum horizontal flexible acceleration (A_{FLEX}) of 2.20 g and a rigid acceleration (A_{RIG}) of 0.88 g. This test level corresponds to an $S_{DS} = 2.20$ g with a z/h of 0.0. Functionality was verified before and after the shake test.

C32

C32 Genset is qualified by comparison to successful seismic shake testing of C27 Genset with V12 Common enclosure and fuel tank. Also qualified by successful seismic shake table testing at the U.S. Army Research and Development Center under the review of the Certified Seismic Qualification Agency, The VMC Group. Testing was conducted in accordance with ICC-ES AC-156 to envelope the required response spectrum (RRS) of maximum horizontal flexible acceleration (A_{FLEX}) of 2.10 g and a rigid acceleration (A_{RIG}) of 0.84 g. This test level corresponds to an $S_{DS} = 2.10$ g with a $z/h = 0.0$. Functionality was verified before and after the shake tes.

Basis of Design for Supports and Attachments to the Building:

For calculations and analysis of the equipment attachment to the building structure, the equivalent static force method was employed using the Seismic Design Acceleration, F_p/W_p ,⁵ for Load Resistance Factored Design (LRFD) methods. This includes but is not limited to the unit anchoring requirements and external isolation calculations.

Seismic Design Acceleration Equation, **C27** $F_p/W_p = 0.4 \times (S_{DS}=2.20) \times (I_p=1.5) \times (a_p/R_p=1.25) \times (1+2(z/h=0.0)) = 1.65$ g

Seismic Design Acceleration Equation, **C32** $F_p/W_p = 0.4 \times (S_{DS}=2.10) \times (I_p=1.5) \times (a_p/R_p=1.25) \times (1+2(z/h=0.0)) = 1.58$ g

a_p/R_p is representative of the worst-case shake tested condition, as determined from Table 13.6-1 in ASCE7-10 Chapter 13.



THE VMC GROUP
The Power of Together™



CERTIFICATE OF COMPLIANCE

SEISMIC DESIGN OF NONSTRUCTURAL COMPONENTS AND SYSTEMS

Certified Product Table:

Genset Type	Standby Rating	Prime Rating	Continuous Rating	Voltage Rating	Model Designation	Emissions Rating	Generator Set	Enclosure Option	Fuel Tank Option
Diesel 60 Hz	650 ekW	591 ekW	---	208 – 4160	C27	ESE (1) And LoBSFC	Approved (2)	Approved (3)	Approved (4) 1000 – 3600 Gallon Capacity
	700 ekW	635 ekW	---						
	700 ekW	---	---						
	750 ekW	680 ekW	---						
	800 ekW	725 ekW	---		C27	Tier 4i			
	800 ekW	---	---						
	800 ekW	725 ekW	---						
	900 ekW	---	---						
1000 ekW	---	---	C32	ESSE (1) And LoBSFC					
1000 ekW	910 ekW	830 ekW		LoBSFC And Emissions					
Diesel 50 Hz	1100 kVA	1000 kVA	910kVA						

- (1) EPA Stationary Emergency (ESE) Tier 2 Emissions
- (2) Open and Enclosed Generator Sets permitted
- (3) Steel Sound Attenuated and Steel Weather Protective Features Permitted
- (4) UL142 rated Double Wall Tanks permitted

This certification **includes** the open generator set and the enclosed generator set when installed with or without the sub-base tank. This certification also includes the sub-base tank as a stand-alone accessory. The generator set and included options must be a catalogue design and factory supplied. The generator set and applicable options shall be installed and attached to the building structure per the manufacturer supplied seismic installation instructions. This certification **excludes** all non-factory supplied accessories, including but not limited to mufflers, isolation/restraint devices, remote control panels, remote radiators, pumps and other electrical/mechanical components.



Issue Date: November 16, 2012
Revision Date: August 27, 2013
Expiration Date: November 30, 2015



THE VMC GROUP
The Power of Together™

CATERPILLAR®

CERTIFICATE OF COMPLIANCE

SEISMIC DESIGN OF NONSTRUCTURAL COMPONENTS AND SYSTEMS

Notes and Comments:

1. All equipment listed herein successfully passed the seismic acceptance criteria for shake testing non-structural components and systems as set forth in the ICC AC-156. The Test Response Spectrum (TRS) enveloped the required response spectrum (RRS) for all units tested. The units cited in this certification were representative sample(s) of a contingent of models and all remained captive and structurally sound after the seismic shake simulation. The units also remained functionally operational after the simulation testing as functional testing was completed by the equipment manufacturer before and after the seismic simulations. Although a seismic qualified unit inherently contains some wind resisting capacity, that capacity is undetermined and is excluded from this certification. Snow/Ice loads have been neglected and thus limit the unit to be installed both indoors (covered by an independent protective structure) and out of doors (exposed to accumulating snow/ice) for ground snow loads no greater than 30 psf for all applications.
2. The following building codes are addressed under this certification:
 - IBC 2012 – referencing ASCE7-10 and ICC AC-156
 - IBC 2009 – referencing ASCE7-05 and ICC AC-156
 - IBC 2006 – referencing ASCE7-05 and ICC AC-156
 - IBC 2003 – referencing ASCE7-02 and ICC AC-156
 - IBC 2000 – referencing ASCE7-98 and ICC AC-156
3. Refer to the manufacturer supplied installation drawings for anchor requirements and mounting considerations for seismic applications. Required anchor locations, size, style, and load capacities (tension and shear) are specified on the installation drawings. Mounting requirement details such as anchor brand, type, embedment depth, edge spacing, anchor-to-anchor spacing, concrete strength, special inspection, wall design, and attachment to non-building structures must be outlined and approved by the Engineer of Record for the project or building. Structural walls, structural floors, and housekeeping pads must also be seismically designed and approved by the project or building Structural Engineer of Record to withstand the seismic anchor loads as defined on the installation drawings. The installing contractor is responsible for observing the installation detailed in the seismic installation drawings and the proper installation of all anchors and mounting hardware.
4. For this certificate and certification to remain valid, this certificate must correspond to the "Seismic Certification Label" found affixed to the unit by the factory. The label ensures the manufacturer built the unit in conformance to the IBC seismic design criteria set forth by the Certified Seismic Qualification Agency, The VMC Group, and meets the seismic design levels claimed by this certificate.
5. When the site soil properties or final equipment installation location are not known, the soil site coefficient, F_A , defaults to the Soil Site Class D coefficient. Soil Classes A, B, C, D, Seismic Risk Category I, II, III, IV, and Seismic Design Categories A, B, C, D, E, and F are all covered under this certification, limited by the S_{DS} values on page 1, respective to the applicable building code, Importance factor, and z/h ratio.
6. Mechanical, Electrical, and Plumbing connections to the equipment must be flexibly attached as to not transfer load through the connection. The structural integrity of any conduit, cable trays, piping, ductwork and/or flexible connections is the responsibility of others. This certification does not guarantee the equipment will remain compliant to UL or NEMA standards after a seismic event.

John P. Giuliano, PE
President, The VMC Group

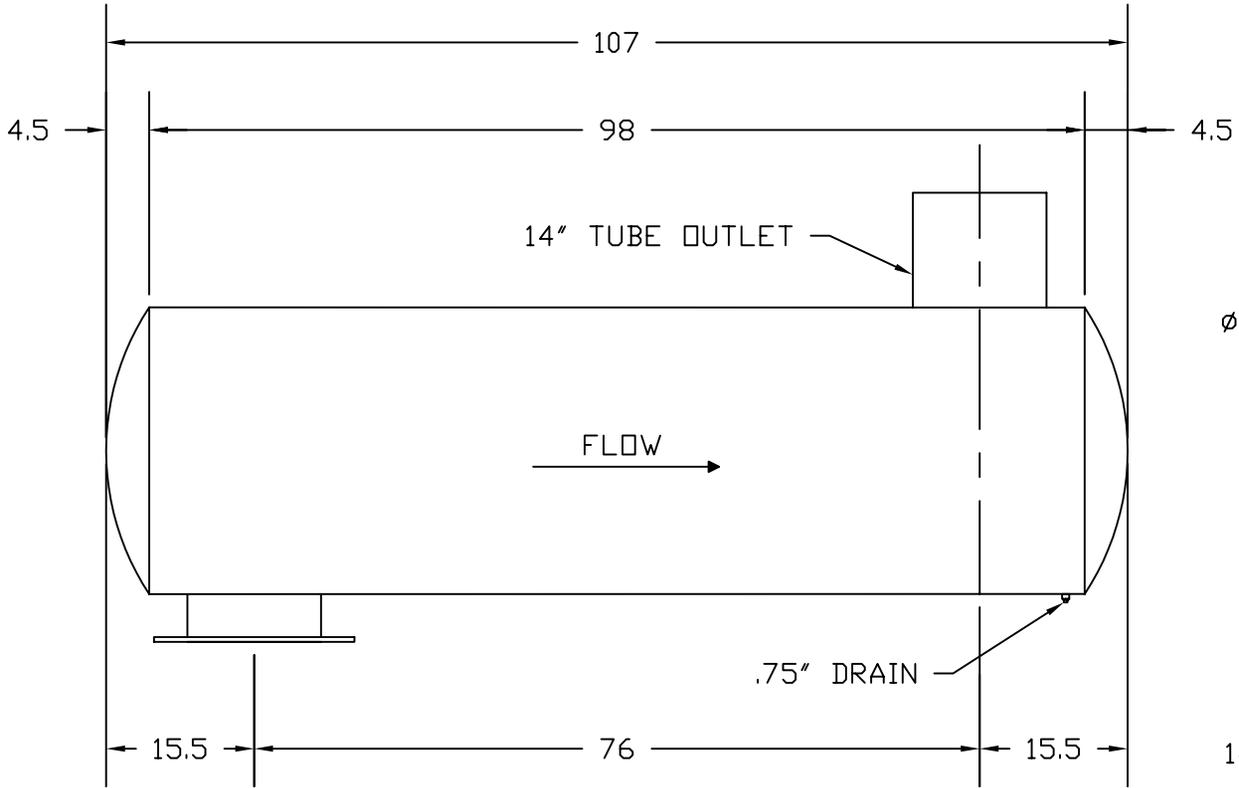
Issue Date: November 16, 2012
Revision Date: August 27, 2013
Expiration Date: November 30, 2015



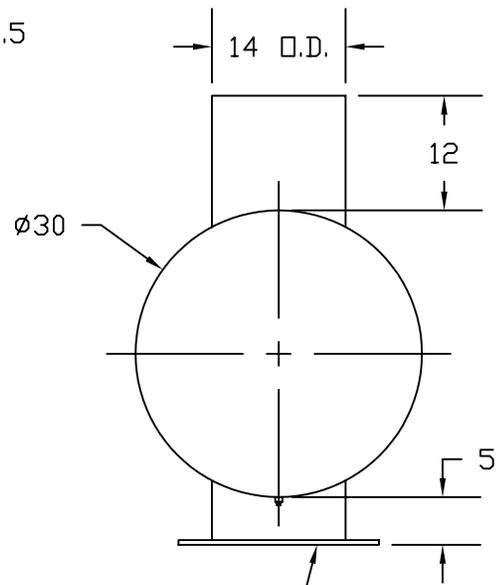
SECTION 2
CUSTOM ENCLOSURE & FUEL TANK
DATA SHEETS

REV	DATE	REVISION	BY
-----	------	----------	----

D
C
B
A



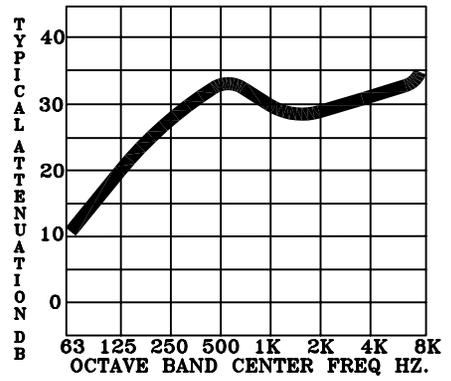
OUTLET VIEW



14" A.S.A. FLG
21" O.D.
18.75" B.C.
WITH 12-1.125Ø HOLES THRU
EQUALLY SPACED

NOTES:

1. MATERIAL: CARBON STEEL
2. PAINTED WITH HIGH TEMP. PAINT AND PRIMER



ENGINE:	CFM:	FPM:	KW:	WT: 750 Lbs	PRESSURE DROP H2O
UNLESS OTHERWISE SPECIFIED- 1) DIMENSIONS ARE IN INCHES 2) TOLERANCES ARE: .XXX± .010 ANGLES± 1/2° .XX± .030 SURFACE FINISH .X± .062		HARCO ENGINE PRODUCTS HARCO MANUFACTURING CO. 1000 INDUSTRIAL PARKWAY, NEWBERG, OR, 97132-7071, USA (503)537-0600 FAX(503)-537-0601 THIS DRAWING, IN DESIGN AND DETAIL, IS PROPERTY OF HARCO MANUFACTURING COMPANY.			
APPROVALS	DATE	TITLE CRITICAL GRADE 3098VRS 14 SI-SØ			
DRAWN MJB	07/13/07	SCALE 1:22	CAD NO. #1008A-1S	SHEET A	
CHECKED		PLOTTED	DWG. NO.		
APPROVED					

ITEM	QTY	DESCRIPTION
------	-----	-------------

CUSTOMER APPROVED DWG:

4

3

2

1

ENCLOSURE AND FUEL TANK PAINT COLOR

Engine & Compressor Accessories Approximate Color Selector

NOTE: Depending on monitor settings and printer hardware these colors may vary.



Morrison Bros. Co. Fig. 9095A

www.morbros.com

AST Overfill Prevention Valve

The 9095A AST Overfill Prevention Valve is installed at the fill port of an aboveground storage tank. Used in a tight fill application, the valve terminates flow of product when the liquid level reaches a preset warning level (90-95% full). The valve is installed on a standard N.P.T. male connection when used with the quick disconnect or female adaptor. When installed to manufacturers requirements the Overfill Prevention Valve can eliminate environmentally hazardous spills. A built-in bleed hole also provides anti-syphoning protection. ULC Listed.

The valve can be used in conjunction with the Morrison Fig. 518 and 515 lines of AST Spill Containers for added spill protection. All models are supplied with an adaptor to mount Morrison Fig. 419 aluminum drop tubes. A test mechanism is also sold separately for denoted models. The test mechanism allows a technician to pull on the test line at any time during the filling process to actuate the float and stop the fill. This allows a technician to verify the valve is working properly.

This Valve Complies With the Following Codes:

NFPA 30, 30A, UFC, BOCA, SBCCI/SFC and PEI /RP2000

Product Warnings and Cautions:

- 5 PSI & 5 GPM is the *minimum* flow requirement for valve operation at the following *maximum* viscosities (in centistokes): 2" Valve—150 3" Valve—60.
- Maximum flow rate of the 2" valve is 125 GPM at 100 PSI. The 3" valve is 300 GPM at 100 PSI.
- The valve cannot leak more than 1.5 GPM.
- A tight fill is required for the valve to operate. Do not substitute any other fill adaptors for the special adaptor supplied.
- The valve must be used with clean product. Debris from products such as contaminated waste oil may cause the valve to function improperly.
- Consult Morrison Bros. Co. for product compatibility with the valve.
- The 3" valve can be used w/6" Sch. 40 or 80 pipe.
- The 2" and 4" valves can only be used with Sch. 40 pipe.
- These valves are rated for a maximum pressure of 100 PSI.
- Not suitable for motor oil or other heavy oils.

Failure to follow any or all of the above warnings may render the valve non-functional and could result in a hazardous product spill, which may result in personal injury, property damage, fire, explosion or environmental contamination.

Specification/Detail Options:

A—Body Size: 2" N.P.T. (2"), 3" N.P.T. (3") (BSP Models Available)

B—Adaptor :

- (2S): 2" x 4" Standard 2" Male Disconnect x 4" Female
- (2X): 2" Quick Disconnect Adaptor
- (2D): 2" x 2" x 4" Female Ductile Iron Adaptor
- (3S4): 3" x 4" Standard 3" Male Disconnect x 4" Female
- (3F): 3" x 4" Standard 3" Female x 4" Female With Line Purge
- (3S): 3" x 6" Standard 3" Male Disconnect x 6" Female
- (3X): 3" Quick Disconnect Adaptor
- (3D): 3" x 3" x 6" Female Ductile Iron Adaptor

C—Gasoline Shutoff Height From Top of Valve (Inches)

D—Diesel Shutoff Height From Top of Valve (Inches)

E—Test Mechanism: Yes (Y) or No (N)

HT.—Height: Dimension from base to top of valve (Inches)

WT.—Shipping Weight (lbs.)

Body: Anodized Aluminum

Internal Components: Brass/Stainless Steel

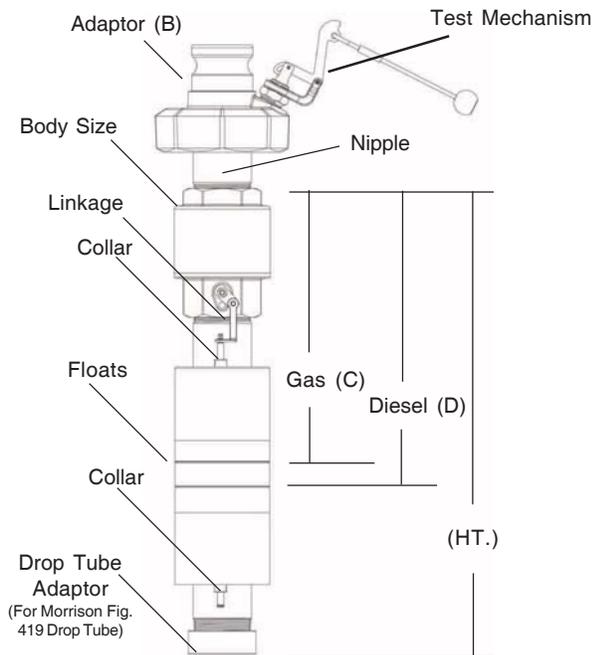
Linkage: Stainless Steel



SHOWN WITH
STANDARD
ADAPTOR
9095A-0200 AV or
9095A-0300 AV

SHOWN WITH
FEMALE
ADAPTOR
9095A-3200 AV or
9095A-3300 AV

SHOWN WITH TEST
MECHANISM
9095ATM0100 AM



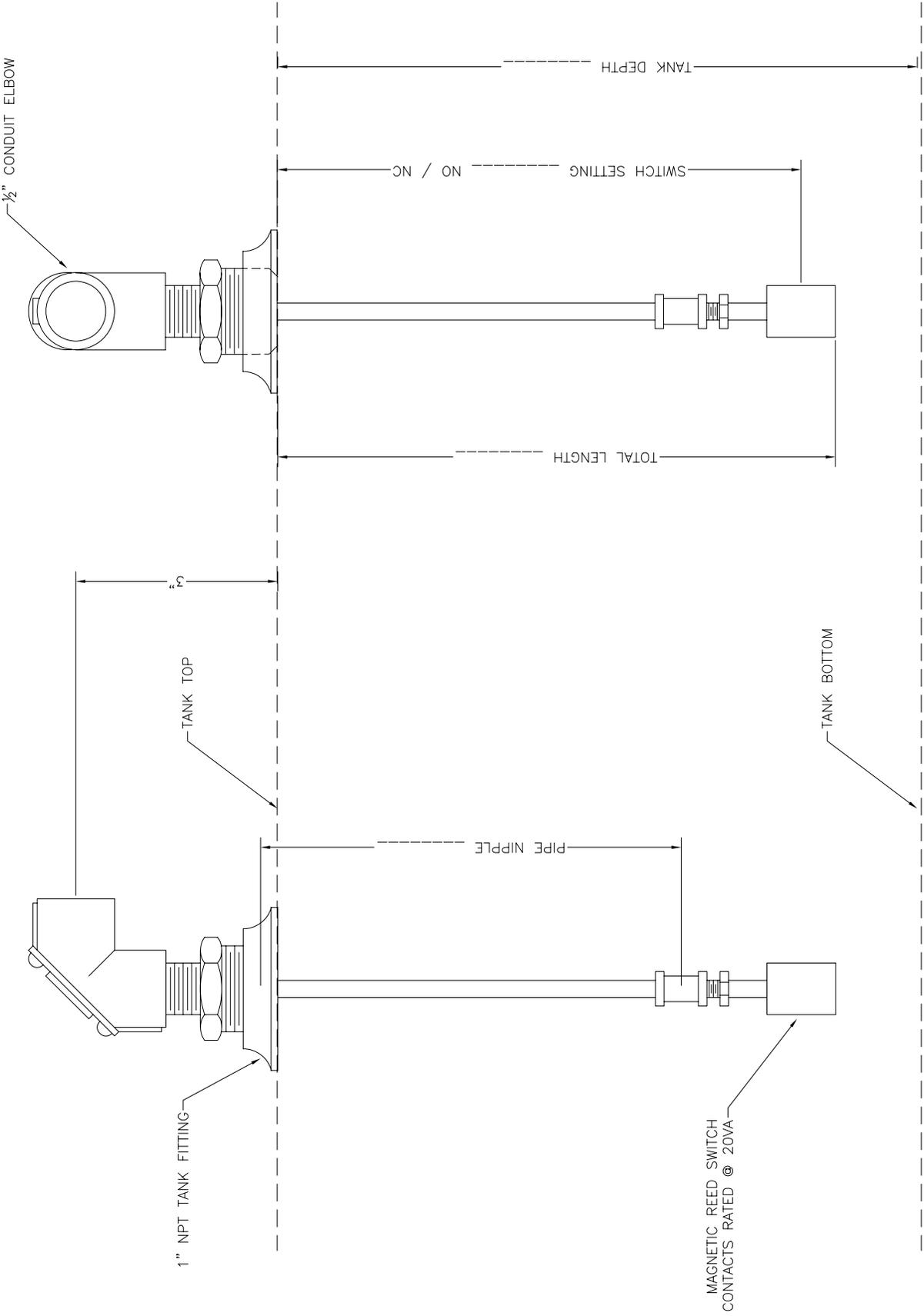
Specification Options:

I.D. NUMBER	A	B	C	D	E	HT.	WT.
9095A-0200 AV	2"	2S	11	12	Y	19.25	14.1
9095A-3200 AV	2"	2D	11	12	Y	19.25	14.1
9095A-0500 AV	2"	2X	11	12	N	19.25	12.6
9095A-0300 AV	3"	3S	13.56	13.75	Y	19.56	29
9095A-0600 AV	3"	3X	13.56	13.75	N	19.56	26
9095A-3300 AV	3"	3D	13.56	13.75	Y	19.56	38
9095A-4000 AV	2"	3S4	11.67	12.67	N	19.9	
9095A-4200 AV	2"	3F	11.67	12.67	N	19.9	

9095ATM0100 AM Mechanical Test Mechanism Assembly
(Existing Valve May Require New Top for Retrofit)

P.O. Box 238 • Dubuque, Iowa 52004-0238
563.583.5701 (tel) • 800.553.4840 • 563.583.5028 (fax)
www.morbros.com

1/2" CONDUIT ELBOW



1" NPT TANK FITTING

TANK TOP

3"

PIPE NIPPLE

TANK BOTTOM

TOTAL LENGTH

SWITCH SETTING NO / NC

TANK DEPTH

MAGNETIC REED SWITCH CONTACTS RATED @ 20VA

E & C A		APPROVED BY	DRAWN BY
			TMP
SCALE	NONE	DATE	2-2-98
		REVISED	1
LEVEL SWITCH		DRAWING NUMBER	
GENERATOR BASE TANKS		03591	

Selection and application guide



Siemens PL and ES Series Load Centers™

www.usa.siemens.com/loadcenters

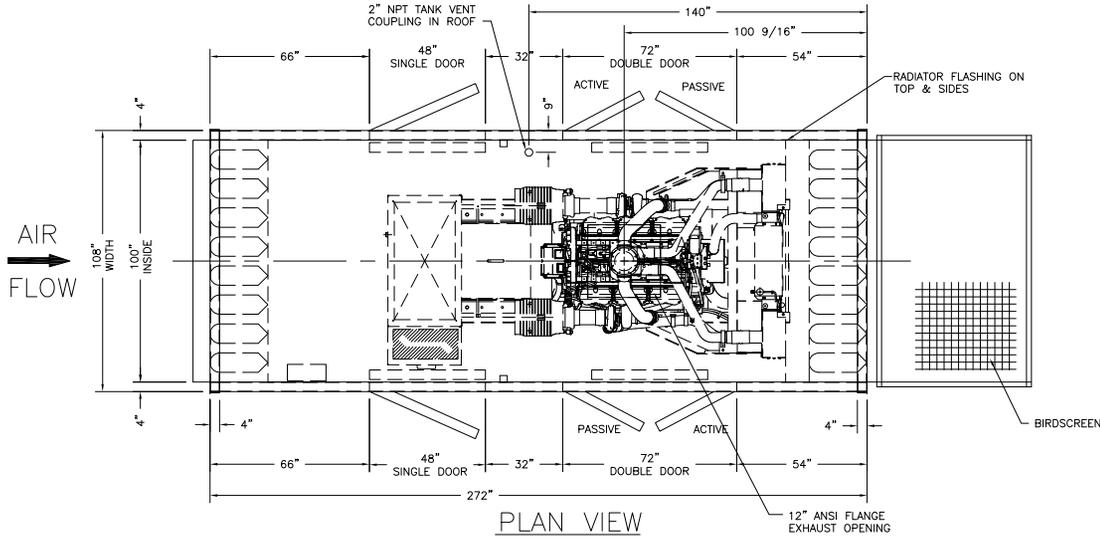
SIEMENS

SECTION 3
GENERATOR DRAWINGS

GENERATOR DRAWINGS

C32 ACOUSTICAL ENCLOSURE.....	DWG# 09421 S1
C32 ACOUSTICAL ENCLOSURE.....	DWG# 09421-1 S2
AC DISTRIBUTION PANEL.....	DWG# 09421-2 S3
FUEL TANK.....	DWG# 09241-3 S4
WYE CONNECTOR – EXHAUST FLANGE.....	DWG# 1027148814
REMOTE FUEL FILL PANEL SCHEMATIC.....	DWG# 03943S
REMOTE FUEL FILL PANEL.....	DWG# 03521
GENERATOR INTERCONNECT DC.....	DWG# CE12764-E1
GENERATOR INTERCONNECT DC.....	DWG# CE12764-E2
GENERATOR INTERCONNECT AC.....	DWG# CE12764-E3

E & C A "CUSTOM FIT"



- NOTES:**
- ENCLOSURE ASSEMBLY:**
- * FOR A CAT C32-1000 KW GEN-SET.
 - * FULLY ASSEMBLED DROP OVER ENCLOSURE TO BE ANCHORED TO BASE TANK.
 - * PANEL JOINTS ARE SKIP WELDED AND CAULKED.
- ENCLOSURE CONSTRUCTION:**
- * WALLS AND ROOF - 14 GAUGE GALVANNEALED STEEL.
 - * FRAME CONSTRUCTION - A36 STRUCTURAL CHANNEL & A-500 TUBING.
 - * INNER LINER - PERFORATED GALVANIZED STEEL.
 - * INSULATION - MINERAL WOOL AND POLY LINER.
 - * DOORS - TWO (2) DOUBLE, TWO (2) SINGLE ACCESS SERVICE DOOR WITH STAINLESS STEEL HINGES AND DOOR LATCHES.
 - * BAFFLES - 24" DEEP INLET & 24" DEEP DISCHARGE PANELS. GALVANNEALED CONSTRUCTION.
 - * LOUVERS - FIXED INLET W/BIRDSCREEN. GALVANNEALED CONSTRUCTION.
 - * BOLTING HARDWARE - STAINLESS STEEL.

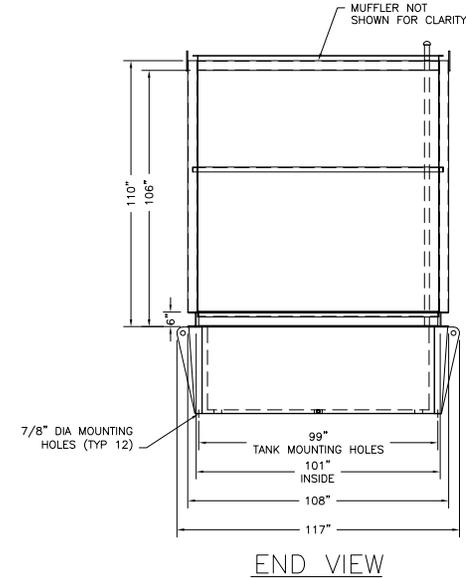
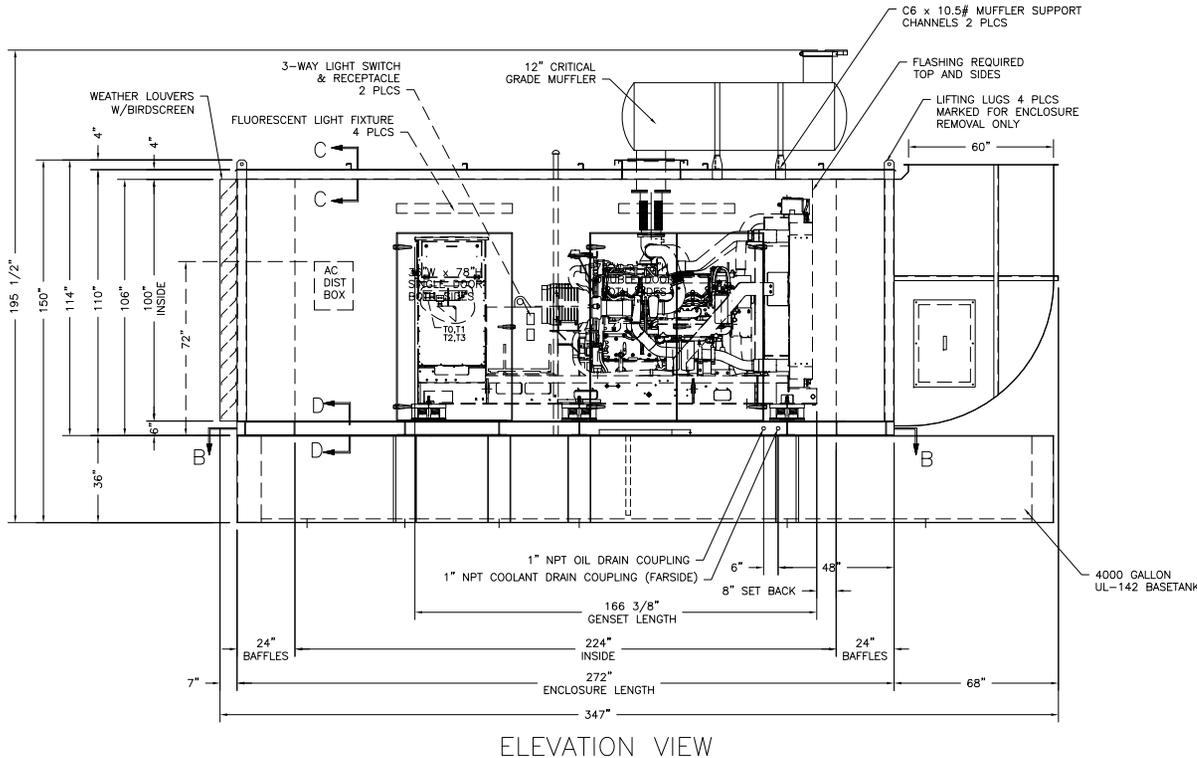
- DESIGN SPECIFICATIONS:**
- * DESIGNED TO REDUCE THE AIRBORNE GEN-SET EQUIPMENT NOISE LEVELS TO 85 dB(A) WHEN MEASURED AT A DISTANCE OF 23 FEET FROM THE ENCLOSURE AND 5 1/2 FEET ABOVE GRADE IN A TREE FIELD ENVIRONMENT.
 - * THE GEN-SET EQUIPMENT NOISE DOESN'T EXCEED 120 dB.
 - * BASED ON A TOTAL AIR REQUIREMENT OF 42,762 CFM AT LESS THAN 1/2" W.G. BACK PRESSURE THROUGH THE ENCLOSURE.
 - * ENGINE EXHAUST IS NOT INCLUDED.

- PAINTING:**
- * ALL EXTERIOR GALVANNEALED SURFACES TO BE SOLVENT CLEANED PER SSPC-SP1 AND PAINTED AS FOLLOWS:
 - INTERMEDIATE - ONE COAT AMERICAN COATINGS POLYURETHANE (1-1.5 MILS DFT)
 - FINISH - ONE COAT AMERICAN COATINGS POLYURETHANE (.5-1 MILS DFT)
 - * ALL CARBON STEEL SURFACES TO BE POWER TOOL CLEANED PER SSPC-SP3 AND PAINTED AS FOLLOWS:
 - PRIMER - ONE COAT PRIMER (3-5 MILS DFT)
 - INTERMEDIATE - ONE COAT AMERICAN COATINGS POLYURETHANE (1-1.5 MILS DFT)
 - FINISH - ONE COAT AMERICAN COATINGS POLYURETHANE (.5-1 MILS DFT)
 - COLOR - PRECISION TAN.

- ELECTRICAL:**
- * SEE DRAWING 09421-2

- ENCLOSURE SHIPPING SIZE & WEIGHT:**
- * SIZE - 347" L x 114" W x 114" H
 - * WEIGHT - 10,500 LBS.

- PACKAGE SHIPPING SIZE & WEIGHT:**
- * SIZE - 347" L x 117" W x 150" H
 - * WEIGHT - 38,800 LBS.



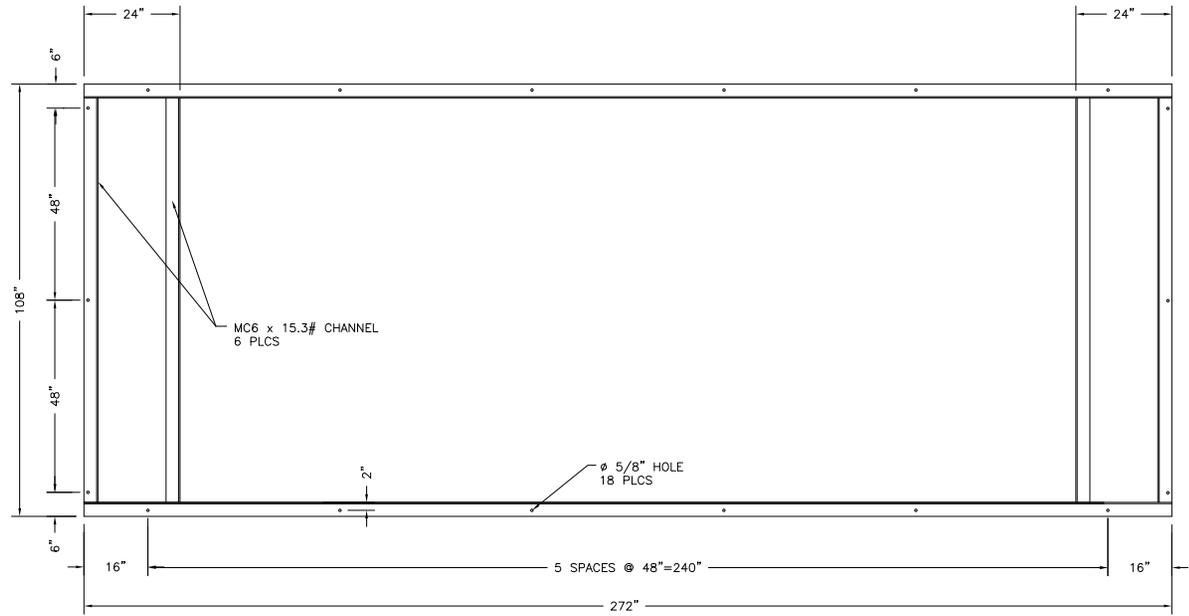
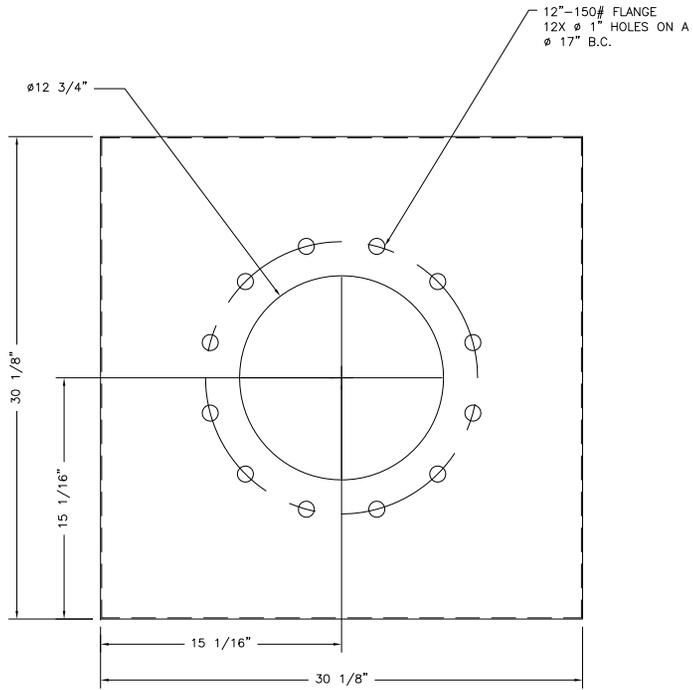
ACOUSTICAL ENCLOSURE

CAT C32-1000 KW

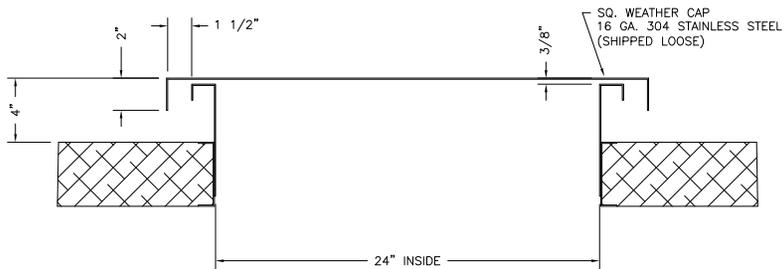
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	DATE 5/20/15		REVISION 3

SHEET	PROJECT NAME
1 OF 4	

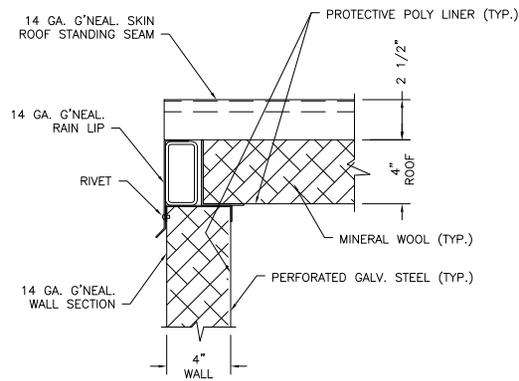
E & C A "CUSTOM FIT"



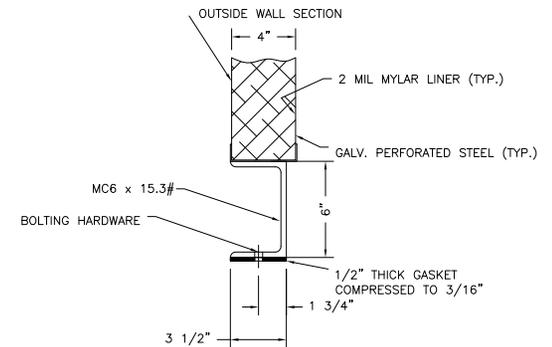
SECTION B-B



SECTION A-A



SECTION C-C



SECTION D-D

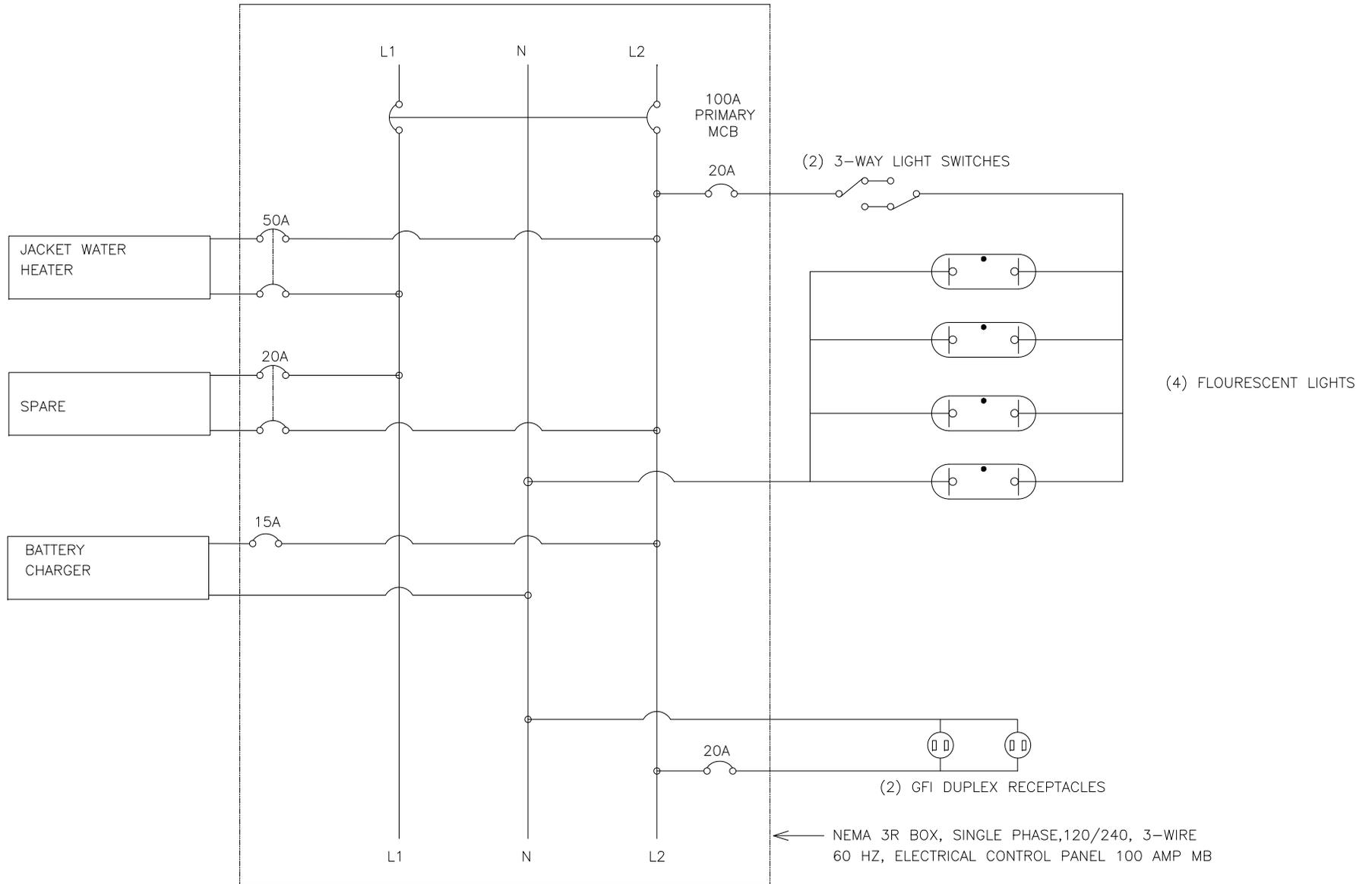
ACOUSTICAL ENCLOSURE

CAT C32-1000 KW

DRAWING NUMBER	SCALE NONE	APPROVED BY	DRAWN BY
DATE 6-29-15			REVISION 0

SHEET	PROJECT NAME
2 of 4	

E & C A "CUSTOM FIT"



WIRING DIAGRAM

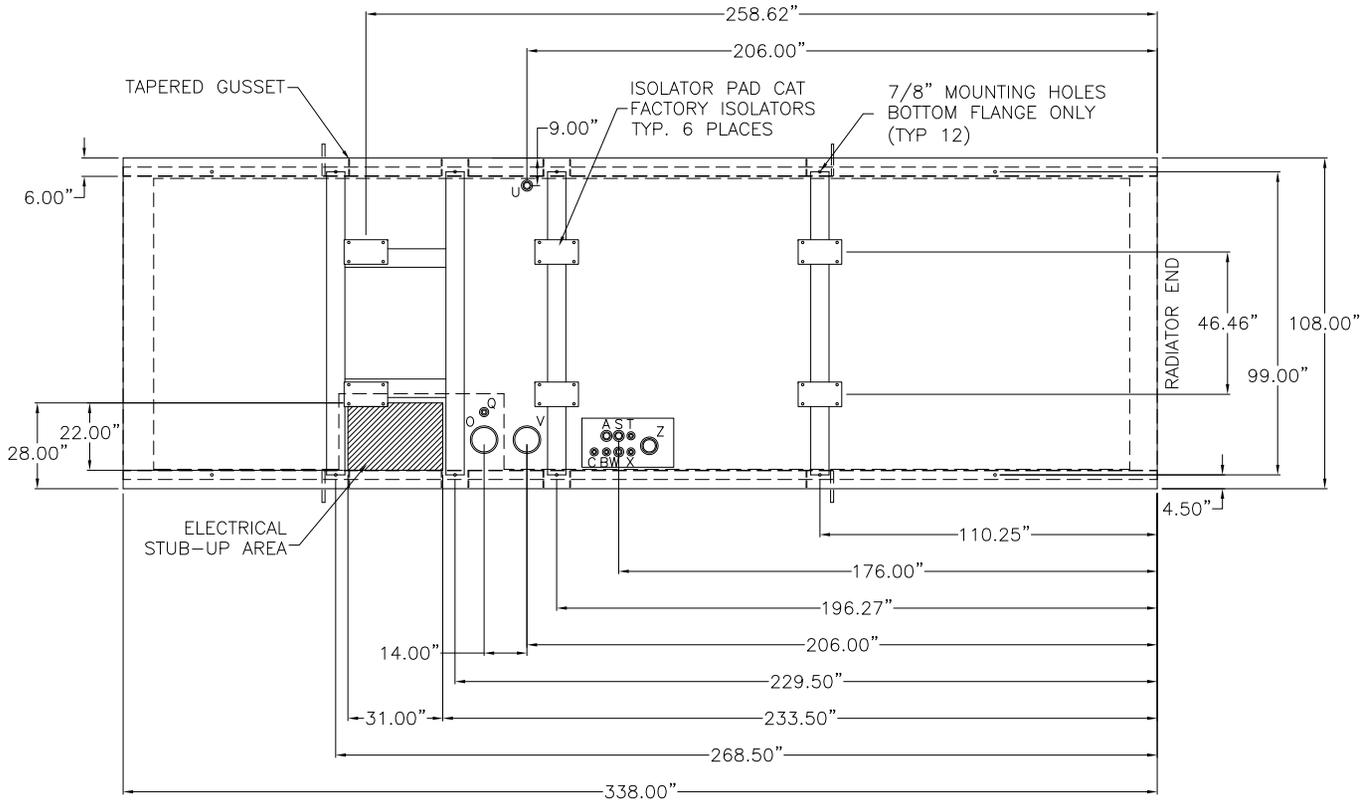
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DATE 06-29-15			REVISION 0

CAT 32-1000 KW

SHEET
3 OF 4

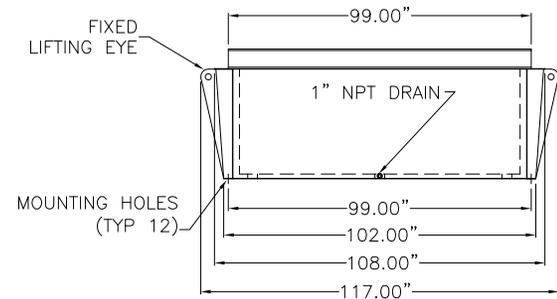
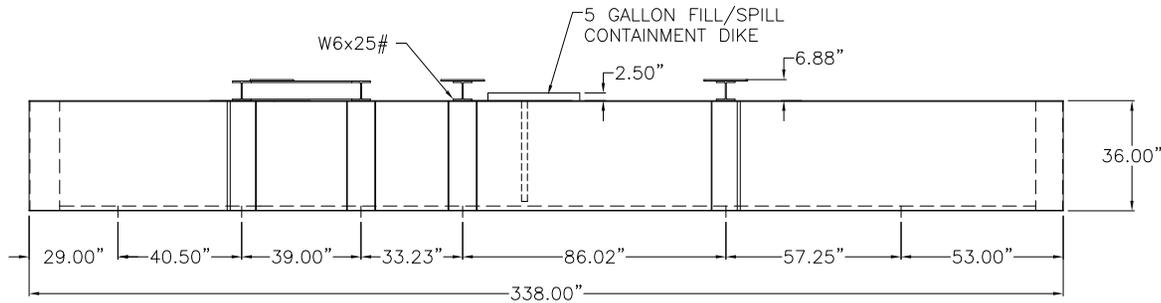
PROJECT NAME

E & C A "CUSTOM FIT"



REFERENCES	DESCRIPTION
O	8" NPT OUTER TANK EMERGENCY VENT CONNECTION
Q	1 1/4" OPTIONAL LEAK DETECTOR LOCATION
S	2"x1/2" NPT REMOVABLE FUEL SUPPLY DIP TUBE
T	1" NPT FUEL RETURN
U	2" NPT NORMAL VENT CONNECTION
V	8" NPT INNER TANK EMERGENCY VENT CONNECTION
W	1 1/2" LEVEL GAUGE
X	1" NPT OPTIONAL LOW LEVEL ALARM
Z	4" NPT FILL CONNECTION W/ OPFV SET AT 90%
A	2" NPT SPARE
B	1" NPT HIGH LEVEL ALARM SET AT 90%
C	1" NPT HIGH HIGH LEVEL ALARM SET AT 95%

- OPTIONS:
- 530B LEAK DETECTOR FLOAT SWITCH
 - 540B LOW LEVEL FLOAT SWITCH
 - DESIGNED PER UL-142
 - LABEL PER UL-142
 - INNER TANK EMERGENCY VENT
 - OUTER TANK EMERGENCY VENT
- PAINT: PRECISION TAN
- GEN SET MODEL NO. CAT C32-1000 KW
 GEN SET WEIGHT 19,300 LBS
 TANK CAPACITY 4000 GALLONS
 TANK WEIGHT 10,000 LBS.
- MODEL NUMBER SCGBT4000
 PROPOSAL NUMBER _____
 CUSTOMER NAME _____
 P.O. # _____

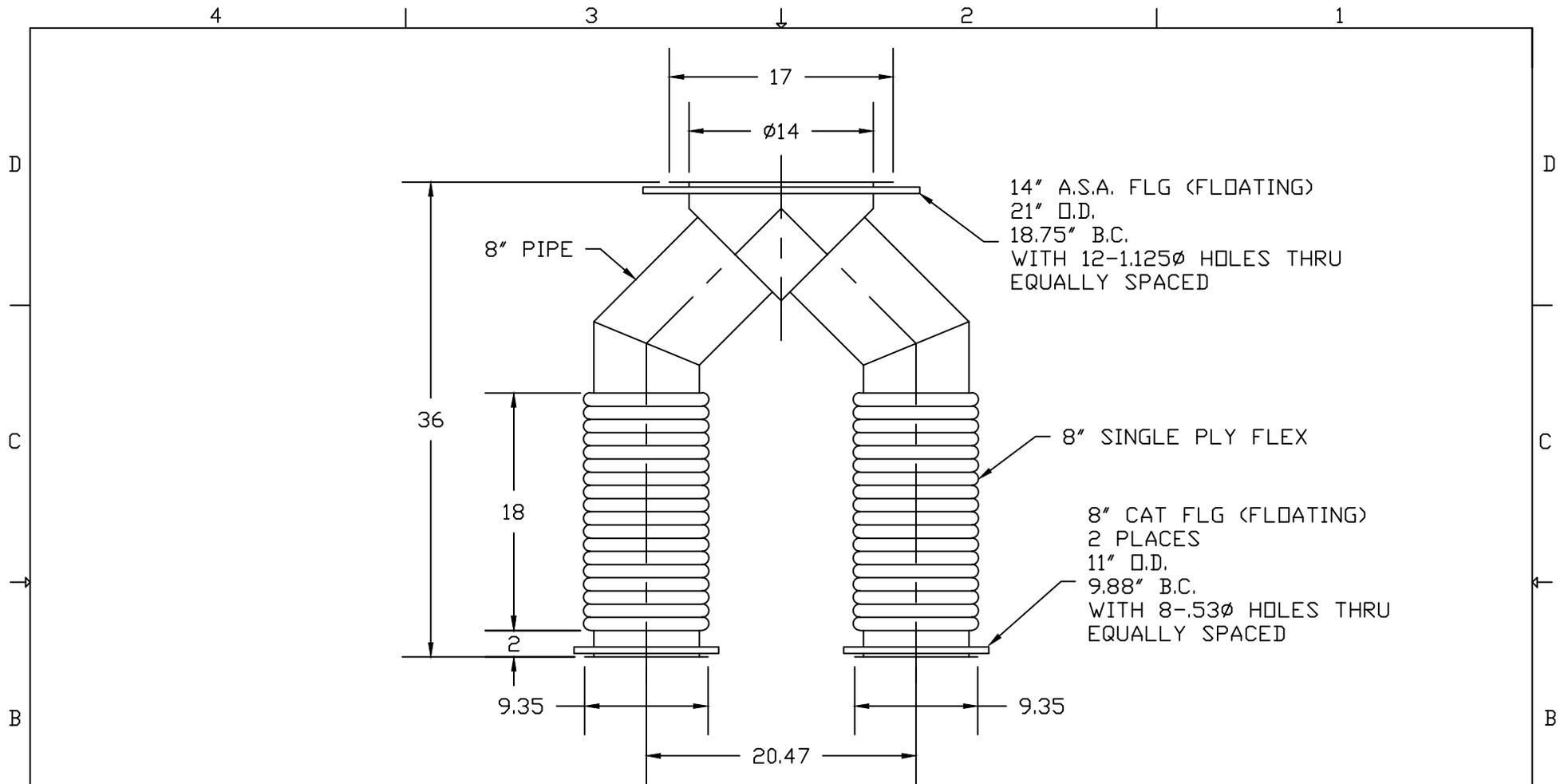


This drawing contains information that is proprietary to E&CA. This information is to be held in confidence. No disclosure or other use of this drawing is to be made without prior written consent of E&CA.

2

SECONDARY CONTAINMENT (DOUBLE WALL) GENERATOR BASE TANK

DRAWING NUMBER	SCALE NONE	APPROVED BY	DRAWN BY MEP	PROJECT DESCRIPTION	SHEET	PROJECT NAME
	DATE 06/30/15		REVISION 0	CAT C32 1000KW	4 OF 4	



14" A.S.A. FLG (FLOATING)
21" O.D.
18.75" B.C.
WITH 12-1.125 ϕ HOLES THRU
EQUALLY SPACED

8" SINGLE PLY FLEX

8" CAT FLG (FLOATING)
2 PLACES
11" O.D.
9.88" B.C.
WITH 8-.53 ϕ HOLES THRU
EQUALLY SPACED

NOTES:

1. MATERIAL: FLEX IS 321 STAINLESS STEEL,
FLANGES AND PIPE ARE CARBON STEEL

2. PAINTED WITH HIGH TEMP BLACK PAINT

ENGINE:	CFM:	FPM:	KW:	WT:	PRESSURE DROP H2O
---------	------	------	-----	-----	----------------------

UNLESS OTHERWISE SPECIFIED-
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX \pm .010 ANGLES \pm 1/2°
.XX \pm .030 SURFACE FINISH
.X \pm .062 MAX.
FRACTIONS \pm MAX.

HARCO ENGINE PRODUCTS
HARCO MANUFACTURING CO.
1000 INDUSTRIAL PARKWAY,
NEWBERG, OR, 97132-7071, USA
(503)537-0600 FAX(503)-537-0601
THIS DRAWING, IN DESIGN AND DETAIL, IS
PROPERTY OF HARCO MANUFACTURING
COMPANY.

APPROVALS	DATE	TITLE WYE-CONNECTOR 8x8x14		
DRAWN	06/08/06	SCALE 1:12	CAD NO.	4 SHEET
CHECKED		PLOTTED	DWG. NO.	A
APPROVED				

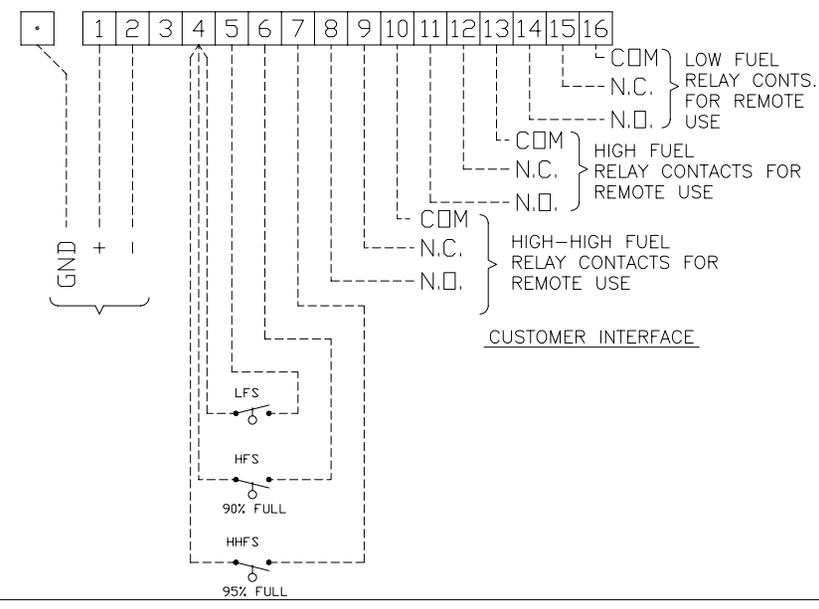
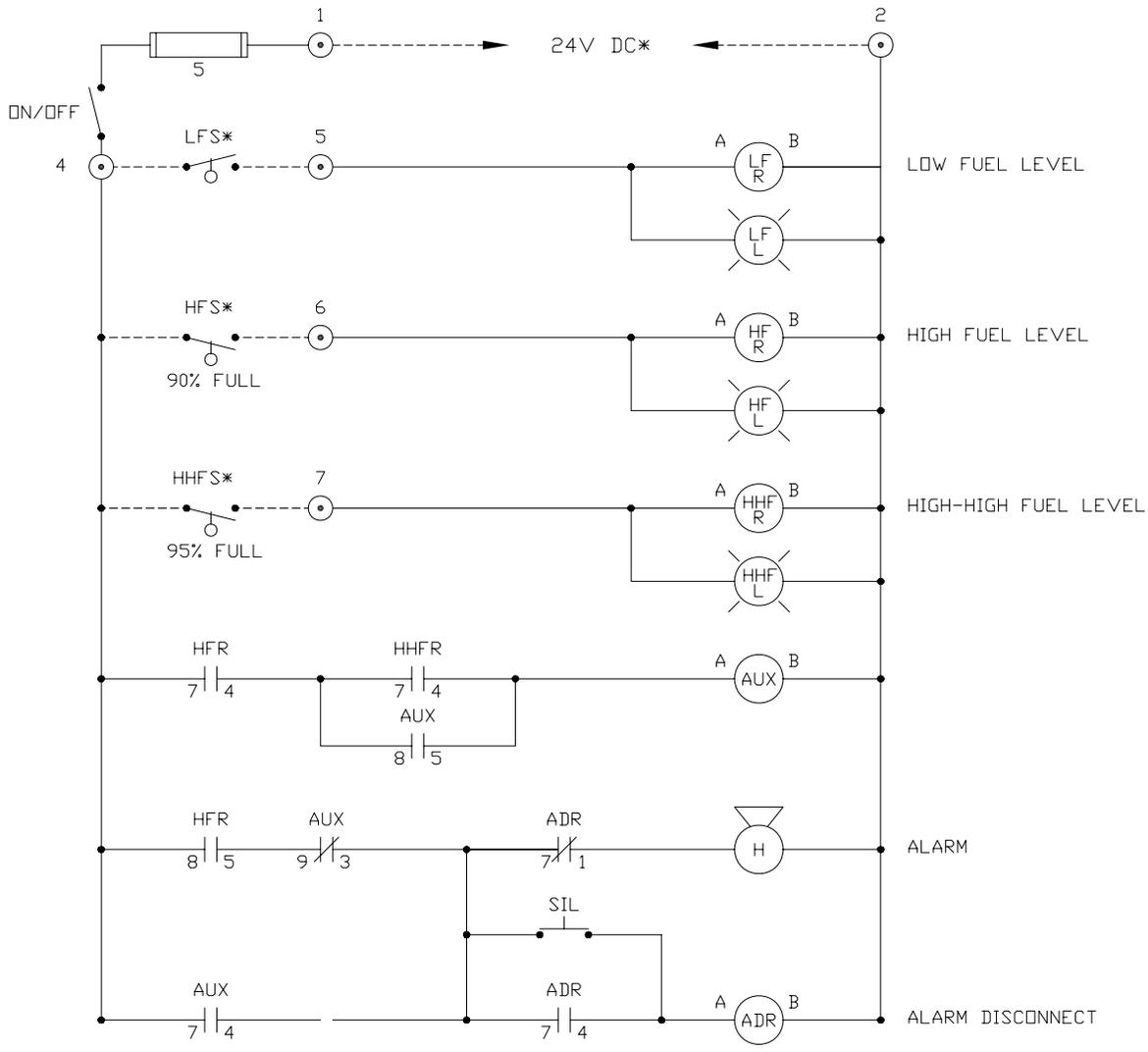
ITEM	QTY	DESCRIPTION	CUSTOMER APPROVED DWG:
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4

3

2

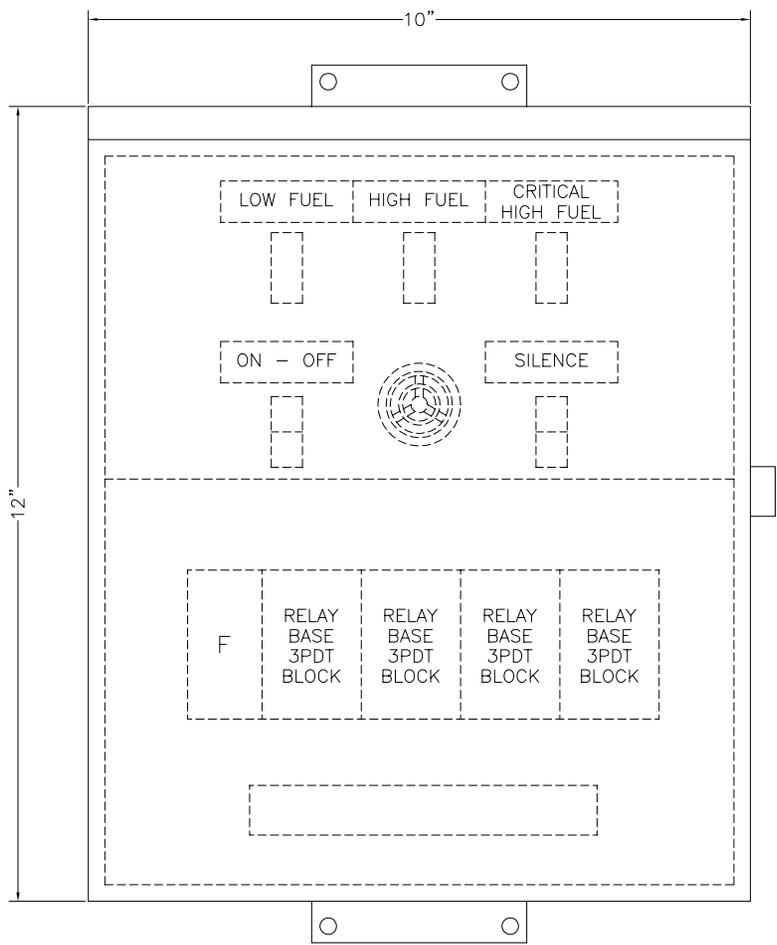
1



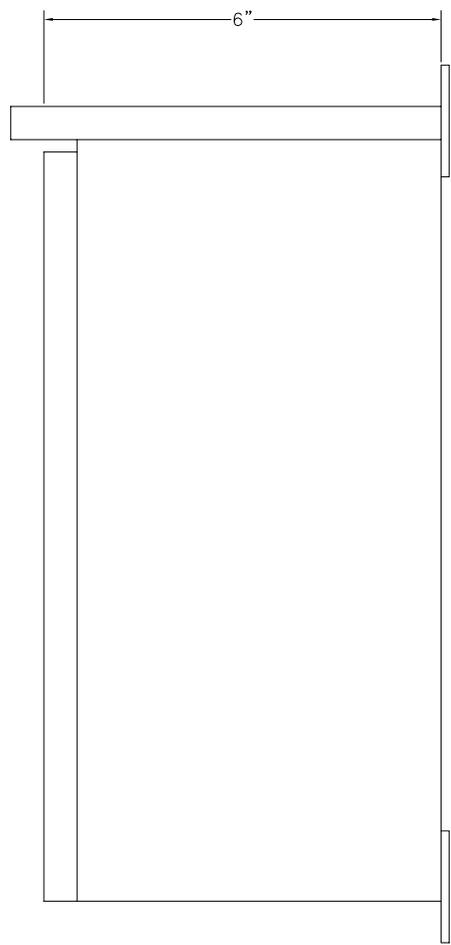
- NOTES:
- WIRING BY FACTORY
 - - - - - FIELD WIRING
 - * NOT BY FACTORY
 - ⊙ CONTROL PANEL TERMINAL POINT

E & C A			
SCALE NONE	APPROVED BY	DRAWN BY TMP	
DATE 7-9-97		REVISED	
WIRING SCHEMATIC			24V DC
REMOTE FUEL FILL PANEL			DRAWING NUMBER 03943S

1	8-07	ADDED LOW RELAY/HIGH CONTACTS	WFP
REV	DATE	DESCRIPTION	BY



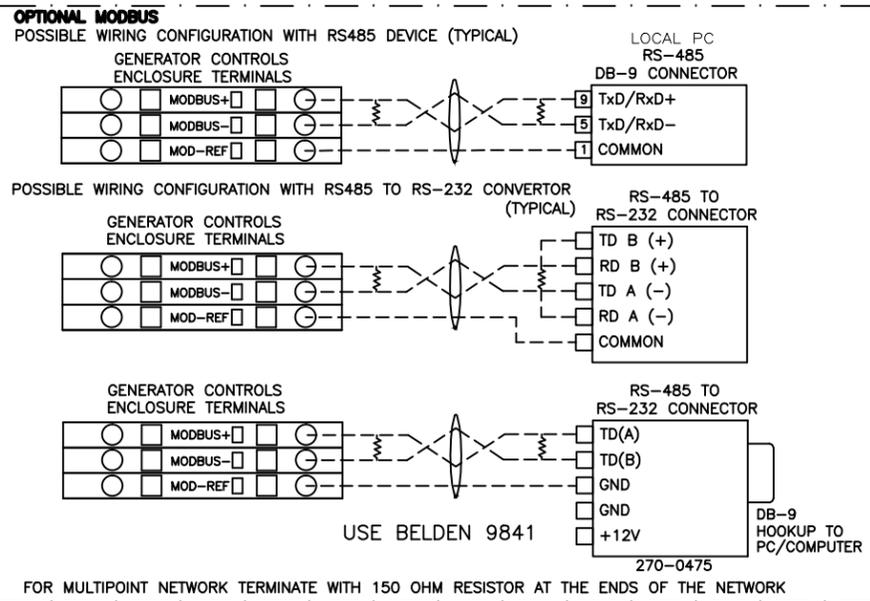
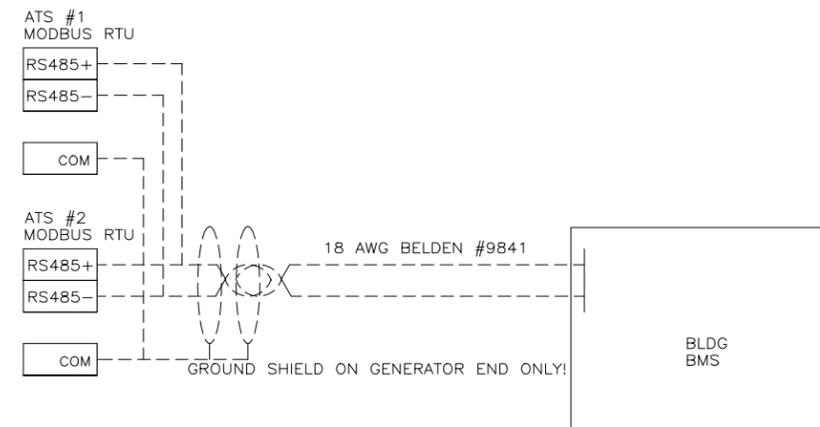
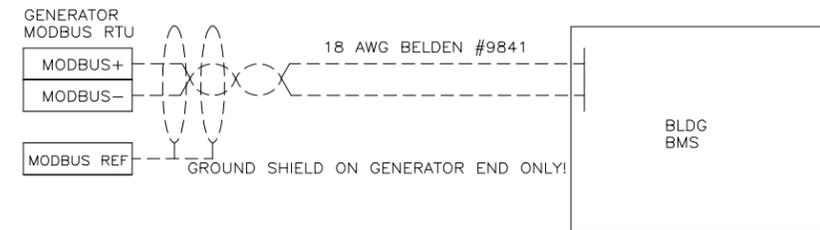
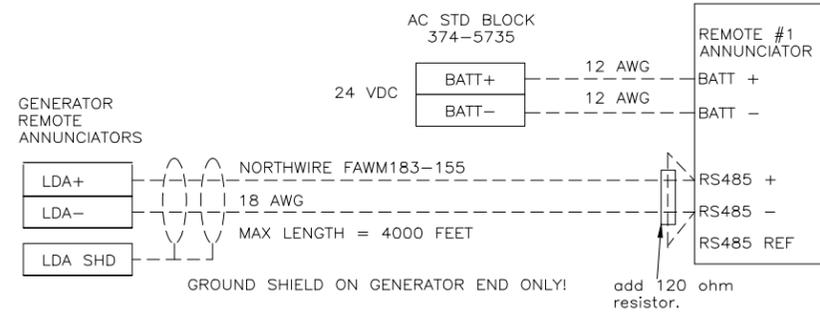
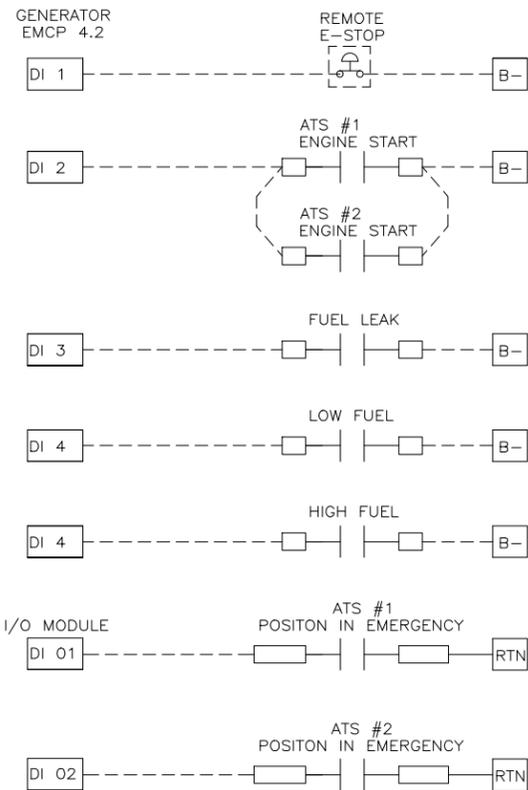
FRONT



RIGHT SIDE

E & C A	
SCALE NONE	APPROVED BY
DATE 7-9-97	DATE
REMOTE FUEL FILL PANEL	
OPTION #326-02609	DRAWING NUMBER
	03521

2	8/07	CHANGED LIGHTS	JMR
1	10-98	CHANGED TITLE DESCRIPTION	TMP
REV	DATE	DESCRIPTION	BY



- NOTES:
- A. UNLESS NOTED, USE 14 AWG STRANDED COPPER WIRES
 - B. SPARES RECOMMENDED (20%)
 - C. ALL FIELD WIRING TERMINATION BY ON SITE ELECTRICAL TECHNICIAN
 - D. DC TO BE RUN IN SEPARATE CONDUIT FROM AC
 - E. ATS'S SUPPLIED BY OTHERS.
 - F. TWO ATS'S SHOWN AS AN EXAMPLE, COULD CONNECT N+1.
 - G. ADD 120 OHM RESISTOR ON COMMUNICATION END.

----- CONTRACTOR WIRING -----

_____ CAT/QUINN WIRING _____

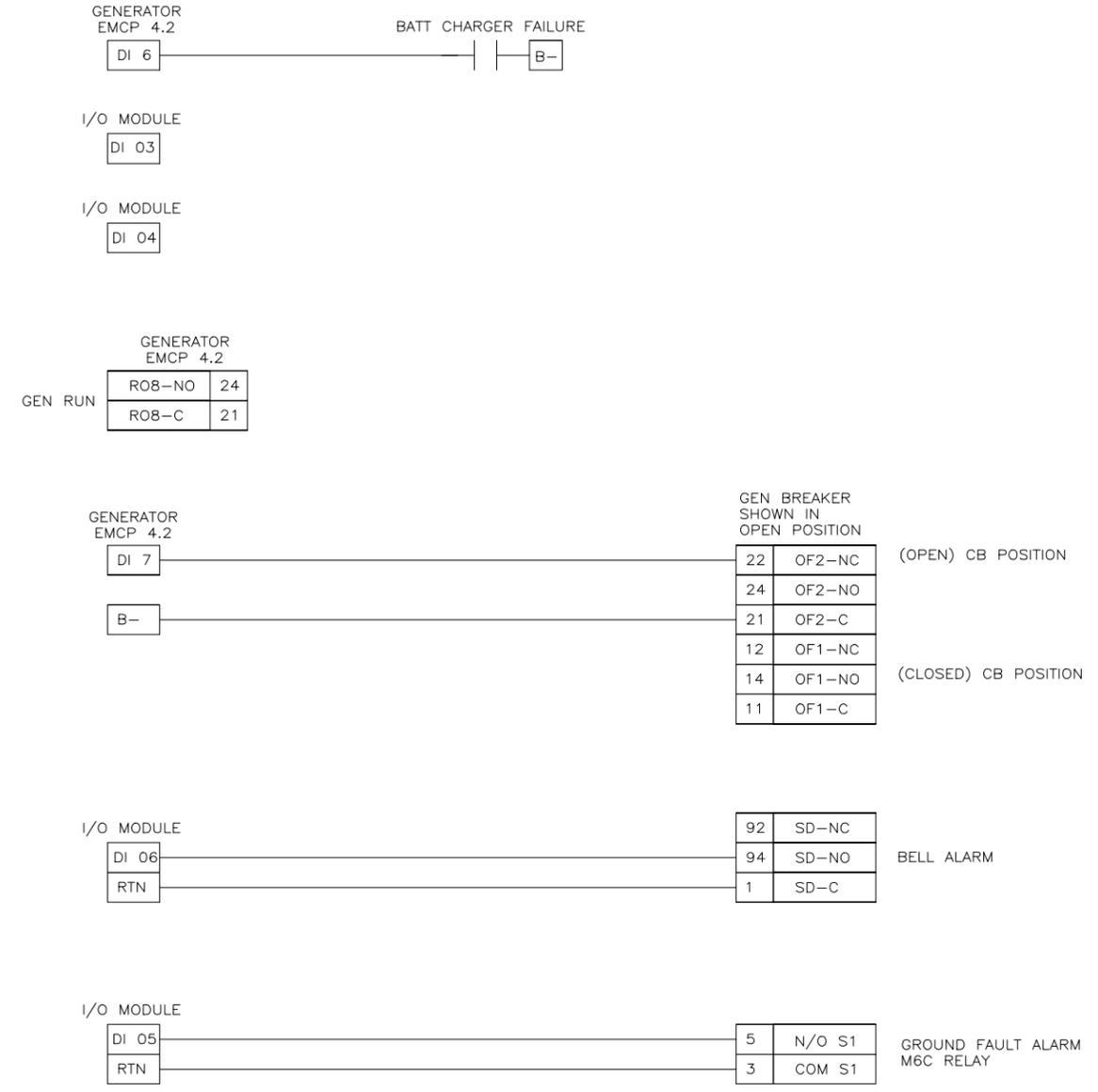
DRAWN M. Ramirez	DATE 11/18/15		3500 SHEPHERD STREET WHITTIER, CA 90601
CHECKED X.XX.	DATE X.XX.XX		
APPROVED	DATE		
TITLE		SCALE: NONE	JOB: CARRINGTON
ATS, GEN EMCP 4.2 INTERCONNECT DC			DWG NO. CE12764-E1

I/O MODULE DRY CONTACTS OUTPUTS

D01-A	GEN STATUS
D01-B	GEN RUN
D01-COM	
D02-A	
D02-B	NOT IN AUTO
D02-COM	
D03-A	
D03-B	FUEL LEAK
D03-COM	
D04-A	
D04-B	LOW FUEL
D04-COM	
D05-A	
D05-B	COMMON ALARM
D05-COM	
D06-A	
D06-B	SHUTDOWN
D06-COM	
D07-A	
D07-B	
D07-COM	
D08-A	
D08-B	
D08-COM	

REMOTE ANNUNCIATOR PROGRAMMING				
	DESCRIPTION	SPN	PROGRAM	LED
1	EMERGENCY STOP	970	SHUTDOWN	RED
2	OVERCRANK	1664	SHUTDOWN	RED
3	HIGH COOLANT TEMP	110	SHUTDOWN	RED
4	LOW COOLANT TEMP	110	ALARM	AMBER
5	LOW OIL PRESSURE	100	SHUTDOWN	RED
6	OVERSPEED	190	SHUTDOWN	RED
7	LOW COOLANT LEVEL	111	SHUTDOWN	RED
8	LOW FUEL LEVEL	96	ALARM	AMBER
9	NOT IN AUTO	4007	ALARM	AMBER
10	HIGH BATTERY VOLTAGE	168	ALARM	AMBER
11	LOW BATTERY VOLTAGE		ALARM	AMBER
12	LOW CRANKING VOLTAGE	4256	ALARM	AMBER
13	BATTERY CHARGER FAIL		ALARM	AMBER
14	EPS SUPPLYING LOAD	3829	ALARM	RED
15	ENGINE RUNNING			GREEN
16	ENGINE EMISSIONS SYSTEM FAILURE	4000	ALARM	AMBER

LOCAL ANNUNCIATOR PROGRAMMING				
	DESCRIPTION	SPN	PROGRAM	LED
1	EMERGENCY STOP	970	SHUTDOWN	RED
2	OVERCRANK	1664	SHUTDOWN	RED
3	LOW COOLANT TEMP	110	ALARM	AMBER
4	HIGH COOLANT TEMP	110	ALARM	AMBER
5	LOW OIL PRESSURE	100	SHUTDOWN	RED
6	OVERSPEED	190	SHUTDOWN	RED
7	LOW COOLANT LEVEL	111	SHUTDOWN	RED
8	LOW FUEL LEVEL	96	ALARM	AMBER
9	EPS SUPPLYING LOAD	3829	ALARM	AMBER
10	NOT IN AUTO	4007	ALARM	AMBER
11	HIGH BATTERY VOLTAGE	168	ALARM	AMBER
12	LOW BATTERY VOLTAGE		ALARM	AMBER
13	LOW CRANKING VOLTAGE	4256	ALARM	AMBER
14	BATTERY CHARGER FAIL		ALARM	AMBER
15	AIR DAMPER SHUTDOWN	4000	NOT USED	
16	SPARE		NOT USED	



EMCP 4.2 I/O CONFIGURATION

DESCRIPTION	EMCP4.2
RELAY 01 (R01)	SPARE
RELAY 02 (R02)	SPARE
RELAY 03 (R03)	SPARE
RELAY 04 (R04)	COMMON SHUTDOWN
RELAY 05 (R05)	SPARE
RELAY 06 (R06)	AUX RELAY
RELAY 07 (R07)	SPARE
RELAY 08 (R08)	SPARE
DIGITAL OUTPUT #1 (D01)	AUX RELAY
DIGITAL OUTPUT #2 (D02)	SPARE
DIGITAL INPUT #1 (D11)	E-STOP
DIGITAL INPUT #2 (D12)	REMOTE START
DIGITAL INPUT #3 (D13)	FUEL LEAK
DIGITAL INPUT #4 (D14)	LOW FUEL ALARM
DIGITAL INPUT #5 (D15)	HIGH FUEL ALARM
DIGITAL INPUT #6 (D16)	CHARGER FAIL
DIGITAL INPUT #7 (D17)	GEN BREAKER OPEN
DIGITAL INPUT #8 (D18)	SPARE
ANALOG INPUT #1 (A11)	ENGINE OIL PRESSURE
ANALOG INPUT #2 (A12)	ENGINE COOLANT TEMP
ANALOG INPUT #3 (A13)	SPARE

I/O MODULE CONFIGURATION

DESCRIPTION	
RELAY 01 (D01)	GEN RUN
RELAY 02 (D02)	NOT IN AUTO
RELAY 03 (D03)	FUEL LEAK
RELAY 04 (D04)	LOW FUEL
RELAY 05 (D05)	COMMON ALARM
RELAY 06 (R06)	SHUTDOWN
RELAY 07 (R07)	SPARE
RELAY 08 (R08)	SPARE
DIGITAL INPUT #1 (DI 01)	ATS #1 IN EMERGENCY
DIGITAL INPUT #2 (DI 02)	ATS #2 IN EMERGENCY
DIGITAL INPUT #3 (DI 03)	SPARE
DIGITAL INPUT #4 (DI 04)	SPARE
DIGITAL INPUT #5 (DI 05)	GROUND FAULT
DIGITAL INPUT #6 (DI 06)	BELL ALARM
DIGITAL INPUT #7 (DI 07)	
DIGITAL INPUT #8 (DI 08)	
DIGITAL INPUT #9 (DI 09)	
DIGITAL INPUT #10 (DI 10)	
DIGITAL INPUT #11 (DI 11)	
DIGITAL INPUT #12 (DI 12)	

- NOTES:
- UNLESS NOTED, USE 14 AWG STRANDED COPPER WIRES
 - SPARES RECOMMENDED (20%)
 - ALL FIELD WIRING TERMINATION BY ON SITE ELECTRICAL TECHNICIAN
 - DC TO BE RUN IN SEPARATE CONDUIT FROM AC

----- CONTRACTOR WIRING -----
 _____ CAT/QUINN WIRING _____

DRAWN M. Ramirez CHECKED x.xx. APPROVED DATE	DATE 11/18/15 DATE x.xx.xx DATE		3500 SHEPHERD STREET WHITTIER, CA 90601 SCALE: NONE JOB: CARRINGTON DWG NO. CE12764-E2
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