

GP100H3R48TE Global Platform Line High Efficiency Rectifier

3Φ-380/480V_{AC} Input; Default Output: 52/48V_{DC} @ 6000W – GP interface



RoHS Compliant

Applications

- 48V_{DC} distributed power architectures
- Routers/ VoIP/Soft and other Telecom Switches
- LAN/WAN/MAN applications
- File servers, Enterprise Networks, Indoor wireless
- SAN/NAS/iSCSI applications

Features

- Efficiency 96.5% typical, exceeds 80plus Titanium levels
- Compact 1RU form factor with 30 W/in³ density
- Constant power from 48 – 58V_{DC}
- 6000W from nominal 3Φ-380/480V_{AC}
- Isolated RS485 based serial bus
- Power factor correction (meets EN/IEC 61000-3-2 and EN 60555-2 requirements)
- Output overvoltage and overload protection
- AC Input overvoltage and undervoltage protection
- Over-temperature warning and protection
- Redundant, parallel operation with active load sharing
- Internally controlled Variable-speed fan
- Hot insertion/removal (hot plug)
- Three front panel LED indicators
- EN/IEC/UL/CSA C22.2 60950-1 2nd edition +A1, CCC
- CE mark§
- Meets FCC part 15, EN55022 Class A standards
- Meets EN61000 immunity and transient standards
- Shock & vibration: Meets IPC 9592 Class II standards

Description

The GP100H3R48TE series of rectifiers provide significant efficiency improvements in the Global Platform of Power supplies. High-density front-to-back airflow is designed for minimal space utilization and is highly expandable for future growth. The 3Φ - 380/480Vrms input product is designed to be deployed internationally. It is configured with an isolated RS485 compliant communications bus that allows it to be used in a broad range of applications. Feature set flexibility makes these rectifiers an excellent choice for applications requiring modular, very-high-efficiency AC to - 52V_{DC} intermediate voltages, such as in distributed power.

* UL is a registered trademark of Underwriters Laboratories, Inc.

† CSA is a registered trademark of Canadian Standards Association.

§ This product is intended for integration into end-user equipment. All CE marking procedures of end-user equipment should be followed. (The CE mark is placed on selected products.)

** ISO is a registered trademark of the International Organization of Standards



imagination at work

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3Φ-380/480V_{AC} input; Default Output: ±52/48V_{DC} @ 6000W

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only, functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect the device reliability.

Parameter	Symbol	Min	Max	Unit
Input Voltage: Continuous	V _{IN}	0	600	V _{AC}
Operating Ambient Temperature ¹	T _A	-10	75	°C
Storage Temperature	T _{stg}	-40	85	°C
I/O Isolation voltage to Frame (100% factory Hi-Pot tested)			2087	V _{AC}

Electrical Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, V_O=52V_{DC}, resistive load, and temperature conditions. To meet measurement accuracy a warm up time of 1hr may be required.

INPUT					
Parameter	Symbol	Min	Typ	Max	Unit
Operating Voltage Range (3Φ delta with safety frame ground)	V _{IN}	320	380/480	530	V _{AC}
Low voltage	Turn-OFF	(300)		320	
	Turn-ON	(315)		330	
	Hysteresis	5			
High voltage	Turn-OFF	530		(550)	
	Turn-ON	520		(540)	
	Hysteresis	5			
Input voltage phase unbalance	V _{IN}	-15		10	%
Frequency	F _{IN}	47		63	Hz
Operating Current (3Φ - all phases operational)	I _{IN}			15	A _{AC}
Input current phase unbalance [load > 50% of FL]				1	%
Inrush Transient (per Φ at 480V _{AC} , 25°C, excluding X-Capacitor charging)	I _{IN}		25	30	A _{PK}
Source Impedance (NEC allows 2.5% of source voltage drop inside a building)		0.20	0.25		Ω
Idle Power (at 480V _{AC} , 25°C)	P _{IN}		15		W
Main output OFF			25		
Main output ON @ I _O =0					
Leakage Current (per Φ, 530V _{AC} , 60Hz)	I _{IN}		2.5	3.5	mA
Power Factor (50 – 100% load)	PF	0.96	0.995		
Efficiency (380/480V _{AC} @ 25°C)	η	10% load	91		%
20% load		94			
50% load		96.5			
100% load		96			
Holdup time (V _{IN} = 320V _{rms} , V _{OUT} ≥ 42V _{DC} , constant power load)	T	10	12		ms
Ride through (at 480V _{AC} , 25°C, constant power load)	T	1/2	1		cycle
Isolation (per EN60950)	V	Input – Output	3000		V _{AC}
Input-Chassis/Signals			2000		

¹ See the derating guidelines under the Environmental Specifications section

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Electrical Specifications (continued)

52V _{DC} MAIN OUTPUT						
Parameter	Symbol	Min	Typ	Max	Unit	
Output Power (320 – 530V _{AC} – 3Φ, T _{AMB} = 0 – 45°C)	W	6000			W _{DC}	
Factory set default set point V _{IN} = 480V, I = 10% FL, 25°C I ² C/RS485	V _{OUT}	-50	52	450	V _{DC} mV _{DC}	
Nominal set point (droop regulation; max-no load, min-full load)						
Overall regulation (load, temperature, aging) 0 – 45°C LOAD > 2.5A T _{AMB} > 45°C		-0.5		+0.5	%	
Output Current (T _{AMB} = 45°C)	I _{OUT}	1		115	A _{DC}	
		1		125		
Current Share (> 50% FL) remotely controlled I _{SHARE} is employed Max units parallelable remotely controlled		-2		2 100	%FL units	
Output Ripple RMS (5Hz to 20MHz) (20MHz bandwidth, load > 10%FL) Load < 10%FL	V _{OUT}	Peak-to-Peak (5Hz to 20MHz)		100	mV _{rms}	
				250	mV _{p-p}	
				400	mV _{p-p}	
Voice Band Output Noise With 880Ahr battery in system Without battery Psophometric Noise	V _{OUT}			45	dBrnC	
				55		
				2 ²		
External Bulk Load Capacitance	C _{OUT}	0		1,700	μF/A	
Turn-On (monotonic turn-ON from 30 – 100% of V _{nom} , above -5°C ³) Delay Rise Time – RS-485 mode	T		5		s	
Output Overshoot	V _{OUT}			2	%	
Load Step Response ΔI [V _{IN} = 380/480V _{AC} , 25°C, load step 20% ↔ 80%, di/dt = 1A/μs] ΔV, (380/480 V _{AC} , 25°C) Settling Time to normal regulation	I _{OUT} V _{OUT} T	-5		60	%FL % ms	
				5		
				2		
Overload ⁴ - Power limit when V _{OUT} ≥ 48V _{DC} recoverable current limit when 40V _{DC} < V _{OUT} < 48V _{DC} Output shutdown (one retry after a 2 – 10 second delay) Short circuit protection System power up	P _{OUT} I _{OUT} V _{OUT}	6050 110		120	W _{DC} %FL V _{DC}	
				36		
				No damage		
				Upon startup, delay overload shutdown for 20 seconds to allow the insertion and startup of multiple modules within a system.		
Overvoltage 200ms delayed shutdown (default) Immediate shutdown Programmable range	V _{OUT}	59 > 65	59.5	60	V _{DC}	
		44		59.5		
	Latched shutdown	If 3 restart attempted within a 30 sec window unit latches OFF				
	Restart delay		3.5	4	5	sec
Over-temperature warning (prior to commencement of shutdown) Shutdown (below the max device rating being protected) Restart attempt Hysteresis (below shutdown level)	T		5		°C	
			20			
			10			
Isolation Output-Chassis	V	500			V _{DC}	
Restart/Reset conditions	Loss of input > 100ms or Output OFF followed by ON command					

³ Complies with ANSI TI.523-2001 section 4.9.2 emissions max limit of 20mV flat unweighted wideband noise limits

³ Below -5°C, the rise time is approximately 5 minutes to protect the bulk capacitors.

⁴ Overload retries must incorporate normal soft-start turn-ON.

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General Specifications

Parameter	Min	Typ	Max	Units	Notes
Reliability Calculated		560,000 190,000		Hours	Full load, 25°C ; Full load, 55°C ; - MTBF per Telecordia SR232 Reliability protection for electronic equipment, issue 3, method I, case III,
Service Life		10		Years	80% load, 35°C ambient, excluding fans
Unpacked Weight		TBD		Kgs/Lbs	
Packed Weight		TBD		Kgs/Lbs	
Heat Dissipation	200 Watts or 682 BTUs @ 80% load, 250 Watts or 853 BTUs @ 100% load				

Signal Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions. Signals are referenced to Logic_GRD unless noted otherwise.. See the Signal Definitions table for additional information.

Parameter	Symbol	Min	Typ	Max	Unit
Interlock [Connected externally to Vout (-)]	V	—		0.4	V _{DC}
Module Present [Internally shorted to Logic_GRD] Normal operation	V	—		0.4	V _{DC}
8V_INT (no components should be connected to this pin) Interconnected between power supplies to back-bias the internal secondary processor					

Digital Interface Specifications

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Standard measurement parameters	Update frequency Report delay after 25% step Report delay to accuracy				1 2 10	Hz sec sec
I _{out} measurement range		I _{MR}	0		130	A _{DC}
I _{out} measurement accuracy 25°C	> 25A < 25A	I _{OUT(ACC)}	-1 2.5		+1 2.5	% of FL A _{DC}
V _{out} measurement range		V _{OUT(IrMRI)}	0		70	V _{DC}
V _{out} measurement accuracy ⁵		V _{OUT(ACC)}	-1		+1	%
P _{out} measurement range		P _{OUT(IrMRI)}	0		6100	W _{DC}
P _{out} measurement accuracy	30°C -5°C - 55°C	P _{OUT(ACC)}	-30 TBD		30 TBD	W _{DC}
Temp measurement range		Temp _(rMG)	0		150	°C
Temp measurement accuracy ⁶		Temp _(ACC)	-5		+5	%
V _{in} measurement range, each phase		V _{IN(rMRI)}	0		600	V _{AC}
V _{in} measurement accuracy		V _{IN(ACC)}	-1.5		+1.5	%
I _{in} measurement range, each phase		I _{IN(MRI)}	0		20	A _{DC}
I _{in} measurement accuracy		I _{IN(ACC)}	-0.5		0.5	% of FL
P _{in} measurement range, computed 3Φ result		P _{in(rmg)}	0		6750	W _{in}
P _{in} measurement accuracy	> 500W 100 - 500W < 100W	P _{in(ACC)}	-1.5 2.5 30		+1.5 2.5 30	% % W

⁵ Above 2.5A of load current⁶ Temperature accuracy reduces non-linearly with decreasing temperature

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Environmental Specifications

Parameter	Min	Typ	Max	Units	Notes
Ambient Temperature	-5 ⁷		55	°C	Air inlet from sea level to 5,000 feet.
Storage Temperature	-40		85	°C	
Operating Altitude			1524/5000	m / ft	
Non-operating Altitude			8200/30k	m / ft	
Power Derating with Temperature			2.0	%/°C	55°C to 75°C ⁸
Power Derating with Altitude			2.0	°C/305 m °C/1000 ft	Above 1524/5000 m/ft; 3962/13000 m/ft max
Humidity	Operating	5	95	%	Relative humidity, non-condensing
	Storage	5	95	%	
Shock and Vibration	Operational	Meets IPC 9592 Class II, Section 5 and GR-63_CORE requirements			
	Packaged	0.02 0.01 0.005		g ² /Hz	Modified IASTM-D-4728-91 8 hour duration on each axis
Acoustic Noise		55	58	dBA	
Earthquake Rating		4		Zone	Meet GR-63_CORE requirements
Insulation Resistance					

EMC

 [Surges and sags applied one Φ at a time and all 3Φ's simultaneously; phase angles 0, 90, 270°]

Parameter	Function	Standard	Level	Criteria	Test
AC input	Conducted emissions	EN55022, FCC part 15 EN61000-3-2 Telcordia GR1089-CORE	A - 6dB margin		0.15 – 30MHz 0 – 2 KHz
	Radiated emissions	EN55022	A - 6dB margin		30 – 10000MHz
AC Input Immunity	Line surge		3 × V _{NOM} 480V	B	1 Φ only or all 3Φ
	Line sags and interruptions	EN61000-4-11		A	-30%, 10ms
				B	-60%, 100ms
				B	-100%, 5sec
	Lightning surge	EN61000-4-5, Level 4, 1.2/50μs – error free		A	25% sag for 2 sec
				A	1 cycle interruption
Enclosure immunity	Fast transients	ANSI C62.41-2002 100kHz ring wave 1.2/50μs-8/20μs 550ns EFT burst	3, Category B	B, Table 2	6kV/0.5kA
			3, Category B	B, Table 3	6kV, 3kA
	Conducted RF fields	EN61000-4-6	3	B, Table 7	2kV, severity II
			3	A	5/50ns, 2kV (common mode)
	Radiated RF fields	EN61000-4-3	3	A	130dB _μ V, 0.15-80MHz, 80% AM
			3	A	10V/m, 80-1000MHz, 80% AM
	ESD	ENV 50140		A	
			4	A	8kV contact, 15kV air

Criteria

Performance

- A No performance degradation
- B Temporary loss of function or degradation not requiring manual intervention
- C Temporary loss of function or degradation that may require manual intervention
- D Loss of function with possible permanent damage

⁷ Designed to start and work at an ambient as low as -40°C, but may not meet operational limits until above -5°C

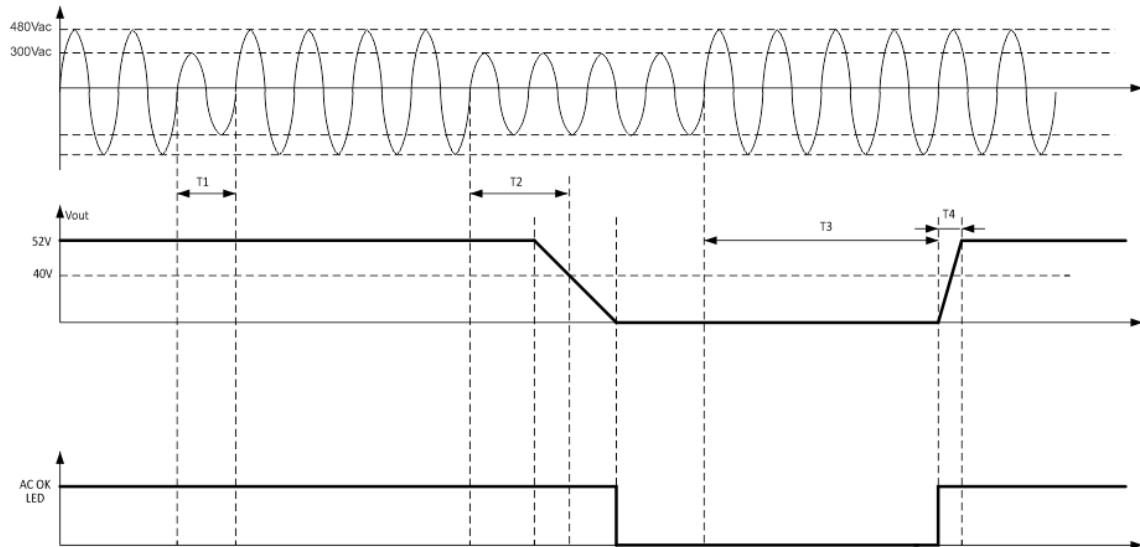
⁸ The maximum operational ambient is reduced in Europe in order to meet certain power cord maximum ratings of 70°C. The maximum operational ambient where 70°C rated power cords are utilized is reduced to 60°C until testing demonstrates that a higher level is acceptable.

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Timing diagrams

Response to input fluctuations



T1 – ride through time – 0.5 to 1 cycles [10 – 20ms] V_{OUT} remains within regulation – load dependent

T2 – hold up time - 15ms – V_{OUT} stays above 40V_{DC}

T3 – delay time – <5s – from when the AC returns within regulation to when the output starts rising

T4 – rise time – varies according to output loading, up to 8 seconds at full load

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Control and Status

This Rectifier incorporates the GE Galaxy, RS485 based, protocol

GE will provide separate documentation on the Galaxy RS485 based protocol for users desiring to interface to the rectifier. Contact your local GE representative for details.

Signal Reference: Unless otherwise noted, all signals, the standby output, and I²C communications are referenced to Logic_GRD. See the Signal Definitions Table at the end of this document for further description of all the signals.

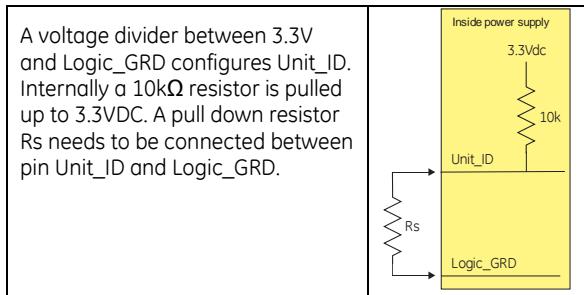
Logic_GRD is capacitively coupled to Frame_GRD inside the rectifier. The maximum voltage differential between Logic_GRD and Frame_GRD should be less than 100V_{DC}. It is assumed that the end user will connect Logic_GRD to his digital ground reference in his system.

Logic_GRD is isolated from the main output of the rectifier.

(Note that RS485 communications is referenced to Vout(-), main power return of the rectifier).

Control Signals

Bay_ID⁹: Up to 10 different units are selectable.



Bay_ID	Voltage level	Rs (± 0.1%)
Invalid	3.30	
1	3.00	100k
2	2.67	45.3k
3	2.34	24.9k
4	2.01	15.4k
5	1.68	10.5k
6	1.35	7.15k
7	1.02	4.99k
8	0.69	2.49k
9	0.36	1.27k
10	0	0

Device address in RS485 mode: The address in RS485 mode is divided into two components; Slot_ID and Shelf_ID

Slot_ID: Up to 10 different modules could be positioned across a 19" shelf if the modules are located vertically within the shelf. The resistor below needs to be placed between Slot_ID and Vout (-). Internal pull-up to 3.3V is 10kΩ.

Slot	Resistor	Voltage	Slot	Resistor	Voltage
invalid	none	3.3V	6	7.15k	1.35V
1	100k	3V	7	4.99k	1.02V
2	45.3k	2.67V	8	2.49k	0.69V
3	24.9k	2.34V	9	1.27k	0.36V
4	15.4k	2.01V	10	0	0
5	10.5k	1.68V			

Shelf_ID: When placed horizontally up to 20 shelves can be stacked on top of each other in a fully configured rack. The shelf will generate the precision voltage level tabulated below referenced to Vout (-).

Shelf	V _{MIN}	V _{NOM}	V _{MAX}
Fault	0	0	0
1	1.21	1.23	1.24
2	2.42	2.45	2.48
3	3.63	3.68	3.72
4	4.84	4.90	4.96
5	6.06	6.13	6.20
6	7.27	7.35	7.43
7	8.48	8.58	8.67
8	9.69	9.80	9.91
9	10.90	11.03	11.15
10	12.11	12.25	12.39
11	13.32	13.48	13.63
12	14.53	14.70	14.87
13	15.74	15.93	16.11
14	16.95	17.15	17.35
15	18.17	18.38	18.59
16	19.38	19.60	19.82
17	20.59	20.83	21.06
18	21.80	22.05	22.30
19	23.01	23.28	23.54
20	24.22	24.50	24.78

Load share (I_{share}): This is a single wire analog signal that is generated and acted upon automatically by power supplies connected in parallel. I_{share} pins should be connected to each other for power supplies, if active current share among the power supplies is desired. No resistors or capacitors should get connected to this pin.

Interlock: This is a shorter pin utilized for hot-plug applications to ensure that the rectifier turns **OFF** before the power pins are disengaged. It also ensures that the rectifier turns **ON** only after the power pins have been engaged. Must be connected to V_{OUT} (-) for the rectifier to be ON.

8V_{INT}: Single wire connection between modules, provides redundant bias to the DC/DC control circuitry of an unpowered module.

⁹ Bay_ID and Unit_ID are the same signals.

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Status Signals

Module Present: This signal is used as an OUTPUT signal by the rectifier to notify the system controller that a rectifier is physically present in the slot. This signal pin is pulled down to Logic_GRD by the rectifier

LEDs

Three LEDs are located on the front faceplate. The AC_OK LED provides visual indication of the INPUT signal function. When the LED is ON GREEN the rectifier input is within normal design limits.

The second LED is the DC_OK LED. When GREEN the DC output is present. When 'blinking' a power limit or overload condition exists. When OFF the output is not present.

The third LED is the FAULT LED. A continuous RED condition indicates that a fault exists and the rectifier has been shut down. Blinking of the RED LED in RS485 mode indicates that communications with the controller was not established.

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Table 2: Alarm and LED state summary

Condition	Rectifier LED State			Monitoring Signals			
	AC OK Green	DC OK Green	Fault Red		Fault	PFW	Module Present
OK	1	1	0		HI	HI	LO
Thermal Alarm (5C before shutdown)	1	1	Blinks		HI	HI	LO
Thermal Shutdown	1	0	1		LO	LO	LO
Defective Fan ¹⁰	1	0	1		LO	?	LO
Blown AC Fuse in Unit	1	0	1		LO	LO	LO
AC Present but not within limits	Blinks	0	0		HI	HI	LO
AC not present ¹	0	0	0		HI	LO	LO
Boost Stage Failure	1	0	1		LO	LO	LO
Over Voltage Latched Shutdown	1	0	1		LO	LO	LO
Over Current	1	Blinks	0		HI	Pulsing ⁴	LO
Non-catastrophic Internal Failure ²	1	1	1		LO	HI	LO
Missing Module							HI

¹ This signal is correct if the rectifier is back biased from other power supplies in the shelf.

² Any detectable fault condition that does not cause a shutting down. For example, ORing FET failure, boost section out of regulation, etc.

³ Signal transition from HI to LO is output load dependent

⁴ Pulsing at a duty cycle of 1ms as long as the unit is in overload.

Table 3: Signal Definitions

Signals (Fault, PFW, OTW, Power Capacity) are open drain FETs. An active LO signal (< 0.4V_{DC}) state. Signals are referenced to Logic_GRD unless otherwise stated.

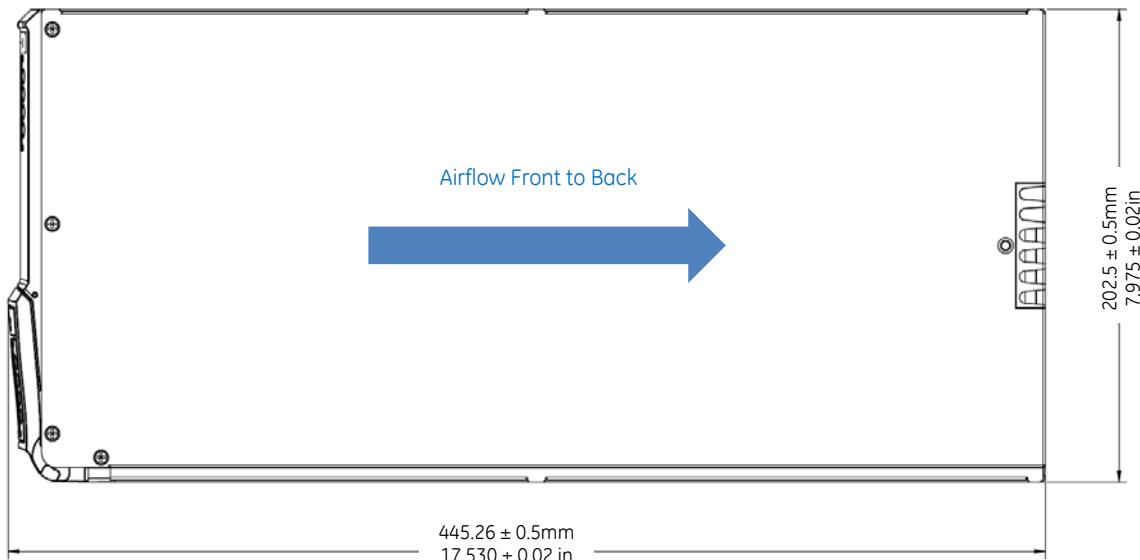
Function	Label	Type	Description
Module Present	MOD_PRES	Output	Short pin, Connected to Logic_GRD notifies the system that module is present,
Slot Address/Interlock	Slot_ID INTERLOCK	Input	Short pin referenced to Vout(-). This signal provides the last-to-make and first-to-break function to properly control the rectifier for hot plug and hot disengagement. A voltage level identifies the rectifier slot address in a shelf.
Shelf Address	Shelf_ID	Input	A voltage level referenced to Vout(-) identifies the shelf address
Unit Address	Unit_ID	Input	I²C mode: A resistor to Logic_GRD (see definition in spec)
DC-DC Back bias	8V_INT	Bi-direct	Used to back bias the DSP from other operating Power supplies. Ref: Vout(-).
Current Share	Ishare	Bi-direct	A single wire active-current-share interconnect between modules Ref: Vout(-).

¹⁰ A fan failure would cause shutdown of the output only if it would trigger a thermal event.

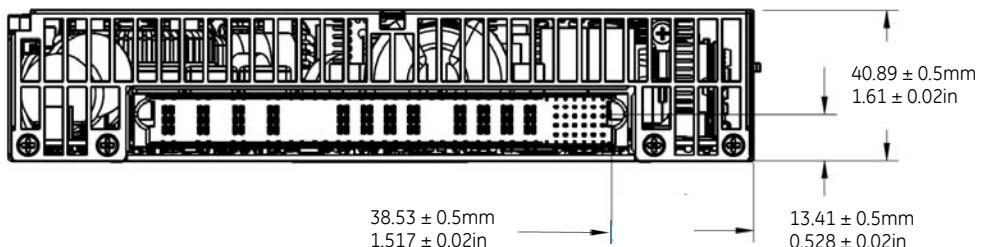
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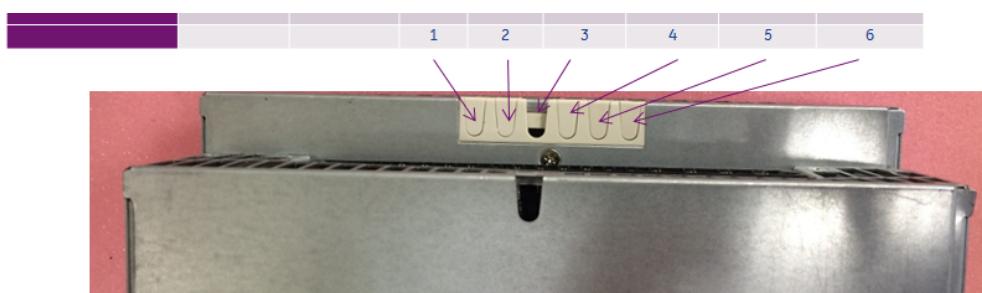
Mechanical Outline



Top View [Note: add safety label to side of unit per UL, EC directives, TUV, Power Systems Practices]



Rear View



Keying

Product	Keying Location Knotched
GP communications	3

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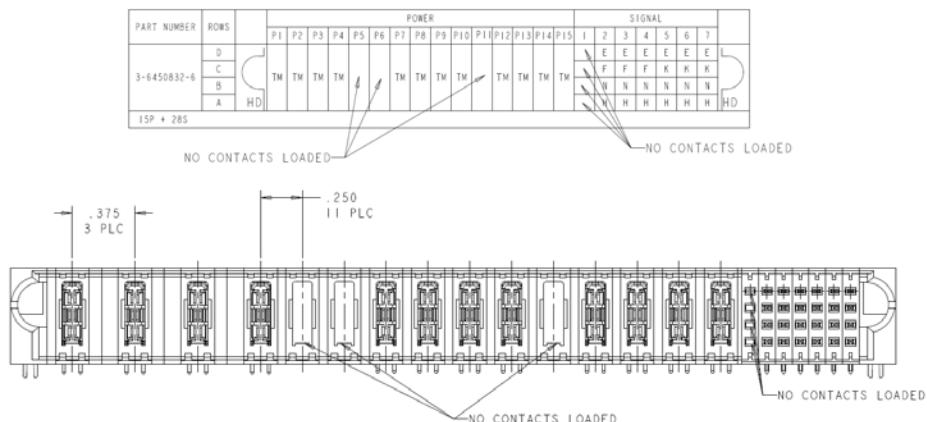
Front View: Faceplate Color: Spattered Finish CO White (OS11148)

Front Panel LEDs

Symbol	Color	Function
	Green	ON: Input ok Blinking: Input out of limits
	Red	ON: Fault Blinking: RS485 – loss of communications I ² C - Impending failure warning
	Green	ON: Output ok Blinking: Overload

Mating Connector

Rectifier side: Tyco 3-6450832-6



AC INPUT			DC OUTPUT												SIGNALS						
P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	1	2	3	4	5	6	7
L1	L2	L3	Frame Gnd	Empty	Empty	Vout+	Vout+	Vout+	Empty	Vout-	Vout-	Vout-	Vout-	Empty	SLOT_ID_INTERLOCK	Bay_ID		RS485-	RS485+	D	

Notes:
 = Short Pin
 = System side mating connector must have its Frame GND pin the longest to ensure that it is mating first.
 = Slot location

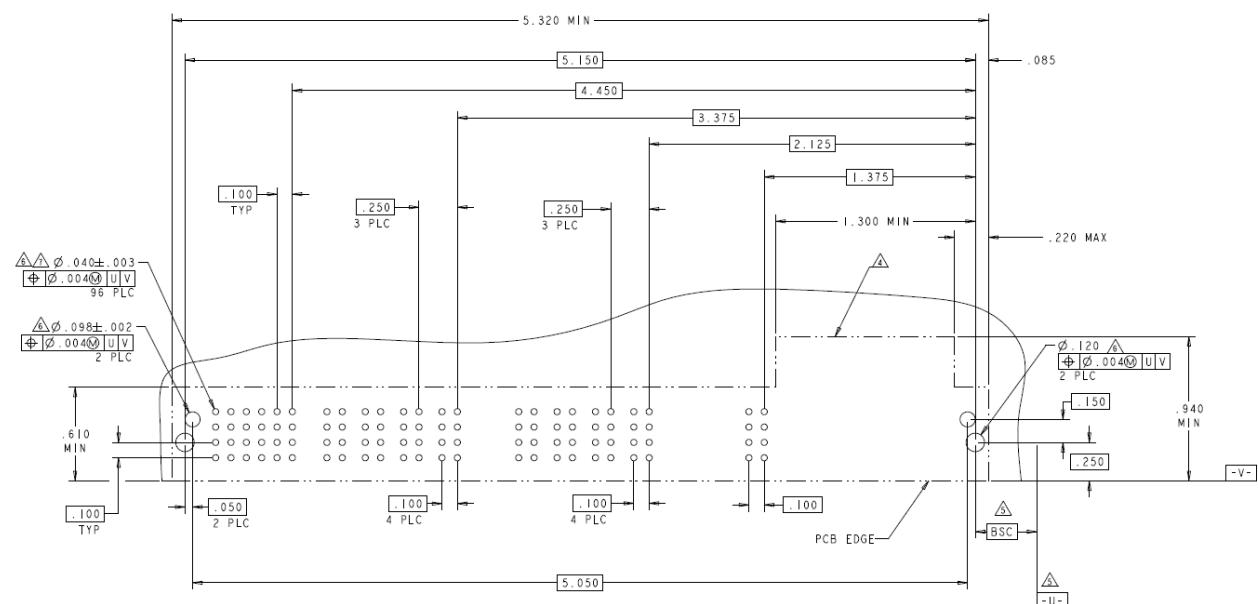
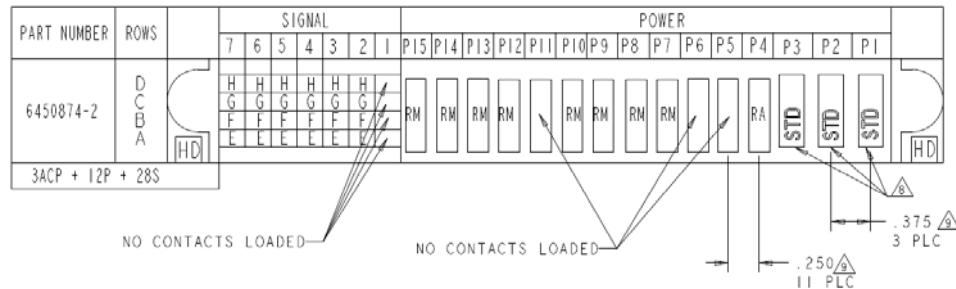
Pin out as looking straight at the connector

SIGNALS						
1	2	3	4	5	6	7
Empty	SLOT_ID_INTERLOCK		Bay_ID		RS485-	RS485+
Empty	SHELF_ID			MOD_PRES		LOGIC_GND
Empty	8V_INT					
Empty	ISHARE					

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System side connector: Tyco soldered version: 6450874-2
press-fit version: 6450884-2



RECOMMENDED PCB LAYOUT

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Ordering Information

Please contact your GE Sales Representative for pricing, availability and optional features.

Item	Description	Comcode
GP100H3R48TEZ	115A rectifier with isolated RS485 communications, 52Vdc default	150034309
GP100H3R48TEZ-IN ¹¹	125A rectifier with isolated RS485 communications, 48Vdc default	150045497

¹¹ Industrial version set to 48Vdc default output.

Contact Us

For more information, call us at

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