

## CP2000AC54TE Compact Power Line High Efficiency Rectifier

Input: 100-120/200-277 Vac; Default Output:  $\pm 54$  Vdc @ 2000W; 5 Vdc @ 4W



### Applications

- 48Vdc distributed power architectures
- Routers/Switches
- VoIP/Soft Switches
- LAN/WAN/MAN applications
- File servers
- Indoor wireless
- Telecommunications equipment
- Enterprise Networks
- SAN/NAS/iSCSI applications
- Advanced workstations

### Features

- Efficiency approaching 96%
- Compact 1RU form factor providing 30 W/in<sup>3</sup>
- Constant power from 52 – 58Vdc
- 2000W from nominal 200 – 277Vac
- 1200W from nominal 100 – 120Vac
- Output voltage programmable from 42V – 58Vdc; output defaulted to 54V
- PMBus compliant dual I<sup>2</sup>C and RS485 serial bus communications
- 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 and redundant +5V Aux power
- Remote ON/OFF
- Hot insertion/removal (hot plug)
- Four front panel LED indicators
- UL\* Recognized to UL60950-1, CAN/ CSA† C22.2 No. 60950-1, and VDE‡ 0805-1 Licensed to IEC60950-1
- CE mark meets 2006/95/EC directive§
- Internally controlled Variable-speed fan
- RoHS 6 compliant

### Description

The CP2000AC54TE Front-End Power Supply provides significant efficiency improvements in the Compact Power Line platform of Rectifiers. The high-density, front-to-back airflow Rectifier is designed for minimal space utilization and is highly expandable for future growth. It is provided with RS485 and dual-redundant I<sup>2</sup>C communications busses that allow it to be used in a broad range of applications. The flexible feature set makes this front-end power supply an excellent choice for applications requiring modular ac-to-dc 48Vdc 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.

‡ VDE is a trademark of Verband Deutscher Elektrotechniker e.V.

§ This product is intended for integration into end-user equipment. All the required procedures for CE marking 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.

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### Electrical Specifications

Input					
Parameter	Min	Typ	Max	Units	Notes
Startup Input Voltage Low-line Operation High-line Operation			90 185		
Operating Voltage Range Low-line Configuration High-line Configuration	90 185	100, 110, 120 200 – 277	140 305	Vac	
Surges (no damage)	305				
Input Frequency	47		66	Hz	
Input Current		12.8 10.6 10.5 9.7		A	At 100Vac At 110Vac At 200Vac At 240Vac
Inrush Transient		25	30	Apk	Measured at 25°C for all line conditions; does not include X-Capacitors charging.
Input Leakage Current		2.5	3.5	mA	Measured at 265Vac, 60Hz
Power Factor	0.96	0.98			From 50% to 100% load.
Efficiency <sup>1</sup> 20 – 90% of FL	95	96		%	With or'ing function, aux 5V output, dual/redundant I <sup>2</sup> C and RS485 communications and POE isolation
Holdup Time		20 30		ms	Measurement starts at zero crossing of the ac voltage, and voltage decayed to 40V. For loads below 1200W.
Ride thru	1/2	1		cycle	Tested at nominal 115V and 230V. Complies to CISPR24 standards
Power Fail Warning <sup>2</sup>	3	5		ms	Alarm issued via PFW signal going LO 5 ms prior to the main output decaying below 40Vdc.

Main Output					
Parameter	Min	Typ	Max	Units	Notes
Output Power	1200 2000			W	At low-line input from nominal 100-120Vac. At high-line input from nominal 200-277Vac
Default Set point		54		Vdc	Output floats with respect to frame ground.
Overall Regulation <sup>3</sup>	-1 -2		+1 +2	%	0 – 45C, minimum load 2.5A > 45C
Output Voltage Set Range	44		58	Vdc	Analog margining.
	42		58	Vdc	Set either by I <sup>2</sup> C, RS485
Output current	1 1		25 <sup>4</sup> 37/38.4	A	At 1200W, 54V @ 100-120Vac. At 2000W, 54V/52V @ 277Vac and T <sub>amb</sub> > 45°C.

<sup>1</sup> At 240Vrms and 25°C. See efficiency curves at the end of this document.

<sup>2</sup> Internal protection circuits may override the PFW signal and may trigger an immediate shutdown.

<sup>3</sup> Includes all variations due to specified load range, drift, and environmental conditions.

<sup>4</sup> At 240Vrms and 25°C, slightly lower at lower input voltages

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### Electrical Specifications (continued)

Main Output (continued)					
Parameter	Min	Typ	Max	Units	Notes
Current Share	-5		5	%FL	Compared to the average output current delivered by a set of Rectifiers. Loads > 50% FL
Proportional Current Share		<7		%FL	Among CP Rectifiers of different output capacities. Loads > 50% FL
Output Ripple RMS (5Hz to 20MHz) Peak-to-Peak (5Hz to 20MHz) Psophometric Noise			250 500 9 <sup>5</sup>	mVrms mVpk-pk mVrms	Measured with 20MHz bandwidth under any condition of loading. Minimum load is 1A.
External Bulk Load Capacitance	0		5,000	μF	External capacitance can be increased but the power supply will not meet its turn-ON rise time requirement.
Turn-On Delay Rise Time <sup>1</sup> - Standard (PMBus) -Telecom (RS-485) <sup>6</sup> Overshoot		5 100 5		s ms s %	Monotonic Turn_On from 30% to 100% of Vnom above -5°C operation. Monotonic Turn_On from 60% to 100% of Vnom below -5°C operation.
Load Step Response ΔI ΔV Response Time		2.0 2	50	%FL Vdc ms	ΔI/Δt slew rate 1A/μs. Settling time to within regulation requirements. Minimum load of 2.5 amperes required.
Overload	Power Limit – high line	2000		W	Down to 52Vdc
	Power limit – low line	1200		W	
	Current limit > 41.5V <sup>7</sup> - HL	39.2	42.9	Adc	Hiccup mode with a 10% duty cycle enabled below 39Vdc. Latched mode current limit optional. (FL = 52.4A @ 52V)
	Current limit < 41.5V <sup>5</sup> - HL	36		Adc	
	Current limit - LL	26		Adc	
	System Power Up	Units should be able to be plugged in one at a time and guarantee system start up. Units should stay in current limit for approximately 20 seconds to guarantee restart.			
Over-voltage  Delayed Immediate Latchoff			60 65	Vdc Vdc	200msec delayed shutdown to be implemented. Instantaneous shutdown above this point.
	Three restart attempts may be implemented within a one minute window prior to a latched shutdown				
Over-temperature Warning		5		°C	Implemented prior to commencement of an OT shutdown Below the maximum rating of the device being protected
Shutdown		20		°C	
Auto-recoverable	Temperature hysteresis of approximately 10°C provided between shutdown and restart.				

<sup>1</sup> Complies with GR947 which calls for a minimum rise time proportional to output load.

<sup>2</sup> Complies with ANSI TI.523-2001 section 4.9.2 emissions max limit of 20mV flat unweighted wideband noise limits

<sup>6</sup> Below -5°C, the rise time is approximately 5 minutes to protect the bulk capacitors.

<sup>7</sup> Above 275V input, the current limit point changes at 45V. There is a 30 second delay prior to shifting to the lower limit.

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Electrical Specifications (continued)					
Auxiliary Output					
Parameter	Min	Typ	Max	Units	Notes
Output Voltage Setpoint		5		Vdc	
Output Current	0.005		0.75	A	
Overall Regulation	-10		+5	%	Within $\pm 5\%$ when load is $< 0.5A$ .
Ripple and Noise		50	100	mVpk-pk	20MHz bandwidth
Over-voltage Clamp			7	Vdc	
Over-current Limit	110		175	%FL	

Mechanical Specifications					
Environmental					
Parameter	Min	Typ	Max	Units	Notes
Ambient Temperature Operating Derating	-40 <sup>8</sup>	1	55 <sup>9</sup> 2	°C °C	Air inlet from sea level to 5,000 feet. Per 1,000 feet above 5,000 feet.
Extended Operating Temperature	55		75	°C	With 2%/°C power derating above 55°C.
Storage Temperature	-40		85	°C	
Humidity	5		95	%	Relative humidity, non-condensing
Altitude	-60 -200		4000 13000	m ft	For operation above 2500m (5000 ft.), maximum operating temperature is derated by 2°C per 305m (1000 ft.).
Shock and Vibration					IPC9592 sections 5.2.8 – 5.2.13
Earthquake Rating	4			Zone	Per Telcordia GR-63-CORE, all floors, when installed in CP Shelf.
Acoustic Noise		55		dba	Noise is proportional to fan speed, load and ambient temperature.
Harmonic Emissions	Per EN/IEC61000-3-2				
Radiated Emissions <sup>10</sup>	Exceeds FCC and CISPR22 (EN55022) - Class A by a 6dB margin				
Conducted Emissions - ac	Exceeds FCC and CISPR22 (EN55022) Class A Telcordia GR-1089-CORE - Class A by a 6dB margin				
ESD	Error free per EN/IEC 61000-4-2 Level 3 (6 kV contact discharge, 8 kV air discharge).				
Radiated Immunity	Error free per EN/IEC 61000-4-3 Level 3 (10 V/m).				
Electrical Fast Transient Burst	Error free per EN/IEC 61000-4-4 Level 3 (2 kV, 5 kHz repetition rate)				
Lightning Surge, Error Free Damage Free	EN/IEC61000-4-5 Level 4 (4 kV common mode, 2 kV differential mode). ANSI C62.41 Level A3 (6 kV common and differential mode)				
Line sags and interruptions	IPC9592A issued May 2010 ; 1 cycle interruption or 25% sag (115V, 230V – nominal for UUT) for 2 seconds the output shall stay above 40Vdc at full load. [Note: An input sag below 80V may cause an immediate shutdown.]				
Conducted Immunity	Error free per EN/IEC 61000-4-6 Level 3 (10Vrms).				
Reliability (calculated)		450,000		Hours	At ambient of 25°C at full load per Telcordia SR-332, issue 2, Reliability Prediction for Electronic Equipment, Method I Case III.
Isolation Input-Chassis/Signals Input - Output Output-Chassis Output-Chassis/Signals	1500 3000 500 2250			Vrms Vrms Vdc Vdc	Per EN60950. Consult factory for testing to this requirement Internal Lineage standard, GR_947 POE compliant Rectifier, Per IEEE802.3.
Service Life		10		Years	25°C ambient, full load excluding fans.

<sup>8</sup> Designed to start and work at an ambient as low as -40°C, but may not meet operational limits until above -5°C

<sup>9</sup> Output power is derated to 2kW for temperatures higher than 45°C and input voltages higher than 285Vrms.

<sup>10</sup> Radiated emissions compliance was met using a Lineage Power shelf. This shelf includes output common and differential mode capacitors that assist in meeting compliance.

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### Status and Control

The Rectifier provides two means for monitor/control: analog or I<sup>2</sup>C.

Details of analog controls are provided in this data sheet under Signal Definitions. GE Energy will provide separate application notes on the I<sup>2</sup>C protocol for users to interface to the CPL RECTIFIERS. Contact your local GE Energy representative for details.

### Hot Plug

When rapidly extracting and reinserting modules care should be taken to allow for discharging the internal bias supply so that a predictable restart could be achieved. The way to ensure that the circuit sufficiently discharges is to observe the spinning of the fans after an extraction. The unit should not be reinserted until the fans stop spinning.

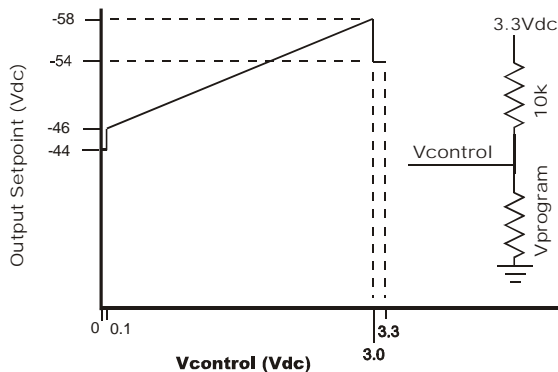
Without bleeding down internal bias the module may remember its last assigned address and may not configure itself properly if reinserted into another slot.

### Control Definitions

All signals are referenced to Logic\_GRD unless otherwise noted. See the Signal Definitions Table at the end of this document for further description of all the signals.

### Input Signals

**Margining:** Set point of the Rectifier can be changed via this input pin. Programming can be either a voltage source or a resistance divider. The margining pin is connected to 3.3Vdc via a 10k $\Omega$  resistor inside the Rectifier. See graphs below.



An open circuit on this pin reverts the voltage level back to the original setting.

Software commanded margining overrides the hardware set point indefinitely or until the default setting is reinstated for example if input power and bias power have been removed from the module.

**Module Present Signal:** This signal has dual functionality. It can be used to alert the system when a module is inserted. A 500 $\Omega$  resistor is present in series between this signal and Logic\_GRD. An external pull-up should not raise the voltage on the pin above 0.25Vdc. Above 1Vdc, the write\_protect feature of the EEPROM is enabled.

**Protocol Select:** Establishes the communications mode of the power supply, between analog/I<sup>2</sup>C and RS485 modes. For RS485, connect 10k $\Omega$  pull-down resistor to 54\_OUT(-DC).

**Enable:** On/Off control when I<sup>2</sup>C communications are utilized as configured by the Protocol pin. This pin must be pulled low to turn **ON** the power supply. The power supply will turn **OFF** if either the **Enable** or the **ON/OFF** pin is released. This signal is referenced to Logic\_GRD.

**ON/OFF:** This is a short pin utilized for hot-plug applications to ensure that the power supply turns **OFF** before the power pins are disengaged. It also ensures that the power supply turns **ON** only after the power pins have been engaged. Must be connected to V\_OUT (-DC).

### Output Signals

**Power\_OK:** This signal is HI when the main output is present and goes LO when the main output is not present.

**I\_limit:** This signal is HI when the main output is not in current limit and goes LO when current limit has activated.

**Alert #:** I<sup>2</sup>C interrupt signal.

**Fault:** This signal goes LO for any failure that requires Rectifier replacement. Some of these faults may be due to:

- Fan failure
- Over-temperature condition
- Over-temperature shutdown
- Over-voltage shutdown
- Internal Rectifier Fault

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### Alarm Table

Condition	Power Supply LED State				Monitoring Signals (Referenced to Logic_GRD)			
	AC OK Green	DC OK Green	Service Amber	Fault Red	Fault	OTW	PFW	Module Present
OK	1	1	0	0	HI	HI	HI	LO
Thermal Alarm (5C before shutdown)	1	1	1	0	HI	LO	HI	LO
Thermal Shutdown	1	0	1	1	LO	LO	LO	LO
Defective Fan	1	0	0	1	LO	HI	LO	LO
Blown AC Fuse in Unit	1	0	0	1	LO	HI	LO	LO
No AC <15mS (single unit)	0	1	0	0	HI	HI	LO <sup>3</sup>	LO
AC Present but not within limits	Blinks	0	0	0	HI	HI	LO	LO
AC not present <sup>1</sup>	0	0	0	0	HI	HI	LO	LO
Boost Stage Failure	1	0	0	1	LO	HI	LO	LO
Over Voltage Latched Shutdown	1	0	0	1	LO	HI	LO	LO
Over Current	1	Blinks	0	0	HI	HI	LO	LO
Non-catastrophic Internal Failure <sup>2</sup>	1	1	0	1	LO	HI	HI	LO
1 Missing Module								HI <sup>4</sup>
Standby (remote)	1	0	0	0	HI	HI	LO	LO
Service Request (PMBus mode)	1	1	Blinks	0	HI	HI	HI	LO
Communications Fault (RS485 mode)	1	1	0	Blinks	HI	HI	HI	LO

<sup>1</sup> This signal is correct if the Rectifier is back biased from other Rectifiers in the shelf .

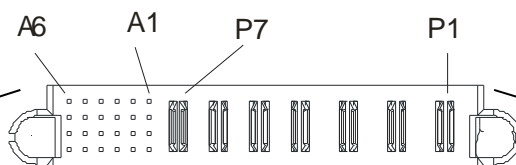
<sup>2</sup> Any detectable fault condition that does not result in the power supply shutting down. For example, ORing FET failure, boost section out of regulation, etc.

<sup>3</sup> Signal transition from HI to LO is output load dependent

<sup>4</sup> Signal must be pulled HI external to the module

### Output Connector

**Mating Connector:** right angle PWB mate – all pins: AMP 1450572-1, right angle PWB mate except pass-thru input power: AMP 6450378-1



SIGNAL PINS						POWER OUTPUT				POWER INPUT			
	6	5	4	3	2	1	P7	P6	P5	P4	P3	P2	P1
A	SCL_0	MOD_PRES	PFW	LOGIC_GRD	RS 485+	UNIT_ADDR							
B	SCL_1	OTW	Alert#_0	Alert#_1	RS 485-	8V_INT	V_OUT	V_OUT	V_OUT	V_OUT	EARTH	LINE-2	LINE-1
C	SDA_0	Margin	Enable	Reset	Ishare	Protocol	(-)	(+)	(+)	(-)	(GND)	(Neutral)	(HOT)
D	SDA_1	Fault	5VA	Power_Cap	ON/OFF	SHELF_ADDR							
Note: Connector is viewed from the rear positioned inside the rectifier													
Signal pins columns 1 and 2 are referenced to V_OUT (-)													
Signal pins columns 3 through 6 are referenced to Logic GRD													
Last to make-first to break shortest pin													
Earth First make-last to break longest pin implemented in the mating connector													

## CP2000AC54TE CPL High Efficiency Rectifier

Input: 100-120/200-277 Vac; Default Output:  $\pm 54$  Vdc @ 2000W; 5 Vdc @ 4W

### Signal Definitions

All hardware alarm signals (Fault, PFW, OTW, Power Capacity) are open drain FETs. These signals should be pulled HI to either 3.3V or 5V. Maximum sink current 5mA. An active LO signal (< 0.4Vdc) state. All signals are referenced to Logic GRD unless otherwise stated. Contact your Lineage Power representative for more details.

Function	Label	Type	Description
Output Enable	Enable	Input	If shorted to LOGIC_GRD, the Rectifier output is enabled when using I <sup>2</sup> C mode of operation. May also be toggled to reset a latched OFF Rectifier. Function not available in RS485 mode.
Power Fail Warning	PFW	Output	An open drain FET; normally HI, indicating output power is present. Changes to LO at least 5msec before the output voltage decays below 40Vdc.
I <sup>2</sup> C Interrupt	Alert#_0 Alert#_1	Output	Interrupt signal via I <sup>2</sup> C lines indicating that service is requested from the host controller. This signal pin is pulled up to 3.3V via a 10k $\Omega$ resistor and switches to active LO when an interrupt occurs.
Rectifier Fault	Fault	Output	Indicates that an internal fault exists. An open drain FET; normally HI, changes to LO.
Module Present	MOD_PRES	Output	Short pin, see Status and Control description for further information on this signal.
ON/OFF	ON/OFF	Input	Short pin, connects last and breaks first; used to activate and deactivate output during hot-insertion and extraction, respectively. Ref: Vout ( - ).
Protocol select	Protocol	Input	See Status and Control description for further information on this signal. Ref: Vout ( - ).
Margining	Margin	Input	Allows changing of output voltage through an analog voltage input or via resistor divider.
Over-Temperature Warning	OTW	Output	An open drain FET; normally HI, changes to LO approximately 5°C prior to thermal shutdown.
Power Capacity	POWER_CAP	Output	Open drain FET; Used to indicate Rectifier operation mode; HI indicates 2725W operation and LO indicates 1200W operation.
Rectifier address	Unit_addr	Input	Voltage level addressing of Rectifiers within a single shelf. Ref: Vout ( - ).
Shelf Address	Shelf_addr	Input	Voltage level addressing of Rectifiers within multiple shelves. Ref: Vout ( - ).
Back bias	8V_INT	Bi-direct	Diode OR'ed 8Vdc drain; used to back bias microprocessors and DSP of failed Rectifier from operating Rectifiers. Ref: Vout ( - ).
Mux Reset	Reset	Input	Resets the I <sup>2</sup> C lines to I <sup>2</sup> C line 0.
Standby power	5VA	Output	5V at 0.75A provided for external use by either adjacent power supplies or the using system.
Current Share	Ishare	Bi-direct	A single wire interface between each of the power unit forces them to share the load current. Ref: Vout ( - ).
I <sup>2</sup> C Line 0	SCL_0, SDA_0	Input	I <sup>2</sup> C line 0.
I <sup>2</sup> C Line 1	SCL_1, SDA_1	Input	I <sup>2</sup> C line 1.
I <sup>2</sup> C Interrupt	Alert#	Output	Goes active LO
RS485 Line	RS_485+ RS_485-	Bi-direct	RS485 line.

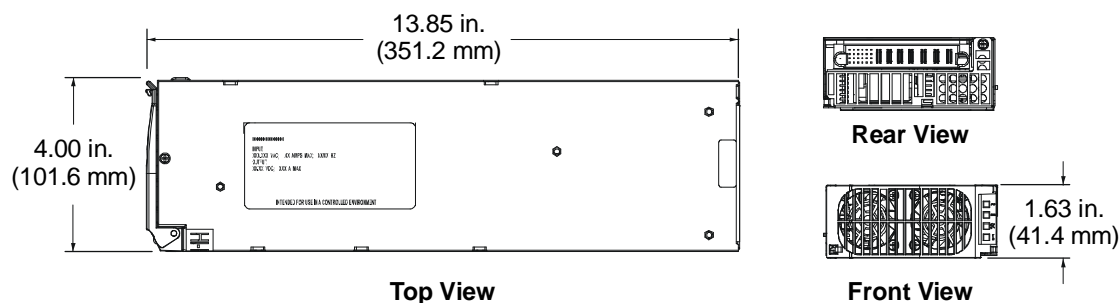
## CP2000AC54TE CPL High Efficiency Rectifier

Input: 100-120/200-277 Vac; Default Output:  $\pm 54$  Vdc @ 2000W; 5 Vdc @ 4W

## Front Panel LEDs

	Analog Mode	I <sup>2</sup> C Mode	RS485 Mode
<input type="checkbox"/> ~	←	ON: Input ok Blinking: Input out of limits	→
<input type="checkbox"/> ≡	←	ON: Output ok Blinking: Overload	→
<input type="checkbox"/> ✖	ON: Over-temperature Warning	ON: Over-temperature Warning Blinking: Service	ON: Over-temperature Warning
<input type="checkbox"/> !	←	ON: Fault	ON: Fault Blinking: Not communicating

## Dimensions



## Physical

Packaged weight	5.4/2.45 lbs/kgs
Unpacked weight	4.8/2.18 lbs/kgs
Heat release	100 Watts or 341 BTUs @ 80% load 153 Watts or 522 BTUs @ 100% load

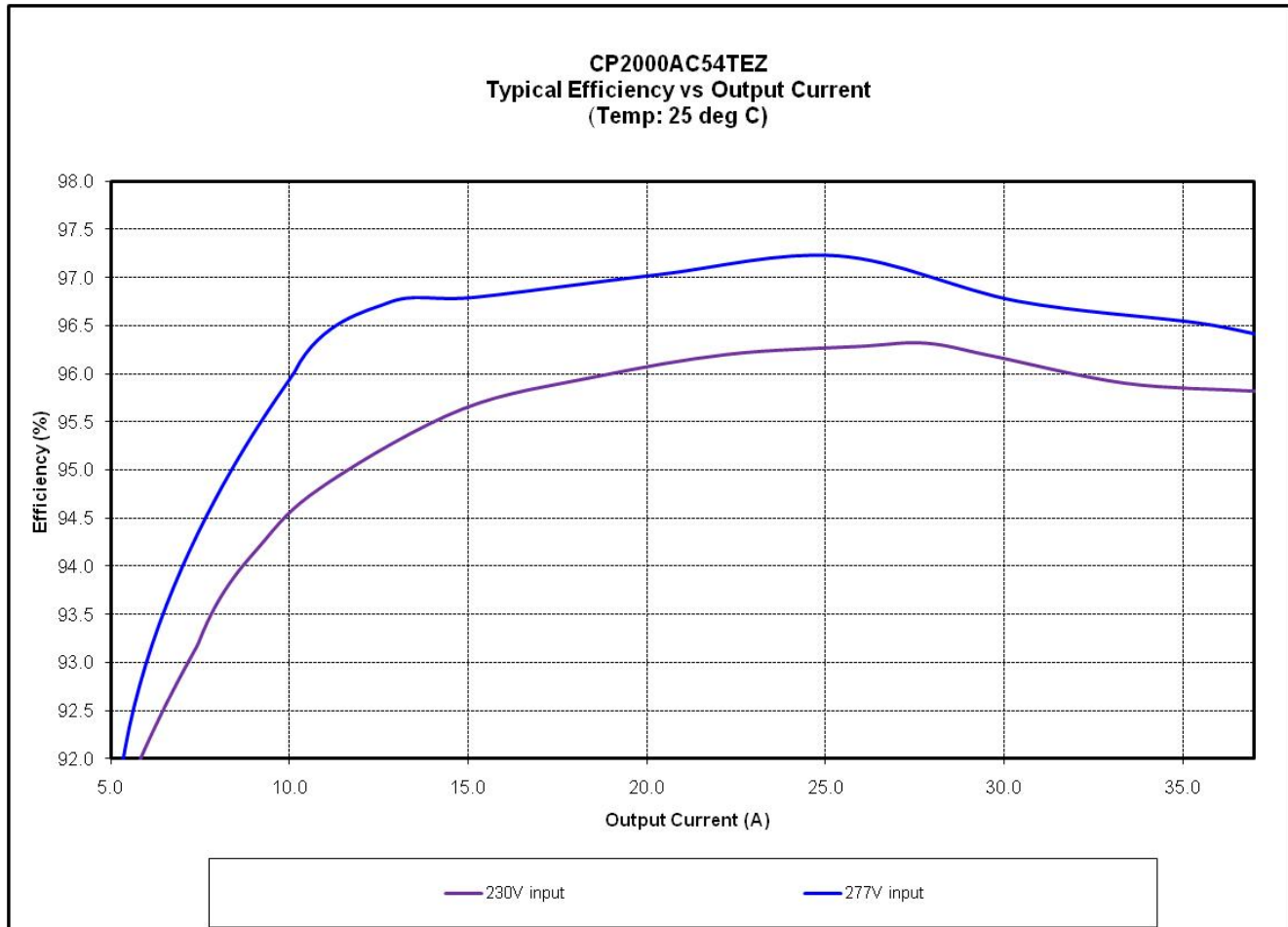
## Ordering Information

Item	Description	Comcode
CP2000AC54TEP	54Vdc @ 50A, 5Vdc @ 0.75A, RoHS 6/6 with POE isolation	CC109167565



**CP20000AC54TE CPL High Efficiency Rectifier**Input: 100-120/200-277 Vac; Default Output:  $\pm 54$  Vdc @ 2000W; 5 Vdc @ 4W

## Typical Efficiency



## Contact Us

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