

CP2725AC54TE Compact Power Line High Efficiency Rectifier

Input: 100-120/200-277 Vac; Default Outputs: ± 54 Vdc @ 2725W; 5 Vdc @ 4W



Features

- Efficiency 96.2%
- Compact 1RU form factor with 30 W/in³ density
- Constant power from 52 – 58Vdc
- 2725W from nominal 200 – 277Vac
- 1200W from nominal 100 – 120Vac
- Output voltage programmable from 42V – 58Vdc
- PMBus compliant dual I²C and RS485 serial busses
- 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
- Redundant +5V Aux power
- Remote ON/OFF
- Internally controlled Variable-speed fan
- 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§
- RoHS 6 compliant

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

Description

The CP2725AC54TE Rectifier provides significant efficiency improvements in the Compact Power Line platform of Rectifiers. High-density front-to-back airflow is designed for minimal space utilization and is highly expandable for future growth. The standard product is provided with both RS485 and dual-redundant I²C communications busses that allow it to be used in a broad range of applications. Feature set flexibility makes this rectifier 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.



imagination at work

CP2725AC54TE CPL High Efficiency Rectifier

Input: 100-120/200-277 Vac; Default Output: ±54 Vdc @ 2725W; 5 Vdc @ 4W

Electrical Specifications

| Input | | | | | |
|--|----------------|----------------------------|------------|-------|---|
| Parameter | Min | Typ | Max | Units | Notes |
| Startup Input Voltage Low-line Operation High-line Operation | | | 90 185 | | <p>CP2725AC54TEZ Line Derating</p> <p>Equation for derating zone: $y = 55.015x - 6991.6$</p> <p>tolerance: +/-5%</p> |
| Operating Voltage Range Low-line Configuration High-line Configuration | 90 185 | 100, 110, 120 200 - 277 | 140 300 | Vac | |
| Input Voltage Swell (no damage) | 305 | | | | |
| Input Frequency | 47 | | 66 | Hz | |
| Input Current | | 11.9 13.1 | | A | At 110 Vac At 240 Vac |
| 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 ¹ | 30 - 80% of FL | 94.5 | 96.2 | % | With OR'ing function, aux. 5V output, dual/redundant I ² 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 ² | 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 2725 2000 | | | W | At low-line input from nominal 100-120Vac. At high-line input from nominal 200-277Vac At nominal 277Vac and T _{amb} > 45°C |
| Default Set point | | 54 | | Vdc | Output floats with respect to frame ground. |
| Overall Regulation ³ | -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 ² C, RS485 |
| Output current | 1 1 1 | | 25 50.5/52.4 37/38.4 | A | At 1200W, 54V @ 100-120Vac. At 2725W, 54V/52V @ 200-240Vac. At 2000W, 54V/52V @ 277Vac and T _{amb} > 45°C. |

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

² Internal protection circuits may override the PFW signal and may trigger an immediate shutdown.

³ Includes all variations due to specified load range, drift, and environmental conditions.

CP2725AC54TE CPL High Efficiency Rectifier

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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. Valid for loads > 50% of FL | |
| Proportional Current Share | | <7 | | %FL | Among CP Rectifiers of different output capacities. Loads > 50% of FL | |
| Output Ripple RMS (5Hz to 20MHz) Peak-to-Peak (5Hz to 20MHz) Psophometric Noise | | | 100 250 ⁴ 9 ⁵ | mVrms mVp-p mVrms | Measured with 20MHz scope 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 rectifier may not meet its turn-ON rise time requirement. | |
| Turn-On Delay Rise Time ¹ - Standard (PMBus) -Telecom (RS-485) ⁶ Output 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 | dI/dt (output current slew rate) 1A/µs. Settling time to within regulation requirements. Minimum load of 2.5 amperes required. | |
| Overload | Power Limit - high line | 2725 | | W | Down to 52Vdc | |
| | Power limit - low line | 1200 | | W | | |
| | Current limit > 41.5V _o ⁷ - HL | 53 | | 58 | Adc | Hiccup mode with a 10% duty cycle enabled below 39Vdc. Latched mode current limit optional. For Vin > 275Vac hiccup starts at Vout < 45Vdc after a 30sec delay. (FL = 52.4A @ 52V) |
| | Current limit < 41.5V _o - 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. Instantaneous shutdown above this point. | |
| | | Three restart attempts are attempted within a one minute window prior to a latched shutdown | | | | |
| Over-temperature Warning Shutdown Auto-recoverable | | 5 | | °C | Activates prior to commencement of an OT shutdown Below the maximum rating of the device being protected | |
| | | 20 | | °C | | |
| | Temperature hysteresis of approximately 10°C provided between shutdown and restart. | | | | | |

⁴ 500mVp-p max above 280Vrms , 300mVp-p max for POE product

⁵ Complies with ANSI TL523-2001 section 4.9.2 emissions max limit of 20mV flat unweighted wideband noise limits

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

⁷ 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 ±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 | |

| Environmental, EMC, Reliability Specifications | | | | | |
|--|--|---------|----------------------|----------------------------|---|
| Environmental | | | | | |
| Parameter | Min | Typ | Max | Units | Notes |
| Ambient Temperature Operating Derating | -40 ⁸ | 1 | 55 ⁹ 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 (8202 ft.), maximum operating temperature is derated by 2°C per 305m (1000 ft.). |
| Shock and Vibration | | | | | |
| 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 ¹⁰ | Meets FCC and CISPR22 (EN55022) Class A | | | | |
| Conducted Emissions - ac | Meets FCC and CISPR22 (EN55022) Class A Meets Telcordia GR-1089-CORE - Class A by a 3dB margin | | | | |
| ESD | Meets EN/IEC 61000-4-2 Level 3 (6 kV contact discharge, 8 kV air discharge). | | | | |
| Radiated Immunity | Meets EN/IEC 61000-4-3 Level 3 (10 V/m). | | | | |
| Electrical Fast Transient Burst | Meets 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 | 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. |

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

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

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

GE Energy

CP2725AC54TE CPL High Efficiency Rectifier

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Status and Control

The Rectifier provides two means for monitor/control: analog or I²C.

Details of analog controls are provided in this data sheet under Signal Definitions. GE Energy will provide separate application notes on the I²C protocol for users to interface to the CPL rectifiers. Contact your local GE Energy representative for details.

Hot Plug

Care should be taken extracting and reinserting modules to allow for depletion of internal bias. Reinsertion should be delayed for about 60 seconds to guarantee resetting of the internal circuitry into its default state.

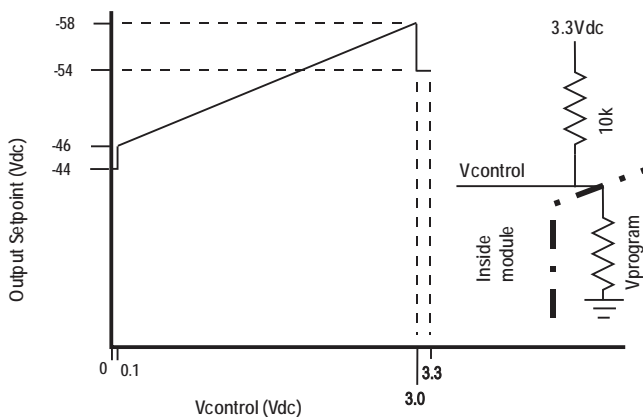
Without bleeding down internal bias, the module may remember its last assigned address and may not configure itself properly if reinserted into another slot.

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: The output voltage set point of the rectifier can be changed by adjusting the voltage at the Margin pin. The Margin pin voltage can be adjusted either via an adjustable external voltage source or a resistance divider. The margining pin is connected to 3.3Vdc via a 10k Ω resistor inside the rectifier as shown in the graph below. The graph below also shows the relationship between the output voltage setpoint and the margin pin voltage.



An open circuit on this pin sets 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 rectifier is inserted. A 500 Ω 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. When the voltage on this pin exceeds 1Vdc, the write_protect feature of the EEPROM is enabled.

Protocol Select: Establishes the communications mode of the rectifier, between analog/I²C and RS485 modes. For RS485, connect a 10k Ω pull-down resistor from this pin to 54_OUT(-DC).

Enable: On/Off control when I²C communications are utilized as configured by the Protocol pin. This pin must be pulled low to turn **ON** the rectifier. The rectifier 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 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 (-DC) for the rectifier to be ON.

Output Signals

Power Capacity: A HI on this pin indicates that the rectifier delivers high line rated output power; a LO indicates that the rectifier is connected to low line configured for 1200W operation.

Power Fail Warning: This signal is HI when the main output is being delivered and goes LO for the duration listed in this data sheet prior to the output decaying below the voltage level listed in this data sheet.

Alert #: I²C interrupt signal, functionally equivalent to the PMBus #SMBALERT 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 ³ | LO |
| AC Present but not within limits | Blinks | 0 | 0 | 0 | HI | HI | LO | LO |
| AC not present ¹ | 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 ² | 1 | 1 | 0 | 1 | LO | HI | HI | LO |
| 1 Missing Module | | | | | | | | HI ⁴ |
| 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 |

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

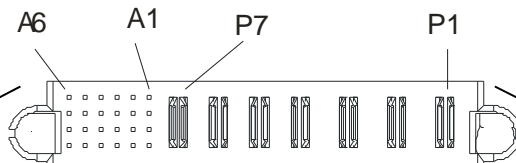
² Any detectable fault condition that does not result in the power supply shutting down. For example, ORing FET failure, boost section out of regulation, etc.

³ Signal transition from HI to LO is output load dependent

⁴ 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



Manufacturer part numbers: FCI 51939-568

| | SIGNAL | | | | | | OUTPUT POWER | | | | INPUT POWER | | |
|---|--------|----------|----------|-----------|---------|------------|--------------|-------|-------|-------|-------------|-----------|--------|
| | 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

Earth Last to make-first to break shortest pin

Earth First make-last to break longest pin implemented in the mating connector

CP2725AC54TE CPL High Efficiency Rectifier

Input: 100-120/200-277 Vac; Default Output: ± 54 Vdc @ 2725W; 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 through external pull-up resistors. 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 ² 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 ² C Interrupt | Alert#_0 Alert#_1 | Output | Interrupt signal via I ² C lines indicating that service is requested from the host controller. This signal pin is pulled up to 3.3V via a 10k Ω 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 ² C lines to I ² 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 ² C Line 0 | SCL_0, SDA_0 | Input | I ² C line 0. |
| I ² C Line 1 | SCL_1, SDA_1 | Input | I ² C line 1. |
| I ² C Interrupt | Alert# | Output | Goes active LO |
| RS485 Line | RS_485+ RS_485- | Bi-direct | RS485 line. |

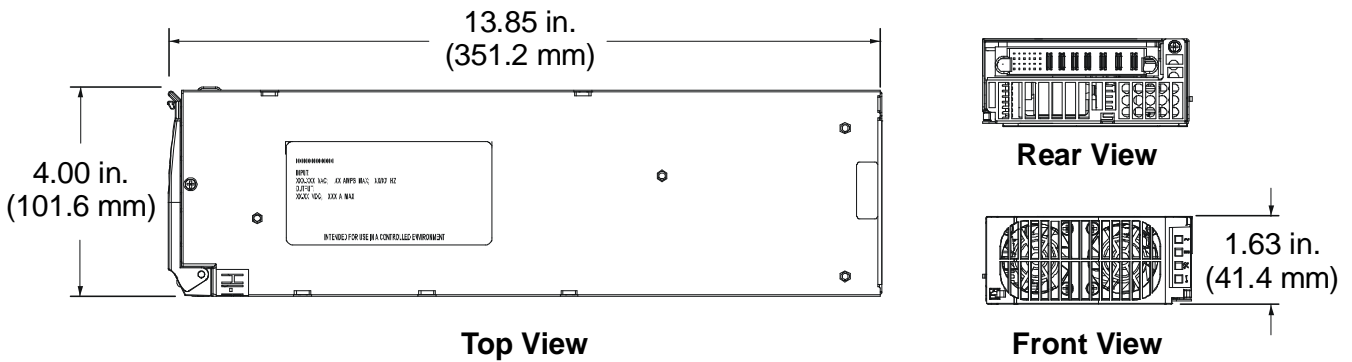
CP2725AC54TE CPL High Efficiency Rectifier

Input: 100-120/200-277 Vac; Default Output: ±54 Vdc @ 2725W; 5 Vdc @ 4W

Front Panel LEDs

| | Analog Mode | I ² 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 |

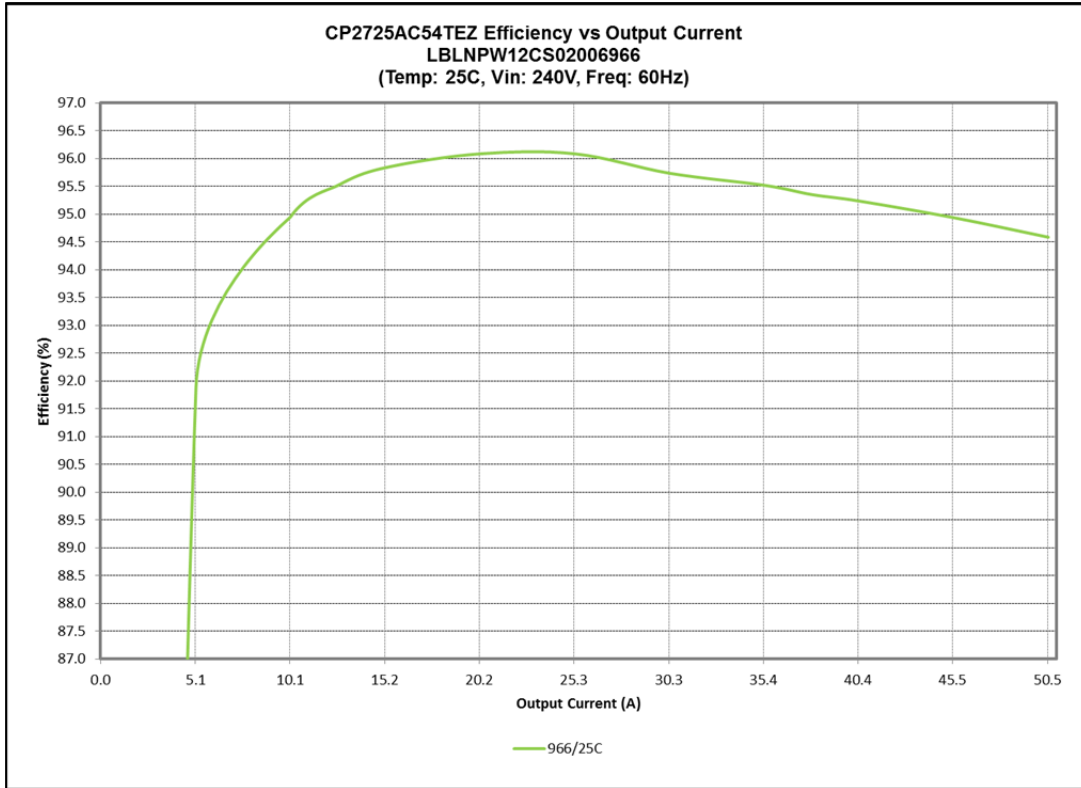
Ordering Information

| Item | Description | Comcode |
|---------------|--|-------------|
| CP2725AC54TEZ | 54Vdc @ 50A, 5Vdc @ 0.75A, RoHS 6/6 | CC109149423 |
| CP2725AC54TEP | 54Vdc @ 50A, 5Vdc @ 0.75A, RoHS 6/6, POE compliant | CC109167632 |

CP2725AC54TE CPL High Efficiency Rectifier

Input: 100-120/200-277 Vac; Default Output: ± 54 Vdc @ 2725W; 5 Vdc @ 4W

Typical Efficiency



Contact Us

For more information, call us at

USA/Canada:

+1 888 546 3243, or +1 972 244 9288

Asia-Pacific:

+86.021.54279977*808

Europe, Middle-East and Africa:

+49.89.878067-280

India:

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