LINEAGE POWER

Compact Power Line
CP2000DC54-PE DC/DC Converter
Input: -40 to -72 Vdc; Outputs: ±54 Vdc at 2000W; 5 Vdc at 4W

Applications

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

Features

- Compact 1-RU form factor providing 22 W/in3
- Input Current < 60A at 40 Vdc input
- Programmable output voltage from 44V to 58 Vdc,
- Output defaulted to 54V
- PMBus compliant dual I^2C serial bus communications
- Designed to IEEE802.3af Compliance, 2250 output*** isolation to chassis/signals for POE applications. (see ordering info)
- DC Output over-voltage and over-current protection
- DC Input over-voltage and under-voltage 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 [§]
- Internal variable-speed fan control
- RoHS 5 compliant

The CP2000DC54-PE DC/DC Converter, also called a Power Entry Module (PEM) in the Compact Power Line platform is specifically designed to operate as an integral part of a complete distributed power system. The high-density, front-to-back airflow PEM is designed for minimal space utilization and is highly expandable for future growth. It is provided with many features including PoE isolation, and dual-redundant I^2C communications busses that allow it to be used in a broad range of applications. The flexible feature set makes this Power Entry Module an excellent choice for applications requiring modular dc-to-dc bulk intermediate voltages, such as in distributed power.

Specifications

Input					
Parameter	**Min**	**Typ**	**Max**	**Units**	**Notes**
Operating Voltage	-40		-72	Vdc	
Low Input Shutdown of Main output	-38.5	-39	-39.5	Vdc	
Input Turn-ON of both Outputs	-43	-43.5	-44	Vdc	
Reverse Input Voltage	The module shall not be damaged				
Idling Power Output OFF Output ON			35 60	W	5Vdc output at no-load Both outputs at no-load
Input Current			60	Adc	At input voltages > 40Vdc
Cold Start Inrush Current			60	Adc	Measured at 25°C for all line conditions. Does not include X-capacitor charging spike
Efficiency	88 82	90 84		%	From 75% to 100% of full load For loads > 25% of full load
Holdup Time	8			ms	Minimum Vin = 48Vdc, output at ½ Full Load, output can droop down to -40Vdc
Ride Through	8			ms	
Input Capacitance			25	μF	

Main Output					
Parameter	**Min**	**Typ**	**Max**	**Units**	**Notes**
Maximum Output Power			2000	W	At voltages > 54Vdc
Output Voltage Setpoint		54		Vdc	Output floats with respect to frame ground.

Voltage Regulation
     Set Point at 50% FL
     Set Point Tolerance
     Set Point Regulation
     Droop Regulation
     Droop Accuracy
	
	 -0.5
	 -1
	
	 -5
		
		 54
		
		 1
		
			 0.5
			 1
			
			 5
				
				 Vdc
				 %
				 %
				 Vdc
				 %
					Resets to factory setting if power is removed
					
					 All conditions (temp, line, drift)
					 Linear from 1 to 39 A.
					 All conditions (temp, line, drift)

Output Voltage Range	44		58	Vdc	Set either by I^{2}C, or analog margining.
Output Current	0.1		37	A	At 54Vdc. Below 0.1A the module meets its regulation requirements.
Reverse (sink) output current			0.5	A	Isolation function provided
Active Current Share	-5		5	%FL	Single-wire connection. Loads > 25%FL
Passive Current Share	-15		+15	%FL	Between modules without the single wire connection. Loads > 25%FL

Output Ripple (5 to 20MHz)
     RMS
     Peak-to-Peak
     Psophometric Noise
			
			 250
			 500
			 2
				
				 mVrms
				 mVpk-pk
				 mVrms
					Measured with 20MHz bandwidth under any condition of loading. Minimum load is 1A. Phosphomeric noise measured with battery inserted at the input terminations.

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.

Specifications (continued)

Output (continued)					
Parameter	**Min**	**Typ**	**Max**	**Units**	**Notes**
Turn-On					Monotonic Turn_On after detection of valid DC input voltage. Measured from 30% to 100% of Vnom.
Delay		5		s	
Rise Time[1]		500		ms	
Overshoot			5	%	
Restart Shutdown Delay		20		S	Shutdown is delayed during a re-start in order to guarantee restart of multiple paralleled modules.
Load Step Response					$\Delta I/\Delta t$ slew rate 1A/µs. Settling time to within regulation requirements.
ΔI			50	%FL	
ΔV		2.0		Vdc	
Response Time		2		ms	
Overload[2]					
Current Limit	38.9		43	Adc	Fold-down.
Shutdown			39	Vdc	Default state – hiccup mode
System Start-up	A 20 second shutdown delay is implemented to allow modules to be plugged in one at a time. During this time fold-down occurs but the module will not shut down below 39Vdc.				
Over-voltage					
Delayed			60	Vdc	200msec delayed shutdown implemented.
Instantaneous			65	Vdc	Latched shutdown without hiccup.
Latchoff	Three restart attempts are implemented within a one minute window prior to a latched shutdown when Vout < 65Vdc. Beyond 1 minute the counter restarts				
Over-temperature					
Warning		5		°C	Implemented prior to commencement of an OT shutdown
Shutdown	20			°C	Below the maximum rating of the device being protected
Auto-recoverable	Temperature hysteresis of approximately 10°C provided between shutdown and restart.				

Auxiliary Output					
Parameter	**Min**	**Typ**	**Max**	**Units**	**Notes**
ON when the input voltage is	-26		-72	Vdc	
Output Voltage Setpoint		5.2		Vdc	Isolated from the main output to meet POE requirements. 50mA dedicated for powering adjacent PEMs during a fault. 700mA available for external use.
Output Current	0.005		0.75	A	
Overall Regulation	-5		+5	%	
Ripple and Noise		50	100	mVpk-pk	20MHz bandwidth. Measured across a 1µF tantalum and a 0.1µF ceramic capacitor
			25	mVrms	
Over-voltage Clamp			7	Vdc	
Over-current Limit	110		175	%FL	

[1] *Below -5°C the rise time is approximately 5 minutes to protect bulk capacitors in the unit*

[2] *Hiccup performance attempts automatic recovery from an overload shutdown with approximately a 90% off-time duty cycle. The duty cycle varies periodically in order to guarantee multi-module recovery synchronization. Latchoff can be chosen via software instead of the default hiccup. Recovery from a latchoff requires ENABLING, or software commanding OFF followed by an ON after a 2 second delay.*

Specifications (continued)

Physical	
Length (in./mm)	13.85 / 351.8
Width (in./mm)	4.00 / 101.6
Height (in./mm)	1.66 / 42.2
Weight (lb/kg)	4.6 / 2.1

Environmental					
Parameter	Min	Typ	Max	Units	Notes
Ambient Temperature Operating Ambient Derating Power Derating[2]	-5^2	1	45 1	°C °C %/°C	Air inlet from sea level to 5,000 feet. Per 1,000 feet above 5,000 feet. Up to 55°C
Storage Temperature	-40		85	°C	
Humidity	5		95	%	Relative humidity, non-condensing
Shock and Vibration Operational Test Test Levels Drop and Tip Over					IEC 68-2 IEC 721-3-2 IEC 68-2-31
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.
Radiated Emissions[3]	FCC and CISPR22 (EN55022) - Class A[3]				
Conducted Emissions - dc	Telcordia GR-1089-CORE and CISPR22 (EN55022) - Class A				
ESD	Error free per EN/IEC 61000-4-2 Level 4 (8 kV contact discharge, 15 kV air discharge).				
Radiated Immunity	Error free per EN/IEC 61000-4-3 Level 3 (10 V/m).				
Differential mode surge			100	Vdc	ANSI T1.315, No errors
Differential mode surge transient			1000	Vdc	No errors. IEEE C62.41 defined pulse transient
Common mode surge (1.2/50μs pulse)			1000	Vdc	
Conducted Immunity	Error free per EN/IEC 61000-4-6 Level 3 (10Vrms).				
Reliability (calculated)		400,000		Hours	At ambient of 25°C at full load per Telcordia SR-332, Reliability Prediction for Electronic Equipment, Method I Case III.
Isolation Input-Chassis/Signals Input-Output/Signals Output-Chassis/Signals Main-Aux Outputs	1700 2250 2250 2250			Vdc	Per EN60950. Per IEEE802.3af.
Service Life		10		Years	25°C ambient, full load excluding fans.

2. Designed to start at an ambient as low as -40°C, but may not meet operational limits until above -5°C.
3. Radiated emissions compliance was met using a Lineage Power shelf. This shelf includes output common and differential
mode capacitors that assist in meeting compliance.

Status and Control

The PEM provides two means for monitor/control: analog or I^{2}C.

Details of analog controls are provided in this data sheet under Signal Definitions. Lineage Power will provide separate application notes on the I^{2}C protocol for users to interface to the CPL PEMs. Contact your local Lineage Power 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 PEM 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 10kΩ resistor inside the PEM. See graphs below.
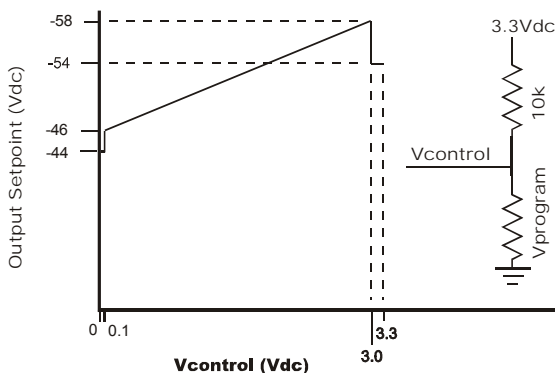
An open circuit on this pin reverts the voltage level back to the original setting.

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 500Ω 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^{2}C and RS485 modes. For RS485, connect 10kΩ pull-down resistor to 54_OUT(-DC).

Enable: On/Off control when I^{2}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^{2}C interrupt signal.

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

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

Alarm Table

Condition	Power Supply LED State					Monitoring Signals (Referenced to Logic_GRD)				
	IN OK Green	DC OK Green	Service Amber	Fault Red		Fault	OTW	Power OK	I_Limit	Module Present
OK	1	1	0	0		HI	HI	HI	HI	LO
Thermal Alarm (5C before shutdown)	1	1	1	0		HI	LO	HI	HI	LO
Thermal Shutdown	1	0	1	1		LO	LO	LO	HI	LO
Defective Fan	1	0	0	1		LO	HI	LO	HI	LO
Blown Input Fuse in Unit	1	0	0	1		LO	HI	LO	HI	LO
No Input > 8mS (single unit)	0	1	0	0		HI	HI	LO[2]	HI	LO
Input Present but not within limits	0	0	0	0		HI	HI	LO	HI	LO
Input not present (with back bias)	0	0	0	0		HI	HI	LO	HI	LO
Over Voltage Latched Shutdown	1	0	0	1		LO	HI	LO	HI	LO
Over Current	1	Blinks	0	0		HI	HI	LO	LO	LO
Over Current Shutdown	1	0	0	1		HI	HI	LO	LO	LO
Non-catastrophic Internal Failure[1]	1	1	0	1		LO	HI	HI	HI	LO
1 Missing Module (external pull-up)										HI
Standby (remote)	1	0	0	0		HI	HI	LO	HI	LO
Service Request (i²C mode)	1	1	Blinks	0		HI	HI	HI	HI	LO

[1] *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.*
[2] *Signal transition from HI to LO is output load dependent*

Output Connector

Mating Connector: AMP 1450572-1
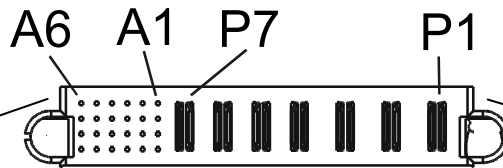
	Signal						Output Power		Input Power				
	6	5	4	3	2	1	P7	P6	P5	P4	P3	P2	P1
A	SCL_0	MOD_PRES	Ilimit	LOGIC_GRD	RS 485+	UNIT_ADDR							
B	SCL_1	OTW	Alert#_0	Alert#_1	RS 485-	8V_INT	V_OUT (-DC)	V_OUT (+DC)	CO_RTN Vin (+)		EARTH (GND)	CO_LINE Vin (-)	
C	SDA_0	Margin	Enable	Reset	Ishare	N/C							
D	SDA_1	Fault	5VA	Power_OK	ON/OFF	SHELF_ADDR							

Connector is viewed from the rear positioned inside the power supply.

Signal pins columns 1 and 2 are referenced to V_OUT (-DC).

Signal pins columns 3 through 6 are referenced to Logic GRD.

☐ Last-to-make first-to-break pins.

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

☐ N/C – no connect pins must be left open. Do not connect these pins to either voltage sources or ground.
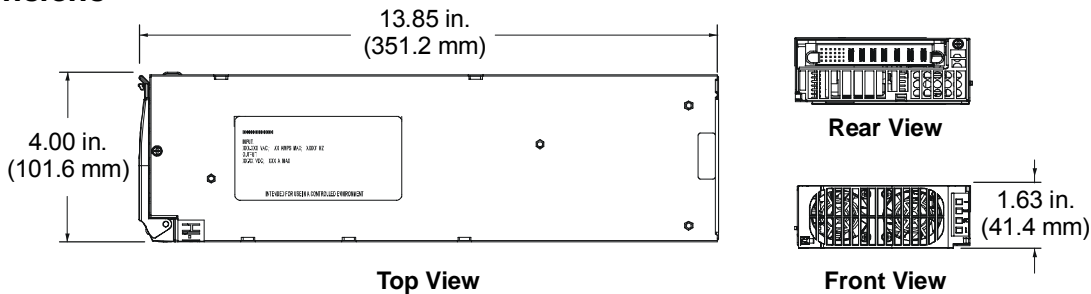
Signal Definitions

All hardware alarm signals (Fault, Power_OK, I_Limit, OTW) 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 is 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 PEM output is enabled when using I^2C mode of operation. May also be toggled to reset a latched OFF PEM.
Output Good	Power_OK	Output	An open drain FET; normally HI, indicating output power is present. Changes to LO when the main output is OFF,
Current Limit	I_Limit	Output	An open drain FET; normally HI, indicating normal operation. Changes to LO when in current limit,
I^2C Interrupt	Alert#_0 Alert#_1	Output	Interrupt signal via I^2C lines indicating that service is requested from the host controller. This signal pin is pulled up to 3.3V via a 10kΩ resistor and switches to active LO when an interrupt occurs.
PEM Fault	Fault	Output	Indicates that an internal fault exists. An open drain FET; normally HI, changes to LO.
Module Present	MOD_PRES	Output	Used to Indicate presence of PEM.
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: V_OUT (-DC)
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.
PEM address	Unit_addr	Input	Voltage level addressing of PEMs within a single shelf. Ref: V_OUT (-DC).
Shelf Address	Shelf_addr	Input	Voltage level addressing of PEMs within multiple shelves. Ref: V_OUT (-DC).
Back bias	8V_INT	_	Diode OR'ed 8Vdc drain; used to back bias microprocessors and DSP of failed PEM from operating PEMs. Ref: V_OUT (-DC).
Mux Reset	Reset	Input	Resets the I^2C lines to I^2C 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	-	A single wire interface between each of the power unit forces them to share the load current. Ref: V_OUT (-DC).
I^2C Line 0	SCL_0, SDA_0	Input	I^2C line 0.
I^2C Line 1	SCL_1, SDA_1	Input	I^2C line 1.

Front Panel LEDs

	Analog Mode	I²C Mode
⬜→⊙	← —————	**ON:** Input ok **OFF:** Input out of limits	————— →
⬜→	← —————	**ON:** Output ok **Blinking:** Overload	————— →
⬜✖	**ON:** Over-temperature Warning	**ON:** Over-temperature Warning **Blinking:** Service
⬜!	← —————	**ON:** Fault	————— →

Dimensions

13.85 in.
(351.2 mm)

4.00 in.
(101.6 mm)

Top View

Rear View

1.63 in.
(41.4 mm)

Front View

Ordering Information

Item	Description	Comcode
CP2000DC54-PE	Designed and factory tested to IEEE802.3af POE compliance, Auxiliary Output: 5Vdc at 0.75A.	CC109146692

Consult the 1U shelf data sheet for potential shelf configurations for this module from Lineage Power.

LINEAGE POWER