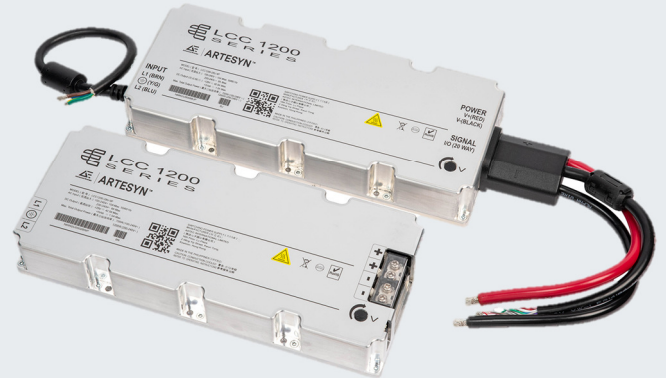


# ARTESYN

## LCC1200 SERIES

### 1200 Watts Conduction Cooling



## PRODUCT DESCRIPTION

Advanced Energy's Artesyn LCC1200 series of fully enclosed conduction cooled AC-DC power supplies comprises three models, offering main output voltages of 24 V, 28 V or 48 V. Each model also provides a 5 V standby output that can supply up to 1.5 A. Rated at 1200 W, these power supplies incorporate a thermal baseplate and are capable of delivering full output power over a wide operating baseplate temperature range of -40 to 85°C. For maximum applications flexibility, the main output is adjustable. The 28 V model, for example, can be adjusted from 24 to 30 V and has a maximum current rating of 42.9 A.

## AT A GLANCE

### Total Power

1200 Watts

### Input Voltage

90 to 264 Vac

### # of Outputs

Main and Standby

## SPECIAL FEATURES

- Full power up to 85°C baseplate temperature
- Wide operating temperature range (-40°C to 95°C baseplate)
- Adjustable output
- Remote output on/off
- AC\_OK, DC\_OK signals
- 5 V standby voltage
- Active current share
- Conduction-cooled/fanless
- I<sup>2</sup>C/PMBus™
- Active power factor correction
- ITE safety
- Optional IP65 variant (-4P suffix)
- Build-in OR-ing FETs for parallel operation
- 3 years warranty

## COMPLIANCE

- EMI Class B
- EN 61000 immunity

## SAFETY

- UL + CSA IEC 62368-1
- Demko IEC 62368-1
- CB Scheme IEC 60950-1/IEC 62368-1
- CCC
- CE Mark
- UKCA Mark



## MODEL NUMBERS

| Standard         | Output Voltage | Output Adjustment Range | Constant Voltage Mode |          | Constant Current Mode <sup>2</sup> |             |          |          | Max Output Power <sup>1</sup> | Standby Output | IP Rating |
|------------------|----------------|-------------------------|-----------------------|----------|------------------------------------|-------------|----------|----------|-------------------------------|----------------|-----------|
|                  |                |                         | Min Load              | Max Load | Min CV Load                        | Max CV Load | Min Prog | Max Prog |                               |                |           |
| LCC1200-28U-4P   | 28             | 24 to 30 V              | 0                     | 42.9 A   | 14 V                               | 30 V        | 5%       | 100%     | 1200 W                        | 5 V@1.5 A      | IP65      |
| LCC1200-28U-9P   | 28             | 24 to 30 V              | 0                     | 42.9 A   | 14 V                               | 30 V        | 5%       | 100%     | 1200 W                        | 5 V@1.5 A      | IP20      |
| LCC1200-28U-4P24 | 24             | -                       | 0                     | 50.0 A   | 14 V                               | 24 V        | 5%       | 100%     | 1200 W                        | 5 V@1.5 A      | IP65      |
| LCC1200-28U-9P24 | 24             | -                       | 0                     | 50.0 A   | 14 V                               | 24 V        | 5%       | 100%     | 1200 W                        | 5 V@1.5 A      | IP20      |
| LCC1200-48U-4P   | 48             | 42 to 57.6 V            | 0                     | 25.0 A   | 24 V                               | 57.6 V      | 5%       | 100%     | 1200 W                        | 5 V@1.5 A      | IP65      |
| LCC1200-48U-9P   | 48             | 42 to 57.6 V            | 0                     | 25.0 A   | 24 V                               | 57.6 V      | 5%       | 100%     | 1200 W                        | 5 V@1.5 A      | IP20      |

Note 1 -  $90 \leq V_{IN} \leq 179$  Vac,  $P_O = 800$  W;  $V_{IN} \geq 180$  Vac,  $P_O = 1200$  W.

Note 2 - Refer to Output Current Adjustment section

## ELECTRICAL SPECIFICATIONS

### Absolute Maximum Ratings

Stress in excess of those listed in the “Absolute Maximum Ratings” may cause permanent damage to the power supply. These are stress ratings only and functional operation of the unit is not implied at these or any other conditions above those given in the operational sections of this TRN. Exposure to any absolute maximum rated condition for extended periods may adversely affect the power supply’s reliability.

| Table 1. Absolute Maximum Ratings                                                                                    |                          |                 |             |             |                     |                   |
|----------------------------------------------------------------------------------------------------------------------|--------------------------|-----------------|-------------|-------------|---------------------|-------------------|
| Parameter                                                                                                            | Model                    | Symbol          | Min         | Typ         | Max                 | Unit              |
| Input Voltage<br>AC continuous operation                                                                             | All models               | $V_{IN,AC}$     | 90          | -           | 264                 | Vac               |
| Maximum Output Power<br>90 Vac $\leq V_{IN} \leq 179$ Vac<br>180 Vac $\leq V_{IN} \leq 264$ Vac                      | All models               | $P_{O,max}$     | -<br>-      | -<br>-      | 800<br>1200         | W<br>W            |
| Isolation Voltage (Qualification)<br>Input to output<br>Input to safety ground<br>Outputs to safety ground           | All models               |                 | -<br>-<br>- | -<br>-<br>- | 3000<br>1500<br>500 | Vac<br>Vac<br>Vdc |
| Isolation Voltage (Production) <sup>1</sup><br>Input to output<br>Input to safety ground<br>Outputs to safety ground | All models               |                 | -<br>-<br>- | -<br>-<br>- | 2500<br>2200<br>500 | Vdc<br>Vdc<br>Vdc |
| Baseplate Operating Temperature <sup>2</sup>                                                                         | All models               | $T_{BASEPLATE}$ | -40         | -           | +95                 | °C                |
| Storage Temperature                                                                                                  | All models               | $T_{STG}$       | -40         | -           | +85                 | °C                |
| Ambient Temperature                                                                                                  | All models               | $T_{AMB}$       | -40         | -           | +50                 | °C                |
| Humidity (non-condensing)<br>Operating<br>Non-operating                                                              | All models<br>All models |                 | 10<br>10    | -<br>-      | 95<br>95            | %<br>%            |
| Altitude<br>Operating<br>Non-operating                                                                               | All models<br>All models |                 | -<br>-      | -<br>-      | 16,402<br>50,000    | feet<br>feet      |

Note 1 - Duration 2 to 6 Sec, maximum trip current is 10 mA (For AC Hi-Pot). Arc detect is Mid-level.

Note 2 - Refer Figure 25 and Figure 26 on page 24 and page 25 for details.

## ELECTRICAL SPECIFICATIONS

## Input Specifications

| Table 2. Input Specifications                                                                            |                                                                                                                                  |                  |                                                   |                              |                              |                 |
|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------------------|------------------------------|------------------------------|-----------------|
| Parameter                                                                                                | Condition                                                                                                                        | Symbol           | Min                                               | Typ                          | Max                          | Unit            |
| Operating Input Voltage, AC <sup>1</sup>                                                                 | All                                                                                                                              | $V_{IN,AC}$      | 90                                                | 115/230                      | 264                          | Vac             |
| Input AC Frequency                                                                                       | All                                                                                                                              | $f_{IN,AC}$      | 47                                                | 50/60                        | 63(440 <sup>2</sup> )        | Hz              |
| Startup Surge Current (Inrush)<br>@ 25°C <sup>3</sup>                                                    | $V_{IN,AC} = 264 \text{ Vac}$                                                                                                    |                  | -                                                 | -                            | 25                           | A <sub>PK</sub> |
| Input Current<br>( $V_O = \text{On}$ , $I_O = I_{O,max}$ )                                               | 50/60 Hz<br>$V_{IN,AC} = 90 \text{ Vac}$<br>$V_{IN,AC} = 180 \text{ Vac}$                                                        | $I_{IN,max}$     | -<br>-                                            | -<br>-                       | 11.5<br>8                    | A               |
| No Load Input Power <sup>4</sup><br>( $V_O = \text{On}$ , $I_O = 0 \text{ A}$ , $I_{SB} = 0 \text{ A}$ ) | $V_{IN,AC} = 180 \text{ Vac}$                                                                                                    | $P_{IN,no-load}$ | -                                                 | -                            | 15                           | W               |
| Standby Input Power<br>( $V_O = \text{Off}$ , $I_{SB} = 0 \text{ A}$ )                                   | $V_{IN,AC} = 180 \text{ Vac}$                                                                                                    | $P_{IN,no-load}$ | -                                                 | -                            | 8                            | W               |
| Harmonic Line Currents                                                                                   | All                                                                                                                              | THD              | Per EN 61000-3-2 Class A and Class C <sup>5</sup> |                              |                              |                 |
| Power Factor <sup>6</sup><br>(47 - 63 Hz)                                                                | $V_{IN,AC} = 100 \text{ Vac}$<br>$V_{IN,AC} = 180 \text{ Vac}$<br>$V_{IN,AC} = 230 \text{ Vac}$<br>$V_{IN,AC} = 264 \text{ Vac}$ | PF               | -<br>-<br>-<br>-                                  | 0.98<br>0.98<br>0.96<br>0.93 | 0.98<br>0.99<br>0.97<br>0.96 |                 |
| Power Factor <sup>7</sup><br>(440 Hz)                                                                    | $V_{IN,AC} = 180 \text{ Vac}$<br>$V_{IN,AC} = 230 \text{ Vac}$<br>$V_{IN,AC} = 264 \text{ Vac}$                                  | PF               | -<br>-<br>-                                       | 0.78<br>0.50<br>0.46         | 0.88<br>0.69<br>0.63         |                 |
| Input Fuse                                                                                               | All                                                                                                                              |                  | -                                                 | -                            | 16                           | A               |
| Earth Leakage Current                                                                                    | $V_{IN,AC} = 264 \text{ Vac}$<br>50/60 Hz                                                                                        |                  | -                                                 | -                            | 3500                         | uA              |
| PFC Switching Frequency                                                                                  | All                                                                                                                              | $f_{SW,PFC}$     | -                                                 | 60                           | -                            | KHz             |
| Operating Efficiency                                                                                     | $T_{AMB} = 25^\circ\text{C}$<br>$I_O = I_{O,max}$<br>$V_{IN,AC} = 180 \text{ Vac}$                                               | $\eta$           | 91                                                | 93                           | -                            | %               |

Note 1 - Safety rating: 100 to 240 Vac, PSU can meet functional requirement with 90 to 264 Vac.

Note 2 - Safety rating: 50 or 60 Hz only.

Note 3 - Cold start, 25°C ambient temperature, excluding X caps.

Note 4 - Standalone operation only, input power is measured using a moving average function on power meter with 16 samples updating every 0.25 Sec, minimum load is 4% of full load current.

Note 5 - Meets Class C at 100% load.

Note 6 - The PSU has an active power factor, the requirements includes harmonics that meet AC Harmonic Current Emissions (IEC61000-3-2).

Note 7 - The PSU has an active power factor, and can be qualified to meet AC Harmonic Current Emissions (IEC61000-3-2).

## ELECTRICAL SPECIFICATIONS

## Output Specifications

| Table 3. Output Specifications                       |                  |                                                                                                                   |          |       |                  |                  |                     |
|------------------------------------------------------|------------------|-------------------------------------------------------------------------------------------------------------------|----------|-------|------------------|------------------|---------------------|
| Parameter                                            |                  | Condition                                                                                                         | Symbol   | Min   | Typ              | Max              | Unit                |
| Factory Set Voltage                                  | LCC1200-28U-XX24 | $I_O = 50\%I_{O,max}$                                                                                             | $V_O$    | 23.88 | 24.00            | 24.12            | Vdc                 |
|                                                      | LCC1200-28U      |                                                                                                                   |          | 27.86 | 28.00            | 28.14            |                     |
|                                                      | LCC1200-48U      |                                                                                                                   |          | 47.76 | 48.00            | 48.24            |                     |
| Output Voltage Adjustment Range                      | LCC1200-28U-XX24 | $I_O = 0$ A                                                                                                       | $V_O$    | -     | 24.00            | -                | Vdc                 |
|                                                      | LCC1200-28U      |                                                                                                                   |          | 24.00 | 28.00            | 30.00            |                     |
|                                                      | LCC1200-48U      |                                                                                                                   |          | 42.00 | 48.00            | 57.60            |                     |
| Output Current                                       | LCC1200-28U-XX24 | All                                                                                                               | $I_O$    | 0     | -                | 50               | A                   |
|                                                      | LCC1200-28U      |                                                                                                                   |          | 0     | -                | 42.9             |                     |
|                                                      | LCC1200-48U      |                                                                                                                   |          | 0     | -                | 25               |                     |
|                                                      | All models       | $I_{SB}$                                                                                                          | 0        | -     | 1.5 <sup>1</sup> |                  |                     |
| Output Regulation                                    | LCC1200-28U-XX24 | Inclusive of set-point, temperature change, warm-up drift                                                         | $V_O$    | 23.52 | 24.00            | 24.48            | Vdc                 |
|                                                      | LCC1200-28U      |                                                                                                                   |          | 27.44 | 28.00            | 28.56            |                     |
|                                                      | LCC1200-48U      |                                                                                                                   |          | 47.04 | 48.00            | 48.96            |                     |
|                                                      | All models       |                                                                                                                   | $V_{SB}$ | 4.75  | 5.00             | 5.25             |                     |
| Output Ripple, pk-pk <sup>2</sup>                    | LCC1200-28U-XX24 | 20 MHz bandwidth, Measure with a 0.1 $\mu$ F ceramic capacitor in parallel with a 10 $\mu$ F E-cap <sup>3</sup> . | $V_O$    | -     | -                | 240              | mV <sub>PK-PK</sub> |
|                                                      | LCC1200-28U      |                                                                                                                   |          | -     | -                | 280 <sup>4</sup> |                     |
|                                                      | LCC1200-48U      |                                                                                                                   |          | -     | -                | 480              |                     |
|                                                      | All models       |                                                                                                                   | $V_{SB}$ | -     | -                | 50               |                     |
| Analog Dimming                                       |                  | By external voltage                                                                                               | -        | 0     | -                | 10               | Vdc                 |
|                                                      |                  | By external resistance                                                                                            |          | 0     | -                | 100              | K ohm               |
| Main Output Switching Frequency                      |                  | All                                                                                                               | $f_{SW}$ | -     | 200              | -                | KHz                 |
| Quantity of Units in Parallel Operation <sup>5</sup> |                  | Main Output "ISHARE" connected                                                                                    | -        | -     | -                | 3                | Units               |
| V <sub>O</sub> Load Capacitance                      |                  | Start up                                                                                                          | -        | 0     | -                | 330              | uF/A                |

Note 1 - Including parallel/redundant application. Standby output only support droop current share.

Note 2 - If voltage is adjust above nominal setting, ripple expected is 1% of output voltage. Ripple noise at extreme low temperature (below 0°C) is expected higher until unit gets stabilized due to ESR change of the E-caps. Ripple noise at -20°C ambient is expected to be around +/-10% of output voltage. For LCC1200-28U, the main output peak to peak ripple is less than 300 mV at no load condition.

Note 3 - Ripple noise measurement below -20°C ambient is measured together with minimum load capacitance of 1000  $\mu$ F with maximum ESR of 14 mohm.

Note 4 - Main output ripple at absolute no load: power supply expected to enter burst operation mode, peak to peak ripple on main output should be <300 mV for LCC1200-28U.

Note 5 - Power supply designed with output OR'ing built in. ISHARE pin for main output only.

## ELECTRICAL SPECIFICATIONS

## Output Specifications

| Table 3. Output Specifications                  |                                                                                                                                               |                              |     |     |     |      |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-----|-----|-----|------|
| Parameter                                       | Condition                                                                                                                                     | Symbol                       | Min | Typ | Max | Unit |
| V <sub>O</sub> Dynamic Response <sup>1</sup>    | I <sub>O,min</sub> to 25% I <sub>O,max</sub>                                                                                                  | $\pm\%V_O$<br>T <sub>s</sub> | -   | -   | 5   | %    |
|                                                 | I <sub>O,min</sub> to 50% I <sub>O,max</sub><br>50% I <sub>O,max</sub> to I <sub>O,max</sub><br>slew rate = 1 A/us,<br>load frequency < 1 KHz |                              | -   | -   | 500 | mS   |
| V <sub>O</sub> Long Term Stability <sup>2</sup> | After thermal equilibrium<br>(30 mins, maximum)                                                                                               | $\pm\%V_O$                   | -   | -   | 2   | %    |

Note 1 - Tested with low ESR output capacitors and dynamic limits at 5°C to 85°C and with minimum capacitors of 1000 uF with maximum ESR of 14 m ohm, typically +/-5% of average nominal voltage. If operation conditions is at 0 to -40°C, the power supply will be able to handle dynamic load and regulation limits expected and typically -20%/+5% of average nominal voltage. I<sub>O,min</sub> is 50 W, tested with minimum output capacitor of 330 uF/A.

Note 2 - Input voltage for stability over time is 100 Vac and 200 Vac. Maximum change over 24 hours.

## ELECTRICAL SPECIFICATIONS

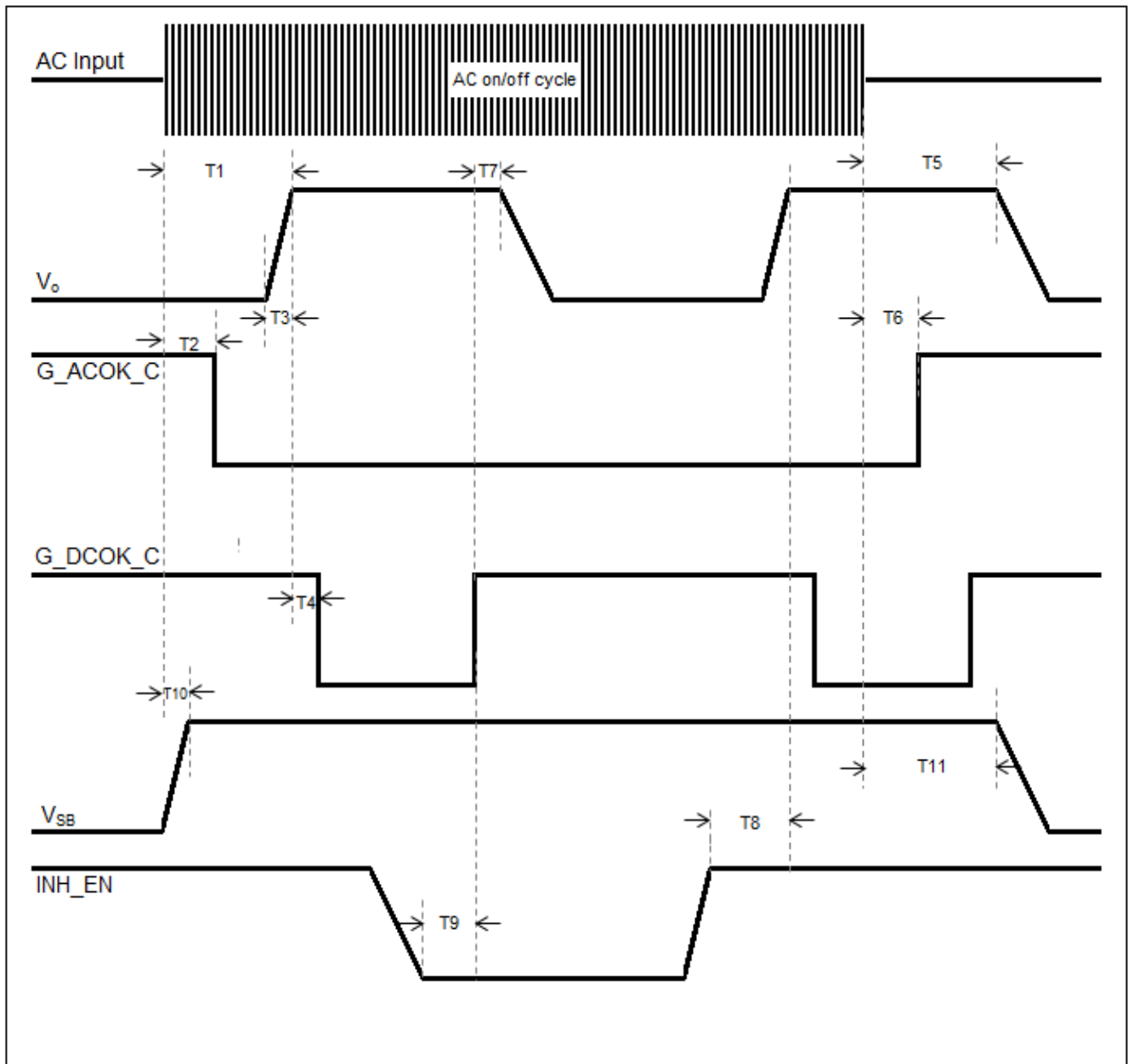
## System Timing Specifications

| Table 5. Specifications |                                                                                                                               |     |      |      |      |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----|------|------|------|
| Label                   | Parameter                                                                                                                     | Min | Typ  | Max  | Unit |
| T1                      | Delay from AC being applied to $V_O$ being within regulation                                                                  | -   | 1500 | 2500 | mS   |
| T2                      | Delay from AC being applied to G_ACOK_C signal assertion (going low)                                                          | 200 | 800  | 1500 | mS   |
| T3                      | $V_O$ rise time, 10% $V_O$ to 95% $V_O$ in regulation - LCC1200-28U <sup>1</sup>                                              | -   | -    | 100  | mS   |
|                         | $V_O$ rise time, 10% $V_O$ to 95% $V_O$ in regulation - LCC1200-48U <sup>1</sup>                                              | -   | -    | 210  | mS   |
| T4                      | Delay from $V_O$ within regulation to G_DCOK_C signal assertion (going Low)                                                   | -   | 200  | 500  | mS   |
| T5                      | Delay from AC loss to $V_O$ falling out of regulation. $V_O$ at nominal set point.                                            | 20  | 35   | -    | mS   |
| T6                      | Delay from AC loss to G_ACOK_C signal de-assertion (going high)                                                               | -   | 16   | 19   | mS   |
| T7                      | Delay from G_DCOK_C signal de-assertion (going high) to $V_O$ dropping to less than the output lower regulation range         | 1   | 9    | -    | mS   |
| T8                      | Delay from INH_EN going high to $V_O$ being within regulation                                                                 | -   | 112  | 1500 | mS   |
| T9                      | Delay from INH_EN assertion (pulled low) to G_DCOK_C signal going high.                                                       | -   | 3    | 8    | mS   |
| T10                     | Delay from AC being applied to $V_{SB}$ output being within regulation.                                                       | -   | 120  | 1500 | mS   |
| T11                     | Delay from AC loss to $V_{SB}$ going out of regulation. Last one to turn-off to guarantee other logic & control functionality | 30  | 120  | -    | mS   |

Note 1 - Capacitive load 330uF/A.

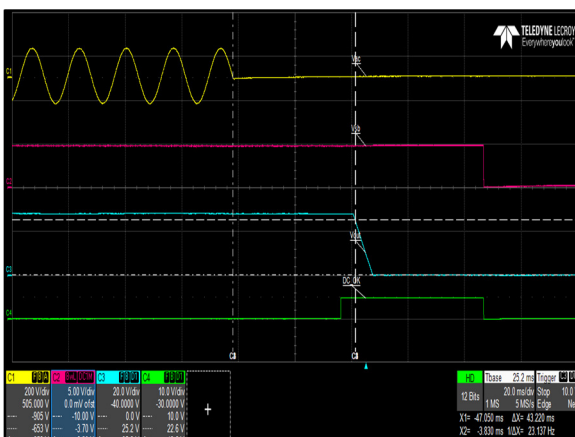
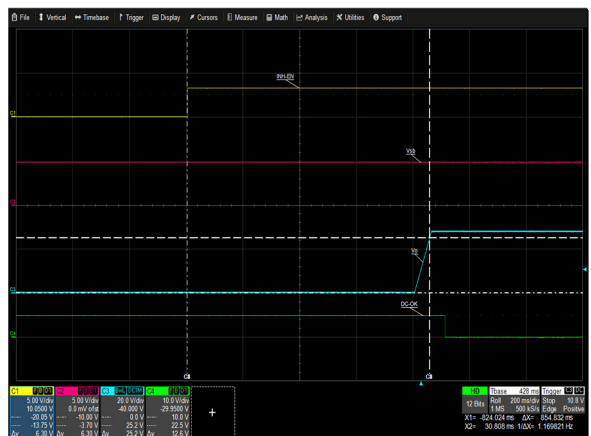
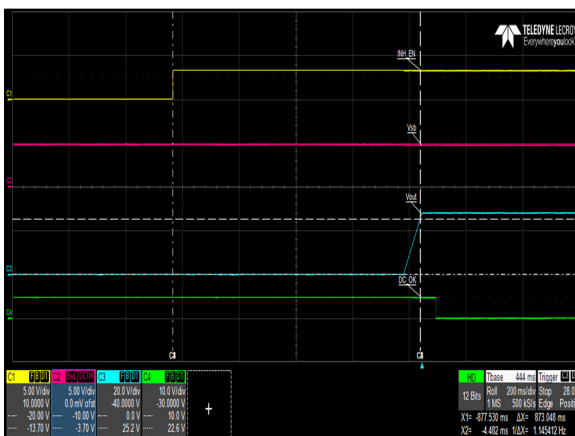
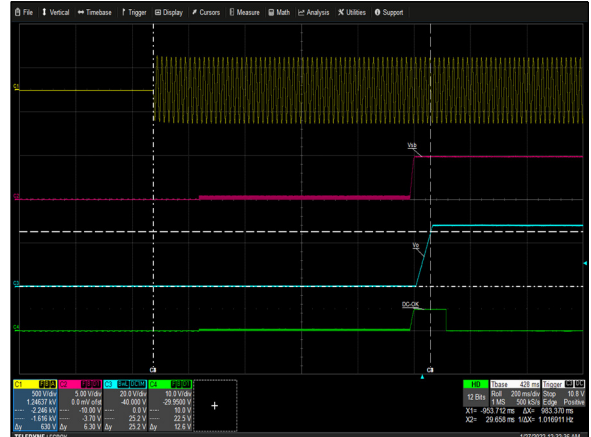
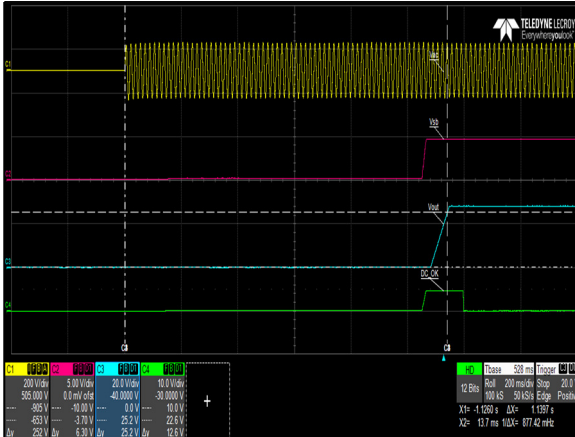
## ELECTRICAL SPECIFICATIONS

## System Timing Diagram



## ELECTRICAL SPECIFICATIONS

## LCC1200-28U-9P Performance Curves



## ELECTRICAL SPECIFICATIONS

## LCC1200-28U-9P Performance Curves

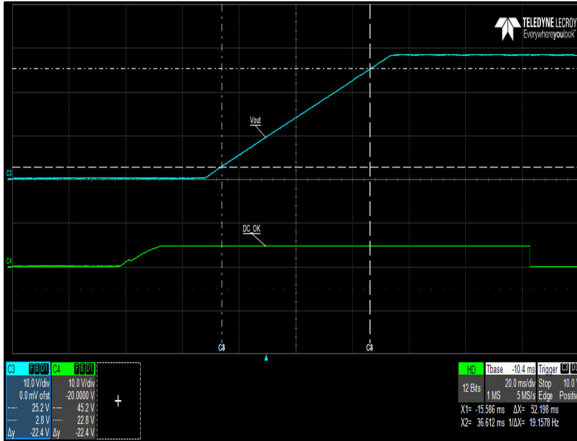


Figure 7: LCC1200-28U-9P Output Startup Characteristic  
 $V_{in} = 264V_{ac}$  Load:  $I_o = 28.57A$  (28V),  $I_{SB} = 1.5A$  (5V)  
 Ch 3:  $V_O$  Ch 4: G\_DCOK\_C



Figure 8: LCC1200-28U-9P Turn Off Characteristic via INH\_EN  
 Load:  $I_o = 42.9A$  (28V),  $I_{SB} = 1.5A$  (5V)  
 Ch 1: INH\_EN Ch 2:  $V_{SB}$  Ch 3:  $V_O$  CH 4: G\_DCOK\_C

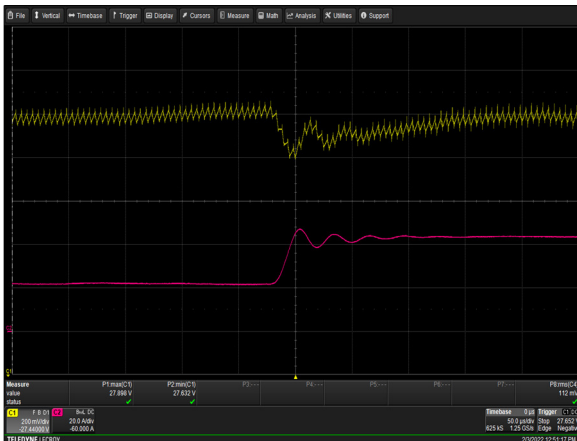


Figure 9: LCC1200-28U-9P Transient Response -  $V_O$  Deviation  
 50% to 100% load change (1KHz) 1A/uS slew rate  $V_{in} = 230V_{ac}$   
 Ch 1:  $V_O$  Ch 2:  $I_O$

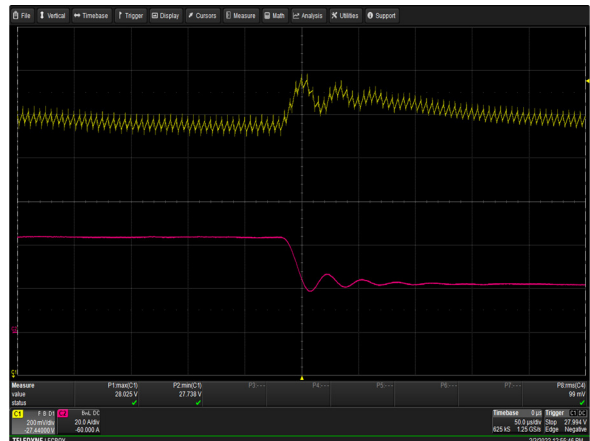


Figure 10: LCC1200-28U-9P Transient Response -  $V_O$  Deviation  
 100% to 50% load change (1KHz) 1A/uS slew rate  $V_{in} = 230V_{ac}$   
 Ch 1:  $V_O$  Ch 2:  $I_O$

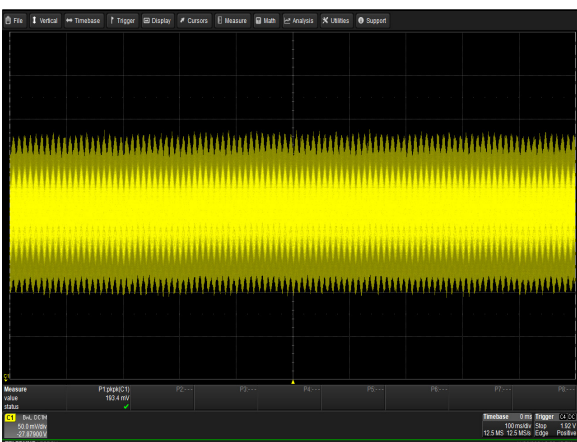


Figure 11: LCC1200-28U-9P Ripple and Noise Measurement  
 $V_{in} = 230V_{ac}$  Load:  $I_o = 42.9A$  (28V),  $I_{SB} = 1.5A$  (5V)  
 Ch 1:  $V_O$

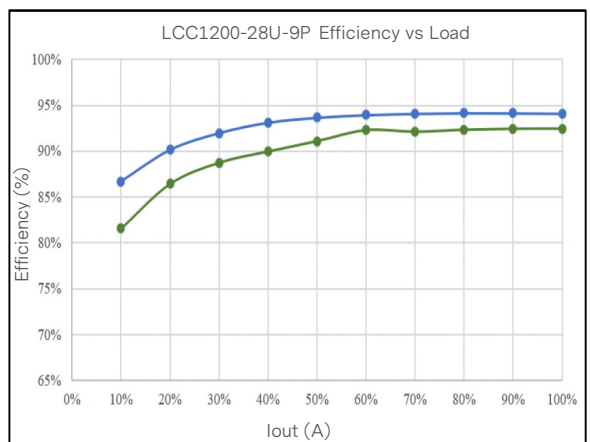
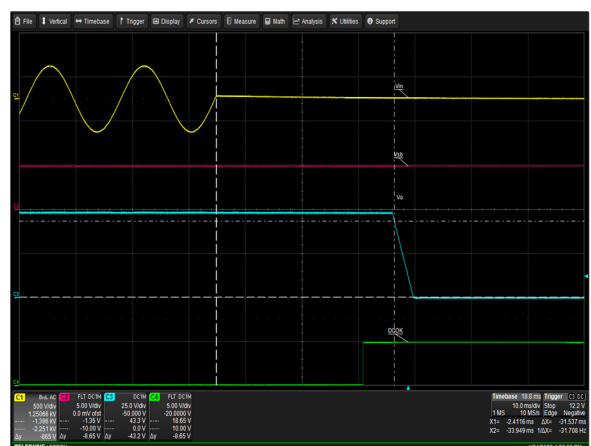
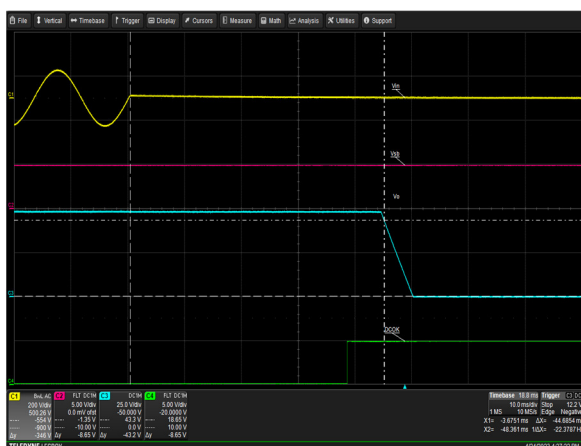
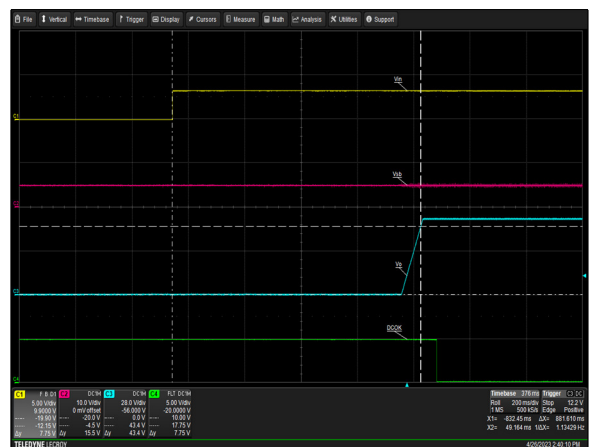
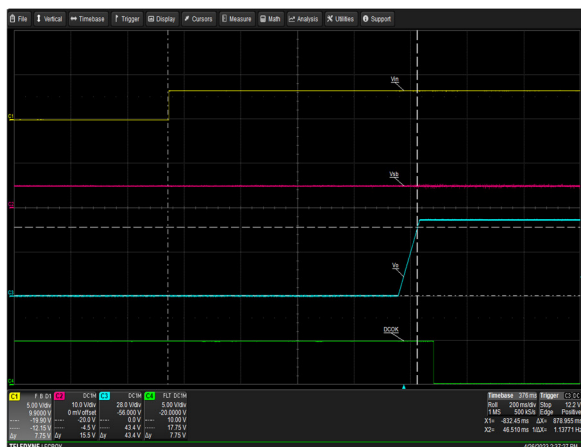
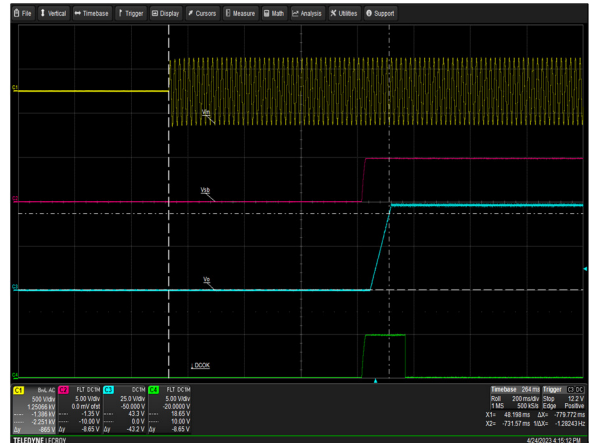
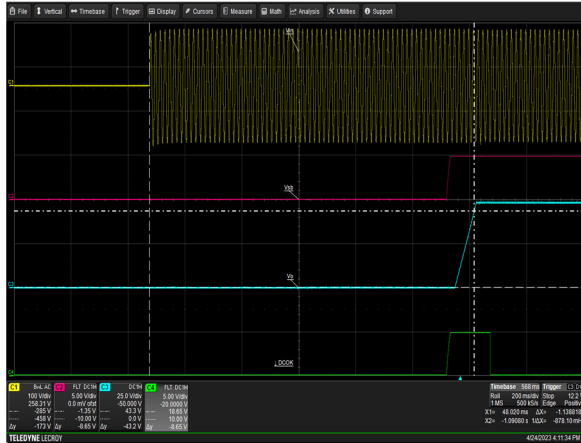


Figure 12: LCC1200-28U-9P Efficiency Curve @ 25°C  
 —●— 230Vac@1200W —●— 115Vac@800W  
 Loading:  $I_{O\_main} = 10\% I_{O\_max}$  increment to full load

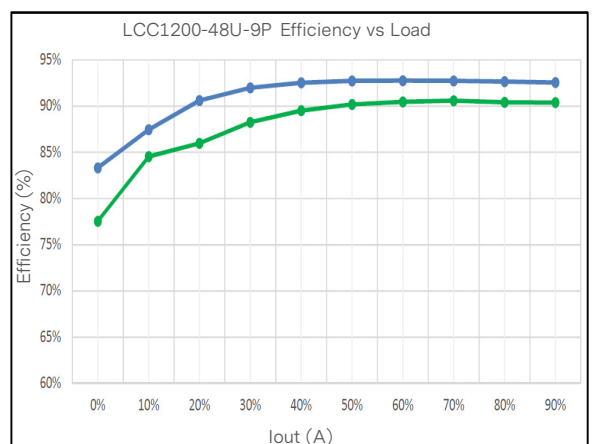
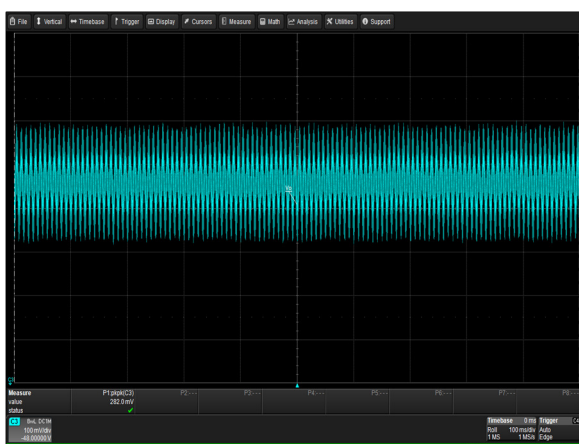
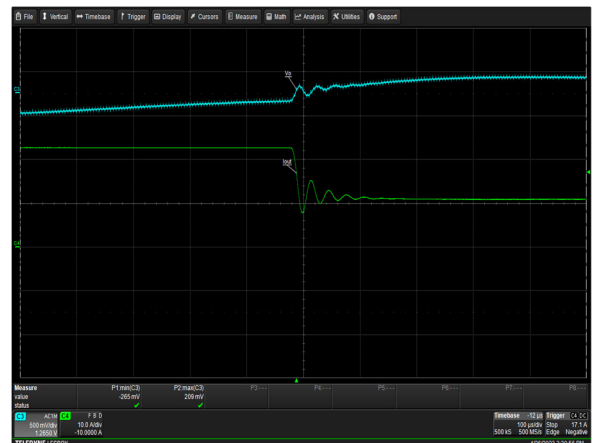
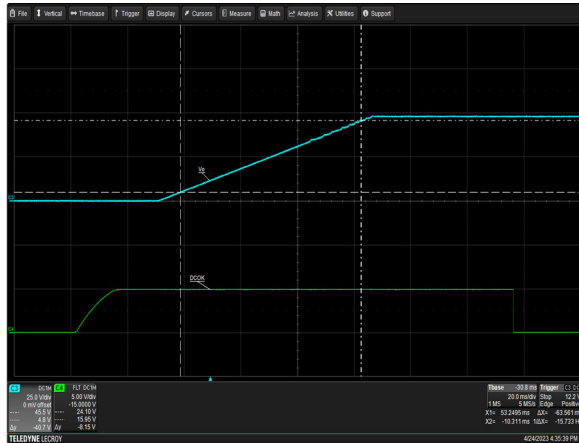
## ELECTRICAL SPECIFICATIONS

## LCC1200-48U-9P Performance Curves



## ELECTRICAL SPECIFICATIONS

## LCC1200-48U-9P Performance Curves



## ELECTRICAL SPECIFICATIONS

### Protection Function Specifications

#### Input Fuse

LCC1200 is equipped with an internal primary fuse of 250 V, 16 A to protect against catastrophic failures.

#### Over Voltage Protection (OVP)

The main and standby output is over voltage protected. The power supply latches off when output overvoltage is activated and needs an AC line recycled manually to reset the power supply and remove the fault condition.

| Parameter                         | Min | Typ | Max | Unit              |
|-----------------------------------|-----|-----|-----|-------------------|
| V <sub>O</sub> Output Overvoltage | 105 | /   | 145 | % V <sub>O</sub>  |
| Standby Voltage Overvoltage       | 125 | /   | 155 | % V <sub>SB</sub> |

#### Over Current Protection (OCP)

LCC1200 series includes internal current limit circuitry to prevent damage in the event of overload or short circuit. Recovery is automatic when the overload is removed. No damage will result to the supply as the result of either short term or long term overloads of the output at all line and load conditions. In case of continued overload, main output will retry after 20 Sec. Optional digital or analog constant current limit adjustment is available.

Main output OCP response: output will shutdown and auto recover approximately every 2 to 3 Sec within a period 20 Sec. If overload still present after the 20 Sec time frame, main output will latch and needs AC recycle or inhibit toggling or thru PMBus™ command to turn unit back on.

5 V Standby OCP response: output will shutdown and auto recover approximately every 2 to 3 Sec within a period 20 Sec. If overload still present after the 13 to 21 Sec time frame, 5V standby and main output will latch needs AC recycle.

| Parameter                         | Min | Typ | Max | Unit <sup>1</sup>      |
|-----------------------------------|-----|-----|-----|------------------------|
| V <sub>O</sub> Output Overcurrent | 105 | /   | 130 | % I <sub>O,rated</sub> |
| Standby Voltage Overcurrent       | 105 | /   | 140 | % I <sub>O,rated</sub> |

Note 1 -  $I_{O,rated} = P_{max}/V_{O,set}$

#### Short Circuit Protection (SCP)

The LCC1200 series will protect itself when any output is shorted to ground or to any other output. The power supply can withstand a continuous short circuit applied to its main output during start-up or while running with no permanent damage.

#### Over Temperature Protection (OTP)

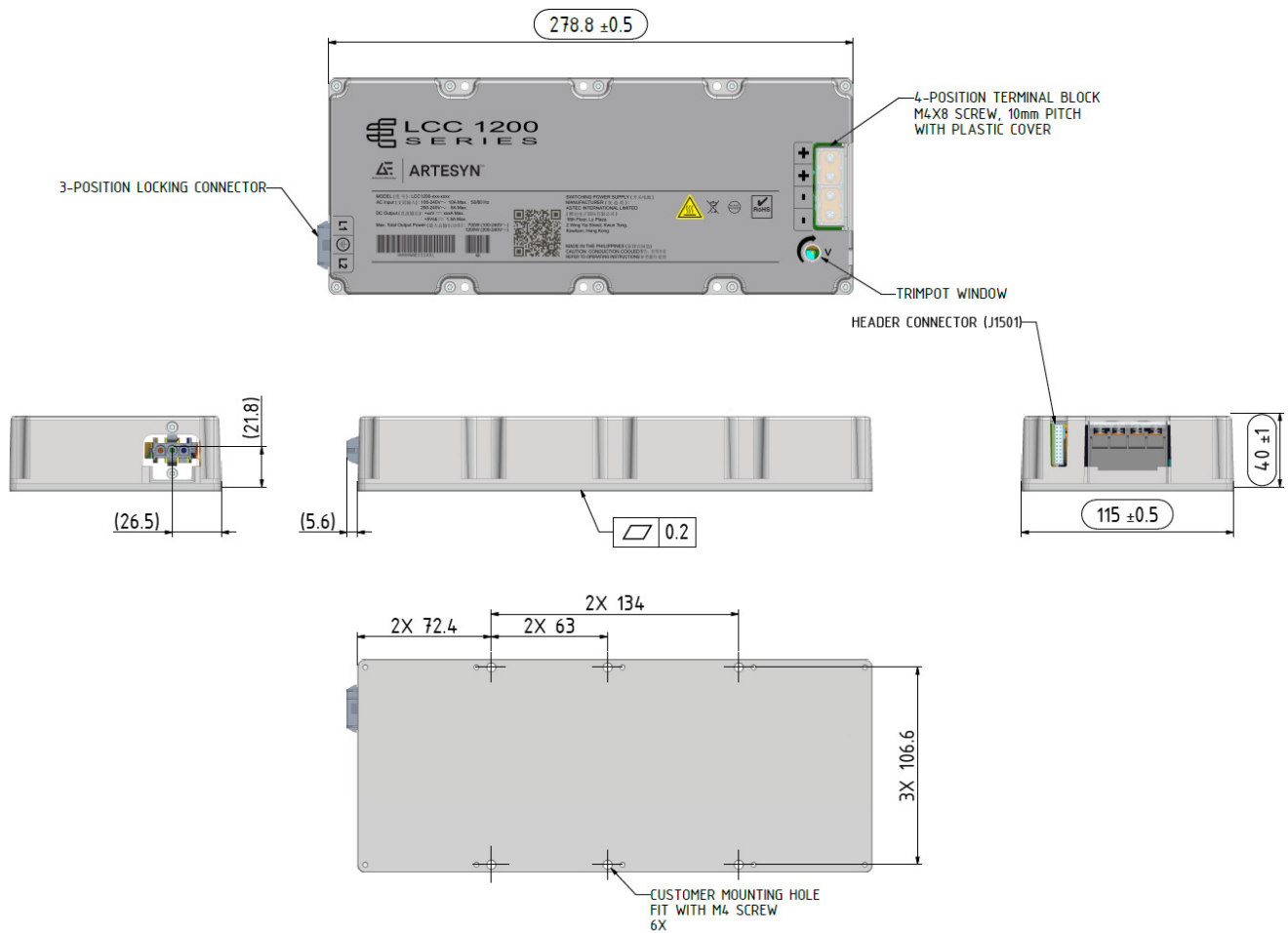
The power supply is internally protected against over temperature conditions. The power supply will shut off and auto-recover once the OTP condition is removed.

| Baseplate Temperature | Min | Typ | Max | Unit |
|-----------------------|-----|-----|-----|------|
| OTP Level             | /   | /   | 95  | °C   |
| Hysteresis            | 5   | /   | 10  | °C   |

## MECHANICAL SPECIFICATIONS

### Mechanical Outlines (unit: mm)

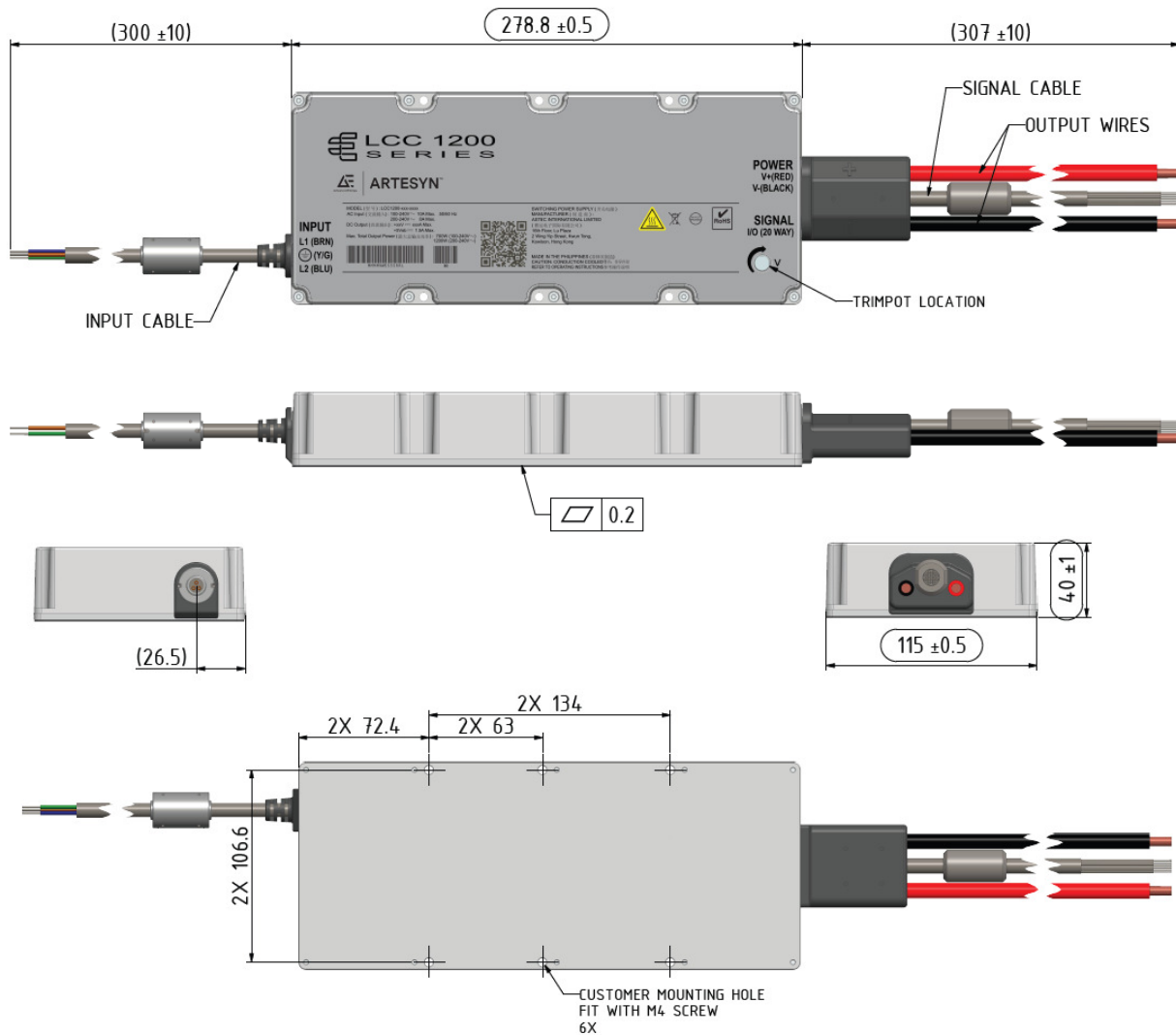
#### “-9P” Suffix



## MECHANICAL SPECIFICATIONS

### Mechanical Outlines (unit: mm)

#### “-4P” Suffix



## MECHANICAL SPECIFICATIONS

### Connector Definitions

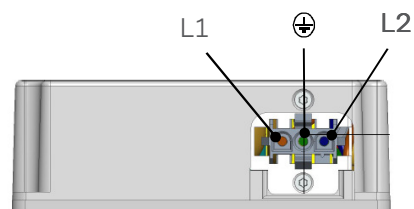
AC Input Connector (-9P)

L1 – Line1

L2 – Line2

⊕ – Ground

“-9P”  
Input



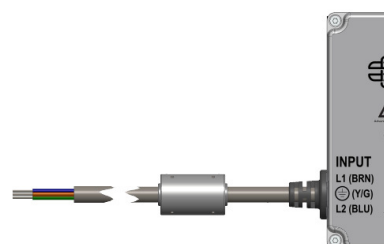
AC Input Connector (-4P)

BRW – Line1

BLU – Line2

Y/G – Ground

“-4P”  
Input

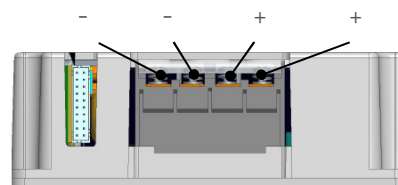


Output Connector (-9P)

“+” – Main Output

“-” – Main Output Return

“-9P”  
Output

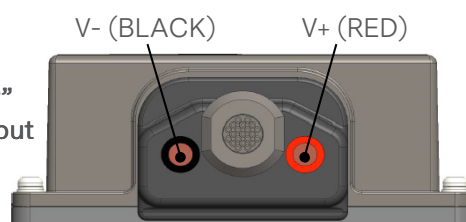


Output Connector (-4P)

RED – Main Output

BLACK – Main Output Return

“-4P”  
Output

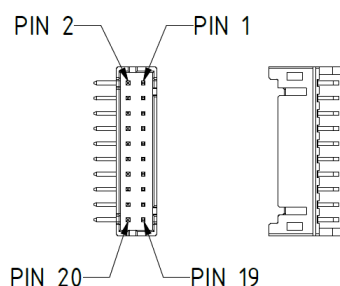


## MECHANICAL SPECIFICATIONS

### Pin Assignment

| Table 6. Output Signal Connector Pin Assignment |                                                                          |                             |                       |
|-------------------------------------------------|--------------------------------------------------------------------------|-----------------------------|-----------------------|
| Signals                                         | Description                                                              | -9P Suffix J1501 Pin Number | -4P Suffix Wire Color |
| CC_CV_SELECT                                    | Select between CC and CV mode                                            | 1                           | BLACK                 |
| GND                                             | Ground                                                                   | 2                           | BROWN                 |
| A1                                              | I <sup>2</sup> C Bit Address                                             | 3                           | RED                   |
| -VOUT_RS                                        | Remote Sense Return (main O/P)                                           | 4                           | ORANGE                |
| ISHARE                                          | Load Share Voltage                                                       | 5                           | YELLOW                |
| A0                                              | I <sup>2</sup> C Bit Address                                             | 6                           | GREEN                 |
| SDA                                             | Serial Data Signal (I <sup>2</sup> C)                                    | 7                           | BLUE                  |
| CC_SET_POINT                                    | Constant Current Level Adjust                                            | 8                           | VIOLET                |
| SCL                                             | Serial Clock Signal (I <sup>2</sup> C)                                   | 9                           | GRAY                  |
| +VOUT_RS                                        | Remote Sense Positive                                                    | 10                          | WHITE                 |
| 5VSB                                            | 5 V Standby (1.5 A maximum)                                              | 11                          | PINK                  |
| 5VSB_RET                                        | 5 V Standby Return                                                       | 12                          | LIGHT BLUE            |
| 5VSB_SENSE                                      | For Factory Use                                                          | 13                          | WHITE/VIOLET          |
| G_DCOK_C                                        | Global DC_OK Collector                                                   | 14                          | WHITE/YELLOW          |
| RESERVE                                         | RESERVE                                                                  | 15                          | WHITE/ORANGE          |
| G_DCOK_E                                        | Global DCOK Emitter (GND)                                                | 16                          | WHITE/BLACK           |
| GND                                             | Return Ground (for the output signal and I <sup>2</sup> C communication) | 17                          | WHITE/RED             |
| G_ACOK_C                                        | Global AC_OK Collector                                                   | 18                          | WHITE/BROWN           |
| INH_EN #                                        | Output Inhibit_Enable Pin (turns output off)                             | 19                          | WHITE/GREEN           |
| RESERVE                                         | RESERVE                                                                  | 20                          | WHITE/BLUE            |

-9P Suffix J1501 connector



## MECHANICAL SPECIFICATIONS

### Power/Signal Mating Connectors and Pin Types

#### “-9P” Suffix (IP20 Enclosure)

| Reference              | On Power Supply                                                                                                               | Mating Connector or Equivalent                                                                                                                         |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Input Connector     | 3-Position locking connector<br>Part number: 350767-1 (Housing)/350218-1 or equivalent (Contact Pin)<br>Manufacturer: Tyco    | Part number: 350766-1 (Housing)/350536-1 (Contact Terminal)<br>Manufacturer: Tyco                                                                      |
| J1501                  | Part number: CI0120P1HD0-LF<br>Manufacturer: LANDWIN Co., Ltd.<br>Part number: S20B-PHDSS<br>Manufacturer: JST Mfg. Co., Ltd. | Part number: PHDR-20VS (Housing)<br>Manufacturer: JST Mfg. Co., Ltd.<br>Part number: SPHD-001T-P0.5 (Contact Pins)<br>Manufacturer: JST Mfg. Co., Ltd. |
| Output Power Connector | 4-Position Terminal Block (M4x8 screw, 10mm pitch with plastic cover)                                                         | Part number: BB-124-08 (19141-0058) or equivalent ring/spade terminal<br>Manufacturer: Molex Co., Ltd.<br>Or equivalent ring/spade terminal.           |

#### “-4P” Suffix (IP65 Enclosure)

| Reference     | On Power Supply                                                              | Mating Connector or Equivalent                   |
|---------------|------------------------------------------------------------------------------|--------------------------------------------------|
| AC Input      | Live = Brown<br>Neutral = Blue<br>Ground = Y/GR                              | SJTW 18AWGX3C;<br>PVC jacket;<br>105°C/300 V     |
| DC Output     | (48 V model)<br>+Vout = Red<br>+Vout = Red<br>-Vout = Black<br>-Vout = Black | 12AWGX2C;<br>PVC Jacket;<br>105°C/300 V          |
|               | (28 V model)<br>+Vout = Red<br>-Vout = Black                                 | 6AWG Multi-Strand;<br>PVC Jacket;<br>105°C/600 V |
| Control Cable | Table 6. Output Signal Connector Pin Assignment                              | 26AWGX20C+AL; PVC Jacket; 105°C/300 V            |

## MECHANICAL SPECIFICATIONS

### Weight

The LCC1200 series weight as below.

For “-9P” suffix, weight is 1.8 kg typical.

For “-4P” suffix, weight is 2.2 kg typical.

## ENVIRONMENTAL SPECIFICATIONS

### EMC Immunity

The LCC1200 series are designed to meet the following EMC immunity specifications.

| Table 7. ENVIRONMENTAL SPECIFICATIONS |                                                                                                                                                                                                                                                                   |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Document                              | Description                                                                                                                                                                                                                                                       |
| EN 61000-3-2                          | Harmonics Current<br>– Meets Class A at full load condition<br>– Meets Class C from 100% load to full load                                                                                                                                                        |
| EN 61000-3-3                          | Voltage Fluctuations and Flicker<br>– Meets the requirements, tested with full load condition                                                                                                                                                                     |
| IEC/EN 61000-4-2                      | Electrostatic Discharge (ESD)<br>– $\pm 8$ KV contact, performance criteria A, at user-accessible points<br>– $\pm 15$ KV air discharge, performance criteria A, at user-accessible points                                                                        |
| IEC/EN 61000-4-3                      | Radio Frequency Electromagnetic Field (RS)<br>– 80 - 1000 MHz, 1000 - 2700 MHz (1 KHz sine wave with 80% AM: 10 V/m)<br>– Performance criteria A                                                                                                                  |
| IEC/EN 61000-4-4                      | Fast Transient Common Mode (EFT)<br>– $\pm 0.5$ KV, $\pm 1.0$ KV, $\pm 2.0$ KV for Power Lines and Protective Earth Terminal<br>– Performance criteria A                                                                                                          |
| IEC/EN 61000-4-5                      | Surge<br>– Criteria A: 2 KV CM; 1 KV DM with 230 Vac input                                                                                                                                                                                                        |
| EN 61000-4-6                          | Radio Freq Common Mode (CS)<br>– 0.15 – 10 MHz (1 KHz sine wave with 80% AM: 3 V/m)<br>– Performance criteria A                                                                                                                                                   |
| EN 61000-4-8                          | Power Freq Magnetic Field (PFMF)<br>– Performance criteria A, level 4 for continuous field, 30 A/m                                                                                                                                                                |
| IEC/EN 61000-4-11                     | Voltage Dips and Interruptions (DIP) <sup>1</sup><br>– 30% reduction for 500 mS, Criteria C<br>– > 95% reduction for 10 mS, Criteria A<br>– > 95% reduction for 5000 mS, Criteria C<br>– Hold-up time of 20 mS can be met at full load and nominal output voltage |
| EN 55032                              | Conducted Emissions from Power Ports<br>Minimum passing Class B margin is -8.93 dB at 0.40000 MHz                                                                                                                                                                 |
| EN 55032                              | Radiated Emissions up to 1 GHz<br>Minimum passing Class B margin is -6.33 dB at 219.68 MHz                                                                                                                                                                        |

Note 1- Performance Criteria

- Performance Criteria A - Performance within specification limits
- Performance Criteria B - Temporary degradation which is self-recoverable
- Performance Criteria C - Temporary degradation which requires operator intervention
- Performance Criteria D - Loss of function which is not recoverable

## ENVIRONMENTAL SPECIFICATIONS

### Safety Certifications

The LCC1200 series are intended for inclusion in other equipment and the installer must ensure that it is in compliance with all the requirements of the end application. This product is only for inclusion by professional installers within other equipment and must not be operated as a standard alone product.

| Table 8. Safety Certifications for LCC1200 Series Power Supply System |            |                            |
|-----------------------------------------------------------------------|------------|----------------------------|
| Standard                                                              | Agency     | Description                |
| IEC 62368-1                                                           | UL + CSA   | US and Canada Requirements |
| IEC 60950-1/62368-1                                                   | Demko + CB | European Requirements      |
| CE Mark                                                               |            | European Requirements      |
| UKCA Mark                                                             |            | UK Requirements            |
| CHINA CCC Approval                                                    |            | China Requirements         |

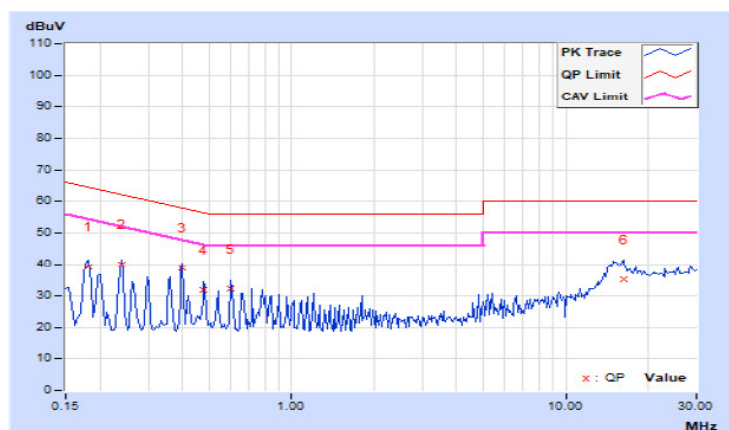
## ENVIRONMENTAL SPECIFICATIONS

### EMI Emissions

The LCC1200 series has been designed to comply with the Class B limits of EMI requirements of EN55035 (FCC Part 15) and CISPR 32 (EN 55032) for emissions and relevant sections of EN 61000 (IEC 61000) for immunity. The unit was tested at 1200 W using resistive load. Conditions is 28 V output, 100% Load, 110 Vac input, 60 Hz. Recommend to use a snap on ferrite (Würth Elektronik PN 74271222 or equivalent) on the AC input cable of LCC1200-28U-9P for radiated EMI performance.

### Conducted Emissions

The applicable standard for conducted emissions is EN55032 (FCC Part 15). Conducted noise can appear as both differential mode and common mode noise currents. Differential mode noise is measured between the two input lines, with the major components occurring at the supply fundamental switching frequency and its harmonics. Common mode noise, a contributor to both radiated emissions and input conducted emissions, is measured between the input lines and system ground and can be broadband in nature.



The LCC1200 power supplies have internal EMI filters to ensure the converter's conducted EMI levels comply with EN 55032 (FCC Part 15) Class B and EN 55032 (CISPR 22) Class B limits. The EMI measurements are performed with resistive loads at maximum rated loading.

Sample of EN 55032 Conducted EMI Measurement at 110 Vac input

Note: Red Line refers to Advanced Energy's Artesyn Quasi Peak margin, which is 6 dB below the CISPR international limit. Pink Line refers to the Average margin, which is 6 dB below the CISPR international limit.

| Parameter                  | Model | Symbol | Min | Typ | Max | Unit |
|----------------------------|-------|--------|-----|-----|-----|------|
| FCC Part 15, Class B       | All   | Margin | -   | -   | 6   | dB   |
| EN 60601-1-2: 2001         | All   | Margin | -   | -   | 6   | dB   |
| CISPR 32 (EN55032) Class B | All   | Margin | -   | -   | 6   | dB   |

## ENVIRONMENTAL SPECIFICATIONS

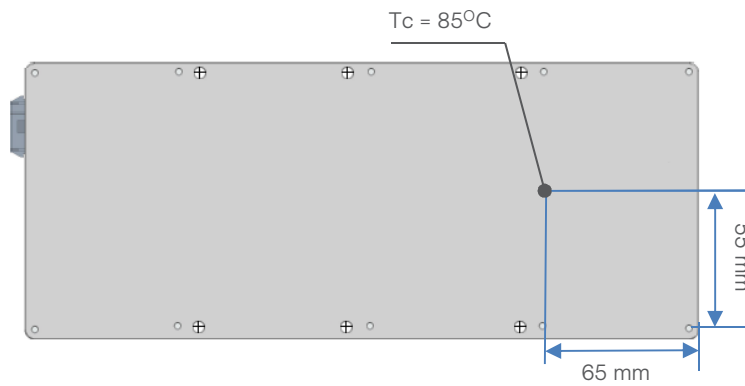
### Radiated Emissions

Unlike conducted EMI, radiated EMI performance in a system environment may differ drastically from that in a stand-alone power supply. The shielding effect provided by the system enclosure may bring the EMI level from Class A to Class B. It is thus recommended that radiated EMI be evaluated in a system environment. The applicable standard is EN55032 Class A (FCC Part 15). Testing ac-dc convertors as a stand-alone component to the exact requirements of EN55032 can be difficult, because the standard calls for 1m leads to be attached to the input and outputs and aligned such as to maximize the disturbance. In such a set-up, it is possible to form a perfect dipole antenna that very few ac-dc convertors could pass. However, the standard also states that 'an attempt should be made to maximize the disturbance consistent with the typical application by varying the configuration of the test sample.

## ENVIRONMENTAL SPECIFICATIONS

### Output Power Derating

The LCC1200 series power supplies can provide high useable power at elevated temperature, full power up to 85°C baseplate temperature, derated from 85°C to 95°C.



### Thermal Derating Curves

LCC1200 series total output power will be derated according to the curves shown below.

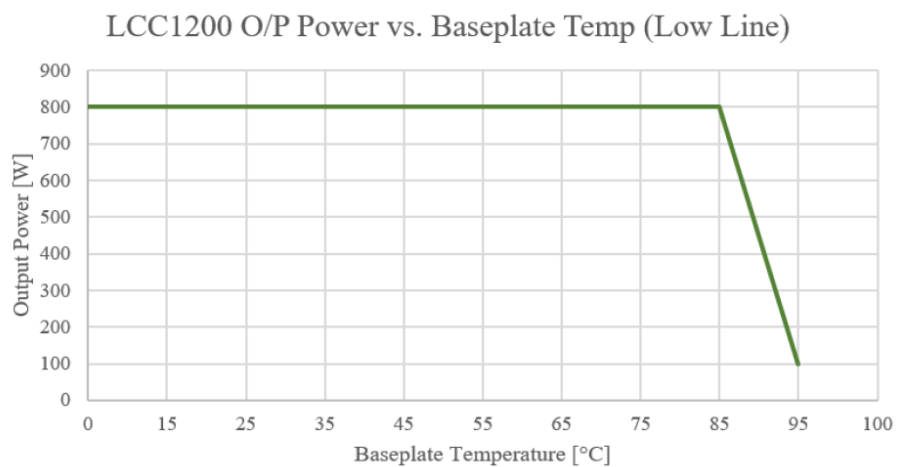


Figure 25. Output Power Vs Baseplate Temperature (low line: 90 Vac to 179 Vac)

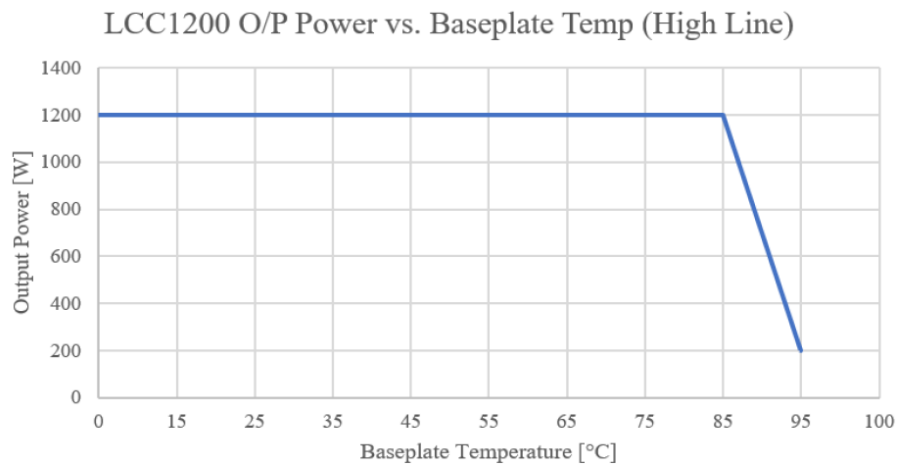
**ENVIRONMENTAL SPECIFICATIONS**

Figure 26. Output Power Vs Baseplate Temperature (High Line: 180 Vac to 264 Vac)

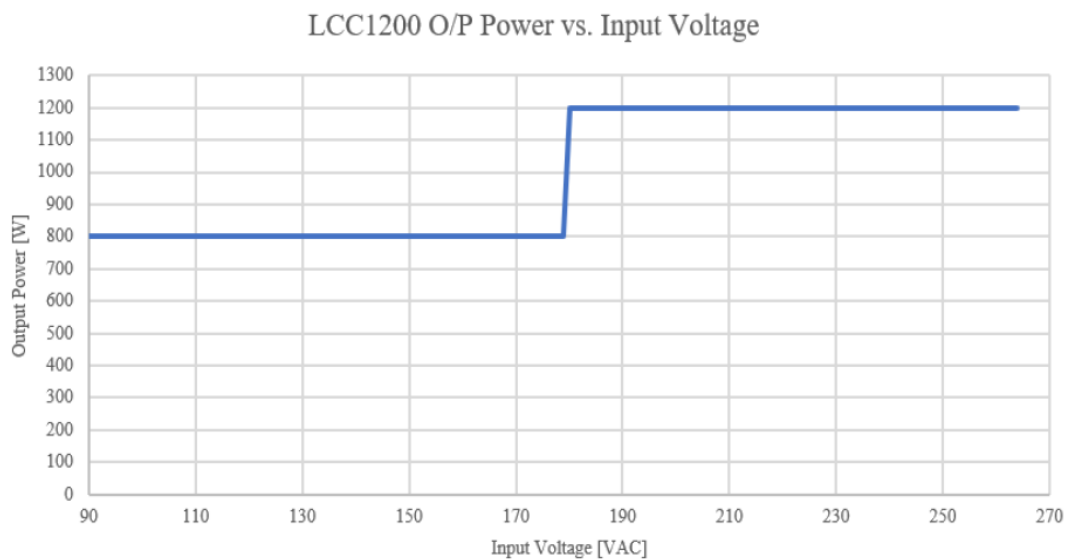
**Input Voltage and Output Power Derating**

Figure 27. Output Power Vs Input Voltage

## ENVIRONMENTAL SPECIFICATIONS

### Storage and Shipping Temperature

The LCC1200 series power supplies can be stored or shipped at temperatures between  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  and humidity from 10% to 95% non-condensing.

### Altitude

The LCC1200 series will operate within specifications at altitudes up to 16,402 feet above sea level. The power supply will not be damaged when stored at altitudes of up to 50,000 feet above sea level.

### Humidity

The LCC1200 series will operate within specifications when subjected to a relative humidity from 10% to 95% non-condensing. The LCC1200 series can be stored in a relative humidity from 10% to 95% non-condensing.

### Vibration

The LCC1200 series power supply will pass the following vibration specifications:

#### Non-operating Random Vibration

|                 |                       |               |            |
|-----------------|-----------------------|---------------|------------|
| Acceleration    | 1.87                  |               | gRMS       |
| Frequency Range | 10 to 500             |               | Hz         |
| Duration        | 30                    |               | mins       |
| Direction       | Three orthogonal axis |               |            |
| PSD Profile     | Frequency(Hz)         | Slope(db/oct) | PSD(g²/Hz) |
|                 | 10                    | -             | 0.01       |
|                 | 200                   | -2.66         | 0.01       |
|                 | 500                   | -             | 0.003      |

#### Operating Random Vibration

|                 |                       |               |            |
|-----------------|-----------------------|---------------|------------|
| Acceleration    | 0.15                  |               | gRMS       |
| Frequency Range | 5 to 100              |               | Hz         |
| Duration        | 30                    |               | mins       |
| Direction       | Three orthogonal axis |               |            |
| PSD Profile     | Frequency(Hz)         | Slope(db/oct) | PSD(g²/Hz) |
|                 | 5                     | 11            | 0.000025   |
|                 | 10 - 50               | -             | 0.0004     |
|                 | 100                   | -10           | 0.000025   |

## ENVIRONMENTAL SPECIFICATIONS

### Shock

The LCC1200 series power supply will pass the following shock specifications:

#### Non-operating Half-Sine Shock

|                 |                             |    |
|-----------------|-----------------------------|----|
| Acceleration    | 30                          | G  |
| Duration        | 11                          | mS |
| Pulse           | Half-Sine                   |    |
| Number of Shock | 3 shocks on each of 6 faces |    |

#### Operating Half-Sine Shock

|                 |                             |    |
|-----------------|-----------------------------|----|
| Acceleration    | 4                           | G  |
| Duration        | 22                          | mS |
| Pulse           | Half-Sine                   |    |
| Number of Shock | 3 shocks on each of 6 faces |    |

## POWER AND CONTROL SIGNAL DESCRIPTIONS

### AC Input Connector

This connector supplies the AC Mains to the LCC1200 series power supply.

L1 – Line1

L2 – Line2

⊕ – Ground

### Output Connector – Terminal Block

These pins provide the main output for the LCC1200 series. The + Main Output ( $V_O$ ) and the Main Output Return pins are the positive and negative rails, respectively, of the  $V_O$  main output of the LCC1200 series power supply. The Main Output ( $V_O$ ) is electrically isolated from the power supply chassis.

+Vout – Positive Main Output

+Vout – Positive Main Output

-Vout – Return GND for Main Output

-Vout – Return GND for Main Output

### Control Signals – J1501

The LCC1200 series J1501 contains 20 pins control signal header providing analogy control interface, standby power and I<sup>2</sup>C interface.

| PN Number                 | Maximum Voltage Inject with Respect to GND |
|---------------------------|--------------------------------------------|
| Pin 1, 3, 6, 7, 9, 14, 18 | 5 V                                        |
| Pin 15, 19, 20            | 3.3 V                                      |
| Pin 4, 5, 8, 10           | Refer below for details                    |

#### CC\_CV\_SELECT – (Pin 1)

Select between CC and CV mode.

CC mode – 0 V (Pull low/Close)

CV mode – 3.3 V (Pull High/Open)

#### A0, A1 – (Pin 6, Pin3)

Please refer to “COMMUNICATION BUS DESCRIPTIONS” section.

#### -VOUT\_RS, +VOUT\_RS – (Pin 4, Pin10)

This remote sense circuit is designed to compensate for a power path drop around the entire loop of 0.5 V. These pins should be connected as close to the loading as possible. Preferred termination of O/P load capacitor. In case if remote send is not required, connect this signal close to power supply mating connector side for proper operation. If left open, the remote sense does not work proper operation and the main output will fail regulation requirements.

Reverse connection protected.

#### ISHARE – (Pin 5)

The main output have active load sharing feature using single wire loop signal connection. This signal should be tied with same signal of other power supply intended to do current sharing. Short trace length with good ground(return line) shield is recommended for better performance on system back plane. Recommend to use Pin2 of J1501 for ISHARE Return.

## POWER AND CONTROL SIGNAL DESCRIPTIONS

### SDA, SCL – (Pin 7, Pin9)

Please refer to “COMMUNICATION BUS DESCRIPTIONS” section.

### CC\_SET\_POINT – (Pin 8)

LED dimming input pin for analog voltage (0 to 10 V) or resistance.

The analog DC voltage should be between CC\_SET\_POINT and 5VSB\_RET pin.

The resistor should be between CC\_SET\_POINT pin and 5VSB pin, dim resistor pulled up to 5VSB or external 5 V supply.

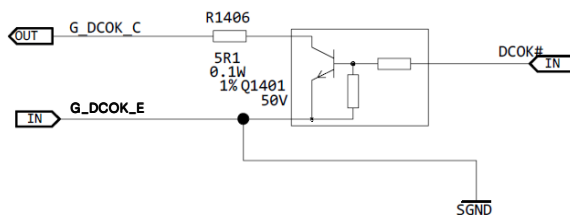
### 5VSB, 5VSB\_RET – (Pin11, Pin12)

The LCC1200 series provides a regulated 5 volt 1.5 amp auxiliary output voltage to power critical circuitry that must remain active regardless of the on/off status of the power supply's main output. 5VSB does not have active current sharing, only droop sharing. The 5VSB output residual voltage at absolute no load condition is less than 0.7 Vdc.

### G\_DCOK\_C, G\_DCOK\_E – (Pin14, Pin16)

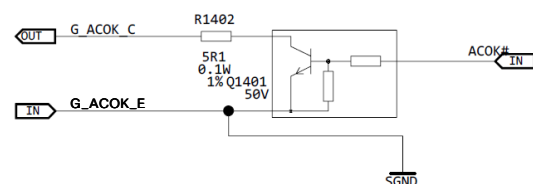
G\_DCOK\_C is a power good signal and is pulled LOW by the power supply to indicate the main output is valid. If the output fails, then this output signal will be driven HIGH. This is an open collector/drain output capable of driving the output pin below 0.5 V with load of 10 mA.

This signal should be pulled up to 5VSB using 4.7 to 10 K ohm resistor on system side with suitable noise filter capacitor.



### G\_ACOK\_C – (Pin18)

G\_ACOK\_C is an open collector signal, active logic LOW level (Isink=10 mA with Vlow=0.5 Vmax) indicates input supply voltage is within allowable limits. It is pulled high (requires external 4.7 K to 10 K ohm pull up to 5VSB) at least 5 mS early warning signal is sent before the main DC output loses regulation. Suitable noise filter capacitor (4.7 nF max) is recommended to avoid noise pick-up by system during surge operation.

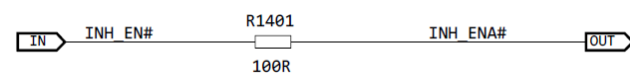


### INH\_EN # – (Pin19)

This signal is an input pin used to enable or disable the main output. This pin is active high if left open or floating to enable the main output.

Shorting this pin to GND (less than 0.5 V contact closure) will disable the main output.

The 5V standby is not affected by INH\_EN pin and continues to run regardless of the pin status.



## COMMUNICATION BUS DESCRIPTIONS

### I<sup>2</sup>C Bus Signals

The LCC1200 series contains enhanced monitor and control functions implemented via the I<sup>2</sup>C bus. The LCC1200 series I<sup>2</sup>C functionality (PMBus™ and FRU data) can be accessed via the output connector control signals. The communication bus is powered either by the internal 3.3 V supply or from an external power source connected to the Standby Output (ie: accessing an unpowered power supply as long as the Standby Output of another power supply connected in parallel is on).

If units are connected in parallel or in redundant mode, the Standby Outputs must be connected together in the system. Otherwise, the I<sup>2</sup>C bus will not work properly when a unit is inserted into the system without the AC source connected.

Note - PMBus™ functionality can be accessed only when the PSU is powered-up. Guaranteed communication I<sup>2</sup>C speed is 10 KHz to 100 KHz.

### SDA, SCL (I<sup>2</sup>C Data and Clock Signals) - (pin7, pin 9)

These pins used for I<sup>2</sup>C communication. SCL is an open drain serial bus clock line, it requires an external 2.2 K ohm pull up resistor. SDA is an open drain digital serial data line for I<sup>2</sup>C devices, it requires an external 2.2 K ohm pull up resistor.

The SDA/SCL should come from 3V3 internal pull-up. If 5 V pull-up will be used, it will need to be level shifted to 3.3 V outside the power supply.

If units are connected in parallel or redundant mode, the standby output must be connected in the system, otherwise, these pins will malfunction when a unit is inserted into the system without the AC source connected.

### A0, A1 (I<sup>2</sup>C Address BIT 0, BIT1 Signals) - (pin6, pin3)

These input pins are the address lines A0, A1 to indicate the slot position the power supply occupies in the power bay and define the power supply addresses for FRU data and PMBus™ data communication. This allows the system to assign different addresses for each power supply. During I<sup>2</sup>C communication between system and power supplies, the system will be the master and power supplies will be slave. These lines are pulled up to +3.3 V internal supply.

Slave device address is configurable via address pins. Base address is 0xB0.

Below table shows the possible address that can be used via the address pin configuration. Note that the address pins are high state initially.

| Address Pins |    | PMBus™ Write Address | PMBus™ Read Address |
|--------------|----|----------------------|---------------------|
| A1           | A0 |                      |                     |
| 1            | 1  | 0xB6                 | 0xB7                |
| 1            | 0  | 0xB4                 | 0xB5                |
| 0            | 1  | 0xB2                 | 0xB3                |
| 0            | 0  | 0xB0                 | 0xB1                |

### I<sup>2</sup>C Bus Communication Interval

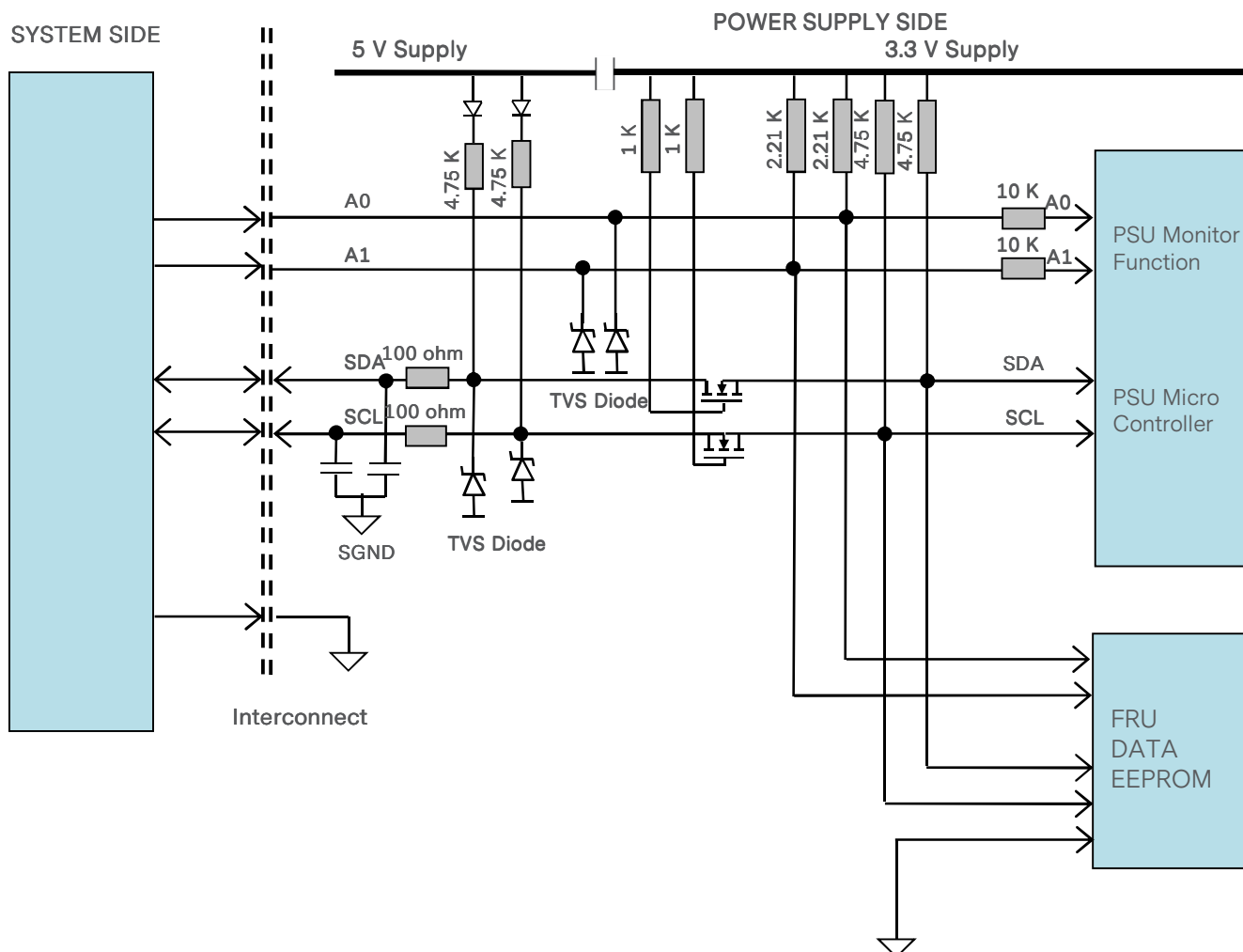
The interval between two consecutive I<sup>2</sup>C communications to the power supply should be at least 15 mS to ensure proper monitoring functionality.

### I<sup>2</sup>C Bus Signal Integrity

The ripple noise on the I<sup>2</sup>C bus (SDA, SCL lines) will be less than 450 mV peak-to-peak when measured external 2.2 K ohm pull up.

## COMMUNICATION BUS DESCRIPTIONS

### I<sup>2</sup>C Bus Internal Implementation, Pull-ups and Bus Capacitances



### I<sup>2</sup>C Bus - Recommended External Pull-ups

Electrical and interface specifications of I<sup>2</sup>C signals (referenced to standby output return pin, unless otherwise indicated):

| Parameter                             | Condition | Symbol    | Min | Type | Max | Unit  |
|---------------------------------------|-----------|-----------|-----|------|-----|-------|
| SDA, SCL Internal Pull-up Resistor    | -         | $R_{int}$ | -   | 4.7  | -   | K ohm |
| Recommended External Pull-up Resistor | -         | $R_{ext}$ | -   | -    | 2.2 | K ohm |

## COMMUNICATION BUS DESCRIPTIONS

### Logic Levels

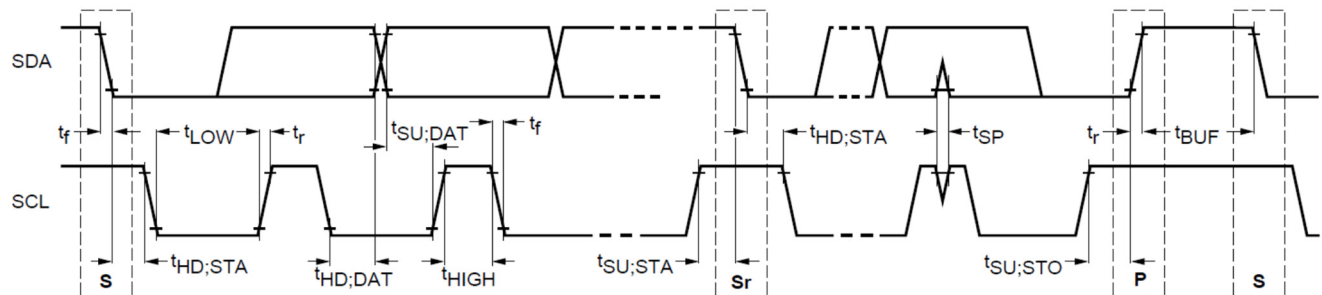
LCC1200 series power supply I<sup>2</sup>C communication bus will respond to logic levels as per below:

Logic High: 5.1 V nominal (Spec is 2.1 V to 5.5 V)\*\*

Logic Low: 500 mV nominal (Spec is 800 mV max)\*\*

\*\*Note - Artesyn 73-769-001 I<sup>2</sup>C adapter was used.

### Timings



| Parameter                                        | Symbol       | Standard-Mode Specs |      | Actual Measured |           | Unit |
|--------------------------------------------------|--------------|---------------------|------|-----------------|-----------|------|
|                                                  |              | Min                 | Max  |                 |           |      |
| SCL clock frequency                              | $f_{SCL}$    | 10                  | 100  | 104.6           |           | KHz  |
| Hold time (repeated) START condition             | $t_{HD;STA}$ | 4.0                 | -    | 4.83            |           | uS   |
| LOW period of SCL clock                          | $t_{LOW}$    | 4.7                 | -    | 14.9            |           | uS   |
| HIGH period of SCL clock                         | $t_{HIGH}$   | 4.0                 | 50   | 15.24           |           | uS   |
| Setup time for repeated START condition          | $t_{SU;STA}$ | 4.7                 | -    | 5.04            |           | uS   |
| Data hold time                                   | $t_{HD;DAT}$ | 300                 | -    | 414             |           | uS   |
| Data setup time                                  | $t_{SU;DAT}$ | 250                 | -    | 454             |           | uS   |
| Rise time                                        | $t_r$        | -                   | 1000 | SCL = 260       | SDA = 280 | uS   |
| Fall time                                        | $t_f$        | -                   | 300  | SCL = 58        | SDA = 67  | uS   |
| Setup time for STOP condition                    | $t_{SU;STO}$ | 4.0                 | -    | 10.216          |           | uS   |
| Bus free time between a STOP and START condition | $t_{BUF}$    | 4.7                 | -    | 9.79***         |           | uS   |

\*\*\*Note: Artesyn 73-769-001 I<sup>2</sup>C adapter (USB-to-I<sup>2</sup>C) and Universal PMBus™ GUI software was used.

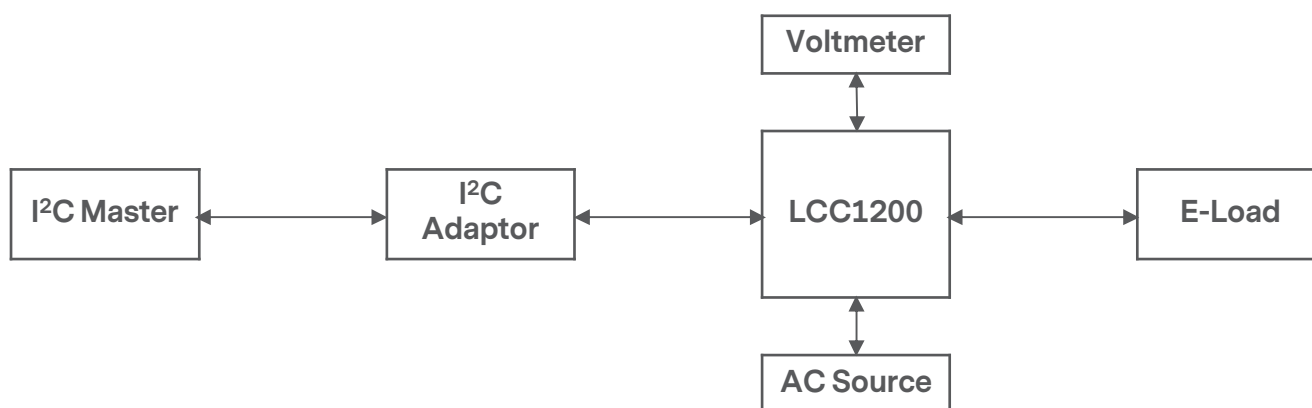
## PMBUS™ SPECIFICATIONS

The LCC1200 series is compliant with the industry standard PMBus™ protocol for monitoring and control of the power supply via the I<sup>2</sup>C interface port.

### LCC1200 Series PMBus™ General Instructions

#### Equipment Setup

The following is typical I<sup>2</sup>C communication setup:



#### PMBus™ Writing Instructions

When writing to any PMBus™ R/W registers, ALWAYS do the following:

Disable Write Protect (command 0x10h) by writing any of the following accordingly:

Levels: 80h - Disable write except 0x10h

To save changes on the USER PMBus™ Table:

Use send byte command: 0x15h STORE\_USER\_ALL

Wait for 5 Sec, turn-off the PSU, wait for another 5 Sec before turning it on.

## PMBUS™ SPECIFICATIONS

### PMBus™ Accuracy

| Parameter Type | Reporting Function | Command Code | Command Name       | Accuracy Range                     |                                                     |                                                         |
|----------------|--------------------|--------------|--------------------|------------------------------------|-----------------------------------------------------|---------------------------------------------------------|
|                |                    |              |                    | 0% to 5% load                      | >5% to 20% load                                     | >20% to 100% load                                       |
| Input          | Input Voltage      | 88h          | READ_VIN           | No requirement                     | +/-10%                                              | +/-5%                                                   |
|                | Input Current      | 89h          | READ_IIN           | No requirement                     | +/-10% of rated max input current (>5% to 35% load) | +/-20% (>35% to 60% load)<br>+/-10% (>60% to 100% load) |
|                | Input Power        | 97h          | READ_PIN           | No requirement                     | +/-10% of rated max input power (>5% to 35% load)   | +/-20% (>35% to 50% load)<br>+/-10% (>50% to 100% load) |
| Output         | Output Voltage     | 8Bh          | READ_VOUT          | +/-2%                              |                                                     |                                                         |
|                | Output Current     | 8Ch          | READ_IOUT          | +/-10%<br>(+/-1.5 A for < 8% load) |                                                     | +/-5%                                                   |
|                | Output Power       | 96h          | READ_POUT          | +/-10%                             |                                                     | +/-5%                                                   |
| Thermal        | Temperature        | 8Dh          | READ_TEMPERATURE_1 | +/-5%°C                            |                                                     |                                                         |
|                |                    | 8Eh          | READ_TEMPERATURE_2 | +/-5%°C                            |                                                     |                                                         |

## PMBUS™ SPECIFICATIONS

The LCC1200 Series Supported PMBus™ Command List:

| Command Code | Command Name                                               | Default Value | Access Type | Data Bytes | Data Format   | Description                                                                                                                                                                                                                                            |
|--------------|------------------------------------------------------------|---------------|-------------|------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01h          | OPERATION                                                  | 80h           | R/W         | 1          | Bitmapped     | Used to turn the unit ON/OFF in conjunction with the input CONTROL pin                                                                                                                                                                                 |
|              | b7:6<br>7 - Unit off<br>6 - Soft off                       |               |             |            |               | 00 - Invalid input<br>01 - PSU off<br>10 - PSU on(default)<br>11 - Invalid input                                                                                                                                                                       |
|              | b5:4<br>5 - Margin high<br>4 - Margin low                  |               |             |            |               | 00 - Valid input (default)                                                                                                                                                                                                                             |
|              | b3:2<br>3 - Margin act on fault<br>2 - Margin ignore fault |               |             |            |               | 00 - Valid input (default)                                                                                                                                                                                                                             |
|              | b1:0 Reserved                                              |               |             |            |               | 00 - Valid input (default)                                                                                                                                                                                                                             |
| 02h          | ON_OFF_CONFIG <sup>1</sup>                                 | 1Eh           | R           | 1          | Bitmapped     | Configures the combination of CONTROL pin and serial communication commands needed to turn the unit ON/OFF                                                                                                                                             |
|              | b7:5 Reserved                                              | 000           |             |            |               | Default                                                                                                                                                                                                                                                |
|              | b4 - Control pin and serial communication control          | 1             |             |            |               | 1 - Unit powers up as dictated by CONTROL pin and OPERATION command                                                                                                                                                                                    |
|              | b3 - Serial communication control                          | 1             |             |            |               | 1 - Enables serial communication ON/OFF portion of OPERATION command<br>Requires CONTROL pin to be asserted for the unit to start and energize the output                                                                                              |
|              | b2 - Control pin                                           | 1             |             |            |               | 1 - Unit requires CONTROL pin to be asserted to start the unit                                                                                                                                                                                         |
|              | b1 - Control pin polarity                                  | 0             |             |            |               | 1 - Active low (Pull low to start the unit)                                                                                                                                                                                                            |
|              | b0 - Control pin action                                    | 0             |             |            |               | 0 - Use programmed turn ON/OFF delay                                                                                                                                                                                                                   |
| 03h          | CLEAR_FAULTS                                               | N/A           | S           | 0          | N/A           |                                                                                                                                                                                                                                                        |
| 10h          | WRITE_PROTECT                                              | 80h           | R/W         | 1          | Bitmapped     | Used to control writing to the PMBus™ device<br>80h - Write protection                                                                                                                                                                                 |
| 15h          | STORE_USER_ALL                                             | N/A           | S           | 0          | N/A           | Needs AC recycle to take effect                                                                                                                                                                                                                        |
| 20h          | VOUT_MODE                                                  | 17h           | R           | 1          | Bitmapped     | Specifies the mode and parameters of output voltage related data formats                                                                                                                                                                               |
| 21h          | VOUT_COMMAND                                               | 0             | R/W         | 2          | Linear (VOUT) | User Configuration command<br>LCC1200-28U: 24 - 30 V<br>LCC1200-48U: 42 - 54 V<br>If value is set to 0 V, target voltage will be based from trimmer<br>If value is set between minimum and maximum value, target voltage will be based on VOUT_COMMAND |

Note 1 - Control pin is the INH\_ENA input to PSU.

## PMBUS™ SPECIFICATIONS

The LCC1200 Series Supported PMBus™ Command List:

| Command Code | Command Name           | Default Value  | Access Type | Data Bytes | Data Format   | Description                                                                                                                                                                                            |
|--------------|------------------------|----------------|-------------|------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 35h          | VIN_ON                 | 87 Vac (EAB8h) | R           | 2          | Linear        | Sets the value of input, in volts, at which the unit should start                                                                                                                                      |
| 36h          | VIN_OFF                | 80 Vac (EA80h) | R           | 2          | Linear        | Sets the value of input, in volts, at which the unit should stop power conversion                                                                                                                      |
| 40h          | VOUT_OV_FAULT_LIMIT    | -              | R           | 2          | Linear (VOUT) | Tracks SET_POINT input and Vout command (125% of the target output voltage)<br>LCC1200-28U Default: 35 V<br>LCC1200-48U Default: 60 V                                                                  |
| 42h          | VOUT_OV_WARN_LIMIT     | -              | R           | 2          | Linear (VOUT) | LCC1200-28U Default: 31 V<br>LCC1200-48U Default: 53.14 V                                                                                                                                              |
| 43h          | VOUT_UV_WARN_LIMIT     | -              | R           | 2          | Linear (VOUT) | LCC1200-28U Default: 13.5 V<br>LCC1200-48U Default: 40 V                                                                                                                                               |
| 44h          | VOUT_UV_FAULT_LIMIT    | -              | R           | 2          | Linear (VOUT) | LCC1200-28U Default: 8.4 V<br>LCC1200-48U Default: 14.4 V                                                                                                                                              |
| 46h          | IOUT_OC_FAULT_LIMIT    | -              | R           | 2          | Linear        | Tracks SET_POINT input and VOUT_COMMAND (115% of rated output current)<br>LCC1200-28U Default: 49.23 A (high line), 28.75 A (low line)<br>LCC1200-48U Default: 28.75 A (high line), 16.77 A (low line) |
| 4Ah          | IOUT_OC_WARN_LIMIT     | -              | R           | 2          | Linear        | LCC1200-28U Default: 47.14 A (high line), 27.5 A (low line)<br>LCC1200-48U Default: 27.5 A (high line), 16.04 A (low line)                                                                             |
| 4Fh          | OT_FAULT_LIMIT         | 97.5°C         | R           | 2          | Linear        |                                                                                                                                                                                                        |
| 51h          | OT_WARN_LIMIT          | 95°C           | R           | 2          | Linear        |                                                                                                                                                                                                        |
| 58h          | VIN_UV_WARN_LIMIT      | 86 Vac         | R           | 2          | Linear        |                                                                                                                                                                                                        |
| 59h          | VIN_UV_FAULT_LIMIT     | 80 Vac         | R           | 2          | Linear        |                                                                                                                                                                                                        |
| 6Ah          | POUT_OP_WARN_LIMIT     | 1395 W         | R           | 2          | Linear        |                                                                                                                                                                                                        |
| 78h          | STATUS_BYTE            | 00             | R           | 1          | Bitmapped     | PMBus™ status bits that are supported in the different status registers                                                                                                                                |
|              | b7 - BUSY              |                |             |            |               | Not support                                                                                                                                                                                            |
|              | b6 - OFF               |                |             |            |               | Unit is OFF                                                                                                                                                                                            |
|              | b5 - VOUT_OV_FAULT     |                |             |            |               | Reflect status 7Ah bit 7, auto clear                                                                                                                                                                   |
|              | b4 - IOUT_OC_FAULT     |                |             |            |               | Reflect status 7Bh bit 7, auto clear                                                                                                                                                                   |
|              | b3 - VIN_UV_FAULT      |                |             |            |               | Reflect bit 4 of STATUS_INPUT                                                                                                                                                                          |
|              | b2 - TEMPERATURE       |                |             |            |               | Reflect STATUS_TEMPERATURE                                                                                                                                                                             |
|              | b1 - CML               |                |             |            |               |                                                                                                                                                                                                        |
|              | b0 - NONE OF THE ABOVE |                |             |            |               | Not support                                                                                                                                                                                            |

## PMBUS™ SPECIFICATIONS

The LCC1200 Series Supported PMBus™ Command List:

| Command Code | Command Name             | Default Value | Access Type | Data Bytes | Data Format | Description                                                             |
|--------------|--------------------------|---------------|-------------|------------|-------------|-------------------------------------------------------------------------|
| 79h          | STATUS_WORD              | 0000          | R           | 2          | Bitmapped   | PMBus™ status bits that are supported in the different status registers |
|              | b15 - VOUT               |               |             |            |             | An output voltage fault or warning has occurred                         |
|              | b14 - IOUT/POUT          |               |             |            |             | An output current or power fault or warning has occurred.               |
|              | b13 - INPUT              |               |             |            |             | An input voltage, current or power fault or warning as occurred         |
|              | b12 - MFR_SPECIFIC       |               |             |            |             | Not support                                                             |
|              | b11 - POWER_GOOD#        |               |             |            |             | The POWER_GOOD signal is de-asserted                                    |
|              | b10 - FANS               |               |             |            |             | Not support                                                             |
|              | b9 - OTHER               |               |             |            |             | Not support                                                             |
|              | b8 - UNKNOWN             |               |             |            |             | Not support                                                             |
|              | b7 - BUSY                |               |             |            |             | Not support                                                             |
|              | b6 - OFF                 |               |             |            |             | Unit is OFF                                                             |
|              | b5 - VOUT_OV_FAULT       |               |             |            |             | Reflect status 7Ah bit 7, auto clear                                    |
|              | b4 - IOUT_OC_FAULT       |               |             |            |             | Reflect status 7Bh bit 7, auto clear                                    |
|              | b3 - VIN_UV_FAULT        |               |             |            |             | Reflect bit 4 of STATUS_INPUT                                           |
|              | b2 - TEMPERATURE         |               |             |            |             | Reflect STATUS_TEMPERATURE                                              |
|              | b1 - CML                 |               |             |            |             |                                                                         |
|              | b0 - NONE OF THE ABOVE   |               |             |            |             | Not support                                                             |
| 7Ah          | STATUS_VOUT              | 00            | R/W         | 1          | Bitmapped   | Output voltage related faults                                           |
|              | b7 - VOUT_OV_FAULT       |               |             |            |             | VOUT over-voltage fault                                                 |
|              | b6 - VOUT_OV_LV_FAULT    |               |             |            |             | VOUT over-voltage warning, auto clear                                   |
|              | b5 - VOUT_UV_WARNING     |               |             |            |             | VOUT under-voltage warning, auto clear                                  |
|              | b4 - VOUT_UV_FAULT       |               |             |            |             |                                                                         |
|              | b3 - VOUT_MAX Warning    |               |             |            |             | Not support                                                             |
|              | b2 - TON_MAX_FAULT       |               |             |            |             | Default limit 1 Sec                                                     |
|              | b1 - TOFF_MAX_WARNING    |               |             |            |             | Not support                                                             |
|              | b0 - VOUT Tracking Error |               |             |            |             | Not support                                                             |

## PMBUS™ SPECIFICATIONS

The LCC1200 Series Supported PMBus™ Command List:

| Command Code | Command Name                                                                      | Default Value | Access Type | Data Bytes | Data Format | Description                                                               |
|--------------|-----------------------------------------------------------------------------------|---------------|-------------|------------|-------------|---------------------------------------------------------------------------|
| 7Bh          | STATUS_IOUT                                                                       | 00            | R/W         | 1          | Bitmapped   | Output current related faults                                             |
|              | b7 - IOUT_OC_FAULT                                                                |               |             |            |             | IOUT Over current fault                                                   |
|              | b6 - IOUT_OC_LV_FAULT                                                             |               |             |            |             | This bit will assert only at CC mode                                      |
|              | b5 - IOUT_OC_WARNING                                                              |               |             |            |             | This bit will not assert when CC mode is enabled, auto clear when CV mode |
|              | b4 - IOUT_UC_FAULT                                                                |               |             |            |             | Not support                                                               |
|              | b3 - Current Share Fault                                                          |               |             |            |             | Not support                                                               |
|              | b2 - In Power Limiting Mode                                                       |               |             |            |             | Not support                                                               |
|              | b1 - POUT_OP_FAULT                                                                |               |             |            |             | Not support                                                               |
|              | b0 - POUT_OP_WARNING                                                              |               |             |            |             | This bit will not assert when CC mode is enable                           |
| 7Ch          | STATUS_INPUT                                                                      | 00            | R/W         | 1          | Bitmapped   | Input related faults and warnings                                         |
|              | b7 - VIN_OV_FAULT                                                                 |               |             |            |             | VIN over voltage fault, auto clear                                        |
|              | b6 - VIN_OV_WARNING                                                               |               |             |            |             | VIN over voltage warning, auto clear                                      |
|              | b5 - VIN_UV_WARNING                                                               |               |             |            |             | VIN under voltage warning, auto clear                                     |
|              | b4 - VIN_UV_FAULT                                                                 |               |             |            |             | VIN under voltage fault, auto clear                                       |
|              | b3 - Unit Off For Insufficient Input Voltage                                      |               |             |            |             | Absence of or no input condition (not UV), auto clear                     |
|              | b2 - IIN_OC_FAULT                                                                 |               |             |            |             | Not support                                                               |
|              | b1 - IIN_OC_WARNING                                                               |               |             |            |             | Not support                                                               |
|              | b0 - PIN_OP_WARNING                                                               |               |             |            |             | Not support                                                               |
| 7Dh          | STATUS_TEMPERATURE                                                                | 00            | R/W         | 1          | Bitmapped   | Temperature related faults and warnings                                   |
|              | b7 - OT_FAULT                                                                     |               |             |            |             | Over temperature fault                                                    |
|              | b6 - OT_WARNING                                                                   |               |             |            |             | Over temperature warning                                                  |
|              | b5 - UT_WARNING                                                                   |               |             |            |             | Not support                                                               |
|              | b4 - UT_FAULT                                                                     |               |             |            |             | Not support                                                               |
|              | b3 : 0                                                                            |               |             |            |             | Not support                                                               |
| 7Eh          | STATUS_CML                                                                        | 00            | R/W         | 1          | Bitmapped   |                                                                           |
|              | b7 - Invalid or unsupported command received                                      |               |             |            |             |                                                                           |
|              | b6 - Invalid or unsupported data received                                         |               |             |            |             |                                                                           |
|              | b5 - Packet error check failed                                                    |               |             |            |             |                                                                           |
|              | b4 - Memory fault detected                                                        |               |             |            |             |                                                                           |
|              | b3 - Processor fault detected                                                     |               |             |            |             | Not support                                                               |
|              | b2 - Reserved                                                                     |               |             |            |             | Not support                                                               |
|              | b1 - A communication fault other than the ones listed in this table has occurred. |               |             |            |             | Not support                                                               |
|              | b0 - Other memory or logic fault has occurred                                     |               |             |            |             | Not support                                                               |

## PMBUS™ SPECIFICATIONS

The LCC1200 Series Supported PMBus™ Command List:

| Command Code | Command Name        | Default Value | Access Type | Data Bytes | Data Format   | Description                                                                        |
|--------------|---------------------|---------------|-------------|------------|---------------|------------------------------------------------------------------------------------|
| 80h          | STATUS_MFR_SPECIFIC | 00            | R/W         | 1          | Bitmapped     |                                                                                    |
| 88h          | READ_VIN            | Varies        | R           | 2          | Linear        |                                                                                    |
| 89h          | READ_IIN            | Varies        | R           | 2          | Linear        |                                                                                    |
| 8Bh          | READ_VOUT           | Varies        | R           | 2          | Linear (VOUT) |                                                                                    |
| 8Ch          | READ_IOUT           | Varies        | R           | 2          | Linear        |                                                                                    |
| 8Dh          | READ_TEMPERATURE_1  | Varies        | R           | 2          | Linear        | Read base SEC temperature                                                          |
| 8Eh          | READ_TEMPERATURE_2  | Varies        | R           | 2          | Linear        | Read base PRI temperature                                                          |
| 96h          | READ_POUT           | Varies        | R           | 2          | Linear        |                                                                                    |
| 97h          | READ_PIN            | Varies        | R           | 2          | Linear        |                                                                                    |
| 98h          | PMBUS_REVISION      | 22            | R           | 1          | Linear        |                                                                                    |
| 99h          | MFR_ID              | ARTESYN       | BR          | Varies     | ASCII         |                                                                                    |
| 9Ah          | MFR_MODEL           | -             | BR          | Varies     | ASCII         | # of byte is 14<br>Default value:<br>LCC1200-28U-XXXX<br>LCC1200-48U-XXXX          |
| 9Bh          | MFR_REVISION        | -             | BR          | Varies     | ASCII         | Default: default value can be found on serial number                               |
| 9Ch          | MFR_LOCATION        | -             | BR          | Varies     | ASCII         | Linked to FRU, default: "Philippines"                                              |
| 9Dh          | MFR_DATE            | -             | BR          | Varies     | ASCII         | Default: "WW" Default value can be found on serial number                          |
| 9Eh          | MFR_SERIAL          | -             | BR          | Varies     | ASCII         | Default "MMMMWWSSSSRRL"                                                            |
| A0h          | MFR_VIN_MIN         | 90 Vac        | R           | 2          | Linear        | Minimum input voltage                                                              |
| A1h          | MFR_VIN_MAX         | 264 Vac       | R           | 2          | Linear        | Maximum input voltage                                                              |
| A2h          | MFR_IIN_MAX         | 8 A           | R           | 2          | Linear        |                                                                                    |
| A3h          | MFR_PIN_MAX         | 1320 W        | R           | 2          | Linear        |                                                                                    |
| A4h          | MFR_VOUT_MIN        | -             | R           | 2          | Linear        | Minimum output voltage<br>LCC1200-28U Default: 24 V<br>LCC1200-48U Default: 44 V   |
| A5h          | MFR_VOUT_MAX        | -             | R           | 2          | Linear        | Maximum output voltage<br>LCC1200-28U Default: 30 V<br>LCC1200-48U Default: 54 V   |
| A6h          | MFR_IOUT_MAX        | -             | R           | 2          | Linear        | Maximum output current<br>LCC1200-28U Default: 50 A<br>LCC1200-48U Default: 25.0 A |
| A7h          | MFR_POUT_MAX        | 1200 W        | R           | 2          | Linear        | Maximum output power                                                               |
| A8h          | MFR_TAMBIENT_MAX    | 50°C          | R           | 2          | Linear        | Maximum operating ambient                                                          |
| A9h          | MFR_TAMBIENT_MIN    | -40°C         | R           | 2          | Linear        | Minimum Operating Ambient                                                          |
| AAh          | MFR_EFFICIENCY_LL   | -             | BR          | 14         | Linear        | Default: 100, 700, 90, 700, 90, 700, 90                                            |
| ABh          | MFR_EFFICIENCY_HL   | -             | BR          | 14         | Linear        | Default: 230, 1200, 87, 1200, 87, 1200, 87                                         |

## PMBUS™ SPECIFICATIONS

The LCC1200 Series Supported PMBus™ Command List:

| Command Code | Command Name                  | Default Value  | Access Type | Data Bytes | Data Format | Description                                                                                                                                                                                                                                                       |
|--------------|-------------------------------|----------------|-------------|------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| D0h          | CONFIG_OUTPUT_SIGNAL_POLARITY | 0              | R/W         | 2          | Bitmapped   |                                                                                                                                                                                                                                                                   |
|              | b15:2 Reserved                | 00000000000000 |             |            |             |                                                                                                                                                                                                                                                                   |
|              | b1 - DC_OK                    |                |             |            |             | 0 - DC_OK pin set to active low<br>1 - DC_OK pin set to active high                                                                                                                                                                                               |
|              | b0 - AC_OK                    |                |             |            |             | 0 - AC_OK pin set to active low<br>1 - AC_OK pin set to active high                                                                                                                                                                                               |
| D1h          | IOUT_COMMAND                  | 0              | R/W         | 2          | Linear      | User Configuration command<br>LCC1200-28U-XXXX: 2 - 50 A<br>LCC1200-48U-XXXX: 1 - 28.57 A<br>If value is set to 0 A, target current will be based from trimmer<br>If value is set between minimum and maximum value, target voltage will be based on IOUT Command |
| E0h          | FW_PRI_VERSION                | -              | BR          | 8          | ASCII       | Varies                                                                                                                                                                                                                                                            |
| E1h          | FW_SEC_VERSION                | -              | BR          | 8          | ASCII       | Varies                                                                                                                                                                                                                                                            |
| E2h          | CONFIG_UNLOCK_CODE            | 30, 30, 30, 30 | BR/W        | 4          | ASCII       |                                                                                                                                                                                                                                                                   |
| F1h          | ISP_UNLOCK_CODE               | -              | BR/W        | 4          | ASCII       | Default: 00h, 00h, 00h, 00h                                                                                                                                                                                                                                       |
| F2h          | ISP_CTRL_CMD                  | -              | W           | 1          | Bitmapped   | Command available in ISP mode                                                                                                                                                                                                                                     |
| F3h          | ISP_STATUS_BYTE               | -              | R           | 1          | Bitmapped   | Varies, command available in ISP Mode                                                                                                                                                                                                                             |
| F4h          | ISP_FLASH_ADDR                | -              | BR/W        | 4          | Hex         | Varies, command available in ISP Mode                                                                                                                                                                                                                             |
| F5h          | ISP_FLASH_DATA                | -              | BR/W        | 4          | Hex         | Varies, command available in ISP Mode                                                                                                                                                                                                                             |

## APPLICATION NOTES

### Output Current Adjustment (For CC option)

The unit supports constant current mode of operation with tolerance of +/-10% around a default or programmed current limit. The CC mode supports down to the lowest output voltage trim range.

The PSU operating at 20% or below of the maximum programmed CC limit may have reduced accuracy (tolerance of about +/- 30% due to signal-noise ratio limitation on the current sensing circuit).

The output current will be adjustable approximately 0 to 100% relative to the full load current. Full load current is equal Pout max/output voltage setting.

Pout max = 1200 W at high line & 800 W at low line

Iout max = Pout max/Min Vout Trim

| Series           | Nominal Output Voltage | Trim Voltage |         | Minimum CV Load Set | Maximum Output Current |           |
|------------------|------------------------|--------------|---------|---------------------|------------------------|-----------|
|                  |                        | Minimum      | Maximum |                     | Low Line               | High Line |
| LCC1200-28U-xxxx | 28 V                   | 24 V         | 30 V    | 14 V                | 33.33 A                | 50 A      |
| LCC1200-48U-xxxx | 48 V                   | 42 V         | 57.6 V  | 24 V                | 19.05 A                | 28.57 A   |

The output current can be adjusted by the methods of below.

#### 0-10 V dimming

The output current is adjustable approximately 0 to 100% relative to the rated load current.

The adjustment method is via a 2-wire connection.

0-10 V source connected across pin8 and GND of J1501 which sets an output current approximately proportional to the applied voltage.

| Voltage             | 0 V / Shorted | 1 V | 2 V | 3 V | 4 V | 5 V | 6 V | 7 V | 8 V | 9 V | 10 V | 11-12 V / Open |
|---------------------|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|----------------|
| % Full load current | 3% to 5%      | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% | 100%           |

#### Resistance Dimming

The output current is adjustable approximately 0 to 100% relative to the rated current.

The adjustment method is via 2-wire connection.

A resistor connected across SGND and Pin8 of connector J1501 which sets an output current approximately proportional to the applied resistance.

| Resistance          | 0 K ohm / Shorted | 10 K ohm | 20 K ohm | 30 K ohm | 40 K ohm | 50 K ohm | 60 K ohm | 70 K ohm | 80 K ohm | 90 K ohm | 100 K ohm | Open |
|---------------------|-------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|------|
| % Full load current | 3% to 5%          | 10%      | 20%      | 30%      | 40%      | 50%      | 60%      | 70%      | 80%      | 90%      | 100%      | 100% |

#### Digital Dimming

The adjustment method is via PMBus™ MFR. SPECIFICATION Command thru I<sup>2</sup>C communication. IOUT\_COMMAND is for setting fix output current. VOUT\_COMMAND for setting both maximum output current (Pout max/Vout) and output voltage.

Zero value written on PMBus™ VOUT\_COMMAND or IOUT\_COMMAND means analog output voltage trimming or analog output current trimming respectively.

## APPLICATION NOTES

Note:

1. CV CC selection can be done thru Pin1 of J1501: Open (CV mode), short to GND (CC mode). Main output must be off or turned OFF for the change to take effect, main output can be turn OFF by either AC OFF or thru inhibit.
2. CC mode operation limited for single unit configuration for LED type load.
3. Default dimming configuration is analog, through external voltage dimming or resistance dimming.
4. LED driver mode/CC mode tested using Electronic Load set on Constant Voltage mode.
5. For CV load of 14 V to 18 V (LCC1200-28U variant), the output current is limited to about 70% load of full load current. To set the output to 100% load, digital dimming must be used.

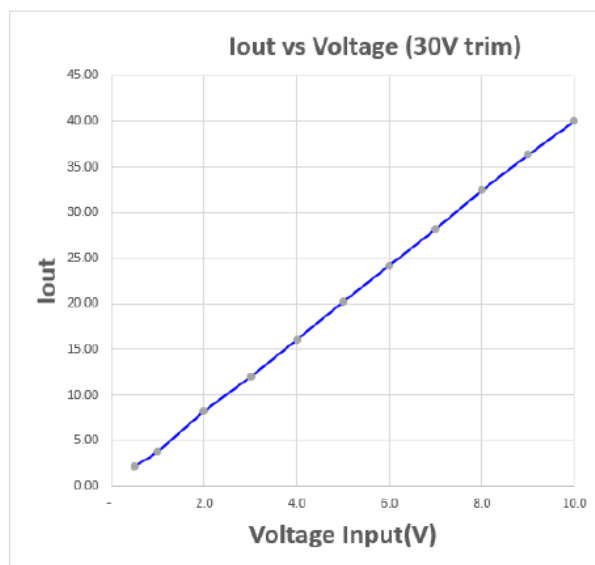


Figure 28. Typical Voltage Dimming using LED load at around 25°C

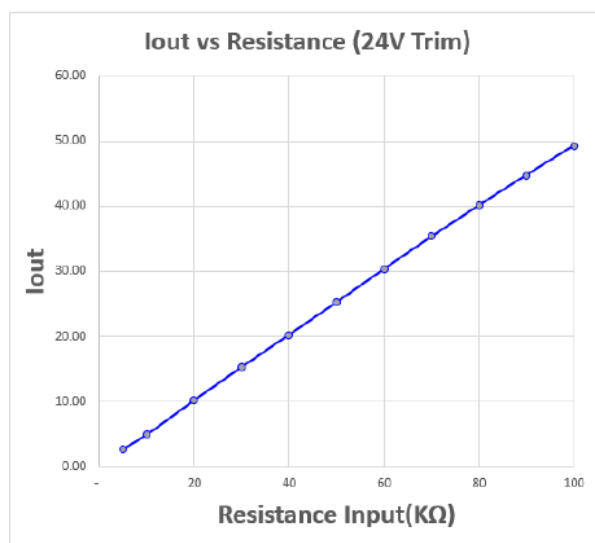


Figure 29. Typical Resistance Dimming using LED load at around 25°C

## APPLICATION NOTES

### Parallel Operation (For CC option)

The active current share is not applicable to parallel operation at CC mode. Individual load current is function of the programmed CC current. LCC1200 was tested in parallel at CC mode using 4 units with CV load (battery load or LED load)

## APPLICATION NOTES

### Output Voltage Programming

User Configuration command - 21h command code is used to change the output voltage level. Below is the commands list on how to change the output voltage level.

Enable writing:

|   |                   |   |     |   |     |   |
|---|-------------------|---|-----|---|-----|---|
| S | Slave Address / W | A | 10h | A | 00h | P |
|---|-------------------|---|-----|---|-----|---|

Unlock VOUT\_COMMAND

|   |                   |   |     |   |     |   |     |   |     |   |     |   |     |   |
|---|-------------------|---|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|
| S | Slave Address / W | A | E2h | A | 04h | A | 55h | A | 73h | A | 65h | A | 72h | P |
|---|-------------------|---|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|

Change output voltage to 30V, per linear 16, write: 3C00h

|   |                   |   |     |   |     |   |     |   |
|---|-------------------|---|-----|---|-----|---|-----|---|
| S | Slave Address / W | A | 21h | A | 00h | A | 3Ch | P |
|---|-------------------|---|-----|---|-----|---|-----|---|

Change output voltage to 24V, per linear 16, write: 3000h

|   |                   |   |     |   |     |   |     |   |
|---|-------------------|---|-----|---|-----|---|-----|---|
| S | Slave Address / W | A | 21h | A | 00h | A | 30h | P |
|---|-------------------|---|-----|---|-----|---|-----|---|

Notes:

1. The output protection level also changes after the output voltage level is changed via this command
2. The value is stored in the non-volatile memory
3. To disable the digital output voltage programming function, user must send 0V to 21h

## APPLICATION NOTES

### Output Current Programming

User Configuration command - D1h command code is used to change the output current level under constant current mode. Below is the commands list on how to change the output current level.

Enable writing:

|   |                   |   |     |   |     |   |
|---|-------------------|---|-----|---|-----|---|
| S | Slave Address / W | A | 10h | A | 00h | P |
|---|-------------------|---|-----|---|-----|---|

Unlock IOUT\_COMMAND

|   |                   |   |     |   |     |   |     |   |     |   |     |   |     |   |
|---|-------------------|---|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|
| S | Slave Address / W | A | E2h | A | 04h | A | 55h | A | 73h | A | 65h | A | 72h | P |
|---|-------------------|---|-----|---|-----|---|-----|---|-----|---|-----|---|-----|---|

Change output current to 2A, per linear 11 format, write: C200h

|   |                   |   |     |   |     |   |     |   |
|---|-------------------|---|-----|---|-----|---|-----|---|
| S | Slave Address / W | A | D1h | A | 00h | A | C2h | P |
|---|-------------------|---|-----|---|-----|---|-----|---|

Change output current to 42.85A, per linear 11 format, write: E2AEh

|   |                   |   |     |   |     |   |     |   |
|---|-------------------|---|-----|---|-----|---|-----|---|
| S | Slave Address / W | A | D1h | A | AEh | A | E2h | P |
|---|-------------------|---|-----|---|-----|---|-----|---|

Notes:

1. The output protection level also changes after the output current level is changed via this command
2. The value is stored in the non-volatile memory
3. To disable the digital output voltage programming function, user must send 0A to D1h command

## APPLICATION NOTES

### Current Sharing and Parallel Operation

The LCC1200 series main output is equipped with current sharing capability. This allows up to 3 power supplies to be connected in parallel for higher power application. The power supply is designed with output OR'ing FETs/Diodes built in.

Considering the 10% load sharing tolerance. The table below shows the possible maximum power capacity when units are in parallel configuration.

Max load during start-up in parallel operation is limited to 1200 W.

| Number of Units in Parallel (N) | Maximum Output power<br>Rated + [(N-1) x 0.8] x Rated, Where: Rated = 1200 W<br>N = Number of PSU in Parallel |
|---------------------------------|---------------------------------------------------------------------------------------------------------------|
| Stand-alone                     | 1200 W                                                                                                        |
| 2                               | 2160 W                                                                                                        |
| 3                               | 3120 W                                                                                                        |

Typical sharing percentage of 2 PSU in parallel.

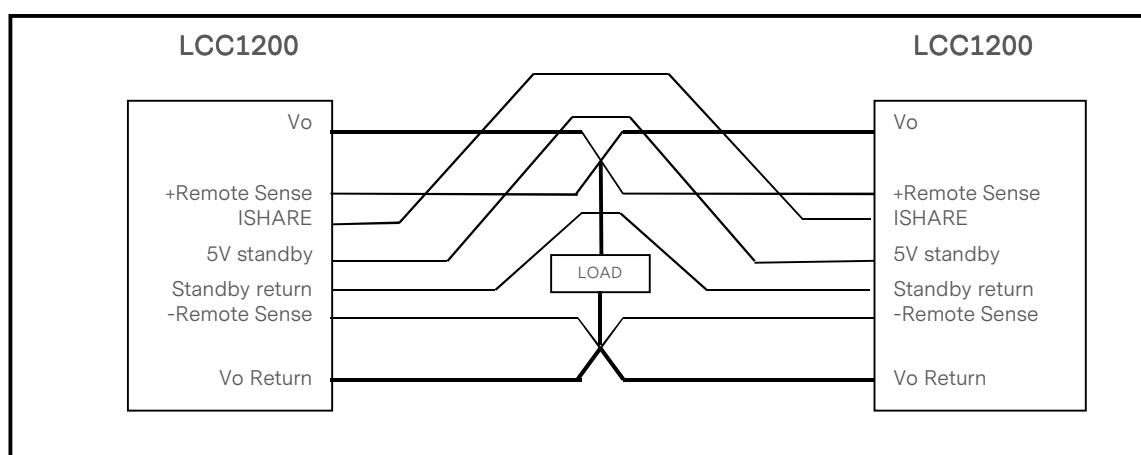
| Rail Loading (%) | Sharing Percent Error (%) |
|------------------|---------------------------|
| 25%              | 30%                       |
| 50%              | 15%                       |
| 75%              | 15%                       |
| 100%             | 10%                       |

Percent Err =  $\text{ABS}(\text{PSU1} - \text{average current}) / (\text{average current})$

PSU1 - current delivered by PSU1

PSU2 - current delivered by PSU2

Average current =  $(\text{PSU1} + \text{PSU2}) / 2$



## APPLICATION NOTES

### Mounting Configurations

Customer can mount the supply in various configurations. Thermals need to be considered in these various mounting and placement.



Vertical Mount  
(with either output/input on top or bottom orientation)



Horizontal Mount



Vertical Sideways Mount

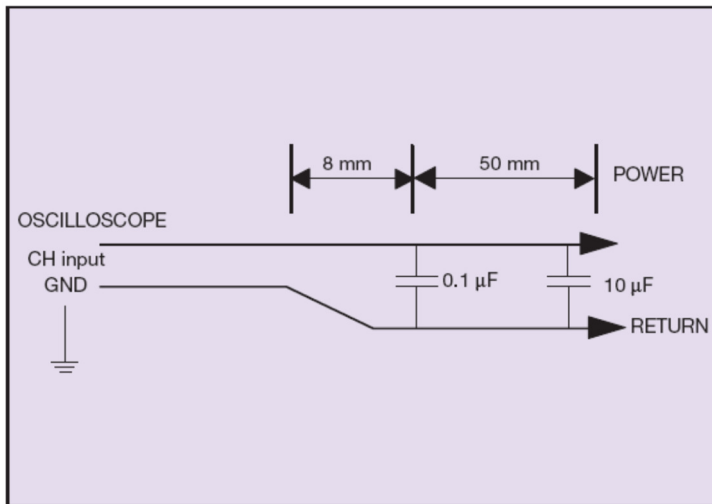


Mounted Upside Down

## APPLICATION NOTES

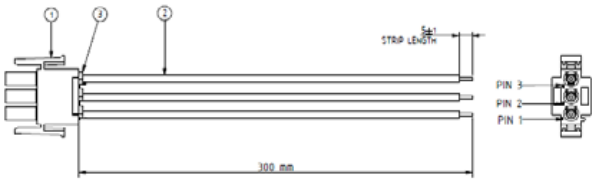
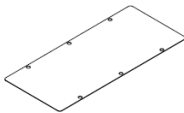
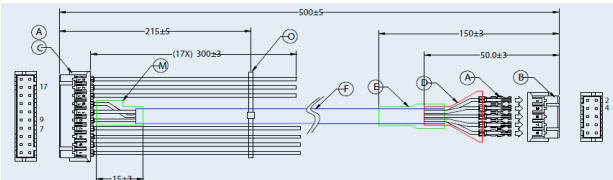
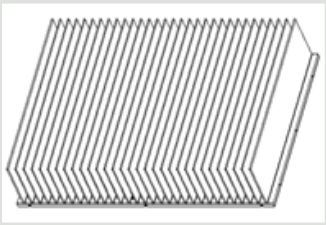
### Output Ripple and Noise Measurement

The setup outlined in the diagram below has been used for output voltage ripple and noise measurements on the LCC1200 series when measuring output ripple and noise, a scope jack in parallel with a 0.1 uF ceramic chip capacitor, and a 10 uF E-cap electrolytic capacitor should be used. Oscilloscope should be set to 20 MHz bandwidth for this measurement.



## APPLICATION NOTES

## Accessories

| Orderable Part Number | Description                                                                                                       | Diagram                                                                              |
|-----------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 70-841-030            | For Suffix "-9P" AC Input Mating Connector Cable Assembly (with 0.3 m wire length)                                |    |
| 73-788-001            | J1501 (20 Pin Control Signal) Mating Connector with 300mm flying leads (for "-9P" suffix)                         |    |
| TBD                   | Pre-Cut thermal insulator (Laird TFLX HR220FG)                                                                    |   |
| 73-769-002            | USB to I <sup>2</sup> C High Speed Adaptor for PMBus™ Communication                                               |  |
| 73-769-007            | J1501 (20 Pin) Mating connector with 10 Pin header termination for use with 73-769-002                            |  |
| TBD                   | Test Heatsink for unit characterization. Size: 331 x 220 x 69 mm; Aluminum with natural finish; Weight = 1.7 kgs. |  |

## RECORD OF REVISION AND CHANGES

| Issue | Date       | Description                                                                                          | Originators |
|-------|------------|------------------------------------------------------------------------------------------------------|-------------|
| 1.0   | 03.02.2022 | First Release                                                                                        | K. Ma       |
| 1.1   | 04.27.2022 | Add user configuration command description                                                           | K. Ma       |
| 1.2   | 09.09.2022 | Update total power at different input voltage range and efficiency curve of -4P model                | K. Ma       |
| 1.3   | 12.21.2022 | Update 48 V variant specification and PMBus™ accuracy                                                | K. Ma       |
| 1.4   | 06.16.2023 | Add 48 V variant performance curves<br>Update some specifications per internal specification updated | K. Ma       |
| 1.5   | 09.26.2023 | Add warranty and update format issue                                                                 | K. Wang     |
| 1.6   | 10.03.2023 | Update low line power rating                                                                         | K. Ma       |
| 1.7   | 01.16.2024 | Update J1501 connector part number                                                                   | K. Ma       |



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