TECHNICAL REFERENCE NOTE

# ARTESYN LCM1500 SERIES

## 1500 Watts Bulk Front End


## PRODUCT DESCRIPTION

Advanced Energy's Artesyn LCM1500 series provide for a very wide range of AC-DC embedded power requirement. Featuring high build quality with robust screw terminals, long life, and typical full-load efficiency of greater than 89 percent, these units are ideal for use in industrial and medical applications. They are backed by a comprehensive set of industrial and medical safety approvals and certificates. Variable-speed 'Smart Fans' draw on software controls developed by Advanced Energy to match fan speed to the unit's cooling requirement and load current. Slowing the fan not only saves power but also reduces wear, thus extending its life.

## AT A GLANCE

**Total Power**

1500 Watts

**Input Voltage**

90 to 264 Vac

**# of Outputs**

Single

## SPECIAL FEATURES

- 1500 Watts output power
- Low cost
- 2.5" x 5.2" x 10.0"
- 12 Watts per cubic inch
- Industrial/medical safety
- -40 $^{O}$C to 70 $^{O}$C with derating
- Optional 5 Vdc @ 2 A housekeeping
- High efficiency: 89% typical
- Variable speed "smart fans"
- DSP controlled
- Conformal coat option
- ±10% adjustment range
- Margin programming
- OR-ing FET
- Semi F47 compliance at high line

## COMPLIANCE

- EMI Class A
- EN61000 Immunity
- RoHS 3

## SAFETY

- ULcUL Recognized
- ITE(UL62368-1)
- ULcUL Recognized Medical(ANSI/ AAMI ES60601-1)
- TUV-SuD ITE + Medical (EN62368-1 and EN60601-1)
- CE LVD (EN60950-1 + ROHS)
- BSMI
- UKCA Mark
- CB Report
  through Demko for IEC60950-1
  through TUV-SuD for IEC60601-1

# MODEL NUMBERS

| Standard[1] | Output Voltage | Minimum Load | Maximum Load | Adjustment Range | Maximum Power |
|---|---|---|---|---|---|
| LCM1500L | 12Vdc | 0A | 133A | 10.8-13.2Vdc | 1500W |
| LCM1500N | 15Vdc | 0A | 100A | 13.5-16.5Vdc | 1500W |
| LCM1500Q | 24Vdc | 0A | 67A | 21.6-26.4Vdc | 1500W |
| LCM1500R | 28Vdc | 0A | 53A | 25.2-30.8Vdc | 1500W |
| LCM1500U | 36Vdc | 0A | 43A | 32.4-39.6Vdc | 1500W |
| LCM1500W | 48Vdc | 0A | 33A | 43.2-52.8Vdc | 1500W |

Note 1 - Blank - Standard T- Terminal Block

## Options

Blank = No Options

1 = Conformal Coat

2 = Reverse Air

4 = 5V Standby

5 = Opt 1 + 4

8 = Constant current

B = Opt 2 + 8

C = Opt 1 + 2 + 8

D = Opt 4 + 8

E = Opt 1 + 4 + 8

F = Opt 2 + 4 + 8

G = Opt 1 + 2 + 4 + 8

# 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, continuous | All models | $P_{O,max}$ | - | - | 1500 | W |
| Isolation Voltage (Qualification)<br>Input to outputs (2X MOPP)<br>Input to safety ground (1X MOPP)<br>Outputs to safety ground (1X MOPP) | All models | | <br>-<br>-<br>- | <br>-<br>-<br>- | <br>4000<br>2087<br>250 | <br>Vac<br>Vac<br>Vdc |
| Isolation Voltage (Production)<br>Input to outputs<br>Input to safety ground<br>Outputs to safety ground | <br>All models<br>All models<br>All models | | <br>-<br>-<br>- | <br>-<br>-<br>- | <br>1800<br>1800<br>250 | <br>Vac<br>Vac<br>Vdc |
| Ambient Operating Temperature | All models | $T_A$ | -40 | - | +70[1] | °C |
| Storage Temperature | All models | $T_{STG}$ | -40 | - | +85 | °C |
| Humidity (non-condensing)<br>Operating<br>Non-operating | <br>All models<br>All models | | <br>20<br>10 | <br>-<br>- | <br>90<br>95 | <br>%<br>% |
| Altitude<br>Operating<br>Non-operating | <br>All models<br>All models | | <br>-<br>- | <br>-<br>- | <br>16,404<br>30,000 | <br>feet<br>feet |

Note 1 - With linear 50% derating from 50 °C to 70 °C.

# ELECTRICAL SPECIFICATIONS

## Input Specifications

**Table 2. Input Specifications**

| Parameter | Condition | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Operating Input Voltage, AC | All | $V_{IN,AC}$ | 90 | 115/230 | 264 | Vac |
| Input AC Frequency | All | $f_{IN}$ | 47 | 50/60 | 440 | Hz |
| Maximum Input Current ($I_O = I_{O,max}$, $I_{SB} = I_{SB,Max}$) | $V_{IN,AC}$ = 90Vac | $I_{IN,max}$ | - | - | 18 | A |
| No Load Input Current ($V_O$ =On, $I_O$ = 0A, $I_{SB}$ = 0A) | $V_{IN,AC}$ = 90Vac<br>$V_{IN,AC}$ = 264Vac | $I_{IN,no-load}$ | -<br>- | -<br>- | 600<br>400 | mA |
| No Load Input Power ($V_O$ =On, $I_O$ = 0A, $I_{SB}$ = 0A) | $V_{IN,AC}$ = 90Vac | $P_{IN,no-load}$ | - | - | 32 | W |
| Harmonic Line Currents | All | THD | IEC61000-3-2 | | | |
| Power Factor | $I_O = I_{O,max}$<br>$V_{IN,AC}$ = 90 to 264Vac | PF | - | 0.99 | - | |
| Startup Surge Current (Inrush) @ 25°C | $V_{IN,AC}$ = 264Vac | $I_{IN,surge}$ | - | - | 25 | $A_{PK}$ |
| Input Fuse | Internal, L and N 250VAC rated | | - | - | 30 | A |
| Input AC Low Line Start-up Voltage | $I_O = I_{O,max}$ | $V_{IN,AC-start}$ | 85 | - | 90 | Vac |
| Input AC Undervoltage Lockout Voltage | $I_O = I_{O,max}$ | $V_{IN,AC-stop}$ | 80 | - | 90 | Vac |
| PFC Switching Frequency | All | $f_{SW,PFC}$ | 65 | - | 75 | KHz |
| Efficiency ($T_A$ = 25°C, forced air cooling) | $V_{IN,AC}$ = 230Vac<br>$I_O = I_{O,max}$ | η | - | 89 | - | % |
| Leakage Current to safety ground | UL test method | $I_{IN,leakage}$ | - | - | 0.4 | mA |
| | IEC test method | $I_{IN,leakage}$ | - | - | 0.5 | mA |

# ELECTRICAL SPECIFICATIONS

## Output Specifications

**Table 3. Output Specifications**

| Parameter | | Condition | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Factory Set Voltage | LCM1500L | $V_{IN,AC}$ = 230Vac Half load | $V_{O,Factory}$ | 11.94 | 12.00 | 12.06 | Vdc |
| | LCM1500N | | | 14.92 | 15.00 | 15.07 | |
| | LCM1500Q | | | 23.88 | 24.00 | 24.12 | |
| | LCM1500R | | | 27.86 | 28.00 | 28.14 | |
| | LCM1500U | | | 35.82 | 36.00 | 36.18 | |
| | LCM1500W | | | 47.76 | 48.00 | 48.24 | |
| Output Adjust Range | LCM1500L | $I_O$ = 0A | $V_O$ | 10.8 | - | 13.2 | Vdc |
| | LCM1500N | | | 13.5 | - | 16.5 | |
| | LCM1500Q | | | 21.6 | - | 26.4 | |
| | LCM1500R | | | 25.2 | - | 30.8 | |
| | LCM1500U | | | 32.4 | - | 39.6 | |
| | LCM1500W | | | 43.2 | - | 52.8 | |
| Total Regulation | | Inclusive of line, load temperature change, warm-up drift | $V_O$ | -2.0 | - | +2.0 | % $V_O$ |
| | | | $V_{SB}$ | 4.8 | - | 5.48 | V |
| Output Ripple, pk-pk | LCM1500L | See note 2 | $V_O$ | - | - | 120 | $mV_{pk-pk}$ |
| | LCM1500N | | | - | - | 150 | |
| | LCM1500Q | | | - | - | 240 | |
| | LCM1500R | | | - | - | 280 | |
| | LCM1500U | | | - | - | 360 | |
| | LCM1500W | | | - | - | 480 | |
| | All models | | $V_{SB}$ | - | - | 50 | |
| Hold Up Time | | See note 1 | $t_{Hold-Up}$ | 14 | - | - | mSec |
| DC DC Switching Frequency | | All | $f_{SW,DC-DC}$ | 125 | - | 145 | KHz |
| Output Current, continuous | LCM1500L | All | $I_{O,max}$ | 0 | - | 133 | A |
| | LCM1500N | | | 0 | - | 100 | |
| | LCM1500Q | | | 0 | - | 67 | |
| | LCM1500R | | | 0 | - | 53.6 | |
| | LCM1500U | | | 0 | - | 43 | |
| | LCM1500W | | | 0 | - | 33 | |
| | All models | | $I_{SB}$ | - | - | 2 | |

Note 1 - Adjusting the Output to higher tolerance (i.e. 26.4V which is the +10% adjustment range of 24V Nominal) will give a typical Hold-up of 10mSec.
Note 2 - Measure with a 0.1uF ceramic capacitor in parallel with a 10uF tantalum capacitor using a 20MHz bandwidth limited oscilloscope. Measurement circuit needs to be made at PSU terminals or at mating connector.

# ELECTRICAL SPECIFICATIONS

## Output Specifications

**Table 3. Output Specifications**

| Parameter | | Condition | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_O$ Dynamic Response<br>Peak Deviation<br>Settling Time | | 50% load change, slew rate = 1A/uS step load valid between 10% to 100% of $I_{O,max}$ | ±%$V_O$<br>$t_s$ | -<br>- | -<br>- | 4<br>300 | %<br>uSec |
| Turn On Overshoot | | $I_O$ = 0 | %$V_O$ | - | - | 10 | % |
| Load Capacitor | LCM1500L | All | $C_O$ | 0 | - | 20000 | uF |
| | LCM1500N | | | 0 | - | 16000 | |
| | LCM1500Q | | | 0 | - | 10000 | |
| | LCM1500R | | | 0 | - | 8200 | |
| | LCM1500U | | | 0 | - | 6700 | |
| | LCM1500W | | | 0 | - | 5000 | |
| | All models | | $C_{SB}$ | 0 | - | 270 | |
| Number of Parallel Units | | All | | - | - | 10 | Units |
| $V_O$ Current Share Accuracy | | 100% of $I_{O,max}$ | | | | 10 | %$I_{O,max}$ |
| Minimum Load for Current Sharing | | | | 1 | - | - | %$I_{O,max}$ |

# ELECTRICAL SPECIFICATIONS

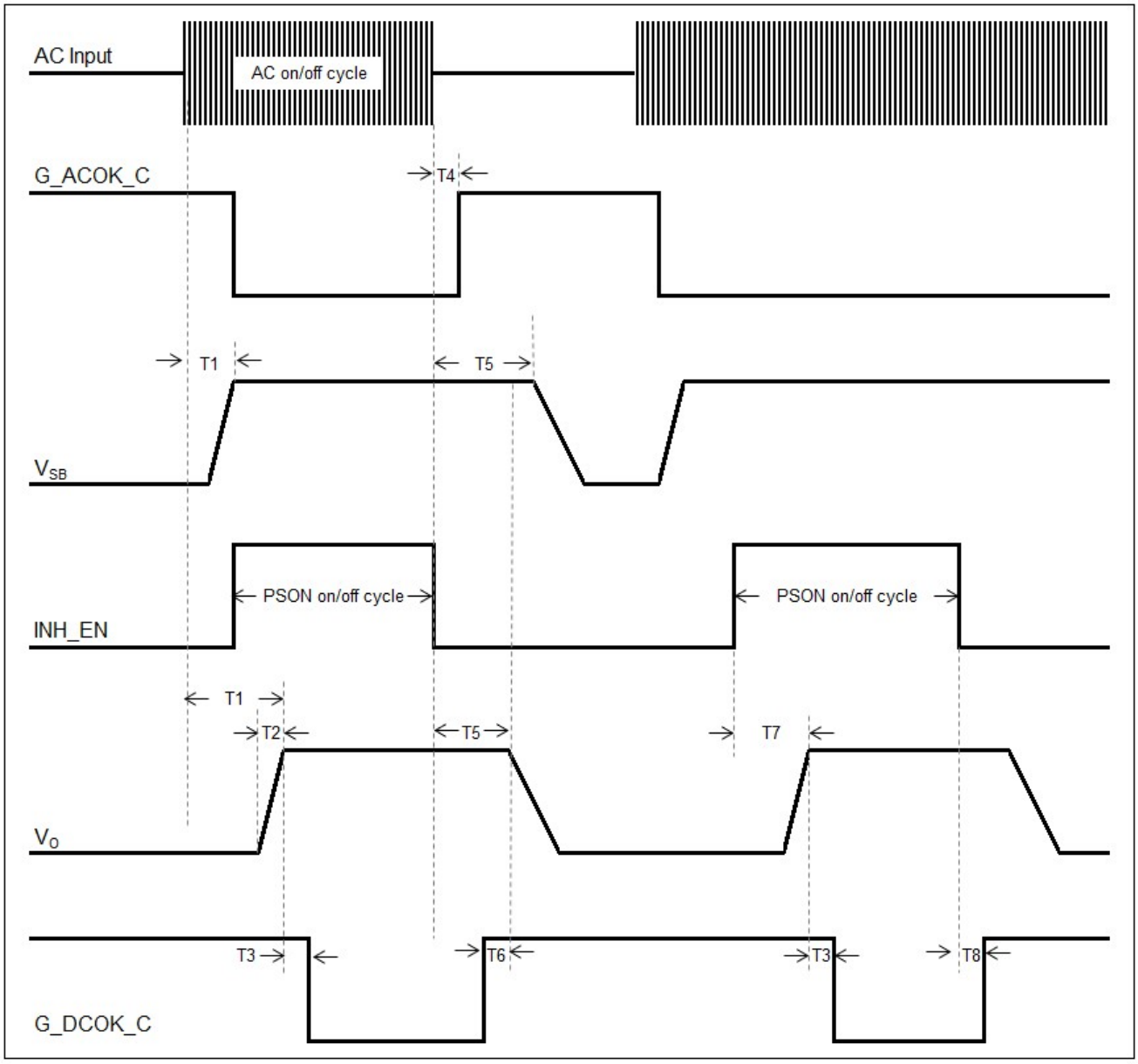
## System Timing Specifications

**Table 4. Specifications**

| Label | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| T1 | Delay from AC being applied to output voltages being within regulation. | - | - | 3000 | mSec |
| T2 | $V_O$ rise time, 10% to 90% of the nominal voltage. | - | - | 100 | mSec |
| T3 | Delay from main output within regulation to G_DCOK_C signal assertion (going Low). | - | - | 500 | mSec |
| T4 | Delay from loss of AC input to 0 to G_ACOK_C going to high. | - | - | 50 | mSec |
| T5 | Delay from AC loss to main output being within regulation. Main output set at nominal voltage setting | 14 | - | - | mSec |
| T6 | Delay from G_DCOK_C signal de-assertion (going High) to main output dropping to less than the lower trimming range ( -20% of the nominal output). | 1 | - | - | mSec |
| T7 | Delay from INH_EN active to output voltages within regulation limits. | - | - | 500 | mSec |
| T8 | Delay from Inhibit assertion (Pulled low) to G_DCOK_C signal going High. | - | - | 2 | mSec |

# ELECTRICAL SPECIFICATIONS

## System Timing Diagram



# ELECTRICAL SPECIFICATIONS

## LCM1500L Performance Curves

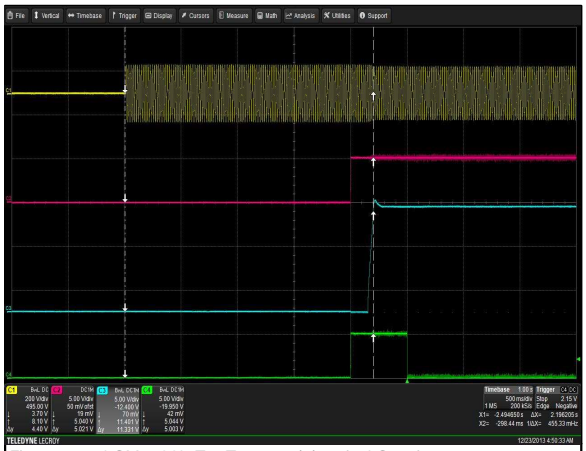


Figure 1: LCM1500L-T-4 Turn-on delay via AC mains
Vin = 90Vac Load: Io = 125A (12V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

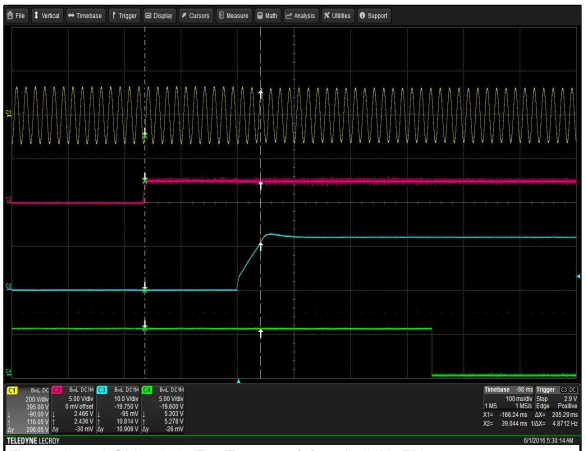


Figure 2: LCM1500L-T-4 Turn-on delay via INH_EN
Vin = 90Vac Load: Io = 125A (12V), Isb = 2A (5V)
Ch 1: Vin Ch 2: INH_EN Ch 3: Vo Ch 4: G_DCOK_C

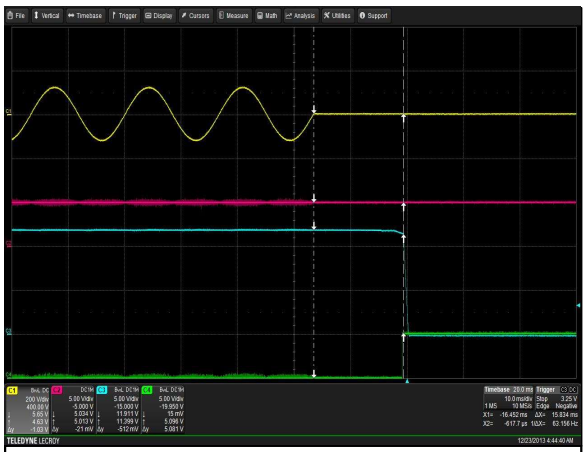


Figure 3: LCM1500L-T-4 Hold-up Time
Vin = 90Vac / 47Hz / 0° Load: Io = 125A (12V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

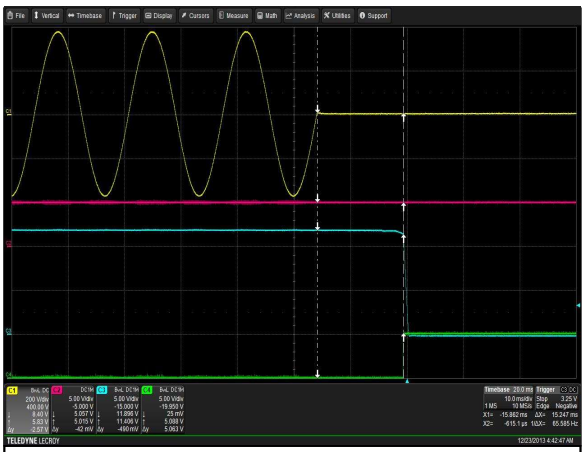


Figure 4: LCM1500L-T-4 Hold-up Time
Vin = 264Vac / 60Hz / 0° Load: Io = 125A (12V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

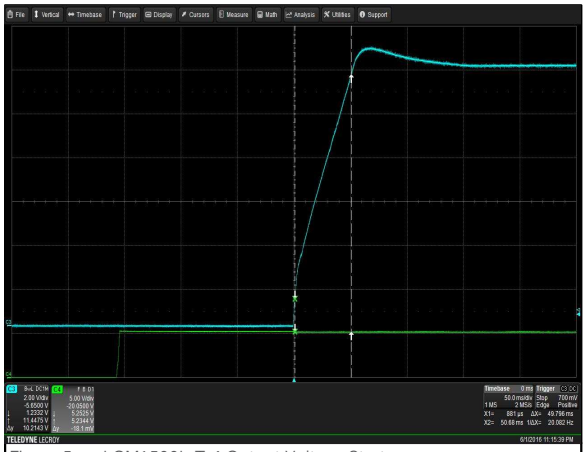


Figure 5: LCM1500L-T-4 Output Voltage Startup
Vin = 90Vac Load: Io = 125A (12V), Isb = 2A (5V)
Ch 3: Vo Ch 4: G_DCOK_C

Figure 6: LCM1500L-T-4 Turn Off Characteristic via INH_EN
Load: Io = 125A (12V), Isb = 2A (5V)
Ch 2: INH_EN Ch 3: Vo Ch 4: G_DCOK_C

# ELECTRICAL SPECIFICATIONS

## LCM1500L Performance Curves

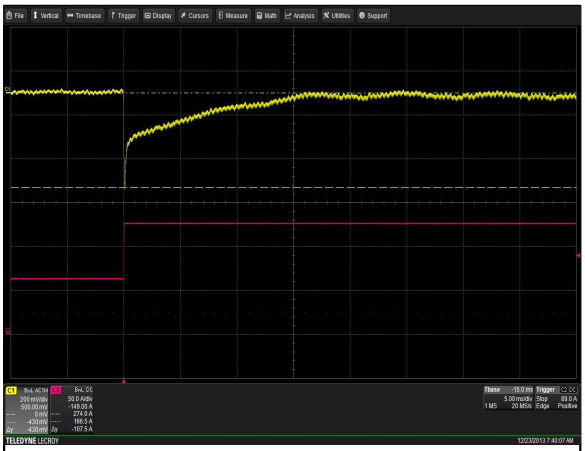


Figure 7: LCM1500L-T-4 Transient Response - Vo Deviation
50% to 100% load change 1A/uS slew rate Vin = 230Vac
Ch 1: Vo Ch 2: Io

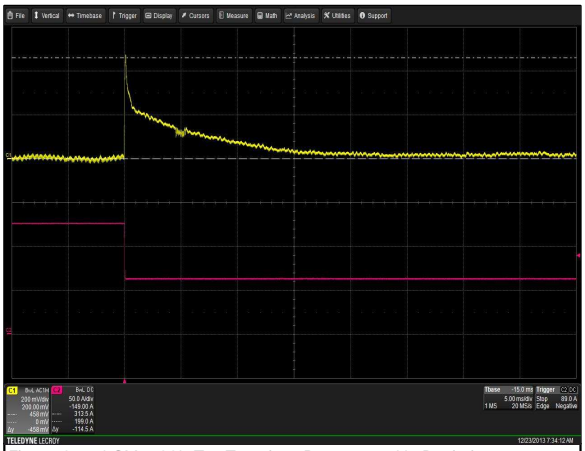


Figure 8: LCM1500L-T-4 Transient Response - Vo Deviation
100% to 50% load change 1A/uS slew rate Vin = 230Vac
Ch 1: Vo Ch 2: Io

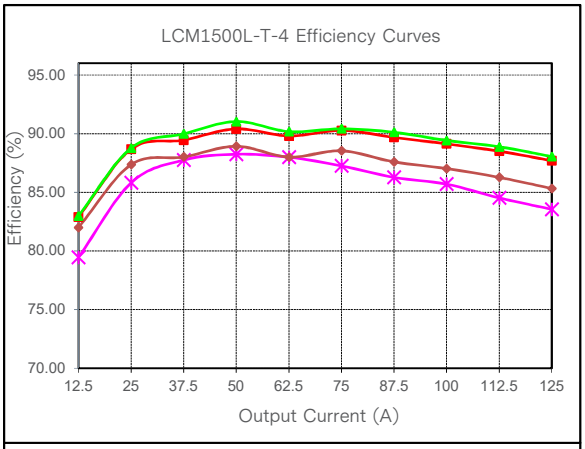



Figure 9: LCM1500L-T-4 Efficiency Curve @ 25°C
90Vac 115Vac 230Vac 264Vac
Loading: $I_{o\_main}$ = 10%$I_{o,max}$ increment to 125A, $I_{SB}$ = 0A (5V)

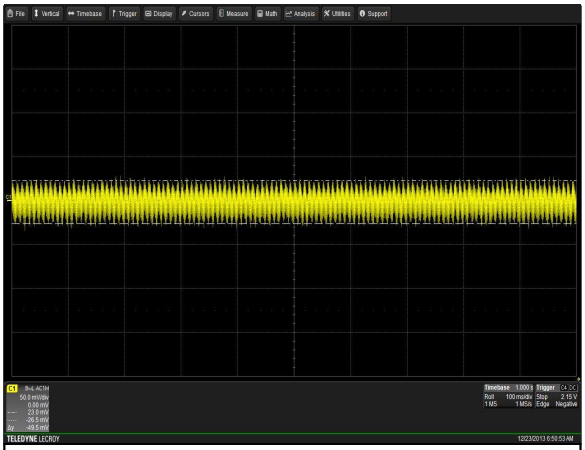


Figure 10: LCM1500L-T-4 Ripple and Noise Measurement
Vin = 115Vac Load: Io = 125A (12V), Isb = 2A (5V)
Ch 1: Vo

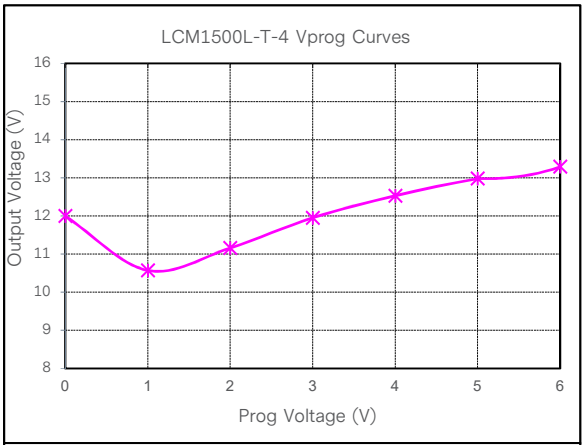



Figure 11: LCM1500L-T-4 Output Voltage Adjustment by Vprog @ 25°C
115Vac
Loading: $I_o$ = 0A (12V), $I_{SB}$ = 0A (5V)

# ELECTRICAL SPECIFICATIONS

## LCM1500N Performance Curves

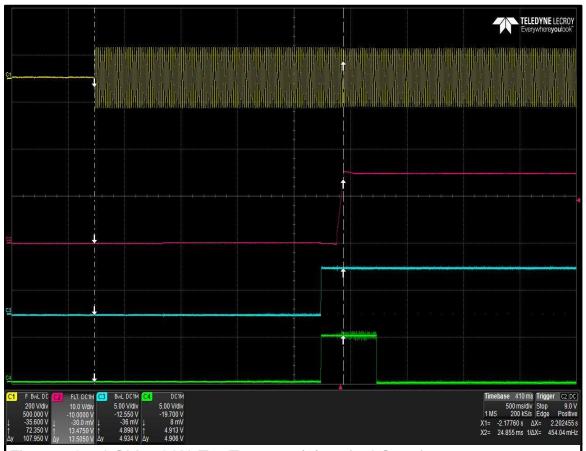


Figure 12: LCM1500N-T-4 Turn-on delay via AC mains
Vin = 90Vac Load: Io = 100A (15V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

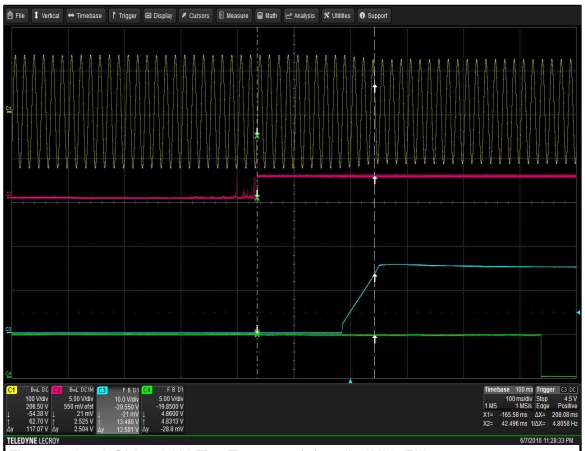


Figure 13: LCM1500N-T-4 Turn-on delay via INH_EN
Vin = 90Vac Load: Io = 100A (15V), Isb = 2A (5V)
Ch 1: Vin Ch 2: INH_EN Ch 3: Vo Ch 4: G_DCOK_C

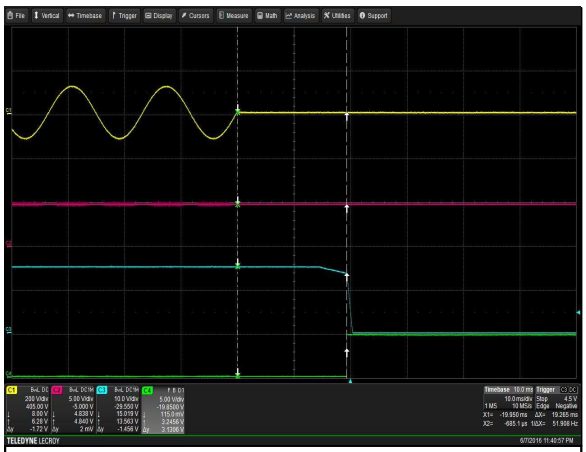


Figure 14: LCM1500N-T-4 Hold-up Time
Vin = 90Vac / 47Hz / 0° Load: Io = 100A (15V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

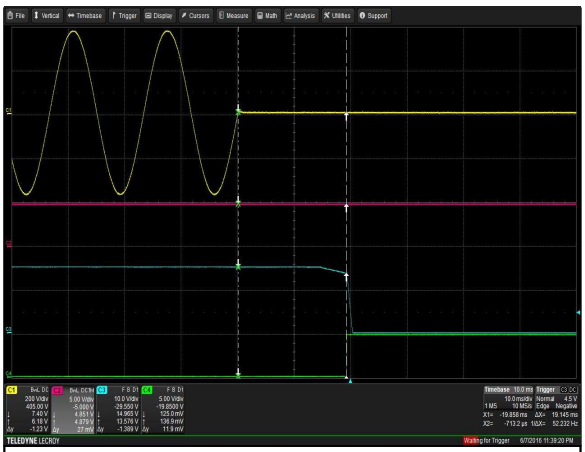


Figure 15: LCM1500N-T-4 Hold-up Time
Vin = 264Vac / 60Hz / 0° Load: Io = 100A (15V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

Figure 16: LCM1500N-T-4 Output Voltage Startup
Vin = 90Vac Load: Io = 100A (15V), Isb = 2A (5V)
Ch 1: Vo Ch 2: G_DCOK_C

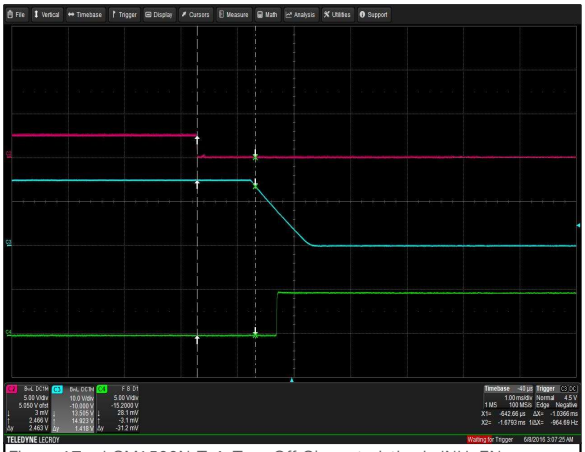


Figure 17: LCM1500N-T-4 Turn Off Characteristic via INH_EN
Load: Io = 100A (15V), Isb = 2A (5V)
Ch 1: INH_EN Ch 2: Vo Ch 3: G_DCOK_C

# ELECTRICAL SPECIFICATIONS

## LCM1500N Performance Curves

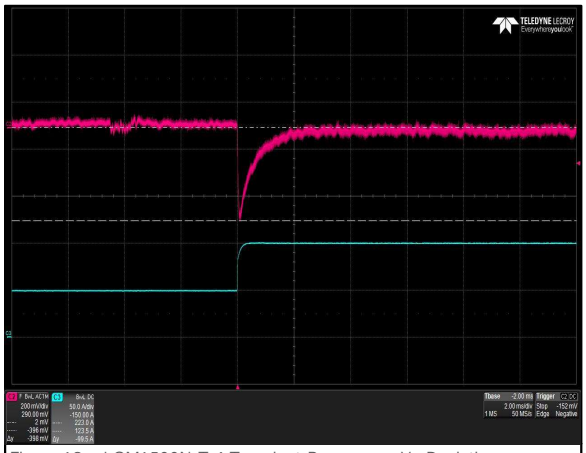


Figure 18: LCM1500N-T-4 Transient Response - Vo Deviation
50% to 100% load change 1A/uS slew rate Vin = 230Vac
Ch 1: Vo Ch 2: Io

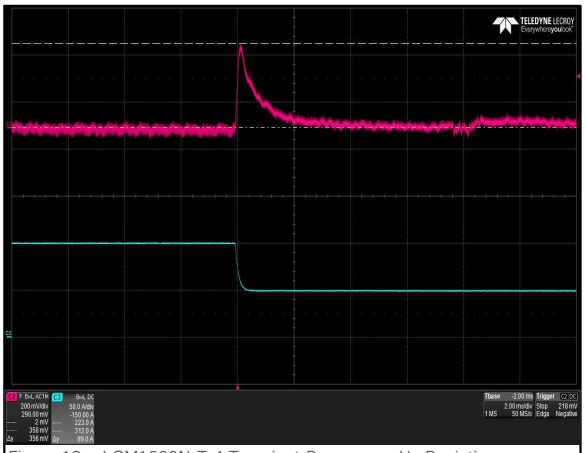


Figure 19: LCM1500N-T-4 Transient Response - Vo Deviation
100% to 50% load change 1A/uS slew rate Vin = 230Vac
Ch 1: Vo Ch 2: Io

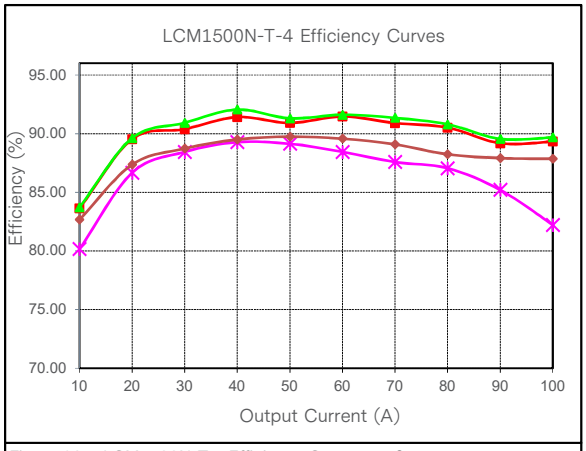



Figure 20: LCM1500N-T-4 Efficiency Curve @ 25°C
90Vac 115Vac 230Vac 264Vac
Loading: $I_{o\_main}$ = 10%$I_{o,max}$ increment to 100A, $I_{SB}$ = 0A (5V)

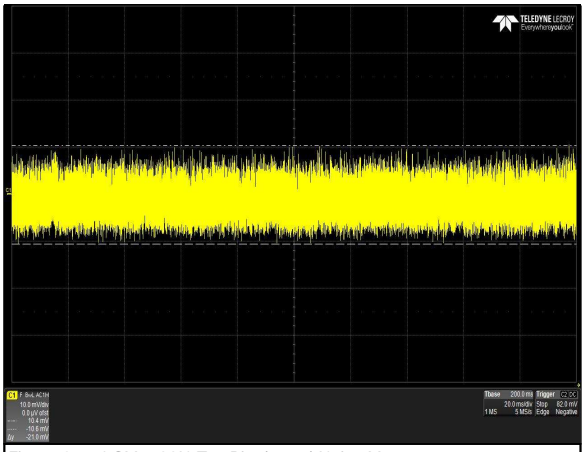


Figure 21: LCM1500N-T-4 Ripple and Noise Measurement
Vin = 115Vac Load: Io = 100A (15V), Isb = 2A (5V)
Ch 1: Vo

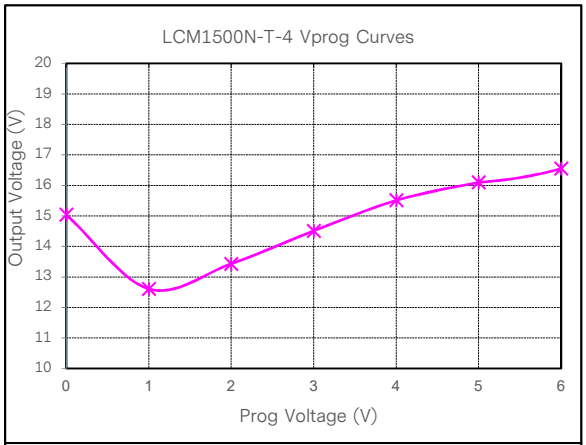



Figure 22: LCM1500N-T-4 Output Voltage Adjustment by Vprog @ 25°C
115Vac
Loading: $I_o$ = 0A (15V), $I_{SB}$ = 0A (5V)

# ELECTRICAL SPECIFICATIONS

## LCM1500Q Performance Curves

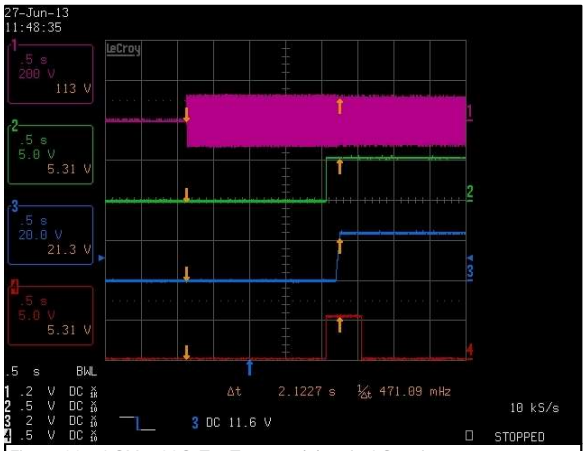



Figure 23: LCM1500Q-T-4 Turn-on delay via AC mains
Vin = 90Vac Load: Io = 63A (24V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

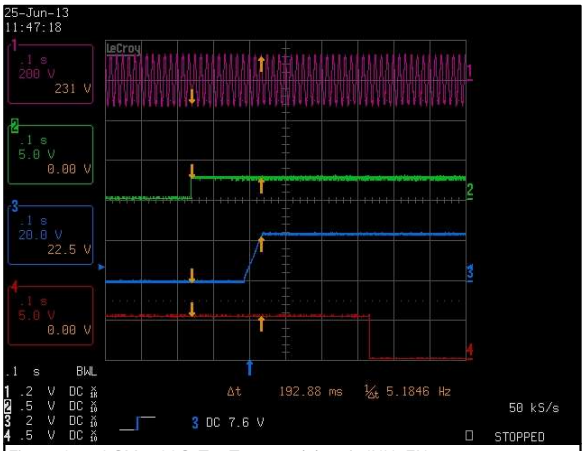



Figure 24: LCM1500Q-T-4 Turn-on delay via INH_EN
Vin = 90Vac Load: Io = 63A (24V), Isb = 2A (5V)
Ch 1: Vin Ch 2: INH_EN Ch 3: Vo Ch 4: G_DCOK_C

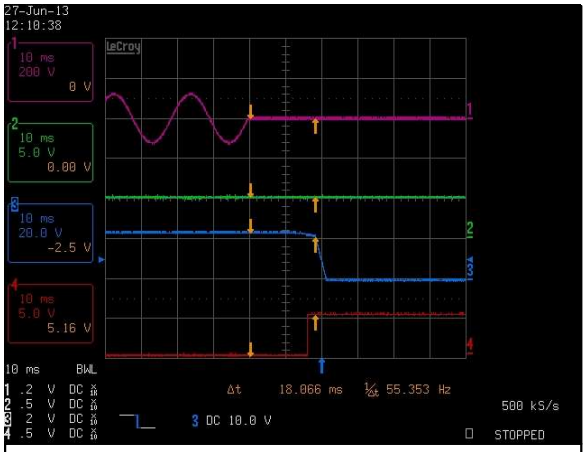



Figure 25: LCM1500Q-T-4 Hold-up Time
Vin = 90Vac / 47Hz / 0° Load: Io = 63A (24V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

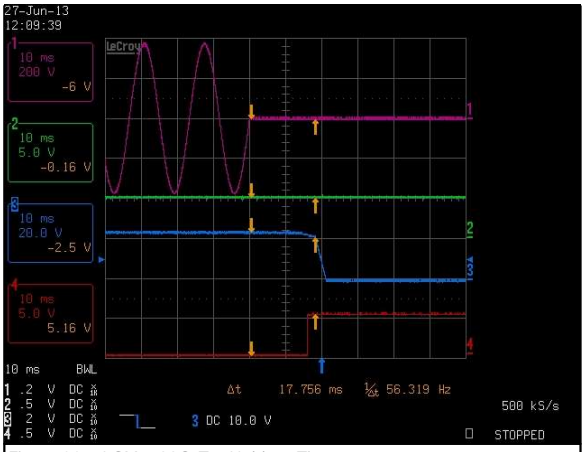



Figure 26: LCM1500Q-T-4 Hold-up Time
Vin = 264Vac / 60Hz / 0° Load: Io = 63A (24V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

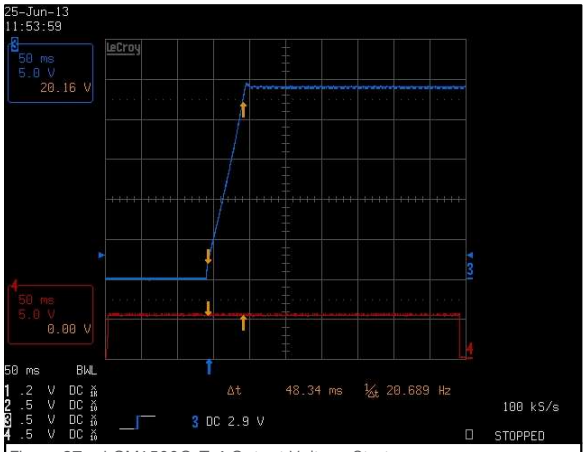



Figure 27: LCM1500Q-T-4 Output Voltage Startup
Vin = 90Vac Load: Io = 63A (24V), Isb = 2A (5V)
Ch 3: Vo Ch 4: G_DCOK_C

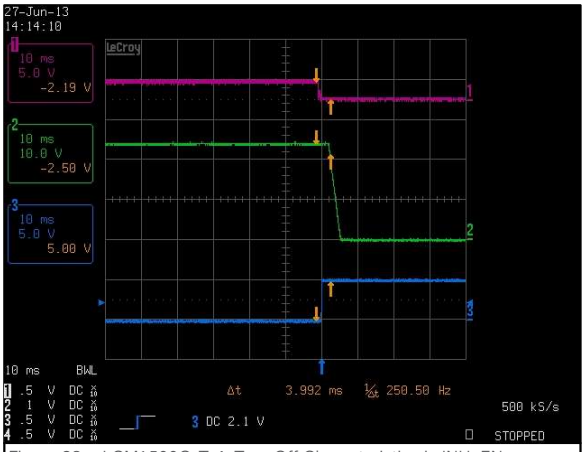



Figure 28: LCM1500Q-T-4 Turn Off Characteristic via INH_EN
Load: Io = 63A (24V), Isb = 2A (5V)
Ch 1: INH_EN Ch 2: Vo Ch 3: G_DCOK_C

# ELECTRICAL SPECIFICATIONS

## LCM1500Q Performance Curves

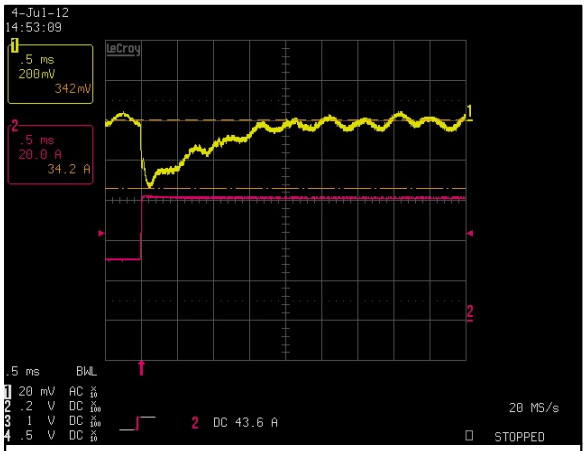



Figure 29: LCM1500Q-T-4 Transient Response - Vo Deviation
50% to 100% load change 1A/uS slew rate Vin = 230Vac
Ch 1: Vo Ch 2: Io

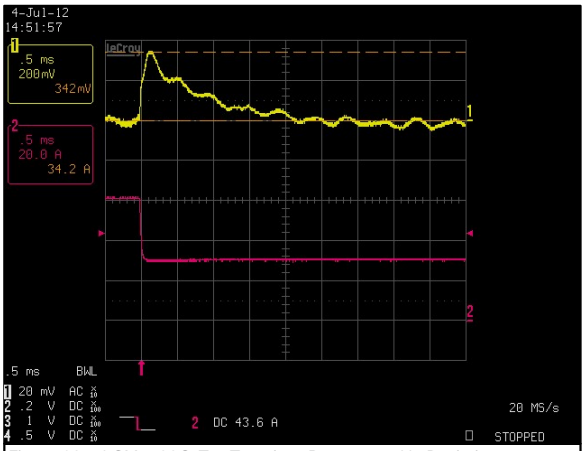



Figure 30: LCM1500Q-T-4 Transient Response - Vo Deviation
100% to 50% load change 1A/uS slew rate Vin = 230Vac
Ch 1: Vo Ch 2: Io

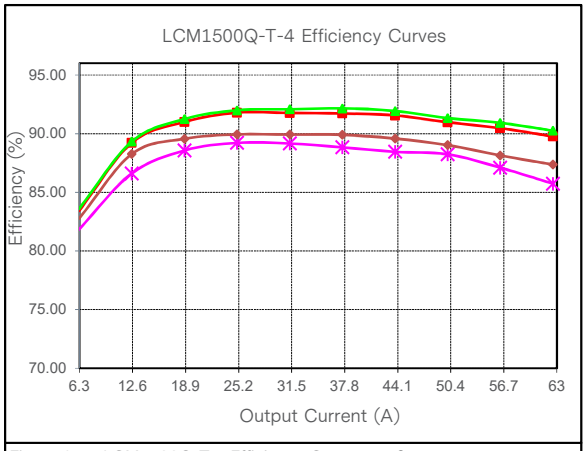



Figure 31: LCM1500Q-T-4 Efficiency Curve @ 25°C
90Vac 115Vac 230Vac 264Vac
Loading: $I_{o\_main}$ = 10%$I_{o,max}$ increment to 63A, $I_{SB}$ = 0A (5V)

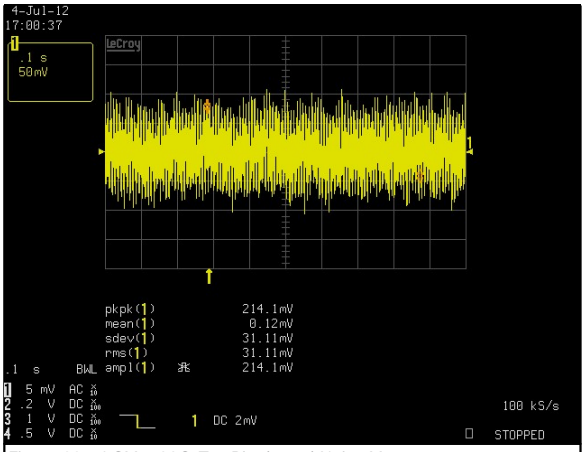



Figure 32: LCM1500Q-T-4 Ripple and Noise Measurement
Vin = 115Vac Load: Io = 63A (24V), Isb = 2A (5V)
Ch 1: Vo

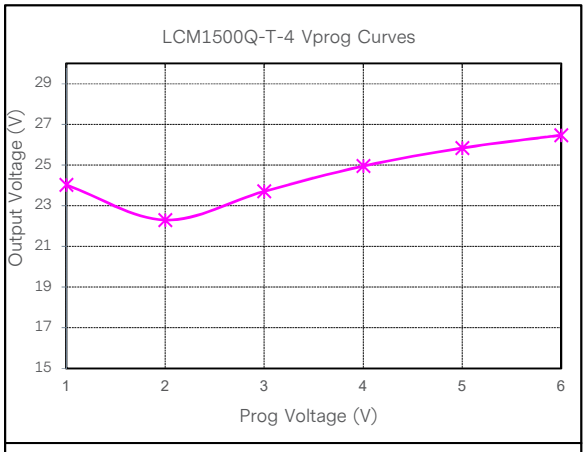



Figure 33: LCM1500Q-T-4 Output Voltage Adjustment by Vprog @ 25°C
115Vac
Loading: $I_o$ = 0A (24V), $I_{SB}$ = 0A (5V)

# ELECTRICAL SPECIFICATIONS

## LCM1500R Performance Curves

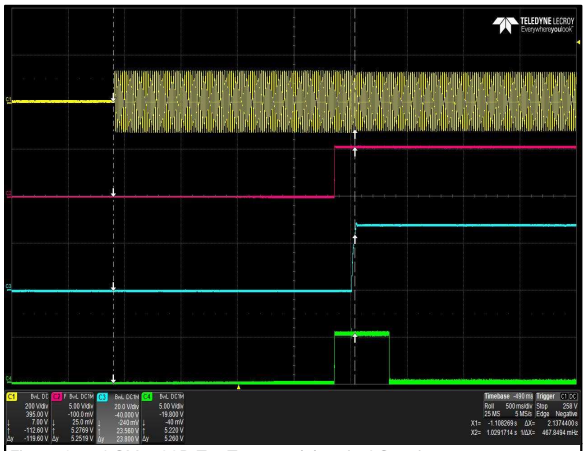


Figure 34: LCM1500R-T-4 Turn-on delay via AC mains
Vin = 90Vac Load: Io = 53.6A (28V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

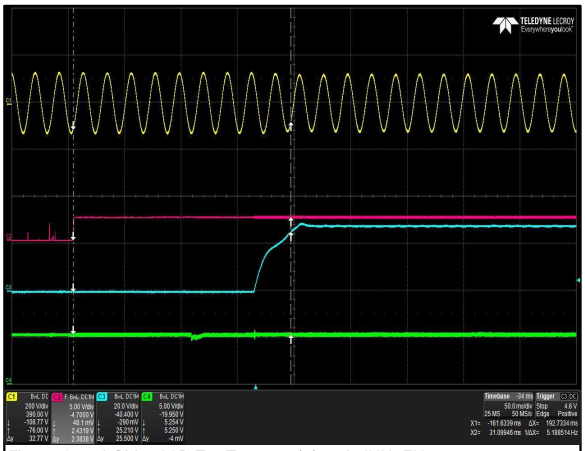


Figure 35: LCM1500R-T-4 Turn-on delay via INH_EN
Vin = 90Vac Load: Io = 53.6A (28V), Isb = 2A (5V)
Ch 1: Vin Ch 2: INH_EN Ch 3: Vo Ch 4: G_DCOK_C

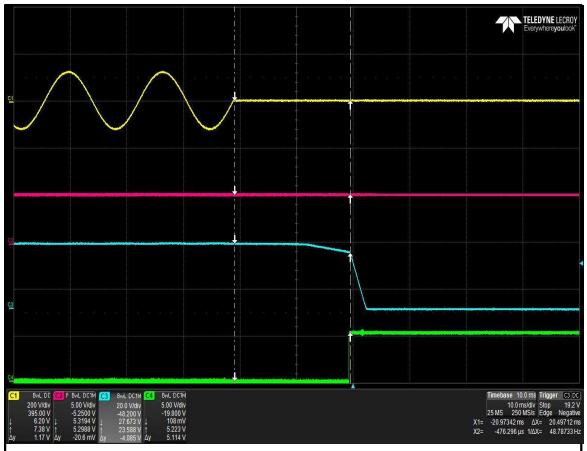


Figure 36: LCM1500R-T-4 Hold-up Time
Vin = 90Vac / 47Hz / 0° Load: Io = 53.6A (28V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

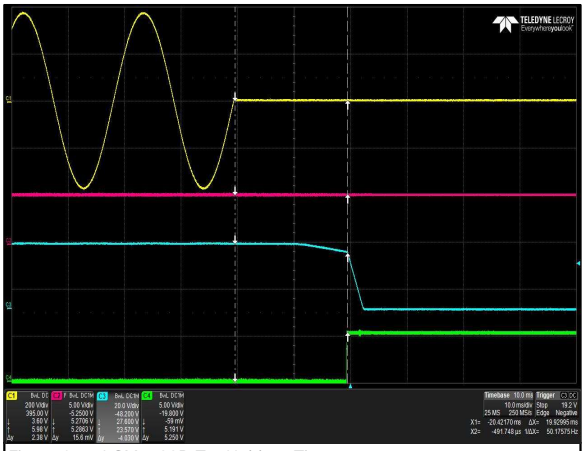


Figure 37: LCM1500R-T-4 Hold-up Time
Vin = 264Vac / 60Hz / 0° Load: Io = 53.6A (28V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

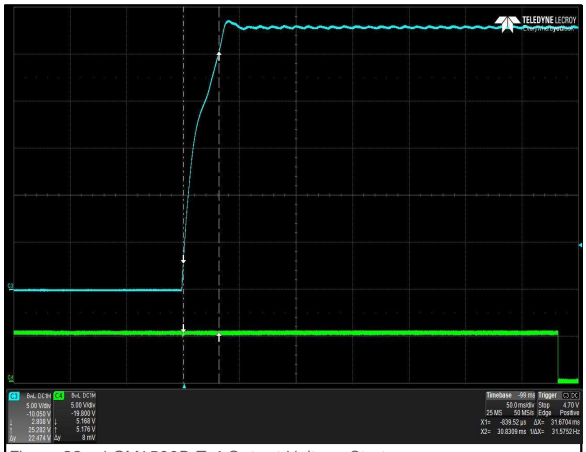


Figure 38: LCM1500R-T-4 Output Voltage Startup
Vin = 90Vac Load: Io = 53.6A (28V), Isb = 2A (5V)
Ch 3: Vo Ch 4: G_DCOK_C

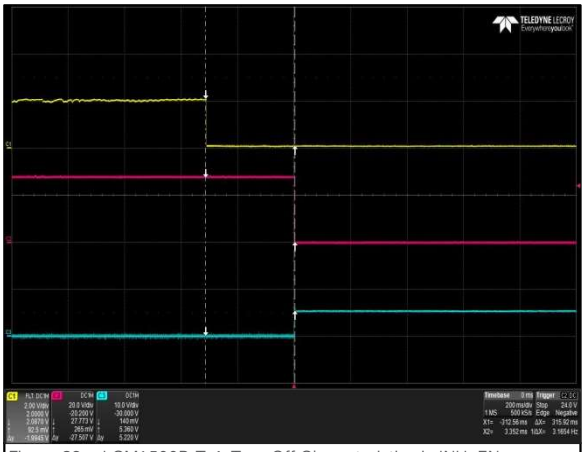


Figure 39: LCM1500R-T-4 Turn Off Characteristic via INH_EN
Load: Io = 53.6A (28V), Isb = 2A (5V)
Ch 1: INH_EN Ch 2: Vo Ch 3: G_DCOK_C

# ELECTRICAL SPECIFICATIONS

## LCM1500R Performance Curves

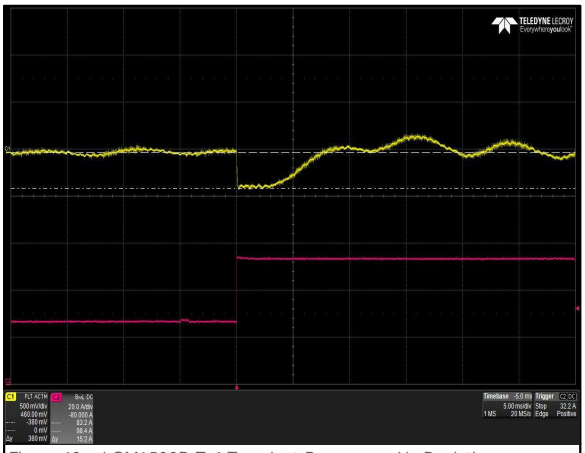


Figure 40: LCM1500R-T-4 Transient Response - Vo Deviation
50% to 100% load change 1A/uS slew rate Vin = 230Vac
Ch 1: Vo Ch 2: Io

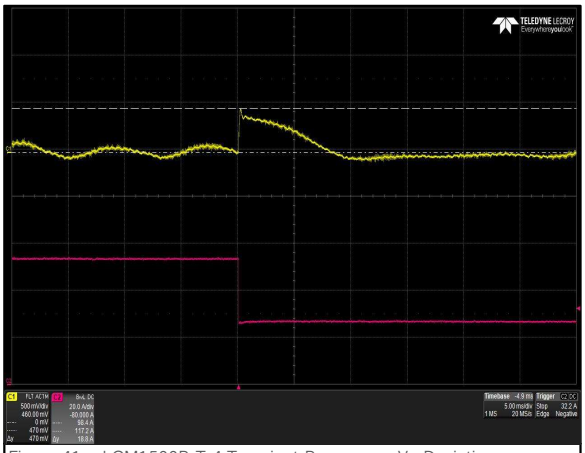


Figure 41: LCM1500R-T-4 Transient Response - Vo Deviation
100% to 50% load change 1A/uS slew rate Vin = 230Vac
Ch 1: Vo Ch 2: Io

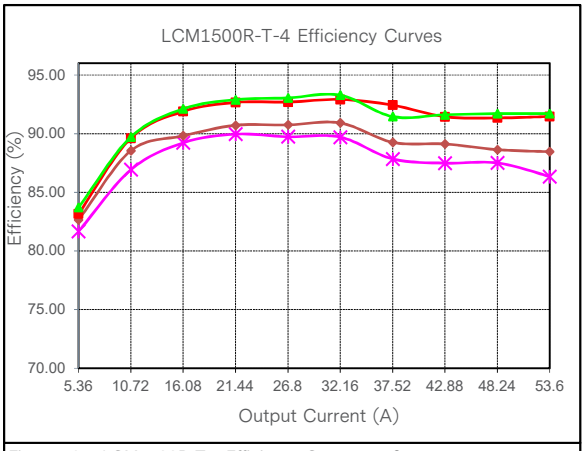



Figure 42: LCM1500R-T-4 Efficiency Curve @ 25°C
90Vac 115Vac 230Vac 264Vac
Loading: $I_{o\_main}$ = 10%$I_{o,max}$ increment to 53.6A, $I_{SB}$ = 0A (5V)

Figure 43: LCM1500R-T-4 Ripple and Noise Measurement
Vin = 115Vac Load: Io = 53.6A (28V), Isb = 2A (5V)
Ch 2: Vo

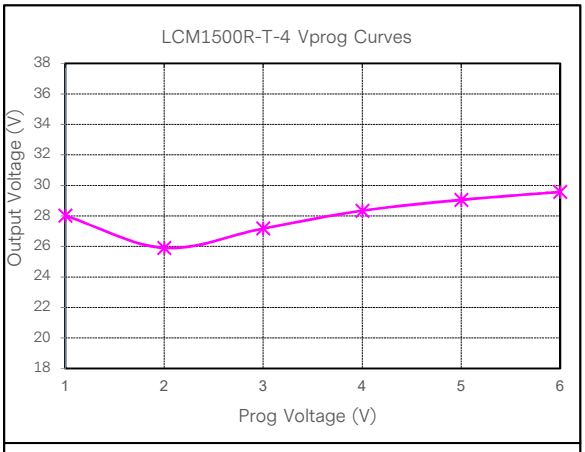



Figure 44: LCM1500R-T-4 Output Voltage Adjustment by Vprog @ 25°C
115Vac
Loading: $I_o$ = 0A (28V), $I_{SB}$ = 0A (5V)

# ELECTRICAL SPECIFICATIONS

## LCM1500U Performance Curves

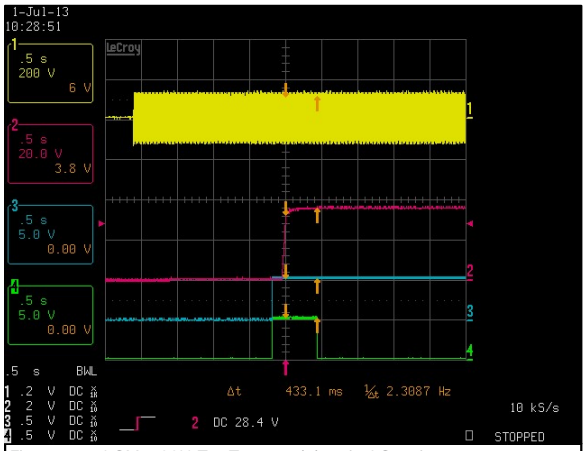



Figure 45: LCM1500U-T-4 Turn-on delay via AC mains
Vin = 90Vac Load: Io = 42A (36V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

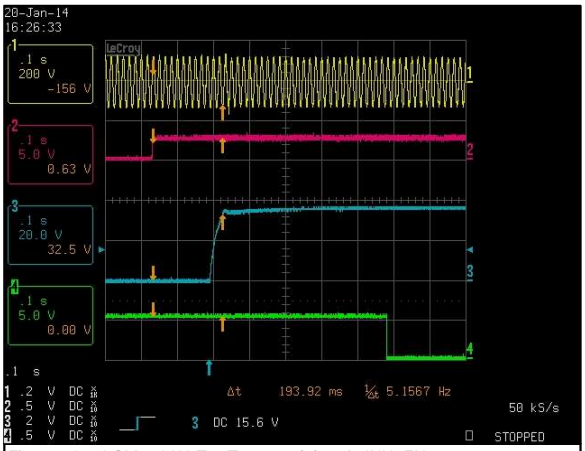



Figure 46: LCM1500U-T-4 Turn-on delay via INH_EN
Vin = 90Vac Load: Io = 42A (36V), Isb = 2A (5V)
Ch 1: Vin Ch 2: INH_EN Ch 3: Vo Ch 4: G_DCOK_C

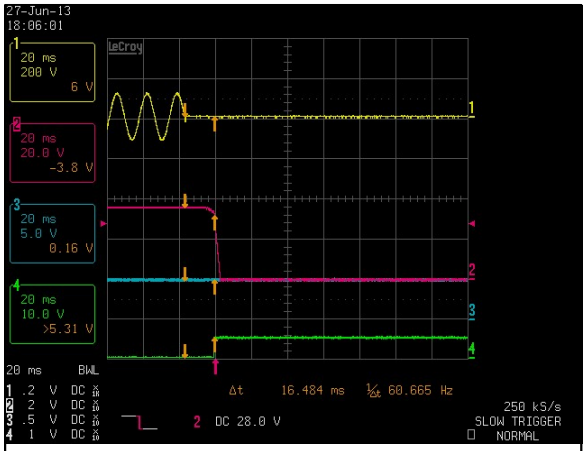



Figure 47: LCM1500U-T-4 Hold-up Time
Vin = 90Vac / 47Hz / 0° Load: Io = 42A (36V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

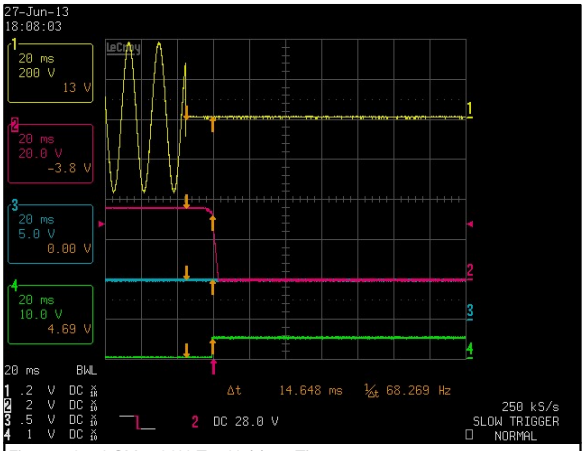



Figure 48: LCM1500U-T-4 Hold-up Time
Vin = 264Vac / 60Hz / 0° Load: Io = 42A (36V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

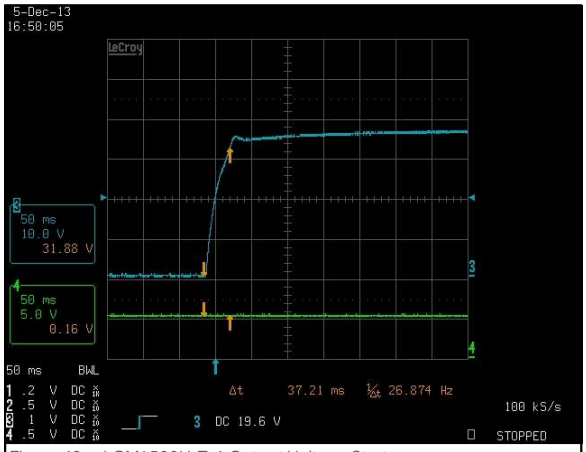



Figure 49: LCM1500U-T-4 Output Voltage Startup
Vin = 90Vac Load: Io = 42A (36V), Isb = 2A (5V)
Ch 3: Vo Ch 4: G_DCOK_C

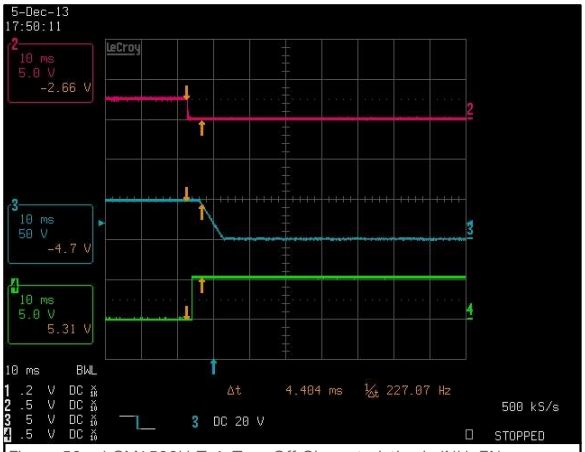



Figure 50: LCM1500U-T-4 Turn Off Characteristic via INH_EN
Load: Io = 42A (36V), Isb = 2A (5V)
Ch 2: INH_EN Ch 3: Vo Ch 4: G_DCOK_C

# ELECTRICAL SPECIFICATIONS

## LCM1500U Performance Curves

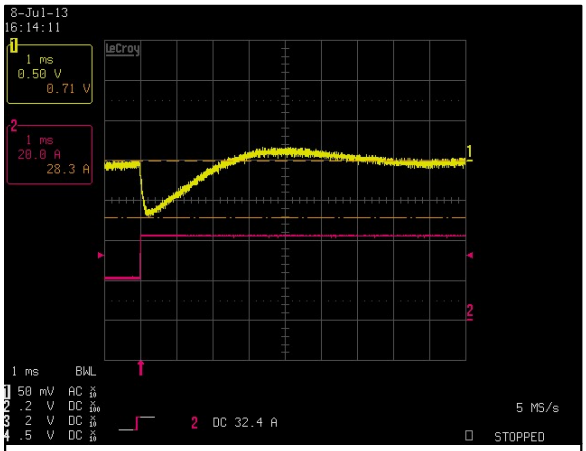



Figure 51: LCM1500U-T-4 Transient Response - Vo Deviation
50% to 100% load change 1A/uS slew rate Vin = 230Vac
Ch 1: Vo Ch 2: Io

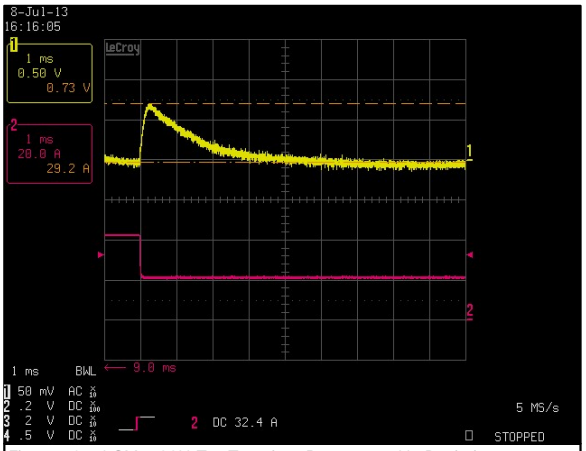



Figure 52: LCM1500U-T-4 Transient Response - Vo Deviation
100% to 50% load change 1A/uS slew rate Vin = 230Vac
Ch 1: Vo Ch 2: Io

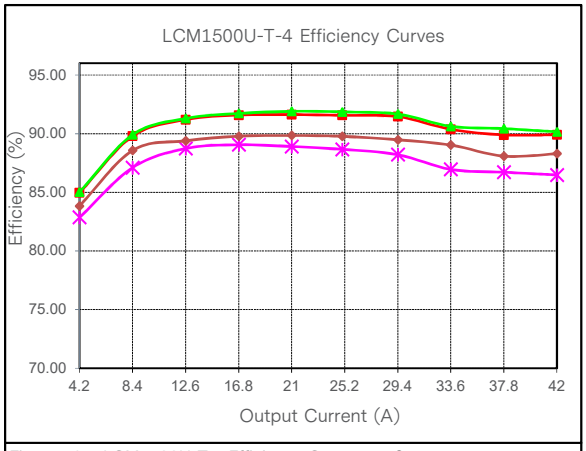



Figure 53: LCM1500U-T-4 Efficiency Curve @ 25°C
90Vac 115Vac 230Vac 264Vac
Loading: $I_{o\_main}$ = 10%$I_{o,max}$ increment to 42A, $I_{SB}$ = 0A (5V)

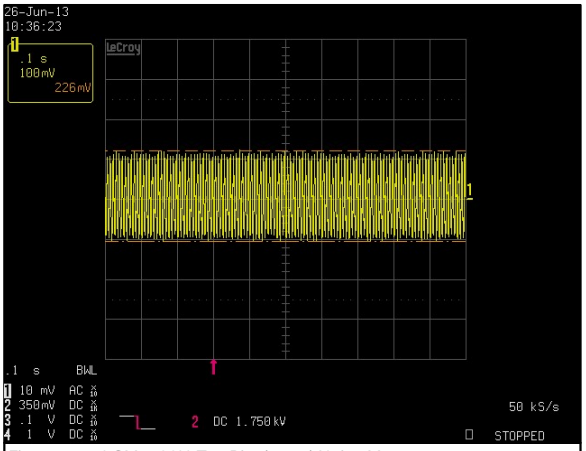



Figure 54: LCM1500U-T-4 Ripple and Noise Measurement
Vin = 115Vac Load: Io = 42A (36V), Isb = 2A (5V)
Ch 1: Vo

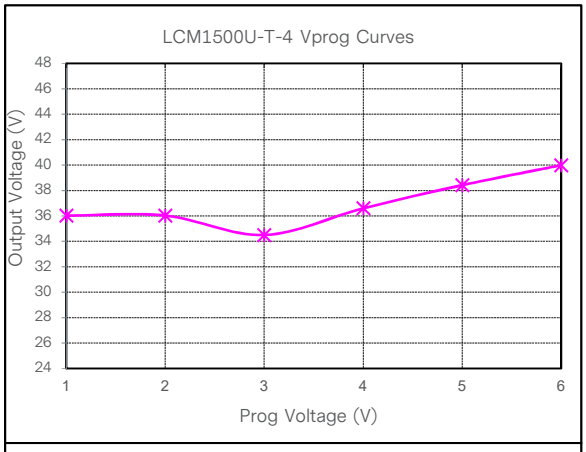



Figure 55: LCM1500U-T-4 Output Voltage Adjustment by Vprog @ 25°C
115Vac
Loading: $I_o$ = 0A (36V), $I_{SB}$ = 0A (5V)

# ELECTRICAL SPECIFICATIONS

## LCM1500W Performance Curves

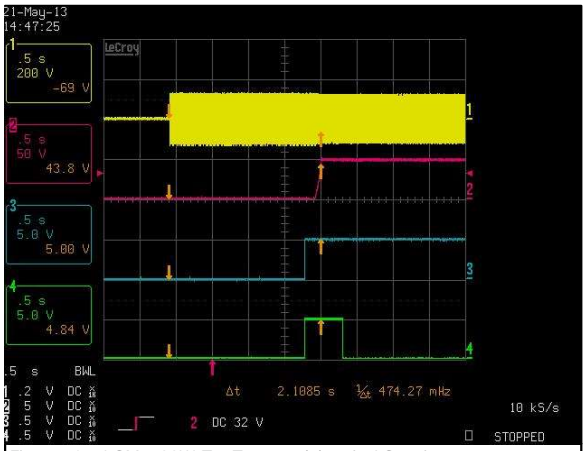



Figure 56: LCM1500W-T-4 Turn-on delay via AC mains
Vin = 90Vac Load: Io = 32A (48V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

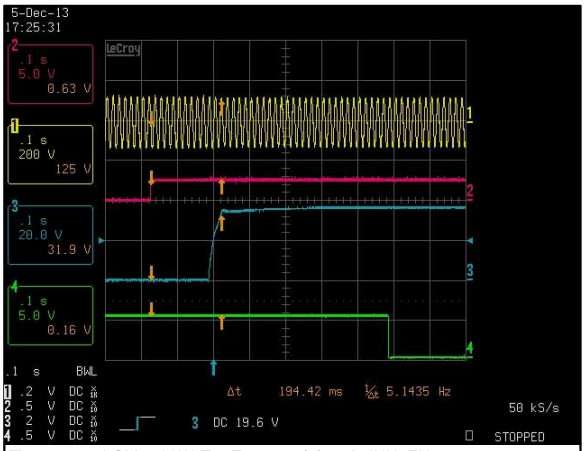



Figure 57: LCM1500W-T-4 Turn-on delay via INH_EN
Vin = 90Vac Load: Io = 32A (48V), Isb = 2A (5V)
Ch 1: Vin Ch 2: INH_EN Ch 3: Vo Ch 4: G_DCOK_C

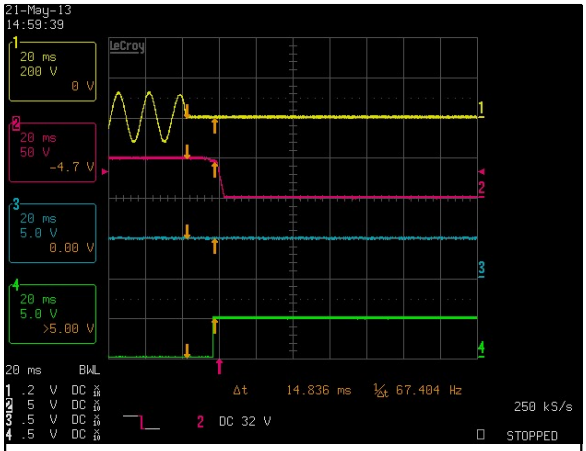



Figure 58: LCM1500W-T-4 Hold-up Time
Vin = 90Vac / 47Hz / 0° Load: Io = 32A (48V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

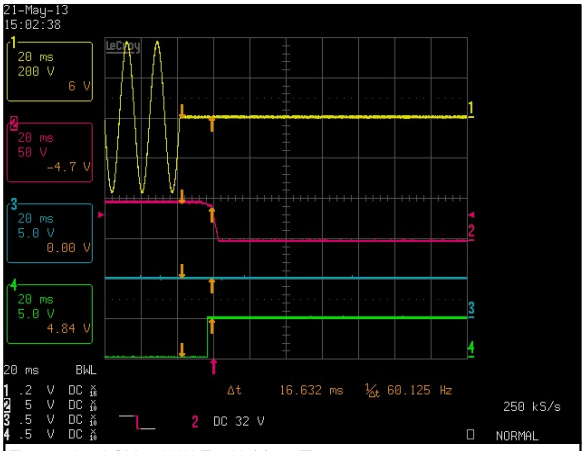



Figure 59: LCM1500W-T-4 Hold-up Time
Vin = 264Vac / 60Hz / 0° Load: Io = 32A (48V), Isb = 2A (5V)
Ch 1: Vin Ch 2: Vsb Ch 3: Vo Ch 4: G_DCOK_C

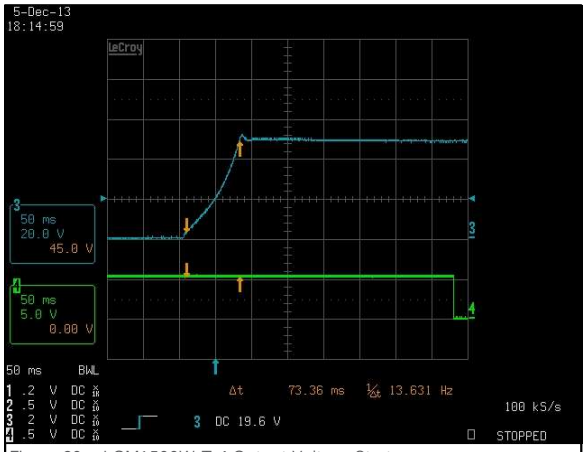



Figure 60: LCM1500W-T-4 Output Voltage Startup
Vin = 90Vac Load: Io = 32A (48V), Isb = 2A (5V)
Ch 3: Vo Ch 4: G_DCOK_C

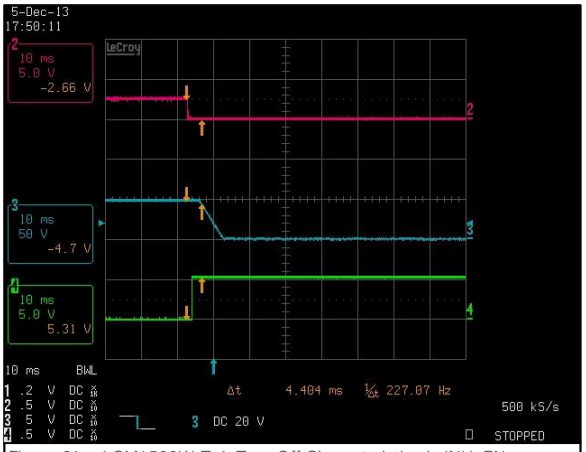



Figure 61: LCM1500W-T-4 Turn Off Characteristic via INH_EN
Load: Io = 32A (48V), Isb = 2A (5V)
Ch 2: INH_EN Ch 3: Vo Ch 4: G_DCOK_C

# ELECTRICAL SPECIFICATIONS

## LCM1500W Performance Curves

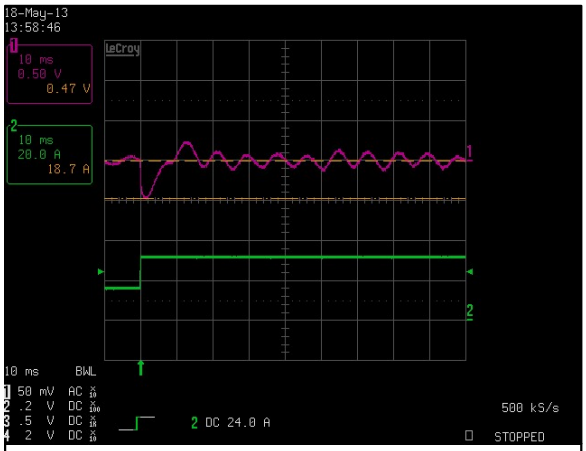



Figure 62: LCM1500W-T-4 Transient Response - Vo Deviation
50% to 100% load change 1A/uS slew rate Vin = 230Vac
Ch 1: Vo Ch 2: Io

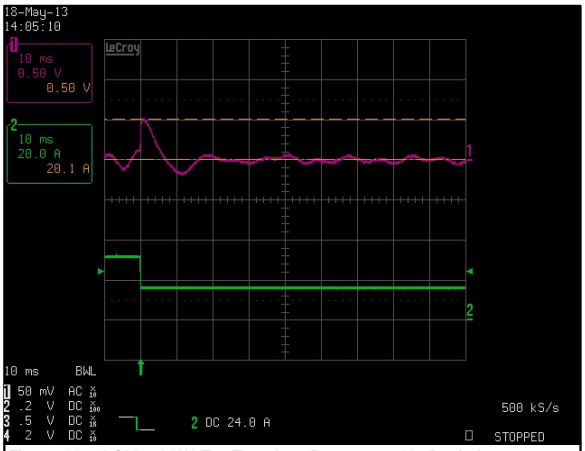



Figure 63: LCM1500W-T-4 Transient Response - Vo Deviation
100% to 50% load change 1A/uS slew rate Vin = 230Vac
Ch 1: Vo Ch 2: Io

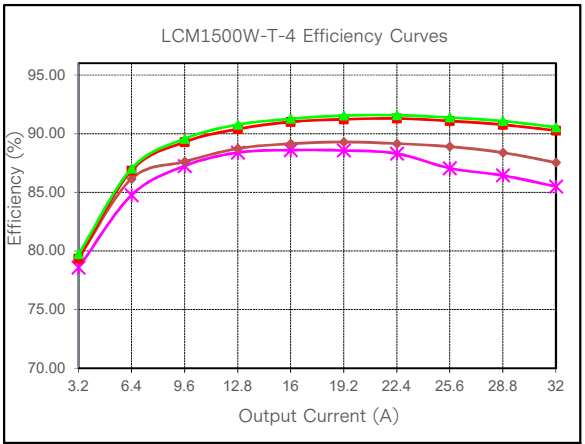



Figure 64: LCM1500W-T-4 Efficiency Curve @ 25°C
90Vac 115Vac 230Vac 264Vac
Loading: $I_{o\_main}$ = 10%$I_{o,max}$ increment to 32A, $I_{SB}$ = 0A (5V)

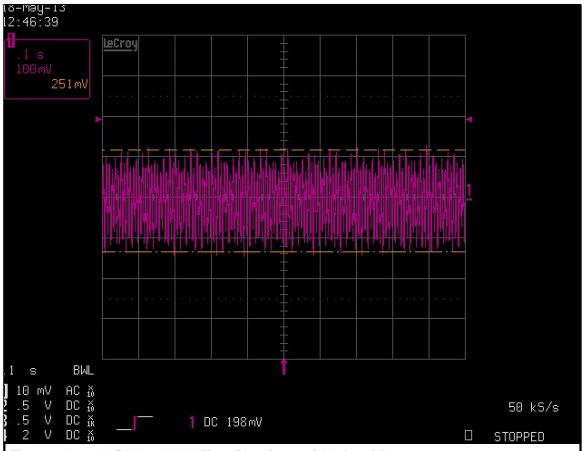



Figure 65: LCM1500W-T-4 Ripple and Noise Measurement
Vin = 115Vac Load: Io = 32A (48V), Isb = 2A (5V)
Ch 1: Vo

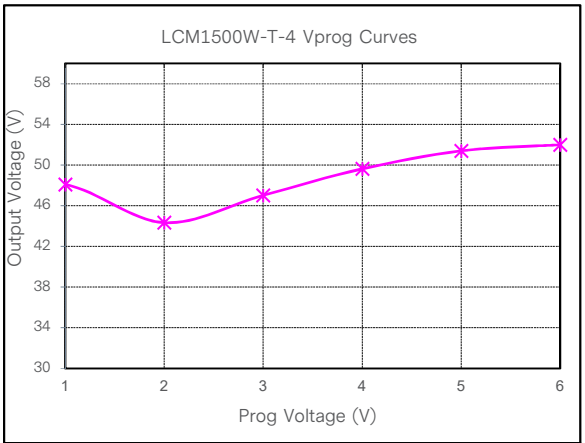



Figure 66: LCM1500W-T-4 Output Voltage Adjustment by Vprog @25°C
115Vac
Loading: $I_o$ = 0A (48V), $I_{SB}$ = 0A (5V)

# ELECTRICAL SPECIFICATIONS

## Protection Function Specifications

### Input Fuse

LCM1500 series is equipped with an internal non user serviceable 30A high rupturing capacity (HRC) 250 Vac fuse to IEC 127 for fault protection in both the L1 and L2 lines input.

### Over Voltage Protection (OVP)

The power supply latches off during output overvoltage with the AC line recycled to reset the latch.

| Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|
| $V_O$ Output Overvoltage | 125 | / | 145 | % Vo |
| Standby Voltage Overvoltage | 110 | / | 125 | % Vo |

### Over Current Protection (OCP)

LCM1500 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, the OCP is bouncing mode with a recovery time delay of 20 seconds.

| Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|
| $V_O$ Output Overcurrent | 105 | / | 125 | % Io,max |
| Standby Voltage Overcurrent | 120 | / | 170 | % Io,max |

### Short Circuit Protection (SCP)

A short circuit is defined as less than 0.03 ohm resistance between the output terminals. All outputs will be protected against short circuit to ground or other outputs. No damage will result. In the event of short circuit, output will be in bouncing mode with a recovery delay of 20Sec. Optional 5V standby, independent of the main output, will also be in bouncing mode once the fault occurred.

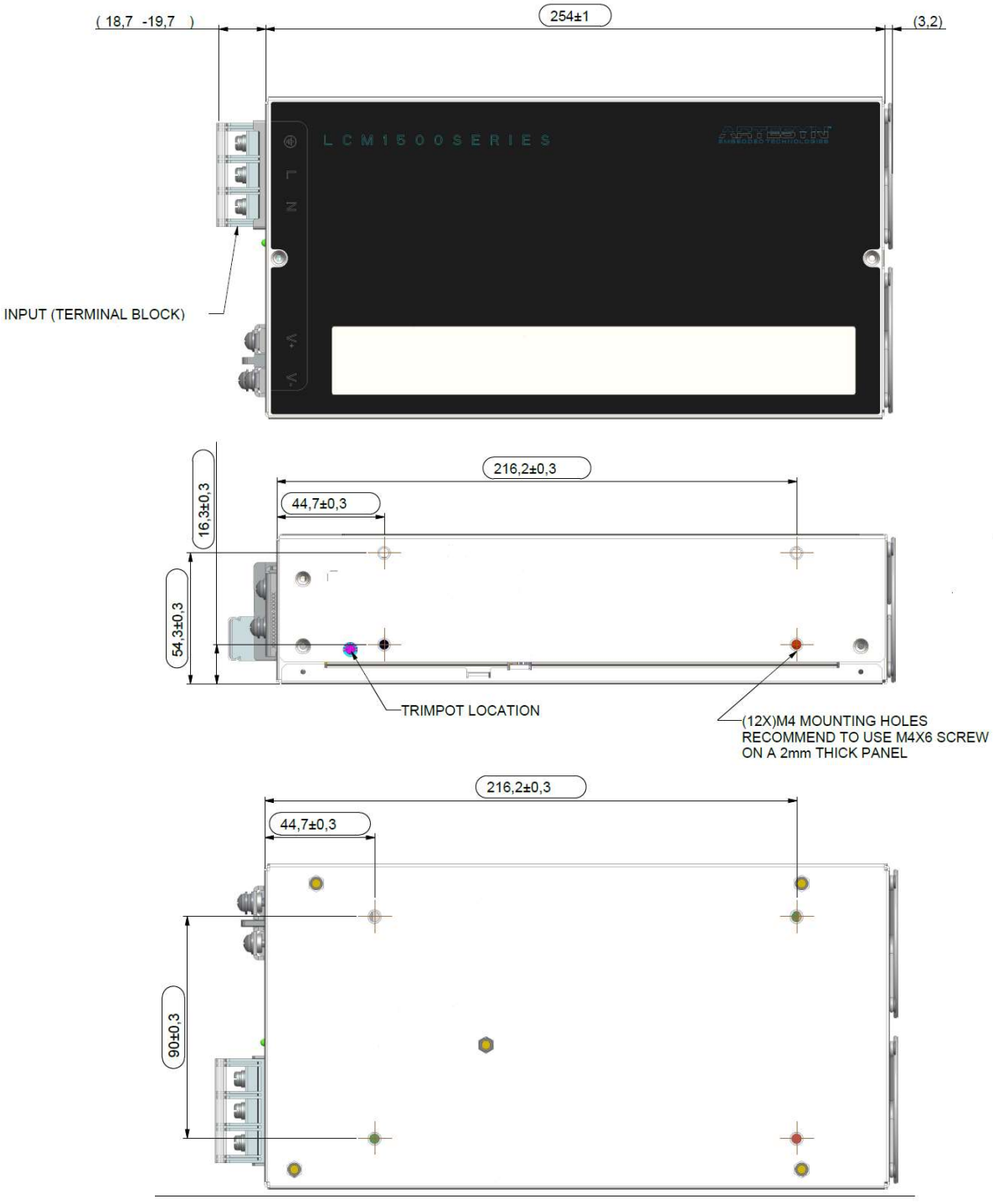
### Over Temperature Protection (OTP)

The power supply will be internally protected against over temperature conditions. When the OTP circuit is activated, the power supply will shut off and will auto-recover once the OTP condition is gone. OTP trip-point at full Load is set at a nominal of 55 $^{O}$C to 65 $^{O}$C ambient temperature.

# MECHANICAL SPECIFICATIONS

## Mechanical Outlines (unit: mm)

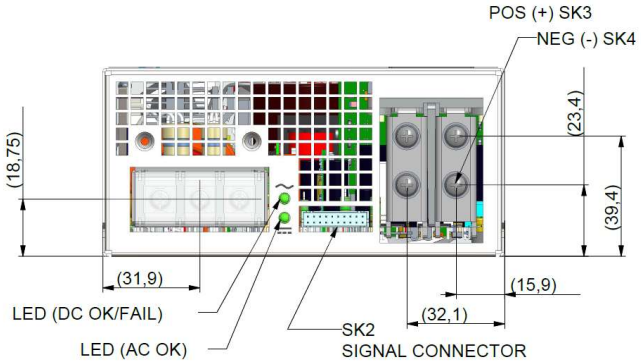
LCM1500Q/R/U/W



# MECHANICAL SPECIFICATIONS

## Mechanical Outlines (unit: mm)

LCM1500Q/R/U/W

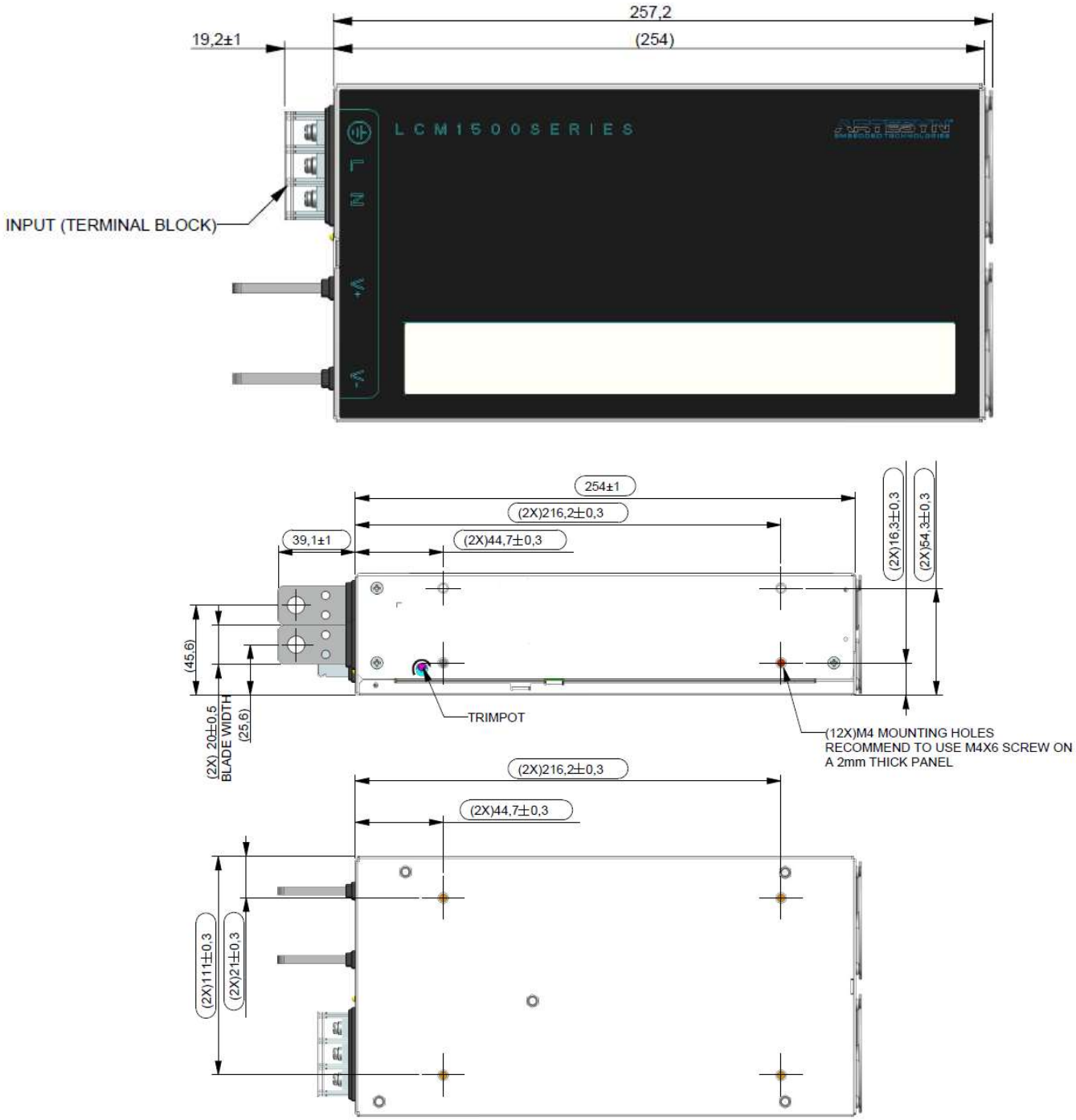




# MECHANICAL SPECIFICATIONS

## Mechanical Outlines (unit: mm)

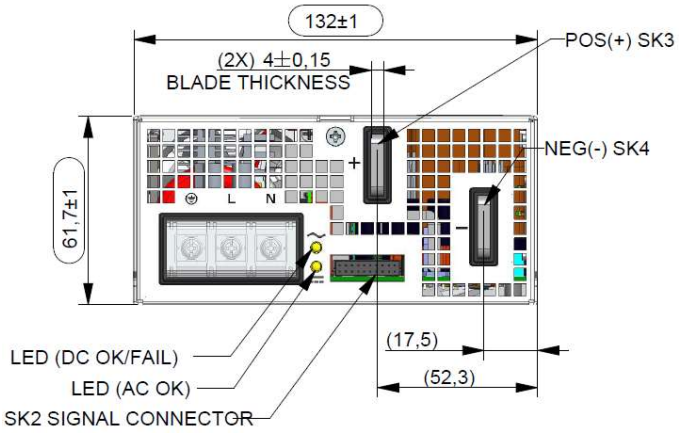
LCM1500L/N



# MECHANICAL SPECIFICATIONS

## Mechanical Outlines (unit: mm)

LCM1500L/N




# Mechanical Specifications

## Connector Definitions

AC Input Connector - SK1

⏚ – Earth Ground

L – Line

N – Neutral

Output Connector – SK3&SK4

SK3 – Main Output (Vo)

SK4 – Main Output Return

Output Connector – SK2

Pin 1 – A2

Pin 2 – -VPROG

Pin 3 – A1

Pin 4 – -Vsense

Pin 5 – ISHARE

Pin 6 – A0

Pin 7 – SDA1

Pin 8 – +VPROG

Pin 9 – SCL1

Pin 10 – +Vsense

Pin 11 – 5VSB

Pin 12 – GND

Pin 13 – 5VSB

Pin 14 – G_DCOK_C

Pin 15 – GPIOA6

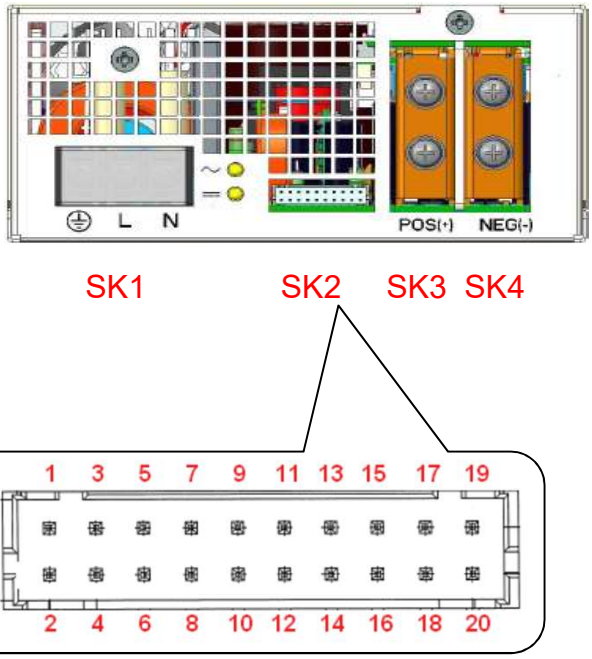
Pin 16 – G_DCOK_E

Pin 17 – GND

Pin 18 – G_ACOK_C

Pin 19 – INH_EN

Pin 20 – G_ACOK_E



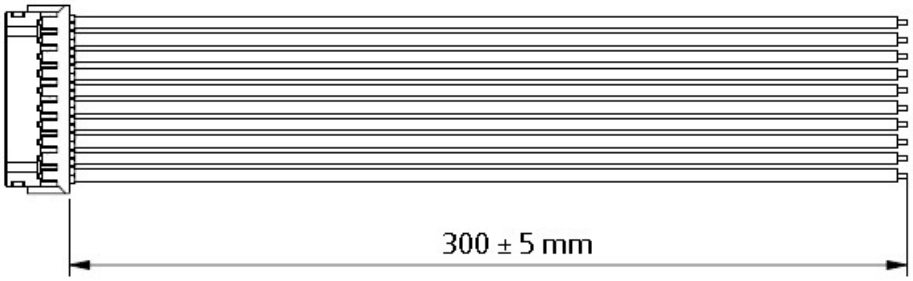
# Mechanical Specifications

## Power / Signal Mating Connectors and Pin Types

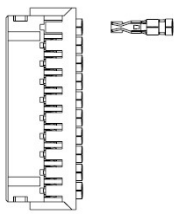
| Table 5. Mating Connectors for LCM1500 Series | | |
|---|---|---|
| Reference | On Power Supply | Mating Connector or Equivalent |
| AC Input Connector | 451-004155-0000 (TERM-BLOCK DT-7C-B14W-03) | M4 Screw |
| SK2 | CI0120P1HD0-LF | LANDWIN<br>(LWE PN: 2050S) Housing<br>(LWE PN: 2053T) Contact<br>CVILUX<br>(CX PN: CI0120SD000) Housing<br>(CX PN: CI01TD21PE0) Contact |
| SK3, SK4 | For LCM1500Q/R/U/W<br>500-004305-0000<br><br>For LCM1500L/N<br>500-007008-0001 | For LCM1500Q/R/U/W<br>Molex: BB-124-08 (19141-0058) M4 screw<br><br>For LCM1500L/N<br>Clearance hole diameter φ8.5 |

Accessories for SK2:

1. Order kit part number 73-788-001 for control connector interface with .3m wires attached

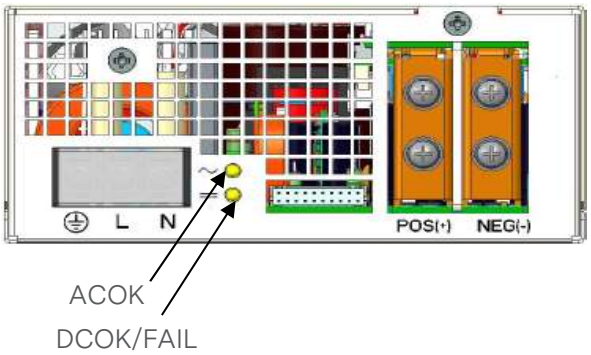



2. Order kit part number 73-788-002 for control connector interface with unloaded housing and 20 pins



# MECHANICAL SPECIFICATIONS

## LED Indicator Definitions




Two user-friendly LEDs for status and diagnostics show status of input power, output power and alarm condition valuable troubleshooting aid to reduce system downtime.

| Conditions | LED Status | |
|---|---|---|
| | ACOK LED | DCOK/FAIL LED |
| AC present / Output On | Green | Green |
| No AC power to PSU | OFF | OFF |
| Standby mode/main output off | Green | OFF |
| Power supply failure | Green | OFF |

# MECHANICAL SPECIFICATIONS

## Weight

The LCM1500 series weight is 4.20lbs (1.91kg) maximum.

# ENVIRONMENTAL SPECIFICATIONS

## EMC Immunity

The LCM1500 series are designed to meet the following EMC immunity specifications

| Table 6. Environmental Specifications | |
|---|---|
| Document | Description |
| EN55032 | Conducted and radiated EMI limits |
| EN61000-3-2 harmonic | EMC limits for harmonic current emissions |
| EN61000-3-3 | Voltage fluctuations |
| EN61000-4-2 | Electromagnetic Compatibility (EMC) - Testing and measurement techniques – Electrostatic discharge immunity test. +/-8KV air, +/-15KV contact discharge, Level 3 |
| EN61000-4-3 | Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Radiated, radio-frequency, electromagnetic field immunity test. 80 – 1000 MHz,10V/m, AM 80% (1KHz),900MHz, 10V/M, PM100%(200Hz), Level 3 |
| EN61000-4-4 | Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Electrical Fast Transient/Burst Immunity Test. 2KV for AC power port, 1.0KV for DC ports, I/O and signal ports, Level 3 |
| EN61000-4-5 | Electromagnetic Compatibility (EMC) - Testing and measurement techniques – 2KV common mode and 1KV differential mode for AC ports and 0.5kV differential mode for DC power, I/O and signal ports, Level 3 |
| EN61000-4-8 | Power Freq Magnetic, Level 3. |
| EN61000-4-11 | Electromagnetic Compatibility (EMC) - Testing and measurement techniques : Voltage Dips and Interruptions: 30% reduction for 500mS- Criteria B>95% reduction for 10mS, Criteria A, >95% reduction for 5000mS, Level 3 |
| EN55024: 1998 | Information Technology Equipment – Immunity Characteristics, Limits and Method of Measurement |

# ENVIRONMENTAL SPECIFICATIONS

## Safety Certifications

The LCM1500 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 7. Safety Certifications for LCM1500 Series Power Supply System**

| Standard | File# | Description |
|---|---|---|
| UL 62368-1, 2nd Ed, 2014-12-01, CAN/CSA C22.2 No. 62368-1-14, 2nd Ed | E186249-A6046-UL-X10 | US and Canada Requirements |
| ANSI/AAMI ES60601-1 (2005/(R) 2012 +A1:2012, C1: 2009/(R) 2012 + A2:2010/(R) 2012) | E182560-V4-S5 | US and Canada Medical Electrical Equipment |
| ANSI/AAMI ES60601-1 (2005 + C1:09 + A2:10, CAN/CSA-C22.2 No. 60601-1 (2008) | E182560-A37-UL | US and Canada Medical Electrical Equipment |
| EN 62368-1:2014/A11:2017, EN 60601-1:2006/A1:20163268-1 | B 013890 3163 Rev. 00 | European Requirements |
| IEC62368-1/EN63268-1 | E186249-A6046-CB-1 | International Requirements |
| IEC60601 | SG-MD-00487A1/M2 | International Medical Electrical Equipment |
| IEC60601-1/EN60601-1 | 211-400848-201 | European and International Electrical Equipment |
| CB Certificate and Report | DK-48584-A2-UL | (All CENELEC Countries) |
| CE (LVD+RoHS),EN62368-1 | 20022 | European Requirements |
| BSMI | CI333161602465 01 | Taiwan Requirements |
| UKCA Mark | | UK Requirements |

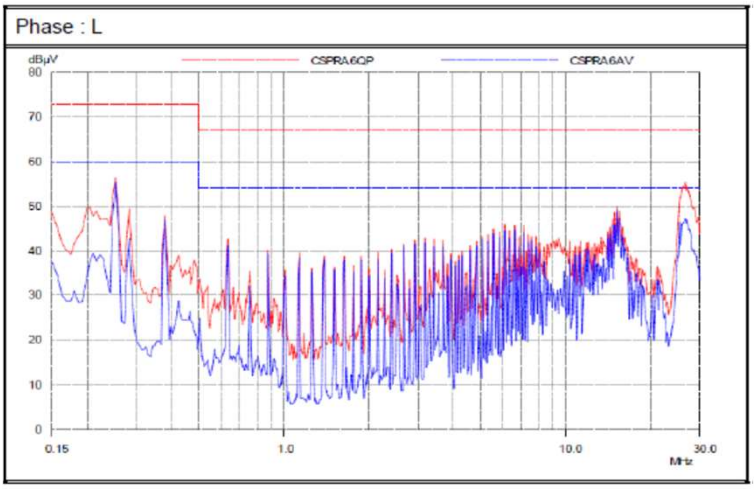
# ENVIRONMENTAL SPECIFICATIONS

## EMI Emissions

The LCM1500 series has been designed to comply with the Class A limits of EMI requirements of EN55022 (FCC Part 15) and CISPR 32 (EN55022) for emissions and relevant sections of EN61000 (IEC 61000) for immunity. The unit is enclosed inside a metal box, tested at 1500W using resistive load with cooling fan.

### Conducted Emissions

The applicable standard for conducted emissions is EN55022 (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 LCM1500 series have internal EMI filters to ensure the convertors' conducted EMI levels comply with EN55022 (FCC Part 15) Class A.

The EMI measurements are performed with resistive loads at maximum rated loading Sample of EN55022 Conducted EMI Measurement at 110Vac input.

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

Conducted EMI emissions specifications of the LCM1500 series:

| Parameter | Model | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| FCC Part 15, class A | All | Margin | 6 | - | - | dB |
| CISPR 22 (EN55022), class A | 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 EN55022 Class A (FCC Part 15). Testing ac-dc convertors as a stand-alone component to the exact requirements of EN55022 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.

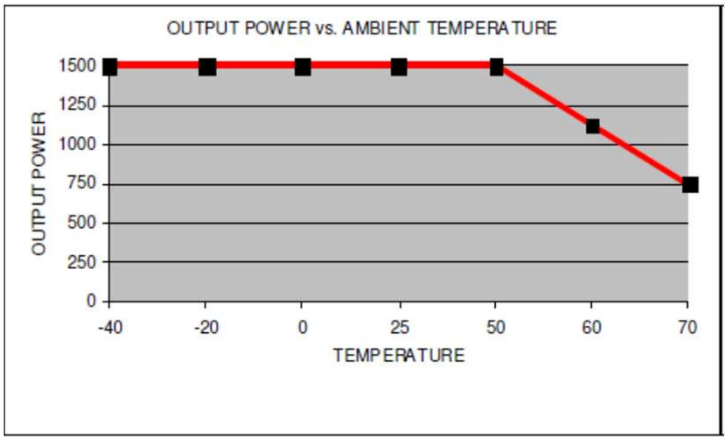
# ENVIRONMENTAL SPECIFICATIONS

## Operating Temperature

The LCM1500 series maximum output power (1500W) can be loaded up to an ambient temperature of +50 $^{O}$C.

Only 50 % of the maximum output power can be loaded at ambient temperature of +70 $^{O}$C. Linear derating to 50% nominal output power starts from +50 $^{O}$C. The elapsed time between the application of input power and the attainment steady state values requires 5 minute warm up for -20 $^{O}$C to -40 $^{O}$C operation.

### Output power vs operating temperature




### Forced Air Cooling

The LCM1500 series power supplies included internal cooling fans as part of the power supply assembly to provide forced air-cooling to maintain and control temperature of devices and ambient. The standard direction of airflow is from the end of the power supply.

The cooling fan is a variable speed fan. Fan will be smart based on internal temperature. Fan noise <45 dBA with 80% load @ 30$^{O}$C.

Note: LCM1500L noise is <61dB at 80% load @ 25$^{O}$C.

# ENVIRONMENTAL SPECIFICATIONS

## Storage and Shipping Temperature

The LCM1500 series can be stored or shipped at temperatures between -40°C to +85°C and relative humidity from 20% to 95% non-condensing.

## Altitude

The LCM1500 series will operate within specifications at altitudes up to 16404 feet above sea level. The power supply will not be damaged when stored at altitudes of up to 30,000 above sea level.

## Humidity

The LCM1500 series will operate within specifications when subjected to a relative humidity from 20% to 90% non-condensing. The LCM1500 series can be stored in a relative humidity from 10% to 95% non-condensing.

## Vibration

The LCM1500 series will pass the following vibration specifications:

Non-Operating Random Vibration

| | | | |
|---|---|---|---|
| Acceleration | 2.7 | | gRMS |
| Frequency Range | 10-2000 | | Hz |
| Duration | 20 | | Mins |
| Direction | 3 mutually perpendicular axis | | |
| PSD Profile | FREQ (Hz) | SLOPE (db/oct) | PSD ($g^2$/Hz) |
| | 10 | / | 0.009 |
| | 200 | -2.66 | 0.009 |
| | 500 | / | 0.004 |

Operating Random Vibration

| | | | |
|---|---|---|---|
| Acceleration | 1.0 | | gRMS |
| Frequency Range | 10 – 500 | | Hz |
| Duration | 20 | | Mins |
| Direction | 3 mutually perpendicular axis | | |
| PSD Profile | FREQ (Hz) | SLOPE (db/oct) | PSD ($g^2$/Hz) |
| | 5 | 11 | 0.00003 |
| | 10-50 | / | 0.00004 |
| | 100 | -10 | 0.00003 |

# ENVIRONMENTAL SPECIFICATIONS

## Shock

The LCM1500 series power supply will pass the following shock specifications:

Non-Operating Half-Sine Shock

| | | |
|---|---|---|
| Acceleration | 30 | G |
| Duration | 18 | mSec |
| Pulse | Half-Sine | |
| Number of Shock | 3 shock on each of 6 faces | |

Operating Half-Sine Shock

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

# POWER AND CONTROL SIGNAL DESCRIPTIONS

## AC Input Connector

This connector supplies the AC Mains to the LCM1500 series power supply.

SK1 – Earth Ground
SK1 – Line
SK1 – Neutral

## Output Connectors- SK3&SK4

These pins provide the main output for the LCM1500 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 LCM1500 series power supply. The Main Output ($V_O$) is electrically isolated from the power supply chassis.

SK3 – +Main Output ($V_O$)
SK4 – Main Output Return

## Control Signals - SK2

The LCM1500 series SK2 contains 20 pins control signal header providing analogy control interface, standby power and $i^2C$ interface.

### A0, A1, A2 - (Pin 6, Pin3, Pin1)

Please refer to “Communication Bus Descriptions” section.

### -VPROG, +VPROG - (Pin2, Pin8)

Positive and return connection of external supply for Margin Programming. The Power supplies will have a “margin” pin which will accept a 1-6VDC signal referenced to a floating return that will program the output the entire adjustment range. Applying voltage greater than 6V may result to damage of PSU internal circuit.

### -Vsense, +Vsense - (Pin 4, Pin10)

This remote sense circuit will be designed to compensate for a power path drop around the entire loop of 0.5 volt. These pins should be connected as close to the loading as possible, If left open, the power supply will regulate the voltage at its output terminals but the voltage level at the load may go lower than the guaranteed spec.

### ISHARE - (Pin 5)

The main output will have active load sharing. The output will share within 10% at full load. All current sharing functions are implemented internal to the power supply by making use of the ISHARE signal. The system connects the ISHARE lines between the power supplies. The supplies must be able to load share with up to 4 power supplies in parallel.

### SDA1, SCL1, GND - (Pin 7, Pin9, Pin17)

Please refer to “Communication Bus Descriptions” section.

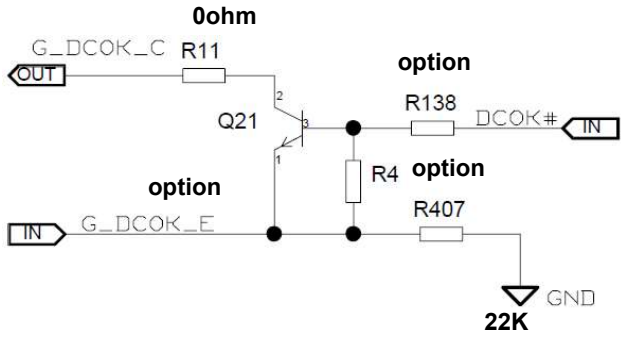
### 5VSB, GND - (Pin11, Pin12, Pin13)

The LCM1500 series provides a regulated 5VSB output voltage to power critical circuitry that must remain active regardless of the on/off status of the power supply’s main output. The 5VSB voltage is available whenever a valid AC input voltage is applied to the unit.

# POWER AND CONTROL SIGNAL DESCRIPTIONS

## G_DCOK_C, G_DCOK_E - (Pin14, Pin16)

G_DCOK_C is a power good signal and will be pulled LOW by the power supply to indicate that both the outputs are above the regulation limits of the power supply. When any output voltage falls below regulation limits or when AC power has been removed for a time sufficiently long so that power supply operation is no longer guaranteed, G_DCOK_C will be de-asserted to a HIGH state. Connect 4.7K ohm resistor on G_DCOK_C to PSU's 5V standby.

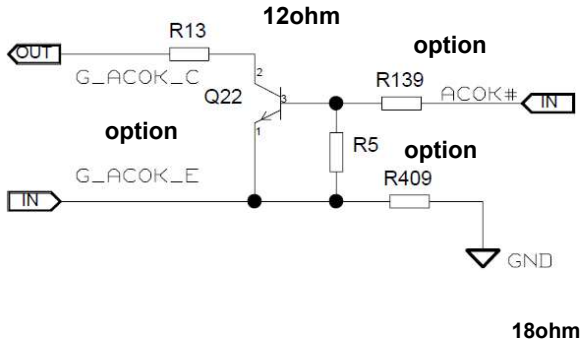



## GPIOA6 - (Pin15)

EEPROM Write Protect Allows Read/Write operation when connected to Gnd. When GPIOA6 pin is connected to 3.3V, the write protection is enabled.

## G_ACOK_C, G_ACOK_E - (Pin18, Pin20)

G-ACOK_C signal is used to indicate presence of AC input to the power supply. A logic "Low" level on this signal shall indicate AC input to the power supply is present. A Logic "High" on this signal shall indicate a loss of AC input to the power supply. Connect 4.7K ohm resistor on G_ACOK_C to 5V standby.




## INH_EN - (Pin19)

0.0 - 0.5V contact closure. Main output is disabled if INH_EN is pulled low.

# COMMUNICATION BUS DESCRIPTIONS

## I²C Bus Signals

The LCM1500 series contains enhanced monitor and control functions implemented via the I²C bus. The LCM1500 series I²C functionality (PMBus™ and FRU data) can be accessed via the output connector control signals. The communication bus is powered either by the internal 3.3V 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 I²C 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 I²C speed is 100KHz.

### SDA1, SCL1 (I²C Data and Clock Signals) - (pin7, pin 9)

I²C serial data and clock bus - these pins are internally pulled up to internal 3.3V supply with a 4.7K ohm resistor. These pins recommended to be pulled-up in the system by an 2.2K ohm resistor to the 3.3V external voltage.

### A0, A1, A2 (I2C Address BIT 0, BIT1, BIT2 Signals) - (pin6, pin3, pin1)

These three input pins are the address lines A0, A1 and A2 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 I²C communication between system and power supplies, the system will be the master and power supplies will be slave.

They are internally pulled up to internal 3.3V supply with a 2K ohm resistor.

### I²C Bus Communication Interval

The interval between two consecutive I²C communications to the power supply should be at least 50ms to ensure proper monitoring functionality.

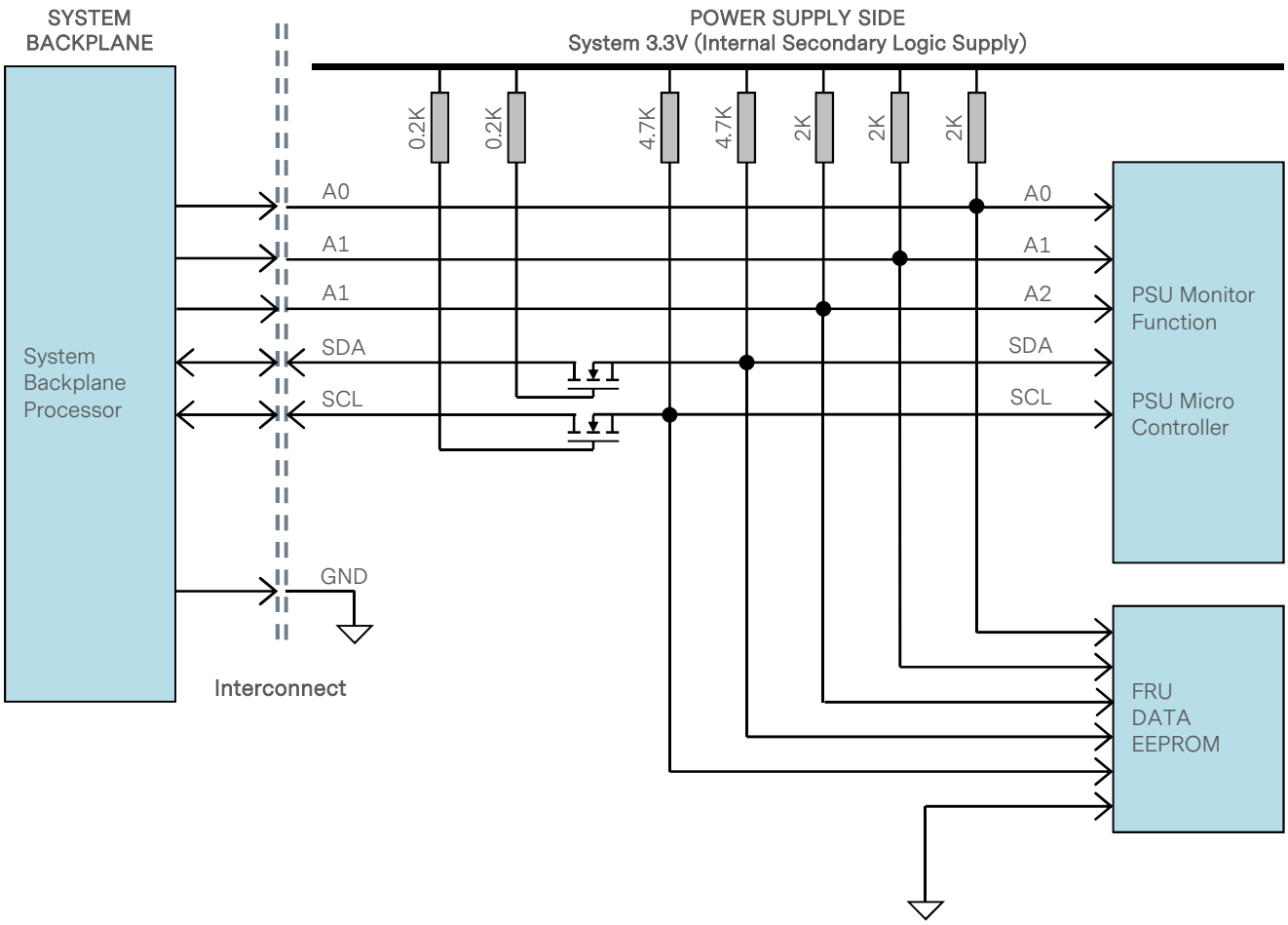
### I²C Bus Signal Integrity

The noise on the I²C bus (SDA, SCL lines) due to the power supply will be less than 450mV peak-to-peak. This noise measurement should be made with an oscilloscope bandwidth limited to 100MHz. Measurements should be make at the power supply output connector with 2.2K ohm resistors pulled up to standby Output and 20pf ceramic capacitors to standby output Return.

The noise on the address lines A0 and A1 will be less than 100mV peak-to-peak. This noise measurement should be made at the power supply output connector.

# COMMUNICATION BUS DESCRIPTIONS

## I²C Bus Internal Implementation, Pull-ups and Bus Capacitances




## I²C Bus - Recommended external pull-ups

Electrical and interface specifications of I²C 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 | - | Kohm |
| SDA, SCL Internal Bus Capacitance | | $C_{int}$ | - | 0 | - | pF |
| Recommended External Pull-up Resistor | 1 to 4 PSU | $R_{ext}$ | - | 2.2 | - | Kohm |

# COMMUNICATION BUS DESCRIPTIONS

## Device Addressing

The LCM1500 series will respond to supported commands on the I²C bus that are addressed according to pins A0, A1 and A2 of output connector.

Address pins are held HIGH by default via pulled up to internal 3.3V supply with a 2K resistor. To set the address as "0", the corresponding address line should be pulled down to logic ground level. Below tables show the address of the power supply with A0, A1 and A2 pins set to either "0" or "1":

| PSU Slot | Slot ID Bits | | | PMBus™ Address |
|---|---|---|---|---|
| | A2 | A1 | A0 | |
| 1 | 0 | 0 | 0 | B0h |
| 2 | 0 | 0 | 1 | B2h |
| 3 | 0 | 1 | 0 | B4h |
| 4 | 0 | 1 | 1 | B6h |
| 5 | 1 | 0 | 0 | B8h |
| 6 | 1 | 0 | 1 | Bah |
| 7 | 1 | 1 | 0 | BCh |
| 8 | 1 | 1 | 1 | BEh* |

* Default PMBus™ address is BEh

# COMMUNICATION BUS DESCRIPTIONS

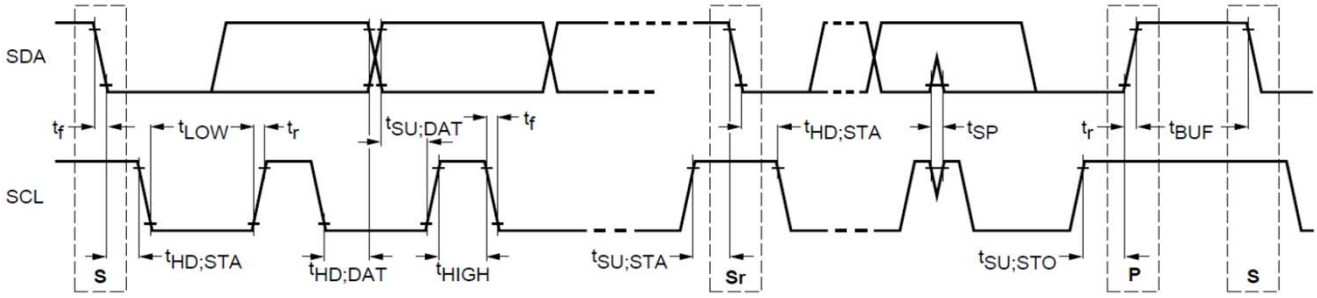
## Logic Levels

LCM1500 series power supply I²C communication bus will respond to logic levels as per below:

Logic High: 5.1V nominal (Spec is 2.1V to 5.5V)**
Logic Low: 500mV nominal (Spec is 800mV max)**

**Note: Artesyn 73-769-001 I²C adapter was used.

### Timings




| Parameter | Symbol | Standard-Mode Specs | | Actual Measured | | Unit |
|---|---|---|---|---|---|---|
| | | Min | Max | | | |
| SCL clock frequency | $f_{SCL}$ | 10 | 100 | 98 | | KHz |
| Hold time (repeated) START condition | $t_{HD;STA}$ | 4.0 | - | 4.5 | | uS |
| LOW period of SCL clock | $t_{LOW}$ | 4.7 | - | 5.9 | | uS |
| HIGH period of SCL clock | $t_{HIGH}$ | 4.0 | - | 4.3 | | uS |
| Setup time for repeated START condition | $t_{SU;STA}$ | 4.7 | - | 4.5 | | uS |
| Data hold time | $t_{HD;DAT}$ | 0 | 3.45 | 1.2 | | uS |
| Data setup time | $t_{SU;DAT}$ | 250 | - | 4500 | | nS |
| Rise time | $t_r$ | - | 1000 | SCL = 850 | SDA = 903 | nS |
| Fall time | $t_f$ | - | 300 | SCL = 298 | SDA = 590 | nS |
| Setup time for STOP condition | $t_{SU;STO}$ | 4.0 | - | 5.2 | | uS |
| Bus free time between a STOP and START condition | $t_{BUF}$ | 4.7 | - | 60*** | | uS |

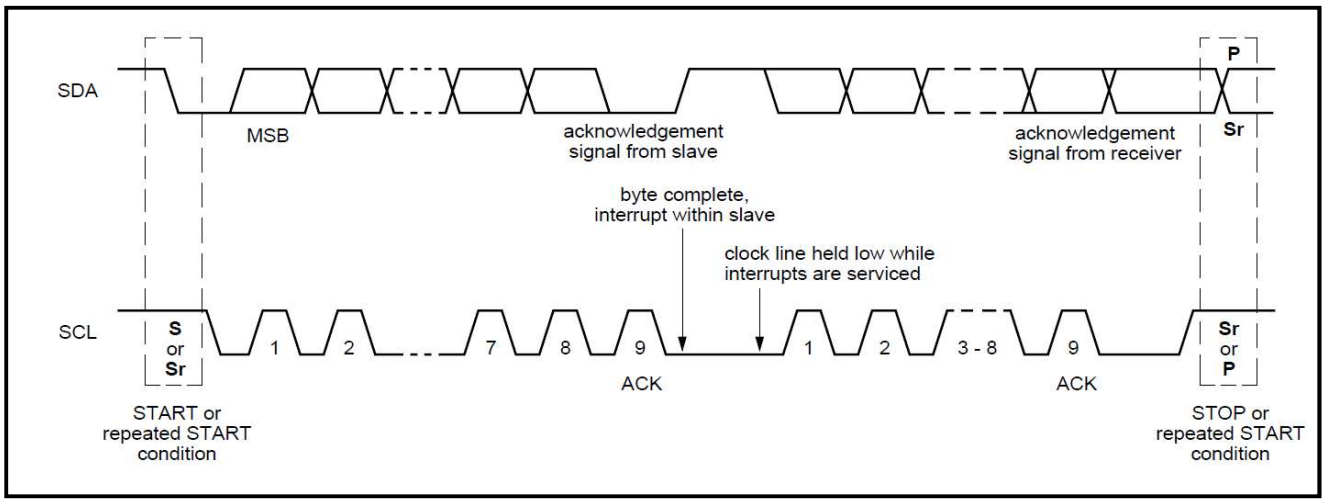
***Note: Artesyn 73-769-001 I²C adapter (USB-to-I2C) and Universal PMBus™ GUI software was used.

# COMMUNICATION BUS DESCRIPTIONS

## I²C Synchronization

The LCM1500 series power supply might apply clock stretching. An addressed slave power supply may hold the clock line (SCL) low after receiving (or sending) a byte, indicating that it is not yet ready to process more data. The system master that is communicating with the power supply will attempt to raise the clock to transfer the next bit, but must verify that the clock line was actually raised. If the power supply is clock stretching, the clock line will still be low (because the connections are open-drain).

The maximum time-out condition for clock stretching for LCM1500 series is 25 milliseconds.



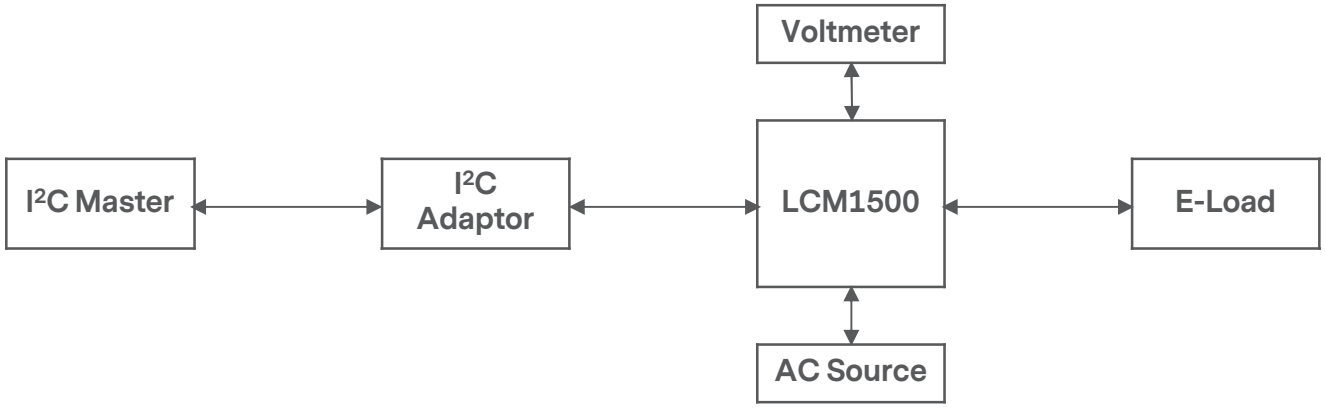
# PMBUS™ SPECIFICATIONS

The LCM1500 series is compliant with the industry standard PMBus™ protocol for monitoring and control of the power supply via the I²C interface port.

## LCM1500 Series PMBus™ General Instructions

### Equipment Setup

The following is typical I²C communication setup:




### PMBus™ Writing Instructions

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

Disable Write Protect (command 10h) by writing any of the following accordingly:

Levels: 00h - Enable writing to all writeable commends

20h - Disables write except 10h, 01h, 00h, 02h and 21h commands

40h - Disables write except 10h, 01h, and 00h commends

80h - Disable write except 0x00h

To save changes on the USER PMBusTM Table:

Use send byte command: 15h STORE_USER_ALL

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

# PMBUS™ SPECIFICATIONS

The LCM1500L Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 01h | OPERATION | 80 | R/W | 1 | B | Used to turn the unit ON/OFF in conjunction with the input INH_EN pin. |
| 02h | ON_OFF_CONFIG | 1E | R | 1 | B | Configures the combination of INH_EN pin and serial communication commands needed to turn the unit ON/OFF. |
| 03h | CLEAR_FAULTS | - | S | 1 | | |
| 10h | WRITE_PROTECT | 80 | R/W | 1 | MSF | Used to Control Writing to the PMBus Device<br>80h - Disables write except 10h<br>40h - Disables write except 10h, 01h, 00h<br>20h - Disables write except 10h,01h,00h,02h and 21h commands<br>00 -Enables write to all writeable commands. |
| 15h | STORE_USER_ALL | - | S | 0 | | Copies the Operating memory table to the matching USER non-volatile memory. |
| 20h | VOUT_MODE | 17 | R | 1 | B | Specifies the mode and parameters of Output Voltage related Data Formats |
| 21h | VOUT_COMMAND | 1800 | R/W | 2 | Linear | Sets the Output Voltage Reference<br>Vout command sends discreet value to change<br>or trim output voltage. (12V) |
| 24h | VOUT_MAX | 1A66 | R | 2 | Linear | The max adjustable output voltage limit. (13.2V) |
| 3Ah | FAN_CONFIG_1_2 | 99h | R | 1 | Bitmapped | Read only to reflect setting of Fans |
| 3Bh | FAN_COMMAND_1 | 0 | R/W | 2 | Linear | Adjust fan speed, duty cycle control from 0 to 100% |
| 3Ch | FAN_COMMAND_2 | 0 | R/W | 2 | Linear | Adjust fan speed, duty cycle control from 0 to 100% |
| 40h | VOUT_OV_FAULT_LIMIT | 2066 | R/W | 2 | Linear | Sets Output Over voltage threshold. (16.2V) |
| 41h | VOUT_OV_FAULT_RESPONSE | 80 | R | 1 | MSF | Unit Latches OFF. Resets on INH_EN or CONTROL pin recycle or AC recycle. |
| 42h | VOUT_OV_WARN_LIMIT | 1C66 | R | 2 | Linear | Over-voltage Warning threshold. (14.2V) |
| 43h | VOUT_UV_WARN_LIMIT | 1466 | R | 2 | Linear | Under-voltage Warning threshold. (10.2V) |
| 44h | VOUT_UV_FAULT_LIMIT | 1400 | R | 2 | Linear | Under-voltage Fault threshold. (10V) |
| 45h | VOUT_UV_FAULT_RESPONSE | 80 | R | 1 | MSF | Turn PSU OFF |
| 46h | IOUT_OC_FAULT_LIMIT | F21C | R | 2 | Linear | Over current threshold in Amps. (135A ) |
| 47h | IOUT_OC_FAULT_RESPONSE | C0 | R | 1 | MSF | OCP ride through. If OCP persists. |
| 4Ah | IOUT_OC_WARN_LIMIT | EBFC | R | 2 | Linear | Over Current Warning threshold in Amps. (127.5A) |

# PMBUS™ SPECIFICATIONS

The LCM1500L Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 4Fh | OT_FAULT_LIMIT | EBB0 | R | 2 | Linear | Secondary ambient temperature Fault threshold, in degree C. (118degC) |
| 50h | OT_FAULT_RESPONSE | F8 | R | 1 | MSF | Turn PSU OFF and will retry indefinitely |
| 51h | OT_WARN_LIMIT | EA30 | R | 2 | Linear | Secondary ambient temperature warning threshold, in degree C.(114degC) |
| 55h | VIN_OV_FAULT_LIMIT | FA3A | R | 2 | Linear | Sets Input Over voltage threshold. (285V) |
| 56h | VIN_OV_FAULT_RESPONSE | C0 | R | 1 | Linear | Turn PSU OFF |
| 58h | VIN_UV_WARN_LIMIT | EAB0 | R | 2 | Linear | Sets Input Under voltage warning threshold(86V) |
| 59h | VIN_UV_FAULT_LIMIT | EA78 | R | 2 | Linear | Sets Input Under voltage threshold(79V) |
| 5Ah | VIN_UV_FAULT_RESPONSE | F8 | R | 1 | Linear | Turn PSU OFF |
| 5Eh | POWER_GOOD_ON | 1757 | R | 2 | Linear | Sets the threshold by which the Power Good signal is asserted. (11.67V) |
| 5Fh | POWER_GOOD_OFF | 158F | R | 2 | Linear | Sets the threshold by which the Power Good signal is de-asserted. (10.78V) |
| 60h | TON_DELAY | EB20 | R | 2 | Linear | Sets the time (sec), from start condition (Power ON) until the output starts to rise. 100mS |
| 61h | TON_RISE | DA80 | R | 2 | Linear | Sets the time (ms), for the output rises from 0 to regulation. 20mS |
| 64h | TOFF_DELAY | DA80 | R | 2 | Linear | Sets the time (ms), from a stop condition (Power OFF) until the output starts to drop (converter OFF). |
| 78h | STATUS_BYTE | 00 | R | 1 | Binary | Returns the summary of critical faults |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under--voltage fault has occurred |
| | b2 - TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE OF THE ABOVE | | | | | A Fault Warning not listed in bits[7:1] has occurred. |

# PMBUS™ SPECIFICATIONS

The LCM1500L Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 79h | STATUS_WORD | 0000 | R | 2 | Binary | Summary of units Fault and warning status. |
| | 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 | | | | | A manufacturer specific fault or warning has occurred. |
| | b11 – POWER_GOOD# | | | | | The POWER_GOOD signal is de-asserted |
| | b10 - FANS | | | | | A fan or airflow fault or warning has occurred. |
| | b9 – OTHER | | | | | A bit in STATUS_OTHER is set. |
| | b8 – UKNOWN | | | | | A fault type not given in bits [15:1] of the STATUS_WORD has been detected. |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under-voltage fault has occurred |
| | b2 – TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE_OF_THE_ABOVE | | | | | A fault or warning not listed in bits[7:1] of this byte has occurred. |
| 7Ah | STATUS_VOUT | 00 | R | 1 | Binary | Output voltage related faults and warnings |
| | b7 | | | | | VOUT Over--voltage Fault |
| | b6 | | | | | VOUT Over-voltage warning |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |

# PMBUS™ SPECIFICATIONS

The LCM1500L Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 7Bh | STATUS_IOUT | 00 | R | 1 | Binary | Output Current related faults and warnings |
| | b7 | | | | | IOUT Over current Fault |
| | b6 | | | | | IOUT Over current And Low Voltage shutdown Fault |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |
| 7Dh | STATUS_TEMPERATURE | 00 | R | 1 | Binary | Temperature related faults and warnings |
| | b7 | | | | | Over temperature Fault |
| | b6 | | | | | Over temperature Warning |
| | b5 | | | | | Under temperature Warning |
| | b4 | | | | | Under temperature Fault |
| | b3:0 | | | | | reserved |
| 7Eh | STATUS_CML | C0 | R | 1 | Binary | Communications, Logic and Memory |
| 80h | STATUS_MFR_SPECIFIC | 0 | R | 1 | Binary | Manufacturer Status codes |
| 88h | READ_VIN | - | R | 2 | Linear | Returns input Voltage in Volts ac |
| 8Bh | READ_VOUT | - | R | 2 | Linear | Returns the actual, measured voltage in Volts. |
| 8Ch | READ_IOUT | - | R | 2 | Linear | Returns the output current in amperes. |
| 8Dh | READ_TEMPERATURE_1 | - | R | 2 | Linear | PSU Air inlet temp ( inside PSU) |
| 8Eh | READ_TEMPERATURE_2 | - | R | 2 | Linear | PSU Air inlet temp ( inside PSU) |
| 96h | READ_POUT | - | R | 2 | Linear | Returns the output power, in Watts. |
| 97h | READ_PIN | - | R | 2 | Linear | Returns the input power, in Watts |
| 99h | MFR_ID | - | R/W | 8 | ASCII | Artesyn |
| 9Ah | MFR_MODEL | - | R/W | 8 | ASCII | LCM1500 |
| 9Bh | MFR_REVISION | - | R/W | 2 | ASCII | |
| 9Ch | MFR_LOCATION | - | R/W | 8 | ASCII | Laguna |
| 9Dh | MFR_DATE | - | R/W | 8 | ASCII | Manufacture Date, ASCII format structure : YYMMDD |
| 9Eh | MFR_SERIAL | - | R/W | 13 | ASCII | 13 CHAR |

# PMBUS™ SPECIFICATIONS

The LCM1500L Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| A0h | MFR_VIN_MIN | EAD0 | R | 2 | Linear | Minimum Input Voltage (90Vac) |
| A1h | MFR_VIN_MAX | FA10 | R | 2 | Linear | Maximum Input Voltage (264Vac) |
| A2h | MFR_IIN_MAX | DA60 | R | 2 | Linear | Maximum Input Current (19A) |
| A4h | MFR_VOUT_MIN | 1599 | R | 2 | Linear | Minimum Output Voltage Regulation Window. (10.8V) |
| A5h | MFR_VOUT_MAX | 1A66 | R | 2 | Linear | Maximum Output Voltage. Regulation Window (13.2V) |
| A6h | MFR_IOUT_MAX | EBE8 | R | 2 | Linear | Maximum Output Current (125A) |
| A7h | MFR_POUT_MAX | - | R | 2 | Linear | Maximum Output Power (1560W) |
| A8h | MFR_TAMBIENT_MAX | EA30 | R | 2 | Linear | Maximum Operating Ambient Temperature (Secondary Ambient) (70 degC) |
| A9h | MFR_TAMBIENT_MIN | - | R | 2 | Linear | Minimum Operating Ambient Temperature (Secondary Ambient) (-40 degC) |
| E0h | FW_PRI_VERSION | - | BR | 8 | ASCII | Varies |
| E1h | FW_SEC_VERSION | - | BR | 8 | ASCII | Varies |

# PMBUS™ SPECIFICATIONS

The LCM1500Q Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 01h | OPERATION | 80 | R/W | 1 | B | Used to turn the unit ON/OFF in conjunction with the input INH_EN pin. |
| 02h | ON_OFF_CONFIG | 1E | R | 1 | B | Configures the combination of INH_EN pin and serial communication commands needed to turn the unit ON/OFF. |
| 03h | CLEAR_FAULTS | - | S | 1 | | |
| 10h | WRITE_PROTECT | 80 | R/W | 1 | MSF | Used to Control Writing to the PMBus Device<br>80h - Disables write except 10h<br>40h - Disables write except 10h, 01h, 00h<br>20h - Disables write except 10h,01h,00h,02h and 21h commands<br>00 -Enables write to all writeable commands. |
| 15h | STORE_USER_ALL | - | S | 0 | | Copies the Operating memory table to the matching USER non-volatile memory. |
| 20h | VOUT_MODE | 17 | R | 1 | B | Specifies the mode and parameters of Output Voltage related Data Formats |
| 21h | VOUT_COMMAND | 3000 | R/W | 2 | Linear | Sets the Output Voltage Reference<br>Vout command sends discreet value to change or trim output voltage. |
| 24h | VOUT_MAX | 34CC | R | 2 | Linear | The max adjustable output voltage limit. 26.4V |
| 3Ah | FAN_CONFIG_1_2 | 99h | R | 1 | Bitmapped | Read only to reflect setting of Fans |
| 3Bh | FAN_COMMAND_1 | 0 | R/W | 2 | Linear | Adjust fan speed, duty cycle control from 0 to 100% |
| 3Ch | FAN_COMMAND_2 | 0 | R/W | 2 | Linear | Adjust fan speed, duty cycle control from 0 to 100% |
| 40h | VOUT_OV_FAULT_LIMIT | 40CC | R/W | 2 | Linear | Sets Output Over voltage threshold. (31V) |
| 41h | VOUT_OV_FAULT_RESPONSE | 80 | R | 1 | MSF | Unit Latches OFF. Resets on INH_EN or CONTROL pin recycle or AC recycle. |
| 42h | VOUT_OV_WARN_LIMIT | 35DC | R | 2 | Linear | Over-voltage Warning threshold. (30V) |
| 43h | VOUT_UV_WARN_LIMIT | 28CC | R | 2 | Linear | Under-voltage Warning threshold. (18V) |
| 44h | VOUT_UV_FAULT_LIMIT | 2800 | R | 2 | Linear | Under-voltage Fault threshold. (15V) |
| 45h | VOUT_UV_FAULT_RESPONSE | 80 | R | 1 | MSF | Turn PSU OFF |
| 46h | IOUT_OC_FAULT_LIMIT | EA18 | R | 2 | Linear | Over current threshold in Amps. (67A ) |
| 47h | IOUT_OC_FAULT_RESPONSE | C0 | R | 1 | MSF | OCP ride through. If OCP persists. |
| 4Ah | IOUT_OC_WARN_LIMIT | EA03 | R | 2 | Linear | Over Current Warning threshold in Amps. (64.4A) |

# PMBUS™ SPECIFICATIONS

The LCM1500Q Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 4Fh | OT_FAULT_LIMIT | EB80 | R | 2 | Linear | Secondary ambient temperature Fault threshold, in degree C. (80degC) |
| 50h | OT_FAULT_RESPONSE | F8 | R | 1 | MSF | Turn PSU OFF and will retry indefinitely |
| 51h | OT_WARN_LIMIT | EA30 | R | 2 | Linear | Secondary ambient temperature warning threshold, in degree C. (108degC) |
| 55h | VIN_OV_FAULT_LIMIT | FA3A | R | 2 | Linear | Sets Input Over voltage threshold. (285V) |
| 56h | VIN_OV_FAULT_RESPONSE | C0 | R | 1 | Linear | Turn PSU OFF |
| 58h | VIN_UV_WARN_LIMIT | EAB0 | R | 2 | Linear | Sets Input Under voltage warning threshold(86V) |
| 59h | VIN_UV_FAULT_LIMIT | EA78 | R | 2 | Linear | Sets Input Under voltage threshold(79V) |
| 5Ah | VIN_UV_FAULT_RESPONSE | F8 | R | 1 | Linear | Turn PSU OFF |
| 5Eh | POWER_GOOD_ON | 2E00 | R | 2 | Linear | Sets the threshold by which the Power Good signal is asserted. (19V) |
| 5Fh | POWER_GOOD_OFF | 2B33 | R | 2 | Linear | Sets the threshold by which the Power Good signal is de-asserted. |
| 60h | TON_DELAY | EB20 | R | 2 | Linear | Sets the time (sec), from start condition (Power ON) until the output starts to rise. 100mS |
| 61h | TON_RISE | DA80 | R | 2 | Linear | Sets the time (ms), for the output rises from 0 to regulation. 20mS |
| 64h | TOFF_DELAY | DA80 | R | 2 | Linear | Sets the time (ms), from a stop condition (Power OFF) until the output starts to drop (converter OFF). |
| 78h | STATUS_BYTE | 00 | R | 1 | Binary | Returns the summary of critical faults |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under--voltage fault has occurred |
| | b2 - TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE OF THE ABOVE | | | | | A Fault Warning not listed in bits[7:1] has occurred. |

# PMBUS™ SPECIFICATIONS

The LCM1500Q Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 79h | STATUS_WORD | 0000 | R | 2 | Binary | Summary of units Fault and warning status. |
| | 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 | | | | | A manufacturer specific fault or warning has occurred. |
| | b11 – POWER_GOOD# | | | | | The POWER_GOOD signal is de-asserted |
| | b10 - FANS | | | | | A fan or airflow fault or warning has occurred. |
| | b9 – OTHER | | | | | A bit in STATUS_OTHER is set. |
| | b8 – UKNOWN | | | | | A fault type not given in bits [15:1] of the STATUS_WORD has been detected. |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under-voltage fault has occurred |
| | b2 – TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE_OF_THE_ABOVE | | | | | A fault or warning not listed in bits[7:1] of this byte has occurred. |
| 7Ah | STATUS_VOUT | 00 | R | 1 | Binary | Output voltage related faults and warnings |
| | b7 | | | | | VOUT Over--voltage Fault |
| | b6 | | | | | VOUT Over-voltage warning |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |

# PMBUS™ SPECIFICATIONS

The LCM1500Q Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 7Bh | STATUS_IOUT | 00 | R | 1 | Binary | Output Current related faults and warnings |
| | b7 | | | | | IOUT Over current Fault |
| | b6 | | | | | IOUT Over current And Low Voltage shutdown Fault |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |
| 7Dh | STATUS_TEMPERATURE | 00 | R | 1 | Binary | Temperature related faults and warnings |
| | b7 | | | | | Over temperature Fault |
| | b6 | | | | | Over temperature Warning |
| | b5 | | | | | Under temperature Warning |
| | b4 | | | | | Under temperature Fault |
| | b3:0 | | | | | reserved |
| 7Eh | STATUS_CML | C0 | R | 1 | Binary | Communications, Logic and Memory |
| 80h | STATUS_MFR_SPECIFIC | 0 | R | 1 | Binary | Manufacturer Status codes |
| 88h | READ_VIN | - | R | 2 | Linear | Returns input Voltage in Volts ac |
| 8Bh | READ_VOUT | - | R | 2 | Linear | Returns the actual, measured voltage in Volts. |
| 8Ch | READ_IOUT | - | R | 2 | Linear | Returns the output current in amperes. |
| 8Dh | READ_TEMPERATURE_1 | - | R | 2 | Linear | PSU Air inlet temp ( inside PSU) |
| 8Eh | READ_TEMPERATURE_2 | - | R | 2 | Linear | PSU Air inlet temp ( inside PSU) |
| 96h | READ_POUT | - | R | 2 | Linear | Returns the output power, in Watts. |
| 97h | READ_PIN | - | R | 2 | Linear | Returns the input power, in Watts |
| 99h | MFR_ID | - | R/W | 8 | ASCII | Artesyn |
| 9Ah | MFR_MODEL | - | R/W | 8 | ASCII | LCM1500 |
| 9Bh | MFR_REVISION | - | R/W | 2 | ASCII | |
| 9Ch | MFR_LOCATION | - | R/W | 8 | ASCII | Laguna |
| 9Dh | MFR_DATE | - | R/W | 8 | ASCII | Manufacture Date, ASCII format structure : YYMMDD |
| 9Eh | MFR_SERIAL | - | R/W | 13 | ASCII | 13 CHAR |

# PMBUS™ SPECIFICATIONS

The LCM1500Q Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| A0h | MFR_VIN_MIN | EAD0 | R | 2 | Linear | Minimum Input Voltage (90Vac) |
| A1h | MFR_VIN_MAX | FA10 | R | 2 | Linear | Maximum Input Voltage (264Vac) |
| A2h | MFR_IIN_MAX | DA60 | R | 2 | Linear | Maximum Input Current (19A) |
| A4h | MFR_VOUT_MIN | 2B33 | R | 2 | Linear | Minimum Output Voltage Regulation Window. (21.6V) |
| A5h | MFR_VOUT_MAX | 34CC | R | 2 | Linear | Maximum Output Voltage. Regulation Window |
| A6h | MFR_IOUT_MAX | EA08 | R | 2 | Linear | Maximum Output Current |
| A7h | MFR_POUT_MAX | 0B0C | R | 2 | Linear | Maximum Output Power (1560W) |
| A8h | MFR_TAMBIENT_MAX | EA30 | R | 2 | Linear | Maximum Operating Ambient Temperature (Secondary Ambient) (70 degC) |
| A9h | MFR_TAMBIENT_MIN | - | R | 2 | Linear | Minimum Operating Ambient Temperature (Secondary Ambient) (0 degC) |
| E0h | FW_PRI_VERSION | - | BR | 8 | ASCII | Varies |
| E1h | FW_SEC_VERSION | - | BR | 8 | ASCII | Varies |

# PMBUS™ SPECIFICATIONS

The LCM1500N Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 01h | OPERATION | 80 | R/W | 1 | B | Used to turn the unit ON/OFF in conjunction with the input INH_EN pin. |
| 02h | ON_OFF_CONFIG | 1E | R | 1 | B | Configures the combination of INH_EN pin and serial communication commands needed to turn the unit ON/OFF. |
| 03h | CLEAR_FAULTS | - | S | 1 | | |
| 10h | WRITE_PROTECT | 80 | R/W | 1 | MSF | Used to Control Writing to the PMBus Device<br>80h - Disables write except 10h<br>40h - Disables write except 10h, 01h, 00h<br>20h - Disables write except 10h,01h,00h,02h and 21h commands<br>00 - Enables write to all writeable commands. |
| 15h | STORE_USER_ALL | - | S | 0 | | Copies the Operating memory table to the matching USER non-volatile memory. |
| 21h | VOUT_COMMAND | 1E00 | R/W | 2 | Linear | Output Voltage Reference<br>Vout command sends discreet value to change<br>or trim output voltage. (15V) |
| 24h | VOUT_MAX | 2100 | R | 2 | Linear | Sets the max adjustable output voltage limit. (16.5V) |
| 3Ah | FAN_CONFIG_1_2 | 99h | R | 1 | Bitmapped | Read only to reflect setting of Fans |
| 3Bh | FAN_COMMAND_1 | 0 | R/W | 2 | Linear | Adjust fan speed, duty cycle control from 0 to 100% |
| 3Ch | FAN_COMMAND_2 | 0 | R/W | 2 | Linear | Adjust fan speed, duty cycle control from 0 to 100% |
| 40h | VOUT_OV_FAULT_LIMIT | 2700 | R/W | 2 | Linear | Sets Output Over-voltage threshold. (19.5V) |
| 41h | VOUT_OV_FAULT_RESPONSE | 80 | R | 1 | MSF | Unit Latches OFF. Resets on INH_EN or CONTROL pin recycle or AC recycle. |
| 42h | VOUT_OV_WARN_LIMIT | 2360 | R | 2 | Linear | Over-voltage Warning threshold. (17.7V) |
| 43h | VOUT_UV_WARN_LIMIT | 1800 | R | 2 | Linear | Under-voltage Warning threshold. (12V) |
| 44h | VOUT_UV_FAULT_LIMIT | 1799 | R | 2 | Linear | Under-voltage Fault threshold. (11.8V) |
| 45h | VOUT_UV_FAULT_RESPONSE | 80 | R | 1 | MSF | Turn PSU OFF |
| 46h | IOUT_OC_FAULT_LIMIT | EB60 | R | 2 | Linear | Over current threshold in Amps. (108A ) |
| 47h | IOUT_OC_FAULT_RESPONSE | C0 | R | 1 | MSF | OCP ride through. If OCP persists. |
| 4Ah | IOUT_OC_WARN_LIMIT | EB30 | R | 2 | Linear | Over Current Warning threshold in Amps. (102A) |
| 4Fh | OT_FAULT_LIMIT | EBB0 | R | 2 | Linear | Secondary ambient temperature Fault threshold, in degree C. (118degC) |

# PMBUS™ SPECIFICATIONS

The LCM1500N Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 50h | OT_FAULT_RESPONSE | F8 | R | 1 | MSF | Turn PSU OFF and will retry indefinitely |
| 51h | OT_WARN_LIMIT | EA30 | R | 2 | Linear | Secondary ambient temperature warning threshold, in degree C.(114degC) |
| 55h | VIN_OV_FAULT_LIMIT | FA3A | R | 2 | Linear | Sets Input Over voltage threshold. (285V) |
| 56h | VIN_OV_FAULT_RESPONSE | C0 | R | 1 | Linear | Turn PSU OFF |
| 58h | VIN_UV_WARN_LIMIT | EAB0 | R | 2 | Linear | Sets Input Under voltage warning threshold(86V) |
| 59h | VIN_UV_FAULT_LIMIT | EA78 | R | 2 | Linear | Sets Input Under voltage threshold(79V) |
| 5Ah | VIN_UV_FAULT_RESPONSE | F8 | R | 1 | Linear | Turn PSU OFF |
| 5Eh | POWER_GOOD_ON | 1957 | R | 2 | Linear | Sets the threshold by which the Power Good signal is asserted. (12.67V) |
| 5Fh | POWER_GOOD_OFF | 1900 | R | 2 | Linear | Sets the threshold by which the Power Good signal is de-asserted. (12.5V) |
| 60h | TON_DELAY | EB20 | R | 2 | Linear | Sets the time (sec), from start condition (Power ON) until the output starts to rise. 100mS |
| 61h | TON_RISE | DA80 | R | 2 | Linear | Sets the time (ms), for the output rises from 0 to regulation. 20mS |
| 64h | TOFF_DELAY | DA80 | R | 2 | Linear | Sets the time (ms), from a stop condition (Power OFF) until the output starts to drop (converter OFF). |
| 78h | STATUS_BYTE | 00 | R | 1 | Binary | Returns the summary of critical faults |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under--voltage fault has occurred |
| | b2 - TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE OF THE ABOVE | | | | | A Fault Warning not listed in bits[7:1] has occurred. |

# PMBUS™ SPECIFICATIONS

The LCM1500N Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 79h | STATUS_WORD | 0000 | R | 2 | Binary | Summary of units Fault and warning status. |
| | 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 | | | | | A manufacturer specific fault or warning has occurred. |
| | b11 – POWER_GOOD# | | | | | The POWER_GOOD signal is de-asserted |
| | b10 - FANS | | | | | A fan or airflow fault or warning has occurred. |
| | b9 – OTHER | | | | | A bit in STATUS_OTHER is set. |
| | b8 – UKNOWN | | | | | A fault type not given in bits [15:1] of the STATUS_WORD has been detected. |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under-voltage fault has occurred |
| | b2 – TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE_OF_THE_ABOVE | | | | | A fault or warning not listed in bits[7:1] of this byte has occurred. |
| 7Ah | STATUS_VOUT | 00 | R | 1 | Binary | Output voltage related faults and warnings |
| | b7 | | | | | VOUT Over--voltage Fault |
| | b6 | | | | | VOUT Over-voltage warning |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |

# PMBUS™ SPECIFICATIONS

The LCM1500N Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 7Bh | STATUS_IOUT | 00 | R | 1 | Binary | Output Current related faults and warnings |
| | b7 | | | | | IOUT Over current Fault |
| | b6 | | | | | IOUT Over current And Low Voltage shutdown Fault |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |
| 7Dh | STATUS_TEMPERATURE | 00 | R | 1 | Binary | Temperature related faults and warnings |
| | b7 | | | | | Over temperature Fault |
| | b6 | | | | | Over temperature Warning |
| | b5 | | | | | Under temperature Warning |
| | b4 | | | | | Under temperature Fault |
| | b3:0 | | | | | reserved |
| 7Eh | STATUS_CML | C0 | R | 1 | Binary | Communications, Logic and Memory |
| 80h | STATUS_MFR_SPECIFIC | 0 | R | 1 | Binary | Manufacturer Status codes |
| 88h | READ_VIN | - | R | 2 | Linear | Returns input Voltage in Volts ac |
| 8Bh | READ_VOUT | - | R | 2 | Linear | Returns the actual, measured voltage in Volts. |
| 8Ch | READ_IOUT | - | R | 2 | Linear | Returns the output current in amperes. |
| 8Dh | READ_TEMPERATURE_1 | - | R | 2 | Linear | PSU Air inlet temp ( inside PSU) |
| 8Eh | READ_TEMPERATURE_2 | - | R | 2 | Linear | PSU Air inlet temp ( inside PSU) |
| 96h | READ_POUT | - | R | 2 | Linear | Returns the output power, in Watts. |
| 97h | READ_PIN | - | R | 2 | Linear | Returns the input power, in Watts |
| 99h | MFR_ID | - | R/W | 8 | ASCII | Artesyn |
| 9Ah | MFR_MODEL | - | R/W | 8 | ASCII | LCM1500 |
| 9Bh | MFR_REVISION | - | R/W | 2 | ASCII | |
| 9Ch | MFR_LOCATION | - | R/W | 8 | ASCII | Laguna |
| 9Dh | MFR_DATE | - | R/W | 8 | ASCII | Manufacture Date, ASCII format structure : YYMMDD |
| 9Eh | MFR_SERIAL | - | R/W | 13 | ASCII | 13 CHAR |

# PMBUS™ SPECIFICATIONS

The LCM1500N Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| A0h | MFR_VIN_MIN | EAD0 | R | 2 | Linear | Minimum Input Voltage (90Vac) |
| A1h | MFR_VIN_MAX | FA10 | R | 2 | Linear | Maximum Input Voltage (264Vac) |
| A2h | MFR_IIN_MAX | DA40 | R | 2 | Linear | Maximum Input Current (18A) |
| A4h | MFR_VOUT_MIN | 1B00 | R | 2 | Linear | Minimum Output Voltage Regulation Window. (13.5V) |
| A5h | MFR_VOUT_MAX | 8448 | R | 2 | Linear | Maximum Output Voltage. Regulation Window (16.5V) |
| A6h | MFR_IOUT_MAX | EB20 | R | 2 | Linear | Maximum Output Current (100A) |
| A7h | MFR_POUT_MAX | - | R | 2 | Linear | Maximum Output Power (1560W) |
| A8h | MFR_TAMBIENT_MAX | EA30 | R | 2 | Linear | Maximum Operating Ambient Temperature (Secondary Ambient) (70 degC) |
| A9h | MFR_TAMBIENT_MIN | - | R | 2 | Linear | Minimum Operating Ambient Temperature (Secondary Ambient) (-40 degC) |
| E0h | FW_PRI_VERSION | - | BR | 8 | ASCII | Varies |
| E1h | FW_SEC_VERSION | - | BR | 8 | ASCII | Varies |

# PMBUS™ SPECIFICATIONS

The LCM1500R Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 01h | OPERATION | 80 | R/W | 1 | B | Used to turn the unit ON/OFF in conjunction with the input INH_EN pin. |
| 02h | ON_OFF_CONFIG | 1E | R | 1 | B | Configures the combination of INH_EN pin and serial communication commands needed to turn the unit ON/OFF. |
| 03h | CLEAR_FAULTS | - | S | 1 | | |
| 10h | WRITE_PROTECT | 80 | R/W | 1 | MSF | Used to Control Writing to the PMBus Device<br>80h - Disables write except 10h<br>40h - Disables write except 10h, 01h, 00h<br>20h - Disables write except 10h,01h,00h,02h and 21h commands<br>00 -Enables write to all writeable commands. |
| 15h | STORE_USER_ALL | - | S | 0 | | Copies the Operating memory table to the matching USER non-volatile memory. |
| 20h | VOUT_MODE | 17 | R | 1 | B | Specifies the mode and parameters of Output Voltage related Data Formats |
| 21h | VOUT_COMMAND | 3800 | R/W | 2 | Linear | Sets the Output Voltage Reference<br>Vout command sends discreet value to change<br>or trim output voltage. (28V) |
| 24h | VOUT_MAX | 3D99 | R | 2 | Linear | The max adjustable output voltage limit. (30.8V) |
| 3Ah | FAN_CONFIG_1_2 | 99h | R | 1 | Bitmapped | Read only to reflect setting of Fans |
| 3Bh | FAN_COMMAND_1 | 0 | R/W | 2 | Linear | Adjust fan speed, duty cycle control from 0 to 100% |
| 3Ch | FAN_COMMAND_2 | 0 | R/W | 2 | Linear | Adjust fan speed, duty cycle control from 0 to 100% |
| 40h | VOUT_OV_FAULT_LIMIT | - | R/W | 2 | Linear | Sets Output Over voltage threshold. (48.6V) |
| 41h | VOUT_OV_FAULT_RESPONSE | 80 | R | 1 | MSF | Unit Latches OFF. Resets on INH_EN or CONTROL pin recycle or AC recycle. |
| 42h | VOUT_OV_WARN_LIMIT | - | R | 2 | Linear | Over-voltage Warning threshold. (42.5V) |
| 43h | VOUT_UV_WARN_LIMIT | - | R | 2 | Linear | Under-voltage Warning threshold. (30.6V) |
| 44h | VOUT_UV_FAULT_LIMIT | - | R | 2 | Linear | Under-voltage Fault threshold. (30V) |
| 45h | VOUT_UV_FAULT_RESPONSE | 80 | R | 1 | MSF | Turn PSU OFF |
| 46h | IOUT_OC_FAULT_LIMIT | E2D0 | R | 2 | Linear | Over current threshold in Amps. (45A ) |
| 47h | IOUT_OC_FAULT_RESPONSE | C0 | R | 1 | MSF | OCP ride through. If OCP persists. |
| 4Ah | IOUT_OC_WARN_LIMIT | E2A8 | R | 2 | Linear | Over Current Warning threshold in Amps. (42.5A) |

# PMBUS™ SPECIFICATIONS

The LCM1500R Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 4Fh | OT_FAULT_LIMIT | EBB0 | R | 2 | Linear | Secondary ambient temperature Fault threshold, in degree C. (118degC) |
| 50h | OT_FAULT_RESPONSE | - | R | 1 | MSF | Turn PSU OFF and will retry indefinitely |
| 51h | OT_WARN_LIMIT | EA30 | R | 2 | Linear | Secondary ambient temperature warning threshold, in degree C.(70degC) |
| 55h | VIN_OV_FAULT_LIMIT | FA3A | R | 2 | Linear | Sets Input Over voltage threshold. (285V) |
| 56h | VIN_OV_FAULT_RESPONSE | C0 | R | 1 | Linear | Turn PSU OFF |
| 58h | VIN_UV_WARN_LIMIT | EAB0 | R | 2 | Linear | Sets Input Under voltage warning threshold(86V) |
| 59h | VIN_UV_FAULT_LIMIT | EA78 | R | 2 | Linear | Sets Input Under voltage threshold(79V) |
| 5Ah | VIN_UV_FAULT_RESPONSE | F8 | R | 1 | Linear | Turn PSU OFF |
| 5Eh | POWER_GOOD_ON | - | R | 2 | Linear | Sets the threshold by which the Power Good signal is asserted. (32.25V) |
| 5Fh | POWER_GOOD_OFF | - | R | 2 | Linear | Sets the threshold by which the Power Good signal is de-asserted. (31.86V) |
| 60h | TON_DELAY | EB20 | R | 2 | Linear | Sets the time (sec), from start condition (Power ON) until the output starts to rise. 100mS |
| 61h | TON_RISE | DA80 | R | 2 | Linear | Sets the time (ms), for the output rises from 0 to regulation. 20mS |
| 64h | TOFF_DELAY | DA80 | R | 2 | Linear | Sets the time (ms), from a stop condition (Power OFF) until the output starts to drop (converter OFF). |
| 78h | STATUS_BYTE | 00 | R | 1 | Binary | Returns the summary of critical faults |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under--voltage fault has occurred |
| | b2 - TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE OF THE ABOVE | | | | | A Fault Warning not listed in bits[7:1] has occurred. |

# PMBUS™ SPECIFICATIONS

The LCM1500R Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 79h | STATUS_WORD | 0000 | R | 2 | Binary | Summary of units Fault and warning status. |
| | 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 | | | | | A manufacturer specific fault or warning has occurred. |
| | b11 – POWER_GOOD# | | | | | The POWER_GOOD signal is de-asserted |
| | b10 - FANS | | | | | A fan or airflow fault or warning has occurred. |
| | b9 – OTHER | | | | | A bit in STATUS_OTHER is set. |
| | b8 – UKNOWN | | | | | A fault type not given in bits [15:1] of the STATUS_WORD has been detected. |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under-voltage fault has occurred |
| | b2 – TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE_OF_THE_ABOVE | | | | | A fault or warning not listed in bits[7:1] of this byte has occurred. |
| 7Ah | STATUS_VOUT | 00 | R | 1 | Binary | Output voltage related faults and warnings |
| | b7 | | | | | VOUT Over--voltage Fault |
| | b6 | | | | | VOUT Over-voltage warning |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |

# PMBUS™ SPECIFICATIONS

The LCM1500R Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 7Bh | STATUS_IOUT | 00 | R | 1 | Binary | Output Current related faults and warnings |
| | b7 | | | | | IOUT Over current Fault |
| | b6 | | | | | IOUT Over current And Low Voltage shutdown Fault |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |
| 7Dh | STATUS_TEMPERATURE | 00 | R | 1 | Binary | Temperature related faults and warnings |
| | b7 | | | | | Over temperature Fault |
| | b6 | | | | | Over temperature Warning |
| | b5 | | | | | Under temperature Warning |
| | b4 | | | | | Under temperature Fault |
| | b3:0 | | | | | reserved |
| 7Eh | STATUS_CML | C0 | R | 1 | Binary | Communications, Logic and Memory |
| 80h | STATUS_MFR_SPECIFIC | 0 | R | 1 | Binary | Manufacturer Status codes |
| 88h | READ_VIN | - | R | 2 | Linear | Returns input Voltage in Volts ac |
| 8Bh | READ_VOUT | - | R | 2 | Linear | Returns the actual, measured voltage in Volts. |
| 8Ch | READ_IOUT | - | R | 2 | Linear | Returns the output current in amperes. |
| 8Dh | READ_TEMPERATURE_1 | - | R | 2 | Linear | PSU Air inlet temp ( inside PSU) |
| 8Eh | READ_TEMPERATURE_2 | - | R | 2 | Linear | PSU Air inlet temp ( inside PSU) |
| 96h | READ_POUT | - | R | 2 | Linear | Returns the output power, in Watts. |
| 97h | READ_PIN | - | R | 2 | Linear | Returns the input power, in Watts |
| 99h | MFR_ID | - | R/W | 8 | ASCII | Artesyn |
| 9Ah | MFR_MODEL | - | R/W | 8 | ASCII | LCM1500 |
| 9Bh | MFR_REVISION | - | R/W | 2 | ASCII | |
| 9Ch | MFR_LOCATION | - | R/W | 8 | ASCII | Laguna |
| 9Dh | MFR_DATE | - | R/W | 8 | ASCII | Manufacture Date, ASCII format structure : YYMMDD |
| 9Eh | MFR_SERIAL | - | R/W | 13 | ASCII | 13 CHAR |

# PMBUS™ SPECIFICATIONS

The LCM1500R Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| A0h | MFR_VIN_MIN | EAD0 | R | 2 | Linear | Minimum Input Voltage (90Vac) |
| A1h | MFR_VIN_MAX | FA10 | R | 2 | Linear | Maximum Input Voltage (264Vac) |
| A2h | MFR_IIN_MAX | DA40 | R | 2 | Linear | Maximum Input Current (18A) |
| A4h | MFR_VOUT_MIN | 1B00 | R | 2 | Linear | Minimum Output Voltage Regulation Window. (13.5V) |
| A5h | MFR_VOUT_MAX | 8448 | R | 2 | Linear | Maximum Output Voltage. Regulation Window (16.5V) |
| A6h | MFR_IOUT_MAX | EB20 | R | 2 | Linear | Maximum Output Current (100A) |
| A7h | MFR_POUT_MAX | - | R | 2 | Linear | Maximum Output Power (1560W) |
| A8h | MFR_TAMBIENT_MAX | EA30 | R | 2 | Linear | Maximum Operating Ambient Temperature (Secondary Ambient) (70 degC) |
| A9h | MFR_TAMBIENT_MIN | - | R | 2 | Linear | Minimum Operating Ambient Temperature (Secondary Ambient) (-40 degC) |
| E0h | FW_PRI_VERSION | - | BR | 8 | ASCII | Varies |
| E1h | FW_SEC_VERSION | - | BR | 8 | ASCII | Varies |

# PMBUS™ SPECIFICATIONS

The LCM1500U Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 01h | OPERATION | 80 | R/W | 1 | B | Used to turn the unit ON/OFF in conjunction with the input INH_EN pin. |
| 02h | ON_OFF_CONFIG | 1E | R | 1 | B | Configures the combination of INH_EN pin and serial communication commands needed to turn the unit ON/OFF. |
| 03h | CLEAR_FAULTS | - | S | 1 | | |
| 10h | WRITE_PROTECT | 80 | R/W | 1 | MSF | Used to Control Writing to the PMBus Device<br>80h - Disables write except 10h<br>40h - Disables write except 10h, 01h, 00h<br>20h - Disables write except 10h,01h,00h,02h and 21h commands<br>00 -Enables write to all writeable commands. |
| 15h | STORE_USER_ALL | - | S | 0 | | Copies the Operating memory table to the matching USER non-volatile memory. |
| 20h | VOUT_MODE | 17 | R | 1 | B | Specifies the mode and parameters of Output Voltage related Data Formats |
| 21h | VOUT_COMMAND | 4800 | R/W | 2 | Linear | Sets the Output Voltage Reference<br>Vout command sends discreet value to change<br>or trim output voltage. (36V) |
| 24h | VOUT_MAX | 4F33 | R | 2 | Linear | The max adjustable output voltage limit. (39.6V) |
| 3Ah | FAN_CONFIG_1_2 | 99h | R | 1 | Bitmapped | Read only to reflect setting of Fans |
| 3Bh | FAN_COMMAND_1 | 0 | R/W | 2 | Linear | Adjust fan speed, duty cycle control from 0 to 100% |
| 3Ch | FAN_COMMAND_2 | 0 | R/W | 2 | Linear | Adjust fan speed, duty cycle control from 0 to 100% |
| 40h | VOUT_OV_FAULT_LIMIT | 6133 | R/W | 2 | Linear | Sets Output Over voltage threshold. (48.6V) |
| 41h | VOUT_OV_FAULT_RESPONSE | 80 | R | 1 | MSF | Unit Latches OFF. Resets on INH_EN or CONTROL pin recycle or AC recycle. |
| 42h | VOUT_OV_WARN_LIMIT | 5500 | R | 2 | Linear | Over-voltage Warning threshold. (42.5V) |
| 43h | VOUT_UV_WARN_LIMIT | 3D33 | R | 2 | Linear | Under-voltage Warning threshold. (30.6V) |
| 44h | VOUT_UV_FAULT_LIMIT | 3C00 | R | 2 | Linear | Under-voltage Fault threshold. (30V) |
| 45h | VOUT_UV_FAULT_RESPONSE | 80 | R | 1 | MSF | Turn PSU OFF |
| 46h | IOUT_OC_FAULT_LIMIT | E2D0 | R | 2 | Linear | Over current threshold in Amps. (45A ) |
| 47h | IOUT_OC_FAULT_RESPONSE | C0 | R | 1 | MSF | OCP ride through. If OCP persists. |
| 4Ah | IOUT_OC_WARN_LIMIT | E2A8 | R | 2 | Linear | Over Current Warning threshold in Amps. (42.5A) |

# PMBUS™ SPECIFICATIONS

The LCM1500U Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 4Fh | OT_FAULT_LIMIT | EBB0 | R | 2 | Linear | Secondary ambient temperature Fault threshold, in degree C. (118degC) |
| 50h | OT_FAULT_RESPONSE | F8 | R | 1 | MSF | Turn PSU OFF and will retry indefinitely |
| 51h | OT_WARN_LIMIT | EA30 | R | 2 | Linear | Secondary ambient temperature warning threshold, in degree C.(70degC) |
| 55h | VIN_OV_FAULT_LIMIT | FA3A | R | 2 | Linear | Sets Input Over voltage threshold. (285V) |
| 56h | VIN_OV_FAULT_RESPONSE | C0 | R | 1 | Linear | Turn PSU OFF |
| 58h | VIN_UV_WARN_LIMIT | EAB0 | R | 2 | Linear | Sets Input Under voltage warning threshold(86V) |
| 59h | VIN_UV_FAULT_LIMIT | EA78 | R | 2 | Linear | Sets Input Under voltage threshold(79V) |
| 5Ah | VIN_UV_FAULT_RESPONSE | F8 | R | 1 | Linear | Turn PSU OFF |
| 5Eh | POWER_GOOD_ON | 4100 | R | 2 | Linear | Sets the threshold by which the Power Good signal is asserted. (32.5V) |
| 5Fh | POWER_GOOD_OFF | 3FB8 | R | 2 | Linear | Sets the threshold by which the Power Good signal is de-asserted. (31.86V) |
| 60h | TON_DELAY | EB20 | R | 2 | Linear | Sets the time (sec), from start condition (Power ON) until the output starts to rise. 100mS |
| 61h | TON_RISE | DA80 | R | 2 | Linear | Sets the time (ms), for the output rises from 0 to regulation. 20mS |
| 64h | TOFF_DELAY | DA80 | R | 2 | Linear | Sets the time (ms), from a stop condition (Power OFF) until the output starts to drop (converter OFF). |
| 78h | STATUS_BYTE | 00 | R | 1 | Binary | Returns the summary of critical faults |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under--voltage fault has occurred |
| | b2 - TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE OF THE ABOVE | | | | | A Fault Warning not listed in bits[7:1] has occurred. |

# PMBUS™ SPECIFICATIONS

The LCM1500U Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 79h | STATUS_WORD | 0000 | R | 2 | Binary | Summary of units Fault and warning status. |
| | 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 | | | | | A manufacturer specific fault or warning has occurred. |
| | b11 – POWER_GOOD# | | | | | The POWER_GOOD signal is de-asserted |
| | b10 - FANS | | | | | A fan or airflow fault or warning has occurred. |
| | b9 – OTHER | | | | | A bit in STATUS_OTHER is set. |
| | b8 – UKNOWN | | | | | A fault type not given in bits [15:1] of the STATUS_WORD has been detected. |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under-voltage fault has occurred |
| | b2 – TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE_OF_THE_ABOVE | | | | | A fault or warning not listed in bits[7:1] of this byte has occurred. |
| 7Ah | STATUS_VOUT | 00 | R | 1 | Binary | Output voltage related faults and warnings |
| | b7 | | | | | VOUT Over--voltage Fault |
| | b6 | | | | | VOUT Over-voltage warning |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |

# PMBUS™ SPECIFICATIons

The LCM1500U Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 7Bh | STATUS_IOUT | 00 | R | 1 | Binary | Output Current related faults and warnings |
| | b7 | | | | | IOUT Over current Fault |
| | b6 | | | | | IOUT Over current And Low Voltage shutdown Fault |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |
| 7Dh | STATUS_TEMPERATURE | 00 | R | 1 | Binary | Temperature related faults and warnings |
| | b7 | | | | | Overtemperature Fault |
| | b6 | | | | | Overtemperature Warning |
| | b5 | | | | | Under temperature Warning |
| | b4 | | | | | Under temperature Fault |
| | b3:0 | | | | | reserved |
| 7Eh | STATUS_CML | C0 | R | 1 | Binary | Communications, Logic and Memory |
| 80h | STATUS_MFR_SPECIFIC | 0 | R | 1 | Binary | Manufacturer Status codes |
| 88h | READ_VIN | - | R | 2 | Linear | Returns input Voltage in Volts ac |
| 8Bh | READ_VOUT | - | R | 2 | Linear | Returns the actual, measured voltage in Volts. |
| 8Ch | READ_IOUT | - | R | 2 | Linear | Returns the output current in amperes. |
| 8Dh | READ_TEMPERATURE_1 | - | R | 2 | Linear | PSU Air inlet temp ( inside PSU) |
| 8Eh | READ_TEMPERATURE_2 | - | R | 2 | Linear | PSU Air inlet temp ( inside PSU) |
| 96h | READ_POUT | - | R | 2 | Linear | Returns the output power, in Watts. |
| 97h | READ_PIN | - | R | 2 | Linear | Returns the input power, in Watts |
| 99h | MFR_ID | - | R/W | 8 | ASCII | Artesyn |
| 9Ah | MFR_MODEL | - | R/W | 8 | ASCII | LCM1500 |
| 9Bh | MFR_REVISION | - | R/W | 2 | ASCII | |
| 9Ch | MFR_LOCATION | - | R/W | 8 | ASCII | Laguna |
| 9Dh | MFR_DATE | - | R/W | 8 | ASCII | Manufacture Date, ASCII format structure : YYMMDD |
| 9Eh | MFR_SERIAL | - | R/W | 13 | ASCII | 13 CHAR |

# PMBUS™ SPECIFIcations

The LCM1500U Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| A0h | MFR_VIN_MIN | EAD0 | R | 2 | Linear | Minimum Input Voltage (90Vac) |
| A1h | MFR_VIN_MAX | FA10 | R | 2 | Linear | Maximum Input Voltage (264Vac) |
| A2h | MFR_IIN_MAX | DA40 | R | 2 | Linear | Maximum Input Current (18A) |
| A4h | MFR_VOUT_MIN | 1B00 | R | 2 | Linear | Minimum Output Voltage Regulation Window. (13.5V) |
| A5h | MFR_VOUT_MAX | 8448 | R | 2 | Linear | Maximum Output Voltage. Regulation Window (16.5V) |
| A6h | MFR_IOUT_MAX | EB20 | R | 2 | Linear | Maximum Output Current (100A) |
| A7h | MFR_POUT_MAX | - | R | 2 | Linear | Maximum Output Power (1560W) |
| A8h | MFR_TAMBIENT_MAX | EA30 | R | 2 | Linear | Maximum Operating Ambient Temperature (Secondary Ambient) (70 degC) |
| A9h | MFR_TAMBIENT_MIN | - | R | 2 | Linear | Minimum Operating Ambient Temperature (Secondary Ambient) (-40 degC) |
| E0h | FW_PRI_VERSION | - | BR | 8 | ASCII | Varies |
| E1h | FW_SEC_VERSION | - | BR | 8 | ASCII | Varies |

# PMBUS™ SPECIFICATIons

The LCM1500W Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 01h | OPERATION | 80 | R/W | 1 | B | Used to turn the unit ON/OFF in conjunction with the input INH_EN pin. |
| 02h | ON_OFF_CONFIG | 1E | R | 1 | B | Configures the combination of INH_EN pin and serial communication commands needed to turn the unit ON/OFF. |
| 03h | CLEAR_FAULTS | - | S | 1 | | |
| 10h | WRITE_PROTECT | 80 | R/W | 1 | MSF | Used to Control Writing to the PMBus Device<br>80h - Disables write except 10h<br>40h - Disables write except 10h, 01h, 00h<br>20h - Disables write except 10h,01h,00h,02h and 21h commands<br>00 - Enables write to all writeable commands. |
| 15h | STORE_USER_ALL | - | S | 0 | | Copies the Operating memory table to the matching USER non-volatile memory. |
| 20h | VOUT_MODE | 18 | R | 1 | B | Specifies the mode and parameters of Output Voltage related Data Formats |
| 21h | VOUT_COMMAND | 3000 | R/W | 2 | Linear | Sets the Output Voltage Reference<br>Vout command sends discreet value to change<br>or trim output voltage. (48V) |
| 24h | VOUT_MAX | 34CC | R | 2 | Linear | The max adjustable output voltage limit. (52.8V) |
| 3Ah | FAN_CONFIG_1_2 | 99h | R | 1 | Bitmapped | Read only to reflect setting of Fans |
| 3Bh | FAN_COMMAND_1 | 0 | R/W | 2 | Linear | Adjust fan speed, duty cycle control from 0 to 100% |
| 3Ch | FAN_COMMAND_2 | 0 | R/W | 2 | Linear | Adjust fan speed, duty cycle control from 0 to 100% |
| 40h | VOUT_OV_FAULT_LIMIT | 819A | R/W | 2 | Linear | Sets Output Over voltage threshold. (64.8V) |
| 41h | VOUT_OV_FAULT_RESPONSE | 80 | R | 1 | MSF | Unit Latches OFF. Resets on INH_EN or CONTROL pin recycle or AC recycle. |
| 42h | VOUT_OV_WARN_LIMIT | 6E66 | R | 2 | Linear | Over-voltage Warning threshold. (55.2V) |
| 43h | VOUT_UV_WARN_LIMIT | 6800 | R | 2 | Linear | Under-voltage Warning threshold. (38.4V) |
| 44h | VOUT_UV_FAULT_LIMIT | 6800 | R | 2 | Linear | Sets Under-voltage Fault threshold. (38.4V) |
| 45h | VOUT_UV_FAULT_RESPONSE | 80 | R | 1 | MSF | Turn PSU OFF |
| 46h | IOUT_OC_FAULT_LIMIT | E220 | R | 2 | Linear | Over current threshold in Amps. (34A ) |
| 47h | IOUT_OC_FAULT_RESPONSE | C0 | R | 1 | MSF | OCP ride through. If OCP persists. |
| 4Ah | IOUT_OC_WARN_LIMIT | E203 | R | 2 | Linear | Over Current Warning threshold in Amps. (32.2A) |

# PMBUS™ SPECIFICATIONS

The LCM1500W Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 4Fh | OT_FAULT_LIMIT | EBB0 | R | 2 | Linear | Secondary ambient temperature Fault threshold, in degree C. (118degC) |
| 50h | OT_FAULT_RESPONSE | F8 | R | 1 | MSF | Turn PSU OFF and will retry indefinitely |
| 5Eh | POWER_GOOD_ON | 6229 | R | 2 | Linear | Sets the threshold by which the Power Good signal is asserted. (46.08V) |
| 5Fh | POWER_GOOD_OFF | 5666 | R | 2 | Linear | Sets the threshold by which the Power Good signal is de-asserted. (43.2V) |
| 60h | TON_DELAY | EB20 | R | 2 | Linear | Sets the time (sec), from start condition (Power ON) until the output starts to rise. 100mS |
| 61h | TON_RISE | DA80 | R | 2 | Linear | Sets the time (ms), for the output rises from 0 to regulation. 20mS |
| 64h | TOFF_DELAY | DA80 | R | 2 | Linear | Sets the time (ms), from a stop condition (Power OFF) until the output starts to drop (converter OFF). 20mS |
| 78h | STATUS_BYTE | 00 | R | 1 | Binary | Returns the summary of critical faults |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under--voltage fault has occurred |
| | b2 - TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE OF THE ABOVE | | | | | A Fault Warning not listed in bits[7:1] has occurred. |

# PMBUS™ SPECIFICATIONS

The LCM1500W Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 79h | STATUS_WORD | 0000 | R | 2 | Binary | Summary of units Fault and warning status. |
| | 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 | | | | | A manufacturer specific fault or warning has occurred. |
| | b11 – POWER_GOOD# | | | | | The POWER_GOOD signal is de-asserted |
| | b10 - FANS | | | | | A fan or airflow fault or warning has occurred. |
| | b9 – OTHER | | | | | A bit in STATUS_OTHER is set. |
| | b8 – UKNOWN | | | | | A fault type not given in bits [15:1] of the STATUS_WORD has been detected. |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under-voltage fault has occurred |
| | b2 – TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE_OF_THE_ABOVE | | | | | A fault or warning not listed in bits[7:1] of this byte has occurred. |
| 7Ah | STATUS_VOUT | 00 | R | 1 | Binary | Output voltage related faults and warnings |
| | b7 | | | | | VOUT Over--voltage Fault |
| | b6 | | | | | VOUT Over-voltage warning |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |

# PMBUS™ SPECIFICATIONS

The LCM1500W Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 7Bh | STATUS_IOUT | 00 | R | 1 | Binary | Output Current related faults and warnings |
| | b7 | | | | | IOUT Over current Fault |
| | b6 | | | | | IOUT Over current And Low Voltage shutdown Fault |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |
| 7Dh | STATUS_TEMPERATURE | 00 | R | 1 | Binary | Temperature related faults and warnings |
| | b7 | | | | | Over temperature Fault |
| | b6 | | | | | Over temperature Warning |
| | b5 | | | | | Under temperature Warning |
| | b4 | | | | | Under temperature Fault |
| | b3:0 | | | | | reserved |
| 7Eh | STATUS_CML | C0 | R | 1 | Binary | Communications, Logic and Memory |
| 80h | STATUS_MFR_SPECIFIC | 0 | R | 1 | Binary | Manufacturer Status codes |
| 88h | READ_VIN | - | R | 2 | Linear | Returns input Voltage in Volts ac |
| 8Bh | READ_VOUT | - | R | 2 | Linear | Returns the actual, measured voltage in Volts. |
| 8Ch | READ_IOUT | - | R | 2 | Linear | Returns the output current in amperes. |
| 8Dh | READ_TEMPERATURE_1 | - | R | 2 | Linear | PSU Air inlet temp ( inside PSU) |
| 8Eh | READ_TEMPERATURE_2 | - | R | 2 | Linear | PSU Air inlet temp ( inside PSU) |
| 96h | READ_POUT | - | R | 2 | Linear | Returns the output power, in Watts. |
| 97h | READ_PIN | - | R | 2 | Linear | Returns the input power, in Watts |
| 99h | MFR_ID | - | R/W | 8 | ASCII | Artesyn |
| 9Ah | MFR_MODEL | - | R/W | 8 | ASCII | LCM1500 |
| 9Bh | MFR_REVISION | - | R/W | 2 | ASCII | |
| 9Ch | MFR_LOCATION | - | R/W | 8 | ASCII | Laguna |
| 9Dh | MFR_DATE | - | R/W | 8 | ASCII | Manufacture Date, ASCII format structure : YYMMDD |
| 9Eh | MFR_SERIAL | - | R/W | 13 | ASCII | 13 CHAR |

# PMBUS™ SPECIFICATIONS

The LCM1500W Series Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| A0h | MFR_VIN_MIN | EAD0 | R | 2 | Linear | Minimum Input Voltage (90Vac) |
| A1h | MFR_VIN_MAX | FA10 | R | 2 | Linear | Maximum Input Voltage (264Vac) |
| A2h | MFR_IIN_MAX | DA40 | R | 2 | Linear | Maximum Input Current (18A) |
| A4h | MFR_VOUT_MIN | 1B00 | R | 2 | Linear | Minimum Output Voltage Regulation Window. (13.5V) |
| A5h | MFR_VOUT_MAX | 8448 | R | 2 | Linear | Maximum Output Voltage. Regulation Window (16.5V) |
| A6h | MFR_IOUT_MAX | EB20 | R | 2 | Linear | Maximum Output Current (100A) |
| A7h | MFR_POUT_MAX | - | R | 2 | Linear | Maximum Output Power (1560W) |
| A8h | MFR_TAMBIENT_MAX | EA30 | R | 2 | Linear | Maximum Operating Ambient Temperature (Secondary Ambient) (70 degC) |
| A9h | MFR_TAMBIENT_MIN | - | R | 2 | Linear | Minimum Operating Ambient Temperature (Secondary Ambient) (-40 degC) |
| E0h | FW_PRI_VERSION | - | BR | 8 | ASCII | Varies |
| E1h | FW_SEC_VERSION | - | BR | 8 | ASCII | Varies |

# PMBUS™ SPECIFICATIONS

## I2C Reading Accuracy

Below is the typical accuracy specification for LCM1500 Series (For Reference Only)

| Reporting Function | Command Code | Command Name | Accuracy Range |
|---|---|---|---|
| | | | 20% to 100% load |
| Input Voltage | 88h | READ_VIN | ±5% |
| Output Voltage | 8Bh | READ_VOUT | ±5% |
| Output Current | 8Ch | READ_IOUT | ±5% |
| Input Current | 89h | READ_IIN | ±5% |
| Input Power | 97h | READ_PIN | ±20% |
| Output Power | 96h | READ_POUT | ±20% |

# APPLICATION NOTES

## Current Sharing

The LCM1500 main output V1 is equipped with current sharing capability. This will allow up to 10 power supplies to be connected in parallel for higher power application. Current share accuracy is typically 10% of full load. SWP Node voltage at full load is to be 5.5 to 6.5 V and 2.5 to 3.5 V at 50% of maximum current. The minimum load at parallel operation is 1% of the total output current that the units can deliver.

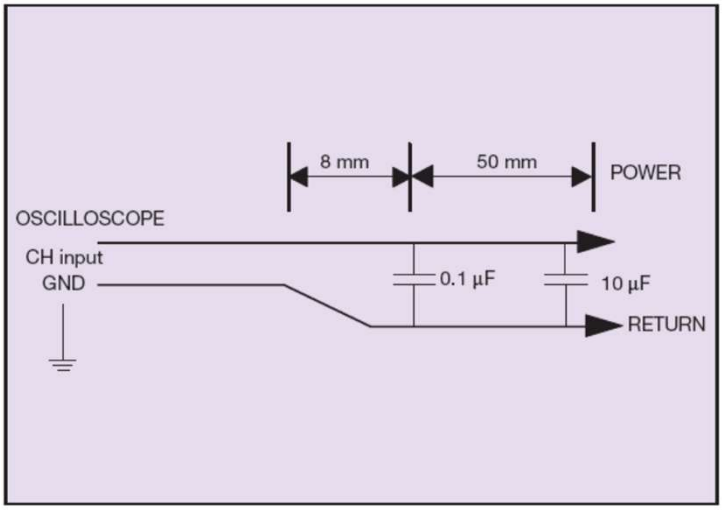
The table below shows the derated maximum power capacity when units are in parallel configuration. This is to consider the 10% load sharing tolerance.

| Number of Units in Parallel ( N ) | Maximum Output power Rated + [(N-1) x 0.9] x Rated, Where: Rated - 1500W, N - Number of PSU in Parallel |
|---|---|
| Stand-alone | 1500W |
| 2 | 2850W |
| 3 | 4200W |
| 4 | 5550W |
| ... | ... |
| 10 | 13650 |

# 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 LCM1500 series. When measuring output ripple and noise, a scope jack in parallel with a 0.1uF ceramic chip capacitor, and a 10 uF tantalum capacitor should be used. Oscilloscope should be set to 20 MHz bandwidth for this measurement.



# RECORD OF REVISION AND CHANGES

| Issue | Date | Description | Originators |
|---|---|---|---|
| 1.0 | 01.21.2014 | First Issue | K. Wang |
| 1.1 | 04.24.2014 | Remove CCC cert | K. Wang |
| 1.2 | 07.10.2014 | Update type error | K. Wang |
| 1.3 | 04.29.2014 | Update the no load input current and power<br>Add EMC section we missed before<br>Update the model number(add the adjust range<br>Update hold up time from 20mS to 14mS | K. Wang |
| 1.4 | 09.07.2015 | Update type error | K. Wang |
| 1.5 | 01.12.2016 | Update the address issue | K. Wang |
| 1.6 | 04.29.2016 | 1.Update input fuse to 30A<br>2. Update the description for remote sense | K. Wang |
| 1.7 | 07.14.2016 | Add the LCM1500L, LCM1500U, LCM1500R | K. Wang |
| 1.8 | 04.20.2017 | Update the load Capacitor | K. Wang |
| 1.9 | 04.28.2017 | Update the leakage current to 240Vac 0.3mA per safety confirm | K. Wang |
| 2.0 | 05.09.2018 | SCP mode update | K. Wang |
| 2.1 | 05.16.2018 | Remove  minimum limit for T4 | K. Wang |
| 2.2 | 09.18.2018 | 1.Update the dynamic spec to 4%<br>2. Add the command list for other model | K. Wang |
| 2.3 | 10.15.2018 | “Delay from loss of AC input to 0 to G_ACOK_C going to high” Add “to 0” | K. Wang |
| 2.4 | 02.19.2019 | Update 21h to R/W | K. Wang |
| 2.5 | 04.01.2019 | Add the I2C Reading Accuracy | K. Wang |
| 2.6 | 05.05.2019 | Update mating connectors | K. Wang |
| 2.7 | 10.29.2019 | Update the regulation for $V_{SB}$ | K. Wang |
| 2.8 | 12.18.2019 | Update timeout to 25mS | K. Wang |
| 2.9 | 03.23.2020 | Update Isolation Voltage | C.Liu |
| 3.0 | 06.18.2020 | 1.Update the leakage current for different test method<br>2.Update the safety 60950 to 62368-1 | K. Wang |
| 3.1 | 07.22.2020 | 1.Update parallel number from 10 to 4<br>2.Add OCP mode | K. Wang |
| 3.2 | 09.30.2020 | Update PFC and DC DC switch frequency | K. Wang |
| 3.3 | 10.20.2020 | Update the 21h, 44h,46h | K. Wang |
| 3.4 | 07.06.2021 | Update typo for 1A/uS | K. Wang |
| 3.5 | 08.10.2021 | Update the isolation voltage and new picture with new logo | K. Wang |
| 3.6 | 09.16.2021 | Update adjust range lower limit for LCM1500W from 40.8V to 43.8V after testing and discus with DE | K. Wang |
| 3.7 | 11.06.2021 | Update transient response step load valid range | K. Zou |
| 3.8 | 01.07.2022 | 1. UKCA 2. Remove D5h and add E0h,E1h | K. Wang |
| 3.9 | 01.20.2022 | 1. Update mating connector 2. Add 3A,3B,3C 3. Timing | K. Wang |

# RECORD OF REVISION AND CHANGES

| Issue | Date | Description | Originators |
|---|---|---|---|
| 4.0 | 10.18.2022 | Update EMC part typo | K. Wang |
| 4.1 | 02.24.2023 | Add Semi 47 compliance | K. Wang |
| 4.2 | 09.04.2023 | Add LCM1500L fan noise spec<br>Update Number of Parallel Units to 10 | K. Wang |
| 4.3 | 12.06.2023 | Update the SCL, SDA description<br>Update typo LCM1500W 46h. It's read only | K. Wang |

## ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

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LCM1500 Rev 12.13.23_#4.3