Advanced Energy

ARTESYN LCM4000HV SERIES

4000 Watts Bulk Front End Centralized Power for LED Horticulture Lighting

PRODUCT DESCRIPTION

Advanced Energy's Artesyn LCM4000HV series and associated LCM12K mounting shelf has been designed specifically to provide a centralized current source for medium to large scale LED lighting and horticulture applications. The output of each 4 kW block provides flicker free current source from 0 to 16 A at an output voltage range between 100 to 300 Vdc. High nominal operating voltage provides the benefits of lower cost standard wiring and higher efficiency with minimal voltage drop over long distance.

AT A GLANCE

Total Power

4000 Watts

Input Voltage

180 to 264 Vac

311 to 528 Vac

Output Voltage

Voltage Source: 100 to 300 Vdc

Current Source: 0 to 16 A

# of Outputs

Single

Modbus

RoHS

SPECIAL FEATURES

- Wide input voltage range
- Single phase
- 4000 W output power
- Low cost
- 480 mm x 140 mm x 40.3 mm
- 24 Watts per cubic inch
- Industrial safety
- High efficiency: up to 95%
- Variable speed "Smart Fans"
- Dust control for fan cooling
- DSP controlled
- Digital and analog communication
- Scales easily (Module/Shelf/Rack)
- Meets DLC 2.1 Requirements
- Supports Artesyn iTS and IHLC
- Five-year warranty

SAFETY

- UL 62368-1 Listed
- CSA 62368-1 Listed
- EN 62368-1 Listed
- IEC 62368-1 Listed
- CB Certificate and Report (IEC 62368-1/IEC 60950-1)
- CE (LVD+RoHS)
- UKCA Mark

COMPLIANCE

- EMI Class A
- EN61000 Immunity
- RoHS 3

MODEL NUMBERS

Description	Standard	Input Range	Default Output Setting[1]		
			Output Mode	Output Current[2]	Output Voltage
Standalone 4 kW Module	LCM4000HV-T-P	180 to 264 Vac	Current Source	0 A	250 Vdc
	LCM4000HV-T-S	311 to 528 Vac	Current Source	0 A	250 Vdc
Pluggable 4 kW Module for Shelf Use	LCM4000HV-P-P	180 to 264 Vac	Current Source	0 A	250 Vdc
	LCM4000HV-P-S	311 to 528 Vac	Current Source	0 A	250 Vdc

Note 1 - Output voltage and current adjustment range please refer to Electrical Specifications section.
Note 2 - Output current can be set down to 0.48 A, lower than 0.48 A will be considered as 0 A or OFF.

Ordering Information

LCM	4000	HV	-	X	-	Y	-	###
①	②	③		④		⑤		⑥

①	Model Series	LCM: Series Name
②	Max Output Power in Watts	4000 = 4 kW
③	Configuration Type	HV = High Voltage
④	Output Connection	T = Terminal for Standalone Module; P = Pluggable for Module Used in Shelf
⑤	Input Range Configuration	P = Low Line Input; S = High Line Input
⑥	Modification	Sequential Factory Assigned 3-digit Number

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[1] AC continuous operation	'-P' suffix '-S' suffix	$V_{IN,AC}$	180 311	- -	264 528	Vac Vac
Maximum Output Power	All modules	$P_{O,max}$	-	-	4000	W
Isolation Voltage Primary to Protective Earth (PE) Primary to Secondary Secondary to Protective Earth (PE) Primary to User-Accessible[2] Secondary to User-Accessible[2]	All modules		- - - - -	- - - - -	4000 4000 3200 6000 5000	Vdc Vdc Vdc Vdc Vdc
Ambient Operating Temperature[3]	All modules	T_A	0	-	+50	^{O}C
Storage Temperature	All modules	T_{STG}	-40	-	+85	^{O}C
Humidity (non-condensing) Operating Non-operating	All modules		20 10	- -	90 95	% %
Altitude Operating Non-operating	All modules		- -	- -	3000 9144	m m
MTBF[4]	All modules		200	-	-	kHours

Note 1 - 180 to 264 Vac (Input low line configuration, '-P' suffix); 311 to 528 Vac (Input high line configuration, '-S' suffix).
Note 2 - Reinforced insulation.
Note 3 - 0°C to 50°C at 100% rated load, 50°C to 60°C derated to 3200 W.
Note 4 - Using Telcordia specifications @ 25°C ambient at full load, nominal line of 220/240 Vac.

ELECTRICAL SPECIFICATIONS

Input Specifications

Table 2. Input Specifications						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Operating Input Voltage[1], AC	All	$V_{IN,AC}$	180 187 198 207 216 311 342 432	200 208 220 230 240 346 380 480	220 229 242 253 264 381 418 528	Vac Vac Vac Vac Vac Vac Vac Vac
Input AC Frequency	All	f_{IN}	47	50/60	63	Hz
Maximum Input Current[2] ($I_O = I_{O,max}$)	$V_{IN,AC}$ = 180 Vac	$I_{IN,max}$	-	-	25	A
No Load Power[2] (V_O = On, I_O = 0A)	$V_{IN,AC}$ = 180 Vac	$P_{IN,no-load}$	-	-	35	W
Turn On Delay via AC Mains	All	$t_{Turn-on}$	-	-	3000	mS
Harmonic Line Currents	All	THD	EN 61000-3-12			
Power Factor	$V_{IN,AC}$ = 208 Vac I_O = 100% $I_{O,max}$	PF	-	0.99	-	-
	$V_{IN,AC}$ = 480 Vac I_O = 100% $I_{O,max}$		-	0.99	-	-
Startup Surge Current (Inrush)[3]	$V_{IN,AC}$ = 264 Vac $V_{IN,AC}$ = 528 Vac	$I_{IN,surge}$	- -	- -	60 60	A_{PK} A_{PK}
Input Fuse (Double Line Fusing)[4]	Internal, Fast acting, 500 Vac		-	-	20	A
Efficiency	$V_{IN,AC}$ = 480 Vac I_O = 100% $I_{O,max}$	η	-	95	-	%
System Stability 　　　　　　　　Phase Margin 　　　　　　　　Gain Margin			45 -6	- -	- -	Ø dB

Note 1 - Please refer to page 26 for details.
Note 2 - The minimum input voltage is 187 Vac, the unit can still power up at 180 Vac, it is used as a reference.
Note 3 - Ambient temp below 10°C will have the second inrush to avoid start-up delay.
Note 4 - '-P' suffix: 2 x 20 A (parallel), '-S' suffix: 20 A.

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output - Module In Voltage Source Mode						
Parameter	**Condition**	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
Nominal Output Voltage	All	V_O	-	250	-	Vdc
Output Current	All	I_O	-	-	16	A
Output Voltage Adjustment Range	All	V_O	100	-	300	Vdc
Programming Accuracy[1]	Via digital command	$\pm\%V_O$	-	-	0.5	%
	Via analog command	$\pm\%V_O$	-	-	1	%
Output Static Regulation[1]	At steady state line	V_O	-	-	0.50	%
	At steady state load	V_O	-	-	0.75	%
Line Transient Regulation[2] Peak Deviation Settling Time[4]	10% line change	$\pm\%V_O$ t_s	- -	- -	3 1	% mS
Load Transient Regulation[2] Peak Deviation Settling Time[4]	25% load change, 50% load change, slew rate = 1 A/uS	$\pm\%V_O$ t_s	- -	- -	5 1	% mS
Output Voltage Transient Regulation[2,3] Peak Deviation Settling Time[4]	100% Vo change, slew rate = 4 V/mS	$\pm\%V_O$ t_s	- -	- -	5 1	% mS
Output Ripple, pk-pk[5]		V_O	-	-	0.50	%
Overshoot & Undershoot	$I_O \le 1.6A$	$\pm\%V_O$	-	-	5	%
	$I_O > 1.6A$	$\pm\%V_O$	-	-	1	%
Output Load Capacitance	All	C_O	0	-	600	uF
Output Rise Time	0% to 100% $V_{O,set\ point}$	t_{Rise}	-	-	80	mS
Hold Up Time[6]		$t_{Hold-up}$	10	-	-	mS

Note 1 - Ambient temperature at 23°C ± 5°C (with 30 minutes warm-up period).
Note 2 - Minimum Dynamic Load = 1.6 A; Maximum Test Capacitance = 470 uF. Load transient at 50 Hz to 5 kHz, duty cycle 10% to 90%.
Note 3 - Occur during an on-the-fly adjustment of output voltage set-point.
Note 4 - Recovery time of 1 ms at recovery value of 0.5% of nominal output voltage.
Note 5 - Measure with a 0.1 uF ceramic capacitor in parallel with a 10 uF tantalum capacitor using a 20 MHz bandwidth limited oscilloscope.
Ripple performance at 0°C operation is not guaranteed.
Note 6 - The main output remains within its error band for a minimum of 10 ms from a complete line loss, occurring at any point in the line cycle, at the maximum rated output loading when tested at nominal output voltage.

ELECTRICAL SPECIFICATIONS

Output Specifications con't

Table 4. Output - Module In Current Source Mode						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Output Voltage Range	All	V_O	100	-	300	Vdc
Output Current	All	I_O	-	-	16	A
Output Current Adjustment Range[1]	All	I_O	0.48	-	16	A
Programming Accuracy[2]	Via digital command	$\pm\%I_O$	-	-	2.0	%
	Via analog command	$\pm\%I_O$	-	-	2.5	%
Output Static Regulation[2]	At steady state line	I_O	-	-	1.0	%
	At steady state load	I_O	-	-	2.5	%
Line Transient Regulation[3] Peak Deviation Settling Time[5]	10% line change	$\pm\%I_O$ t_s	- -	- -	3 1	% mS
Output Current Transient Regulation[3, 4] Peak Deviation Settling Time[5]	100%$I_{O,max}$ change slew rate = (4% $I_{O,max}$)/mS	$\pm\%I_O$ t_s	- -	- -	5 1	% mS
Output Ripple, RMS[6]		I_O	-	-	3.5	%
Overshoot & Undershoot[7]	$V_O \geq 100V$	$\pm\%I_O$	-	-	1	%
Output Load Capacitance	All	C_O	0	-	600	uF
Output Rise Time	10% to 100% $I_{O,set\ point}$	t_{Rise}	-	-	80	mS
Hold Up Time[8]		$t_{Hold-up}$	10	-	-	mS

Note 1 - Less than 0.48 A will be considered as 0 A or OFF.
Note 2 - Ambient temperature at 23°C $\pm$ 5°C (with 30 minutes warm-up period).
Note 3 - Minimum Dynamic Load: equivalent to 40% of nominal output voltage; Maximum Test Capacitance = 470 uF.
Note 4 - Occur during an on-the-fly adjustment of output current set-point.
Note 5 - Recovery time of 1 ms at recovery value of 0.5% of maximum output current.
Note 6 - Test conditions require the use of current probe to measure the ripple current. Oscilloscope bandwidth set at 20 MHz. Measurement is under all
       line, load and temperature conditions.
Note 7 - Recover within 300 ms, rise is monotonic.
Note 8 - The main output remains within its error band for a minimum of 10 ms from a complete line loss, occurring at any point in the line cycle, at the
       maximum output current when tested at nominal output voltage.

ELECTRICAL SPECIFICATIONS

LCM4000HV-T Performance Curves - Voltage Source Mode

Figure 1:   LCM4000HV-T Turn-on delay via AC mains

Vin = 311Vac   Load: Io = 16A

Ch 1: Vin   Ch 2: Vo   Ch 3: AC_OK   Ch 4: DC_OK

Figure 2:   LCM4000HV-T Turn-on delay via AC mains

Vin = 520Vac   Load: Io = 16A

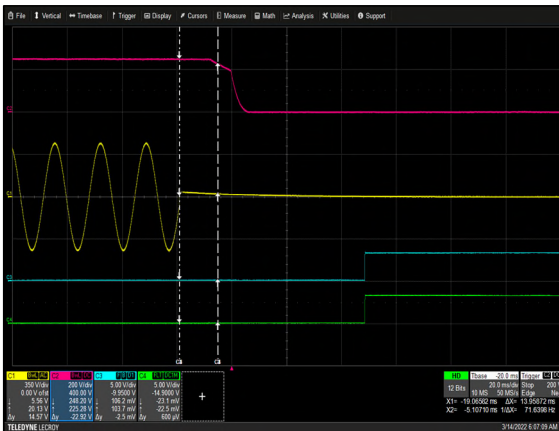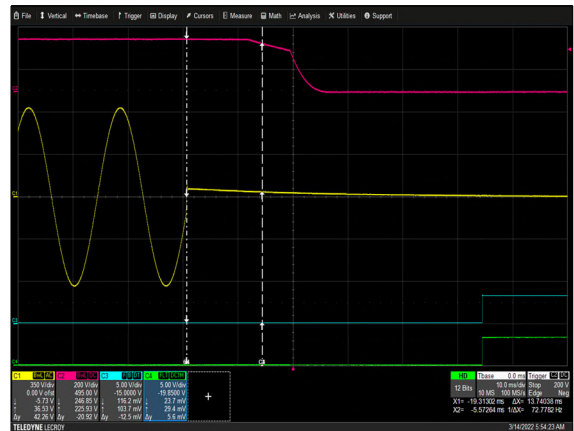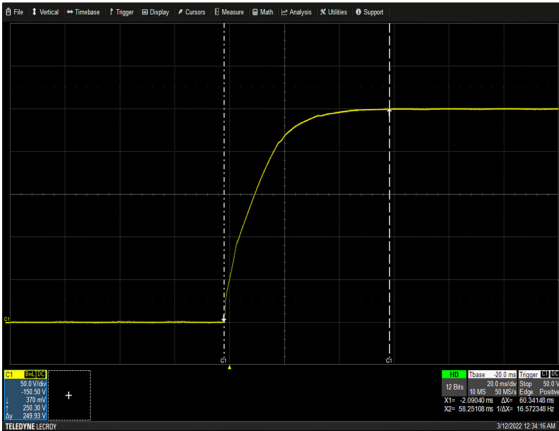Ch 1: Vin   Ch 2: Vo   Ch 3: AC_OK   Ch 4: DC_OK

Figure 3:   LCM4000HV-T Hold-up Time

Vin = 311Vac   Load: Io = 16A

Ch 1: Vin   Ch 2: Vo   Ch 3: AC_OK   Ch 4: DC_OK

Figure 4:   LCM4000HV-T Hold-up Time

Vin = 520Vac   Load: Io = 16A

Ch 1: Vin   Ch 2: Vo   Ch 3: AC_OK   Ch 4: DC_OK

Figure 5:   LCM4000HV-T Output Startup Characteristic
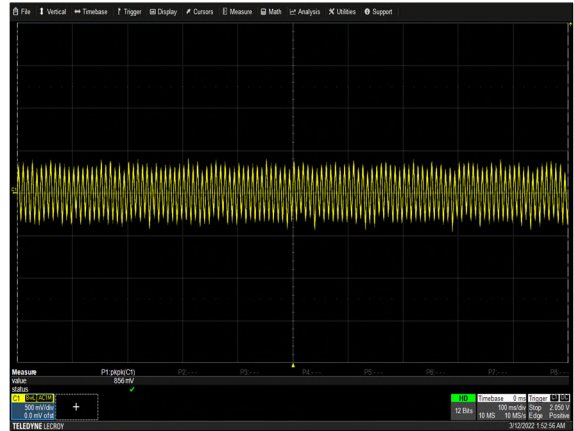
Vin = 311Vac   Load: Io = 16A

Ch 1: Vo

Figure 6:   LCM4000HV-T Ripple and Noise Measurement

Vin = 380Vac   Load: Io = 16A

Ch 1: Vo

ELECTRICAL SPECIFICATIONS

LCM4000HV-T Performance Curves - Voltage Source Mode

Figure 7:   LCM4000HV-T Transient Response - Vo Deviation
50% to 100% load change, 1A/uS slew rate   Vin = 380Vac
Ch 1: Vo   Ch 2: Io

Figure 8:   LCM4000HV-T Transient Response - Vo Deviation
100% to 50% load change, 1A/uS slew rate   Vin = 380Vac
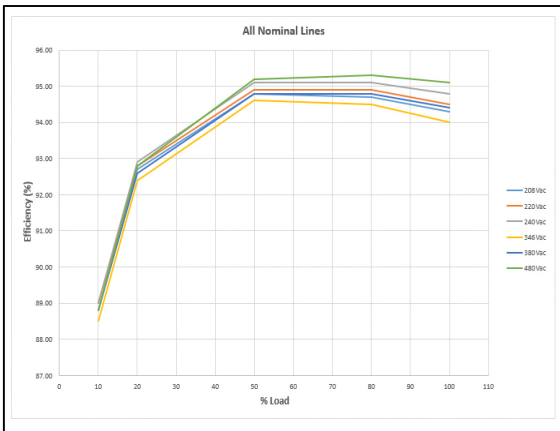Ch 1: Vo   Ch 2: Io

Figure 9:   LCM4000HV-T Efficiency Curve @ 25°C
Vin = 208/220/240/346/380/480Vac
Loading: Io = 10% ~ 100% I$_{o,max}$

ELECTRICAL SPECIFICATIONS

LCM4000HV-T Performance Curves - Current Source Mode
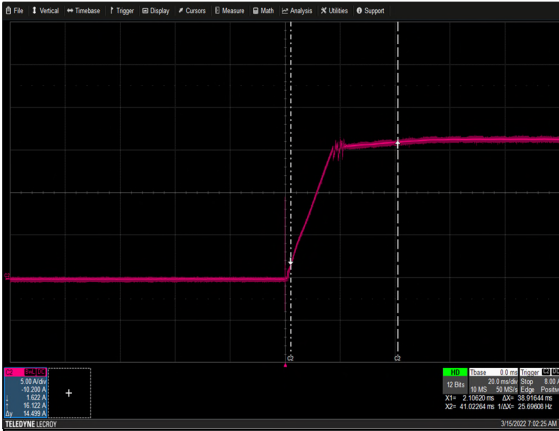

Figure 10:   LCM4000HV-T Output Startup Characteristic

Vin = 311Vac   Load: R = 15.62 ohm

Ch 2: Io

Figure 11:   LCM4000HV-T Ripple and Noise Measurement

Vin = 380Vac   Load: R = 15.62 ohm

Ch 2: Io

ELECTRICAL SPECIFICATIONS

Protection Function Specifications

Input Fuse (Double Line Fusing)

The LCM4000HV series is equipped with internal non user serviceable 20 A, 500 Vac fast acting fuse to protect against catastrophic failures.

Note: '-P' suffix: 2 x 20 A (parallel), '-S' suffix: 20 A.

Over Voltage Protection (OVP)

Voltage Source Mode

The LCM4000HV series power supply latches off during output overvoltage with the AC line recycled to reset the latch.

Parameter	Min	Typ	Max	Unit
Tracking OVP - First level OVP	/	125	/	$\%V_{O,set\ point}$
Brick Wall OVP - Second level OVP	/	130	/	$\%V_{O,max}$

Current Source Mode

The LCM4000HV series power supply is internally protected against output overvoltage.

Parameter	Main Output
First level OVP	Output Voltage Clamp: adjustable up to 120% of nominal output voltage. Recovery is automatic upon clearing of fault.
Second level OVP	Fast Latch Mode: set to 130% (+/- 2%) of nominal output voltage. Recovery needs AC recycle upon clearing of fault.

Over Current Protection (OCP)

Voltage Source Mode

The LCM4000HV series power supply is internally protected against output overcurrent.

Parameter	Main Output
First level OCP	Output Current Clamp: adjustable up to 104% of maximum output current. Recovery is automatic upon clearing of fault.
Second level OCP	Fast Latch Mode: set to 115% (+/- 2%) of maximum output current. Recovery needs AC recycle upon clearing of fault.

ELECTRICAL SPECIFICATIONS

Current Source Mode

The LCM4000HV series power supply latches off during output overcurrent with the AC line recycled to reset the latch.

Parameter	Min	Typ	Max	Unit
Tracking OCP - First level OCP	/	115	/	$\%I_{O,set\ point}$
Brick Wall OCP - Second level OCP	/	120	/	$\%I_{O,max}$

Short Circuit Protection (SCP)

The LCM4000HV series outputs protected from continuous output shorted condition (no damage or reliability issues).
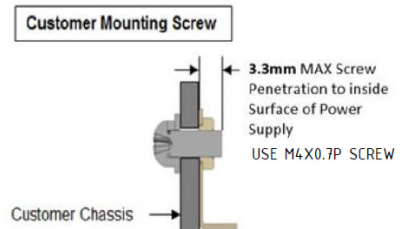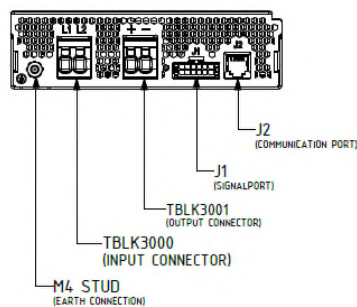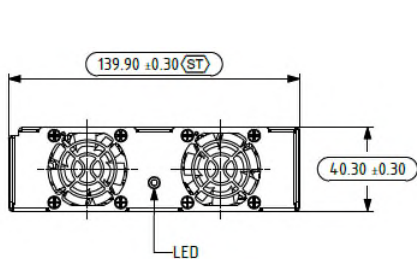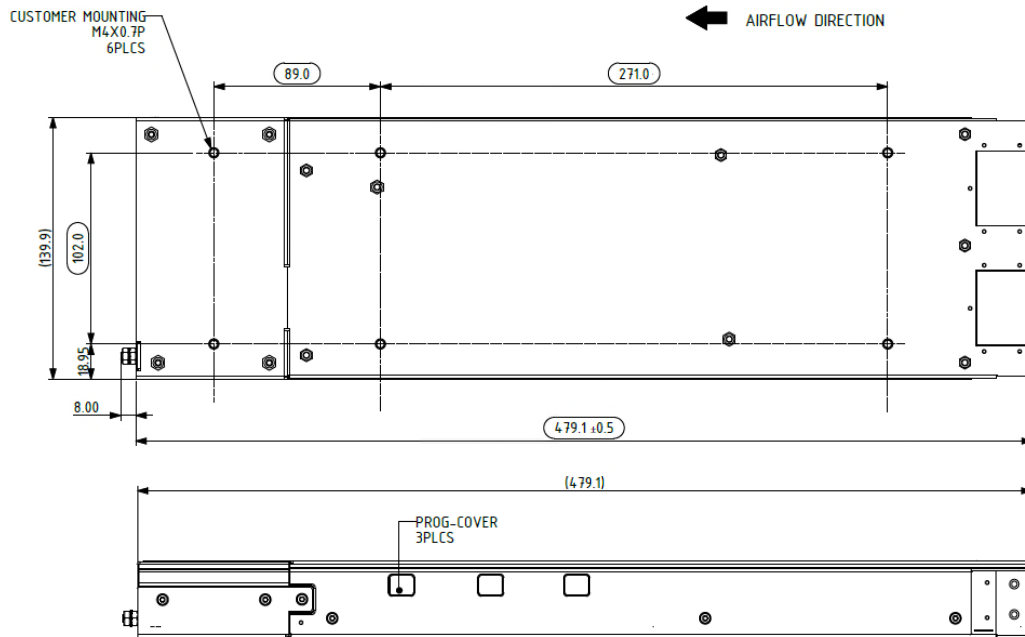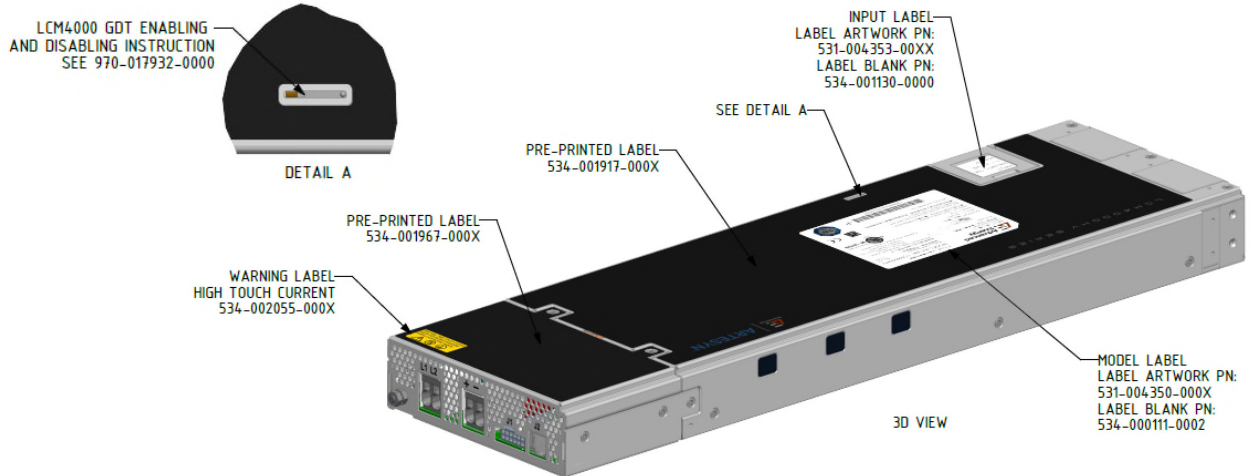
Over Temperature Protection (OTP)

The LCM4000HV series power supply is internally protected against over temperature conditions. When the OTP circuit is activated, the power supply will shut-off and auto-recover once the OTP condition is gone.
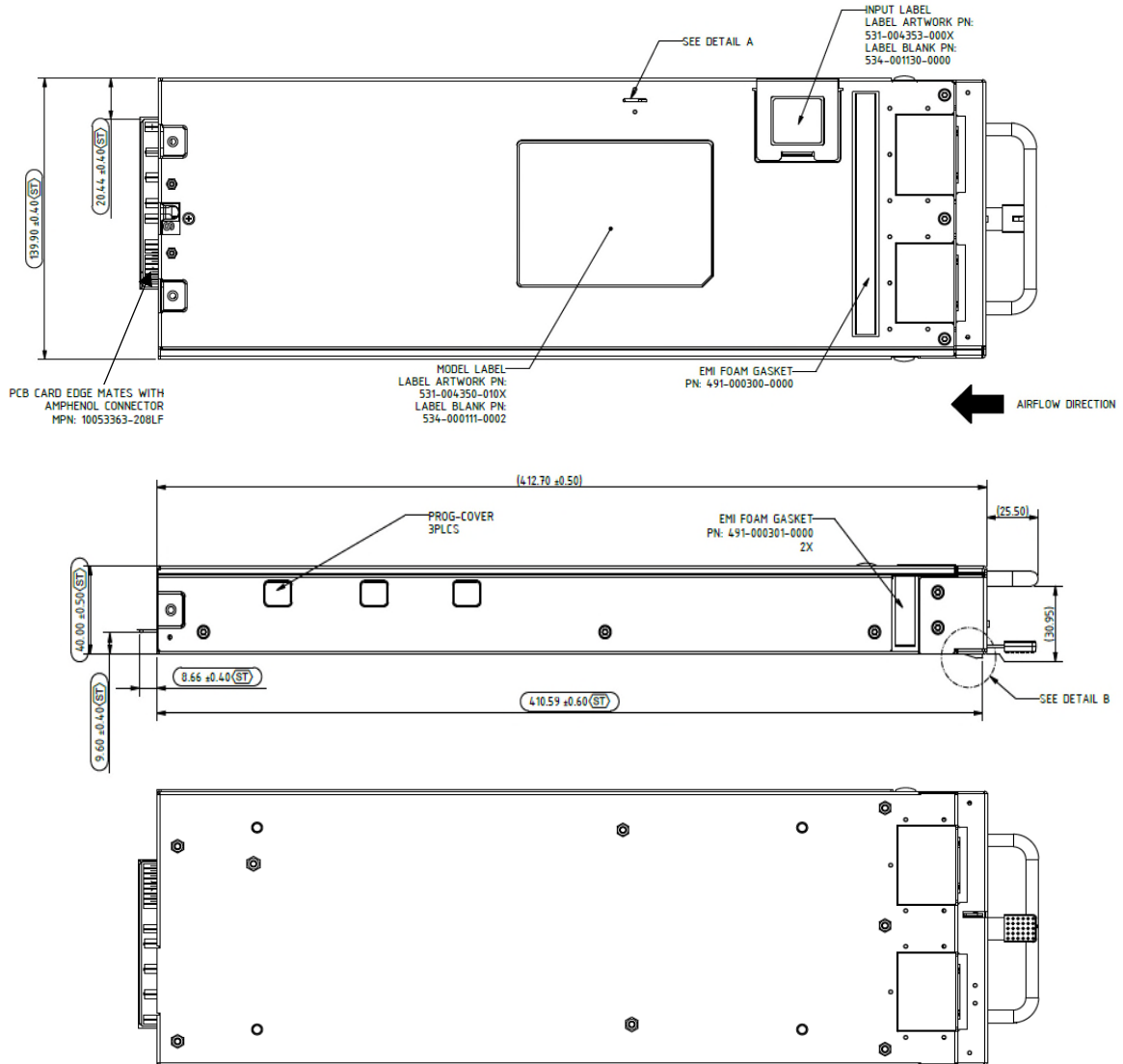
MECHANICAL SPECIFICATIONS

Mechanical Outlines (unit: mm)

LCM4000HV-T: 40.30mm H x 139.90mm W x 479.10mm L

LCM4000 GDT ENABLING
AND DISABLING INSTRUCTION
SEE 970-017932-0000

DETAIL A

INPUT LABEL
LABEL ARTWORK PN:
531-004353-00XX
LABEL BLANK PN:
534-001130-0000

SEE DETAIL A

PRE-PRINTED LABEL
534-001917-000X

PRE-PRINTED LABEL
534-001967-000X

WARNING LABEL
HIGH TOUCH CURRENT
534-002055-000X

MODEL LABEL
LABEL ARTWORK PN:
531-004350-000X
LABEL BLANK PN:
534-000111-0002

3D VIEW

CUSTOMER MOUNTING
M4X0.7P
6PLCS

AIRFLOW DIRECTION

89.0

271.0

139.9

102.0

18.95

8.00

479.1 ±0.5

(479.1)

PROG-COVER
3PLCS

139.90 ±0.30 (ST)

40.30 ±0.30

LED

J2
(COMMUNICATION PORT)

J1
(SIGNALPORT)

TBLK3001
(OUTPUT CONNECTOR)

TBLK3000
(INPUT CONNECTOR)

M4 STUD
(EARTH CONNECTION)

Customer Mounting Screw

3.3mm MAX Screw
Penetration to inside
Surface of Power
Supply

USE M4X0.7P SCREW

Customer Chassis

MECHANICAL SPECIFICATIONS
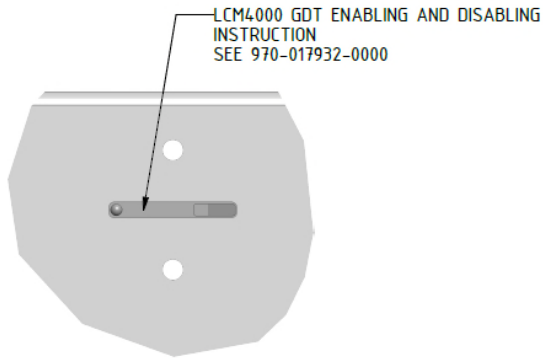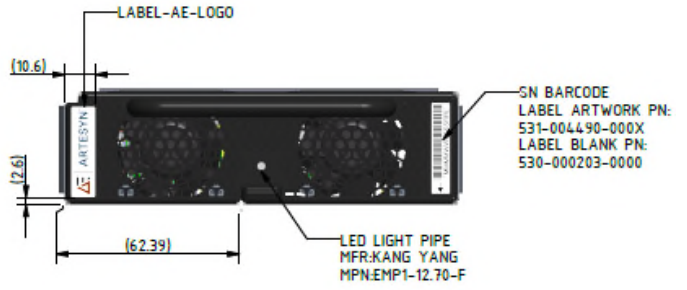
Mechanical Outlines (unit: mm)

LCM4000HV-P (used in LCM12K Power Shelf): 40.00mm H x 139.90mm W x 412.70mm L

MECHANICAL SPECIFICATIONS

LABEL-AE-LOGO

(10.6)

(2.6)

(62.39)

ARTESYN

SN BARCODE
LABEL ARTWORK PN:
531-004490-000X
LABEL BLANK PN:
530-000203-0000

LED LIGHT PIPE
MFR:KANG YANG
MPN:EMP1-12.70-F

LCM4000 GDT ENABLING AND DISABLING
INSTRUCTION
SEE 970-017932-0000

DETAIL A

DTAILL B
SCALE 2:1

1.70 MIN.

Advanced Energy
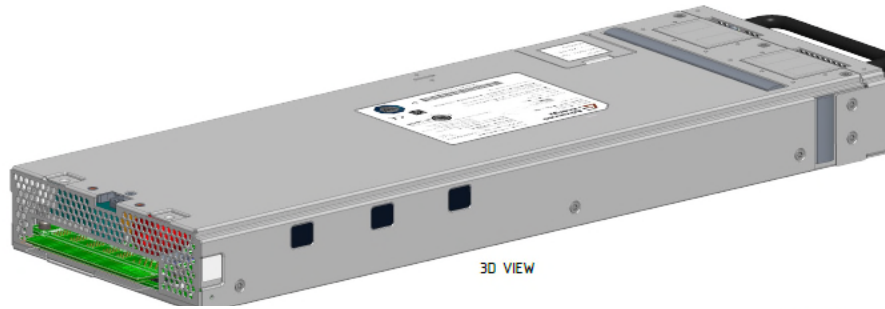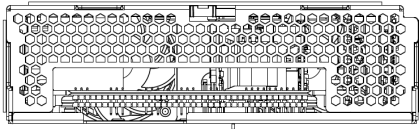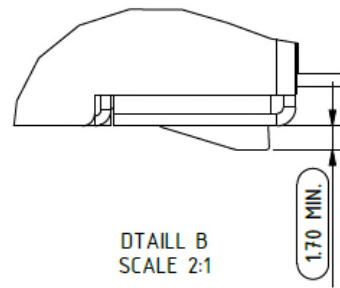
MECHANICAL SPECIFICATIONS
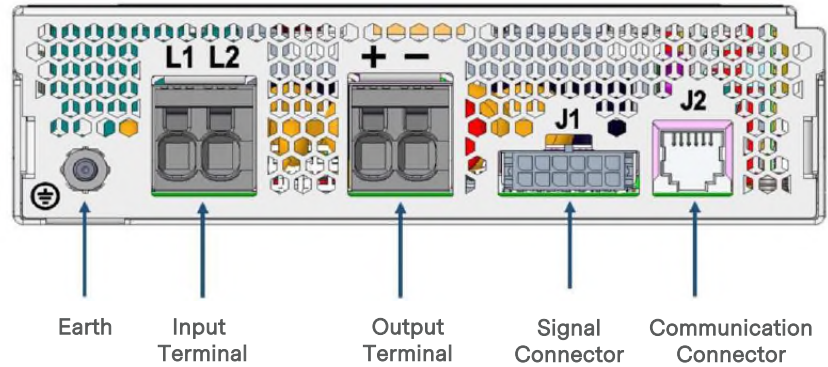
Connector Definitions (LCM4000HV-T)

Input Terminal

L1   – Line1

L2   – Line2

Screw – Earth Ground

Note - For single phase application, the Neutral is connected to either L1 or L2 terminal.

Output Terminal

Main Output (+)

Main Output Return (-)

Signal Connector – J1

Pin 1   – SPARE

Pin 2   – SPARE

Pin 3   – PSU_AC_OK#

Pin 4   – PSU_DC_OK#

Pin 5   – PSU_ALERT#

Pin 6   – PSU_ON#

Pin 7   – ISO_RTN
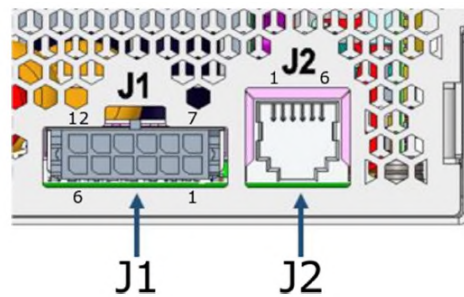
Pin 8   – ISO_RTN

Pin 9   – 5V_ISO

Pin 10 – 0-24V _PROG

Pin 11 – 0-10V_PROG

Pin 12 – ISO_RTN

Communication Connector – J2

Pin 1   – SPARE

Pin 2   – SPARE

Pin 3   – RS485 RTN

Pin 4   – SPARE

Pin 5   – RS485_A_EXT

Pin 6   – RS485_B_EXT

Earth   Input Terminal   Output Terminal   Signal Connector   Communication Connector

Signal and Communication Connector
(J1 & J2)

MECHANICAL SPECIFICATIONS

Power / Signal Mating Connectors and Pin Types

Table 6. Mating Connectors for LCM4000HV-T			
Reference	On Power Supply	Mating Connector or Equivalent	
Input Connector	DINKLE: 0177-8602 PHOENIX CONTACT: 1704746	PANDUIT: FSD78-10-D PHOENIX CONTACT: 3200195	WIRE RANGE: 24~8 AWG RATED VOLTAGE: 600 V RATED CURRENT: 36 A
Output Connector	DINKLE: 0177-8602 PHOENIX CONTACT: 1704746	PANDUIT: FSD78-10-D PHOENIX CONTACT: 3200195	WIRE RANGE: 24~8 AWG RATED VOLTAGE: 600 V RATED CURRENT: 36 A
Earth Ground	M4 Stud		
Signal Connector	MOLEX Micro-fit	MOLEX: 43025-1200 CRIMP TERMINAL: 43030-0002	
Communication Connector	RJ12 (Female)	RJ12 (Male)	

MECHANICAL SPECIFICATIONS

LED Indicator Definitions

One bi-color (blue/amber) LED is provided on the power supply chassis at the end opposite to the input-output connectors. The status LED conditions is shown on the table below.

PSU LED Status

Conditions	LED Status
AC present, main output ON	Solid Blue
Standby mode	Blinking Blue (1s ON; 1s OFF)
Any kind of Fault	Solid Amber
In System Programming	Fast Blinking Blue (0.5s ON; 0.5s OFF)

MECHANICAL SPECIFICATIONS

Weight

The LCM4000HV series weight is shown below.

Module	Weight	
LCM4000HV-T	3316 grams	7.30 lbs.
LCM4000HV-P	2992 grams	6.58 lbs.

ENVIRONMENTAL SPECIFICATIONS

EMC Immunity

The LCM4000HV series are designed to meet the following EMC immunity specifications.

Table 7. Environmental Specifications			
Document	**Description**		
EN55032	Conducted and Radiated EMI limits, Class A		
EN61000-3-11	Voltage Fluctuations		
EN61000-3-12	Power Line Harmonics		
EN61000-4-2	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Electrostatic discharge immunity test. +/-15 kV air, +/-8 kV contact discharge, Criteria B		
EN61000-4-3	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Radiated, radio-frequency, electromagnetic field immunity test. 10 V/m, Criteria A		
EN61000-4-4	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Electrical Fast Transient/Burst Immunity Test. 2 kV for AC power port, Criteria B		
EN61000-4-5	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, 4 kV common mode and 2 kV differential mode for AC ports, Criteria C		
EN61000-4-6	Conducted RF Immunity, Level 3, Criteria A		
EN61000-4-8	Power Frequency Magnetic Field Immunity, Level 3, Criteria A		
EN61000-4-34	Voltage Dips and Interruptions		
	>95% Reduction	0.5 Cycle	Criteria B
	100% Reduction (45° phase angle)	0.5 Cycle	Criteria B
	100% Reduction (0° phase angle)	1 Cycle	Criteria C
	30% Reduction	25/30 Cycle	Criteria C
	30% Reduction (0° phase angle)	25/30 Cycle	Criteria C
	>95% Reduction	250/300 Cycle	Criteria C
	100% Reduction	250/300 Cycle	Criteria C

Note: Performance criteria of EN61000-4-X standards as defined by EN55024:

Performance criterion A: During and after the test, no degradation of performance or loss of function is allowed below a minimum performance level in the EUT specifications.

Performance criterion B: During the test, temporary degradation of performance is allowed which is self-recoverable, without change in operating state. After the application of the disturbance, no degradation of performance or loss of function is allowed.

Performance criterion C: During and after the test, temporary loss of function is allowed which is self-recoverable.

ENVIRONMENTAL SPECIFICATIONS

Safety Certifications

The LCM4000HV series are intended for inclusion in other equipment and the installer must ensure that it is in compliance with all the requirements of the end application. This product is only for inclusion by professional installers within other equipment and must not be operated as a standard alone product.

| Table 8. Safety Certifications for LCM4000HV Series Power Supply System		
Standard	**Agency**	**Description**
UL/CSA 62368-1	UL + CSA	US and Canada Requirements
EN 62368-1	TUV	European Requirements
IEC 60950-1, IEC 62368-1	CB Scheme	International Electrotechnical Commission
CE (LVD + RoHS)		European Requirements
UKCA Mark		UK Requirements

ENVIRONMENTAL SPECIFICATIONS

EMI Emissions

The LCM4000HV series has been designed to comply with the Class A limits of EMI requirements of EN55032 for emissions and relevant sections of EN61000 (IEC 61000) for immunity. The unit is tested at 4000 W load.

Conducted Emissions

The applicable standard for conducted emissions is EN55032. 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.
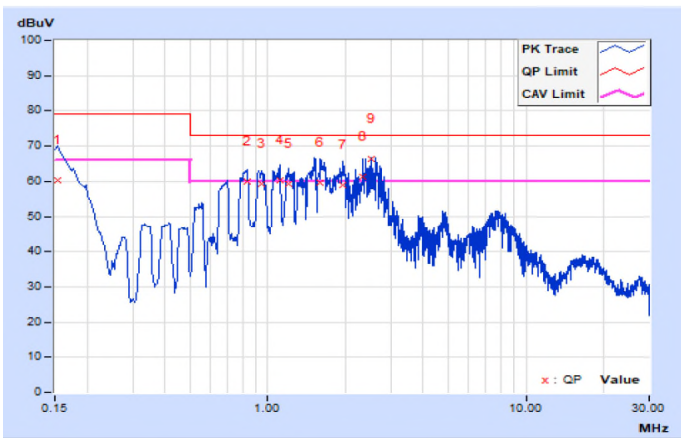
The LCM4000HV series has internal EMI filters to ensure the convertors' conducted EMI levels comply with EN55032 Class A limits. The EMI measurements are performed with resistive loads at maximum rated loading.

Sample of EN55032 Conducted EMI Measurement at 400 Vac single phase input.

ENVIRONMENTAL SPECIFICATIONS

Radiated Emissions

Unlike conducted EMI, radiated EMI performance in a system environment may differ drastically from that in a stand-alone power supply. The shielding effect provided by the system enclosure may bring the EMI level from Class A to Class B. It is thus recommended that radiated EMI be evaluated in a system environment. The applicable standard is EN55032 Class A. Testing ac-dc convertors as a stand-alone component to the exact requirements of EN55032 can be difficult, because the standard calls for 1 m 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 LCM4000HV series power supplies can start and operate within the stated specifications at an ambient temperature from $0^{O}C$ to $50^{O}C$ under all load conditions with internal fan (full performance). Above $50^{O}C$ to $60^{O}C$, the output power will be derated to 3200 W.

Forced Air Cooling

The LCM4000HV series power supplies will operate with forced air. Fan noise < 65 dBA with 70% load @ $30^{O}C$. The fan speed is internally controlled by the PSU and will vary depending on its internal thermal sense circuit. The worse case fan noise will not exceed 75 dBA (average).

Ambient Temp	Loading Condition	Fan Noise
≤ $30^{O}C$	70%	< 65 dBA (average)

Note: To aide in dust control, fans will be turned off when the main output is off.

DLC Life Projection Data

In accordance with DLC technical requirements for LED-based Horticultural Lighting V2.1 "Special Considerations for DC-Powered Fixtures", operating assumptions and certified test data are provided below:

Model: LCM4000HV-T
Description: 380/480 Vac nominal input with 4000 W output power and output voltage of 300 Vdc.
Measured Efficiency: 92.72% @ 380 Vac nominal input with 100% loading on the output. T_{amb}=$25^{O}C$
    94.05% @ 480 Vac nominal input with 100% loading on the output. T_{amb}=$25^{O}C$
Operating Temp Range: 0 to $45^{O}C$. for Horticulture Lighting Applications
Power Factor: 0.99
Total Harmonic Distortion: Meets IEC 61000-3-12 requirements
Warranty: 5 years

Driver ISTMT thermal measurement points and Product Lifetime:

Max. Measured Temperature (^{o}C)		Measured at Input & Output Terminal Block (+/-$2^{o}C$)	
@ Air Inlet Ambient		480VAC	380VAC
	$50^{o}C$	$66.63^{o}C$	$68.41^{o}C$
	$45^{o}C$	$61.31^{o}C$	$62.75^{o}C$
	$40^{o}C$	$55.94^{o}C$	$57.29^{o}C$
	$35^{o}C$	$50.66^{o}C$	$51.85^{o}C$
	$30^{o}C$	$46.05^{o}C$	$46.39^{o}C$
Note: Temperature probe placed in front of each fan		Note: Data is the reference max. temperature for any one (1) location. Probe placed on Input & Output terminal blocks.	
Operating Altitude		Sea Level	

ENVIRONMENTAL SPECIFICATIONS

On Terminal Block

25mm

⊕ Temperature Probe, placed in front of each Fan and on Input & Output Terminal Block
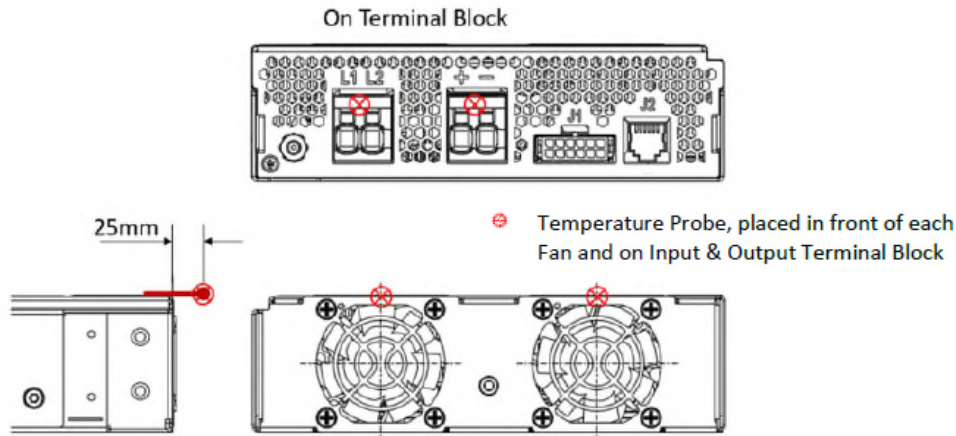
System CMTBF

Inlet Temperature (°C)	Outlet Temperature (°C)	System Projected Life (Years)
50	62.9 to 68.4	8.90
45	57.4 to 62.8	12.60
40	41.0 to 57.3	15.00
35		15.00
30		15.00
25		15.00
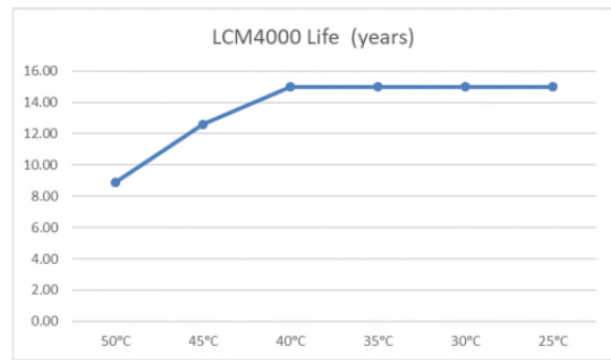
Note: Electrolytic Capacitors are components that define the life limit of product (and system configuration). For this calculation, life depends much on temperature and not on input voltage.

Mechanical Detail

Airflow Direction

Legend:
⊗ Temperature probe locations
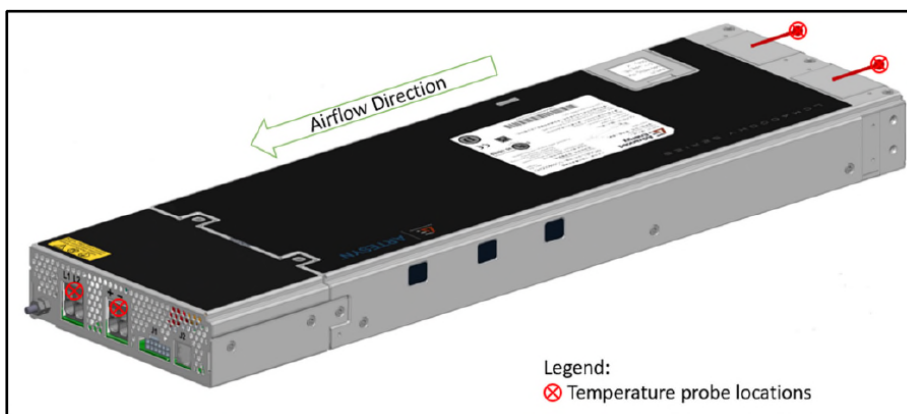
Note: Front & Rear of Power Supply should maintain minimum 100 mm clearance to nearest wall or obstruction.

ENVIRONMENTAL SPECIFICATIONS

Storage and Shipping Temperature

The LCM4000HV series can be stored or shipped at temperatures between -40°C to +85°C.

Altitude

The LCM4000HV series will operate within specifications at altitudes up to 9,842 feet (3,000 meters) above sea level. The power supply shall not be damaged when stored at altitudes of up to 30,000 feet (9,144 meters) above sea level.

Humidity

The LCM4000HV series will operate within specifications when subjected to a relative humidity from 20% to 90% non-condensing. The LCM4000HV series can be stored in a relative humidity from 10% to 95% non-condensing.

Vibration

The LCM4000HV series will pass the following vibration specifications:

Non-Operating Random Vibration

Acceleration	1.87		gRMS
Amplitude	3		mm
Frequency Range	10 - 500		Hz
Duration	30		Mins
Direction	3 mutually perpendicular axis		
PSD Profile	FREQ (Hz)	SLOPE (db/oct)	PSD (g²/Hz)
	10	/	0.01
	200	-2.66	0.01
	500	/	0.003

Operating Random Vibration

Acceleration	0.15		gRMS
Amplitude	1.5		mm
Frequency Range	5 - 100		Hz
Duration	30		Mins
Direction	3 mutually perpendicular axis		
PSD Profile	FREQ (Hz)	SLOPE (db/oct)	PSD (g²/Hz)
	5	11	0.000025
	10 - 50	/	0.0004
	100	10	0.000025

ENVIRONMENTAL SPECIFICATIONS

Shock

The LCM4000HV series will pass the following shock specifications:

Non-Operating Half-Sine Shock

Acceleration	12	G
Duration	11	mSec
Pulse	Half-Sine	
Number of Shock	10 shocks for each of the three axes	

Operating Half-Sine Shock

Acceleration	6	G
Duration	11	mSec
Pulse	Half-Sine	
Number of Shock	5 shocks for each of the three axes	

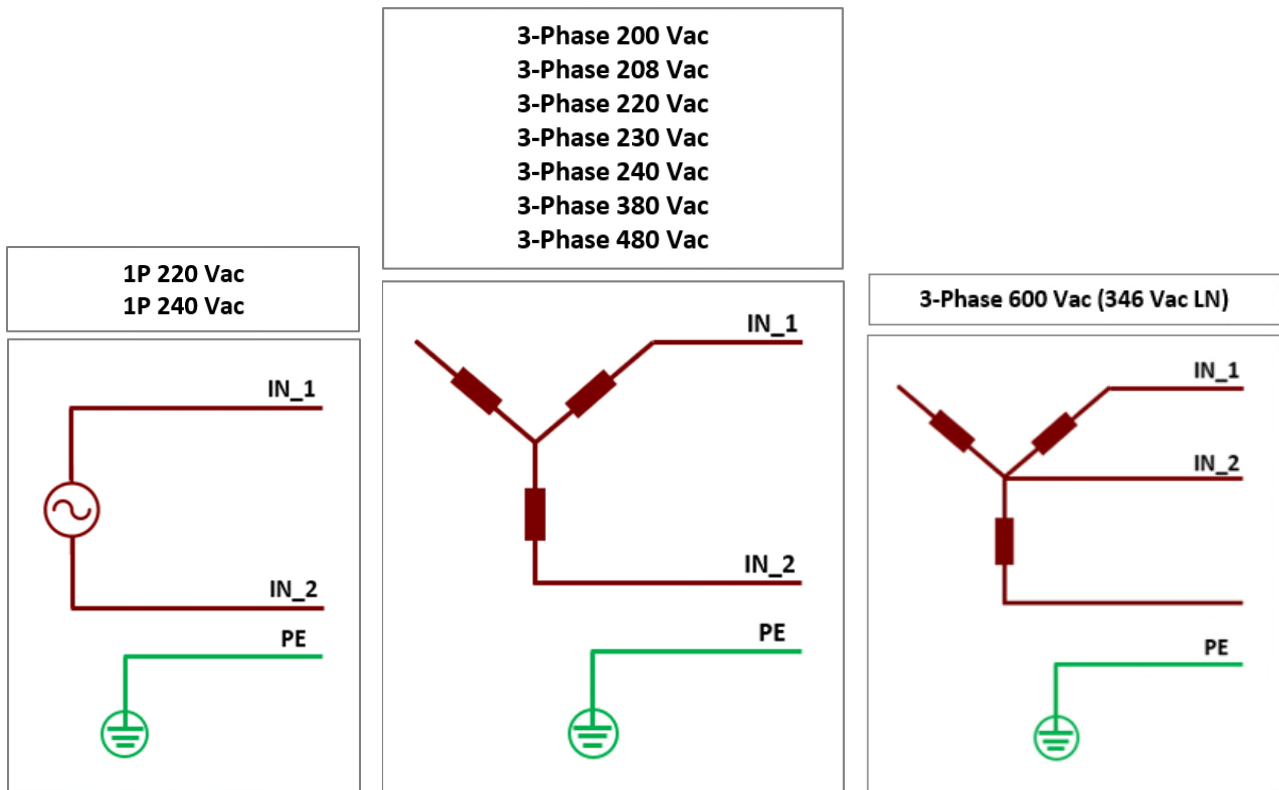# POWER AND CONTROL SIGNAL DESCRIPTIONS

Input Terminal

This connector supplies the AC Mains to the LCM4000HV series power supply.

L1   – Line1

L2   – Line2

Screw – Earth Ground

PSU Input Voltage	
Nominal	Range
200 Vac	180 to 220 Vac
208 Vac	187 to 229 Vac
220 Vac	198 to 242 Vac
230 Vac	207 to 253 Vac
240 Vac	216 to 264 Vac
346 Vac	311 to 381 Vac
380 Vac	342 to 418 Vac
480 Vac	432 to 528 Vac

LCM4000HV

IN_1   OUT+

IN_2   RTN

PE   SIGNALS   Non-Digital LED Dimming Functions

COMMS   RS485 Modbus

3-Phase 200 Vac
3-Phase 208 Vac
3-Phase 220 Vac
3-Phase 230 Vac
3-Phase 240 Vac
3-Phase 380 Vac
3-Phase 480 Vac

1P 220 Vac
1P 240 Vac

IN_1

IN_2

PE

IN_1

IN_2

PE

3-Phase 600 Vac (346 Vac LN)

IN_1

IN_2

PE
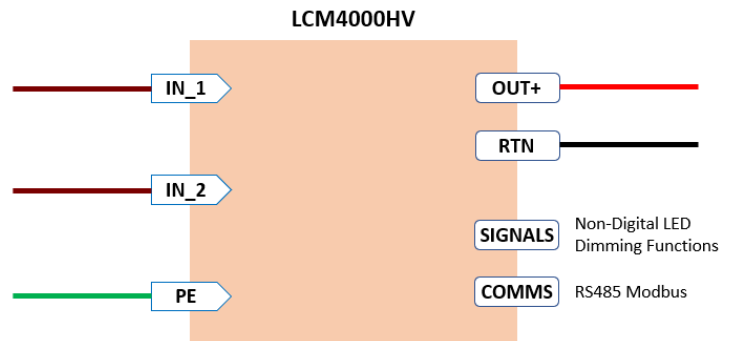
POWER AND CONTROL SIGNAL DESCRIPTIONS

Output Terminal

This connector provides the main output for the LCM4000HV series power supply.

Main Output (+)

Main Output Return (-)

Signal Connector - J1

This connector is a 12-pin control signal header.

PSU_AC_OK# (Pin 3)

Active LOW signal. Indicates that the input supply voltage is within allowable limits and the power supply can use and turn on. Internally pulled up to 3V_ISO via 10k ohm resistor.

PSU_DC_OK# (Pin 4)

Active LOW signal. Indicates that the main output is within the regulation band. Internally pulled up to 3V_ISO via 10k ohm resistor.

PSU_ALERT# (Pin 5)

Active LOW signal. Indicates that there is a fault present in the PSU. Internally pulled up to 3V_ISO via 10k ohm resistor.

PSU_ON# (Pin 6)

Active LOW signal as default. Controls the main output of PSU on and off. Internally pulled up to 3V_ISO via 10k ohm resistor.
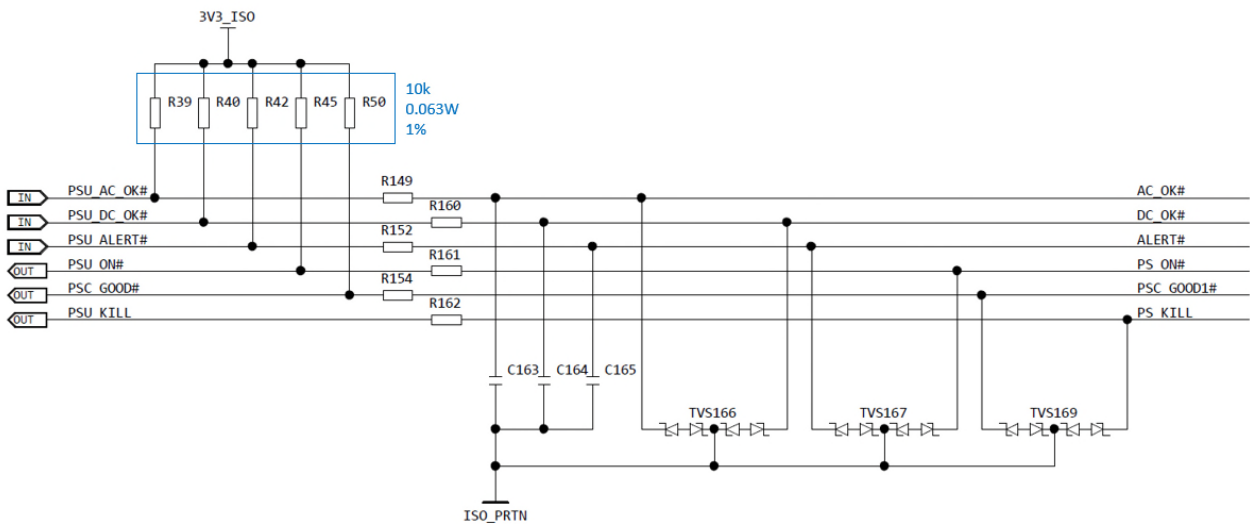
POWER AND CONTROL SIGNAL DESCRIPTIONS

5V_ISO (Pin 9)

5V standby power.

0-24V _PROG (Pin 10)

An analog programming command that accepts a DC voltage up to 24V (with respect to ISO_RTN) in order to adjust the output voltage or current. Please refer to 'Output Adjustability and Programmability' section for details.

0-10V_PROG (Pin 11)

An analog programming command that accepts a DC voltage up to 10V (with respect to ISO_RTN) in order to adjust the output voltage or current. Please refer to 'Output Adjustability and Programmability' section for details.

ISO_RTN (Pin 7, Pin 8 & Pin 12)

The isolated signal return (or ground).

Communication Connector - J2

RS485_A_EXT (Pin 5)

Communication lines for RS485 Modbus Protocol.

RS485_B_EXT (Pin 6)

Communication lines for RS485 Modbus Protocol.

RS485 RTN (Pin 3)

Communication lines RTN for RS485 Modbus Protocol.

MODBUS SPECIFICATIONS

The LCM4000HV series is compliant with the MODBUS application protocol for monitoring and control of the power supply via the RS485 communication port.

LCM4000HV Series MODBUS General Instructions

Equipment Setup

The following is typical RS485 MODBUS communication setup:
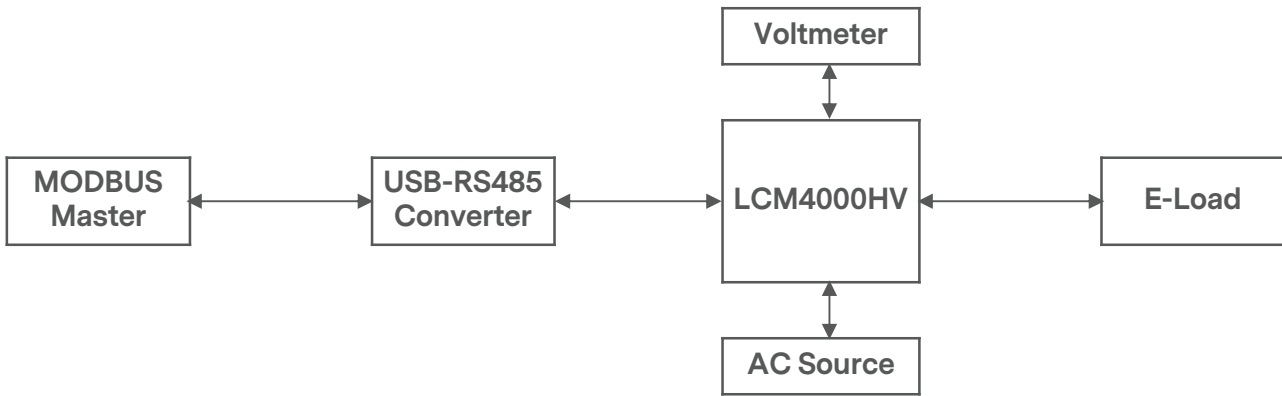
Serial Configuration

The Baud Rate (Data Rate) can be set by the MODBUS register (0xAB).

Parameter	Settings
Data Rate	115200 (Default)
Data Bits	8
Parity	Even
Stop Bits	1
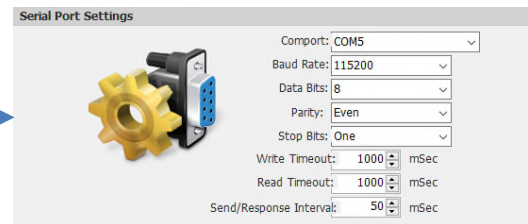
The Data Rate is configurable using the Baud Rate Config Register (0xAB).

Register Address 0xAB	
Value (Hex)	Baud Rate Configuration
0	9600
1	19200
2	38400
3	115200 (Default)

MODBUS SPECIFICATIONS

Device Addressing

The Default MODBUS Address configuration is 0xE0.

Register Address 0xAA			
Hex	Decimal	Hex	Decimal
0xE0	224	0xF0	240
0xE1	225	0xF1	241
0xE2	226	0xF2	242
0xE3	227	0xF3	243
0xE4	228	0xF4	244
0xE5	229	0xF5	245
0xE6	230	0xF6	246
0xE7	231	0xF7	247
0xE8	232	0xF8	248
0xE9	233	0xF9	249
0xEA	234	0xFA	250
0xEB	235	0xFB	251
0xEC	236	0xFC	252
0xED	237	0xFD	253
0xEE	238	0xFE	254
0xEF	239	0xFF	255

CRC Checking

The PSU includes an error-checking field that is based on a Cyclical Redundancy Checking (CRC) method performed on the message contents. Details are found in "MODBUS over Serial Line Specification and Implementation Guide" V1.02 document section 2.5.1.2 CRC Checking.

Error Handling

The PSU will report MODBUS error codes if the request command is invalid. Details are found in "MODBUS over Serial Line Specification and Implementation Guide" V1.02 document section 7 MODBUS Exception Responses.

Error Code	Description
01	Illegal Function
02	Illegal Data Address
03	Illegal Data Value
04	Slave Device Failure

MODBUS SPECIFICATIONS

Reporting Accuracy

Parameter Type	Reporting Function	Hex Address	Command Name	Accuracy Range	
				0% to 20% Load	20% to 100% Load
Output	Output Voltage	0xB0	PSU_OUTPUT_VOLTAGE	±2%	±2%
Output	Output Current	0xB1	PSU_OUTPUT_CURRENT	Fixed±3% of rated max output current	±3%
Output	Output Power	0xB2	PSU_OUTPUT_POWER	Fixed±5% of rated max output power	±5%
Input	Input Voltage	0xB4	PSU_INPUT_VOLTAGE	No requirements	±5%
Input	Input Current	0xB5	PSU_INPUT_CURRENT	No requirements	±10%
Input	Input Power	0xB6	PSU_INPUT_POWER	No requirements	±10%
Thermal	Temperature	0xB7	PSU_TEMP1 – FWD FWL1	±5°C	
Thermal	Temperature	0xB8	PSU_TEMP2 – FWD FWL2	±5°C	
Thermal	Temperature	0xB9	PSU_TEMP3 – TRF1	±5°C	
Thermal	Temperature	0xBA	PSU_TEMP4 – TRF2	±5°C	
Thermal	Temperature	0xBB	PSU_TEMP0 – BOOST	±5°C	
Thermal	Temperature	0xBC	PSU_TEMP5 – AUXILLARY	±5°C	
Thermal	Temperature	0xBD	PSU_TEMP6 – AMBIENT	±5°C	

SAVE_COMMAND [W]

The SAVE_COMMAND (0x8A) is used to manually save the following registers. Write 0x01 to execute SAVE_COMMAND.

Hex Address	Data
0x80	PSU_OUTPUT_OV_MULTIPLIER
0x81	PSU_OUTPUT_OC_MULTIPLIER
0xAB	BAUD_RATE_CONFIG

MODBUS SPECIFICATIONS

The LCM4000HV Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
70h	STATUS_WORD	-	R	2	Bitmapped	Summary of the unit's fault condition.
	b15 - VOUT					Asserts when any of the bit is set in STATUS_VOUT register.
	b14 - IOUT					Asserts when any of the bit is set in STATUS_IOUT register.
	b13 - INPUT					Asserts when any of the bit is set in STATUS_INPUT register.
	b12 - MFR_SPECIFIC					Asserts when any of the bit is set in STATUS_MFR_SPECIFIC register.
	b11					
	b10 - FANS					Asserts when any of the bit is set in STATUS_FAN_1_2 register.
	b9					
	b8					
	b7					
	b6					
	b5					
	b4					
	b3					
	b2 - TEMPERATURE					Asserts when any of the bit is set in STATUS_TEMPERATURE register.
	b1					
	b0					
71h	STATUS_INPUT	-	R	2	Bitmapped	
	b15					
	b14					
	b13					
	b12					
	b11					
	b10					
	b9					
	b8					
	b7 - VIN_OV_FAULT					Asserts when there is an Input Overvoltage Fault. Auto recoverable.
	b6					
	b5					
	b4 - VIN_UV_FAULT					Asserts when there is an Input Under Voltage Fault. Auto recoverable.
	b3					
	b2 - IIN_OC_FAULT					Asserts when there is an Input Overcurrent Fault. Auto recoverable.
	b1					
	b0					

MODBUS SPECIFICATIONS

The LCM4000HV Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
72h	STATUS_VOUT	-	R	2	Bitmapped	
	b15 - VOUT_SC_FAULT					Asserts when there is an Output Short Circuit Fault. This Can be cleared by Input Power Recycle.
	b14					
	b13					
	b12					
	b11					
	b10					
	b9					
	b8					
	b7 - VOUT_OV_FAULT					Asserts when there is an Output Overvoltage Fault. This Can be cleared by Input Power Recycle.
	b6					
	b5					
	b4 - VOUT_UV_FAULT					Asserts when there is an Output Under Voltage Fault at Voltage Source Mode. This Can be cleared by Input Power Recycle.
	b3					
	b2 - TON_MAX_FAULT					Device is unable to reach the target output within the stated power up time. This Can be cleared by Input Power Recycle.
	b1					
	b0					
73h	STATUS_IOUT	-	R	2	Bitmapped	
	b15:8					
	b7 - IOUT_OC_FAULT					Asserts when there is an Output Overcurrent Fault. This Can be cleared by Input Power Recycle.
	b6 - IOUT_OC_LV_FAULT					Asserts when there is an Output Overpower Fault at Current Source Mode. This Can be cleared by Input Power Recycle.
	b5					
	b4					
	b3					
	b2					
	b1					
	b0					

MODBUS SPECIFICATIONS

The LCM4000HV Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
74h	STATUS_MFR_SPECIFIC	-	R	2	Bitmapped	
	b15					
	b14 - BOOST_SCP					Any of the two Bulk output voltage below short circuit protection level. This Can be cleared by Input Power Recycle.
	b13 - BOOST_OVP2					Bulk Voltage 2 is above overvoltage protection level. This Can be cleared by Input Power Recycle.
	b12 - BOOST_OVP1					Bulk Voltage 1 is above overvoltage protection level. This Can be cleared by Input Power Recycle.
	b11 - BOOST_DIFF_PROT					An event when there is a significant difference between VBulk1 and VBulk2 Regulation. This Can be cleared by Input Power Recycle.
	b10 - BOOST_UVP2					Bulk voltage 2 is below under voltage protection level. This Can be cleared by Input Power Recycle.
	b9 - BOOST_UVP1					Bulk voltage 1 is below under voltage protection level. This Can be cleared by Input Power Recycle.
	b8 - BOOST_GOOD					A Bulk voltage at nominal voltage threshold
	b7 - ISO_SUPPLY_MON					Sticky Flag. Asserted by an external ISO digital input.
	b6 - DCDC_SUPPLY_MON					Sticky Flag. Asserted by an external DCDC digital input.
	b5 - BOOST_SUPPLY_MON					Sticky Flag. Asserted by an external BOOST Digital input.
	b4					
	b3 - MAIN_RAIL_ IMBALANCE_PROT					Rail imbalance protection. This Can be cleared by Input Power Recycle.
	b2 - PRIMARY_OC_FAULT					Primary Overcurrent Fault. Auto recoverable.
	b1 - INPUT CONFIG					1 - Input Is Parallel Configuration 0 - Input Is Series Configuration
	b0					

MODBUS SPECIFICATIONS

The LCM4000HV Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
76h	STATUS_TEMPERATURE	-	R	1	Bitmapped	
	b15 - BOOST_FET_OT_FAULT					Primary Boost Temperature is above Over temperature fault limit. Auto recoverable.
	b14 - DCDC_FWD_FREEWHEEL2_ OT_FAULT					Secondary DCDC Forward 2 Temperature is above Over temperature fault limit. Auto recoverable.
	b13 - DCDC_FWD_FREEWHEEL1_ OT_FAULT					Secondary DCDC Forward 1 Temperature is above Over temperature fault limit. Auto recoverable.
	b12 - DCDC_TRF2_OT_FAULT					Secondary DCDC TRF2 Temperature is above Over temperature fault limit. Auto recoverable.
	b11 - DCDC_TRF1_OT_FAULT					Secondary DCDC TRF1 Temperature is above Over temperature fault limit.
	b10 - AUXILIARY_OT_FAULT					ISO Auxiliary Temperature is above Over temperature fault limit Auto recoverable.
	b9 - AMBIENT_OT_FAULT					ISO Ambient Temperature is above Over temperature fault limit Auto recoverable.
	b8					
	b7 - OT_FAULT					Asserts when any of the bit [15:9] in STATUS_TEMPERATURE register is set. Auto recoverable.
	b6					
	b5					
	b4					
	b3					
	b2					
	b1					
	b0					

MODBUS SPECIFICATIONS

The LCM4000HV Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
77h	STATUS_FANS_1_2	-	R	2	Bitmapped	Report the status of any fans installed in position 1 or position 2.
	b15					
	b14					
	b13					
	b12					
	b11					
	b10					
	b9					
	b8					
	b7 - FAN_1_FAULT					Fan 1 failed completely or not able to provide the target RPM to cool the device. Auto recoverable.
	b6 - FAN_2_FAULT					Fan 2 failed completely or not able to provide the target RPM to cool the device. Auto recoverable.
	b5					
	b4					
	b3 - FAN_1_SPEED_OVERRIDDEN					
	b2 - FAN_2_SPEED_OVERRIDDEN					
	b1					
	b0					

MODBUS SPECIFICATIONS

The LCM4000HV Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
84h	OPERATION	-	R/W	2		Used to turn the device on and off.
	b15					
	b14					
	b13					
	b12					
	b11					
	b10					
	b9					
	b8					
	b7 - ON					0 - PSU Off 1 - PSU On
	b6					
	b5					
	b4					
	b3					
	b2					
	b1					
	b0					
87h	MODULE_CONFIG	-	R/W	2		Used to configure the module.
	b15					
	b14					
	b13					
	b12					
	b11					
	b10					
	b9					
	b8					
	b7					
	b6					
	b5					
	b4					
	b3 - OPERATION MODE					0 - Voltage Source Mode 1 - Current Source Mode
	b2					
	b1 - REMOTE MODE					0 - GUI Mode 1 - Remote Mode
	b0					

MODBUS SPECIFICATIONS

The LCM4000HV Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
88h	MODULE_OPERATION	-	R/W	2		Used to enable/disable the module configuration.
	b15					
	b14					
	b13					
	b12					
	b11					
	b10					
	b9					
	b8					
	b7					
	b6					
	b5					
	b4					
	b3					
	b2					
	b1					
	b0 - Enable Module Configuration					0 - Disable Configuration (This will turn on the PSU). 1 - Enable Configuration (This will turn off the PSU).

MODBUS SPECIFICATIONS

The LCM4000HV Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Size in Word	Data Format	Description
00h	PSU_MODEL_ID	-	R	2	ASCII	Default: "N743"
02h	PSU_MFR_MODEL	-	R	10	ASCII	Default: "LCM4000HV-T"
0Ch	PSU_MFR_LOCATION	-	R	10	ASCII	Default: "LAGUNA"
16h	PSU_MFR_DATE	-	R	4	ASCII	Default: "WW/YYYY"
1Ah	PSU_MFR_SERIAL	-	R	10	ASCII	Default: "SSSSS"
24h	PSU_HW_REVISION	-	R	2	ASCII	Default: "ZZZ"
26h	PSU_FW_REVISION	-	R	9	ASCII	Default: "00.00.00.00.00.00"
38h	PSU_CALIB_DATE	-	R	3	ASCII	Default: "YYMMDD"
3Bh to 6Fh	RESERVED FOR MFR SPECIFIC RELATED COMMANDS					
75h	RESERVED FOR STATUS MONITORING COMMANDS					
78h to 7Fh	RESERVED FOR STATUS MONITORING COMMANDS					
80h	PSU_OUTPUT_OV_MULTIPLIER	-	R/W	1	x1	Default: 115% Range: 105% to 115%
81h	PSU_OUTPUT_OC_MULTIPLIER	-	R/W	1	x1	Default: 120% Range: For Latch Protection: 50% to 120%
82h	FAN1 RPM OVERRIDE	-	R/W	1	x1	Default: 0% Range: 0% to 100%
85h	VREF_TRIM	-	R/W	1	x100	Default: 250V Range: 100V to 300V (VREF_MAX_LIMIT)
86h	IREF_TRIM (Unit will turn off if IREF_TRIM is set between 0A to 0.48A)	-	R/W	1	x100	Voltage Source Mode: Default: 16.64A Range: 0.48A to 16.64A (IREF_MAX_LIMIT) Current Source Mode: Default: 0.48A Range: 0.48A to 16.12A (IREF_MAX_LIMIT)
8Bh	DSP_PROG_RESCALE_PROFILE	-	R/W	1	-	Default: 0x00 - Default Profile 0x01 - (Profile 1) 0x02 - (Profile 2) 0x03 - (Profile 3)
8Ch	VPROG_RESCALE_MIN	-	R/W	1	x100	Default: 100V Range: 100V to 300V
8Dh	VPROG_RESCALE_MAX	-	R/W	1	x100	Default: 300V Range: VPROG_RESCALE_MIN to 300V
8Eh	VPROG_RESCALE_PT1	-	R/W	1	x100	Default: Varies Range: VPROG_TURN_ON_POINT to 10V
8Fh	VPROG_RESCALE_PT2	-	R/W	1	x100	Default: Varies Range: VPROG_RESCALE_PT1 to 10V
90h	VPROG_TURN_ON_POINT	-	R/W	1	x100	Default: 0.48V Range: 0.48V to 10V
91h	IPROG_RESCALE_MIN	-	R/W	1	x100	Default: 0.48A Range: 0.48A to 16A
92h	IPROG_RESCALE_MAX	-	R/W	1	x100	Default: 16A Range: IPROG_RESCALE_MIN to 16A

MODBUS SPECIFICATIONS

The LCM4000HV Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Size in Word	Data Format	Description
93h	IPROG_RESCALE_PT1	-	R/W	1	x100	Default: Varies Range: IPROG_TURN_ON_POINT to 10V
94h	IPROG_RESCALE_PT2	-	R/W	1	x100	Default: Varies Range: IPROG_RESCALE_PT2 to 10V
95h	IPROG_TURN_ON_POINT	-	R/W	1	x100	Default: 0.48V Range: 0.48V to 10V
96h	IO_POLARITY	-	R/W	1	-	Default: 0x01 - Disabled Standalone Mode 0x02 - Enable Standalone Mode Range: 0x00 to 0x03
97h	VREF_MAX_LIMIT	-	R/W	1	x100	Default: 300V Range: 100V to 300V (Auto save in Non Volatile Memory after Writing)
98h	IREF_MAX_LIMIT	-	R/W	1	x100	Default: 16.64A Range: 0.48A to 16.64A (Auto save in Non Volatile Memory after Writing)
99h to A9h	RESERVED FOR CONFIGURABLE RELATED COMMANDS					
AAh	DEVICE_ADDRESS	-	R/W	1	-	Default: 224 (0xE0) Range: 224 (0xE0) to 255 (0xFF)
ABh	BAUD_RATE_CONFIG	-	R/W	1	-	
ACh	DROOP_ENABLE	-	R/W	1	x1	0: disable (default) 1: enable
ADh to AFh	RESERVED FOR CONFIGURABLE RELATED COMMANDS					
B0h	PSU_OUTPUT_VOLTAGE	-	R	1	x100	Varies
B1h	PSU_OUTPUT_CURRENT	-	R	1	x100	Varies
B2h	PSU_OUTPUT_POWER	-	R	1	x1	Varies
B4h	PSU_INPUT_VOLTAGE	-	R	1	x100	Varies
B5h	PSU_INPUT_CURRENT	-	R	1	x100	Varies
B6h	PSU_INPUT_POWER	-	R	1	x1	Varies
B7h	PSU_TEMP1- FWD FWL1	-	R	1	x100	Varies
B8h	PSU_TEMP2- FWD FWL2	-	R	1	x100	Varies
B9h	PSU_TEMP3- TRF1	-	R	1	x100	Varies
BAh	PSU_TEMP4- TRF2	-	R	1	x100	Varies
BBh	PSU_TEMP0- BOOST	-	R	1	x100	Varies
BCh	PSU_TEMP5- AUXILLARY	-	R	1	x100	Varies
BDh	PSU_TEMP6-AMBIENT	-	R	1	x100	Varies
BEh	PSU RPM FAN0	-	R	1	x1	Varies
BFh	PSU RPM FAN1	-	R	1	x1	Varies
C0h	PSU_TEMP7- DCDC_PRI1	-	R	1	x100	Varies
C1h	PSU_TEMP8- DCDC_PRI2	-	R	1	x100	Varies
C2h to FFh	RESERVED FOR MONITORING RELATED COMMANDS					

APPLICATION NOTES

Mode of Operation

The power supply is configurable between voltage source and current source. At voltage source mode, the output voltage is kept regulated at different line, load, operating temperature, and any other conditions (as long as it is within the normal operating range). At current source mode, the output current is the one to be kept within regulation level.

Digital and Analog Command

The output of the power supply is remotely programmable, only one programming method is allowed at a time.

Methods for Output Adjustment	
Voltage Source	Digital Command via RS485 ModBus Analog Command via 0-10V and 0-24V Remote Programming
Current Source	Digital Command via RS485 ModBus Analog Command via 0-10V and 0-24V Remote Programming

APPLICATION NOTES

Output Adjustability and Programmability

Output Adjusted via RS485 ModBus Communication Commands

Applicable for both Voltage Source and Current Source mode operation. It is compatible to iHP system, and can be easily tied to iHP PPCM.

0-10V and 0-24V Remote Programming

Applicable for both Voltage Source and Current Source mode operation. The table below is for reference only.

Voltage Source Mode (Output Voltage Programming)

0-10V_PROG (V)	Output Voltage (V)
0	0
1	120
2	140
3	160
4	180
5	200
6	220
7	240
8	260
9	280
10	300

0-24V_PROG (V)	Output Voltage (V)
0	0
2.4	120
4.8	140
7.2	160
9.6	180
12.0	200
14.4	220
16.8	240
19.2	260
21.6	280
24.0	300

APPLICATION NOTES

Current Source Mode (Output Current Programming)

0-10V_PROG (V)	Output Current (A)
0	0
1	1.6
2	3.2
3	4.8
4	6.4
5	8.0
6	9.6
7	11.2
8	12.8
9	14.4
10	16.0

0-24V_PROG (V)	Output Current (A)
0	0
2.4	1.6
4.8	3.2
7.2	4.8
9.6	6.4
12.0	8.0
14.4	9.6
16.8	11.2
19.2	12.8
21.6	14.4
24.0	16.0

APPLICATION NOTES

0-10V Vprog and Iprog Rescaling

This section describes the analog Vprog and Iprog rescaling function of the PSU and corresponding rescale profiles.

Note: The rescaling function is also applicable for the 0-24V PROG, just factor-in a multiplying factor of 2.4 since all the discussions below are referenced to the 0-10V PROG.

Vprog Rescaling

The PSU's mode of operation must be on analog Voltage Source mode when MODULE_CONFIG (command code 87h) is set to 02h. The PSU should be on standby mode when adjusting Vprog rescale profile.

Vprog Rescaling Default Profile

This describes the setting for analog Vprog default profile. Writing 00h (default) to DSP_PROG_RESCALE_PROFILE (command code 8Bh) will update the Vprog profile to default. This profile will set target voltage to 100-300V for 0-10V Vprog respectively.

PSU target voltage versus the 0-10V Vprog for Vprog rescale default profile.
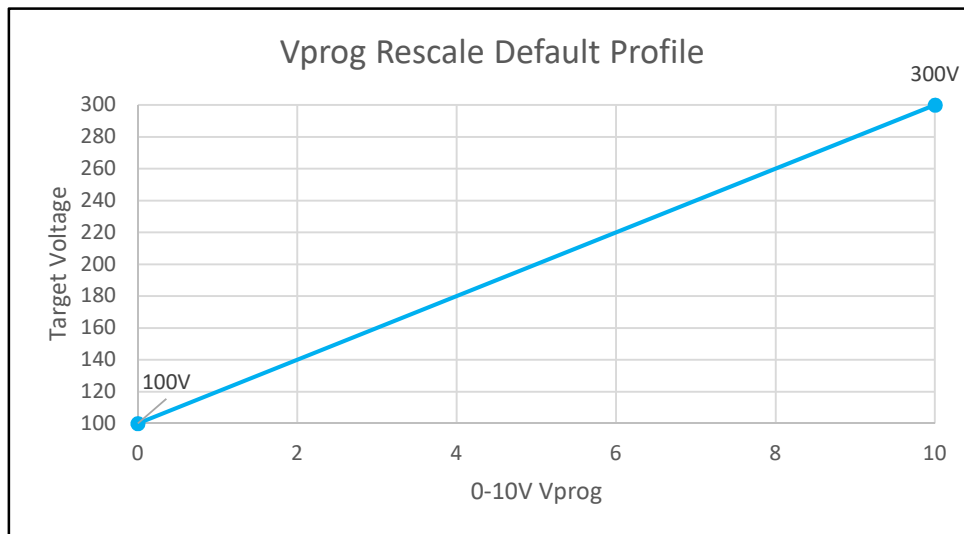
APPLICATION NOTES

VPROG Rescaling Profile 1

The following sequence of commands should be followed to set Vprog Profile 1:

1. Set VPROG_RESCALE_MIN (command code 8Ch) to adjust the minimum rescale value.
2. Set VPROG_RESCALE_MAX (command code 8Dh) to adjust to adjust the maximum rescale value.
3. Set DSP_PROG_RESCALE_PROFILE (command code 8Bh) to 01h (profile 1) to update the Vprog profile based on the written values from the rescale commands.

Sample Vprog rescale profile 1 adjustment is shown below, VPROG_RESCALE_MIN is set to 14000 (140V), and VPROG_RESCALE_MAX is set to 20000 (200V).
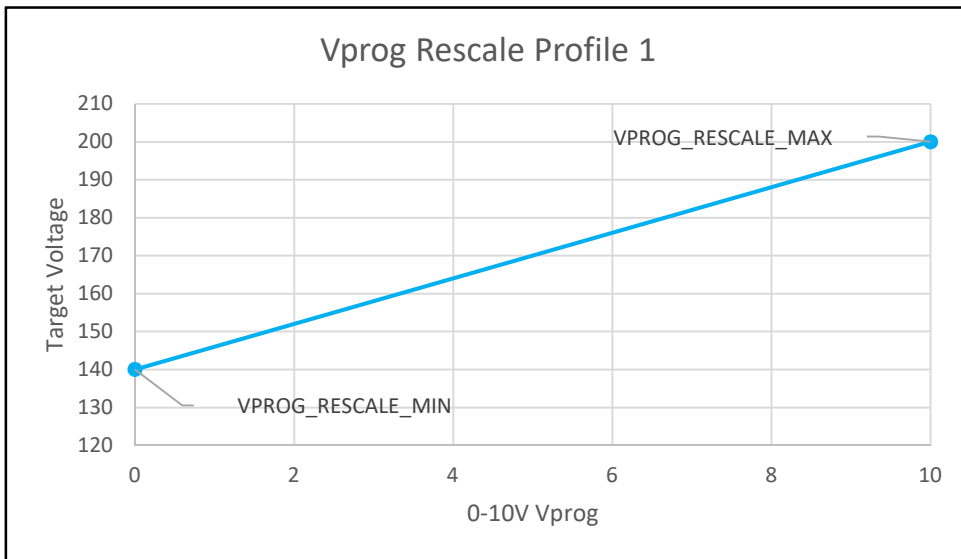
Note: VPROG_RESCALE_MIN must be less than VPROG_RESCALE_MAX.

APPLICATION NOTES

Vprog Rescaling Profile 2

The following sequence of commands should be followed to set Vprog Profile 2:

1. Set VPROG_RESCALE_PT1 (command code 8Eh) to adjust the Vprog Low Point.
2. Set VPROG_RESCALE_PT2 (command code 8Fh) to adjust the Vprog High Point.
3. Set DSP_PROG_RESCALE_PROFILE (command code 8Bh) to 02h (profile 2) to update the Vprog profile based on the written values from the rescale commands.

Sample Vprog rescale profile 2 adjustment is shown below, VPROG_RESCALE_PT1 is set to 200 (2V), and VPROG_RESCALE_PT2 is set to 500 (5V).
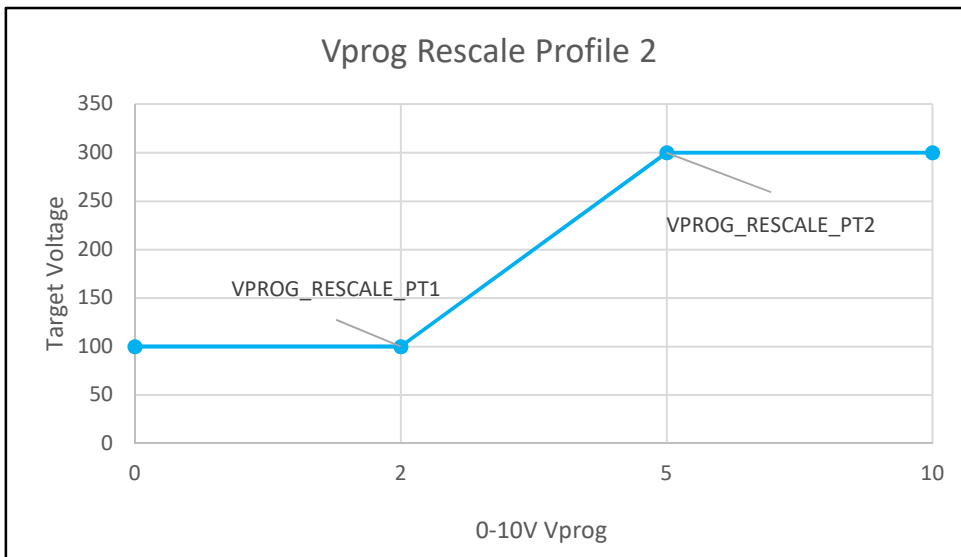
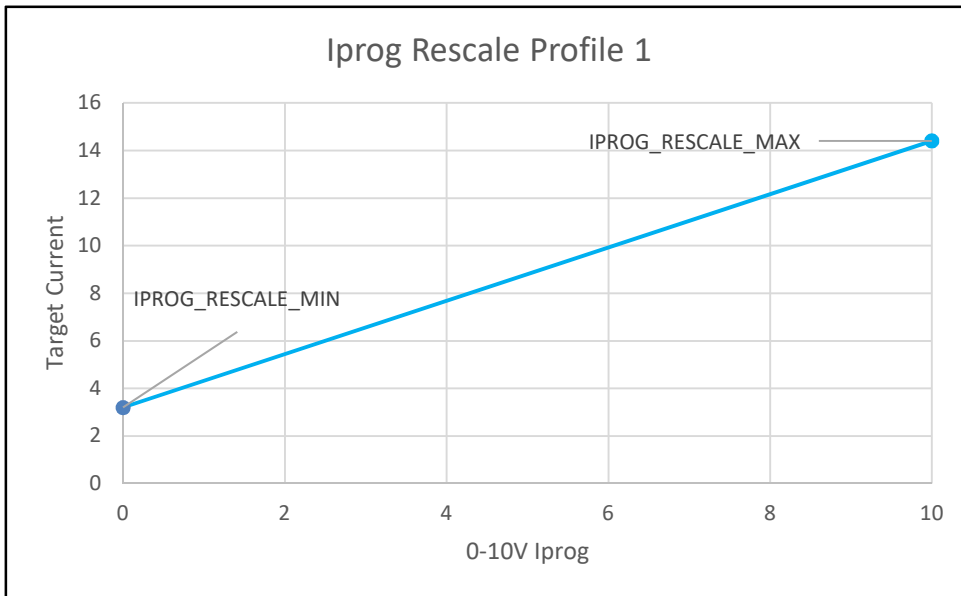

Note: VPROG_RESCALE_PT1 must be less than VPROG_RESCALE_PT2.

APPLICATION NOTES

Vprog Rescaling Profile 3

The following sequence of commands should be followed to set Vprog Profile 3:

1. Set VPROG_TURN_ON_POINT (command Code 90h) to adjust Vprog Turn on Point.
2. Set VPROG_RESCALE_PT1 (command code 8Eh) to adjust the Vprog Low Point.
3. Set VPROG_RESCALE_PT2 (command code 8Fh) to adjust the Vprog High Point.
4. Set DSP_PROG_RESCALE_PROFILE (command code 8Bh) to 03h (profile 3) to update the Vprog profile based on the written values from the rescale commands.

Sample Vprog rescale profile 3 adjustment is shown below, VPROG_TURN_ON_POINT is set to 50 (0.5V), VPROG_RESCALE_PT1 is set to 200 (2V), and VPROG_RESCALE_PT2 is set to 500 (5V).
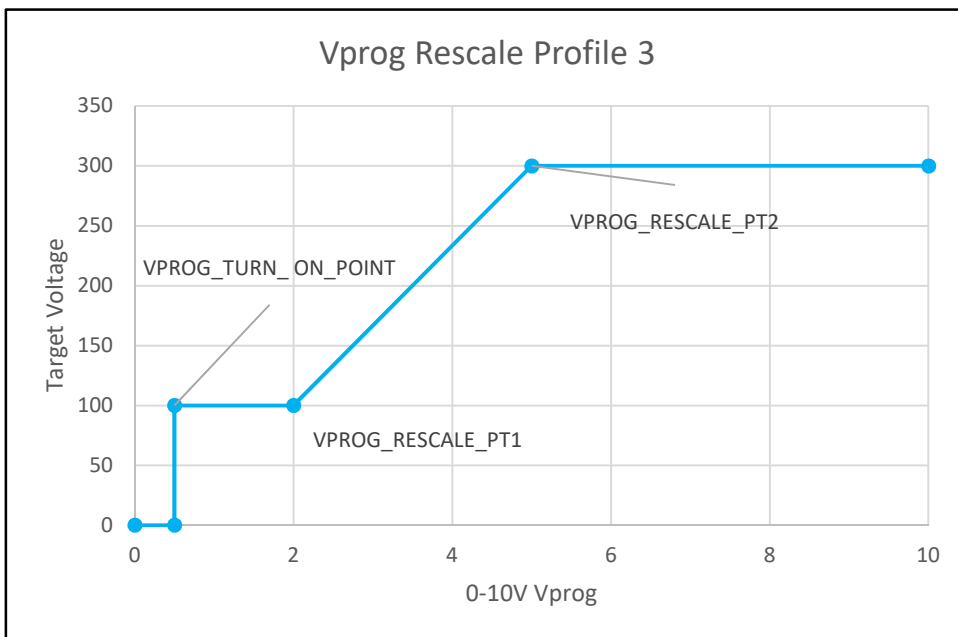
Note: VPROG_TURN_ON_POINT must be less than VPROG_RESCALE_PT1, and VPROG_RESCALE_PT1 must be less than VPROG_RESCALE_PT2.

APPLICATION NOTES

Iprog Rescaling

The PSU's mode of operation must be on analog Current Source mode when MODULE_CONFIG (command code 87h) is set to 0Ah. The PSU should be on standby mode when adjusting Iprog rescale profile.

Iprog Rescaling Default Profile

This describes the setting for analog Iprog default profile. Writing 00h (default) to DSP_PROG_RESCALE_PROFILE (command code 8Bh) will update the Iprog profile to default. This profile will set target current to 0.48-16A for 0-10V Iprog respectively.

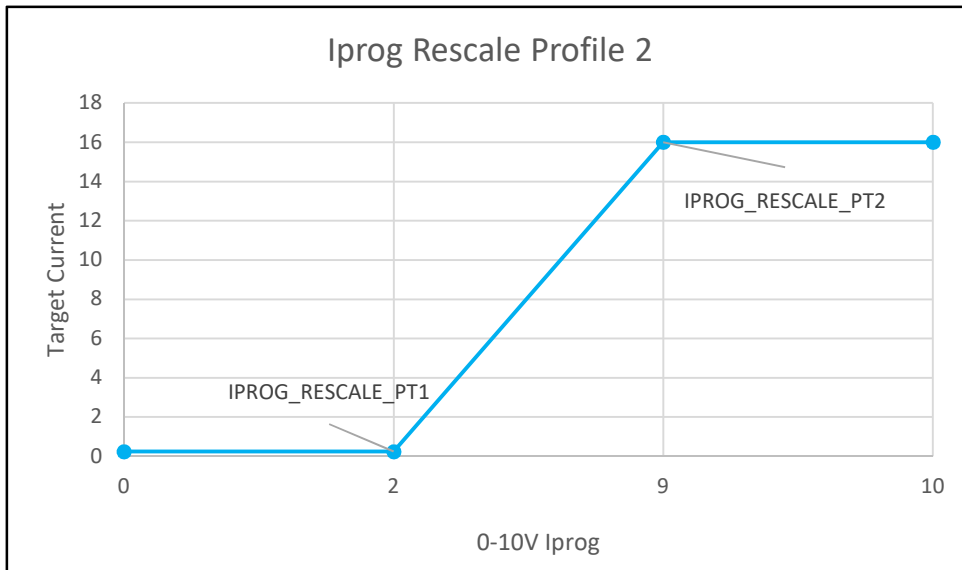PSU target Current versus the 0-10V Iprog for Iprog rescale default profile.
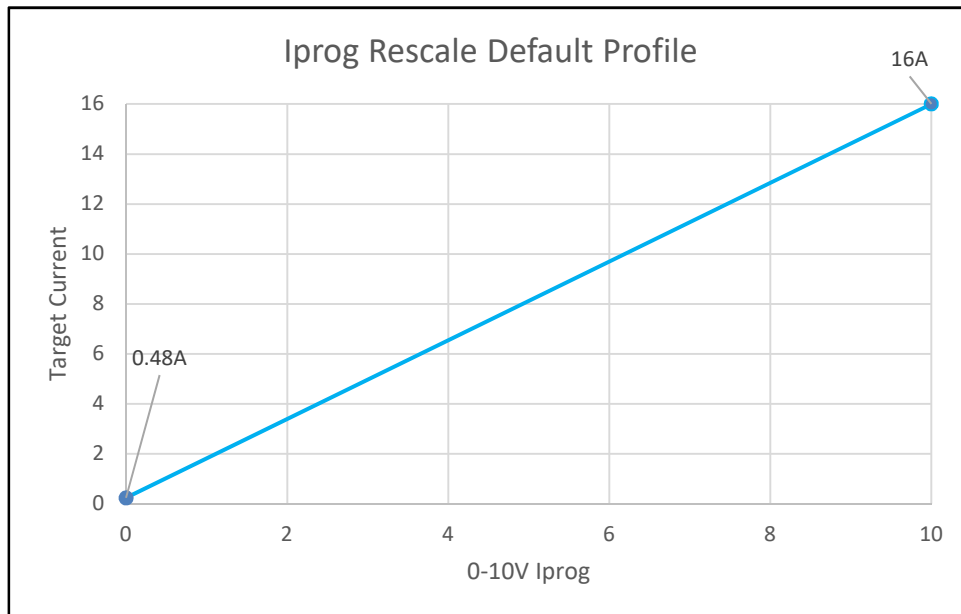
APPLICATION NOTES

Iprog Rescaling Profile 1

The following sequence of commands should be followed to set Iprog Profile 1:

1. Set IPROG_RESCALE_MIN (command code 91h) to adjust the minimum rescale value.
2. Set IPROG_RESCALE_MAX (command code 92h) to adjust to adjust the maximum rescale value.
3. Set DSP_PROG_RESCALE_PROFILE (command code 8Bh) to 01h (profile 1) to update the Iprog profile based on the written values from the rescale commands.

Sample Iprog rescale profile 1 adjustment is shown below, IPROG_RESCALE_MIN is set to 300 (3A), and IPROG_RESCALE_MAX is set to 1440 (14.4A).

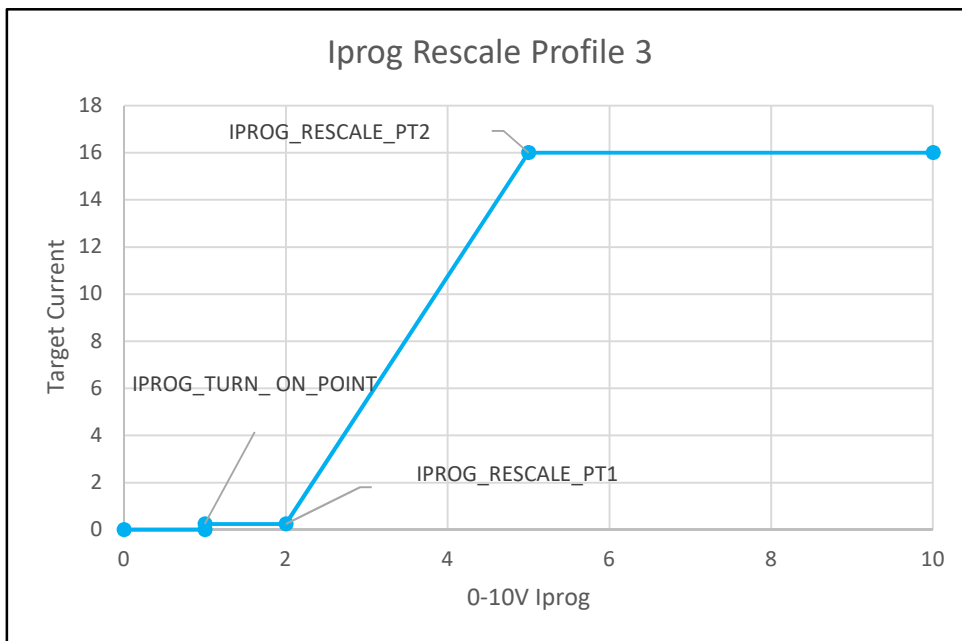Note: VPROG_TURN_ON_POINT must be less than VPROG_RESCALE_PT1, and VPROG_RESCALE_PT1 must be less than VPROG_RESCALE_PT2.

APPLICATION NOTES

Iprog Rescaling Profile 2

The following sequence of commands should be followed to set Iprog Profile 2:

1. Set IPROG_RESCALE_PT1 (command code 93h) to adjust the Iprog Low Point.
2. Set IPROG_RESCALE_PT2 (command code 94h) to adjust the Iprog High Point.
3. Set DSP_PROG_RESCALE_PROFILE (command code 8Bh) to 02h (profile 2) to update the Iprog profile based on the written values from the rescale commands.

Sample Iprog rescale profile 2 adjustment is shown below, IPROG_RESCALE_PT1 is set to 200 (2V), and IPROG_RESCALE_PT2 is set to 900 (9V).

Note: IPROG_RESCALE_PT1 must be less than IPROG_RESCALE_PT2.

APPLICATION NOTES

IPROG Rescaling Profile 3

The following sequence of commands should be followed to set Vprog Profile 3:

1. Set IPROG_TURN_ON_POINT (command Code 95h) to adjust Iprog Turn on Point.
2. Set IPROG_RESCALE_PT1 (command code 93h) to adjust the Iprog Low Point.
3. Set IPROG_RESCALE_PT2 (command code 94h) to adjust the Iprog High Point.
4. Set DSP_PROG_RESCALE_PROFILE (command code 8Bh) to 03h (profile 3) to update the Iprog profile based on the written values from the rescale commands.

Sample Iprog rescale profile 3 adjustment is shown below, IPROG_TURN_ON_POINT is set to 100 (1V), IPROG_RESCALE_PT1 is set to 200 (2V), and IPROG_RESCALE_PT2 is set to 500 (5V).


Note: IPROG_TURN_ON_POINT must be less than IPROG_RESCALE_PT1, and IPROG_RESCALE_PT1 must be less than IPROG_RESCALE_PT2.

APPLICATION NOTES

Output Ripple and Noise Measurement

The setup outlined in the diagram below has been used for output ripple and noise measurements on the LCM4000HV series (Voltage Source Mode). When measuring output ripple and noise, a scope jack in parallel with a 0.1uF ceramic chip capacitor, and a 10uF tantalum capacitor should be used. Oscilloscope should be set to 20MHz bandwidth for this measurement.
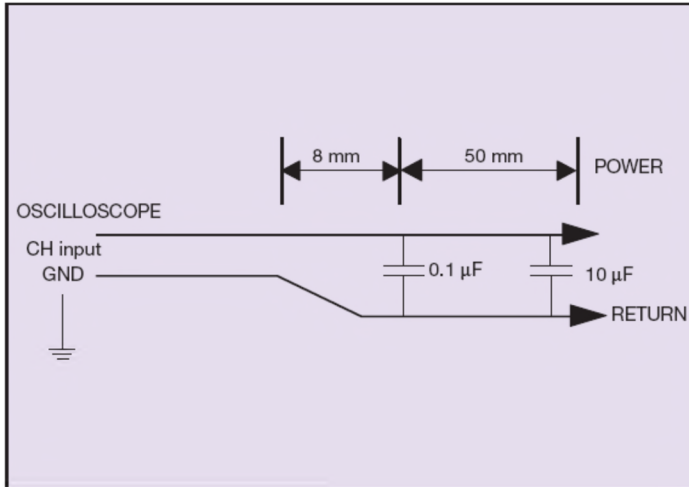
APPLICATION NOTES

Application
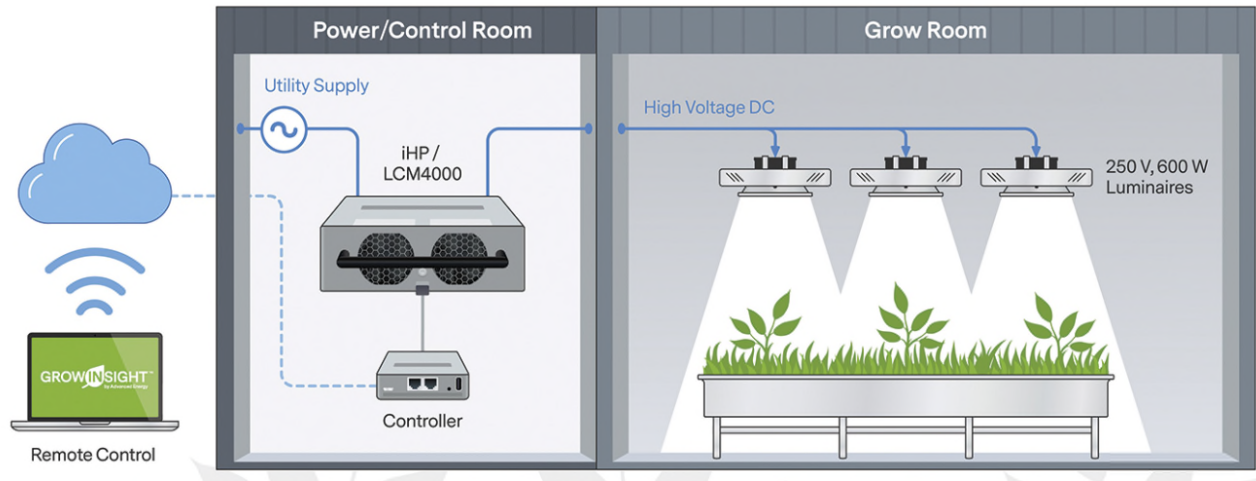
RECORD OF REVISION AND CHANGES

Issue	Date	Description	Originators
1.0	11.16.22	First Issue	J. Ma
1.1	02.09.23	Update Power Factor & Efficiency	J. Ma
1.2	04.04.23	Add DLC Life Projection Data	J. Ma
1.3	06.03.24	Change RJ11 to RJ12	J. Ma

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