

ARTESYN LCM12K

12 kWatts Power Shelf
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 convenient 19" 1U rack mount shelf is designed for hot plug replacement of the 4 kW modules insuring the highest reliability and simplest maintenance possible. For large systems stacking 10 shelves in a short 10U cabinet would provide 120 kW for a normal sized grow area.

SPECIAL FEATURES

- Accepts 3 types of input configurations (3-PH Delta 4W, 3-PH Wye 4W, 3-PH Wye 5W)
- Houses three 4 kW power modules
- 504.3 mm x 446.3 mm x 43.7 mm
- High Efficiency: up to 95%
- Industrial safety
- Five-year warranty
- Low cost

COMPLIANCE

- EMI Class A
- EN61000 Immunity
- RoHS 3

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

AT A GLANCE

Total Power

12 kWatts

Input Voltage

3P 180 to 264 Vac

3P 342 to 528 Vac

3P 540 to 660 Vac
(WYE with Neutral)

Output Voltage

Voltage Source: 100 to 300 Vdc

Current Source: 0 to 16 A

of Outputs

Single



MODEL NUMBERS

Standard	Description	Input
LCM12K-BLK	1U Blank Filler Panel	N/A
LCM12K-SHF-P	12 kW, 250 V, 1U Shelf	Low Line, 200/208/220/230/240 Vac
LCM12K-SHF-S	12 kW, 250 V, 1U Shelf	High Line, 380/480 Vac
LCM12K-SHF-N	12 kW, 250 V, 1U Shelf	High Line, 600 Vac WYE with Neutral Connection

Ordering Information

LCM	12K	-	X	-	Y
①	②		③		④

①	Model Series	LCM: Series Name
②	Max Output Power in Watts	12K = 12 kWatts
③	Configuration Type	BLK = Blank Filler Panel; SHF = Shelf
④	Input Range Configuration	P = Low Line, 200/208/220/230/240 Vac; S = High Line, 380/480 Vac; N = High Line, 600 Vac WYE with Neutral Connection;

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	LCM12K-SHF-P	$V_{IN,AC}$	180	-	264	Vac
	LCM12K-SHF-S		342	-	528	Vac
	LCM12K-SHF-N		540	-	660	Vac
Maximum Output Power	All models	$P_{O,max}$	-	-	12000	W
Ambient Operating Temperature	All models	T_A	0	-	+50	°C
Storage Temperature	All models	T_{STG}	-40	-	+85	°C
Humidity (non-condensing)	All models		Operating	-	90	%
			Non-operating	10	-	95
Altitude	All models		Operating ²	-	3000	m
			Non-operating	-	-	9144

Note 1 - 180 to 264 Vac (3-PH 4W); 342 to 528 Vac (3-PH 4W); 540 to 660 Vac (3-PH WYE with Neutral Connection).
 Note 2 - $T_A = 25^{\circ}C$.

ELECTRICAL SPECIFICATIONS

Input Specifications

Table 2. Input Specifications						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, AC	LCM12K-SHF-P	$V_{IN,AC}$	180	-	264	Vac
	LCM12K-SHF-S		342	-	528	Vac
	LCM12K-SHF-N		540	-	660	Vac
Input AC Frequency	All	f_{IN}	47	50/60	63	Hz
Maximum Input Current ¹ ($I_O = I_{O,max}$)	$V_{IN,AC} = 187$ Vac	$I_{IN,max}$	-	-	45	A
	$V_{IN,AC} = 342$ Vac		-	-	25	A
	$V_{IN,AC} = 540$ Vac		-	-	17	A
Harmonic Line Currents	All	THD	EN 61000-3-12			

Note 1 - 45 A max per phase at 187 Vac, 25 A max per phase at 342 Vac, 17 A max per phase at 540 Vac.

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Nominal Output Voltage	All	V_O	-	250	-	Vdc
Maximum Output Current ¹	All	$I_{O,max}$	-	-	48	A
Maximum Output Power ²	All	$P_{O,max}$	-	-	12000	W
Output Voltage Adjustment Range	All	V_O	100	-	300	Vdc
Output Current Adjustment Range ³	All	I_O	0.48	-	16	A

Note 1 - 16 A max per PSU.

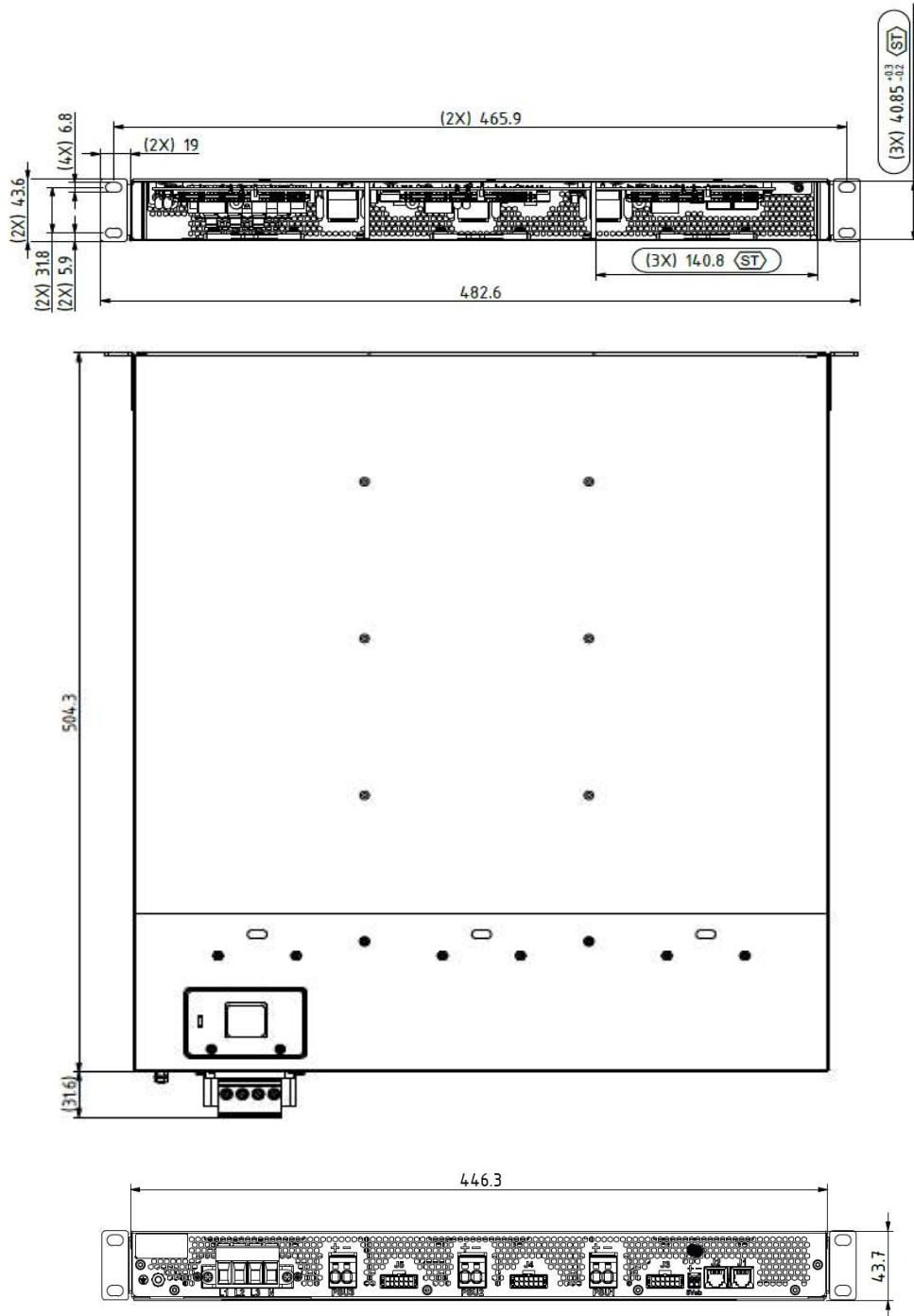
Note 2 - Paralleling operation of PSU is not supported.

Note 3 - Lower than 0.48 A will be considered OFF (0 A).

MECHANICAL SPECIFICATIONS

Mechanical Outlines

LCM12K: 504.3mm L x 446.3mm W x 43.7mm H



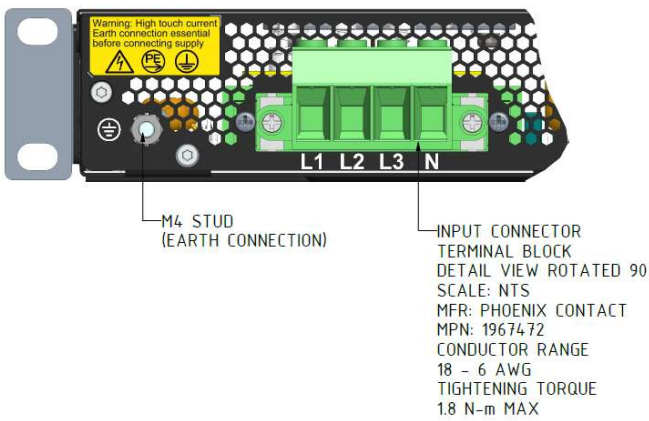
MECHANICAL SPECIFICATIONS



LCM12K Power Shelf Front View

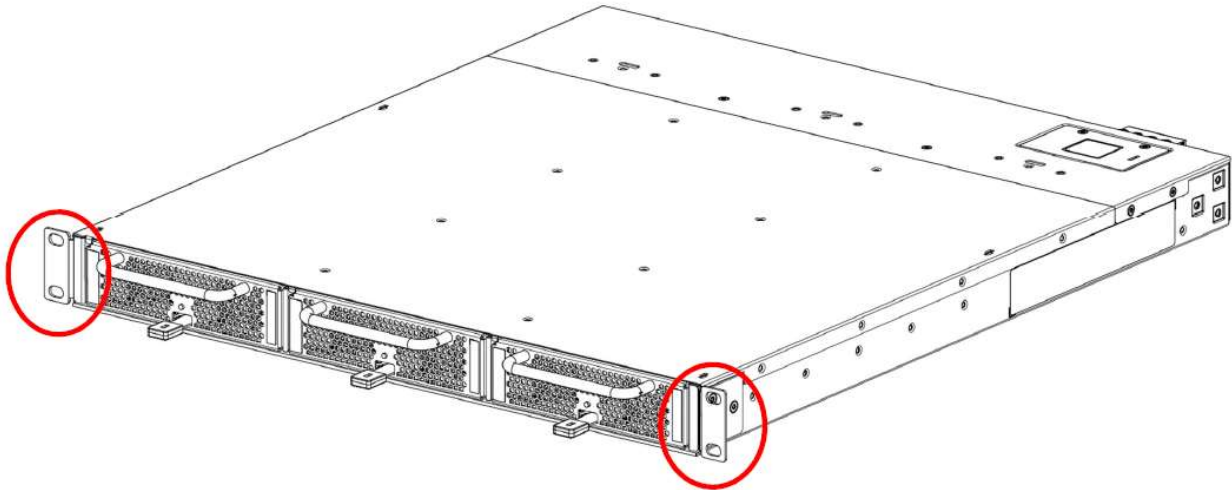


LCM12K Power Shelf Rear View

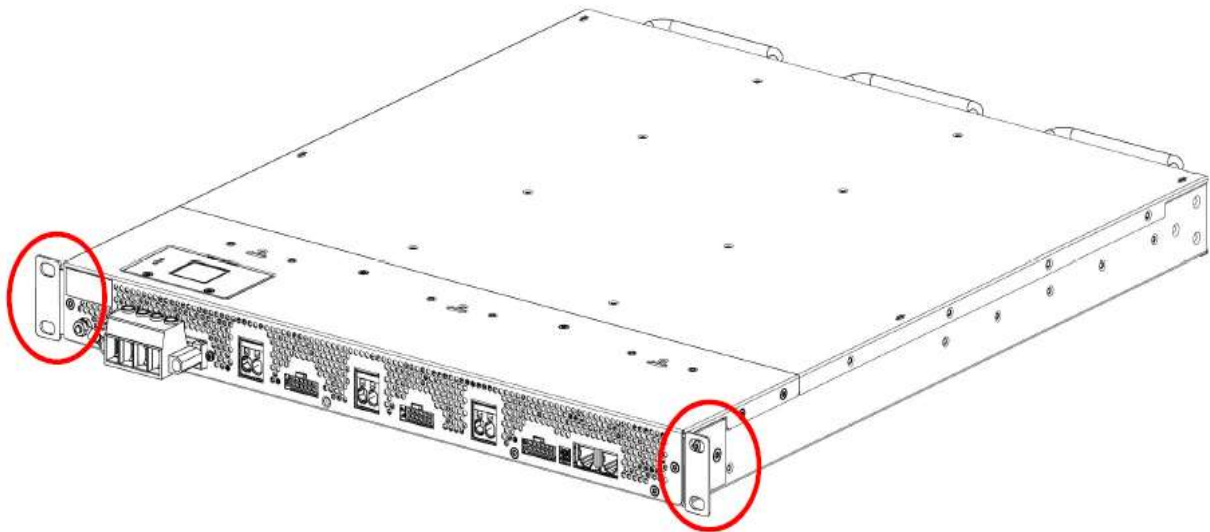


MECHANICAL SPECIFICATIONS

Ear Bracket Mounting Option



Option A - Ear Brackets at Front



Option B - Ear Brackets at Rear

Mounting Screw Information	
Thread Type	Metric 3.5
Head Type & Length	Torx flat head, 8 mm
Torque	12-14 kgf-cm

MECHANICAL SPECIFICATIONS

Connector Definitions

Table 4. AC Input Connector	
Pin Name	Description
L1	Line1
L2	Line2
L3	Line3
N	Neutral
M4 Stud	Earth Ground

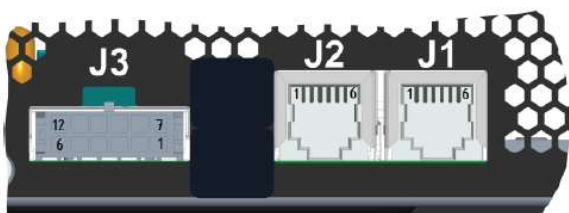
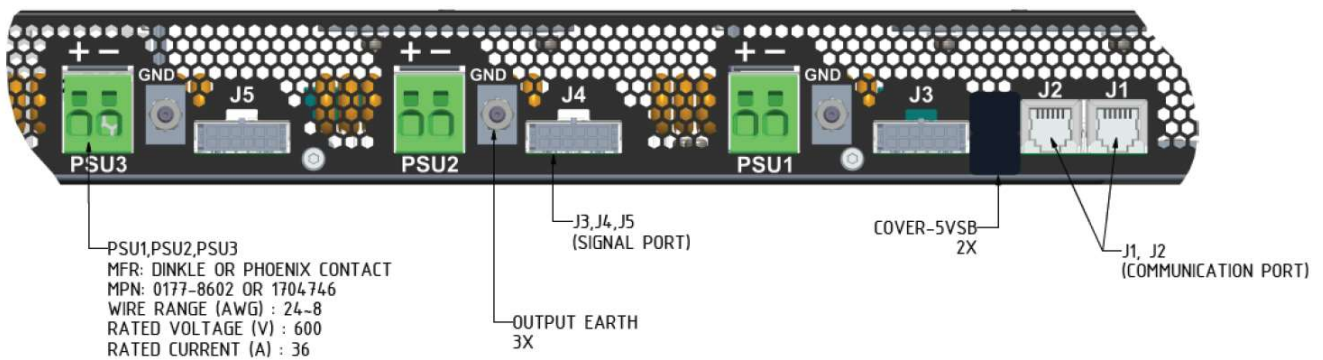
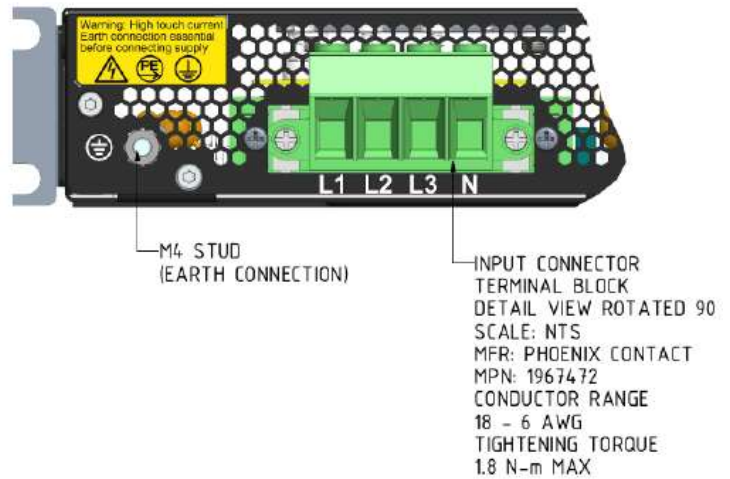


Table 5. Output Connector		
Pin Name		Description
PSU1	+	PSU1 Main Output
	-	PSU1 Main Output Return
PSU2	+	PSU2 Main Output
	-	PSU2 Main Output Return
PSU3	+	PSU3 Main Output
	-	PSU3 Main Output Return

Table 6. Communication Connector (J1 & J2)	
Pin Number	Pin Name
1	SPARE
2	SPARE
3	RTN_RS485
4	SPARE
5	RS485_A_EXT
6	RS485_B_EXT

MECHANICAL SPECIFICATIONS

Connector Definitions

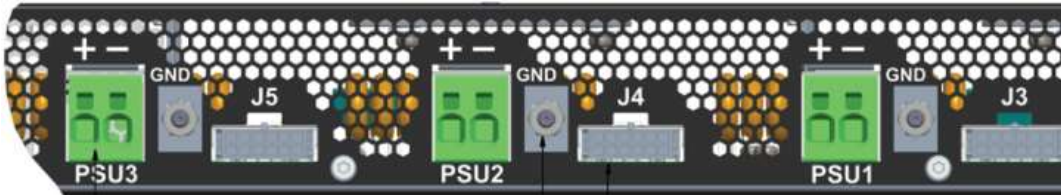


Table 7. Signal Connector

Pin Number	J3	J4	J5
1	PS_ON#1	PS_ON#2	PS_ON#3
2	PSU_PRESENT#1	PSU_PRESENT#2	PSU_PRESENT#3
3	ALERT#1	ALERT#2	ALERT#3
4	AC_OK#1	AC_OK#2	AC_OK#3
5	DC_OK#1	DC_OK#2	DC_OK#3
6	0-10V_PROG1_1	0-10V_PROG1_2	0-10V_PROG1_3
7	ISO_PRTN	ISO_PRTN	ISO_PRTN
8	0-24V_PROG1_1	0-24V_PROG1_2	0-24V_PROG1_3
9	ISO_PRTN	ISO_PRTN	ISO_PRTN
10	SPARE	SPARE	SPARE
11	SPARE	SPARE	SPARE
12	SPARE	SPARE	SPARE

MECHANICAL SPECIFICATIONS

Power / Signal Mating Connectors and Pin Types

Table 8. Mating Connectors for LCM12K			
Reference	On Power Shelf	Mating Connector or Equivalent	
Input Connector	PHOENIX CONTACT: 1967472	CONDUCTOR RANGE: 18~6 AWG TIGHTENING TORQUE: 1.8 N-m MAX	
Earth Ground	M4 Stud		
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
Signal Connector	MOLEX Micro-fit	MOLEX: 43025-1200 CRIMP TERMINAL: 43030-0002	
Communication Connector	RJ11 (Female)	RJ11 (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 LCM12K Power Shelf weight is 4728 g (10.40 lbs.)

ENVIRONMENTAL SPECIFICATIONS

EMC Immunity

The LCM12K is designed to meet the following EMC immunity specifications.

Table 9. Environmental Specifications	
Document	Description
EN55032	Conducted and Radiated EMI limits, Class A
EN61000-3-11	Voltage Flicker
EN61000-3-12	AC Mains Harmonic Current Emissions
EN61000-4-2	ESD, Level 4
EN61000-4-3	Radiated Immunity, 10 V/m
EN61000-4-4	EFT/Burst, Level 3
EN61000-4-5 ¹	AC Mains Surge Immunity, 1 kV Line to Line, 2 kV Line to Earth on AC power port
EN61000-4-6	Conducted Radio Frequency Immunity, 10 V/m
EN61000-4-8	Power Frequency Magnetic Fields Level 3
EN61000-4-34	AC Mains Voltage Dips and Sags, Fluctuations

Note 1 - The Power Shelf complies with EN61000-4-5 Level 3, for any configuration of the shelf with a minimum of 1 PSU module to a maximum of 3 PSU modules. The shelf is protected against surge events and will not get damaged in such occurrences. During the test, temporary degradation of performance or hiccups is allowed which is recoverable. After the application of disturbance, no degradation of performance or loss of function is allowed.

ENVIRONMENTAL SPECIFICATIONS

Safety Certifications

The LCM12K is 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 10. Safety Certifications for LCM12K Power Shelf		
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

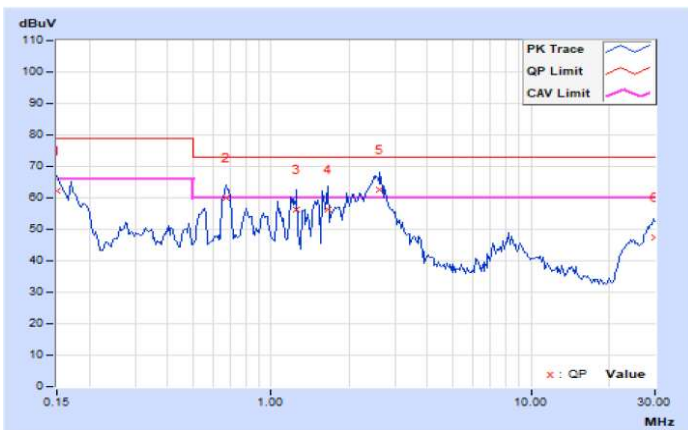
ENVIRONMENTAL SPECIFICATIONS

EMI Emissions

The LCM12K Power Shelf built-in with three modules (LCM4000HV-P) 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 EUT is tested at full 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 EUT has internal EMI filters to ensure the 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 three 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 LCM12K Power Shelf can start and operate within the stated specifications at an ambient temperature from 0°C to 50°C.

Storage and Shipping Temperature

The LCM12K Power Shelf can be stored or shipped at temperatures between -40°C to +85°C.

Altitude

The LCM12K Power Shelf will operate within specifications at altitudes up to 9,842 feet (3,000 meters) above sea level. It will not be damaged when stored at altitudes of up to 30,000 feet (9,144 meters) above sea level.

Humidity

The LCM12K Power Shelf will operate within specifications when subjected to a relative humidity from 20% to 90% non-condensing. It can be stored in a relative humidity from 10% to 95% non-condensing.

DLC Life Projection Data

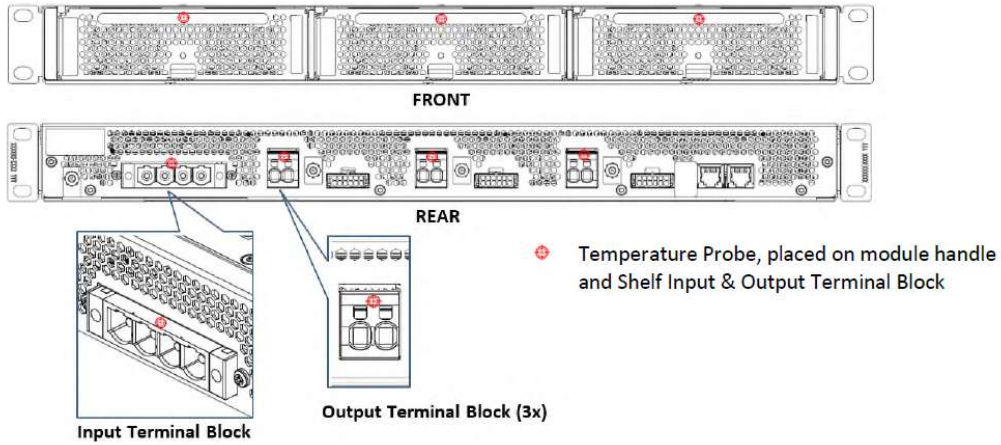
In accordance with DLC technical requirements for LED-based Horticultural Lighting V2.1 “Special Considerations for DC-Powered Fixtures”, operating assumptions and certified test data are provided below:

Model:	LCM12K
Description:	380/480 Vac nominal input with 12 kW output power and output voltage of 300 Vdc.
Measured Efficiency:	94.58% @ 380 Vac nominal input with 100% loading on the output. $T_{amb}=25^{\circ}C$ 95.69% @ 480 Vac nominal input with 100% loading on the output. $T_{amb}=25^{\circ}C$
Operating Temp Range:	0 to 45°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:

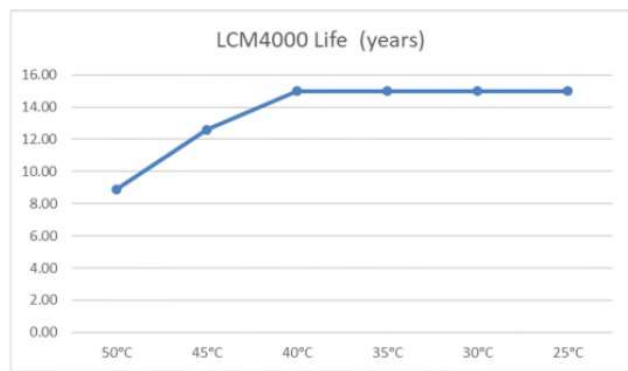
Max. Measured Temperature (°C)	Measured at Shelf Input & Output Terminal Block (+/-2°C)	
@ Air Inlet Ambient	480VAC	380VAC
50°C	65.02°C	68.03°C
45°C	60.94°C	62.55°C
40°C	55.43°C	56.80°C
35°C	50.03°C	51.37°C
30°C	44.71°C	46.01°C
Note: Temperature probe placed on each PSU handle	Note: Data is the reference max. temperature for any one (1) location. Probe placed on Input & Output terminal blocks.	
Operating Altitude	Sea Level	

ENVIRONMENTAL SPECIFICATIONS



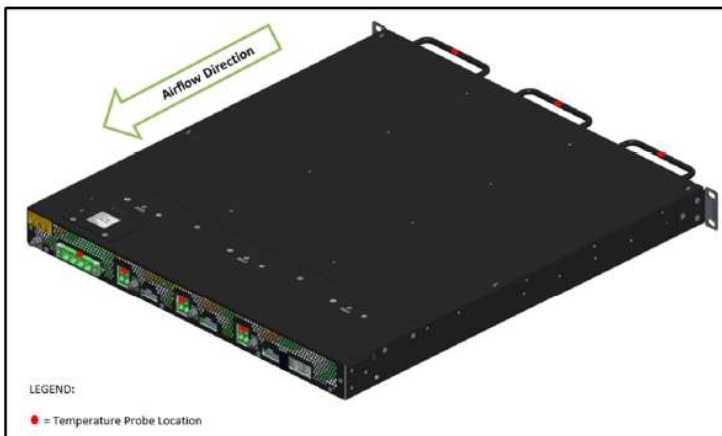
System CMTBF

Inlet Temperature (°C)	Outlet Temperature (°C)	System Projected Life (Years)
50	62.6 to 68.0	8.90
45	56.9 to 62.5	12.60
40	39.0 to 56.8	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



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

ENVIRONMENTAL SPECIFICATIONS

Vibration

The LCM12K Power Shelf 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 (g ² /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 (g ² /Hz)
	5	11	0.000025
	10 - 50	/	0.0004
	100	-10	0.000025

ENVIRONMENTAL SPECIFICATIONS

Shock

The LCM12K Power Shelf 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	

Acceleration	4	G
Duration	22	mSec
Pulse	Half-Sine	
Number of Shock	3 shocks for each of the three axes	

POWER AND CONTROL SIGNAL DESCRIPTIONS

AC Input Connector

This connector supplies the AC Mains to the LCM12K Power Shelf.

L1 – Line1

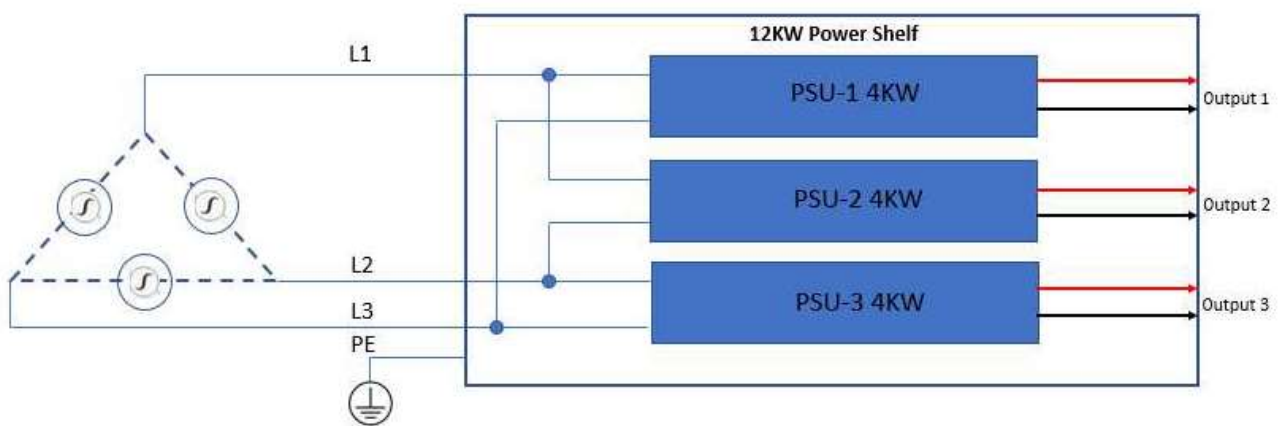
L2 – Line2

L3 – Line3

N – Neutral

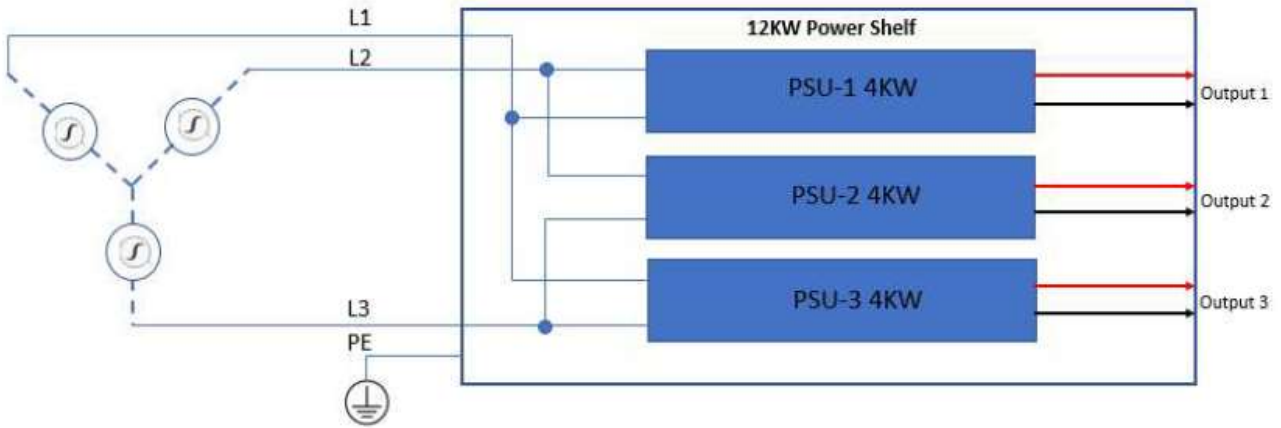
Screw – Earth Ground (M4 Stud)

V _{IN} Nom (Vac)	V _{IN} Range (Vac)	Grid Connection DELTA or WYE	Pout (W)	PF	Efficiency	Pin (W)	Total Input Current I _{rms} (A)	Total Input Current I _{rms} (per NEC210.19) (A)	Recommended Breaker Rating (A)
208	187 - 229	208 Vac 3P mains L - L	12000	0.997	94.30%	12725	35.45	44.31	50
220	198 - 242	220 Vac 3P mains L - L	12000	0.997	94.50%	12698	33.43	41.79	50
240	216 - 264	240 Vac 3P mains L - L	12000	0.997	94.80%	12658	30.54	38.17	40
346	311 - 381	600 Vac 3P mains L - N	12000	0.994	94.00%	12765	21.43	26.79	30
380	342 - 418	380 Vac 3P mains L - L	12000	0.995	94.40%	12711	19.42	24.27	25
480	432 - 528	480 Vac 3P mains L - L	12000	0.996	95.10%	12618	15.24	19.05	20

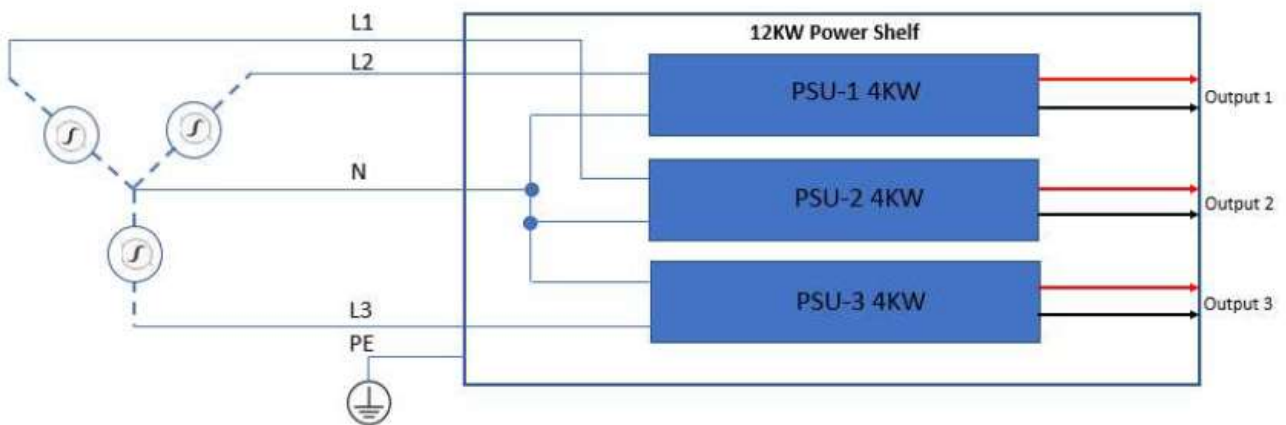


Input Configurations & Power Rails Connections – 3P Delta (4W) as Input Source

POWER AND CONTROL SIGNAL DESCRIPTIONS



Input Configurations & Power Rails Connections - 3P Wye (4W) as Input Source



Input Configurations & Power Rails Connections - 3P Wye (5W) as Input Source

POWER AND CONTROL SIGNAL DESCRIPTIONS

Output Connectors

These connectors provide the main output for PSU1, PSU2 and PSU3 which are plugged in LCM12K Power Shelf.

- PSU1 (+) - PSU1 Main Output
- PSU1 (-) - PSU1 Main Output Return
- PSU2 (+) - PSU2 Main Output
- PSU2 (-) - PSU2 Main Output Return
- PSU3 (+) - PSU3 Main Output
- PSU3 (-) - PSU3 Main Output Return

Communication Connectors - J1 & 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.

POWER AND CONTROL SIGNAL DESCRIPTIONS

Signal Connector - J3

This connector is a 12-pin control signal header for PSU1.

PSU_ON#1 (J3_Pin 1)

Active LOW signal as default. Controls the main output of PSU1 on and off. Internally pulled up to 3V_ISO via 10k ohm resistor.

PSU_PRESENT#1 (J3_Pin 2)

Active LOW signal. Shorted to ISO_RTN inside the PSU1.

ALERT#1 (J3_Pin 3)

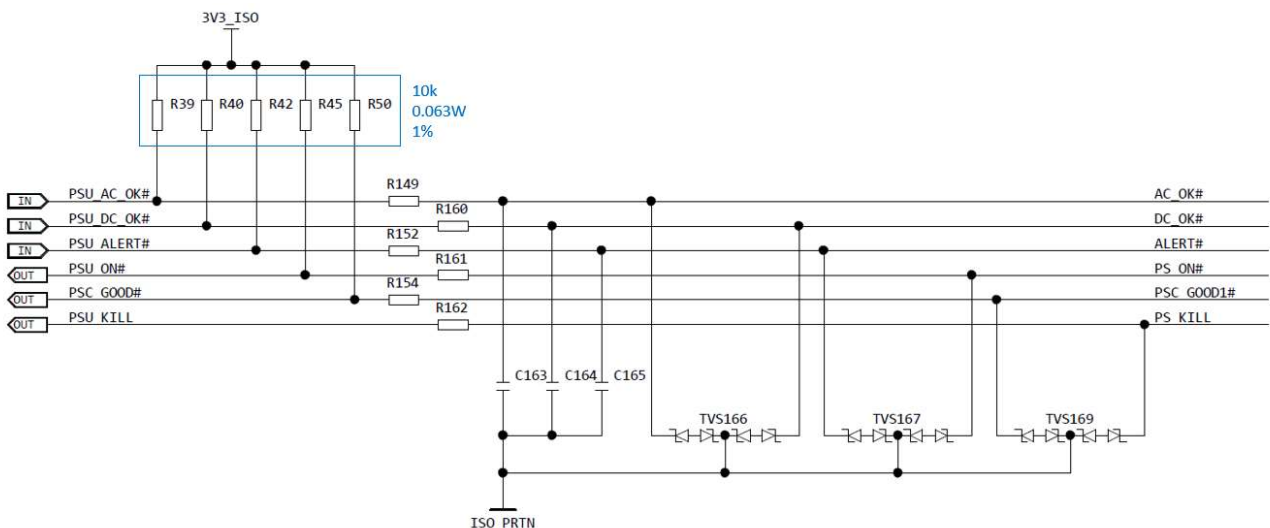
Active LOW signal. Indicates that there is a fault present in the PSU1. Internally pulled up to 3V_ISO via 10k ohm resistor.

AC_OK#1 (J3_Pin 4)

Active LOW signal. Indicates that the input supply voltage is within allowable limits and the PSU1 can use and turn on. Internally pulled up to 3V_ISO via 10k ohm resistor.

DC_OK#1 (J3_Pin 5)

Active LOW signal. Indicates that the PSU1 main output is within the regulation band. Internally pulled up to 3V_ISO via 10k ohm resistor.



POWER AND CONTROL SIGNAL DESCRIPTIONS

0-10V_PROG1_1 (J3_Pin 6)

An analog programming command that accepts a DC voltage up to 10V (with respect to ISO_PRTN) in order to adjust the PSU1 output voltage or current.

0-24V _PROG1_1 (J3_Pin 8)

An analog programming command that accepts a DC voltage up to 24V (with respect to ISO_PRTN) in order to adjust the PSU1 output voltage or current.

ISO_PRTN (J3_Pin 7 & J3_Pin 9)

The isolated signal return (or ground).

POWER AND CONTROL SIGNAL DESCRIPTIONS

Signal Connector - J4

This connector is a 12-pin control signal header for PSU2.

PSU_ON#2 (J4_Pin 1)

Active LOW signal as default. Controls the main output of PSU2 on and off. Internally pulled up to 3V_ISO via 10k ohm resistor.

PSU_PRESENT#2 (J4_Pin 2)

Active LOW signal. Shorted to ISO_RTN inside the PSU2.

ALERT#2 (J4_Pin 3)

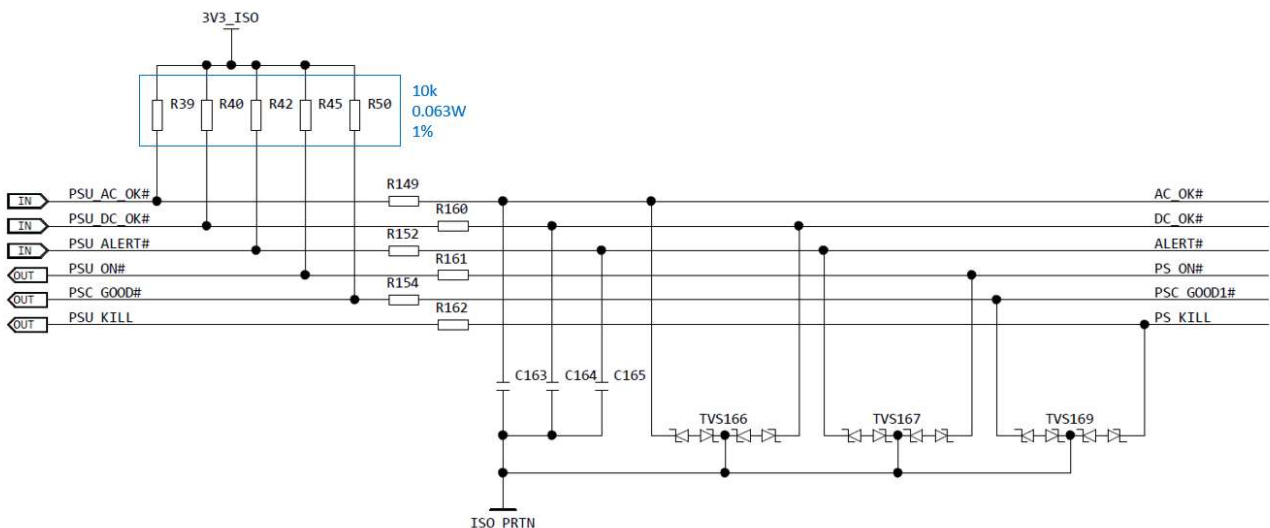
Active LOW signal. Indicates that there is a fault present in the PSU2. Internally pulled up to 3V_ISO via 10k ohm resistor.

AC_OK#2 (J4_Pin 4)

Active LOW signal. Indicates that the input supply voltage is within allowable limits and the PSU2 can use and turn on. Internally pulled up to 3V_ISO via 10k ohm resistor.

DC_OK#2 (J4_Pin 5)

Active LOW signal. Indicates that the PSU2 main output is within the regulation band. Internally pulled up to 3V_ISO via 10k ohm resistor.



POWER AND CONTROL SIGNAL DESCRIPTIONS

0-10V_PROG1_2 (J4_Pin 6)

An analog programming command that accepts a DC voltage up to 10V (with respect to ISO_PRTN) in order to adjust the PSU2 output voltage or current.

0-24V _PROG1_2 (J4_Pin 8)

An analog programming command that accepts a DC voltage up to 24V (with respect to ISO_PRTN) in order to adjust the PSU2 output voltage or current.

ISO_PRTN (J4_Pin 7 & J4_Pin 9)

The isolated signal return (or ground).

POWER AND CONTROL SIGNAL DESCRIPTIONS

Signal Connector - J5

This connector is a 12-pin control signal header for PSU3.

PSU_ON#3 (J5_Pin 1)

Active LOW signal as default. Controls the main output of PSU3 on and off. Internally pulled up to 3V_ISO via 10k ohm resistor.

PSU_PRESENT#3 (J5_Pin 2)

Active LOW signal. Shorted to ISO_RTN inside the PSU3.

ALERT#3 (J5_Pin 3)

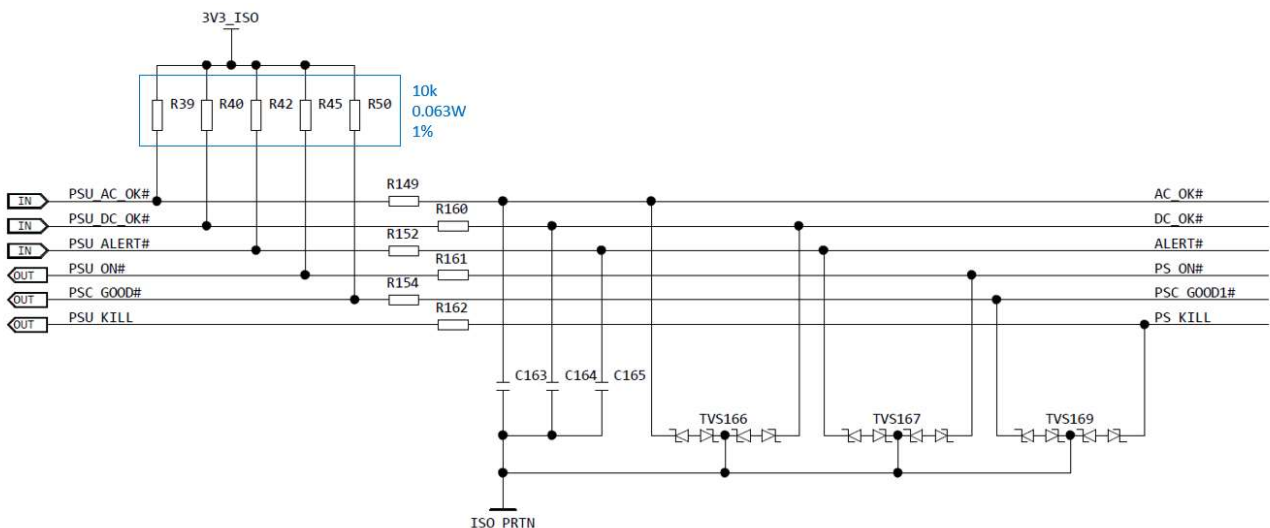
Active LOW signal. Indicates that there is a fault present in the PSU3. Internally pulled up to 3V_ISO via 10k ohm resistor.

AC_OK#3 (J5_Pin 4)

Active LOW signal. Indicates that the input supply voltage is within allowable limits and the PSU3 can use and turn on. Internally pulled up to 3V_ISO via 10k ohm resistor.

DC_OK#3 (J5_Pin 5)

Active LOW signal. Indicates that the PSU3 main output is within the regulation band. Internally pulled up to 3V_ISO via 10k ohm resistor.



POWER AND CONTROL SIGNAL DESCRIPTIONS

0-10V_PROG1_3 (J5_Pin 6)

An analog programming command that accepts a DC voltage up to 10V (with respect to ISO_PRTN) in order to adjust the PSU3 output voltage or current.

0-24V _PROG1_3 (J5_Pin 8)

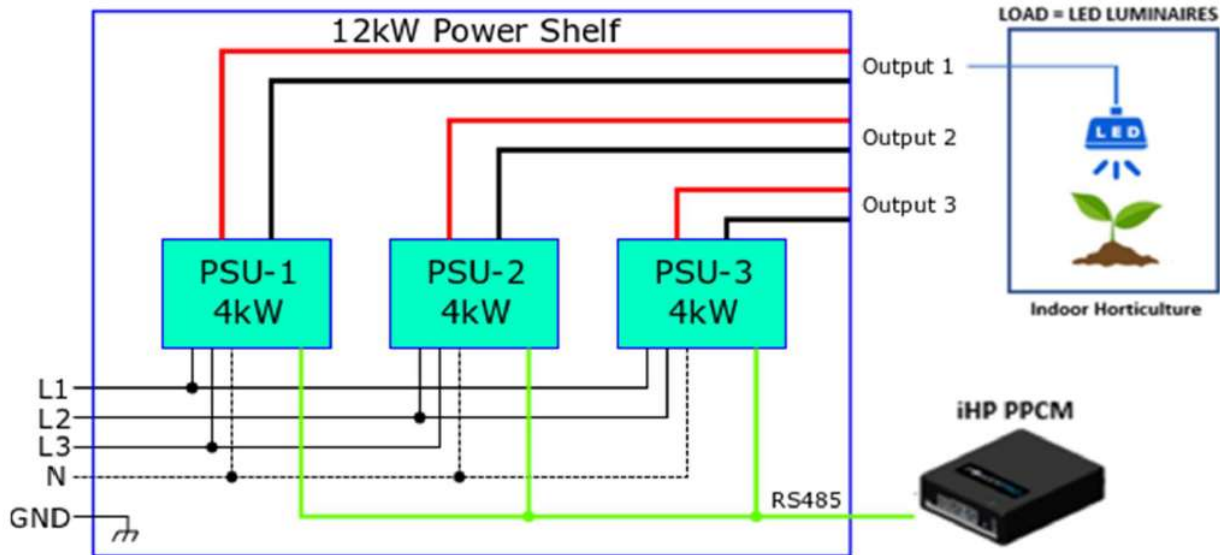
An analog programming command that accepts a DC voltage up to 24V (with respect to ISO_PRTN) in order to adjust the PSU3 output voltage or current.

ISO_PRTN (J5_Pin 7 & J5_Pin 9)

The isolated signal return (or ground).

APPLICATION NOTES

Power Distribution Architecture



APPLICATION NOTES

Application



Retail Store LED Lighting



RECORD OF REVISION AND CHANGES

Issue	Date	Description	Originators
1.0	11.16.22	First Issue	J. Ma
1.1	12.30.22	Add a detailed table which shows the input voltage & current, efficiency and recommended breaker.	J. Ma
1.2	04.04.23	Add DLC Life Projection Data	J. Ma



For international contact information,
visit advancedenergy.com.

powersales@aei.com (Sales Support)
productsupport.ep@aei.com (Technical Support)
+1 888 412 7832

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