

ADVANCED ENERGY FCM30K SERIES MODULE

30,000 W Bulk Front End
Narrow Trim



PRODUCT DESCRIPTION

Advanced Energy's FCM30K Narrow Trim Series provides for a 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 95.5%, these units are ideal for use in industrial applications. They are backed by a comprehensive set of industrial 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.

SPECIAL FEATURES

- 30,000 W output power
- 85.2 mm x 448 mm x 595 mm
- -40 to +50°C, for variants capable of operating up to 70°C, (+50°C to 70°C) power is derated
- 5 V at 1 A housekeeping
- High efficiency: >95.5% typical at full load
- Supports Read-Only NFC Tag Application
- Semi F47 compliance (Tested at 480 VAC, 54.5 VDC, 30 kW)
- Five-year warranty

SAFETY

- UL 62368-1, 3rd Ed
- CAN/CSA C22.2 No. 62368-1:19, 3rd Ed
- EN IEC 62368-1:2020/A11:2020
- IEC 62368-1: 2018 3rd Ed
- CB Certificate and Report (IEC 62368-1 3rd Ed)
- CE (LVD+RoHS), EN 62368-1 3rd Edition

COMPLIANCE

- EMI Class B, with 6 dB margin
- EN61000 Immunity

AT A GLANCE

Total Power

30,000 W

Input Voltage

187 to 528 VAC, 3 Phase 3 Wire + PE

Nominal Output Voltage

54.5 VDC

of Outputs

Single



TABLE OF CONTENTS

Section 1	Model Numbers	4
Section 2	Electrical Specifications	5
2.1	Absolute Maximum Ratings	5
2.2	Input Specifications	6
2.3	Output Specifications	7
2.4	Performance Curves	8
2.5	Protection Function Specifications	11
Section 3	Mechanical Specifications	13
3.1	Mechanical Outlines	13
3.2	Connector Definitions	18
3.3	Power/Signal Mating Connectors and Pin Types	21
3.4	PSM LED Indicator Definition	22
3.5	PSU LED Indicator Definition	23
Section 4	Environmental Specifications	24
4.1	EMC Immunity	24
4.2	Safety Certifications	25
4.3	EMI Emissions	26
4.4	Operating Temperature	28
4.5	Forced Air Cooling	28
4.6	Output Power Derating with Respect to Input Voltage	28
4.7	Storage Temperature	28
4.8	Altitude	28
4.9	Humidity	28
4.10	Vibration	29
4.11	Shock	29

TABLE OF CONTENTS

Section 5	Power and Control Signal Descriptions	30
5.1	Input Terminal	30
5.2	Output Terminal	30
5.3	Isolated Signals	31
5.4	Non- Isolated Signals	32
Section 6	MODBUS Specification	33
6.1	FCM30K Narrow Trim Series MODBUS General Instructions	33
6.2	The FCM30K Narrow Trim Series Supported Modbus Command List	37
Section 7	Application Notes	51
7.1	Mode of Operation	51
7.2	Current Share	52
7.3	Output Ripple and Noise Measurement	53
7.4	Accessories	54
Section 8	Record of Revision and Changes	56

SECTION 1 MODEL NUMBERS

Standard	Nominal Output Voltage	Trim Range	Max Current	Standby Output	Efficiency
FCM30KSHNW	54.5 VDC	48 to 60 VDC	550.5A	5V at 1A	95.5% (480VAC / 54.5VDC)

FCM30K-SHF MODEL NUMBER SCHEME						
FCM30KSHYX	-	A	B	C	D	4XX
Shelf Size (mm)		Input Connector Option	Interface Type	Input Codes	Option Codes	Hardware Code
30000W = 85.2 x 448 x 595		T = Input Terminal Block	R = MODBUS RTU	M = PMI Added	Blank = No Options	4XX = Mod Codes
		P = Input Connection Plug (Pluggable module)		N = PMI Removed	1 = Conformal Coat	
					2 = Future Option	
Module Trim Range Y =						
Code	Volts					
N	Narrow/Std Trim					
Module Output Code X =						
Code	Volts					
W	54.5V					

Example - FCM30KSHNW-PRM = FCM30K Shelf 54V Narrow Trim, Pluggable AC input, MODBUS RTU, with PMI

SECTION 2 ELECTRICAL SPECIFICATIONS

2.1 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 AC continuous operation	All modules	$V_{IN,AC}$	187	-	528	VAC
Maximum Output Power 60VDC 54.5VDC 48VDC	All modules	$P_{O,max}$	- - -	- - -	30000 30000 26400	W
Isolation Voltage Primary to Protective Earth (PE) Primary to Secondary Primary to Isolated Secondary Secondary to Isolated Secondary Secondary to Protective Earth (PE) ¹ Isolated Secondary to Protective Earth (PE) ¹	All modules		- - - - - -	- - - - - -	2500 5000 5000 500 100 100	VDC VDC VDC VDC VDC VDC
Ambient Operating Temperature ²	All modules	T_A	-40	-	+50	°C
Storage Temperature	All modules	T_{STG}	-40	-	+85	°C
Humidity (non-condensing) Operating Non-operating	All modules		10 10	- -	90 95	% %
Altitude Operating Non-operating	All modules		- -	- -	3000 9144	m m
MTBF ³	All modules		200	-	-	kHours

Note 1 - 100 VDC applies to PSU variant with output voltage 60V. During production test, remove SPD connect or disconnect screw for both shelf and module before Hi-pot test; During safety test, lift GDT and remove SPD connect or disconnect Screw before conducting safety level test.

Note 2 - Start at -40°C requires a 5 minutes operating warm-up. Above 50°C to 70°C power is derated.

Note 3 - Using Telcordia specifications @ 25°C ambient at full load, nominal line of 220V/240V AC. With the power supply installed in a system in a 35°C ambient environment and operating at full load, capacitor life shall be 5 years, minimum, for all electrolytic capacitors contained within this power supply.

SECTION 2 ELECTRICAL SPECIFICATIONS

2.2 Input Specifications

Table 2. Input Specifications						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, AC	All	$V_{IN,AC}$	187	208	229	VAC
			216	240	264	VAC
			311	346	381	VAC
			324	360	396	VAC
			342	380	418	VAC
			360	400	440	VAC
			396	440	484	VAC
			432	480	528	VAC
Input AC Frequency	All	f_{IN}	47	50/60	63	Hz
Maximum Input Current ($I_O = I_{O,max}$)	$V_{IN,AC} = 480 \text{ VAC}$ $V_O = 54.5 \text{ VDC}$ $P_O = 30,000 \text{ W}$	$I_{IN,max}$	-	-	45	A
No Load Input Current ($V_O = \text{On}$, $I_O = 0 \text{ A}$)	$V_{IN,AC} = 480 \text{ VAC}$	$P_{IN,no-load}$	-	2.29	-	A
Harmonic Line Currents	All	THD	EN 61000-3-12			
Power Factor	$V_{IN,AC} = 480 \text{ VAC}$ $V_O = 54.5 \text{ V}$ $I_O = 10\% I_{O,max}$ $I_O = 25\% I_{O,max}$ $I_O = 50\% I_{O,max}$ $I_O = 100\% I_{O,max}$	PF	-	0.78	-	-
			-	0.90	-	-
			-	0.98	-	-
			-	0.98	-	-
			-	0.98	-	-
Startup Surge Current (Inrush)	All	$I_{IN,surge}$	-	-	180	A_{PK}
Efficiency	$V_{IN,AC} = 480 \text{ VAC}$ $I_O = 10\% I_{O,max}$ $I_O = 20\% I_{O,max}$ $I_O = 50\% I_{O,max}$ $I_O = 80\% I_{O,max}$ $I_O = 100\% I_{O,max}$	η	-	91.0	-	%
			-	93.0	-	%
			-	96.0	-	%
			-	95.8	-	%
			-	95.5	-	%
System Stability	Phase Margin Gain Margin		45	-	-	$\emptyset$
			-6	-	-	dB

SECTION 2 ELECTRICAL SPECIFICATIONS

2.3 Output Specifications

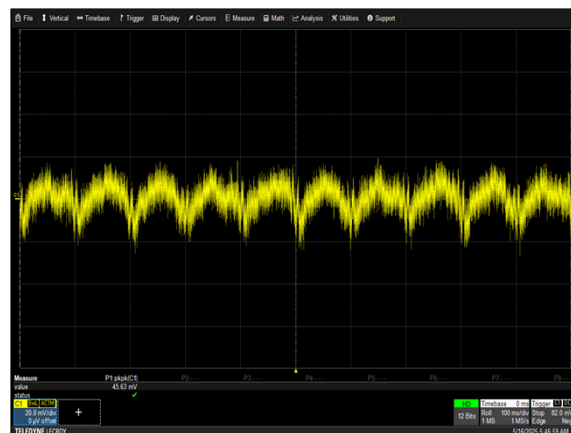
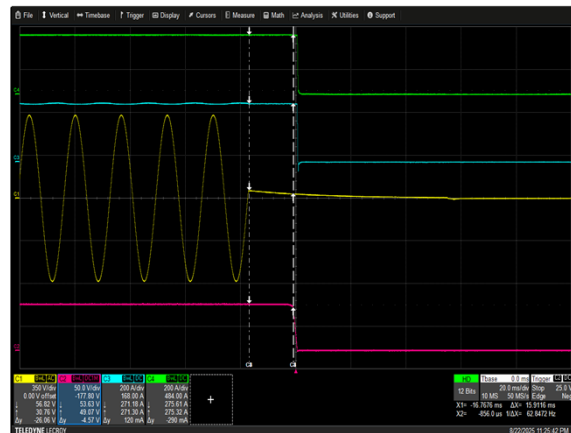
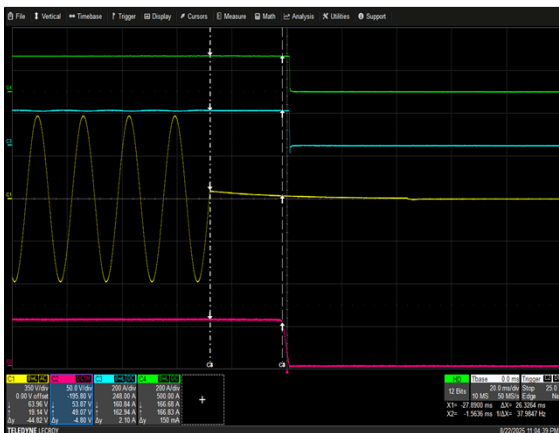
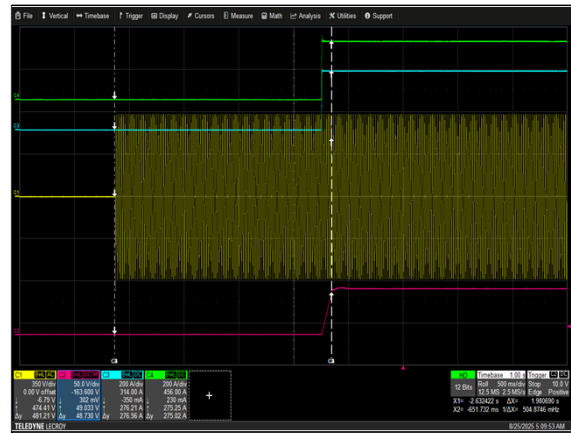
Table 3. Output - Module In Voltage Source Mode						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Nominal Output Voltage	All	V_O	-	54.5	-	VDC
Standby Output Voltage	All	$V_{Standby}$	4.7	5 ¹	5.25	VDC
Output Current	All	I_O	0	-	551	A
Standby Output Current	All	$I_{Standby}$	0	-	1	A
Output Voltage Adjustment Range	All	V_O	48	-	60	VDC
Programming Accuracy	Via digital command	$\pm\%V_O$	-	-	1	%
Output Static Regulation	At steady state line	V_O $\pm V_{Standby}$	- -	- -	+1/-2 5	%
	At steady state load	V_O $\pm V_{Standby}$	- -	- -	+1/-2 5	%
	At no load	V_O $\pm V_{Standby}$	- -	- -	+2/-2 5	%
Line Transient Regulation Peak Deviation	All	$\pm V_O$	-	-	3	%
Load Transient Regulation Peak Deviation	25% load change 1A/us slew rate	$\pm\%V_O$	-	-	5	%
Output Ripple, pk-pk		V_O $V_{Standby}$	- -	- -	1 100	% mV
Output Load Capacitance ²	All	C_O	0	-	66,000	uF
Output Rise Time	All	t_{Rise}	-	-	100	ms
Hold Up Time	$V_O = 54.5$ VDC $P_O = 18$ kW, $P_O = 30$ kW	$t_{Hold-up}$	-	-	20	ms
			-	-	12	ms

Note 1 - 5V standby guaranteed with three FCM10k PSUs.

Note 2 - The maximum capacitive load at system level is 22,000 uF per module (66000uF max).

SECTION 2 ELECTRICAL SPECIFICATIONS

2.4 FCM30K Performance Curves



SECTION 2 ELECTRICAL SPECIFICATIONS

2.4 FCM30K Performance Curves

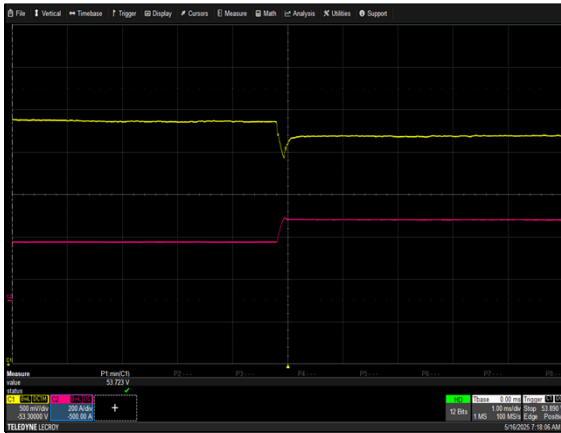


Figure 7: FCM30K Transient Response - Vo Deviation
50% to 100% load change, 1A/uS slew rate $V_{in} = 480VAC$
Ch 1: Vo Ch 2: Io

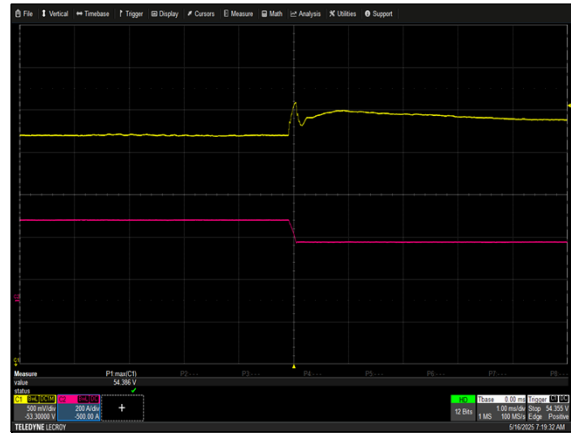


Figure 8: FCM30K Transient Response - Vo Deviation
100% to 50% load change, 1A/uS slew rate $V_{in} = 480VAC$
Ch 1: Vo Ch 2: Io

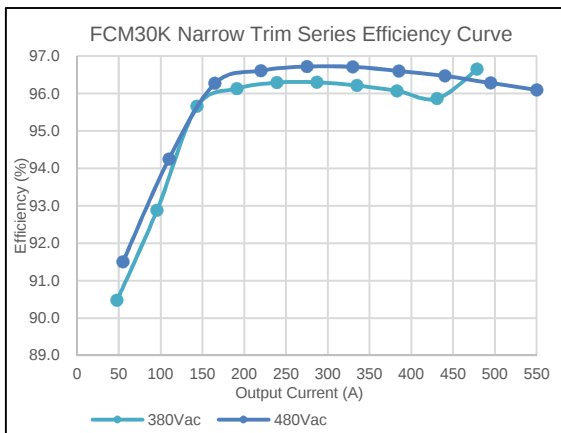


Figure 9: FCM30K Efficiency Curve @ 25°C
 $V_{in} = 380/480 VAC$
Loading: $I_o = 10\% \sim 100\% I_{o,max}$

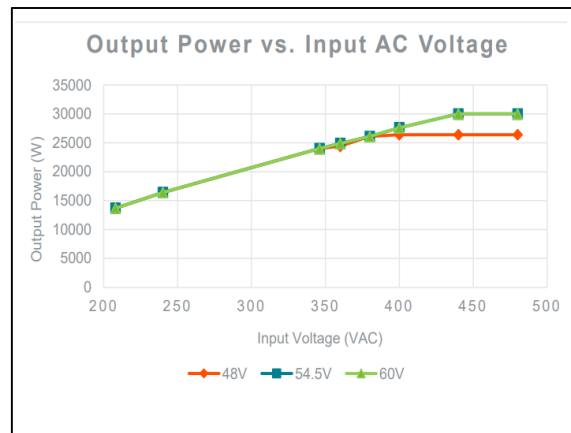


Figure 10: FCM30K Input Voltage vs. Output Power (-40°C to 50°C)

SECTION 2 ELECTRICAL SPECIFICATIONS

2.4 FCM30K Performance Curves

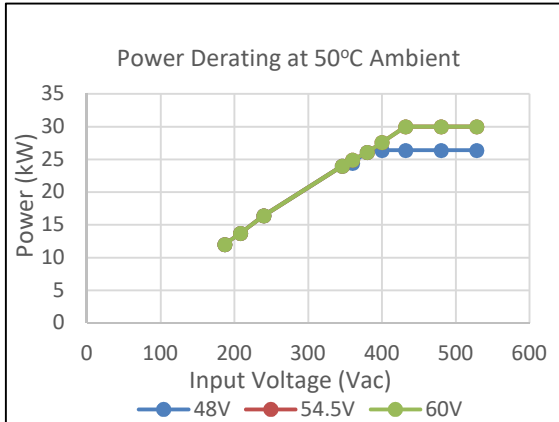


Figure 11: FCM30K Power Derating at 50°C
Note: The power derating is the same for 54.5V and 60V.

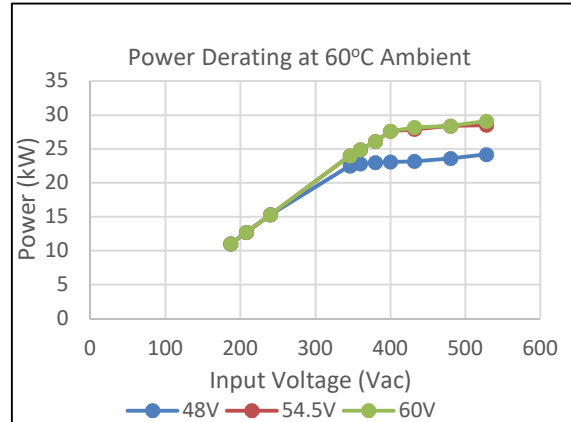


Figure 12: FCM30K Power Derating at 60°C
Note: 60°C and 70°C ambient are applicable only for variants without PMI. FCM30KSHNW-PRN and FCM30KSHNW-TRN

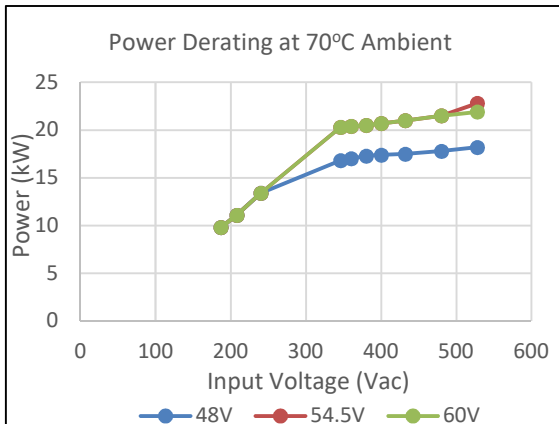


Figure 13: FCM30K Power Derating at 70°C
Note: 60°C and 70°C ambient are applicable only for variants without PMI. FCM30KSHNW-PRN and FCM30KSHNW-TRN

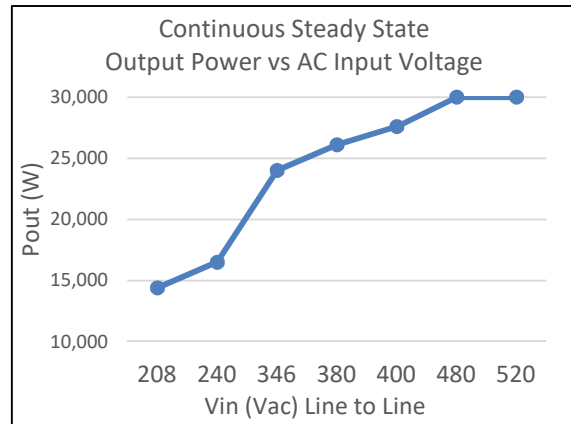


Figure 14: Steady State :FCM10K Output Power vs AC Input Voltage

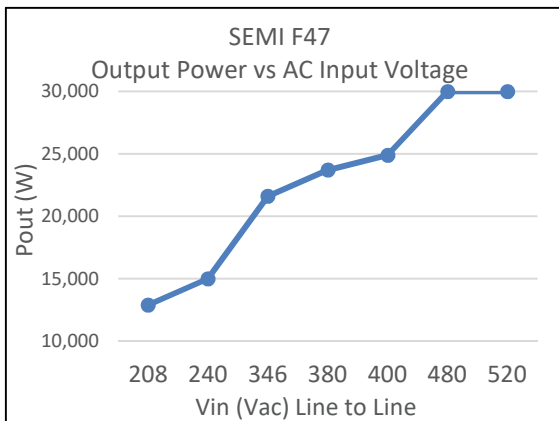


Figure 15: SEMI F47 : FCM30K Output Power vs AC Input Voltage

SECTION 2 ELECTRICAL SPECIFICATIONS

2.5 Protection Function Specifications

Over Voltage Protection (OVP)

The FCM30K Narrow Trim Series power supply is internally protected against output overvoltage.

Parameter	Main Output
First level OVP	- Tracking OVP - Scales with output voltage - Threshold should be 115% (+/- 2%) of voltage set-point - Protection response is latch - Output can be reset/turned on using MODBUS, and AC recycle
Second level OVP	- Threshold should be 65V - Protection response is Latch - Output can be reset/turned on using MODBUS, and AC recycle

Over Current Protection (OCP)

The FCM30K Narrow Trim Series power supply is internally protected against output overcurrent.

Main Output:

Parameter	Main Output
First level OCP	- Fixed setting at typical of 200A (109% of 183.5A) per module - Output voltage droops down to 87.5% of Vout or 44V whichever comes first - Once the output voltage reaches, 87.5% of Vout or 44V, the unit detects it as a fault and the main output turns off - During voltage droop, if the output load was removed (no load) expect a 5% - 115% overshoot on the main output voltage - Main output will continue to do a slow 10-time retry (2s off, 10ms on validation of fault), if the output fault is still present then unit main output remains off - Output can be reset/turned on using MODBUS and AC recycle
Second level OCP	- Tracking with respect to maximum output current set - Set at 124% of maximum output current set - If the current exceeds then immediate output shutdown - Main output will continue to do a slow 10-time retry (2s off, 10ms ON validation of fault), if the output fault is still present then the unit main output remains off - Output can be reset/turned on using MODBUS and AC recycle

Standby Output:

Parameter	Standby Output
5V Standby OCP	- OCP is 230%-280% of its full load current for single module and 400% for 2 to 3 modules 5V standby output will continue to do slow 10 time retry, if the output fault is still present then latch 5V standby - Can be reset/turned on using AC recycle - PSM will turn off and modules will go to standby mode when 5V OCP is triggered or has latched.

SECTION 2 ELECTRICAL SPECIFICATIONS

Short Circuit Protection (SCP)

The FCM30K Narrow Trim Series outputs are protected from continuous output shorted conditions (no damage or reliability issues).

Parameter	Main Output
Main Output Short Circuit	- Immediate shutdown - Main output will continue to do slow 10-time retry, if the output fault is still present then unit main o/p remains off(latch) - Output can be reset/turned on using PSON, PSKILL, MODBUS, and AC recycle.
5V Standby Short Circuit	- Immediate shutdown. Will continue to do slow 10-time retry, if the output fault is still present after 10 retries then unit 5Vstandby o/p remains off(latch) - AC recycle to recover - PSM will turn off and modules will go to standby mode when 5V standby SCP is triggered or has latched.

Over Temperature Protection (OTP)

The power supply is protected against overheating to prevent damage or degradation. The power supply may overheat for several reasons; internal parts failing conditions, environmental factors, and improper use due to airflow restriction.

If only a single power supply is at fault then it should shut down its own output due to over temperature protection (OTP) and in order to resume operations, the temperature will need to fall below OTP limit with hysteresis.

The OTP limit for each module shall be set high enough to maintain safe operation. No components shall be over stressed at the temperature shutdown threshold level. There shall be enough temperature sensors within the power supply to guarantee safe operation.

The shelf has a temperature sensor on the output backplane (power supply exhaust) which will be used for internal ambient sensing. This sensor clamps at 0°C so any negative temperatures will not be read.

Criteria

- PSM shall be able to provide shelf temperature through thermal sense board.
- PSM LED shall turn blinking amber once shelf temperature reaches the set limit.
- If temperature is < 0°C, reported temperature clamps at 0-5°C.

Shelf Temperature	Address	Performance	PSM LED
-5°C < Shelf Temp ≤ 80°C	0xB7	Normal	Blue
Shelf Temp > 86°C (Recovery at 76°C)		Output shutdown	Blinking Amber (500ms)

SECTION 3 MECHANICAL SPECIFICATIONS

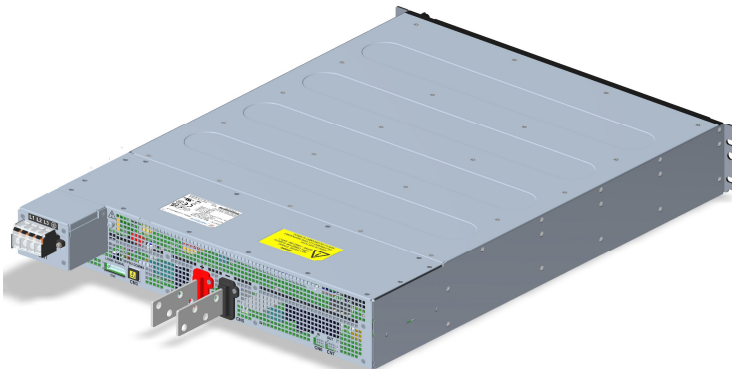
3.1 Mechanical Outlines (unit: mm)

FCM30K: 85.2 mm Hx 448 mm W x 595 mm L

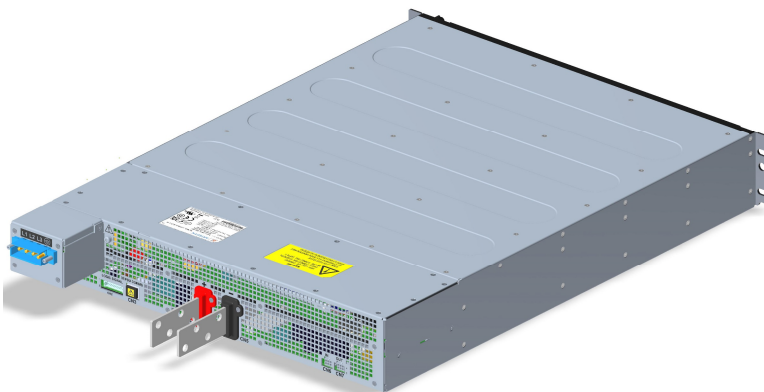
FRONT 3D View



Input Terminal Block Version REAR 3D View



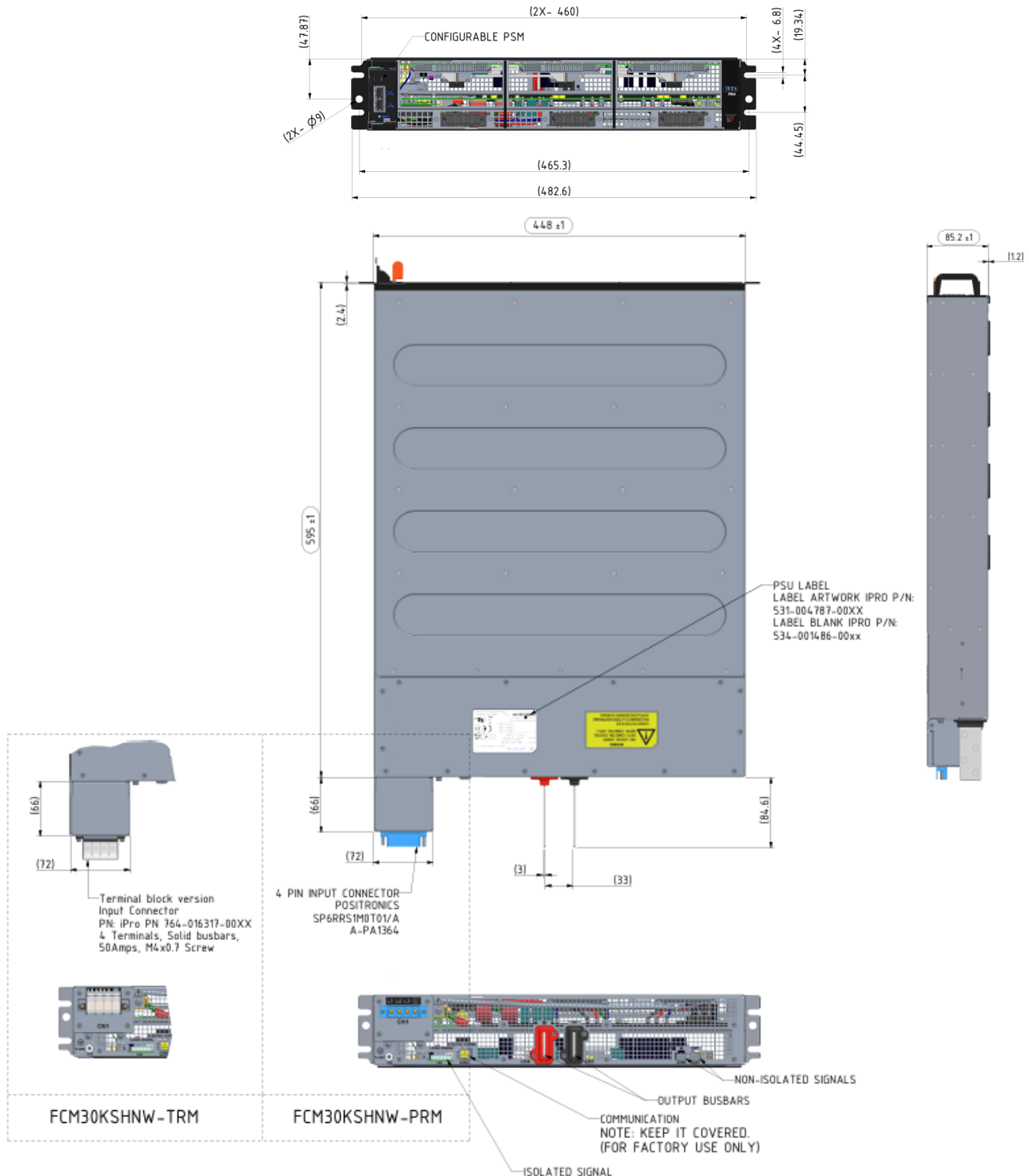
Input Pluggable Version REAR 3D View



SECTION 3 MECHANICAL SPECIFICATIONS

3.1 Mechanical Outlines (unit: mm)

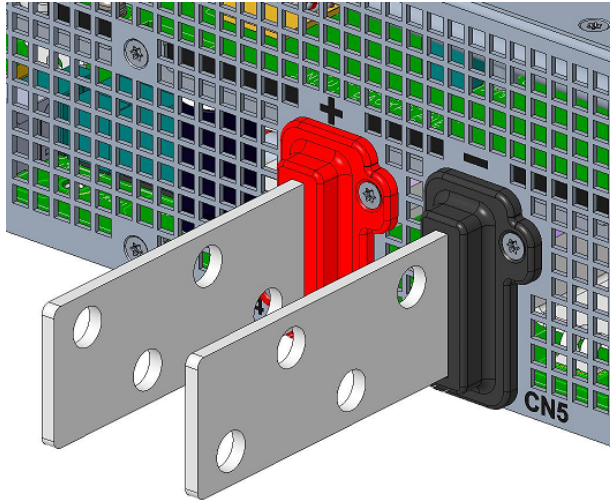
FCM30K: 85.2 mm Hx 448 mm W x 595 mm L



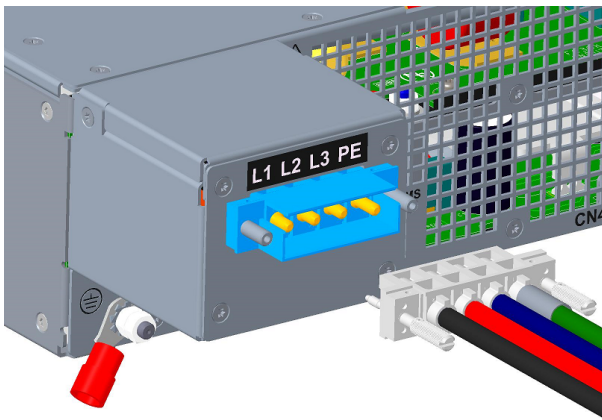
SECTION 3 MECHANICAL SPECIFICATIONS

3.1 Mechanical Outlines (unit: mm)

FCM30K: 85.2 mm H x 448 mm W x 595 mm L

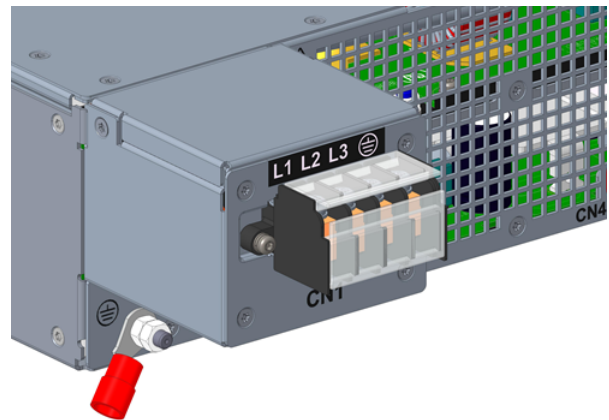


Contact productsupport.ep@aei.com for CN5 busbar weight bearing capacity.



Pluggable version details:
MFR: Positronics
MPN: SP6RRS1M0T01/AA-PA1364
Scorpion series, 4 Pins, 50Amps, w/ FMLB

Note: Wiring colors will depend on country of use

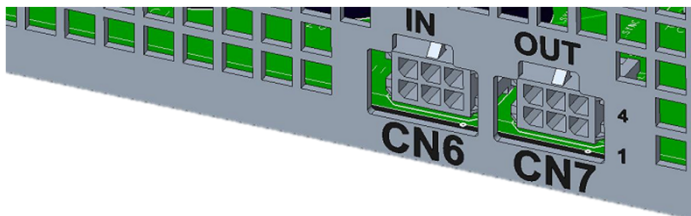


Terminal block version details:
4 terminals, solid busbars, 50Amps, M4x0.7 screw
M4 terminal block screw torque requirement:
8.0Kgf-cm (min) - 10.0Kgf-cm (max)

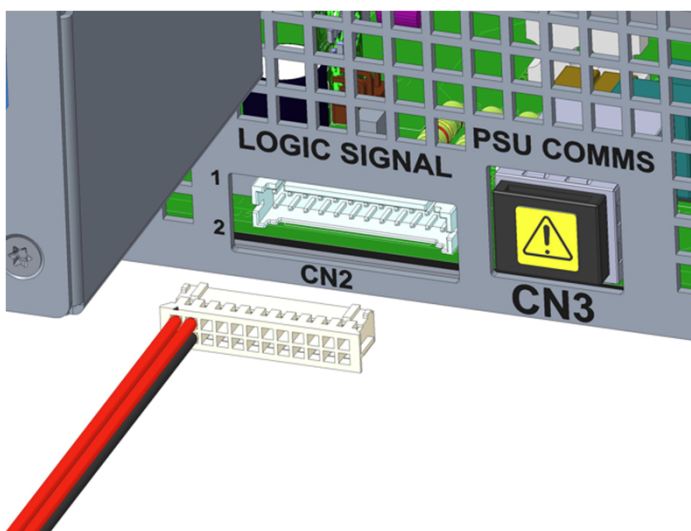
SECTION 3 MECHANICAL SPECIFICATIONS

3.1 Mechanical Outlines (unit: mm)

FCM30K: 85.2 mm Hx 448 mm W x 595 mm L



Note - CN6 and CN7 are used for parallel connection of shelves. Connect CN7 of 1 shelf to CN6 of next shelf using 750-011955-0000



Weight:

FCM10K module: 5.3kg

FCM30K shelf: 9.7kg

FCM30k shelf with three modules: 25.6kg

Note - PSU COMMS pin CN3 is intended only for AE internal debugging inside the shelf and for Factory use only. For Modbus communication, use the RJ45 at the front side located at the PSM (Power Shelf Monitoring).

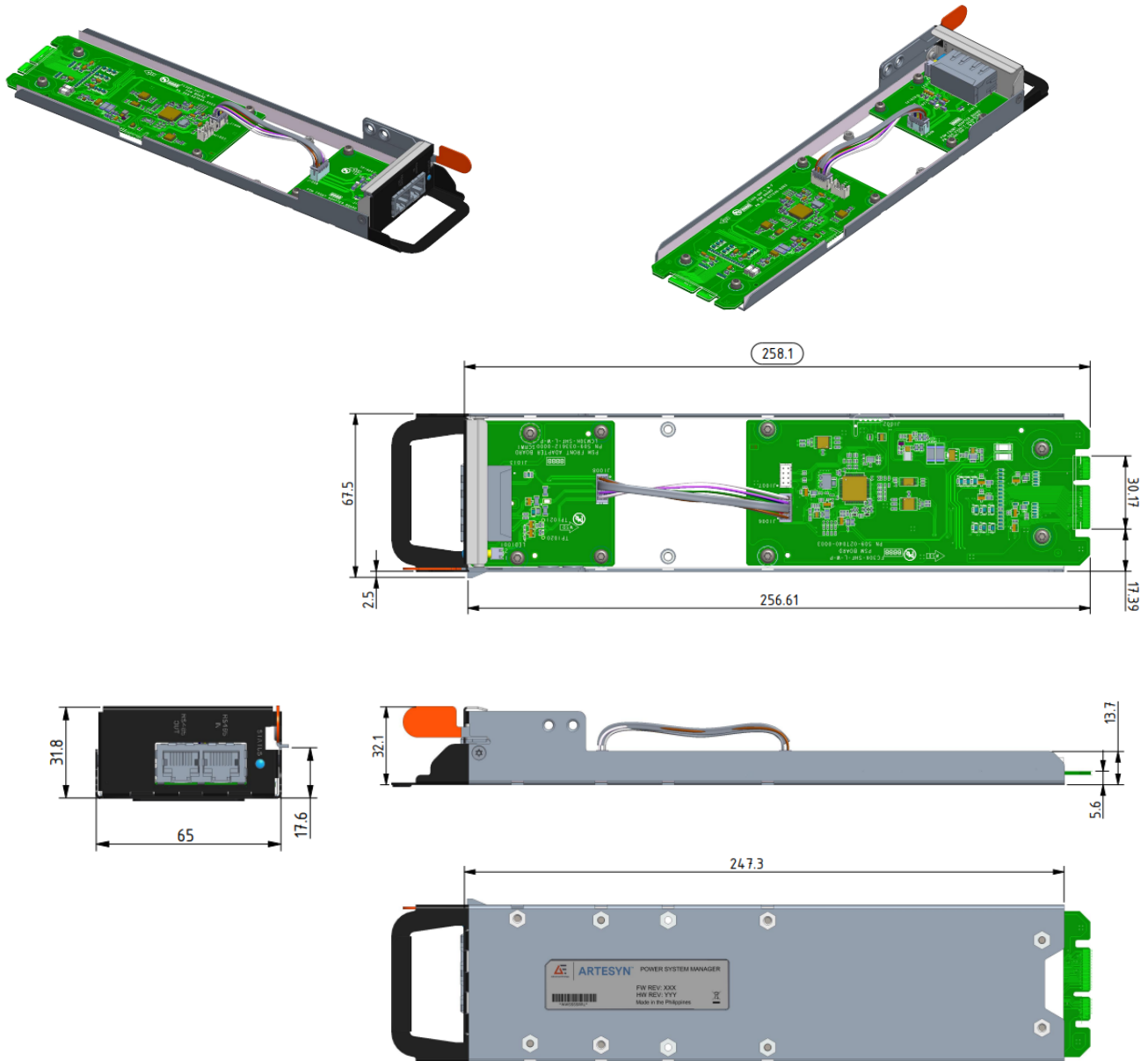
SECTION 3 MECHANICAL SPECIFICATIONS

3.1 Mechanical Outlines (unit: mm)

Power Shelf Monitoring: 31.8 mm Hx 67.5 mm W x 258.1 mm L

Front View

Rear View



SECTION 3 MECHANICAL SPECIFICATIONS

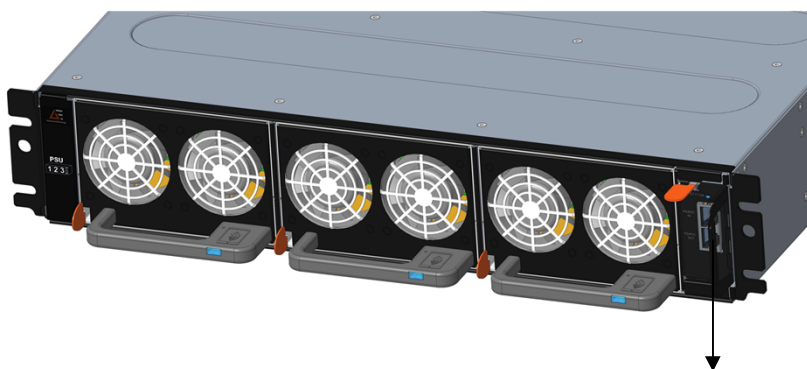
3.2 Connector Definitions

RJ45 Communication Signals

RJ45 (RS485 IN)

Supports Modbus RTU

- Pin 1 – RS485_A_SHLF
- Pin 2 – RS485_B_SHLF
- Pin 3 – N/A
- Pin 4 – N/A
- Pin 5 – N/A
- Pin 6 – N/A
- Pin 7 – 5VSB
- Pin 8 – 5VSB_GND

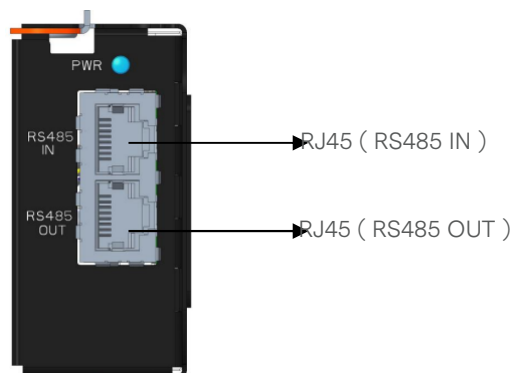


RJ45 Communication Signals Port

RJ45 (RS485 OUT)

Supports Modbus /RS485

- Pin 1 – RS485_A_SHLF
- Pin 2 – RS485_B_SHLF
- Pin 3 – N/A
- Pin 4 – N/A
- Pin 5 – N/A
- Pin 6 – N/A
- Pin 7 – N/A
- Pin 8 – N/A



SECTION 3 MECHANICAL SPECIFICATIONS

3.2 Connector Definitions

Input Connector – CN1

- L1 – Line1
- L2 – Line2
- L3 – Line3
- PE – Earth Ground

Output Busbars

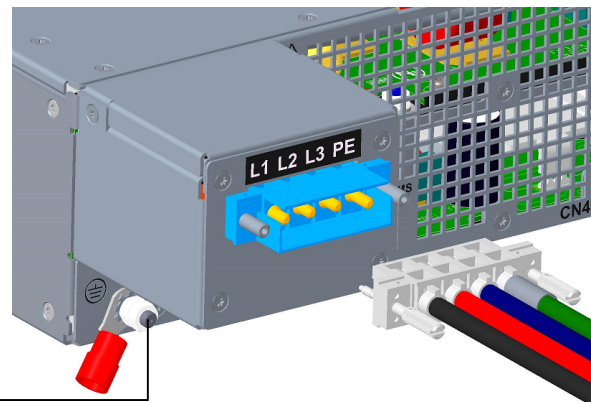
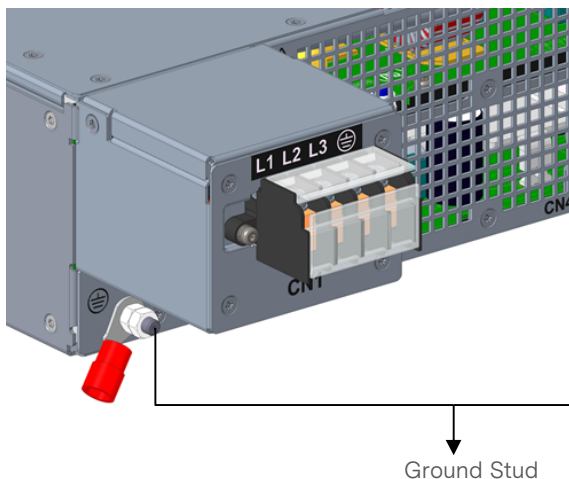
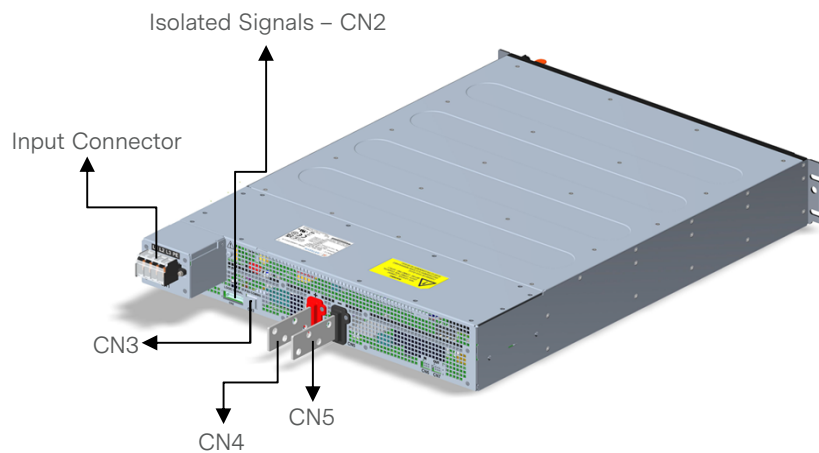
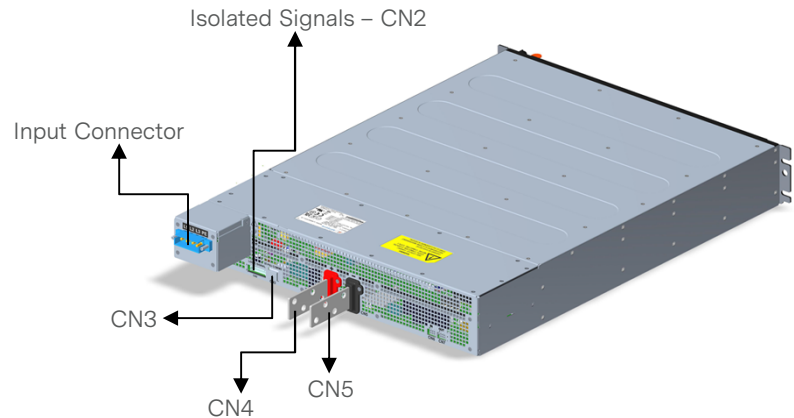
- CN4 - Main Output (+)
- CN5 - Main Output Return (-)

Isolated Signals – CN2

- Pin 1 – 5V Standby
- Pin 2 – 5V Standby_GND_SHLF
- Pin 3 – 5V Standby
- Pin 4 – 5V Standby_GND_SHLF

CN3

Note: CN3 is intended only for AE internal use only. For Modbus communication, use the RJ45 at the front side located at the PSM (Power shelf Monitoring)



Ground Stud

SECTION 3 MECHANICAL SPECIFICATIONS

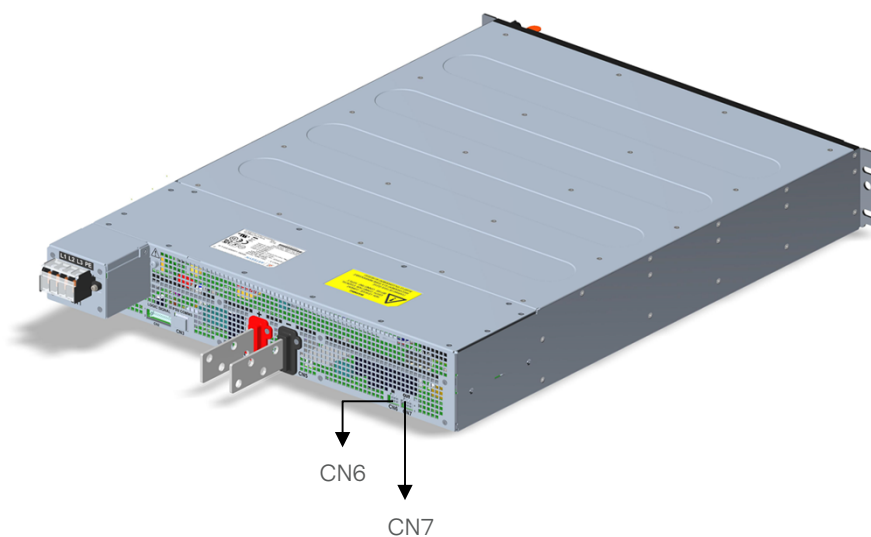
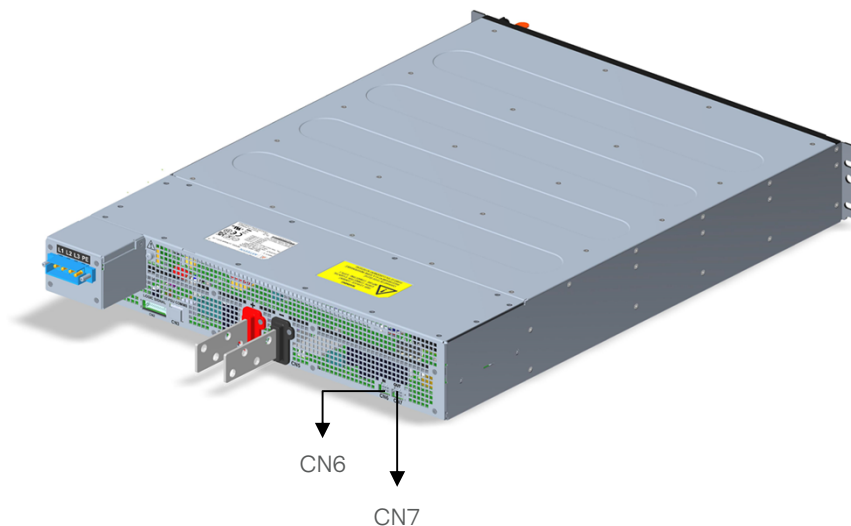
3.2 Connector Definitions

Non-Isolated Signals IN– CN6

- Pin 1 – SYS_GND_SHLF
- Pin 2 – N/A
- Pin 3 – ISHARE_SHLF_RTN
- Pin 4 – ISHARE_SHLF_IO
- Pin 5 – N/A
- Pin 6 – PSU_SYNC_IO

Non-Isolated Signals OUT– CN7

- Pin 1 – PROVISION/RESERVED
- Pin 2 – N/A
- Pin 3 – ISHARE_SHLF_RTN
- Pin 4 – ISHARE_SHLF_IO
- Pin 5 – N/A
- Pin 6 – PSU_SYNC_IO



SECTION 3 MECHANICAL SPECIFICATIONS

3.3 Power / Signal Mating Connectors and Pin Types

Table 4. Mating Connectors		
Reference	On Power Supply	Mating Connector or Equivalent
Input Connector ¹ – CN1 FCM30K-SHF-L-W-P FCM30K-SHF-L-W-T	Positronics: SP6RRS1M0T01/AA-PA1364 ² 764-016317-0000 ³	Positronics: SP6RRS1F0E01/AA-2566
Ground Stud	Ring terminal AWG 8	Molex: 19067-0008
Output Connector – CN4, CN5	CT50-10	
Isolated Signals – CN2	Landwin: 2052P2400T-01 CVILUX: C10124P1HDC-NH	Landwin: 2050S24 00
Non-isolated Signals – CN6, CN7		Molex: 43025-0600
Communication Signals – CN3	RJ45	

Note 1 - L1, L2, L3, and PE are AWG 8. Protective Earth (PE) wire (green or striped green and yellow) must always be terminated to the corresponding system Earth connection.

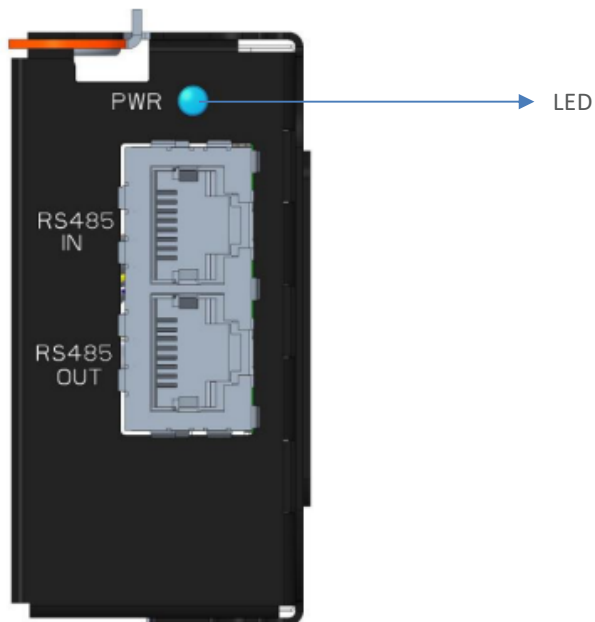
Note 2 - Scorpion Series, 4 Pins, 50Amps, w/ FMLB

Note 3 - Terminals, Solid busbars, 50Amps, M4x0.7 Screw

SECTION 3 MECHANICAL SPECIFICATIONS

3.4 PSM LED Indicator Definitions

One bi-color (blue/amber) LED is provided on the top of the PSM on the power shelf. The status LED conditions is shown on the table below.



Conditions	LED Status
Normal operation (INT_SUPPLY state is ON 3V3_INT_SUPPLY is ON)	Solid Blue
Module firmware update in progress	Blinking Blue (0.5s ON; 0.5s OFF)
Module config error*	Solid Amber
Shelf internal comm error	Blinking Amber (0.2s ON; 0.2s OFF)
Shelf over temperature protection	Blinking Amber (0.5s ON; 0.5s OFF)
No AC input power	OFF

SECTION 3 MECHANICAL SPECIFICATIONS

3.5 PSU 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.



Conditions	LED Status
AC present, main output ON, standby output ON	Solid Blue
Standby mode	Blinking Blue (1s ON; 1s OFF)
Any kind of fault (output over voltage/over current/over temperature/ short circuit)	Solid Amber
In system programming	Fast Blinking Blue (0.5s ON; 0.5s OFF)
Wrong installation/connection of L1, L2 or L3 on the PSU AC input connector or Shelf	Blinking Amber (1s ON; 1s OFF)
AC input under voltage/over voltage/out of operating condition	Blinking Amber (3s ON; 3s OFF)

SECTION 4 ENVIRONMENTAL SPECIFICATIONS

4.1 EMC Immunity

FCM30K Narrow Trim Series power supply is designed to meet the following EMC immunity specifications.

Table 5. Environmental Specifications			
Test Items	Standard	Test Level	Criteria ¹
Conducted Emissions	CISPR 32/EN 55032	Class A. 150k to 30MHz	6dB Margin, average
Radiated Emissions	CISPR 32/EN 55032	Class A. 30M to 1GHz	6dB Margin, average
	FCC CFR 47, Part 15, Subpart B	Class A. 30M to 1GHz	6dB Margin, average
Voltage Fluctuations	IEC 61000-3-11	-	-
Harmonic Current Emissions	EN 61000-3-12	-	-
Electro Static Discharge (ESD) Immunity	EN/IEC 61000-4-2	Typical test points: 6kV contact, 8kV air	A
		Non-typical test points: 6kV contact, 8kV air	A
Radiated RF EM Fields Susceptibility	EN/IEC 61000-4-3	80MHz-1GHz, Level 3 (10V/m)	A
Electrical Fast Transients (EFT) / Bursts	EN/IEC 61000-4-4	AC Power Port: +/-4kV I/O Signal Port: +/-0.5kV	A B
Surges - Line to Line (DM) and Line to GND (CM)	EN/IEC 61000-4-5	2kV DM (line to line), 4kV CM(line to Earth)	A
	IEEE C62.41	2kV DM (line to line), 2kV CM(line to Earth)	A
Conducted Immunity	EN/IEC 61000-4-6	150kHz-80MHz, Level 3 (10V/m)	A
Power Frequency Magnetic Field Immunity	EN 61000-4-8	50kHz, Level 3 (10A/m)	A
Voltage Dips and Interruptions	IEC 61000-4-34	10ms, >95% Reduction	A
		500ms, >30% Reduction	A
		5s, >95% Reduction	C
		500ms, >95% Reduction	C

Note 1 - Performance criteria of EN61000-4-X standards as defined by EN55035. According to the standards, performance criteria are defined as following:

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.

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.

C - Loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the user. A reboot or re-start is allowed.

SECTION 4 ENVIRONMENTAL SPECIFICATIONS

4.2 Safety Certifications

The FCM30K Narrow Trim Series is intended for system use and must be installed by a qualified person. The installer must ensure that the product is compliant with end application requirements.

Table 6. Safety Certifications for FCM30K Narrow Trim Series Power Supply System		
Standard	Agency	Description
UL 62368-1, 3 rd Ed Recognized	UL	US Requirement
CAN/CSA C22.2 No. 62368-1:19, 3 rd Ed	CSA	Canada Requirement
EN IEC 62368-1: 2020/A11:2020		European Requirements
IEC 62368-1: 2018 3 rd Edition		International Electrotechnical Commission
CE (LVD + RoHS), EN 62368-1 3 rd Edition		European Requirements
CB Certifications and Report (IEC 62368-1 3 rd Edition)		All CENELEC Countries

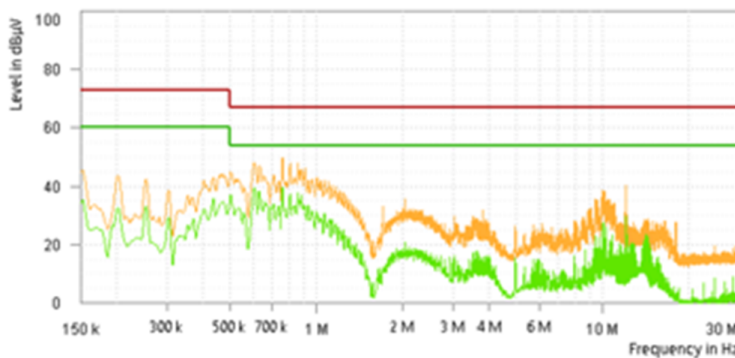
SECTION 4 ENVIRONMENTAL SPECIFICATIONS

4.3 EMI Emissions

The FCM30K Narrow Trim 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 30kW 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 FCM30K Narrow Trim Series has internal EMI filters to ensure the converters' 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 480 VAC three phase input.

Conducted EMI emissions specifications of the FCM30K Narrow Trim Series power system:

Parameter	Model	Symbol	Min	Typ	Max	Unit
FCC CFR 47, Part 15, class A	All	Margin	6	–	–	dB
CISPR 32 (EN55032), class A	All	Margin	6	–	–	dB

SECTION 4 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.

SECTION 4 ENVIRONMENTAL SPECIFICATIONS

4.4 Operating Temperature

The FCM30K Narrow Trim Series power supplies can start and operate within the stated specifications at an ambient temperature from -40°C to 50°C under all load conditions with an internal fan (full performance). Above 50°C to 70°C, the output power will be derated linearly. The FCM30K Narrow Trim Series power supplies is able to start at -40°C rated full load.

4.5 Forced Air Cooling

The power supply will operate with forced air. Worst case fan noise shall not exceed 83dBA. Test method as per ISO 3744.

4.6 Output Power Derating with respect to Input Voltage

Output Voltage ¹	Input Voltage (Nominal)	Max Continuous Power (Steady State)	Semi F47
54.5V to 60V	480 VAC	30,000 W	30,000 W
	400 VAC	27,600 W	24,900 W
	380 VAC	26,100 W	23,700 W
	346 VAC	24,000 W	21,600 W
	240 VAC	16,500 W	15,000 W
	208 VAC	14,400 W	12,900 W

Note 1 – For output voltage below 54.5V, please contact productsupport.ep@aei.com.

4.7 Storage Temperature

The FCM30K Narrow Trim Series can be stored or shipped at temperatures between -40°C to +85°C.

4.8 Altitude

The FCM30K Narrow Trim Series will operate within specifications at altitudes up to 9,842.52 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.

4.9 Humidity

The FCM30K Narrow Trim Series will operate within specifications when subjected to a relative humidity from 10% to 90% non-condensing. The FCM30K Narrow Trim Series can be stored in a relative humidity from 10% to 95% non-condensing.

SECTION 4 ENVIRONMENTAL SPECIFICATIONS

4.10 Vibration

The FCM30K Narrow Trim Series will pass the following vibration specifications:

Non-operating sine vibration shelf stand alone

Acceleration	1	gRMS
Amplitude	3	mm
Frequency Range	5 - 500	Hz
Duration	10	Sweeps for each of the three axes.
Sweep Rate	1	Oct/min

Non-operating sine vibration shelf stand alone

Acceleration	0.5	gRMS
Amplitude	1.5	mm
Frequency Range	5 - 500	Hz
Duration	10	Sweeps for each of the three axes.
Sweep Rate	1	Oct/min

4.11 Shock

The FCM30K Narrow Trim Series will pass the following shock specifications:

Non-Operating Half-Sine Shock (Shelf without three power supplies)

Acceleration	12	G
Duration	11	ms
Pulse	Half-Sine	
Number of Shock	10 shocks for each of the six faces	

Operating Half-Sine Shock (Shelf with three power supplies)

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

SECTION 5 POWER AND CONTROL SIGNAL DESCRIPTIONS

5.1 Input Terminal

This connector supplies the AC Mains to the FCM30K Narrow Trim Series power supply.

- L1 – Line1
- L2 – Line2
- L3 – Line3
- PE – Earth Ground

Power Supply Input Voltage		
Nominal	Range	Remarks
208VAC	187VAC to 229 VAC	Derived from 3 phase 208VAC Mains (Line-to-Line)
240VAC	216VAC to 264 VAC	Derived from 3 phase 240VAC Mains (Line-to-Line)
346VAC	311VAC to 381 VAC	Derived from 3 phase 346VAC Mains (Line-to-Line)
360VAC	324VAC to 396 VAC	Derived from 3 phase 380VAC Mains (Line-to-Line)
380VAC	342VAC to 418 VAC	Derived from 3 phase 380VAC Mains (Line-to-Line)
400VAC	360VAC to 480 VAC	Derived from 3 phase 400VAC Mains (Line-to-Line)
440VAC	396VAC to 484 VAC	Derived from 3 phase 480VAC Mains (Line-to-Line)
480VAC	432VAC to 528 VAC	Derived from 3 phase 480VAC Mains (Line-to-Line)

5.2 Output Terminal

This connector provides the main output for the FCM30K Narrow Trim Series power supply.

- CN4 - Main Output (+)
- CN5 - Main Output Return (-)

SECTION 5 POWER AND CONTROL SIGNAL DESCRIPTIONS

5.3 Isolated Signals – CN2

5V Standby (Pin1, Pin3)

1A max 5V standby load. 5V load is power shelf monitoring plus other external circuits where 5V standby is accessible.

5V Standby_GND_SHLF (Pin2, Pin4)

5V Standby return point.

Do not connect to SYS_GND_SHLF, 5VSB_GND_SHLF, ISHARE_SHLF_RTN, and main output return.

SECTION 5 POWER AND CONTROL SIGNAL DESCRIPTIONS

5.4 Non- Isolated Signals – CN6, CN7

SYS_GND_SHLF (Pin 1 of CN6)

Dedicated non-isolated signal return (or ground). Do not connect to GNDL_SHLF (isolated signal return), 5V Standby_GND_SHLF, ISHARE_SHLF_RTN, SHELF_DET, and main output return.

ISHARE_SHLF_RTN (Pin 3 of CN6 & CN7)

Dedicated return for ISHARE_SHLF_IO bus. Do not connect to GNDL_SHLF (isolated signal return), 5V Standby_GND_SHLF, SYS_GND_SHLF, SHELF_DET, and main output return.

ISHARE_SHLF_IO (Pin 4 of CN6 & CN7)

Provides active current sharing feature for main output using single wire loop signal connection.

PSU_SYNC_IO (Pin 6 of CN6 & CN7)

This signal allows multiple Shelf in parallel to synchronize start-up. This signal is connected together in the backplane/ shelf.

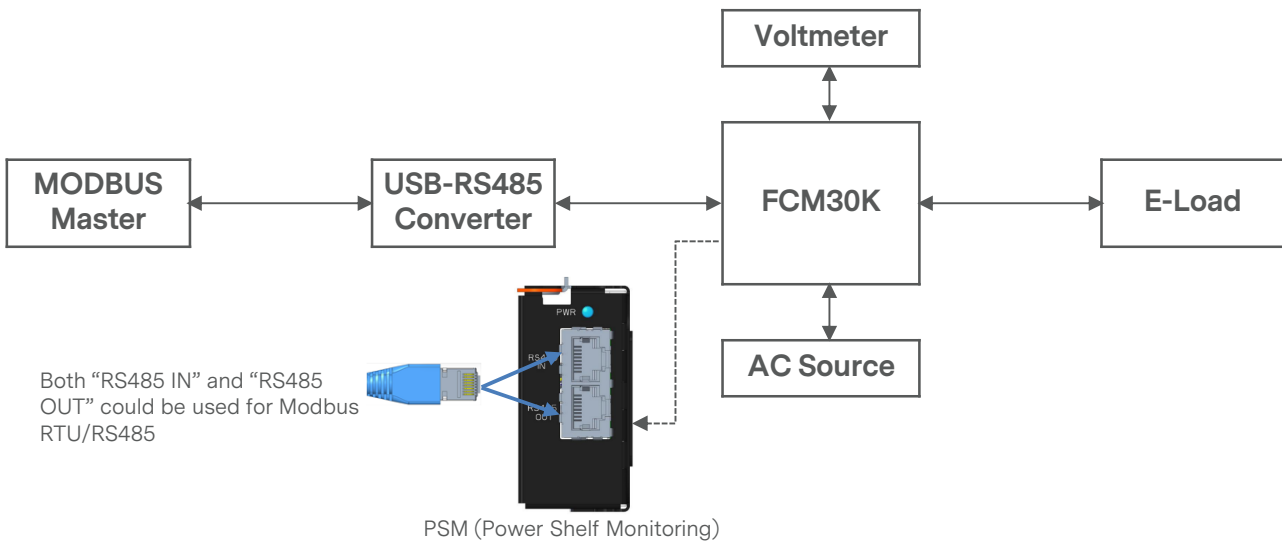
SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim Series is compliant with the MODBUS application protocol for monitoring and control of the power supply via the RS485 communication port.

6.1 FCM30K Narrow Trim Series MODBUS General Instructions

Equipment Setup

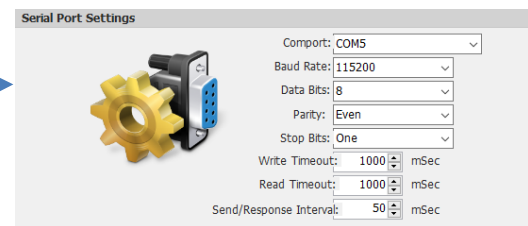
The following is typical RS485 MODBUS communication setup:



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)

Note: The PSM is not hot swappable and must remain within the shelf whenever the shelf is turned on. The PSM can be replaced while the shelf is off.

Note: It is recommended that the USB to RS485 converter must always have a 120Ω terminating resistor.

Another terminating resistor will also be placed at the RS485 OUT port of the last connected PSM in the communications path.
Stewart Connector, ASY39100-001

SECTION 6 MODBUS SPECIFICATIONS

External Device Addressing

The default PSM Modbus address is 0xB0 and configurable via the register 0xAA.

Configurable from address 0x02 to 0xFF.

If there are two or more shelf PSMs in parallel, each must have it's own unique address.

Internal Device Addressing

The power system manager (PSM) will use the high byte of the Modbus register to address individual power supplies connected.

The table below lists the addresses of each power supply:

Register Address 0xAA		
Device	Hex	Decimal
Power Supply 1	0x10	16
Power Supply 2	0x20	32
Power Supply 3	0x30	48

To access the STATUS_WORD (0x70) of power supply 2 for instance, the register address would be 0x2070.

CRC Checking

The power supply 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.

SECTION 6 MODBUS SPECIFICATIONS

Error Handling

The power supply 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 6 MODBUS Exception Responses.

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

SECTION 6 MODBUS SPECIFICATIONS

Input Reporting Accuracy with PMI

Parameter Type	Reporting Function	Hex Address	Command Name	Accuracy Range		
				0% to 100% Load		
Input	Input Voltage	0xB4	PMI- INPUT_LINE_NEUTRAL_VOLTAGE_A	± 1%		
		0xD7	PMI- INPUT_LINE_NEUTRAL_VOLTAGE_B	± 1%		
		0xD8	PMI- INPUT_LINE_NEUTRAL_VOLTAGE_C	± 1%		
		0xD9	PMI-INPUT_LINE_LINE_VOLTAGE_A_B	± 1%		
		0xDA	PMI-INPUT_LINE_LINE_VOLTAGE_B_C	± 1%		
		0xDB	PMI-INPUT_LINE_LINE_VOLTAGE_C_A	± 1%		
				0% to 15% Load	15% to 30% Load	30% to 100% Load
	Input Current	0xB5	PMI_INPUT_CURRENT_A	± 0.5 A	± 2%	± 1%
		0xDC	PMI_INPUT_CURRENT_B	± 0.5 A	± 2%	± 1%
		0xDD	PMI_INPUT_CURRENT_C	± 0.5 A	± 2%	± 1%
				15% to 20% Load		20% to 100% Load
	Input Power	0xB6	PMI_ACTIVE_POWER_TOTAL	± 5%		± 3%
		0xDE	PMI_ACTIVE_POWER_A	± 5%		± 3%
		0xDF	PMI_ACTIVE_POWER_B	± 5%		± 3%
		0xE0	PMI_ACTIVE_POWER_C	± 5%		± 3%
	Input Frequency	0xE1	PMI_INPUT_FREQUENCY	± 1%		
				15% to 30% Load		30% to 100% Load
	Power Factor		PMI_POWER_FACTOR_A	± 0.05		± 0.01
			PMI_POWER_FACTOR_B	± 0.05		± 0.01
			PMI_POWER_FACTOR_C	± 0.05		± 0.01

Temperature Reporting Accuracy

Thermal	Temperature		SHELF_READ_TEMPERATURE_1	± 5°C
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SECTION 6 MODBUS SPECIFICATIONS

6.2 The FCM30K Narrow Trim Series Supported Modbus Command List

This section summarizes all Modbus Registers that are supported which can be read by either Read Holding Register (function code 03h) or Read Input Register (function code 04h), and can be write by Write Single Register (function code 06h).

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 - STANDBY					Asserts when any of the bit is set in STATUS_STANDBY register.
	b10 - FANS					Asserts when any of the bit is set in STATUS_FAN_1_2 register
	b9:3					
	b2 - TEMPERATURE					Asserts when any of the bit is set in STATUS_TEMPERATURE register
	b1:0					
71h	STATUS_INPUT	-	R	2	Bitmapped	
	B15 - INPUT_FREQUENCY_OUT_OF_RANGE					Asserts when there is an input line frequency out of range. Auto recoverable.
	B14 - INPUT_LINE_MIXED_UP_FAULT					Asserts when there is an input line mixed up fault.
	b13:8					
	b7 - VIN_OV_FAULT					Asserts when there is an input overvoltage fault. Auto recoverable
	b6:5					
	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 - IIN_POWER_DERATING					Asserts when there is an input power derating. Auto recoverable
	b0					

SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim 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.
	b14:8					
	b7 - VOUT_OV_FAULT					Asserts when there is an output overvoltage fault. This can be cleared by Input Power Recycle.
	b6:5					
	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 - SECONDARY_RAIL_FAULT					
	b8:14					
	b7 - IOUT_OC_FAULT					Asserts when there is an output overcurrent fault. Input power and PSN, PSKILL recycle can clear this.
	b6 - IOUT_OC_LV_FAULT					Asserts when there is an output overpower fault at current source mode. Input power and PSN, PSKILL recycle can clear this.
	b5:0					

SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim 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 - PRIMARY_RAIL_FAULT					
	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_TON_MAX_FAULT					Device is unable to reach the target bulk voltage within the stated power up time.
	b12 - BOOST_OVP					Bulk voltage 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					
	b9 - BOOST_UVP					Bulk voltage is below under voltage protection level. This can be cleared by Input Power recycle.
	b8 - BOOST_BAD					A bulk voltage is below nominal voltage threshold.
	b7 - BOOST_OVP_NEGATIVE					Bulk voltage on negative rail is above overvoltage protection level. This can be cleared by input power recycle.
	b6 - BOOST_OVP_POSITIVE					Bulk voltage on positive rail is above overvoltage protection level. This can be cleared by input power recycle.
	b5					
	b4					
	b3					
	b2 - PRIMARY_OC_FAULT					Primary Overcurrent Fault. Latch
	b1 - SECONDARY_STUCK_ISP					The SECONDARY_STUCK_ISP is a status if secondary controller is stuck in ISP Mode.
	b0 - PRIMARY_STUCK_ISP					The PRIMARY_STUCK_ISP is a status if primary controller is stuck in ISP Mode.

SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
75h	MODULE_DETECTION	-	R	2	Bitmapped	Returns module detected per slot.
	b15:3					
	b2 - MODULE 3					Module is present on slot 3
	b1 - MODULE 2					Module is present on slot 2
	b0 - MODULE 1					Module is present on slot 1
76h	STATUS_TEMPERATURE	-	R	2	Bitmapped	
	b15 - BOOST_LLC_OT_FAULT					Primary boost temperature is above over temperature fault limit. Auto recoverable.
	b14 - BOOST_PFC_OT_FAULT					Primary boost temperature is above over temperature fault limit. Auto recoverable.
	b13 - DCDC_OR_OT_FAULT					Secondary DCDC oring temperature is above over temperature fault limit. Auto recoverable.
	b12 - DCDC_SYNC_A_OT_FAULT					Secondary DCDC SYNC_A temperature is above over temperature fault limit. Auto recoverable.
	b11 - DCDC_SYNC_B_OT_FAULT					Secondary DCDC SYNC_B temperature is above over temperature fault limit. Auto recoverable.
	b10 - DCDC_SYNC_C_OT_FAULT					Secondary DCDC SYNC_C temperature is above over temperature fault limit. Auto recoverable.
	b9 - AMBIENT_OT_FAULT					Logic 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.
	b6:0					

SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim 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	
	b15:8					
	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.
	b5:4					
	b3 - FAN_1_SPEED_OVERRIDDEN					
	b2 - FAN_2_SPEED_OVERRIDDEN					
	b1:0					
7Dh	STATUS_SPD	-	R	2	Bitmapped	Shows the status of the SPD block.
	b15:1					
	b0 - SPD_FAIL_DETECT					0: SPD block is functional 1: SPD block is for replacement
7Eh	SHELF_STATUS_TEMPERATURE	-	R	2	Bitmapped	
	b15:7					
	b6 - OT_FAULT					Shelf temperature is above over temperature fault limit. Auto recoverable.
	b5:0					
7Fh	STATUS_PMI	-	R	2	Bitmapped	
	b15:1					
	b0 - PMI_PRESENT					Asserts when there is PMI available on the shelf.
84h	OPERATION	-	R	2	Bitmapped	Used to turn the device on and off.
	b15:9					
	b8 - CLEAR_FAULT_LATCH_COMMAND					0 – Disabled (default) 1 – Will clear the latching faults (for module main output-related faults)
	b7 - ON					0 – PSM Off (This will turn OFF all power supplies connected) 1 – PSM On (default) (This will turn ON all power supplies connected)
	b6:0					

SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Data Bytes	Data Format	Description
87h	MODULE_CONFIG	-	R/W	4		Used to configure the module.
	b15:4					
	b3 - OPERATION MODE					0 - Voltage source mode (Default) 1 - current source mode
	b2					
	b1 - PSU OUTPUT CONTROL MODE					0 - Digital mode (Default) 1 - Analog mode
	b0					
88h	MODULE_OPERATION	-	R/W	4		Used to enable/disable the module configuration.
	b15:3					
	b2 - NFC Write Disable					1 - Disable NFC Write 0 - Enable NFC Write (default)
	b1 - MODULE SYNC START OVERRIDE					1 - Enable override for sync start (Not ready for Sync) 0 - Disable override for sync start (Do Sync)
	b0 - ENABLE MODULE CONFIGURATION					0 - Disable configuration (Default) (This will turn on all power supplies) 1 - Enable configuration (This will turn off all power supplies)
AFh	SHELF_FAIL_SAFE_CONFIG					
	b15:2					
	b1 - FAIL SAFE IO POLARITY					1 - Active High 0 - Active Low (Default)
	b0 - FAIL SAFE ENABLE					0 - Disable Fail Safe (default) 1 - Enable Fail Safe

SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Size in Word	Data Format	Description
0000h	MRF_ID	-	R	2	ASCII	Default: "S077"
0002h	MFR_MODEL	-	R	10	ASCII	Default: "FCM30K-SHF-L-W-P"
000Ch	MFR_LOCATION	-	R	10	ASCII	Default: "LAGUNA" Refer to S/N MFR Location (Laguna or Cavite)
0016h	SHELF_MFR_DATE	-	R	4	ASCII	Default: "WW/YYYY" Retrieved from Shelf EEPROM
001Ah	SHELF_MFR_SERIAL	-	R	10	ASCII	Default: "SSSS" Retrieved from Shelf EEPROM
0024h	SHELF_HW_REVISION	-	R	2	ASCII	Default: "ZZ" Retrieved from Shelf EEPROM
003Bh	PMI_FW_REVISION	-	R	9	ASCII	Default: "00.00" Retrieved from Shelf EEPROM
003Eh	PSM_MFR_DATE	-	R	4	ASCII	Default: "WW/YYYY" Retrieved from PSM
0040h	PSM_MFR_MODEL	-	R	5	ASCII	Default: "83-788-011" Retrieved from PSM
0045h	PSM_MFR_LOCATION	-	R	2	ASCII	Default: "L" Retrieved from PSM
0046h	PSM_MFR_DATE	-	R	4	ASCII	Default: "WW/YYYY" Retrieved from PSM
004Ah	PSM_MFR_SERIAL	-	R	3	ASCII	Default: "SSSSS" Retrieved from PSM
004Dh	PSM_HW_REVISION	-	R	1	ASCII	Default: "ZZ" Retrieved from PSM
004Eh	PSM_FW_REVISION	-	R	3	ASCII	Default: "00.00" Retrieved from PSM
0070h	STATUS_WORD	-	R	1	Bitmapped	
0071h	STATUS_INPUT	-	R	1	Bitmapped	
0072h	STATUS_VOUT	-	R	1	Bitmapped	
0073h	STATUS_IOUT	-	R	1	Bitmapped	
0074h	STATUS_MFR_SPECIFIC	-	R	1	Bitmapped	
0075h	MODULE_DETECTION	-	R	1	Bitmapped	
0076h	STATUS_TEMPERATURE	-	R	1	Bitmapped	
0077h	STATUS_FAN_1_2	-	R	1	Bitmapped	
007Dh	STATUS_SPD	-	R	1	Bitmapped	
007Eh	SHELF_STATUS_TEMPERATURE	-	R	1	Bitmapped	
007Fh	STATUS_PMI	-	R	1	Bitmapped	
0084h	OPERATION	-	R/W	1	Bitmapped	
0085h	VREF_TRIM	-	R/W	1	x100	Default: 54.5V Range: 48.0V to 60.0V (VREF_MAX_LIMIT)

SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Size in Word	Data Format	Description
0086h	IREF_TRIM	-	R/W	1	x100	Voltage Source Mode: Default: 183.5A Range: 9.175A to 183.5A (IREF_MAX_LIMIT) Current Source Mode: Default: 9.175A Range: 9.175A to 183.5A (IREF_MAX_LIMIT)
0087h	MODULE CONFIG	-	R/W	1	Bitmapped	
0088h	MODULE OPERATION	-	R/W	1	Bitmapped	
0089h	SHELF_MODULE_COUNT	-	R/W	1	Bitmapped	Default: 3 Range: 0 to 3
00AAh	DEVICE_ADDRESS	-	R/W	1	Bitmapped	
00ABh	BAUD_RATE_CONFIG	-	R/W	1	Bitmapped	
00AFh	SHELF_FAIL_SAFE_CONFIG	-	R/W	1	Bitmapped	
00B0h	OUTPUT_VOLTAGE	-	R	1	x100	(Parallel; Highest or Average) Read from Modules
00B1h	OUTPUT_CURRENT	-	R	1	x100	(Accumulated) Read from Modules
00B2h	OUTPUT_POWER	-	R	1	x1	(Accumulated) Read from Modules
00B4h	PMI-INPUT_LINE_NEUTRAL_VOLTAGE_A	-	R	1	x1	Varies
00B5h	PMI-INPUT_CURRENT_A	-	R	1	x100	Varies
00B6h	PMI_ACTIVE_POWER_TOTAL	-	R	1	x1	Varies
00B7h	SHELF_READ_TEMPERATURE_1	-	R	1	x100	Varies
00D7h	PMI-INPUT_LINE_NEUTRAL_VOLTAGE_B	-	R	1	x1	Varies
00D8h	PMI-INPUT_LINE_NEUTRAL_VOLTAGE_C	-	R	1	x1	Varies
00D9h	PMI-INPUT_LINE_LINE_VOLTAGE_A_B	-	R	1	x1	Varies
00DAh	PMI-INPUT_LINE_LINE_VOLTAGE_B_C	-	R	1	x1	Varies
00DBh	PMI-INPUT_LINE_LINE_VOLTAGE_C_A	-	R	1	x1	Varies
00DCh	PMI-INPUT_CURRENT_B	-	R	1	x100	Varies
00DDh	PMI-INPUT_CURRENT_C	-	R	1	x100	Varies
00DEh	PMI_ACTIVE_POWER_A	-	R	1	x1	Varies
00DFh	PMI_ACTIVE_POWER_B	-	R	1	x1	Varies
00E0h	PMI_ACTIVE_POWER_C	-	R	1	x1	Varies
00E1h	PMI-INPUT_FREQUENCY	-	R	1	x1	Varies
00E2h	PMI_POWER_FACTOR_A	-	R	1	x10000	Varies
00E3h	PMI_POWER_FACTOR_B	-	R	1	x10000	Varies
00E4h	PMI_POWER_FACTOR_C	-	R	1	x10000	Varies
00E8h	PSM_TIMEOUT	-	R/W	1	x1	Default: 0 (Disabled) Range: 1 to 32767 (seconds)
0600h	PSU_BLACKBOX_PAGE	-	R/W	1	-	Default Value: 0 Value: 0-9

SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Size in Word	Data Format	Description
0601h	PSM_BLACKBOX_PAGE	-	R/W	1	-	Default Value: 0 Value: 0-9
0604h	PSM_FAULT_RECORD_STATUS_WORD	-	R	1	Bitmapped	Varies
0605h	PSM_FAULT_RECORD_STATUS_INPUT	-	R	1	Bitmapped	Varies
0606h	PSM_FAULT_RECORD_STATUS_VOUT	-	R	1	Bitmapped	Varies
0607h	PSM_FAULT_RECORD_STATUS_IOUT	-	R	1	Bitmapped	Varies
0608h	PSM_FAULT_RECORD_STATUS_MFR_SPECIFIC	-	R	1	Bitmapped	Varies
0609h	PSM_FAULT_RECORD_SHELF_STATUS_TEMPERATURE	-	R/W	1	Bitmapped	
060Ah	PSM_FAULT_RECORD_SHELF_READ_TEMPERATURE	-	R/W	1	Bitmapped	
060Bh	PSM_FAULT_RECORD_OUTPUT_VOLTAGE	-	R/W	1	x100	(Parallel; Highest Voltage) Read from PSUs
060Ch	PSM_FAULT_RECORD_OUTPUT_CURRENT	-	R	1	x100	(Accumulated) Read from PSUs
060Dh	PSM_FAULT_RECORD_OUTPUT_POWER	-	R	1	x1	(Accumulated) Read from PSUs
060Eh	PSM_FAULT_RECORD_TOTAL_TIME	-	R	1	Raw	In seconds
0610h	PMI-INPUT_LINE_NEUTRAL_VOLTAGE_A	-	R	1	Raw	In seconds
1610h	MODULE1_FAULT_RECORD_STATUS_WORD	-	R	1	Bitmapped	
1611h	MODULE1_FAULT_RECORD_STATUS_INPUT	-	R	1	Bitmapped	
1612h	MODULE1_FAULT_RECORD_STATUS_OUTPUT	-	R	1	Bitmapped	
1613h	MODULE1_FAULT_RECORD_STATUS_IOUT	-	R	1	Bitmapped	
1614h	MODULE1_FAULT_RECORD_STATUS_MFR_SPECIFIC	-	R	1	Bitmapped	
1615h	MODULE1_FAULT_RECORD_STATUS_STANDBY	-	R	1	Bitmapped	
1616h	MODULE1_FAULT_RECORD_STATUS_TEMPERATURE	-	R	1	Bitmapped	
1617h	MODULE1_FAULT_RECORD_STATUS_FAN_1_2	-	R	1	Bitmapped	
1618h	MODULE1_FAULT_RECORD_PSU_OUTPUT_VOLTAGE	-	R	1	x100	
1619h	MODULE1_FAULT_RECORD_PSU_OUTPUT_CURRENT	-	R	1	x100	
161Ah	MODULE1_FAULT_RECORD_PSU_OUTPUT_POWER	-	R	1	x1	
161Bh	MODULE1_FAULT_RECORD_PSU_OUTPUT_VOR_VOLTAGE	-	R	1	x100	
161Ch	MODULE1_FAULT_RECORD_PSU_INPUT_VOLTAGE_A	-	R	1	x1	

SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Size in Word	Data Format	Description
161Dh	MODULE1_FAULT_RECORD_PSU_INPUT_CURRENT_A	-	R	1	x100	
161Eh	MODULE1_FAULT_RECORD_PSU_INPUT_VOLTAGE_B	-	R	1	x1	
161Fh	MODULE1_FAULT_RECORD_PSU_INPUT_CURRENT_B	-	R	1	x100	
1620h	MODULE1_FAULT_RECORD_PSU_INPUT_VOLTAGE_C	-	R	1	x1	
1621h	MODULE1_FAULT_RECORD_PSU_INPUT_CURRENT_C	-	R	1	x100	
1622h	MODULE1_FAULT_RECORD_PSU_INPUT_POWER_TOTAL	-	R	1	x1	
1623h	MODULE1_FAULT_RECORD_TEMP1-PRI	-	R	1	x100	
1624h	MODULE1_FAULT_RECORD_TEMP2-SEC	-	R	1	x100	
1625h	MODULE1_FAULT_RECORD_TEMP3-BUCK	-	R	1	x100	
1626h	MODULE1_FAULT_RECORD_TEMP4-AMBIENT	-	R	1	x100	
1627h	MODULE1_FAULT_RECORD_TEMP5-NFC	-	R	1	x100	
1628h	MODULE1_FAULT_RECORD_PSU_FAN1	-	R	1	x100	
1629h	MODULE1_FAULT_RECORD_PSU_FAN2	-	R	1	x100	
162Ah	MODULE1_FAULT_RECORD_PSU_STANDBY_VOLTAGE	-	R	1	x100	
162Bh	MODULE1_FAULT_RECORD_PSU_STANDBY_CURRENT	-	R	1	x10000	
162Ch	MODULE1_FAULT_RECORD_PSU_MODULE CONFIG	-	R	1	Bitmapped	
162Dh	MODULE1_FAULT_RECORD_PSU_VREF_TRIM	-	R	1	x100	
162Eh	MODULE1_FAULT_RECORD_PSU_IREF_TRIM	-	R	1	x100	
162Fh	MODULE1_FAULT_RECORD_PSU_BAUD_RATE_CONFIG	-	R	1	-	
1630h	MODULE1_FAULT_RECORD_PSU_VREF_MAX_LIMIT	-	R	1	x100	
1631h	MODULE1_FAULT_RECORD_PSU_IREF_MAX_LIMIT	-	R	1	x100	
1632h	MODULE1_FAULT_RECORD_PSU_PRI_ADP_UART_ERROR_COUNT	-	R	1	x1	
1633h	MODULE1_FAULT_RECORD_PSU_SEC_PRI_ADP_UART_ERROR_COUNT	-	R	1	x1	
1634h	MODULE1_FAULT_RECORD_PSU_SEC_LOGIC_ADP_UART_ERROR_COUNT	-	R	1	x1	
1635h	MODULE1_FAULT_RECORD_PSU_LOGIC_ADP_UART_ERROR_COUNT	-	R	1	x1	
1636h	MODULE1_FAULT_RECORD_PSU_TOTAL_TIME	-	R	1	-	

SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Size in Word	Data Format	Description
1638h	MODULE1_FAULT_RECORD_PSU_TIME_SINCE_LAST_ON	-	R	1	-	
2610h	MODULE2_FAULT_RECORD_STSTUS_WORD	-	R	1	Bitmapped	
2611h	MODULE2_FAULT_RECORD_STSTUS_INPUT	-	R	1	Bitmapped	
2612h	MODULE2_FAULT_RECORD_STSTUS_OUTPUT	-	R	1	Bitmapped	
2613h	MODULE2_FAULT_RECORD_STSTUS_IOUT	-	R	1	Bitmapped	
2614h	MODULE2_FAULT_RECORD_STSTUS_MFR_SPECIFIC	-	R	1	Bitmapped	
2615h	MODULE2_FAULT_RECORD_STSTUS_STANDBY	-	R	1	Bitmapped	
2616h	MODULE2_FAULT_RECORD_STSTUS_TEMPERATURE	-	R	1	Bitmapped	
2617h	MODULE2_FAULT_RECORD_STSTUS_FAN_1_2	-	R	1	Bitmapped	
2618h	MODULE2_FAULT_RECORD_PSU_OUTPUT_VOLTAGE	-	R	1	x100	
2619h	MODULE2_FAULT_RECORD_PSU_OUTPUT_CURRENT	-	R	1	x100	
261Ah	MODULE2_FAULT_RECORD_PSU_OUTPUT_POWER	-	R	1	x1	
261Bh	MODULE2_FAULT_RECORD_PSU_OUTPUT_VOR_VOLTAGE	-	R	1	x100	
261Ch	MODULE2_FAULT_RECORD_PSU_INPUT_VOLTAGE_A	-	R	1	x1	
261Dh	MODULE2_FAULT_RECORD_PSU_INTPUT_CURRENT_A	-	R	1	x100	
261Eh	MODULE2_FAULT_RECORD_PSU_INPUT_VOLTAGE_B	-	R	1	x1	
261Fh	MODULE2_FAULT_RECORD_PSU_INTPUT_CURRENT_B	-	R	1	x100	
2620h	MODULE2_FAULT_RECORD_PSU_INPUT_VOLTAGE_C	-	R	1	x1	
2621h	MODULE2_FAULT_RECORD_PSU_INTPUT_CURRENT_C	-	R	1	x100	
2622h	MODULE2_FAULT_RECORD_PSU_INTPUT_POWER_TOTAL	-	R	1	x1	
2623h	MODULE2_FAULT_RECORD_TEMP1-PRI	-	R	1	x100	
2624h	MODULE2_FAULT_RECORD_TEMP2-SEC	-	R	1	x100	
2625h	MODULE2_FAULT_RECORD_TEMP3-BUCK	-	R	1	x100	
2626h	MODULE2_FAULT_RECORD_TEMP4-AMBIENT	-	R	1	x100	
2627h	MODULE2_FAULT_RECORD_TEMP5-NFC	-	R	1	x100	
2628h	MODULE2_FAULT_RECORD_PSU_FAN1	-	R	1	x100	
2629h	MODULE2_FAULT_RECORD_PSU_FAN2	-	R	1	x100	

SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Size in Word	Data Format	Description
262Ah	MODULE2_FAULT_RECORD_PSU_STANDBY_VOLTAGE	-	R	1	x100	
262Bh	MODULE2_FAULT_RECORD_PSU_STANDBY_CURRENT	-	R	1	x10000	
262Ch	MODULE2_FAULT_RECORD_PSU_MODULE_CONFIG	-	R	1	Bitmapped	
262Dh	MODULE2_FAULT_RECORD_PSU_VREF_TRIM	-	R	1	x100	
262Eh	MODULE2_FAULT_RECORD_PSU_IREF_TRIM	-	R	1	x100	
262Fh	MODULE2_FAULT_RECORD_PSU_BAUD_RATE_CONFIG	-	R	1	-	
2630h	MODULE2_FAULT_RECORD_PSU_VREF_MAX_LIMIT	-	R	1	x100	
2631h	MODULE2_FAULT_RECORD_PSU_IREF_MAX_LIMIT	-	R	1	x100	
2632h	MODULE2_FAULT_RECORD_PSU_PRI_ADP_UART_ERROR_COUNT	-	R	1	x1	
2633h	MODULE2_FAULT_RECORD_PSU_SEC_PRI_ADP_UART_ERROR_COUNT	-	R	1	x1	
2634h	MODULE2_FAULT_RECORD_PSU_SEC_LOGIC_ADP_UART_ERROR_COUNT	-	R	1	x1	
2635h	MODULE2_FAULT_RECORD_PSU_LOGIC_ADP_UART_ERROR_COUNT	-	R	1	x1	
2636h	MODULE2_FAULT_RECORD_PSU_TOTAL_TIME	-	R	1	-	
2638h	MODULE2_FAULT_RECORD_PSU_TIME_SINCE_LAST_ON	-	R	1	-	
3610h	MODULE3_FAULT_RECORD_STSTUS_WORD	-	R	1	Bitmapped	
3611h	MODULE3_FAULT_RECORD_STSTUS_INPUT	-	R	1	Bitmapped	
3612h	MODULE3_FAULT_RECORD_STSTUS_OUTPUT	-	R	1	Bitmapped	
3613h	MODULE3_FAULT_RECORD_STSTUS_IOUT	-	R	1	Bitmapped	
3614h	MODULE3_FAULT_RECORD_STSTUS_MFR_SPECIFIC	-	R	1	Bitmapped	
3615h	MODULE3_FAULT_RECORD_STSTUS_STANDBY	-	R	1	Bitmapped	
3616h	MODULE3_FAULT_RECORD_STSTUS_TEMPERATURE	-	R	1	Bitmapped	
3617h	MODULE3_FAULT_RECORD_STSTUS_FAN_1_2	-	R	1	Bitmapped	
3618h	MODULE3_FAULT_RECORD_PSU_OUTPUT_VOLTAGE	-	R	1	x100	
3619h	MODULE3_FAULT_RECORD_PSU_OUTPUT_CURRENT	-	R	1	x100	
361Ah	MODULE3_FAULT_RECORD_PSU_OUTPUT_POWER	-	R	1	x1	
361Bh	MODULE3_FAULT_RECORD_PSU_OUTPUT_VOR_VOLTAGE	-	R	1	x100	

SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Size in Word	Data Format	Description
361Ch	MODULE3_FAULT_RECORD_PSU_INPUT_VOLTAGE_A	-	R	1	x1	
361Dh	MODULE3_FAULT_RECORD_PSU_INTPUT_CURRENT_A	-	R	1	x100	
361Eh	MODULE3_FAULT_RECORD_PSU_INPUT_VOLTAGE_B	-	R	1	x1	
361Fh	MODULE3_FAULT_RECORD_PSU_INTPUT_CURRENT_B	-	R	1	x100	
3620h	MODULE3_FAULT_RECORD_PSU_INPUT_VOLTAGE_C	-	R	1	x1	
3621h	MODULE3_FAULT_RECORD_PSU_INTPUT_CURRENT_C	-	R	1	x100	
3622h	MODULE3_FAULT_RECORD_PSU_INTPUT_POWER_TOTAL	-	R	1	x1	
3623h	MODULE3_FAULT_RECORD_TEMP1-PRI	-	R	1	x100	
3624h	MODULE3_FAULT_RECORD_TEMP2-SEC	-	R	1	x100	
3625h	MODULE3_FAULT_RECORD_TEMP3-BUCK	-	R	1	x100	
3626h	MODULE3_FAULT_RECORD_TEMP4-AMBIENT	-	R	1	x100	
3627h	MODULE3_FAULT_RECORD_TEMP5-NFC	-	R	1	x100	
3628h	MODULE3_FAULT_RECORD_PSU_FAN1	-	R	1	x100	
3629h	MODULE3_FAULT_RECORD_PSU_FAN2	-	R	1	x100	
362Ah	MODULE3_FAULT_RECORD_PSU_STANDBY_VOLTAGE	-	R	1	x100	
362Bh	MODULE3_FAULT_RECORD_PSU_STANDBY_CURRENT	-	R	1	x10000	
362Ch	MODULE3_FAULT_RECORD_PSU_MODULE_CONFIG	-	R	1	Bitmapped	
362Dh	MODULE3_FAULT_RECORD_PSU_VREF_TRIM	-	R	1	x100	
362Eh	MODULE3_FAULT_RECORD_PSU_IREF_TRIM	-	R	1	x100	
362Fh	MODULE3_FAULT_RECORD_PSU_BAUD_RATE_CONFIG	-	R	1	-	
3630h	MODULE3_FAULT_RECORD_PSU_VREF_MAX_LIMIT	-	R	1	x100	
3631h	MODULE3_FAULT_RECORD_PSU_IREF_MAX_LIMIT	-	R	1	x100	
3632h	MODULE3_FAULT_RECORD_PSU_PRI_ADP_UART_ERROR_COUNT	-	R	1	x1	
3633h	MODULE3_FAULT_RECORD_PSU_SEC_PRI_ADP_UART_ERROR_COUNT	-	R	1	x1	
3634h	MODULE3_FAULT_RECORD_PSU_SEC_LOGIC_ADP_UART_ERROR_COUNT	-	R	1	x1	

SECTION 6 MODBUS SPECIFICATIONS

The FCM30K Narrow Trim Series Supported Modbus Command List

Command Code	Command Name	Default Value	Access Type	Size in Word	Data Format	Description
3635h	MODULE3_FAULT_RECORD_PSU_LOGIC_ADP_UART_ERROR_COUNT	-	R	1	x1	
3636h	MODULE3_FAULT_RECORD_PSU_TOTAL_TIME	-	R	1	-	
3638h	MODULE3_FAULT_RECORD_PSU_TIME_SINCE_LAST_ON	-	R	1	-	

SECTION 7 APPLICATION NOTES

7.1 Mode of Operation

There will be two operating modes with respect to how a system may communicate with the PSM: (1) MAP Mode and (2) ISP Mode.

7.1.1 MAP Mode

The MAP (Main Application Program) Mode is the normal operating mode of the PSM. In this mode, readable parameters are available. However, only commands under the Basic Write Protection can be written. New values written to any command in MAP mode are volatile (values will be reset to original if power is recycled).

7.1.2 ISP Mode

In ISP (In-System Programming) Mode, the firmware can be updated through the Modbus communication interface. The MAP Mode function is inhibited in ISP Mode with the exception of some Modbus commands related to the ISP operation. Only the MAP firmware will be affected by any firmware update in ISP mode. All data (except those that should change along with a firmware update, e.g. FW version) and configuration registered in the non-volatile memory will not be altered in ISP mode.

In case of a problem during firmware update (e.g. loss of power, communication error, corrupted MAP firmware, etc.) the product will remain or boot up in ISP mode to be able to reinitiate and complete the firmware update process. After a successful firmware update the PSM shall operate normally again.

During firmware update, conducting PSM or power supply module hotswap is prohibited whether it is from the same shelf or from another shelf within the same parallel connection.

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SECTION 7 APPLICATION NOTES

7.2 Current Sharing

Outputs shall be treated and connected to a common load.

The over current protection threshold for 1 shelf allows 30kW peak power and protects no less than 550.5A.

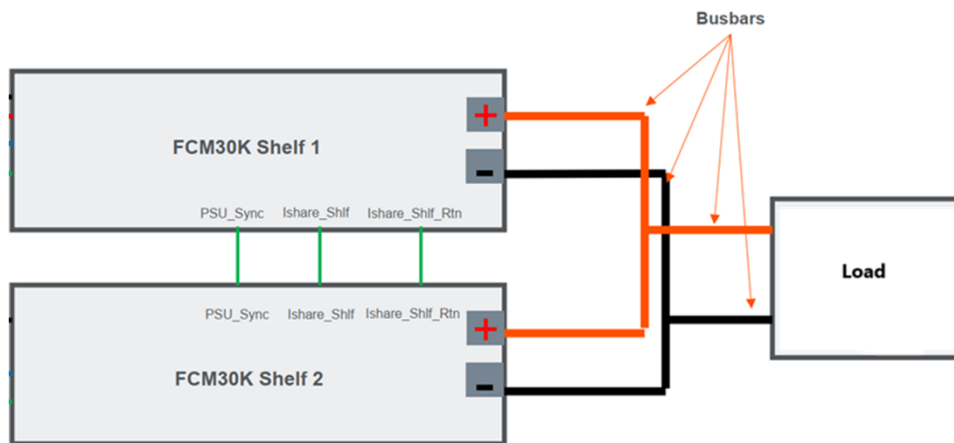
For multi-shelf power system max start-up power limited to 30KW.

No guaranteed sharing on 5Vsb output

Contact AE technical support team for the number of shelves that can be paralleled.

Parallel Shelf Set-up

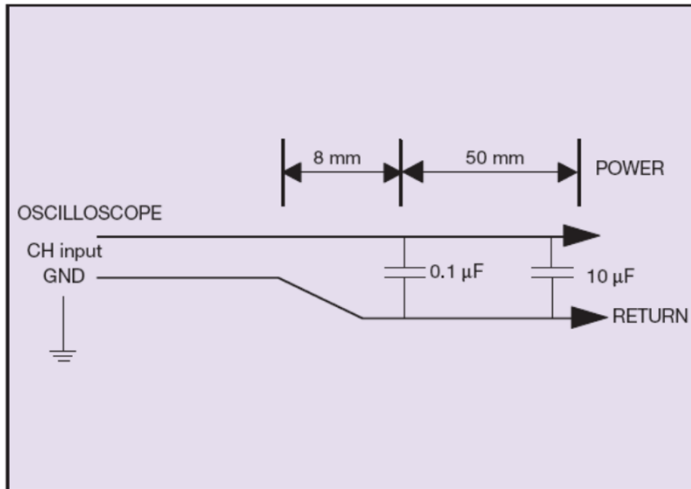
The ISHARE_SHLF, ISHARE_SHLF_RTn and PSU_SYNC should be connected as shown on diagram below.



SECTION 7 APPLICATION NOTES

7.3 Output Ripple and Noise Measurement

The setup outlined in the diagram below has been used for output ripple and noise measurements on the FCM30K Narrow Trim Series (Voltage Source Mode). When measuring output ripple and noise, a scope jack in parallel with a 0.1 μ F ceramic chip capacitor, and a 10 μ F tantalum capacitor should be used. Oscilloscope should be set to 20MHz bandwidth for this measurement.



SECTION 7 APPLICATION NOTES

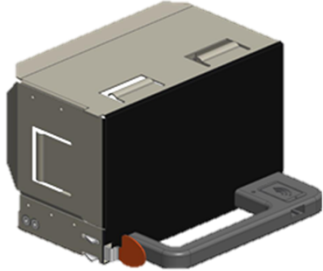
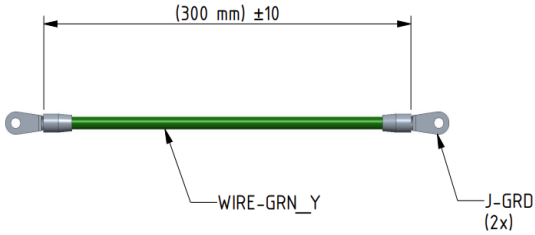
7.4 Accessories

Pluggable Version Order Test Kit number 83-788-004P.
Terminal Block Version Order Test Kit number 83-788-004T (removes input mating connector from the kit)

Description	Diagram
Input Mating Connector (Pluggable version only)	
Isolated Signal Mating	
Non-isolated Signal Mating	

SECTION 7 APPLICATION NOTES

7.4 Accessories

Description	Diagram
FCM30K Shelf Filler 83-788-007	
FCM30K 2U Parallel 83-788-008	
Ground Connector Wire Assy 83-788-009	

SECTION 8 RECORD OF REVISION AND CHANGES

Issue	Date	Description	Originators
1.0	02.12.26	First Issue	Z. Yasheng



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