TDK·Lambda

TPF12500-385
POWER SUPPLY
OPERATION MANUAL

⚠ GENERAL SAFETY INSTRUCTIONS

High Voltage Warning

Dangerous voltages are present within the power supply.

Critical Components

This product is not authorized for use as a critical component in nuclear control systems, life support systems or equipment for use in hazardous environments without the express written approval of the Engineering Director of TDK-Lambda Americas.

Servicing

This product is not customer serviceable.
Unit repairs shall only be carried out by TDK- Lambda Americas or their Authorized agents.

Contact: TDK-Lambda Americas
1669 Brandywine, Suite A
Chula Vista, CA 91911
Tel 619-575-4400
Fax 619-575-7185

Safety Class of Protection

The unit is designed for the following parameters: Material Group IIIb, Pollution Degree 2, Overvoltage Category II, Class 1 (earthed), Indoor use. The unit is considered as fixed and rated IPX0. The TPF12500-385 are capable of providing hazardous energy (>240VA). The final equipment should provide protection to service personnel against inadvertent contact with the PSU output terminals.

Installation

This product is designed for use within other equipment which restricts access to Authorized competent personnel only. The unit covers/chassis must not be made user accessible.

The mains input connector is not acceptable for use as field wiring terminals.
The appliance must be securely mounted and the Ground Stud properly bonded to the main protective earth contact before any connection to AC mains supply is made.

The ventilation openings must not be impeded – ensure a space at least 5cm between any obstruction and the ventilation openings.

BEFORE USING THE POWER SUPPLY UNIT

Be sure to read this instruction manual thoroughly before using this product. Pay attention to all cautions and warnings before using this product. Incorrect usage could lead to an electrical shock, damage to the unit or a fire hazard.

⚠ DANGER

- Never use this product in locations where flammable gas or ignitable substances are present.

⚠ WARNING

- Do not make unauthorized changes to power supply unit, otherwise you might have electric shock and void your warranty.
- Do not touch this unit and the internal components in operation or shortly after shut down. They might have high voltage or high temperature and as the unit dissipates its heat so the surface of the unit is hot. You might receive electric shock or burn.
- When the unit is operating, keep your hands and face away from it; you might be injured by an accident.
- Do not use unit under unusual conditions such as emission of smoke or abnormal smell and sound etc. It might cause fire and electric shock. In such case, please contact us; do not repair by yourself, as it is dangerous for the user.
- Do not drop or insert anything into unit. It might cause failure and fire.
- Do not operate these units under condensation condition. It might cause fire and electric shock.

⚠CAUTION

- As a component part, compliance with the standard will be based upon installation in the final application. This product must be installed in a restricted access location, accessible to authorized competent personnel only. The outputs of these products are energy hazards. The equipment has been evaluated for use in a Pollution Degree 2 environment.
- This product is designed for use within other equipment or enclosures which restrict access to authorized competent personnel only and must not be user accessible. Confirm connections to input/output terminals and signal terminals are correct as indicated in the instruction manual.
- Input voltage, Output current, Output power, ambient temperature and ambient humidity should be used within specifications, otherwise the unit will be damaged.
- For application equipment, which requires very high reliability (Nuclear related equipment, traffic control equipment, medical equipment, etc.), please provide fail safety function in the equipment.
- Do not use the product in environment with strong electromagnetic field, corrosive gas and conductive substance.
- Do not operate and store this unit at an environment where condensation occurs. In such case, waterproof treatment is necessary
- Never operate the unit under over current or shorted conditions for 30 seconds or more and out of Input Voltage Range as specification. Insulation failure, smoking, burning or other damage might occur to the unit.
- The output voltage of this power supply unit is considered to be a hazardous energy level (The voltage is 2V or more and the electric power is 240VA or more). Prevention from direct contact with output terminal is highly necessary. While installing or servicing this power supply unit, avoid dropping tools by mistake or direct contact with output terminal. This might cause an electrical shock. While repairing this power supply unit, the AC input power must be switched off and the input and output voltage should be level.
- The application circuits and their parameter are for reference only. Be sure to verify effectiveness of application circuits and their parameters before finalizing circuit design.
- Do not inject abnormal voltage to output terminal and signal terminal from the outside. The injection of reverse voltage or over voltage exceeding nominal output voltage to output terminals might cause damage to internal components.
- This information in this document is subject to change without prior notice. For actual design-in, please refer to the latest publications of data sheet, etc., for the most up-to date specifications of the unit.

Note: CE Marking, when applied to a product or packing material for a product covered by this handbook, indicates compliance with the Low Voltage Directive and RoHS Directive.

Note: UKCA Marking, when applied to a product or packing material for a product covered by this handbook, indicates compliance with the Electrical Equipment (Safety) Regulations and Restriction of the Use of Certain Hazardous Substances in Electrical & Electronic Equipment Regulations.

Ratings, Specifications and Features

Emissions		
AC Line Conducted Emissions	EN 55032:2015, FCC Part 15	(0.15-30 MHz) Class A with external filter *
Radiated RF Emissions	EN 55032:2015, FCC Part 15	0-1000 MHz Class A with external filter *
Immunity		
Electrostatic Discharge	IEC61000-4-2: 2008	+/-8 kV Air +/-4 kV Contact
RF Radiated Fields	EN 61000-4-3: 2006 +A1:2008 +A2:2010	3 V/m from 80-1000 MHz; (80% AM at 1kHz)
Electrical Fast Transients	EN61000-4-4: 2004+A1:2010	Power line pulses of ± 1 kV; I/O line pulses of ± 0.5 kV
Lightning Surge	IEC61000-4-5: 2005	±4kV common mode ±2kV differential mode Criteria B
Conducted RF Common Mode	EN61000-4-6: 2009	150 kHz - 80 MHz at 3 Vrms 1 kHz 80% amplitude modulated
Power Frequency Magnetic Field	IEC61000-4-8:2009	30A/m (Continuous), 300A/m (Short)
Voltage Dips/Short Variations	IEC61000-4-11:2004	Dip to 0% of nom. line for 0.5 cycles - Criteria C Dip to 0% of nom. line for 1 cycles - Criteria C Dip to 40% of nom. line for 0.2 seconds - Criteria C Dip to 70% of nom. line for 0.5 seconds - Criteria C Dip to 80% of nom. line for 5 seconds - Criteria C
Voltage Dips/Short Variations	SEMI F47-0706	Dip to 50% of nom. line for 10 cycles - Criteria C Dip to 70% of nom. line for 25 cycles - Criteria C Dip to 80% of nom. line for 50 cycles - Criteria C

Table 1

*With appropriate installation

Maximum Ratings		
	Units	
Output Voltage Range	Vdc	385
Rated Output Current (Power) [1]	A(W)	32.5 (12500)
Maximum Output Current (Power) [1, 2]	A(W)	34.0 (13100)
Maximum Output Power with Dropped Phase	W	3100W
Minimum Load – Unit Enabled	A	0.5A (200W)
Minimum Load – Unit Inhibited [3]	Ω	50
Operating Temperature	°C	-10°C to 40°C.
Start-up Temperature	°C	-20°C to +40°C

Table 2

[1] Load needs to remain off until the output voltage has reached 370VDC. If a load is drawn before the output has reached an appropriate voltage, the unit may go into a fault mode and shutdown. The DCOK signal will start to conduct when the output voltage has reached the appropriate level.

[2] Maximum output current (Power) allowable between 380VAC and 504VAC input.

[3]Critical Note: If minimum load is not present while the unit is inhibited, the output can slowly be charged to unsafe levels. DO NOT remove output load connectors while unit is inhibited. Turn off AC input voltage before removing output connectors.

Input Specifications		
	Units	
Input Voltage (rated)		VAC 400/480 (50/60Hz) Three Phase Delta or Wye
Input Voltage (operating)		VAC 360-528VAC (47-63Hz) Three Phase Delta or Wye (Line to Line)
Input Current (RMS) Per Phase 400-480VAC input	A	30A @ 400VAC / 26A @ 480VAC (per phase)
Inrush Current (Peak, at cold start) Per Phase, 400-480VAC input *	A	Less than 70A per phase
Power Factor (at rated output power)	-	0.93 typical @ 400/480VAC line, 25ºC
Input EMI Conducted Emissions	-	FCC Class A, EN55032 Class A (in end system with filter)
Efficiency (at rated output power)	%	97.5 typical @ 400/480VAC line, 25ºC

Table 3

*excluding initial spike charging EMI capacitors lasting <2mS

Output Performance Specifications		
	Units	
Max Voltage Line Regulation	%	Less than 2%
Max Voltage Load Regulation	%	Less than 3%
Total Regulation	%	Less than 8%
Warm up Drift	%	Less than 3%
Temperature Stability	-	0.2% of rated Vout for 8hrs after 30min warm-up. Constant line, load & temp.
Temperature Coefficient	ppm/°C	400ppm/C
Output Ripple, JEITA RC-9131C[4]	Vrms	<10
Remote Sense Compensation (Total)	V	Not applicable

Table 4

[4]Measured with 20MHz Bandwidth Oscilloscope and JEITA RC-9131C method (modified with high voltage capacitors and 100X probe). See Figure 5 for Ripple and Noise Measurement Details; All Three Phases must be present

Protective Functions		
	Units	
OCP TYPE	-	Foldback with delayed shutdown (latch). Manual reset by input cycling or remote on/off signal interface.
OCP KNEE POINT	-	>35A
KNEE POINT PROTECTION	-	NONE. NO DAMAGE AT KNEE POINT
S/C PROTECTION	-	DAMAGE occurs if shorted during live operation. Will protect itself if started into a short circuit.
OVP TYPE	-	Latched shutdown. Manual reset by input cycling or remote on/off signal interface.
OVP RANGE	-	394 - 400V
OVP RESET TIME	s	Not applicable
FAN FAIL	-	Blocked fan and fan failure detection will trigger the FAULT WARNING.
OTP	-	Latch type. Manual reset by input cycling or remote control via the RS485 Interface.

Table 5

Operating Modes	
Series Operation	No
Parallel Operation	Yes – Droop Mode (2 units)

Table 6

Status Indicators

OTW/OTP	This LED is normally OFF. It will turn ON (RED) due to Over temperature warning limit or if any of the power modules has been turned OFF due to the Over temperature condition
ACON/PHASE	This LED will turn ON (GREEN) when the internal bias supply is up and regulating. It will turn ON (RED) if: a. One of the Input AC Phases is low or lost. b. An internal fuse is open in one or more power modules
ENA	Will turn ON (GREEN) when the unit is commanded to turn ON either via RS485 command or via the hardware PSON signal.
DC OK/FAULT	LED will turn ON (GREEN) after the "ENA" LED turns ON and the DC Buss reaches 370VDC. It will turn OFF if the DC Buss is below the 350VDC. It will turn ON (RED) if: a. AC power is applied to the unit and the output is OFF. b. One or more of the Fans is rotating slow or not working at all. c. DC Buss in one or more of the power modules is out of limit. d. OTP Condition. e. OCP Condition.

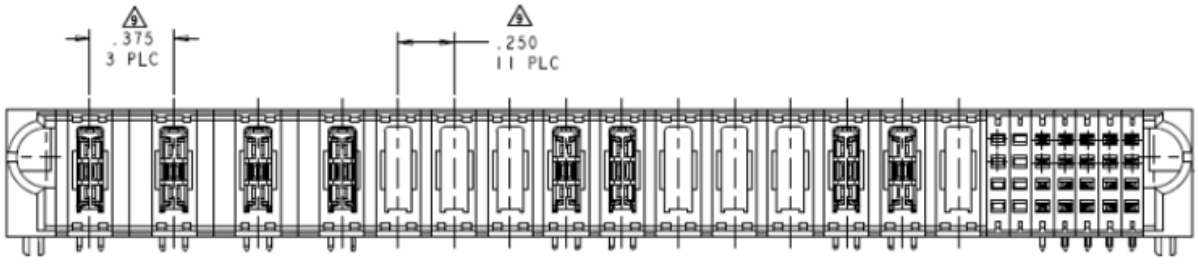
Table 7

Remote Control Features	
Remote On/Off Control	On/Off control: Via signal connector. ENABLE Open = OFF, ENABLE Shorted to LGND = ON High / Low thresholds: 6.0V / 0.6V 20V Maximum allowable. -20V Minimum allowable ISOLATED from Primary

Table 8

INPUT/OUTPUT CONNECTIONS

Figure 1: Rear Panel with Input/Output Connector



Facing rear of module

AC INPUT						DC OUTPUT									SIGNALS							
P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	1	2	3	4	5	6	7	
L1	L2	L3	Frame Gnd	Empty	Empty	Empty	Vout +	Vout +	Empty	Empty	Empty	Vout -	Vout -	Empty	Empty	RESERVED	Empty	Empty	12V_AUX	12V_AUX	LGND	D
															Empty	SEC_RTN	Empty	Empty	RESERVED (RACK_ID)	RS485_B	LGND	C
															Empty	SLOT_ID	Empty	Empty	OPW	RS485_A	MOD_PRES	B
															Empty	INTERLOCK	Empty	Empty	RESERVED (DCOK)		ENABLE	A
PWB																						

= Short Pin
= System side mating connector must have its Frame GRD pin the longest to ensure that it is mating first.

Connected Internally:
P8 & P9
P13 & P14
D5 & D6
C7 & D7

Figure 2: Pin Assignments

Power Section:

Position	Description
P1	AC Line 1
P2	AC Line 2
P3	AC Line 3
P4	GND
P8	+V
P9	+V
P13	-V
P14	-V

Signals Section:

Position	Description	
2A	Interlock	Pin that must be connected to Sec_RTN externally to enable the output.
2B	Slot ID	RS485 Address selection. See RS485 section.
2C	Sec. RTN	Isolated from the main output & LGND.
		Signals above are referenced to Sec._RTN; signals below are referenced to LGND
5B	OPW	Open-collector, normally open. Low impedance to LGND for OTW, OTP, PHASE ALM, FAULT
5D & 6D	12V_AUX	12V @ 1.8A provided for external use; return is LGND.
6B	RS485 A	RS485 "+" or non-inverting signal line.
6C	RS485 B	RS485 "–" or inverting signal line.
7A	Enable	When shorted to LGND, turns ON the main output.
7B	Module Present	Pin connected to LGND, notifies the system that this module is present.
7C & 7D	LGND	Isolated from the main output & Sec_RTN

Mating Connector Information

Connector Housing: TE's p/n: 1-1892903-9
Power Receptacles: TE's p/n: 1-1600961-8 (standard length)
Power Receptacles: TE's p/n: 1-1600961-7 (Make-First-Break-Last for GND)
Signal Receptacles: TE's p/n: 5531216-5
Plastic Insert: TE's p/n: 1600902-1 (each connector requires 7 inserts)
Plastic Secondary Lock: TE's p/n: 1600903-1 (1 for each power receptacle is required)

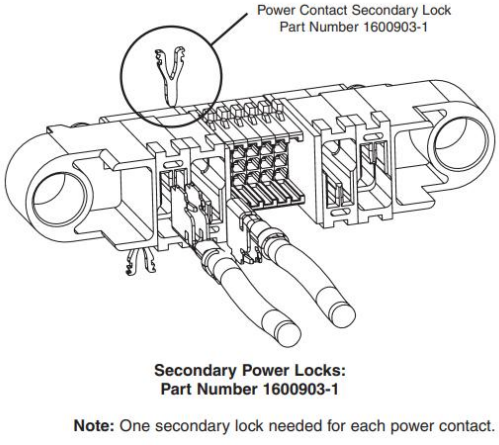


Figure 3: Plastic Secondary Lock

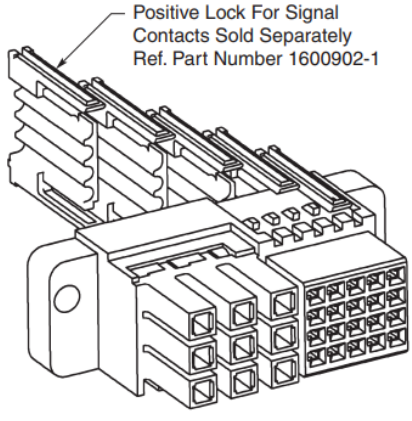


Figure 4: Plastic Insert

Ripple and Noise Notes

Ripple and Noise is measured according to the description below with JEITA RC-9131C, modified with high voltage capacitors (Sections 7.16, 7.17 and 7.18). Use 100X probe to avoid oscilloscope damage.

The measurement connection is shown in Figure 5.
C1 (0.1µF Ceramic Capacitor), C2 (47uF Aluminum Electrolytic Capacitor) must be connected in parallel at 30cm from the output terminals, along the load cable. Attach a maximum 1.5m 50Ω coaxial cable from the ceramic capacitor electrodes to a filter attachment installed on the oscilloscope. The filter attachment consists of C3 (4700pF film capacitor) in series with R (50Ω resistor). Use 20MHz bandwidth oscilloscope or equivalent.

In general, output ripple voltage and output spike noise voltage can be reduced by increasing external capacitance.

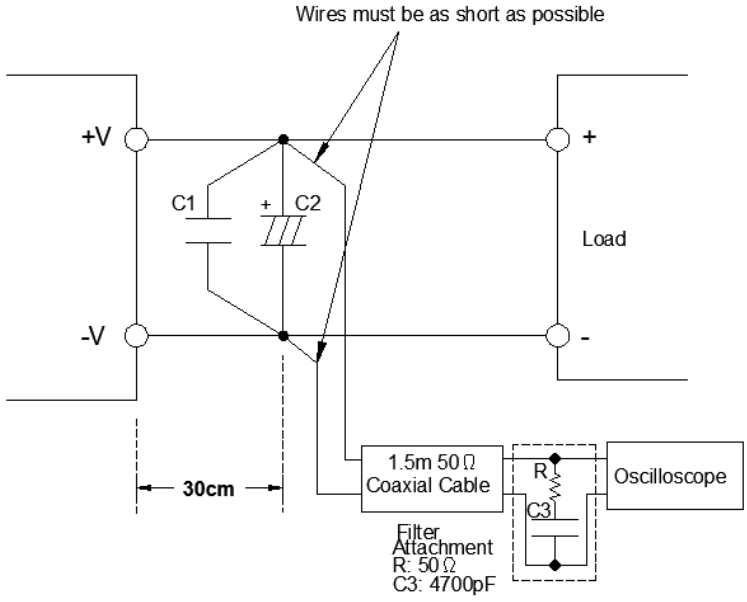


Figure 5: Output Ripple Voltage (including Spike Noise) Measurement Method

Mechanical Drawing

Overall dimensions for the TPF12500-385 are shown below:

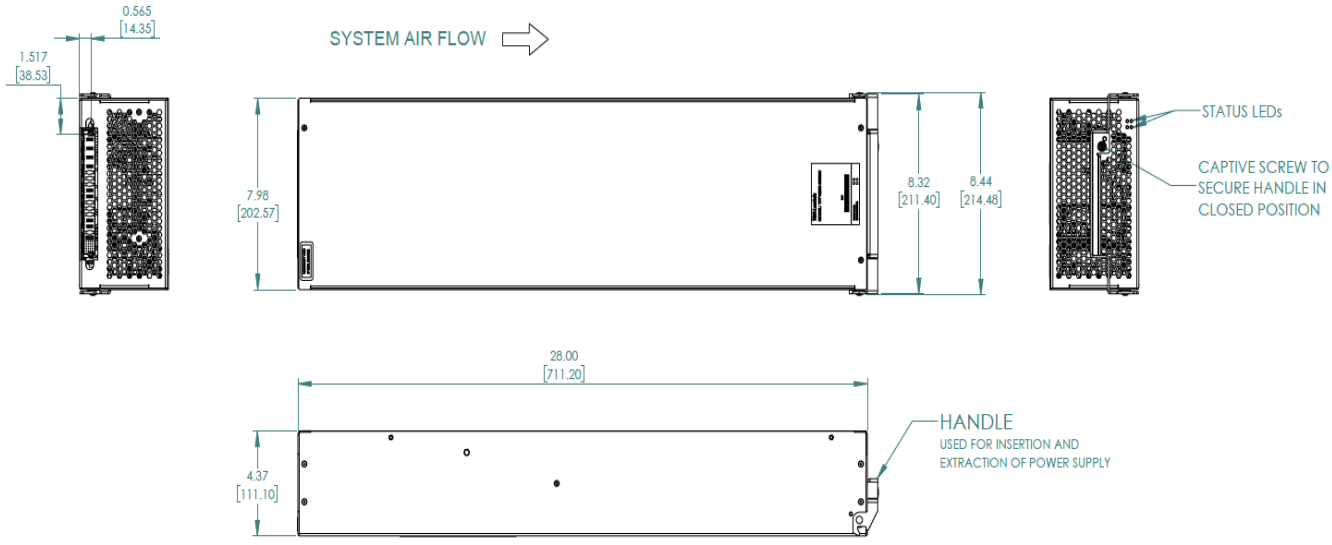


Figure 6: Outline Drawing

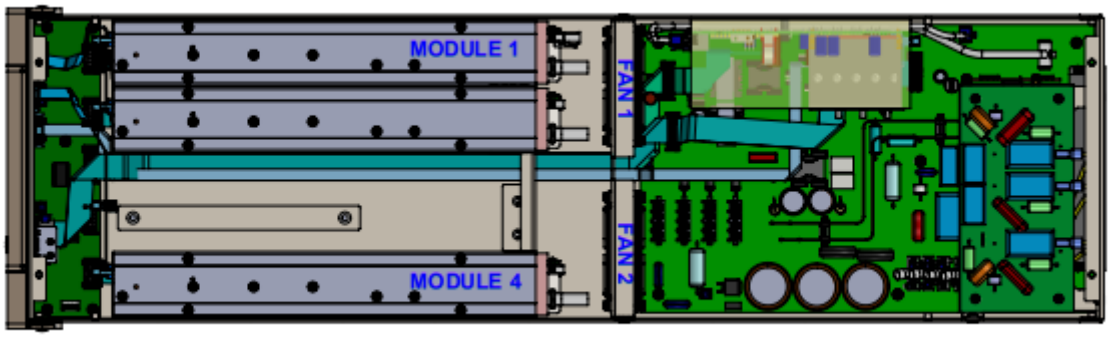


Figure 7: Power Supply Top View

RS485 Bus Communications Interface

RS485 Settings:

Baud: 19200 bps
DataBits: 8
StopBits: 1
Parity: None

The RS485 Address is determined by the state of pin #2B on the connector in the rear of the unit.

- When pin #2B is shorted to pin #2C, RS485 Address is 0x10.
- When pin #2B is left open RS485 Address is 0x01.

The Slave Address is always 0x46.

RS485 Software Interface:

Function	CMD+ Data (→RS485)	Answer (← RS485)	
WriteI2C	DS+'77'+SA+'xxyyzz….'+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>	Successfully Written
		'77'+DS+SA+'00'+CS+<CR>	Error
ReadI2C	DS+'72'+SA+Cnt+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+'Cnt'+'xxyyzz….'+CS+<CR>	Successfully Read Data Packet
		'72'+DS+SA+'00'+CS+<CR>	Error
ScanI2C	DS+'43'+CS+<CR>	'43'+DS+'Cnt'+'xxyyzz….'+CS+<CR>	Devices connected
		'43'+DS+'00'+CS+<CR>	No devices connected
CheckSlvAdr	DS+'63'+SA+CS+<CR>	'63'+DS+SA+'01'+CS+<CR>	Slave connected
		'63'+DS+SA+'00'+CS+<CR>	Slave not connected
		'73'+DS+'01'+CS+<CR>	Checksum Error
		'FF'+DS+'00'+CS+<CR>	Unknown Command

DS=RS485 Address, **SA**=Slave Address, **CS**=Checksum, **Cnt**= # of bytes to read,

xxyyzz….=Command + Data to write / read, **<CR>** =Carriage Return (0x0D).

Checksum Calculation Example:
The 1 byte **0x88**, is to be sent to the RS485 address **0x01** and slave address **0x46**.
Then the following string is sent over the serial interface: '**01774688570D**'

01=RS485 address, **77**=WRITE, **46**=Slave address, **88**=Data
57=Checksum of '01774688'
0D= Carriage Return

Sum of ASCII codes of characters being sent:
Sum = 0x30+0x31+0x37+0x37+0x34+0x36+0x38+0x38= 0x01A9
0 1 7 7 4 6 8 8

CS = 0x0100 – (Sum MOD 0x0100) = 0x0100 – (0x01A9 MOD 0x0100) = 0x0100 – 0xA9 = 0x**57**

Command Set

OPERATION MODE:

This command sets the way you control the output of the TPF12500-385 power supply.
Setting the Operation Mode to "*Remote Mode*" allow you to control the output using the "OPERATION ON/OFF" command via the RS485 only.
In the "*Local Mode*" you can control the output using the "ENABLE" pin on the Signals section of the Input/Output connector.
The default is the "*Local Mode*".

Operation Mode Command Code	0xD8
Operation Mode Remote Data Code	0x00
Operation Mode Local Data Code	0x80

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request Operation Mode	DS+'77'+SA+D8+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read Operation Mode	DS+'72'+SA+01+CS+<CR>	If Remote Mode '72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+01+00+CS+<CR> If Local Mode '72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+01+80+CS+<CR>
Set Operation Mode Remote	DS+'77'+SA+D8+00+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Set Operation Mode Local	DS+'77'+SA+D8+80+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>

OUTPUT STATE:

If the TPF12500-385 is turned OFF with the "*OUTPUT STATE*" command, it can be turned ON with the "*OUTPUT STATE*" command.

Output State Command Code	0x01
Output State OFF Data Code	0x00
Output State ON Data Code	0x80

Note: *This command will not work in the* "*Local Mode*".

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request Output State	DS+'77'+SA+01+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read Output State	DS+'72'+SA+01+CS+<CR>	If Output OFF '72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+01+00+CS+<CR> If Output ON '72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+01+80+CS+<CR>
Set Output State OFF	DS+'77'+SA+01+00+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Set Output State ON	DS+'77'+SA+01+80+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>

CLEAR_FAULTS:

This command clears the "STATUS REGISTERS" after any fault occurs.
If the CLEAR_FAULTS command is not sent after any fault occurs, the "STATUS REGISTERS" will not be cleared.
If a Fault or Warning is still present after "CLEAR_FAULTS" is sent, "STATUS REGISTERS" will be updated again.

Clear Faults Command Code	0x03
Clear Faults Data Code	None

Function	CMD+ Data (→RS485)	Answer (← RS485)
Clear Faults	DS+'77'+SA+03+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>

STATUS:

This Command is used to read the status of the TPF12500-385 power supply. The Status information is stored in a special register inside the unit, called "STATUS REGISTER".
The Status reports a total of 8 different types of Faults and/or Warnings.

Status Command Code	0xD0
Status Data Code	One Byte

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request Status	DS+'77'+SA+D0+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read Status	DS+'72'+SA+01+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+01+xx+CS+<CR>

Fault is indicated by "1".

Faults	Type	Bit#	Output Behavior	Description
ON/OFF	FAULT	0	Output ON or OFF	Output Enabled but system Disabled it
OTW	WARNING	1	Output ON	Internal temperature ~ 10°C below OTP limit
OTP	FAULT	2	Output OFF	Internal temperature higher than safe limit
DCOK	WARNING	3	Output ON or OFF	Vout < 85~95% of Set Vout on one or more modules
PHASEOK	WARNING	4	Output ON	One Input Phase Low or Out
FANOK	FAULT/WARNING	5	Output ON	Fan is rotating slowly or is stopped
OCP	FAULT	6	Output OFF	System Current was higher than safe limit.
ERROR	WARNING	7	Output ON or OFF	Internal Buss Communications Error

OVER TEMP. PROTECTION (OTP)_STATUS: (of Individual Power Module)

This Command determines which of the 4 modules inside the TPF12500-385 power supply set the Over Temp Protection (OTP) Bit in the "STATUS REGISTER".

OTP Status Command Code	0xDB
OTP Status Data Code	One Byte

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request OTP Status	DS+'77'+SA+DB+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read OTP Status	DS+'72'+SA+01+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+01+xx+CS+<CR>

Module in Fault is indicated by "1".

OTP Status Data Byte	Description
0x01	Module #1 in OTP condition
0x02	Module #2 in OTP condition
0x03	Module #1 & #2 in OTP condition
0x04	Module #3 in OTP condition
0x05	Module #1 & #3 in OTP condition
0x06	Module #2 & #3 in OTP condition
0x07	Module #1, #2 & #3 in OTP condition
0x08	Module #4 in OTP condition
….	
0x0F	Module #1, #2, #3 & #4 in OTP condition

DC OUTPUT_STATUS: (of Individual Power Module)

This Command determines which of the 4 modules inside the TPF12500-385 power supply set the DC Output Fault (DCOK) Bit in the "STATUS REGISTER".

DC Output Status Command Code	0xDC
DC Output Status Data Code	One Byte

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request DC Output Status	DS+'77'+SA+DC+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read DC Output Status	DS+'72'+SA+01+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+01+xx+CS+<CR>

Module in Fault is indicated by "1".

DC Output Status Data Byte	Description
0x01	Module #1, Output Voltage < 85~95% of Set Vout
0x02	Module #2, Output Voltage < 85~95% of Set Vout
0x03	Module #1 & #2, Output Voltage < 85~95% of Set Vout
0x04	Module #3, Output Voltage < 85~95% of Set Vout
0x05	Module #1 & #3, Output Voltage < 85~95% of Set Vout
0x06	Module #2 & #3, Output Voltage < 85~95% of Set Vout
0x07	Module #1, #2 & #3, Output Voltage < 85~95% of Set Vout
0x08	Module #4, Output Voltage < 85~95% of Set Vout
….	
0x0F	Module #1, #2, #3 & #4, Output Voltage < 85~95% of Set Vout

INPUT PHASE STATUS: (of Individual Power Module)

This Command determines which of the 4 modules inside the TPF12500-385 power supply set the Input Phase Fault (PHASEOK) Bit in the "STATUS REGISTER".

Input Phase Status Command Code	0xDD
Input Phase Status Data Code	One Byte

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request Input Phase Status	DS+'77'+SA+DD+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read Input Phase Status	DS+'72'+SA+01+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+01+xx+CS+<CR>

Module in Fault is indicated by "1".

PHS Status Data Byte	Description
0x01	Module #1, One Input Phase Low or Out
0x02	Module #2, One Input Phase Low or Out
0x03	Module #1 & #2, One Input Phase Low or Out
0x04	Module #3, One Input Phase Low or Out
0x05	Module #1 & #3, One Input Phase Low or Out
0x06	Module #2 & #3, One Input Phase Low or Out
0x07	Module #1, #2 & #3, One Input Phase Low or Out
0x08	Module #4, One Input Phase Low or Out
….	
0x0F	Module #1, #2, #3 & #4, One Input Phase Low or Out

FAN_STATUS:

This Command determines which Fan inside the TPF12500-385 power supply set the FANOK Bit in the "STATUS REGISTER".

Fan Status Command Code	0xDF
Fan Status Data Code	One Byte

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request Fan Status	DS+'77'+SA+DF+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read Fan Status	DS+'72'+SA+01+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+01+xx+CS+<CR>

Module in Fault is indicated by "1".

Fan Status Data Byte	Description
0x01	Fan #1, is rotating slowly or is stopped.
0x02	Fan #2, is rotating slowly or is stopped.
0x03	Fan #1 and Fan #2, are rotating slowly or are stopped.

OPERATING_HOURS:

This Command retrieves the total Hours that the TPF12500-385 power supply has been operational since first powered up.

On Time Command Code	0xE0
On Time Data Code	Two Bytes

Function	**CMD+ Data (→RS485)**	**Answer (← RS485)**
Request On Time	DS+'77'+SA+E0+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read On Time	DS+'72'+SA+02+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+02+xxyy+CS+<CR>

The two bytes represent hours.
The total operating hours can be calculated by converting the data to decimal values, then multipling the High Byte by 256 and adding the low byte.
Example: Assume the data received is 0x03, 0x45→ 03, 69→ 3*256+69=837Hrs

Monitoring Functions

For Monitoring functions use the following equation

$$X = (Y*10^{-r} - b)/m$$

Where **Y** - digital value received from the supply.
X is the normalized value (V, A, °C)
m, b, r - coefficients that are explained in Table 9.

Physical value	Unit	Min.	Max.	m	b	r
Input Voltage	V	225	300	40	-3850	-1
Output Current	%	0	110	919	-6886	-1
Temperature	°C	0	150	44	4350	-1

Table 9: Coefficient Table

m, b, r coefficients can also be recovered from the EEPROM and are stored in ASCII Format.
Ex: 0x4D,0x3A,0x30,0x31,0x33,0x39,0x42,0x3A,0x2D,0x30,0x33,0x39,0x52,0x3A,0x30,0x30
M:0139B: - 039R:00

Input Voltage, Output Load Current and Internal Temperature Data is read back low byte followed by high byte.

READ_Vin:

This Command retrieves the measured Input voltage of the TPF12500-385 power supply.

Read Vin Command Code	0x88
Read Vin Data Code	Two Bytes

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request Read Vin	DS+'77'+SA+88+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read Vin	DS+'72'+SA+02+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+02+xxyy+CS+<CR>

Example:
Hex Data read back = 0xE2,0x01.
Flip Bytes: 0x01, 0xE2.
Converted to Decimal = 482.
Vin= $(482*10^{1}+3850)/40$=216.75Vac
Measurement accuracy +/- 6% of full scale.

READ_Iout:

This Command retrieves the measured Output Load Current of the TPF12500-385 power supply.

Read Iout Command Code	0x8C
Read Iout Data Code	Two Bytes

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request Read Iout	DS+'77'+SA+8C+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read Iout	DS+'72'+SA+02+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+02+xxyy+CS+<CR>

Example:
Hex Data read back =0xA3, 0x0C.
Flip Bytes: 0x0C, 0xA3.
Converted to Decimal = 3235.
Iout= $(3235*10^{1}+6886)/919$=42.69% of I_o rated load .
Measurement accuracy +/- 12% of full scale above 50% load.

READ Temperature:

This Command retrieves the internal temperature of the TPF12500-385 power supply.

Read Temp. Command Code	0x8D
Read Temp Data Code	Two Bytes

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request Read Temp.	DS+'77'+SA+8D+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read Temp.	DS+'72'+SA+02+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+02+xxyy+CS+<CR>

Example:
Hex read back = 0x1F, 0x02.
Flip Bytes: 0x02, 0x1F.
Converted to Decimal = 543.
Temperature=($(543*10^{1})$-4350)/44= 24.5^{0}C +/- 3^{0}C.

Monitor Coefficients

READ Vin Monitor Coefficients:

This Command retrieves the Input Voltage Monitor Coefficients to be used in conjunction with the measured Vin bytes to calculate the correct reported Input Voltage.

Read Vin Monitor Coeff. Command Code	0xDA
Read Vin Monitor Coeff. Data Code	18 Bytes

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request Vin Mon. Coeff.	DS+'77'+SA+DA+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read Vin Mon. Coeff.	DS+'72'+SA+12+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+12+xxyy….+CS+<CR>

READ Iout Monitor Coefficients:

This Command retrieves the Output Current Monitor Coefficients to be used in conjunction with the measured Iout bytes to calculate the correct reported Output Current.

Read Iout Monitor Coeff. Command Code	0xD5
Read Iout Monitor Coeff. Data Code	17 Bytes

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request Iout Mon. Coeff.	DS+'77'+SA+D5+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read Iout Mon. Coeff.	DS+'72'+SA+11+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+11+xxyy….+CS+<CR>

READ Temp. Monitor Coefficients:

This Command retrieves the Temperature Monitor Coefficients to be used in conjunction with the measured Temp. bytes to calculate the correct reported Temperature.

Read Temp. Monitor Coeff. Command Code	0xD7
Read Temp. Monitor Coeff. Data Code	17 Bytes

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request Temp. Mon. Coeff.	DS+'77'+SA+D7+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read Temp. Mon. Coeff.	DS+'72'+SA+11+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+11+xxyy….+CS+<CR>

Manufacturing Inventory Commands

All details are stored in ASCII format.

Read MFG. ID:

This Command retrieves the Manufacturing ID of the TPF12500-385 power supply.

Read MFG. ID Command Code	0x99
Read MFG. ID Data Code	11 Bytes

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request MFG. ID	DS+'77'+SA+99+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read MFG. ID	DS+'72'+SA+0B+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+0B+xxyy….CS+<CR>

Read MFR MODEL:

This Command retrieves the Manufacturing Model of the power supply.

Read MFR. Model Command Code	0x9A
Read MFG. Model Data Code	13 Bytes

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request MFG. Model	DS+'77'+SA+9A+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read MFG. Model	DS+'72'+SA+0D+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+0D+xxyy….+CS+<CR>

Read MFG. REVISION:

This Command retrieves the hardware and Firmware Revision of the TPF12500-385 power supply.

Read MFG. Revision Command Code	0x9B
Read MFG. Revision Data Code	12 Bytes

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request MFG. Revision	DS+'77'+SA+9B+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read MFG. Revision	DS+'72'+SA+0C+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+0C+xxyy….+CS+<CR>

Example:
0x48,0x3A,0x50,0x32,0x3B,0x46,0x3A,0x30,0x2E,0x31,0x3B → H:P2;F:0.1;
(H) Hardware follows by (F) Firmware Revision.

Read MFG. LOCATION:

This Command retrieves the Manufacturing Location of the TPF12500-385 power supply.

Read MFG. Location Command Code	0x9C
Read MFG. Location Data Code	4 Bytes

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request MFG. Location	DS+'77'+SA+9C+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read MFG. Location	DS+'72'+SA+04+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+04+xxyy….+CS+<CR>

Read MFG. DATE:

This Command retrieves the Manufacturing Date of the TPF12500-385 power supply.

Read MFG. Date Command Code	0x9D
Read MFG. Date Data Code	9 Bytes

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request MFG. Date	DS+'77'+SA+9D+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read MFG. Date	DS+'72'+SA+09+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+09+xxyy….+CS+<CR>

Example:

0x30,0x35,0x2D,0x32,0x33,0x2D,0x32,0x34 → MM-DD-YY → 05-23-24

Read MFG. SERIAL:

This Command retrieves the Serial number of the TPF12500-385 power supply.

Read MFG. Serial # Command Code	0x9E
Read MFG. Serial # Data Code	21 Bytes

Function	CMD+ Data (→RS485)	Answer (← RS485)
Request MFG. Serial #	DS+'77'+SA+9E+CS+<CR>	'77'+DS+SA+'01'+CS+<CR>
Read MFG. Serial #	DS+'72'+SA+15+CS+<CR>	'72'+DS+SA+'01'+CS+<CR> '64'+DS+SA+15+xxyy….+CS+<CR>