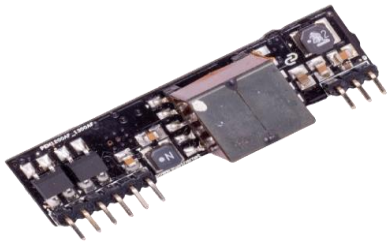
PEM1300AF SERIES

IEEE802.3af Class Programmable POE PD Module



AFD = With Optional Frequency Dithering
AF = Without Optional Frequency Dithering

PRODUCT OVERVIEW

The PEM1300AF is a compact size IEEE802.3af compliant Power Over Ethernet (PoE) Powered Device (PD) extraction module delivering up to 12.95W (PEM1303AF - up to 10W) of power, when sourced from an IEEE 802.3af compliant Power Sourcing Equipment (PSE) using twisted pair CAT5 or higher Ethernet cable. The module also supports Type 1 PD operation of the IEEE 802.3at and IEEE 802.3bt.

The PEM1300AF provides programmable power classification of IEEE802.3af.

POE applications of PEM1300AF include IP phones, IP cameras, security and access control devices, sensors, environment control devices, routers, and network access points.

The output ripple is controlled within IEEE specifications. For improved EMI performance, the PEM1300AFD is featured with Frequency dithering.

The module is low cost and features a high-efficiency DC-DC converter with 1500V safety isolation, in-built under-voltage, output over-load, and short-circuit protection, a well-regulated low noise and low ripple output. The PEM1300AF series requires minimal external components and provide a quick, easy, and low-cost method for Ethernet equipment manufacturers to “PoE enable” their equipment.

PRODUCT FEATURES

- Compact size IEEE 802.3af solution.
- 12.95 watt output load[1]
- IEEE 802.3af.
- Input polarity protection.
- Programmable POE Class 0,1, 2,3
- Highly efficient 1500V isolated DC-DC converter.
- 3.3V, 5V, 12V, 24V* DC output voltage models.
- Minimal external components required.
- Optional Frequency Dithering circuit for improved EMI.
- Wide input voltage (36V to 57V DC)
- Overload and short circuit protection[2]
- Adjustable output voltage.
- RoHS compliant.
- Low output Ripple and Noise.
- Low-cost, quick and easy POE solution.

24V* under development

[1] PEM1303AF - up to 10W
[2] If maximum power is exceeded, the PEM1300AF will operate in over current mode and will auto recover when the over load condition is removed. This condition exceeding continuous 15 seconds may cause damage to the module.

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1. PRODUCT SELECTOR

Part Number	Marking	Nominal Input Voltage (Volts DC)	Output Voltage[3] (Volts DC)	Efficiency[4] (%)	Power (Maximum)[6,7] (Watts)
PEM1303AF	3	48	3.3	79	10
PEM1305AF	5	48	5	81	12.95
PEM1312AF	12	48	12	84	12.95
PEM1324AF*	24	48	24	86	12.95
PEM1303AFD	3	48	3.3	79	10
PEM1305AFD	5	48	5	81	12.95
PEM1312AFD	12	48	12	84	12.95
PEM1324AFD*	24	48	24	86	12.95

AFD = On board Optional Frequency Dithering Circuit for improved EMI.
AF= Without Optional Frequency Dithering Circuit.
*Under Development.

2. INPUT CHARACTERISTICS

Parameter	Symbol	Min.	Typ[4].	Max.	Units
Input Voltage[5]	V_{IN}	36	48	57	Volts
Under Voltage Lockout	V_{UVLO}	30		36	Volts
Input Current[6],[10]	I_{IN}		350	400	mA
Operating Temperature[7]	T_{OP}	-20	25	70	^{O}C
IEEE 802.3af Power Classification[8]			Programmable Class 0, 1, 2, or 3		

3. DC OUTPUT CHARACTERISTICS

DC OUTPUT CHARACTERISTICS					
Parameter	Symbol	Min.	Typ[4].	Max.	Units
Line Regulation[8]	V_{LNRG}		0.2%		
Load Regulation[8]	V_{LDRG}		0.5%		
Output Ripple and Noise[5, 8]	V_{RIP}		80		mV p-p
Isolation Voltage	V_{ISOL}			1500	V DC
Temperature Coefficient (Slope)	TC		100	300	ppm ^{O}C

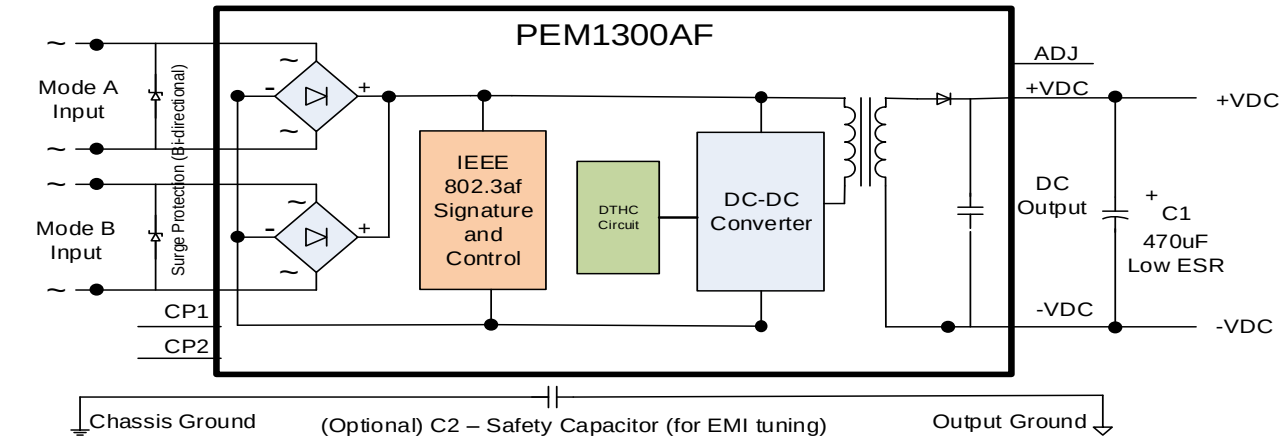
[3] Output voltage typical ± 3% at T_A of 25^{0}C with a nominal input voltage and rated output current.
[4] At nominal Vin at 67% load
[5] With minimum load 100mA
[6] Please refer to IEEE802.3af standards document. Maximum input current is dependent on power class, and **input voltage. Input current (DC or RMS) at V_{PORT} = 37vDC is 350mA, at V_{PORT} = 57vDC is 230mA. Peak inrush current is 400mA for 50mS max at duty cycle of 5% max.**
[7] Please see section 13 - Thermal Management on operating temperature
[8] Please see section 9 - Powered Device Signature and Class programming, for more details

4. ABSOLUTE MAXIMUM RATINGS [9,10]

Supply Voltage (V_{CC})	0V – 57V DC
Storage Temperature (T_S)	-25 ^{O}C – 100 ^{O}C
Output Voltage (V_{OUT})	0V to controlled output voltage (operating or non-operating)

5. BLOCK DIAGRAM AND TYPICAL CONNECTIONS

Figure 1 - BLOCK DIAGRAM and TYPICAL CONNECTIONS



- Provide separate Grounds for Data, Primary Power and Secondary Power
- Place C1 close to DC Output pins

Figure 1: Block Diagram And Typical Connections

6. PIN CONNECTIONS

INPUT PINS			OUTPUT PINS	
1	**VINA1**. This pin connects to the output of the data transformer centre-tap (for Mode A PoE injection). Not polarity sensitive.		7	**-VDC**. The ground return for the +VDC output. Max. Current 3A per pin.
2	**VINA2**. This pin connects to the output of the data transformer centre-tap (for Mode A PoE injection). Not polarity sensitive.		8	**+VDC.** This pin provides the regulated output from the DC/DC converter. Max. Current 3A per pin.
3	**VINB1**. This pin connects to Ethernet cable spare pair (for Mode B PoE injection). Not polarity sensitive.		9	**OADJ.** The output voltage can be adjusted from its nominal value, by connecting an external resistor from this pin to either the +VDC pin or the -VDC pin. For more details, please see section Fig.3,4,5.
4	**VINB2**. This pin connects to Ethernet cable spare pair (for Mode B PoE injection). Not polarity sensitive		**To maintain isolation integrity, always connect respective input and output poles only via X or Y safety capacitor. Maintain isolation barrier on motherboard PCB as per physical package.**	
5	**CP1. Connect this pin only as per the instructions in Table 1.**			
6	**CP2. Connect this pin only as per the instructions in Table 1.**			

[9] All specifications typical are at T_A of 25^{0}C with a nominal input voltage and rated output current unless otherwise noted. These are meant as a design aid only and are indicative, and not guaranteed.

[10] Exceeding the absolute maximum ratings may cause permanent damage to the product. We do not imply functional operation under these conditions. These ratings assume free air flow.

7. INPUTS

The PEM1300AF is compatible with IEEE 802.3af compliant Power Sourcing Equipment (PSE) and supports the different power injection options of Data/Signal pair (Mode A) or Spare Pair (Mode B). See Typical System Configuration, detailed below. As per IEEE 802.3af, it is specified that the PSE does not apply power to both of its outputs at the same time i.e. 4 pair injection. (Refer to IEEE802.3af standards for more information).
The PEM1300AF provides onboard input bridge rectifiers for improved system integration and minimal external components.

8. TYPICAL SYSTEM CONFIGURATION

In Mode A – Signal Pair injection, the signal lines carry both data and power. In Mode B – Spare Pair injection, the Signal pair carries only data, and the spare pair carries power. If Gigabit data, both data and power are carried through Spare Pair.

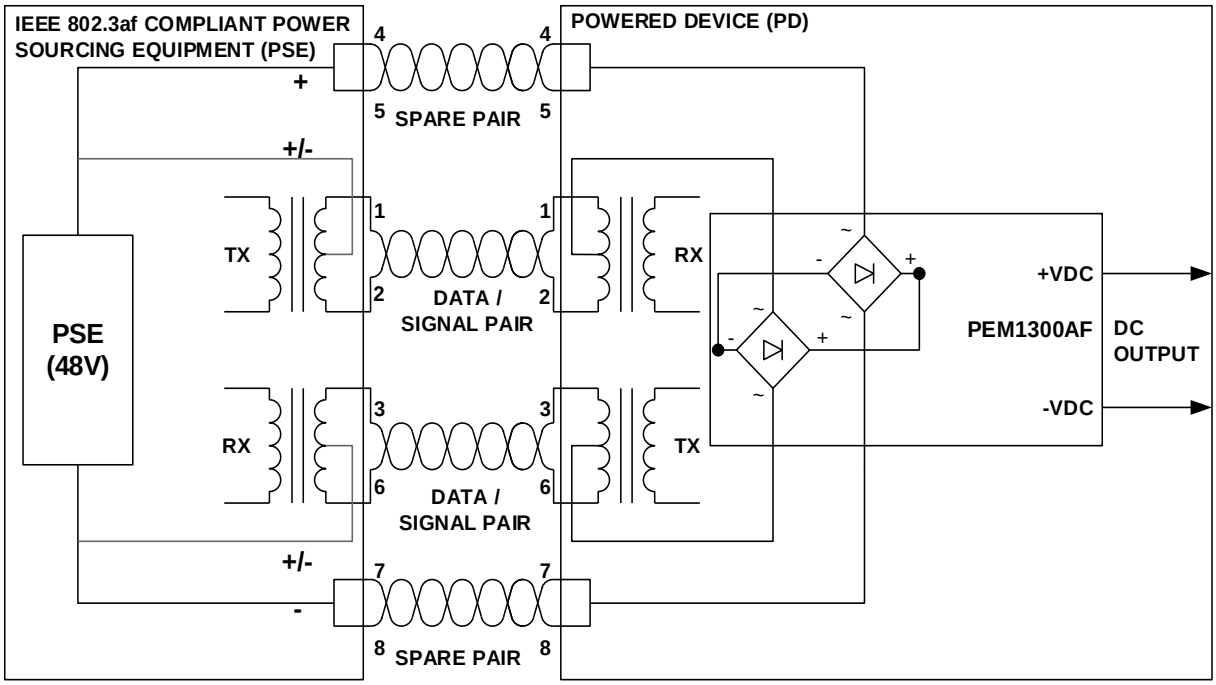


Figure 2: Typical System Configuration

9. POWERED DEVICE (PD) SIGNATURE and POWER CLASSIFICATION

When the PEM1300AF is connected to a Cat 5e or greater Ethernet cable from an IEEE 802.3af compliant Power Sourcing Equipment (PSE), Endspan or Midspan, it will automatically present a Powered Device (PD) signature to the PSE, as and when requested. The PSE will then recognize that a PD is connected to that line and supply power. With the growing emphasis on “Green Power”, in the latest standard, IEEE has stressed for PDs to implement the IEEE 802.3af Power Classification system to ensure the correct provisioning of power from the PSE.
To help in proper power level provisioning and improved power management, the IEEE 802.3af standard provides for PDs to inform the PSE their required power levels via a Class system. The classes are defined as per Table1 below. The PEM1300AF allows system designers for programming the Class by placing a 1/16W or greater and 1% tolerance resistor detailed in Table1.

Table 1 – Power Classification programming				
PoE Power Class	Required PD Power	1/16W or greater and 1% tolerance resistor between		
		Pin 2 (VINA –) and Pin 6 (CP2) (For Mode A PoE injection)	Pin 4 (VINB –) and Pin 6 (CP2) (For Mode B PoE injection)	Pin 5 (CP1) and Pin 6 (CP2)
0	0.44W ~ 12.95W	Do not connect	Do not connect	Any value 10KΩ to 100 KΩ
1	0.44W ~ 3.84W	461KΩ	461KΩ	Do not connect
2	3.84W ~ 6.49W	235KΩ	235KΩ	Do not connect
3	6.49W ~ 12.95W	150KΩ	150KΩ	Do not connect
4	Reserved for 802.3at	Reserved	Reserved	Reserved
Important: **Do not connect Pin 2 or Pin 4 to Pin 5 at any time. Do not connect Pins 4 and 5 and 6 at the same time. Connect Pin 5 only to Pin 6 and only as per Table 1.**				

10. FREQUENCY DITHERING

The PEM1300AFD series is built with Frequency Dithering Circuit to help better controlling of EMI (electromagnetic-interference) emissions. The nominal switching frequency of PEM1300AFD series is 300KHz, with a dithering range of ±10%.

11. OUTPUT VOLTAGE ADJUSTMENT

The PEM1300AF series has an OADJ pin, which allows the output voltage to be increased or decreased from its nominal value using a 1/16W power rating or greater and 1% tolerance resistor connected between the OADJ pin and either the +VDC or –VDC pin as per figures below. Only one connection i.e. between OADJ and +VDC or between OADJ and –VDC is permitted at a time. A change of more than ± 10% from nominal is not permitted. Please contact Infomart technical support for more details or specific resistor values.

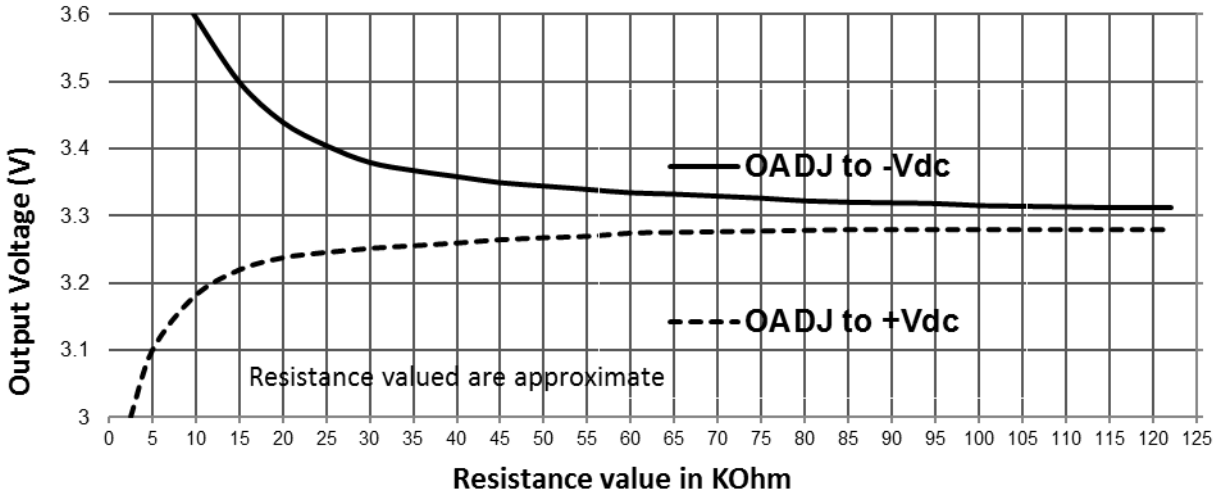


Figure 3: PEM1303AF Output Voltage Adjustment

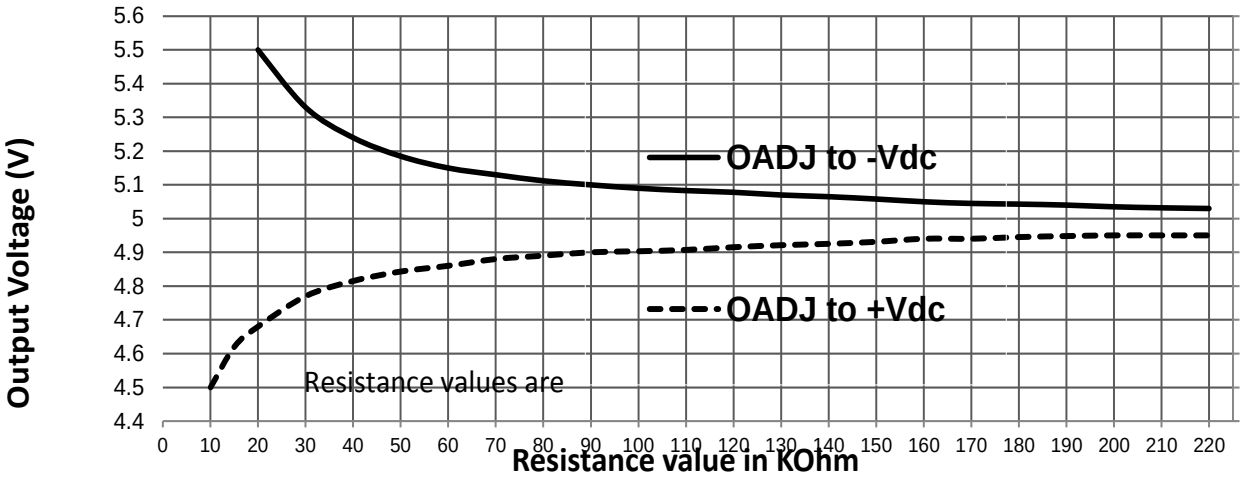


Figure 4: PEM1305AF Output Voltage Adjustment

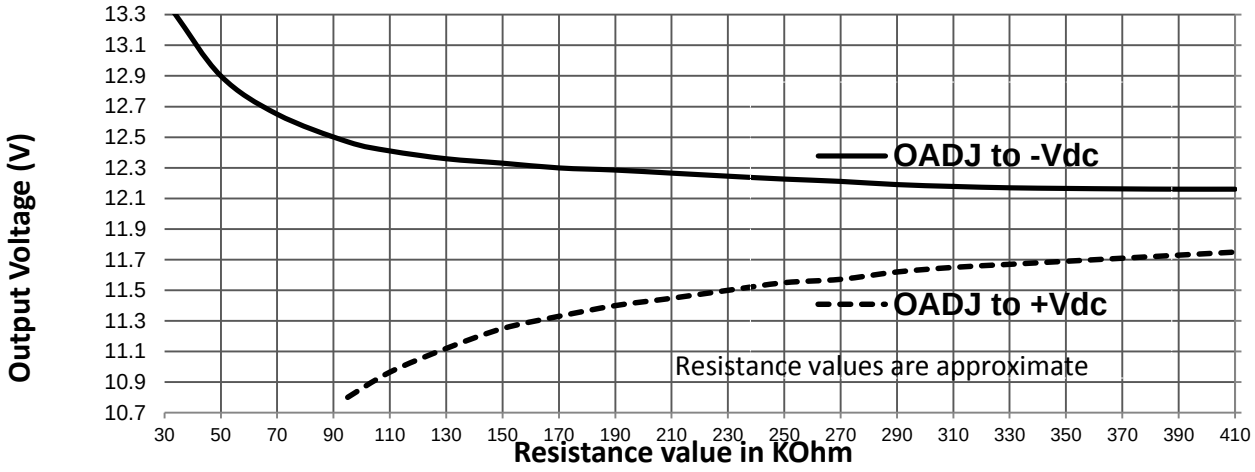


Figure 5: PEM1312AF Output Voltage Adjustment

12. PHYSICAL PACKAGE

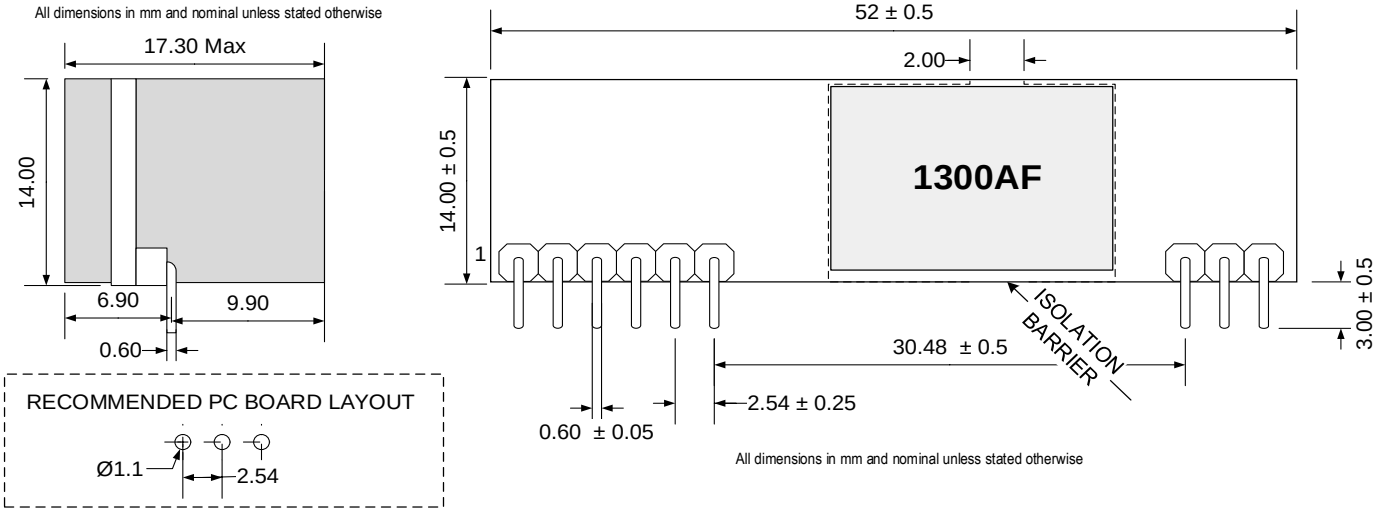


Figure 6: Mechanical Dimensions

13. THERMAL MANAGEMENT

As with any power component, the PEM1300AF modules generate heat. It is important that adequate ventilation and airflow be taken into consideration at the design stage. The quantum of heat generated by the PEM1300AF will depend on the output load it is required to drive. The maximum ambient operating temperature is 70°C. Figure below, shows the thermal performance of the PEM1300AF with a nominal 48VDC input. The PEM1300AF thermal performance can be improved by forced airflow cooling over the module and by using a heat sink (a) glued on to the output diodes using a thermal glue, or (b) by a power plane heat sink described below. The two methods can be combined.

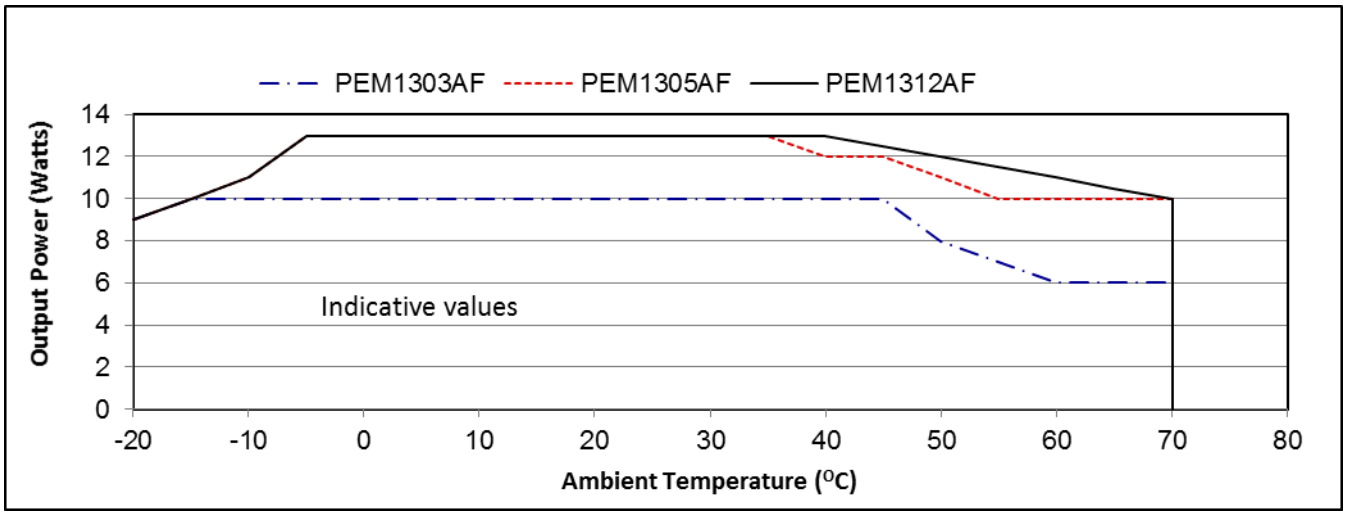


Figure 7: Thermal Performance profile at nominal Vin

14. POWER PLANE HEAT SINK

A power plane heat sink on the motherboard is a relatively simple method to draw some heat away from the PEM1300AF using the output pins (-VDC and +VDC) which are connected to a PCB heat sink on the motherboard. It is important to maintain electrical isolation between OADJ pin and the +VDC and -VDC pins to ensure proper output voltages.
These power plane heat sinks must be on the outer layers of the PCB and the PEM1300AF must not be fitted into a socket. This method can be combined with forced airflow cooling, and with a heat sink glued onto the two output diodes using a thermal glue.

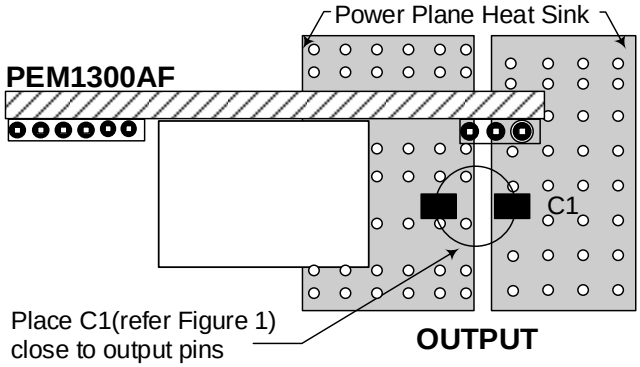


Figure 8: Power Plane Heat Sink

15. APPLICATION NOTES

Power Over Ethernet (PoE) is a technology for wired Ethernet, the most widely installed local area network technology in use today. PoE allows the electrical power necessary for the operation of each end-device to be carried by data cables along with the data, rather than by separate power cords. Thus, it minimizes the number of wires used to install the network, resulting in lower cost, less downtime, easier maintenance and greater installation flexibility.

The IEEE standard governing PoE is IEEE802.3af. Compliance with this standard ensures inter-operability between devices.

The PEM1300AFseries modules offering a modular solution, incorporating full IEEE802.3af compatibility signature to the PSE and isolated on-board DC/DC converter. The PEM1300AF series are ideal modular system blocks allowing manufacturers of Ethernet equipment to “PoE enable” their equipment with minimal effort and cost. PEM1300AF modules series offer simple and quicker product development, maximising return on investment.

PEM1300AF can be powered using a user designed power supply which has adequate thermal and over-current protection. It is strongly recommended that only IEEE802.3af compliant power supply equipment be used to prevent damage to the module, which lacks output stage thermal protection.

16. ESD AND SURGE PROTECTION

It is required that the system designer must provide ESD and surge protection such as a TVS diode, like SMAJ58A (Uni-Directional) or SMAJ58CA (bi-directional), at the PEM1300AF input to prevent damage from over-voltage surges and for system EMC / ESD compliance.

17. APPLICATION AREAS

- Security and alarm systems
- Voice over IP phones
- Access control systems
- IP Cameras
- Displays, Net Monitors
- Public address systems
- Wireless access points
- Environmental control
- Telemetry
- Remote environmental monitoring

18. IMPROVEMENTS

- Updated version improved the supply chain of the components.
- Module size reduced with No Change in performance.
- Added Optional Frequency Dithering Circuit for improved EMI.

19. SAMPLE PoE SYSTEM CONFIGURATION

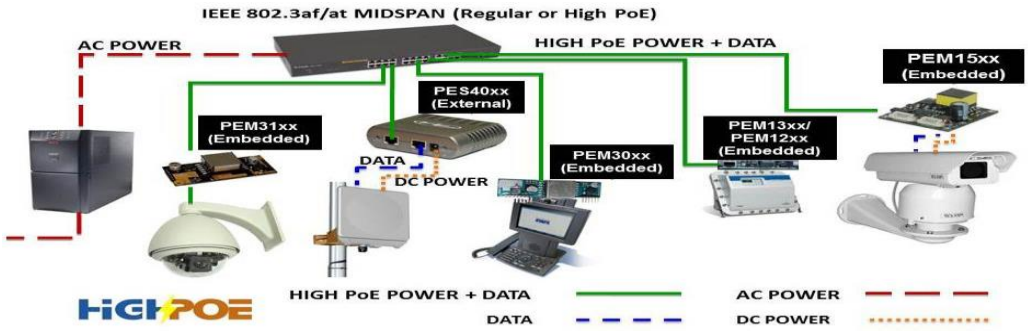


Figure 9: Illustration of POE System Configuration

20. ROHS COMPLIANCE

ROHS compliance details on webpage: http://www.poweredethernet.com/rohs_compliance.html

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Revision History

REVISION NUMBER	DESCRIPTION
21LR1-6	• NRND clause added • Image of the Product changed • PRODUCT OVERVIEW and PRODUCT FEATURES updated • Clerical and aesthetic changes • Revision History added to this document
23LR1-1	• PRODUCT OVERVIEW and PRODUCT FEATURES updated • Image of the Product changed • FREQUENCY DITHERING is added