

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

PRODUCT FEATURES

- Low-Cost IEEE 802.3af PD Module
- Optional Frequency Dithering for improved EMI
- 3.3V, 5V, 12V, 24V DC output voltage models
- Compact size
- Wide input voltage (36V to 57V DC)
- Adjustable output voltage
- Minimal external components required
- Low-cost, quick and easy POE solution
- High Efficiency
- Programmable POE Class 0,1,2,3
- Input polarity protection
- 12.95W output load
- Overload and short circuit protection¹
- Highly efficient 1500V isolated DC-DC converter
- Low output Ripple and Noise
- RoHS compliant

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 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 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.

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.

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

¹ If maximum power is exceeded, the PEM1200AF will operate in over current mode and will auto recover when the overload condition is removed. This condition exceeding continuous 15 seconds may cause damage to the module.

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PRODUCT SELECTOR

Part Number	Marking	Nominal Input Voltage	Output Voltage ²	Efficiency ³	Power (Maximum) ^{5,6}
		(Volts DC)	(Volts DC)	(%)	(Watts)
PEM1303AF	3F	48	3.3	80	12.95
PEM1305AF	5F	48	5	83	12.95
PEM1312AF	12F	48	12	85	12.95
PEM1324AF	24F	48	24	86	12.95
PEM1303AFD	3D	48	3.3	80	12.95
PEM1305AFD	5D	48	5	83	12.95
PEM1312AFD	12D	48	12	85	12.95
PEM1324AFD	24D	48	24	86	12.95

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

INPUT CHARACTERISTICS

Parameter	Symbol	Min.	Typ ³ .	Max.	Units
Input Voltage ⁴	V_{IN}	36	48	57	Volts
Under Voltage Lockout	V_{UVLO}	30		36	Volts
Input Current ^{5,9}	I_{IN}		350	400	mA
Operating Temperature ⁶	T_{OP}	-20	25	70	°C
IEEE 802.3af Power Classification ⁷		Programmable Class 0, 1, 2, or 3			

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 ^{4,7}	V_{RIP}		80		mV
Isolation Voltage	V_{ISOL}			1500	V DC
Temperature Coefficient (Slope)	TC		100	300	ppm/°C

ABSOLUTE MAXIMUM RATINGS^{8,9}

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

² Output voltage typical $\pm 3\%$ at T_A of 25°C with a nominal input voltage and rated output current.

³ At nominal V_{IN} at 67% load

⁴ With minimum load 100mA

⁵ Please refer to IEEE802.3af standards document

⁶ Please see *THERMAL MANAGEMENT* Section for operating temperature.

⁷ Please see *POWERED DEVICE (PD) SIGNATURE and POWER CLASSIFICATION* Section for more details.

⁸ All specifications typical are at T_A of 25°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.

⁹ 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.

TYPICAL INPUT CONNECTIONS

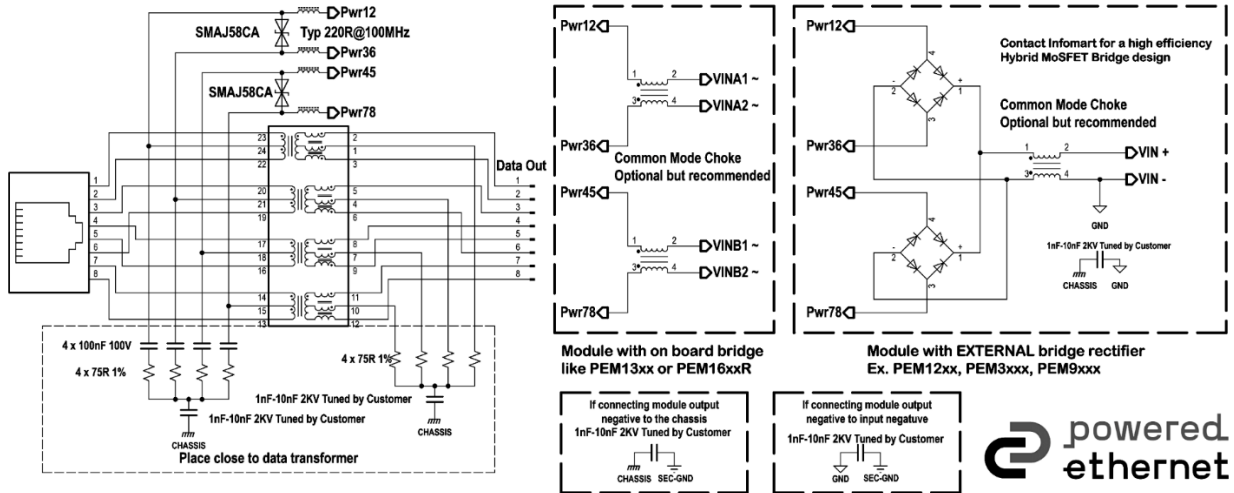


Figure 1- Typical Input Connections

OUTPUT CONNECTIONS

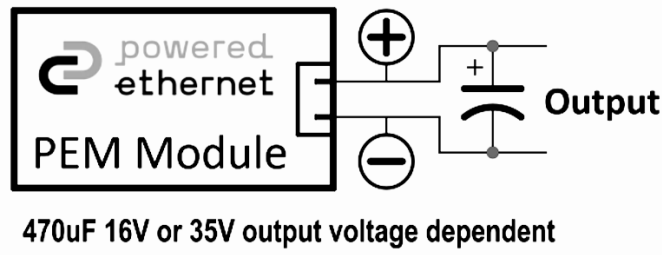
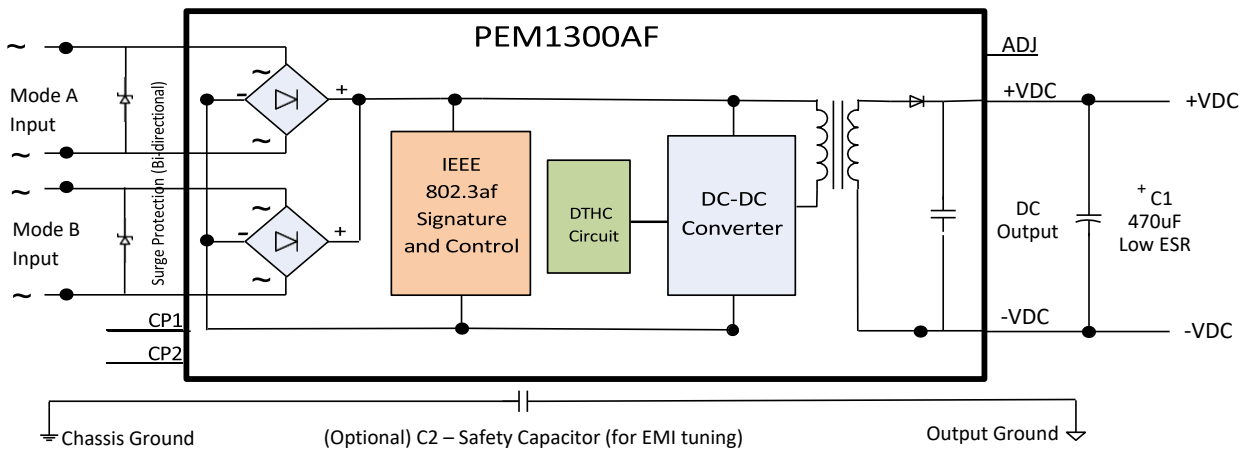


Figure 2- Output Connections

BLOCK DIAGRAM



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

Figure 3- Output Connections

PIN CONNECTIONS

INPUT PINS	
1	VINA1. This pin connects to the output of the data transformer center-tap (for Mode A PoE injection). Not polarity sensitive.
2	VINA2. This pin connects to the output of the data transformer center-tap (for Mode A PoE injection). Not polarity sensitive.
3	VINB1. This pin connects to Ethernet cable spare pair (for Mode B PoE injection). Not polarity sensitive.
4	VINB2. This pin connects to Ethernet cable spare pair (for Mode B PoE injection). Not polarity sensitive.
5	CP1. Connect this pin only as per the instructions in <i>Table 1</i> .
6	CP2. Connect this pin only as per the instructions in <i>Table 1</i> .
OUTPUT PINS	
7	-VDC. The ground return for the +VDC output. Max. Current 3A per pin ¹⁰ .
8	+VDC. This pin provides the regulated output from the DC/DC converter. Max. Current 3A per pin ¹⁰ .
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, see <i>OUTPUT VOLTAGE ADJUSTMENT</i> section
<p>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.</p>	

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). 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.

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 *Table 1* below. System designers can program the power class using 1/16W or greater 1% tolerance resistors as in *Table 1*.

Due to the input polarity neutrality of the PEM1300AF, system designers will need to use four 75V or greater general-purpose diodes, like 1N4148, as detailed in *Figure 4* below. Populate either Rcp1 or Rcp2, do not populate both at the same time.

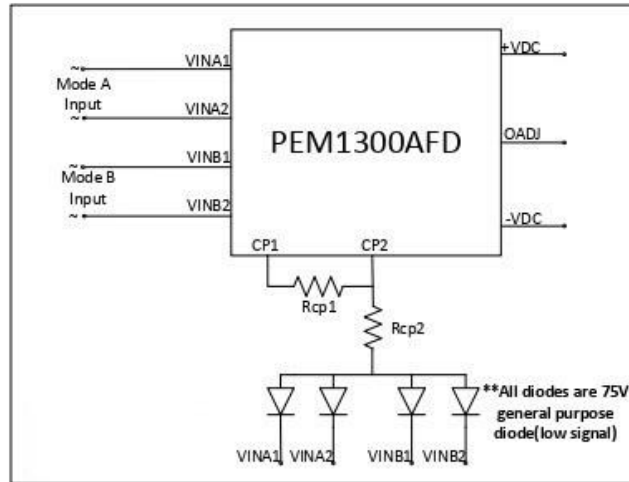


Figure 4- Class Programming

PoE Power Class	Required PD Power	1/16W or greater and 1% tolerance resistor at location	
		Rcp1	Rcp2
0	0.44W ~ 12.95W	Any value 10KΩ to 100 KΩ	Do not connect
1	0.44W ~ 3.84W	Do not connect	461KΩ
2	3.84W ~ 6.49W	Do not connect	235KΩ
3	6.49W ~ 12.95W	Do not connect	150KΩ
4	Reserved for 802.3at	Reserved	Reserved
Note:			
<ul style="list-style-type: none"> Do not populate Rcp1 and Rcp2 at the same time Use 4 x 1N4148 or similar 75V or greater general-purpose diodes as in Figure-4 			

Table 1- Power Classification programming

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%.

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 the below table. 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.

PEM1303AF			PEM1305AF		
Output Voltage	OADJ to +VDC	OADJ to -VDC	Output Voltage	OADJ to +VDC	OADJ to -VDC
3.1V	3.74KΩ		4.6V	20.52KΩ	
3.2V	8.66KΩ		4.8V	46.4KΩ	
3.3V	DNP	DNP	5V	DNP	DNP
3.4V		32.74KΩ	5.2V		45.3KΩ
3.5V		16.2KΩ	5.4V		23.2KΩ
PEM1312AF			PEM1324AF		
Output Voltage	OADJ to +VDC	OADJ to -VDC	Output Voltage	OADJ to +VDC	OADJ to -VDC
11V	121KΩ		22V	324KΩ	
11.5V	249KΩ		23V	681KΩ	
12V	DNP	DNP	24V	DNP	DNP
12.5V		82KΩ	25V		82KΩ
13V		39.2KΩ	26V		41.2KΩ

Table 2- Output Voltage Adjustment

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.

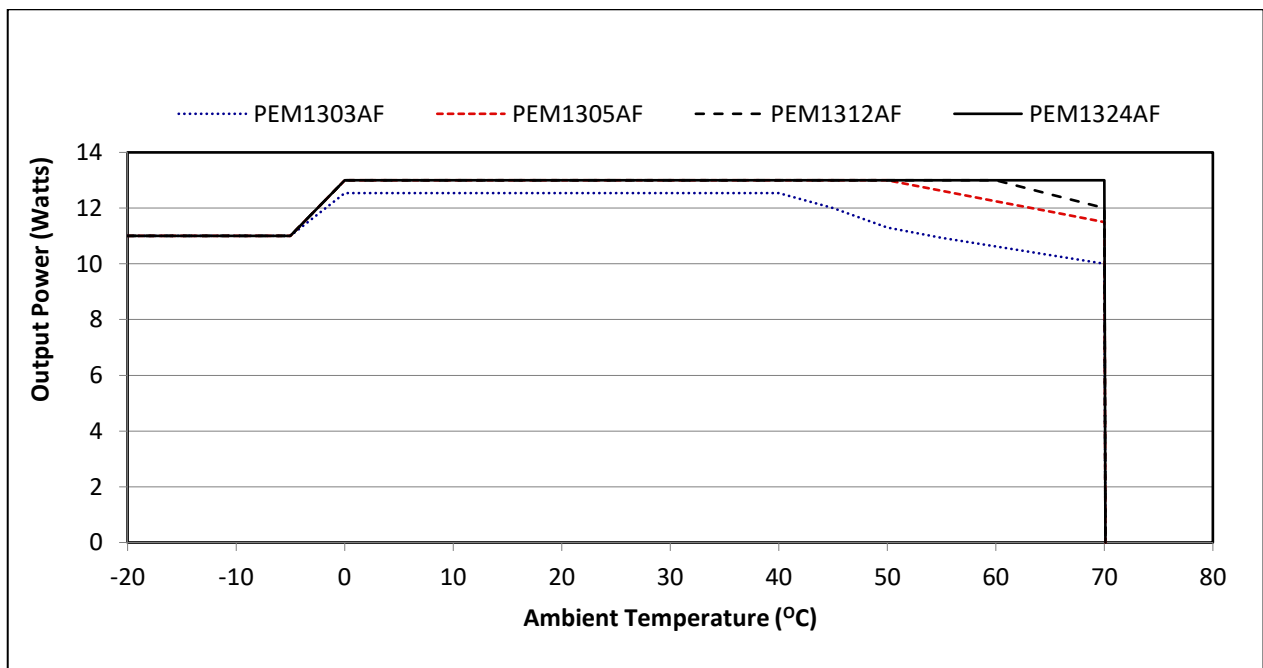


Figure 5- Thermal Performance profile at nominal Vin

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.

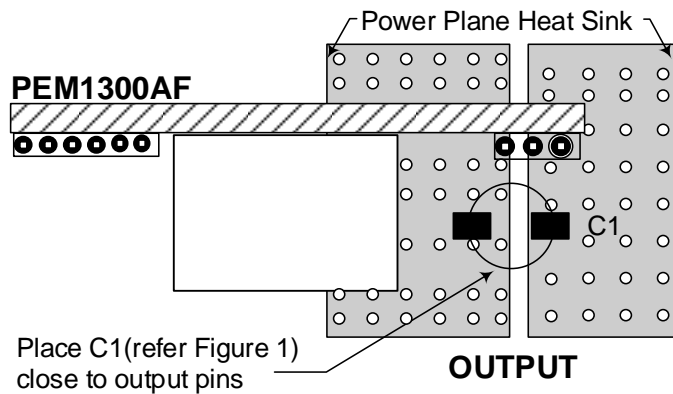


Figure 6- Power Plane Heat Sink

PHYSICAL PACKAGE

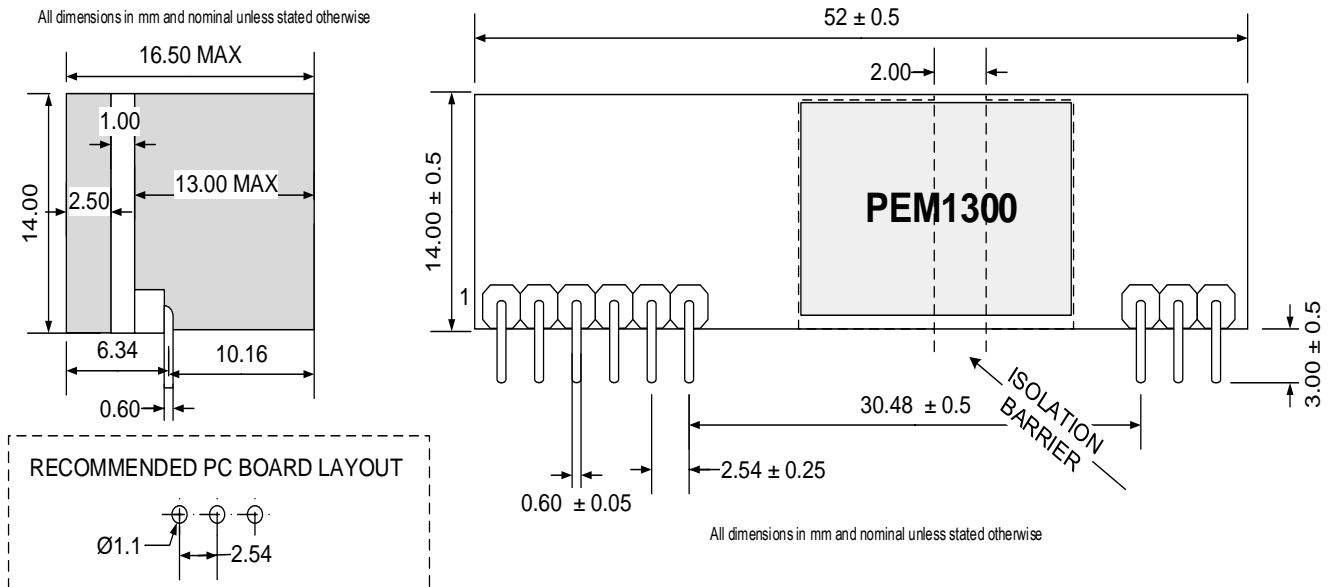


Figure 7- Mechanical Dimensions

IMPROVEMENTS

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

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.

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.

ROHS REACH and CONFLICT MINERALS COMPLIANCE

ROHS compliance details are available on our website.

REVISION HISTORY

REVISION NUMBER	DESCRIPTION
21LR1-6	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ AF series revision modules introduced. PRODUCT OVERVIEW and PRODUCT FEATURES updated ▪ Image of the Product changed ▪ FREQUENCY DITHERING is added
24GR1	<ul style="list-style-type: none"> ▪ Thermal performance updated ▪ Output voltage adjustment resistor values are updated
24JR1	<ul style="list-style-type: none"> ▪ Updated OUTPUT CONNECTION diagram. Updated Figure 4 Class programming
24LR1	<ul style="list-style-type: none"> ▪ Updated IEEE802.3 POWER LEVELS AND CLASSES

IEEE802.3 POWER LEVELS AND CLASSES

IEEE 802.3 Power levels and Classifications for POE Powered Devices

IEEE Standard	Common Name	PD Class	PD / PSE Type	Max num. of events	PD Power ¹	PSE Power ²	Wire pairs energised	AUC ³
802.3af	POE	0	1	-	12.95W	15.4W	2	No Support
802.3af	POE	1	1	1	3.84W	4W	2	No Support
802.3af	POE	2	1	1	6.49W	7W	2	No Support
802.3af	POE	3	1	1	12.95W	15.4W	2	No Support
802.3at	POE+	4	2	2	25.5W	30W	2	No Support
802.3bt	POE++	5	3	4	38.25W	45W	4	Optional
802.3bt	POE++	6	3	4	51W	60W	4	Optional
802.3bt	POE+++	7	4	5	62W	75W	4	Optional
802.3bt	POE+++	8	4	5	71.3W	90W	4	Optional

¹ Min. power delivered to PD / Module input. Max. PD / module output depends on operating conditions

² Power delivered from the Power Sourcing Equipment (PSE) (switch or injector) at its output port

³ Auto Class is supported. It is optional to enable or not.

www.poweredethernet.com. E.&O.E.

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