IEEE 802.3af Class Programmable PoE PD Module

Features

- IEEE802.3af 12.95W PoE PD Module
- Programmable PoE Class 0, 1, 2, 3
- Frequency Dithering (AFD models) for improved EMI
- High Efficiency 1500V isolated DC-DC converter
- 3.3V, 5V, 12V and 24V DC output voltage models
- Overload and short circuit protection[1]
- Adjustable output voltage
- Minimal external components required
- Low output ripple and noise

Applications

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

Brief Description

The KPM5200 is a compact IEEE802.3af compliant Power Over Ethernet (PoE) Powered Device (PD) extraction module delivering up to 12.95W of power, when sourced from an IEEE802.3af compliant Power Sourcing Equipment (PSE) using twisted pair CAT5e or higher Ethernet cable. The module also supports Type 1 PD operation of the IEEE802.3at and IEEE802.3bt standards.

The module is designed with Kinetic Technologies' **KTA1137A** (PoE PD and DC-DC controller) and provides advanced features not found on most PoE PD modules. It features a high-efficiency DC-DC converter with 1500V safety isolation, built-in under-voltage, output over-load, and short-circuit protection, well-regulated low-noise, low-ripple output.

The KPM5200 series requires minimal external components and provide a quick, easy, and cost-effective method for Ethernet equipment manufacturers to "PoE enable" their equipment.

The KPM5200 supports programmable power classification for all classes in IEEE802.3af standard.

The output ripple is controlled within IEEE specifications. For improved EMI performance, the KPM5200 series with 'PND' product options features frequency dithering.

1. If maximum power is exceeded, the KPM5200 will operate in over-current mode and will auto-recover once the overload condition is removed. This condition exceeding continuous 15 seconds may cause damage to the module.

Ordering Information

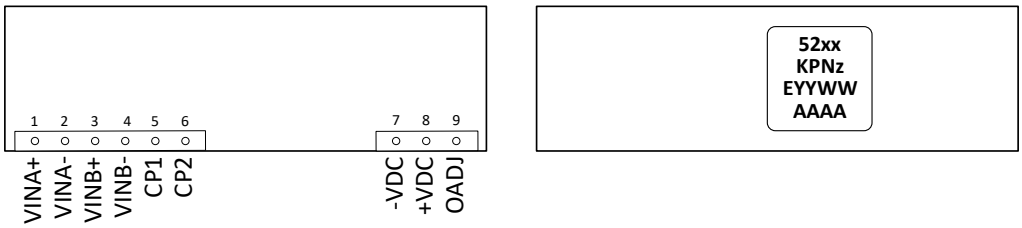
Part Number[2]	Marking[3]	Nominal Input Voltage (VIN)	Output Voltage[4]	Frequency Dithering	Efficiency[5]	Maximum Output Power[6, 7]
		(Volts DC)	(Volts DC)		(%)	(Watts)
KPM5203KPNN-TV	52xx KPNN EYYWW AAAA	48	3.3	No	83	12.95
KPM5205KPNN-TV			5	No	86	
KPM5212KPNN-TV			12	No	88	
KPM5224KPNN-TV			24	No	89	
KPM5203KPND-TV	52xx KPND EYYWW AAAA		3.3	Yes	83	
KPM5205KPND-TV			5	Yes	86	
KPM5212KPND-TV			12	Yes	88	
KPM5224KPND-TV			24	Yes	89	

Pin Descriptions

	INPUT PINS
1	**VINA+**: Connects to the positive (+) output of the input bridge rectifiers (internally connected to pin 3). Polarity Sensitive.
2	**VINA-**: Connects to the negative (-) output of the input bridge rectifiers (internally connected to pin 4). Polarity Sensitive.
3	**VINB+**: Connects to the positive (+) output of the input bridge rectifiers (internally connected to pin 1). Polarity Sensitive.
4	**VINB-**: Connects to the negative (-) output of the input bridge rectifiers (internally connected to pin 2). Polarity Sensitive.
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.
	OUTPUT PINS
7	**-VDC**: Output negative. The ground return for the +VDC output. Max. Current 3A per pin.[8]
8	**+VDC**: Output positive. This pin provides the regulated output from the DC-DC converter. Max. Current 3A per pin.
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 *OUTPUT VOLTAGE ADJUSTMENT* section.
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 Package Information.	

Pin Diagram

Top View



Top Mark

52xx = Device ID,
KPN = Part Number Extension, z = D "Dithering" or N "No Dithering" function
E = Manufacturing Code, YYWW = Date Code
AAAA = Serial Number

2. Part numbers in **Bold**, are available today. For non-bold part numbers, please contact your local sales representative for availability.
3. 52xx = Device ID, KPN = Part Number Extension, z = D "Dithering" or N "No Dithering" function, E = Manufacturing Code, YYWW = Date Code, AAAA = Serial Number
4. Output typical ±3% at T_A of 25°C with a nominal input voltage and rated output current.
5. Typical at nominal V_{IN} with 67% output load, at 25°C ambient.
6. Refer to IEEE802.3 standards document.
7. Refer to *THEMAL MANAGEMENT* Section for operating temperature.
8. Maximum current is 4A per pin when using KPM5203KPNx-TV.

Absolute Maximum Ratings[9, 10]

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)

Electrical Characteristics

INPUT CHARACTERISTICS

Parameter	Symbol	Min.	Typ.	Max.	Units
Input Voltage (V_{IN})[10, 11]	V_{IN}	36	48	57	V
Under Voltage Lockout	V_{UVLO}	30		36	V
Input Current[10, 12]	I_{IN}		350	400	mA
Operating Temperature[12]	T_{OP}	-20	25	70	°C
IEEE 802.3af Classification[13]	Programmable Class 0, 1, 2, or 3				

DC OUTPUT CHARACTERISTICS

Parameter	Symbol	Min.	Typ.[14]	Max.	Units
Line Regulation[9]	V_{LNRG}		0.2		%
Load Regulation[9]	V_{LDRG}		0.5		%
Output Ripple and Noise[9, 11]	V_{RIP}		80	150	mV
Isolation Voltage	V_{ISOL}			1500	V
Temperature Coefficient (slope)	TC		100	300	ppm/ °C

9. All specifications typically are at T_A = 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.
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.
11. With minimum load 100mA.
12. Refer to IEEE 802.3af / 802.3at / 802.3bt standards document.
13. Please see *POWERED DEVICE (PD) SIGNATURE and POWER CLASS PROGRAMMING* Section for more details.
14. Typical values are measured at nominal V_{IN} with 67% load at T_A = 25°C.

Functional Block Diagram

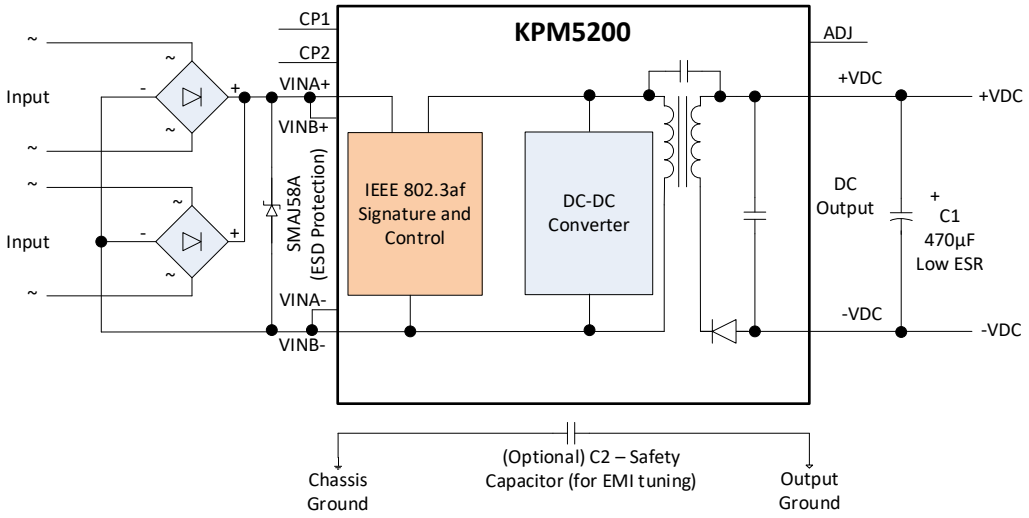


Figure 1. KPM5200 Block Diagram

Functional Description

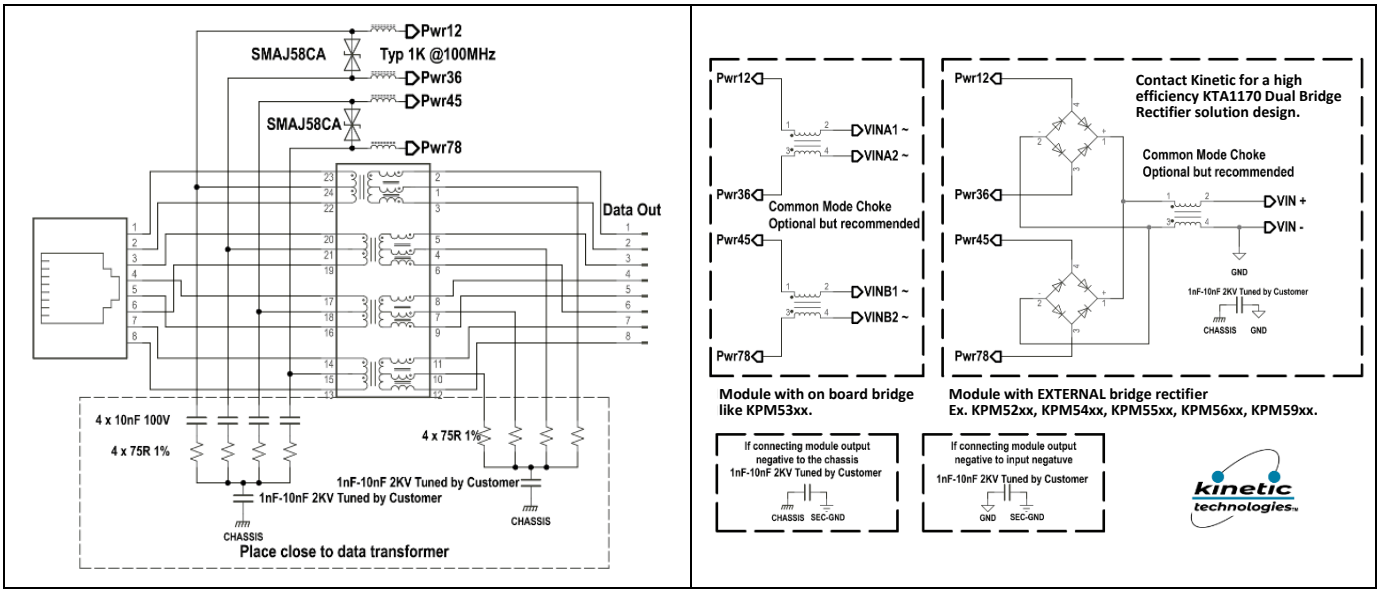


Figure 2. Typical Input Connections

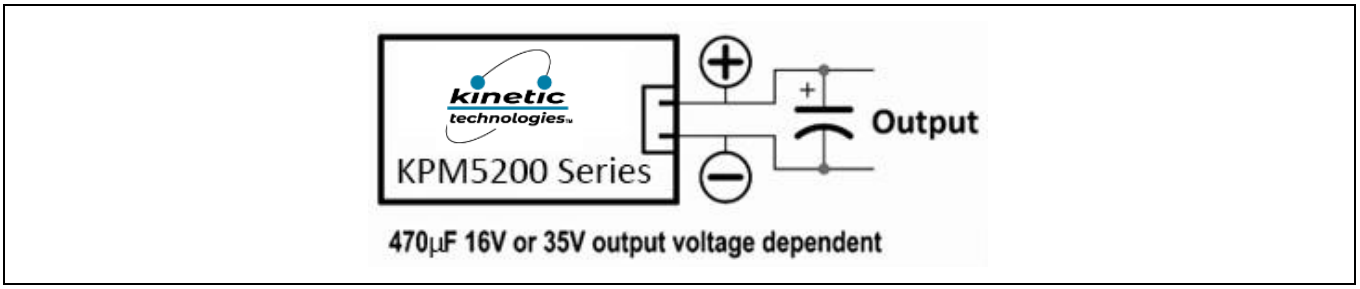


Figure 3. Typical Output Connections

INPUTS

The KPM5200 is compatible with IEEE802.3af 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 IEEE802.3af, 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 KPM5200 provides for external input bridge rectifiers for improved system design flexibility, and distribution of heat generation. As an example, a system designer wanting to provide additional or alternate RJ45 inputs, both of which are PoE enabled, can use only one KPM5200 module to save costs. Another advantage is that this allows the system designer to control the type and costs of the input rectification diodes.

POWERED DEVICE (PD) SIGNATURE and POWER CLASS PROGRAMMING

When the KPM5200 is connected to a CAT5e or higher Ethernet cable from an IEEE802.3af 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”, IEEE, in its latest standard has stressed for PDs to implement the IEEE802.3af 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 IEEE802.3af standard provides for PDs to inform their required power levels to the PSE via a Class system. System designers can program the power class using 1/16W or greater 1% tolerance resistors as in Table 1. The classes are defined as per Table 1 below.

Table 1. Power Classification Programming

PoE Power Class	Required PD Power	Nominal 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 100KΩ
1	0.44W ~ 3.84W	461KΩ	461KΩ	Do not connect
2	3.84W ~ 6.49W	150KΩ	235KΩ	Do not connect
3	6.49W ~ 12.95W	150KΩ	150Ω	Do not connect
4	Reserved for 802.3at	RSVD	RSVD	RSVD

NOTES:

- Do not connect Pin 2 or Pin 4 to Pin 5 at any time.
- Do not connect Pin 4, 5 and 6 together at any time.
- Connect Pin 5 only to Pin 6 and only as mentioned above.

ISOLATION

IEEE802.3af section 33.4.1 calls for a Powered Device (PD) to meet safety isolation requirement by meeting the electrical strength test of IEC 60950 sub clause 6.2. Kinetic Technologies' KPM5200 modules meet or exceed 1500V impulse test. This is also referred to as "Hi Pot Test" or "Isolation Test Voltage".

The "keep-out area" shown in the Package Information - Mechanical Dimensions section of this document indicates the location and size of the electrical isolation barrier. This area must be kept clear of PCB tracks (traces) or planes on the base PCB on which the KPM5200 is mounted to ensure compliance with the isolation requirements.

FREQUENCY DITHERING

The KPM5200 'PND' series is built with a Frequency Dithering Circuit to better help control EMI (electromagnetic interference) emissions. The nominal switching frequency of the KPM5200 'PND' series is 300KHz, with a dithering range of ±10%.

OUTPUT

The system load circuit should be connected across the KPM5200 +VDC and –VDC output pins. To maintain the specified output regulated voltage, a low ESR 470µF capacitor must connected between the +VDC and -VDC pins external to the KMP5200 module – refer to the Figure 1 Block Diagram and Figure 3 for Typical Output Connections details.

OUTPUT VOLTAGE ADJUSTMENT

The KPM5200 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 Kinetic's technical support for more details or specific resistor values.

Table 2. Output Voltage Adjustment

KPM5203			KPM5205		
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
KPM5212			**KPM5224**		
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

THERMAL MANAGMENT

As with any power component, the KPM5200 modules generate heat. Considering adequate ventilation and airflow during the design stage is important. The amount of heat generated by the KPM5200 will depend on the output load it is required to drive. The maximum ambient operating temperature is 70°C. Figure 4, shows the thermal performance of the KPM5200 with a nominal 48V DC input. The KPM5200 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 adhesive, or (b) by a power plane heat sink described in Figure 5. The two methods can be combined.

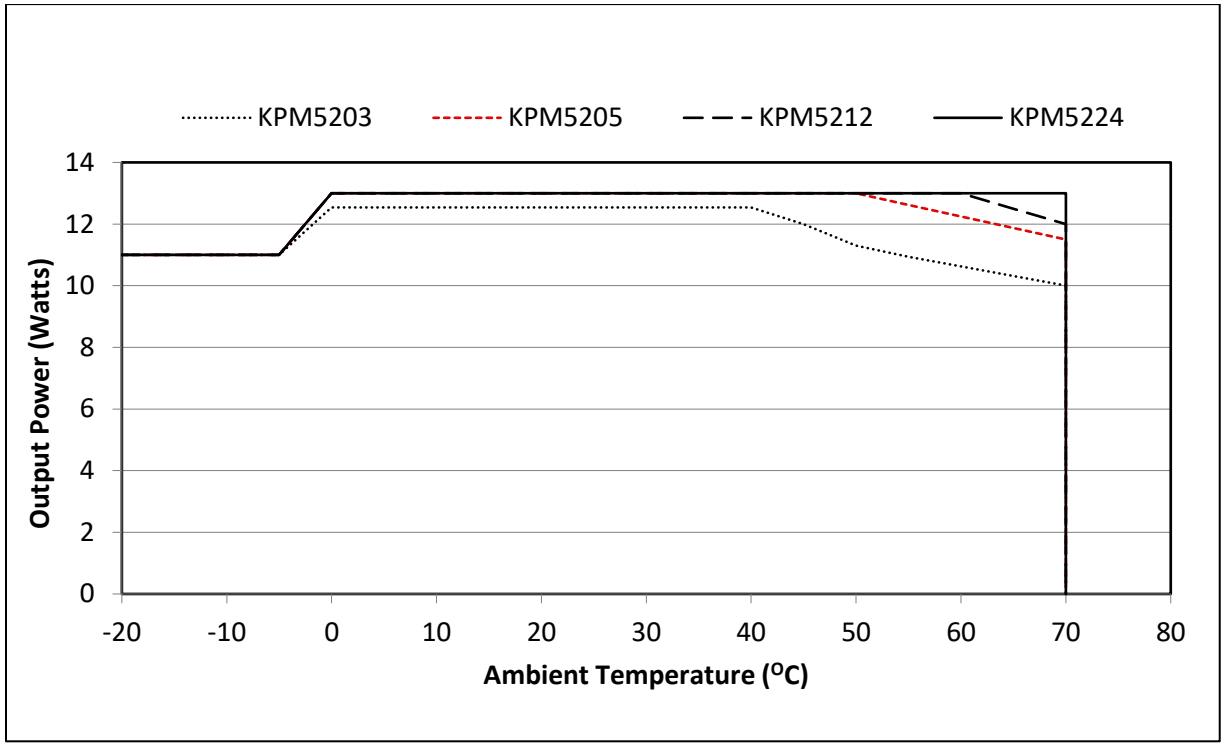


Figure 4. Thermal Performance Profile at Nominal V_{IN}

POWER PLANE HEAT SINK

A power plane heat sink on the motherboard is a relatively simple method to draw some heat away from the KPM5200 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 KPM5200 must not be seated into a socket. This method can be combined with forced airflow cooling, and with a heat sink glued onto the two output diodes using thermal glue.

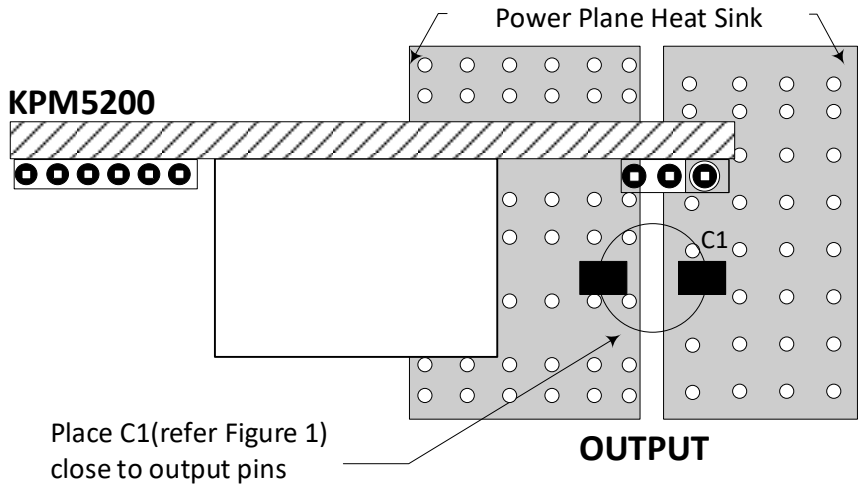


Figure 5. Power Plane Heat Sink

IEEE 802.3 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

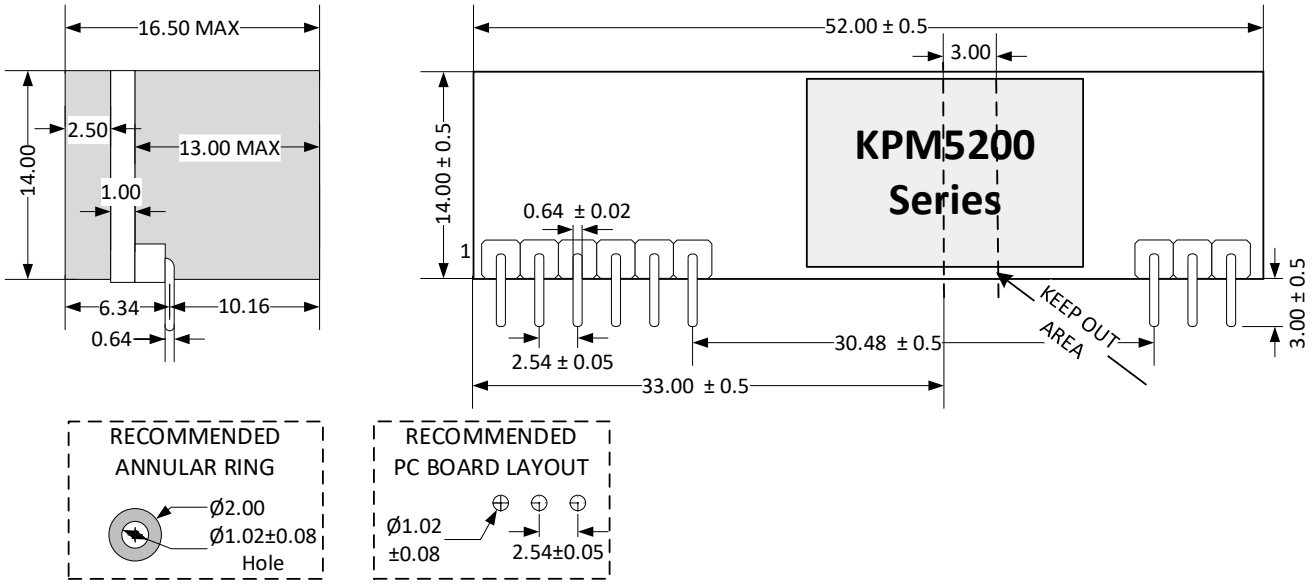
[2] Power delivered from the Power Sourcing Equipment (PSE) (switch or injector) at its output port

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

Packaging Information

Mechanical Dimensions

All dimensions in mm and nominal unless stated otherwise



ESD AND SURGE PROTECTION

It is essential for system designers to incorporate Electrostatic Discharge (ESD) and surge protection measures at the input of the KPM5200 to safeguard against damage from over-voltage surges and to ensure compliance with system EMC and ESD standards. This can be achieved by using a TVS diode, such as the SMAJ58A (uni-directional) or SMAJ58CA (bi-directional). These diodes effectively clamp voltage spikes, providing protection for the module and enhancing the overall reliability of the system.