PT SERIES SIP Package

Up to 6 Watt Isolated DC-DC Converter

PRODUCT OVERVIEW

This PT series offer up to 6 watts of isolated output power in an 8 pin SIP standard package. These converters provide a 4:1 wide input voltage range of 9 to 36 or 18 to 75 Volts and deliver a precise regulated output voltage. The output voltage can be single or dual depending on the model. Other output voltages are also available and please contact DATEL if your application requires such modification.

This series features high efficiency up to 89%; 1500Volts of DC of isolation and can operate over the ambient temperature range of –40°C to +85°C. These modules offer low noise and ripple, have a continuous short circuit protection with a Remote ON/Off Control function.

FEATURES

- Industry Standard 8- pin SIP Package
- Up to 6 Watts of Output power
- 1500 Volts DC of isolation
- 4:1 Input ranges (4:1) (9-36, 18-75 Volts)
- Regulated Outputs
- Up to 89 % Efficiency
- -40°C to +100°C temperature range
- Continuous Short Circuit Protection
- Remote On/Off Control function
- Meets 2004/108/EC
- Safety designed to meets EN5502 Class A/B and UL60950-1

APPLICATIONS:

- Distributed Power Architectures
- Mobile telecommunication
- Industrial applications
- Battery and portable operated equipment
-

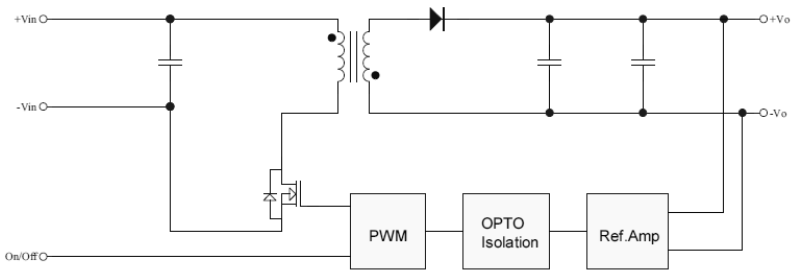
AVAILABLE OPTIONS

- Customizable Input/ Output voltages
- EN5502, UL60950-1 and EN60950-1, 2nd Edition

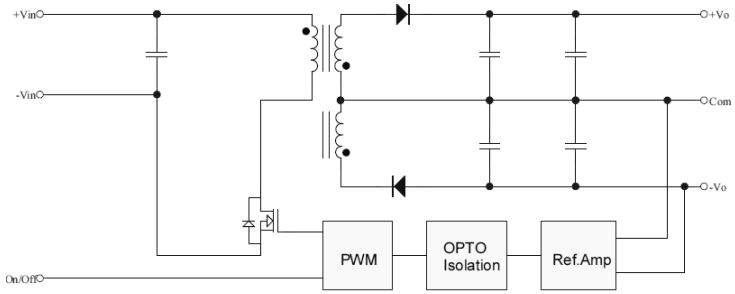
Contact DATEL for other series in SIP Package

- 2:1 Input Ranges
- Cost saving, lower / higher power, other output voltages etc.

BLOCK DIAGRAM



Single Output model



Dual Output model

MODEL SELECTIONS

MODEL NUMBER	INPUT VOLTAGE	OUTPUT VOLTAGE	MAX OUTPUT CURRENT	EFFICIENCY %	MIN INPUT CURRENT	MAX INPUT CURRENT
PT22S3.3-1.5	9 - 36V	3.3 VDC	1500 mA	82	4 mA	310 mA
PT22S5-1.2	9 - 36V	5 VDC	1200 mA	86	4 mA	298 mA
PT22S12-0.5	9 - 36V	12 VDC	500 mA	88	5 mA	288 mA
PT22S15-0.4	9 - 36V	15 VDC	400 mA	89	5 mA	288 mA
PT22S24-0.25	9 - 36V	24 VDC	250 mA	88	5 mA	288 mA
PT22D5-0.6	9 - 36V	±5 VDC	±600 mA	86	4 mA	298 mA
PT22D12-0.25	9 - 36V	±12 VDC	±250 mA	88	6 mA	288 mA
PT22D15-0.2	9 - 36V	±15.0 VDC	±200 mA	88	6 mA	288 mA
PT45S3.3-1.5	18 - 75V	3.3 VDC	1500 mA	82	3 mA	155 mA
PT45S5-1.2	18 - 75V	5 VDC	1200 mA	85	3 mA	150 mA
PT45S12-0.5	18 - 75V	12 VDC	500 mA	88	3 mA	145 mA
PT45S15-0.4	18 - 75V	15 VDC	400 mA	89	3 mA	145 mA
PT45D5-0.6	18 - 75V	±5 VDC	±600 mA	85	4 mA	150 mA
PT45D12-0.25	18 - 75V	±12 VDC	±250 mA	88	3 mA	145 mA
PT45D15-0.2	18 - 75V	±15.0 VDC	±200 mA	88	3 mA	145 mA

ABSOLUTE MAXIMUM RATINGS

PARAMETER	CONDITIONS	MODEL	Min.	Typical	Max.	Units
Input Voltage						
Continuous	DC	$24V_{in}$ $48V_{in}$	-0.3 -0.3		36 75	Volts
Transient	100ms, DC	24Vin 48Vin			50 100	Volts
Operating Ambient Temperature	Derating, Above 61°C	Vo=3.3 Vo = 5 Vo = ±5	-40		+85	°C
	Derating, Above 65 °C	Others	-40		+85	°C
Case Temperature		All	-40		+105	°C
Storage Temperature		All	-55		+125	°C
Input / Output Isolation Voltage	1 minute	All	1500			Volts

INPUT CHARACTERISTICS

Note: All specifications are typical at nominal input, full load at 25°C unless otherwise noted

PARAMETER	CONDITIONS	MODEL	Min.	Typical	Max.	Units
Operating Input Voltage		24Vin 48Vin	9 18	24 48	36 75	Volts
Maximum Input Current	Full Load, Vin = 9 V	24 Vin			800	mA
	Full Load, Vin = 18V	48 Vin			400	
No-Load Input Current	Vin =Nominal input	PT22S3.3-1.5		4		mA
		PT22S5-1.2		4		mA
		PT22S12-0.5		5		mA
		PT22S15-0.4		5		mA
		PT22S24-0.25		5		mA
		PT22D5-0.6		4		mA
		PT22D12-0.25		6		mA
		PT22D15-0.2		6		mA
		PT45S3.3-1.5		3		mA
		PT45S5-1.2		3		mA
		PT45S12-0.5		3		mA
		PT45S15-0.4		3		mA
		PT45D5-0.6		4		mA
		PT45D12-0.25		3		mA
		PT45D15-0.2		3		mA
Off Converter Input Current	Shutdown input idle current			1		mA
Input Reflected-Ripple Current	Peak-Peak thru 12uH inductor, 5Hz to 20MHz			10		mA
Inrush Current (I^2t)	As per ETS300 132-2	All			0.01	A^2s

OUTPUT CHARACTERISTIC

PARAMETER	CONDITIONS	MODEL	Min.	Typical	Max.	Units
		Vo=3.3 Vo=5 Vo=12 Vo=15 Vo=24 Vo=±5.0 Vo=±12 Vo=±15	3.2505 4.85 11.64 14.55 23.76 ±4.85 ±11.64 ±14.55	3.3 5 12 15 24 ±5 ±12 ±15	3.3495 5.15 12.36 15.45 24.24 ±5.15 ±12.36 ±15.45	
Output Voltage Regulation						
Line Regulation	Vin=High line to Low line Full Load	All			±0.2	%
Load Regulation	Io=Full Load to No Load	Single Dual			±.5 ±1	% %
Temperature Coefficient	TC=-40°C to + 85°C				±0.03	%/°C
Output Voltage Ripple and Noise	Peak-to-Peak, Full Load, 20 MHz				100	mV
Operating Output Current Range		Vo=3.3V Vo=5V Vo=12V Vo=15V Vo=24V Vo=±5V Vo=±12V Vo=±15V	0 0 0 0 0 0 0 0		1500 1200 500 400 250 ±600 ±250 ±200	mA
Output DC Current-Limit Inception	Output Voltage =90% Vo nominal			180		%
Maximum Output Capacitance	Full load, Resistance	Vo=3.3V Vo=5V Vo=12V Vo=15V Vo=24V Vo=±5V Vo=±12V Vo=±15V			4700 2200 1100 470 450 1400 660 220	µF

DYNAMIC CHARACTERISTICS

PARAMETER	CONDITIONS	MODEL	Min.	Typical	Max.	Units
Output Voltage Current Transient						
Step Change in Output Current	75% to 100% of I_{o_max}	All			±5	%
Setting Time (within 1% $Vo_{nominal}$)	di/dt=0.1A/us	All			250	µs
Turn-On Delay and Rise Time						
Turn-On Delay Time, From On/Off Control	$V_{on/off}$ to 10%V_{o_set}	All		15		ms
Turn-On Delay Time, From Input	V_{in_min} to 10%V_{o_set}	All		15		ms
Output Voltage Rise Time	10% V_{o_set} to 90% V_{o_set}	All		8		ms

FEATURE CHARACTERISTICS

PARAMETER	CONDITIONS	Device	Min.	Typical	Max.	Units
Efficiency (Full Load)	Vin=Nominal Vin	PT22S3.3-1.5		82		%
		PT22S5-1.2		86		
		PT22S12-0.5		88		
		PT22S15-0.4		89		
		PT22S24-0.25		88		
		PT22D5-0.6		86		
		PT22D12-0.25		88		
		PT22D15-0.2		88		
		PT45S3.3-1.5		82		
		PT45S5-1.2		85		
		PT45S12-0.5		88		
		PT45S15-0.4		89		
		PT45D5-0.6		85		
		PT45D12-0.25		88		
		PT45D15-0.2		88		
ISOLATION CHARACTERISTICS						
Input to Output	1 minutes	All	1500			Volts
Isolation Resistance		All	1000			MΩ
Isolation Capacitance		All		50		pF
Switching Frequency		All		580		KHz
On/Off Control						
Module On	Open Circuit, high impedance	All				
Module Off	Current of Von/off pin	All	2		4	mA
Off Converter Input Current	Shutdown input idle current	All			2.5	mA
MTBF	I_o =100%of I_{o_max};Ta=25°C per MIL-HDBK-217F	All		1850		K hours
Weight		All		4.8		grams

Operating Temperature Range

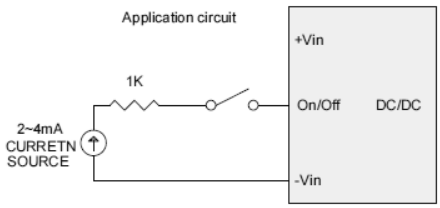
This PT series of converters operate over the wide ambient temperature range from -40°C to +85°C. The case temperature should not go over +105°C during normal operating.

Over Current Protection

All different voltage models have full continuous short-circuit protection. To provide protection in a fault condition, the unit is equipped with internal over-current protection. The unit operates normally once the fault condition is removed. At the point of current-limit inception, the converter will go into over current protection mode.

Remote On/Off

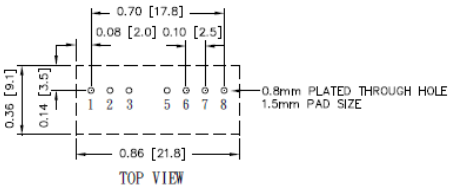
The remote on/off input feature of the converter allows external circuitry to turn the converter on or off. Active-high remote on/off is available as standard. The converter is turned on if the remote on/off pin is open circuit. Supplying the on/off pin at 2mA to 4mA will turn the converter off. The signal level of the on/off pin is defined with respect to ground. If not using the on/off pin, leave the pin open and the module will be on.



On/Off pin applied current via 1K

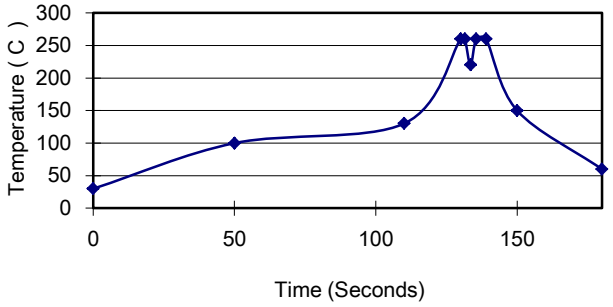
Recommended PCB Layout/Footprints and Soldering Information

The user must ensure that other components and metal in the vicinity of the converter meet the spacing requirements to which the system is approved. Low resistance and low inductance PCB layout should be used where possible. Proper attention must also be given to low impedance tracks between power module, input and output grounds. The recommended footprints and soldering profiles are shown in the next two figures.



Recommended PCB Layout Footprints
Note: Dimensions are in inches (millimeters)

Lead Free Wave Soldering Profile

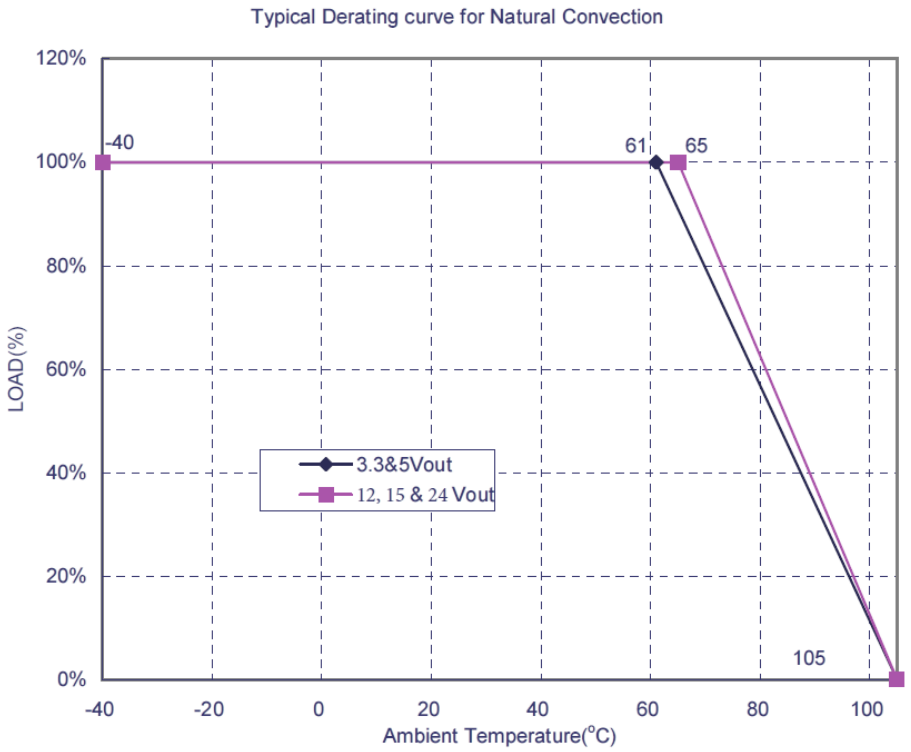


Recommended Wave Soldering Profiles for SIP models

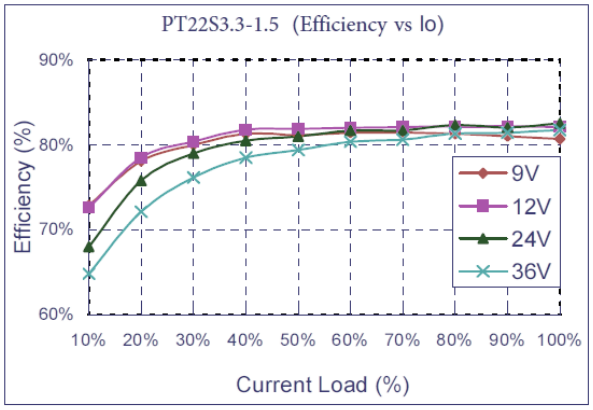
Note：
1. Soldering Materials: Sn/Cu/Ni
2. Ramp up rate during preheating: 1.4 °C/Sec (From +50°C to +100°C)
3. Soaking temperature: 0.5 °C/Sec (From +100°C to +130°C), 60 ± 20 seconds
4. Peak temperature: +260°C, above +250°C 3~6 Seconds
5. Ramp up rate during cooling: -10.0 °C/Sec (From +260°C to +150°C)

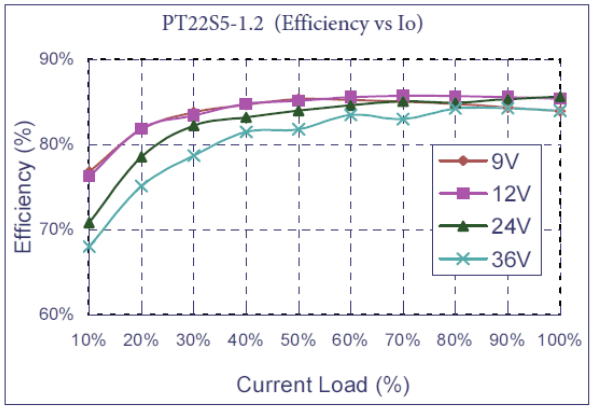
Power De-Rating Curves for PT Series

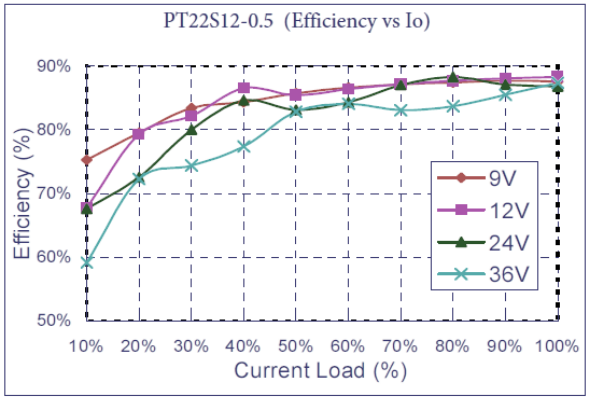
Note that the operating ambient temperature range is -40°C to + 85°C with derating above +61℃ for 3.3 & 5 Vout and +65℃ for 12, 15 & 24 Vout. It is recommended that the maximum case temperature under any operating condition should not exceed +105℃.

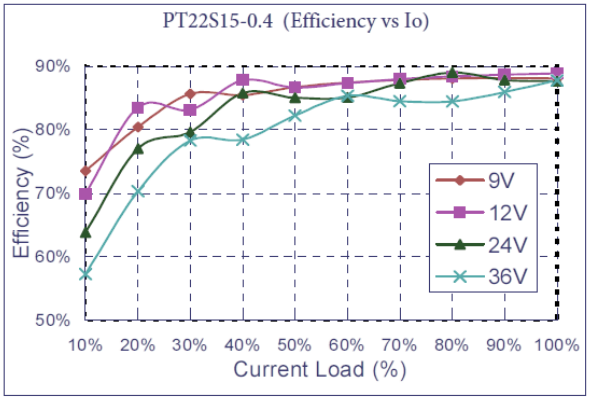


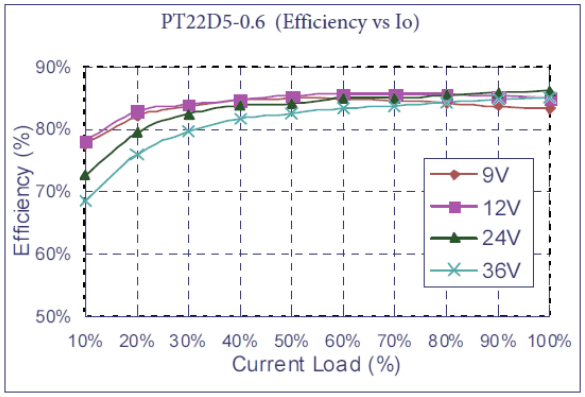
Efficiency vs. Load Curves

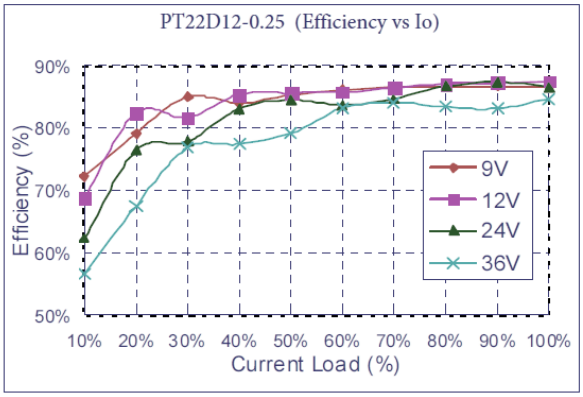


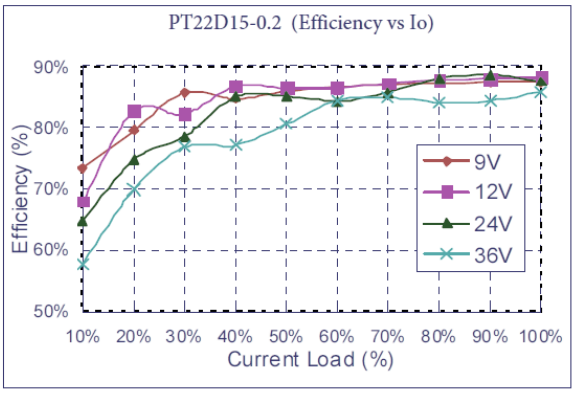


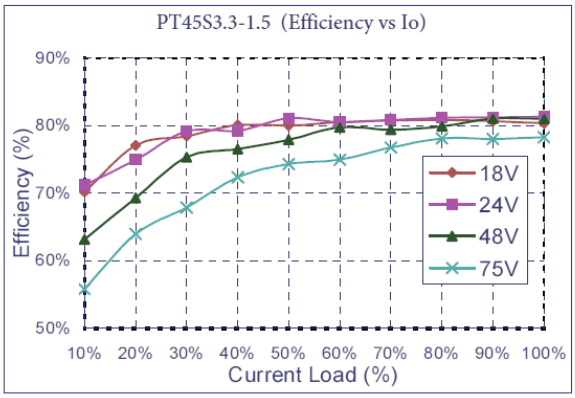


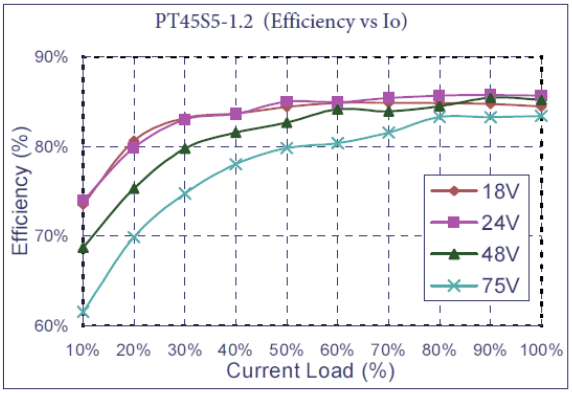


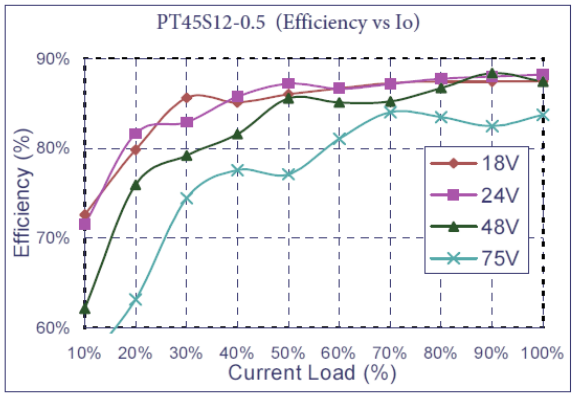


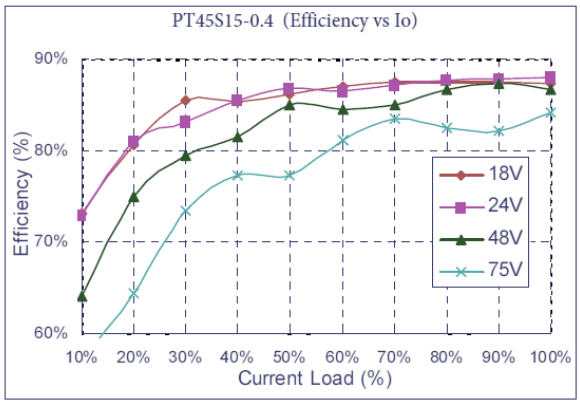


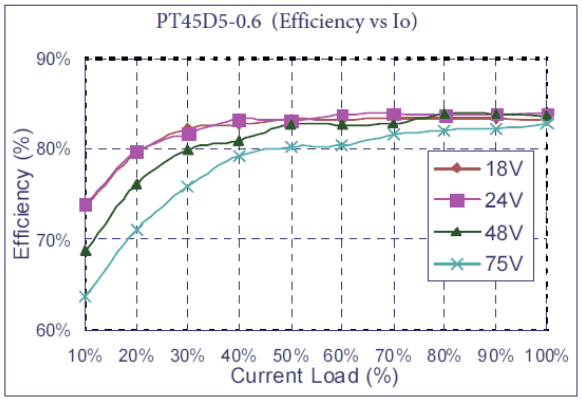

PT22D15-0.2 (Efficiency vs Io)
Efficiency (%)
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
9V
12V
24V
36V

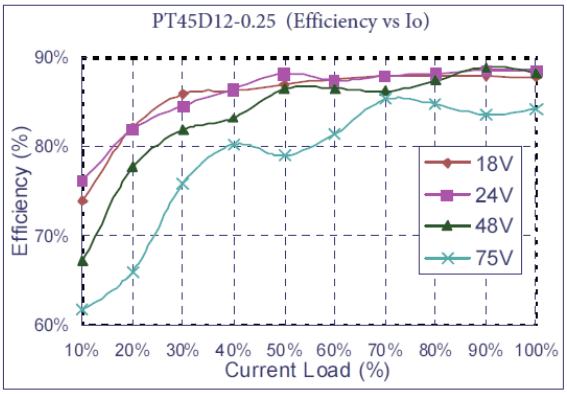

PT45S3.3-1.5 (Efficiency vs Io)
Efficiency (%)
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V

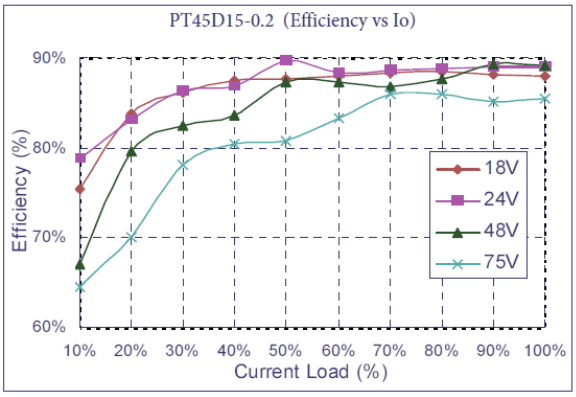

PT45S5-1.2 (Efficiency vs Io)
Efficiency (%)
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V


PT45S12-0.5 (Efficiency vs Io)
Efficiency (%)
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V


PT45S15-0.4 (Efficiency vs Io)
Efficiency (%)
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V

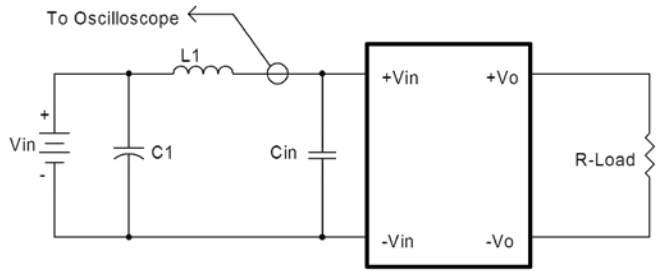

PT45D5-0.6 (Efficiency vs Io)
Efficiency (%)
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V


PT45D12-0.25 (Efficiency vs Io)
Efficiency (%)
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V


PT45D15-0.2 (Efficiency vs Io)
Efficiency (%)
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V

Input Capacitance at the Power Module

In order to avoid problems with loop stability, the converter must be connected to a low impedance AC source and a low inductance source. The input capacitors (Cin) should be placed close to the converter input pins to de-couple distribution inductance. The external input capacitors should have low ESR in order to quiet any ripple. Circuit as shown in the figure below represents typical measurement methods for reflected ripple current The recommended input capacitors (Cin) should be low ESR capacitors for 5Vin and 12Vin models of 2.2µF, and 4.7µF for 24Vin model. Circuit as shown in the figure below represents typical measurement methods for reflected ripple current. C1 and L1 simulate a typical DC source impedance. The input reflected-ripple current is measured by a current probe oscilloscope with a simulated source Inductance (L1).



L1: 12uH
C1: None
2.2uF or 4.7uF Tantalum capacitor
Cin: 47uF ESR<0.7ohm @100KHz

Input Reflected-Ripple Test Setup

Test Set-Up

The basic test set-up to measure efficiency, load regulation, line regulation and other parameters is shown in the next figure. When testing the converter under any transient conditions, the user should ensure that the transient response of the source is sufficient to power the equipment under test. Below is the calculation of:

1- Efficiency
2- Load regulation
3- Line regulation

The value of efficiency is defined as:

$$\eta = \frac{V_O \times I_O}{V_{IN} \times I_{IN}} \times 100\%$$

Where

V_O is output voltage,
I_O is output current,
V_{IN} is input voltage,
I_{IN} is input current.

The value of load regulation is defined as:

$$Load.reg = \frac{V_{FL} - V_{NL}}{V_{NL}} \times 100\%$$

Where

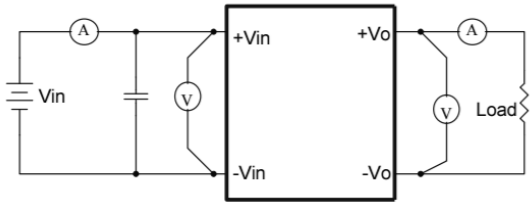
V_{FL} is the output voltage at full load
V_{NL} is the output voltage at 20% load

Line regulation is per 1.0% change in input voltage

The value of line regulation is defined as:

$$Line.reg = \frac{\frac{V_{HL} - V_{LL}}{V_{NOM}} \times 100\%}{20}$$

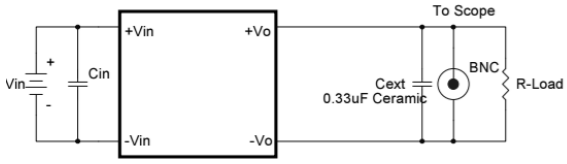
Where: V_{HL} is the output voltage of maximum input voltage at full load.
V_{LL} is the output voltage of minimum input voltage at full load.
V_{NOM} is the output voltage of nominal input voltage at full load.



Output Test Setup

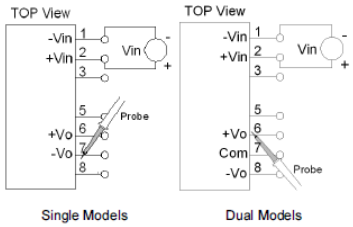
Output Ripple and Noise Measurement

The test set-up for noise and ripple measurements is shown inthe two figures below. A coaxial cable was used to prevent impedance mismatch reflections disturbing the noise readings at higher frequencies. Measurements are taken with output appropriately loaded and all ripple/noise specifications are from D.C. to 20MHz Band Width.



Note: C1: 0.1uF Ceramic capacitor

Using BNC to Measure Output Ripple and Noise



Using Probe to Measure Output Ripple and Noise

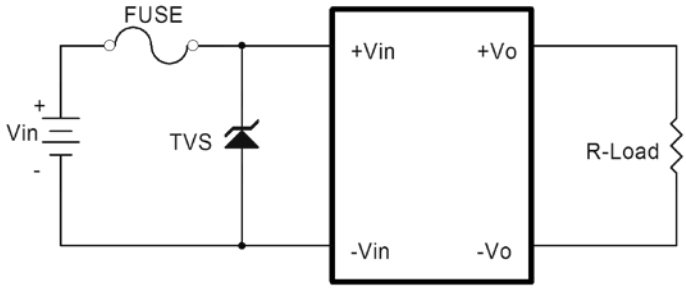
Output Capacitance

The PT series of converters provide unconditional stability with or without external capacitors. For good transient response, low ESR output capacitors should be located closer to the point of load.

SAFETY and EMC

Input Fusing and Safety Considerations

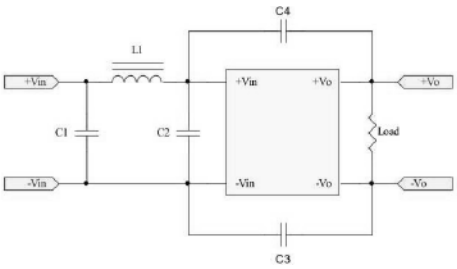
This PT series of converters do not have an internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a time delay fuse 1.25A for 24Vin and 630mA for 48Vin modules. The circuit in the figure below is recommended and it uses a Transient Voltage Suppressor diode across the input terminal to protect the unit against surge or spike voltage and input reverse voltage.



Input Protection

EMC Considerations

EMI Test standard: EN55022 Class A/B Conducted Emission
Test Condition: Input Voltage: Nominal, Output Load: Full Load

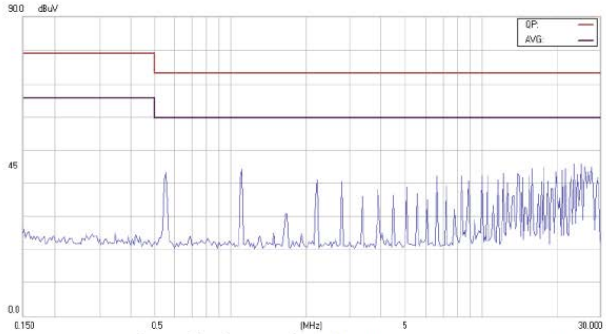


Connection circuit for conducted EMI testing

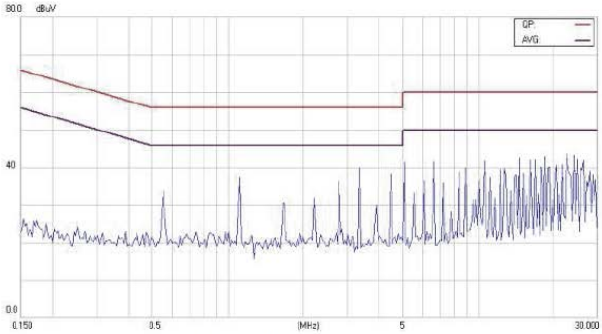
	EN55022 class A					EN55022 class B				
Model No.	**C1**	**C2**	**C3**	**C4**	**L1**	**C1**	**C2**	**C3**	**C4**	**L1**
PT22S3.3-1.5	10µF/50V	NC	150pF/2KV	150pF/2KV	10µH	10µF/50V	NC	1500pF/2KV	1500pF/2KV	10µH
PT22S5-1.2	10µF/50V	NC	150pF/2KV	150pF/2KV	10µH	10µF/50V	NC	1500pF/2KV	1500pF/2KV	10µH
PT22S12-0.5	10µF/50V	NC	150pF/2KV	150pF/2KV	10µH	10µF/50V	NC	1500pF/2KV	1500pF/2KV	10µH
PT22S15-0.4	10µF/50V	NC	150pF/2KV	150pF/2KV	10µH	10µF/50V	NC	1500pF/2KV	1500pF/2KV	10µH
PT22S24-0.25	10µF/50V	NC	150pF/2KV	150pF/2KV	10µH	10µF/50V	NC	1500pF/2KV	1500pF/2KV	10µH
PT22D5-0.6	10µF/50V	NC	150pF/2KV	150pF/2KV	10µH	10µF/50V	NC	1500pF/2KV	1500pF/2KV	10µH
PT22D12-0.25	10µF/50V	NC	150pF/2KV	150pF/2KV	10µH	10µF/50V	NC	1500pF/2KV	1500pF/2KV	10µH
PT22D15-0.2	10µF/50V	NC	150pF/2KV	150pF/2KV	10µH	10µF/50V	NC	1500pF/2KV	1500pF/2KV	10µH
PT45S3.3-1.5	1µF/100V	NC	150pF/2KV	150pF/2KV	10µH	2.2µF/100V	2.2µF/100V	1500pF/2KV	1500pF/2KV	10µH
PT45S5-1.2	1µF/100V	NC	150pF/2KV	150pF/2KV	10µH	2.2µF/100V	2.2µF/100V	1500pF/2KV	1500pF/2KV	10µH
PT45S12-0.5	1µF/100V	NC	150pF/2KV	150pF/2KV	10µH	2.2µF/100V	2.2µF/100V	1500pF/2KV	1500pF/2KV	10µH
PT45S15-0.4	1µF/100V	NC	150pF/2KV	150pF/2KV	10µH	2.2µF/100V	2.2µF/100V	1500pF/2KV	1500pF/2KV	10µH
PT45D5-0.6	1µF/100V	NC	150pF/2KV	150pF/2KV	10µH	2.2µF/100V	NC	1500pF/2KV	1500pF/2KV	10µH
PT45D12-0.25	1µF/100V	NC	150pF/2KV	150pF/2KV	7.5µH	2.2µF/100V	NC	1500pF/2KV	1500pF/2KV	10µH
PT45D15-0.2	1µF/100V	NC	150pF/2KV	150pF/2KV	7.5µH	2.2µF/100V	NC	1500pF/2KV	1500pF/2KV	10µH

Note: All of capacitors are ceramic capacitors

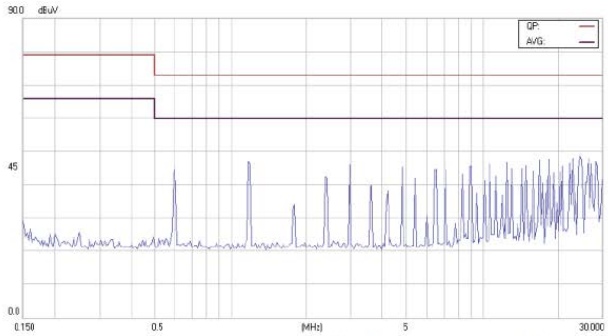
EMI and conducted noise meet EN55022 Class B



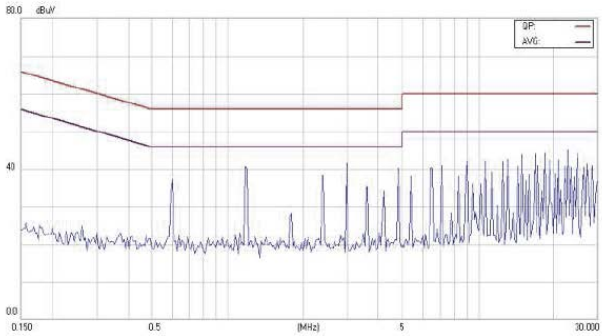
Conducted Class A for PT22S3.3-1.5 @ Vin= 24V



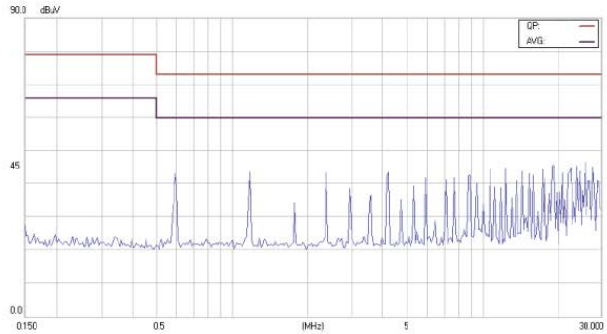
Conducted Class B for PT22S3.3-1.5 @ Vin= 24V



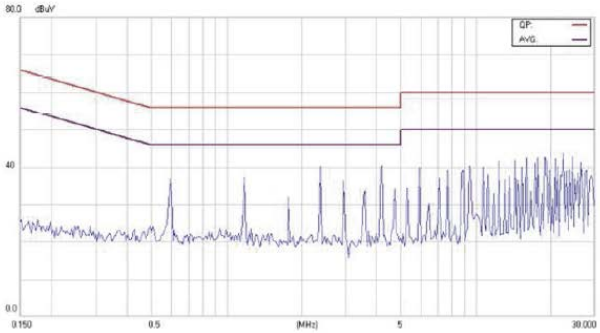
Conducted Class A for PT22S5-1.2 @ Vin= 24V



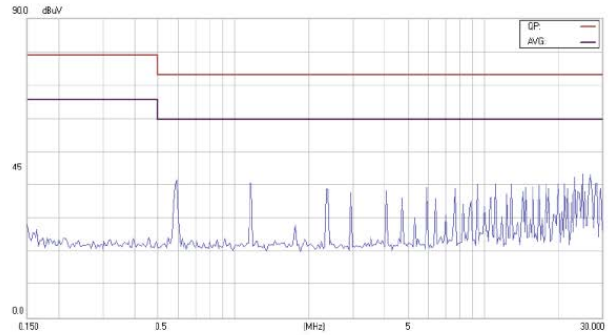
Conducted Class B for PT22S5-1.2 @ Vin= 24V



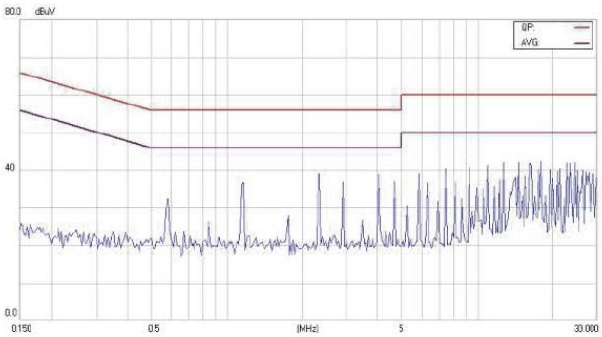
Conducted Class A for PT22S12-0.5 @ Vin= 24V



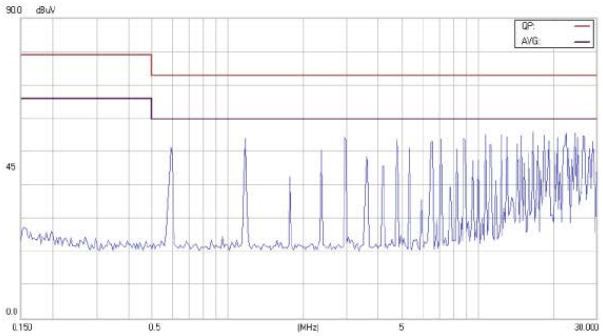
Conducted Class B for PT22S12-0.5 @ Vin= 24V



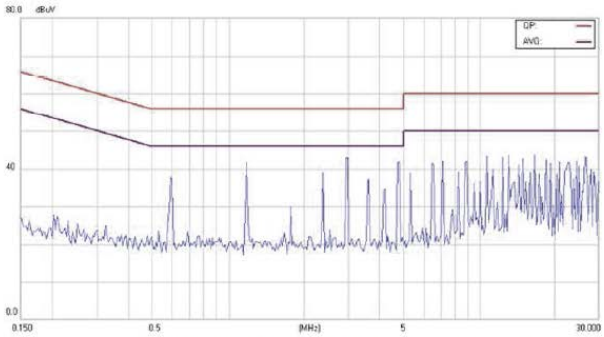
Conducted Class A for PT22S15-0.4 @ Vin= 24V



Conducted Class B for PT22S15-0.4 @ Vin= 24V



Conducted Class A for PT22D5-0.6 @ Vin= 24V



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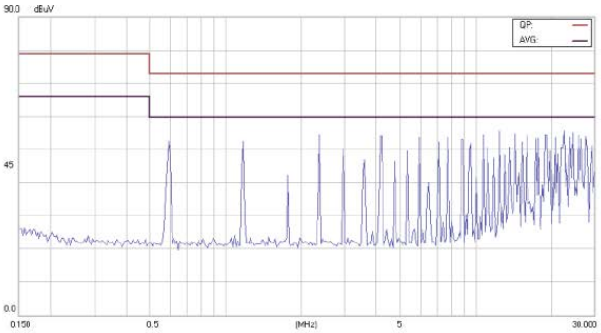
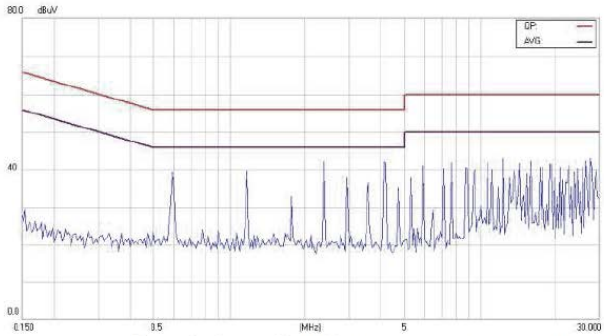
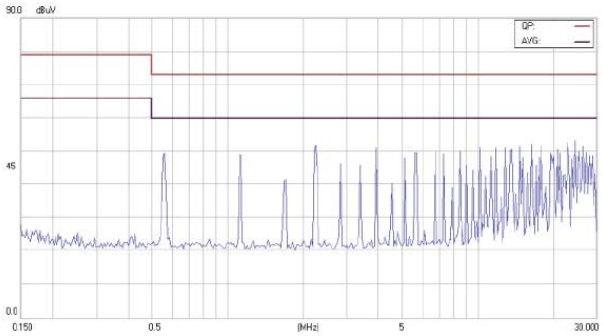


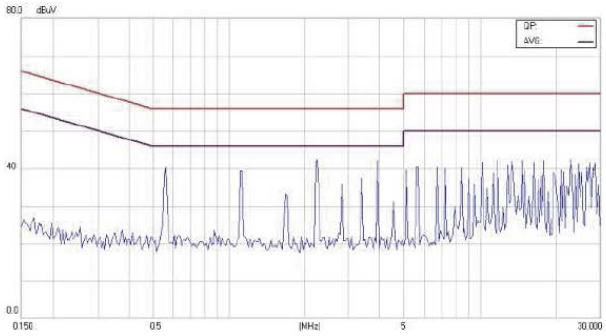
Conducted Class A for PT22D12-0.25 @ Vin= 24V



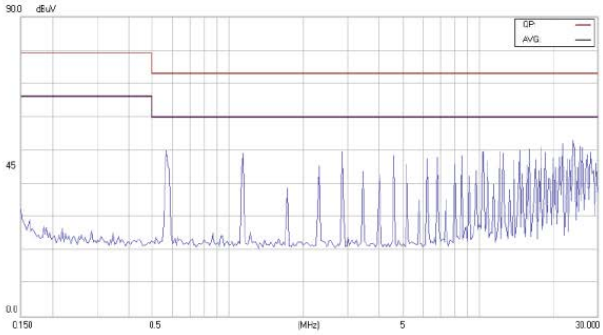
Conducted Class B for PT22D12-0.25 @ Vin= 24V



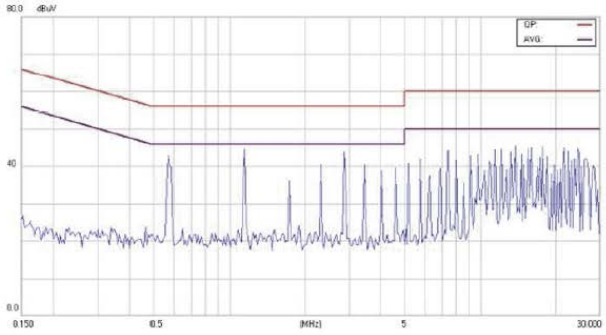
Conducted Class A for PT22D15-0.2 @ Vin= 24V



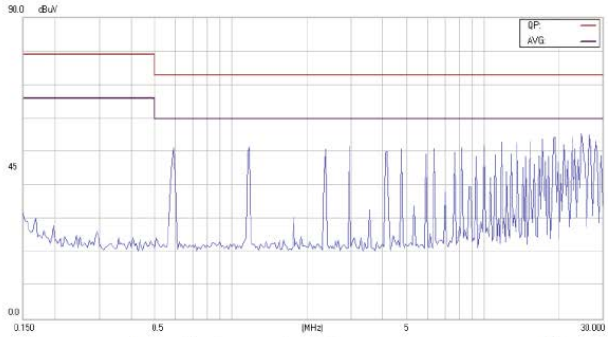
Conducted Class B for PT22D12-0.25 @ Vin= 24V



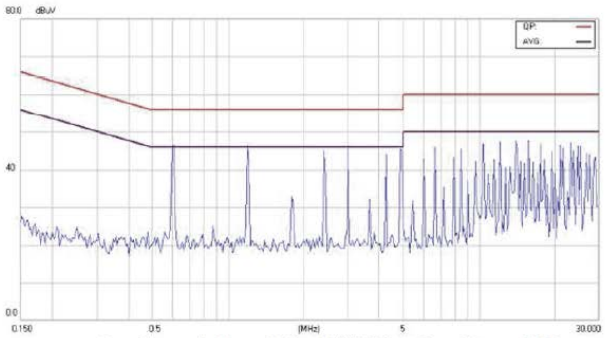
Conducted Class A for PT45S3.3-1.5 @ Vin= 24V



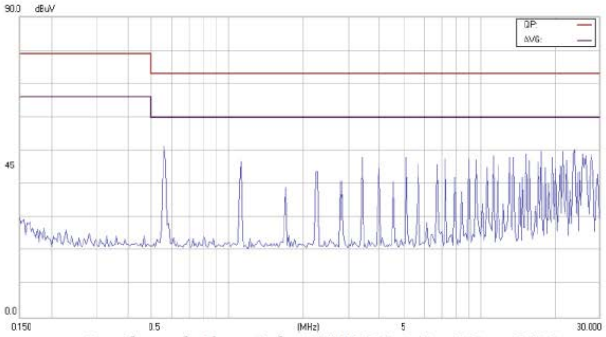
Conducted Class B for PT45S3.3-1.5 @ Vin= 24V



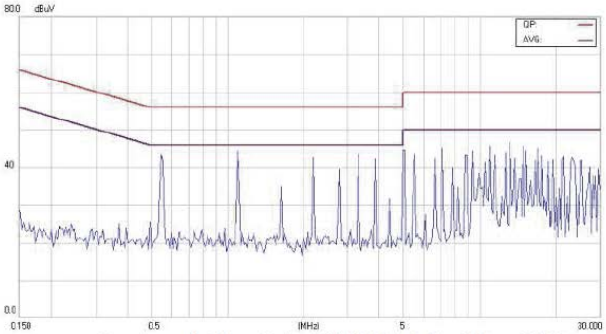
Conducted Class A for PT45S5-1.2 @ Vin= 24VN



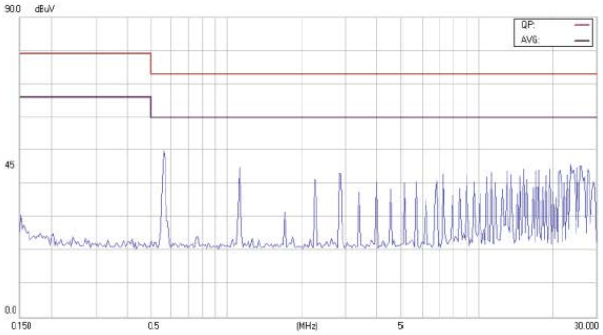
Conducted Class B for PT45S5-1.2 @ Vin= 24V



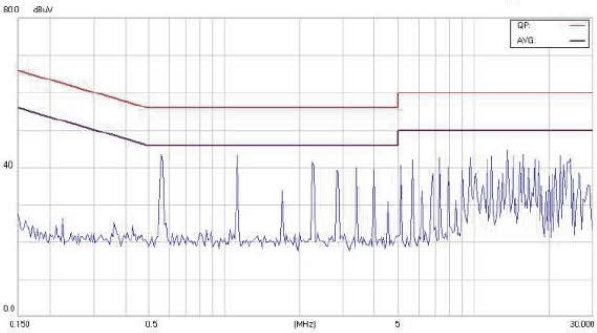
Conducted Class A for PT45S12-0.5 @ Vin= 24V



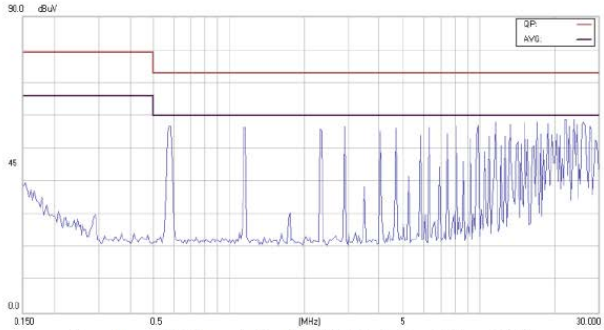
Conducted Class B for PT45S12-0.5 @ Vin= 24V



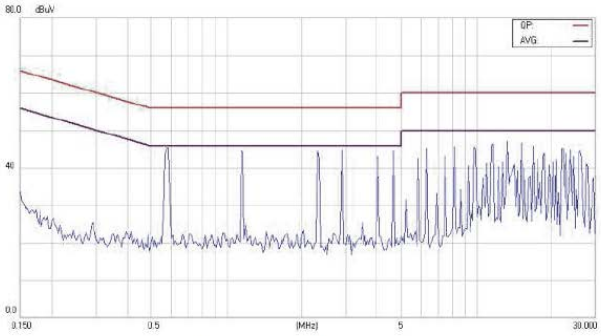
Conducted Class A for PT45S15-0.4 @ Vin= 24V



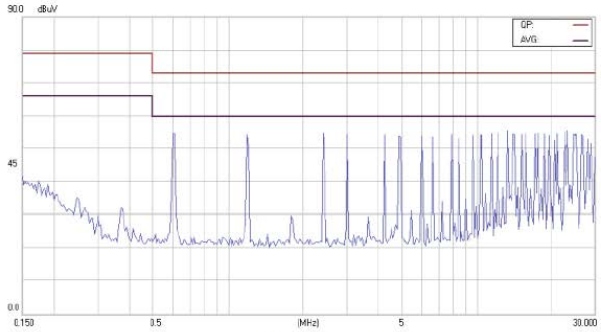
Conducted Class B for PT45S15-0.4 @ Vin= 24V



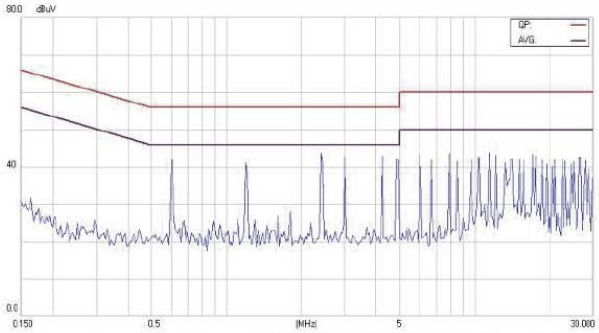
Conducted Class A for PT45D5-0.6 @ Vin= 24V



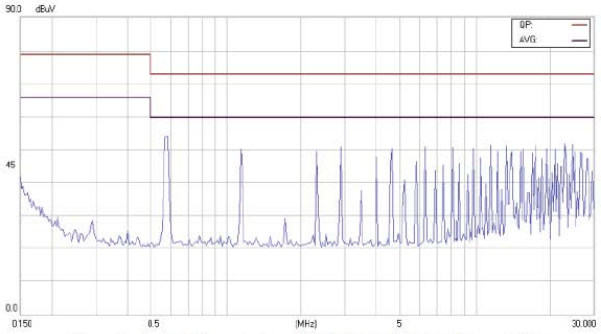
Conducted Class B for PT45D5-0.6 @ Vin= 24V



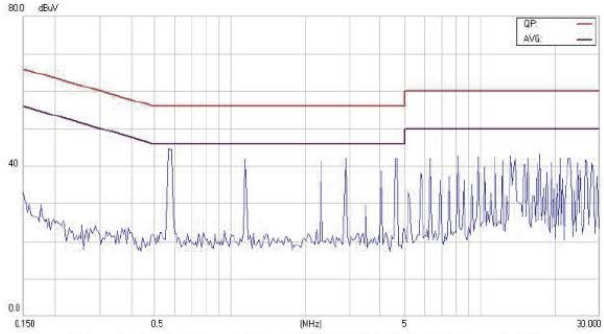
Conducted Class A for PT45D12-0.25 @ Vin= 24V



Conducted Class B for PT45D12-0.25 @ Vin= 24V



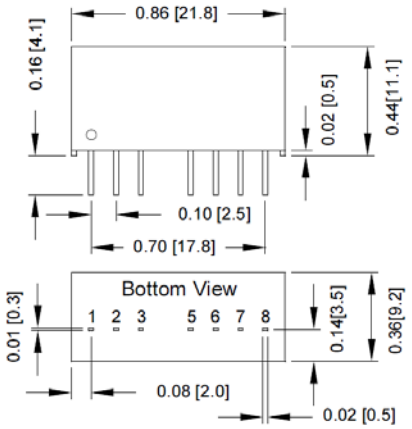
Conducted Class A for PT45D15-0.2 @ Vin= 24V



Conducted Class B for PT45D15-0.2 @ Vin= 24V

MECHANICAL SPECIFICATIONS

Note: All dimensions are in inches (millimeters). Tolerance: x.xx ±0.01 in.(0.25mm), x.xxx ±0.005 in.(0.125 mm) and for pins ±0.002 in (±0.005) are unless otherwise noted



PIN CONNECTIONS

PIN CONNECTIONS			
PIN	SINGLE OUTPUT	PIN	DUAL OUTPUTS
1	- V Input	1	- V Input
2	+V Input	2	+V Input
3	On/Off	3	On/Off
4	No Pin	4	No Pin
5	NC	5	NC
6	+V Output	6	+V Output
7	-V Output	7	Common
8	NC	8	-V Output

PART NUMBER ORDERING INFORMATION

Family, Form Factor	Nominal Input voltage	Number of Outputs	Voltage Output Volts	Current Output (A)
PT	22	S	5	1.2
	(9 - 36 Volts) - 22 (18-75 Volts) - 45	S- Single D- Dual	3.3Volts - 3.3 5 Volts - 5 12 Volts - 12 15 Volts - 15 24 Volts - 24 ±5 Volts - 5 ±12 Volts - 12 ±15 Volts - 15	3.3 Volts -1.5 5 Volts - 1.2 12 Volts - 0.5 15 Volts - 0.4 24 Volts - 0.25 ±5 Volts - 0.6 ±12 Volts - 0.25 ±15 Volts - 0.2

Note: For proper part ordering, enter option suffixes in order listed in table above

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