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POWERBOX Industrial Line
T31W Series
30W 4:1 Dual Output
DC/DC Converter
Manual

Table of Contents

Introduction

The T31W dual output series offer 30 watts of output power from a 2 x 1.0 x 0.4 inch package. T31W dual output series have 4:1 ultra wide input voltage of 9~36VDC and 18~75VDC. The T31W Dual output series features 1600VDC of isolation, short circuit protection, over-voltage protection, over-current protection and six sided shielding. All models are particularly suited to telecommunications, industrial, mobile telecom and test equipment applications.

DC/DC Converter Features

- RoHS directive compliant
- Dual output up to ±3000mA
- Six-sided continuous shield
- No minimum load required
- High power density
- High efficiency up to 88%
- Small size 2.00 x 1.00 x 0.400 inch
- Input to output isolation 1600VDC
- 4:1 ultra wide input voltage range
- Fixed switching frequency
- Input under-voltage protection
- Output over-voltage protection
- Over-current protection
- Output short circuit protection
- Remote on/off
- Case grounding

Options

- Negative logic remote on/off
- Heat-sink available for extended operation

Output Specifications

Parameters	Model	Min	Typ	Max	Unit
Output voltage range (Vin = Vin(nom) , full load , TA=25°C)	□□D05W	4.95	5.0	5.05	VDC
	□□D12W	11.88	12	12.12	VDC
	□□D15W	14.85	15	15.15	VDC
Line regulation (Vin(min) to Vin(max) at full load)	All	-0.2		+0.2	% Vout
Load regulation (0% to 100% of full load) DIP type	All	-1.0		+1.0	% Vout
Cross regulation (asymmetrical load 25%/100% of full load	All	-5.0		+5.0	% Vout
Output ripple and noise					
Peak-to-peak (20MHz bandwidth)	□□D05W			100	mVp-p
(Measured with a 1μF/50V MLCC)	□□D12W			150	mVp-p
	□□D15W			150	mVp-p
Temperature coefficient	All	-0.02		+0.02	%/°C
Output voltage overshoot (Vin(min) to Vin(max) full load; Ta=25°C)	All		0	5	% of Vout
Dynamic load response (Vin = Vin(nom) ; TA=25°C)					
Load step change from 75% to 100% or 100 to 75% of full load					
Peak Deviation	All		300		mV
Setting Time (Vout<10% peak deviation)	All		250		μs
Output current	□□D05W	0		±3000	mA
	□□D12W	0		±1250	mA
	□□D15W	0		±1000	mA
Output over voltage protection (zener diode clamp)	□□D05W		6.2		VDC
	□□D12W		15		VDC
	□□D15W		18		VDC
Output over current protection	All		150		% of FL
Output short circuit protection	All	Hiccups, automatics recovery			

Input Specifications

Parameters	Model	Min	Typ	Max	Unit
Operating input voltage					
Continuous	24D□□W	9	24	36	VDC
	48D□□W	18	48	75	VDC
Transient (100mS maximum)	24D□□W			50	VDC
	48D□□W			100	VDC
Input current (maximum value at Vin=Vin(nom), full load)	24D05W			1488	mA
	24D12W			1506	mA
	24D15W			1506	mA
	48D05W			744	mA
	48D12W			744	mA
	48D15W			744	mA
Input standby current (typical value at Vin=Vin(nom), no load)	24D05W		90		mA
	24D12W		25		mA
	24D15W		25		mA
	48D05W		50		mA
	48D12W		15		mA
	48D15W		15		mA
Under voltage lockout turn-on threshold	24D□□W		9		VDC
	48D□□W		18		VDC
Under voltage lockout turn-off threshold	24D□□W		8		VDC
	48D□□W		16		VDC
Input reflected ripple current (5 to 20MHz, 12µH source impedance)	All		20		mAp-p
Start up time (Vin = Vin(nom) and constant resistive load)					
Power up	All		30		mS
Remote on/off	All		30		mS
Remote on/off control (the CTRL pin voltage is referenced to -INPUT)					
Positive logic					
CTRL pin High voltage (remote ON)	All	3.0		12	VDC
CTRL pin Low voltage (remote OFF)	All	0		1.2	VDC
Negativ logic					
CTRL pin Low voltage (remote ON)	All	0		1.2	VDC
CTRL pin High voltage (remote OFF)	All	3.0		12	VDC
Remote off state input current	All		3		mA
Input current of remote control pin	All	-0.5		0.5	mA

General Specifications

Parameters	Model	Min	Typ	Max	Unit
Efficiency (Vin = Vin(nom) , Full Load , TA=25°C)	24D05W		88		%
	24D12W		87		%
	24D15W		87		%
	48D05W		88		%
	48D12W		88		%
	48D15W		88		%
Case grounding	All	Connect case to -input with decoupling Y cap.			
Isolation voltaga (1 minute)					
Input to output	All	1600			VDC
Input to case, output to case	All	1600			VDC
Isolation resistance	All	1			GΩ
Isolation capacitance	All			1500	pF
Switching frequency	All		430		kHz
Case material	All	Nickel-coated copper			
Base material	All	FR4 PCB			
Potting material	All	Epoxy (UL94 V-0)			
Dimensions	All	50.8 x 25.4 x 10.2 mm (2.00 x 1.00 x 0.40 inch)			
Weight	All		30.5		g
MTBF MIL-HDBK-217F	All		1.288×10^6		hours
Over temperature protection	All		115		°C

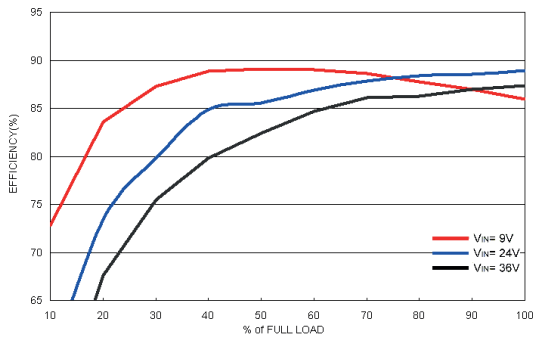
Environmental Specifications

Parameters	Model	Min	Typ	Max	Unit
Operating ambient temperature					
Without derating	All	-40		50	°C
With derating	All	50		85	°C
Storage temperature	All	-55		125	°C
Over temperature protection	All		115		°C
Operating case temperature	All			105	°C
Thermal impedance					
Natural convection	All		10		°C/W
Natural convection with heat-sink	All		12		°C/W
Thermal shock	All	MIL-STD-810F			
Vibration	All	MIL-STD-810F			
Relative humidity	All	5		95	% RH

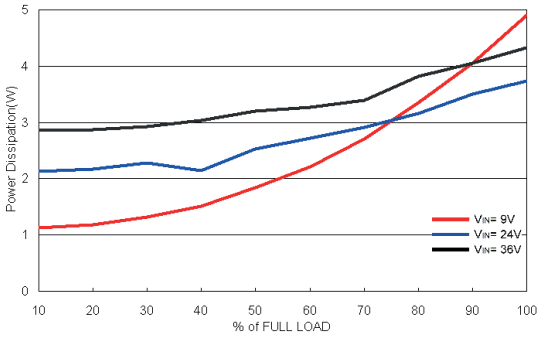
EMC Characteristics

Parameters	Standard	Condition		Level
EMI	EN55022			Class A
ESD	EN61000-4-2	Air	±8kV	Perf. Criteria A
		Contact	±6kV	
Radiated Immunity	EN61000-4-3		10V/m	Perf. Criteria A
Fast transient	EN61000-4-4		±2kV	Perf. Criteria A
Surge	EN61000-4-5		±1kV	Perf. Criteria A
Conducted immunity	EN61000-4-6		10V r.m.s	Perf. Criteria A
Power frequency magnetic field	EN61000-4-8	100A/m continuous; 1000A/m 1 second		Perf. Criteria A

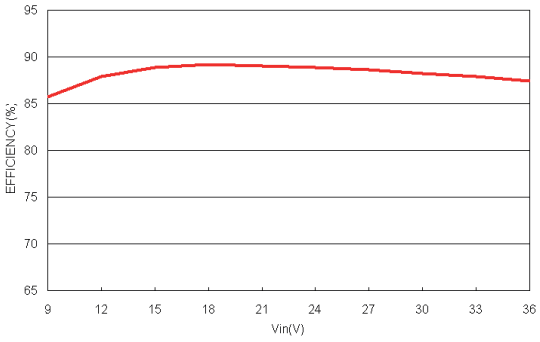
All test conditions are at 25°C.The figures are identical for PMC30-24D05W



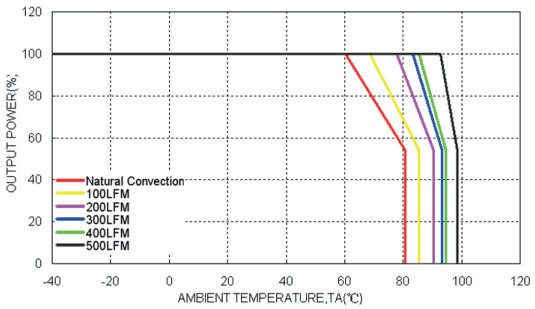
Efficiency Versus Output Current



Power Dissipation Versus Output Current

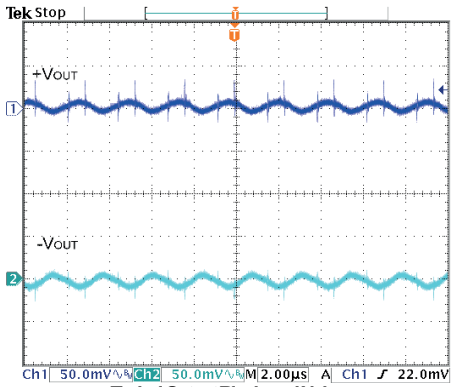


Efficiency Versus Input Voltage. Full Load

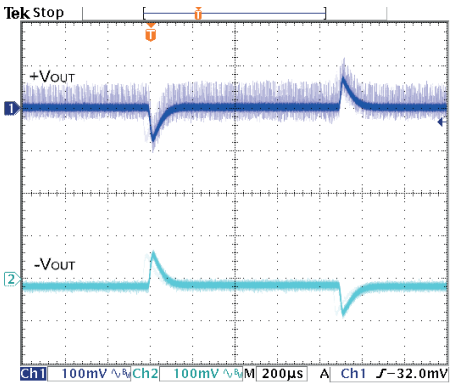


Derating Output Current Versus Ambient Temperature and Airflow Vin=Vin(nom)

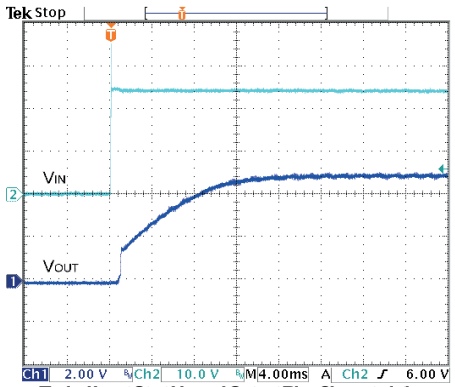
All test conditions are at 25°C.The figures are identical for MC30-24D05W



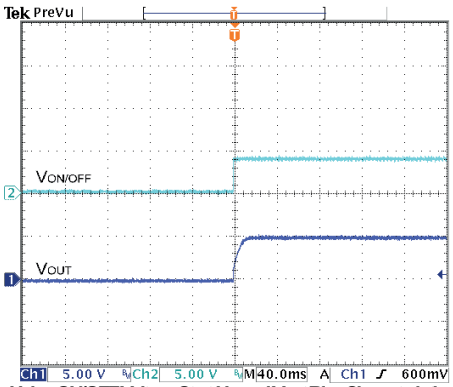
Typical Output Ripple and Noise.
Vin=Vin(nom), Full Load



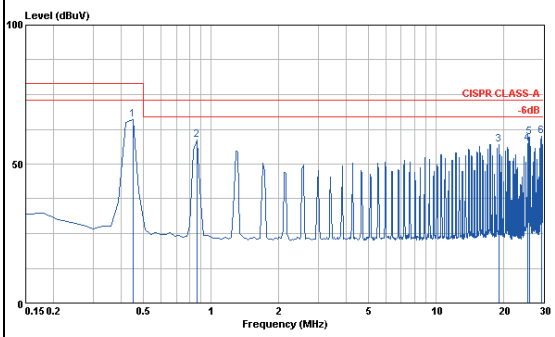
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load ; Vin=Vin(nom)



Typical Input Start-Up and Output Rise Characteristic
Vin=Vin(nom), Full Load

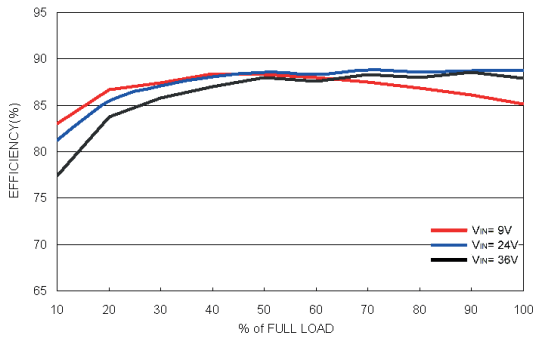


Using ON/OFF Voltage Start-Up and Vout Rise Characteristic
Vin=Vin(nom), Full Load

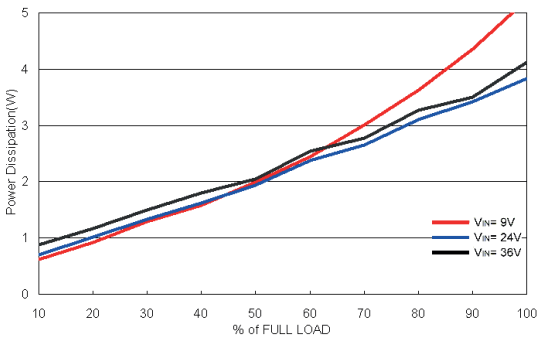


Conduction Emission of EN55022 Class A
Vin=Vin(nom), Full Load

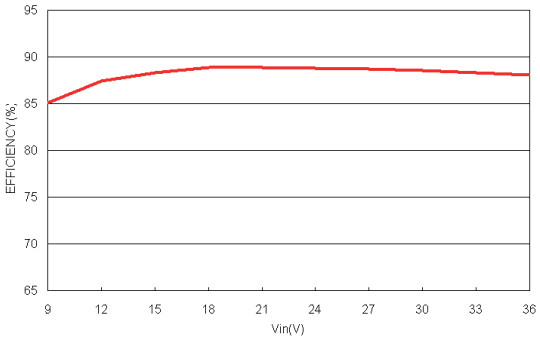
All test conditions are at 25°C.The figures are identical for PMC30-24D12W



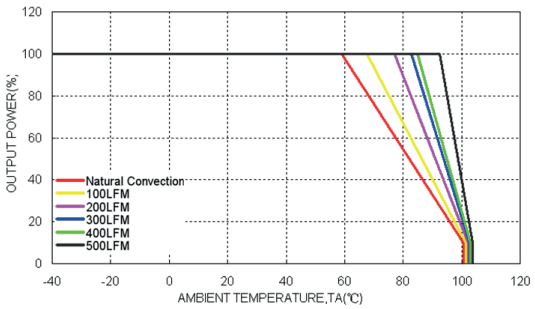
Efficiency Versus Output Current



Power Dissipation Versus Output Current

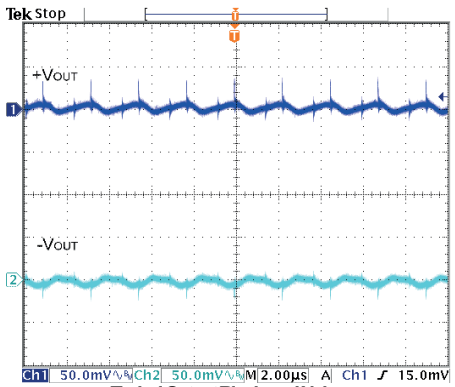


Efficiency Versus Input Voltage. Full Load

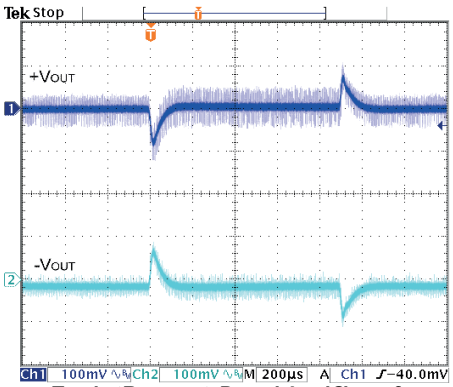


Derating Output Current Versus Ambient Temperature and Airflow Vin=Vin(nom)

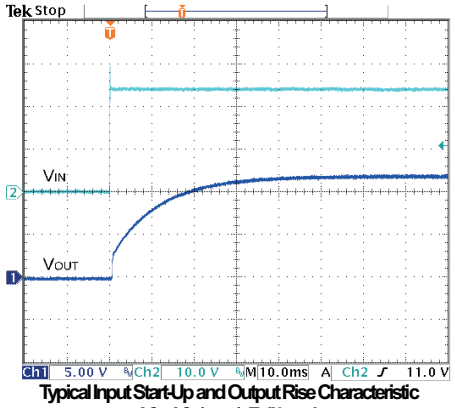
All test conditions are at 25°C.The figures are identical for PMC30-24D12W



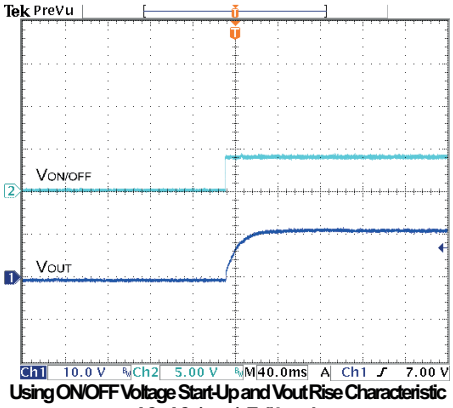
Typical Output Ripple and Noise.
Vin=Vin(nom), Full Load



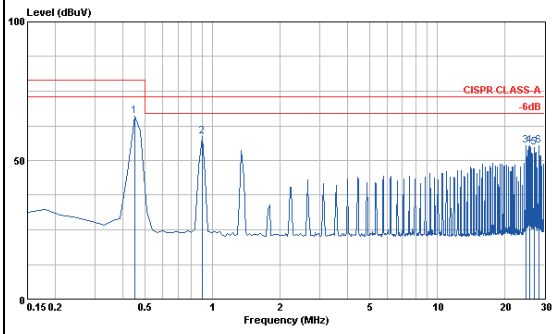
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load ; Vin=Vin(nom)



Typical Input Start-Up and Output Rise Characteristic
Vin=Vin(nom), Full Load

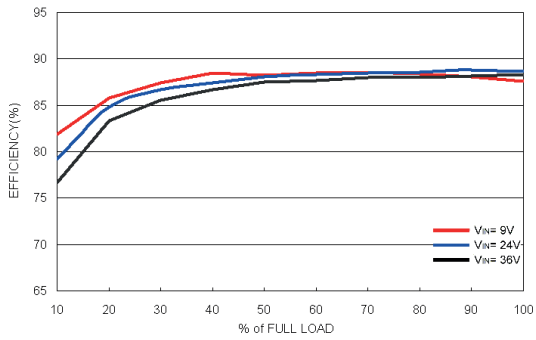


Using ON/OFF Voltage Start-Up and Vout Rise Characteristic
Vin=Vin(nom), Full Load

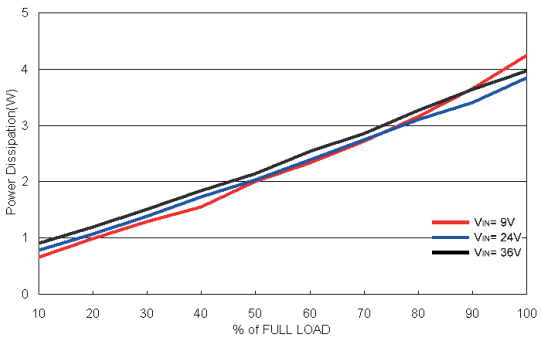


Conduction Emission of EN55022 Class A
Vin=Vin(nom), Full Load

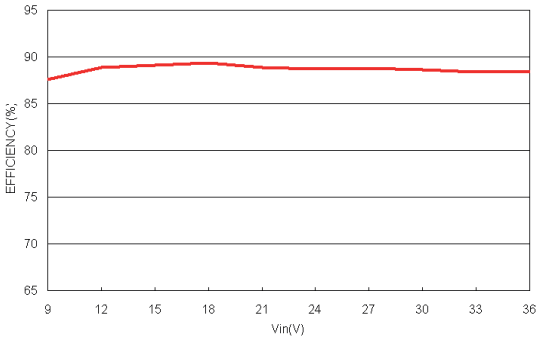
All test conditions are at 25°C.The figures are identical for PMC30-24D15W



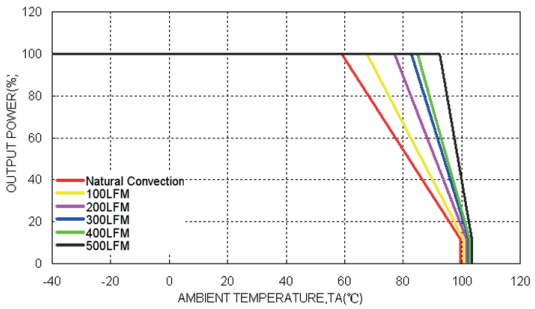
Efficiency Versus Output Current



Power Dissipation Versus Output Current

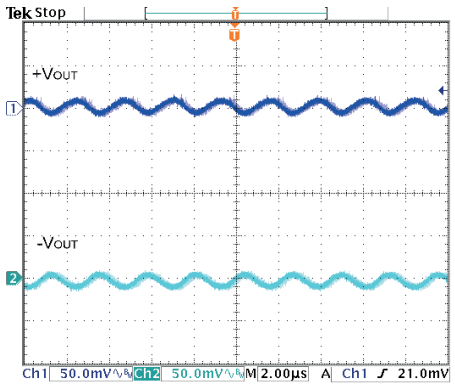


Efficiency Versus Input Voltage. Full Load

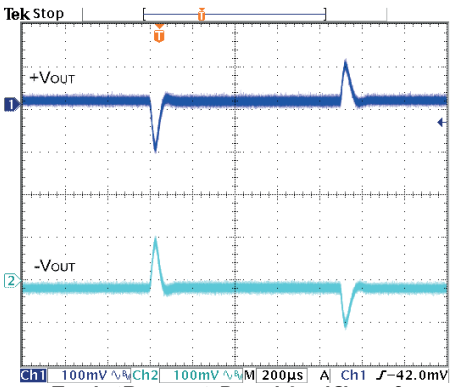


Derating Output Current Versus Ambient Temperature and Airflow Vin=Vin(nom)

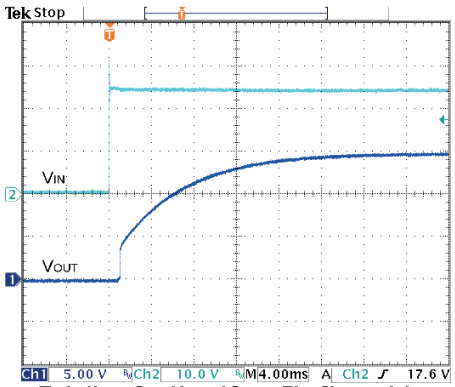
All test conditions are at 25°C.The figures are identical for PMC30-24D15W



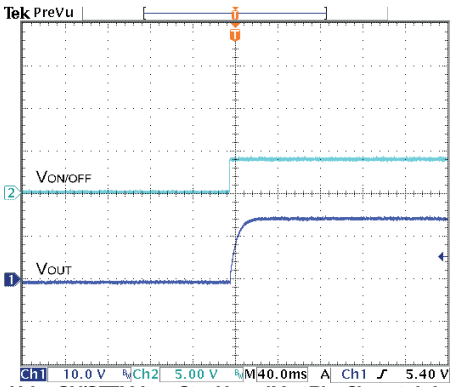
Typical Output Ripple and Noise.
Vin=Vin(nom), Full Load



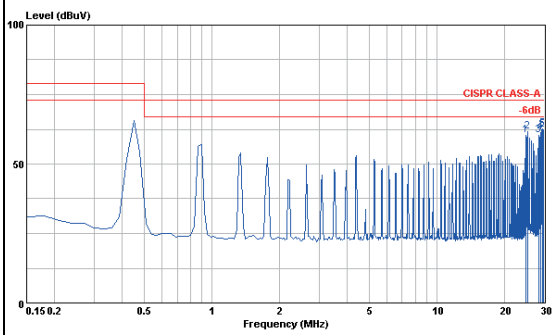
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load ; Vin=Vin(nom)



Typical Input Start-Up and Output Rise Characteristic
Vin=Vin(nom), Full Load

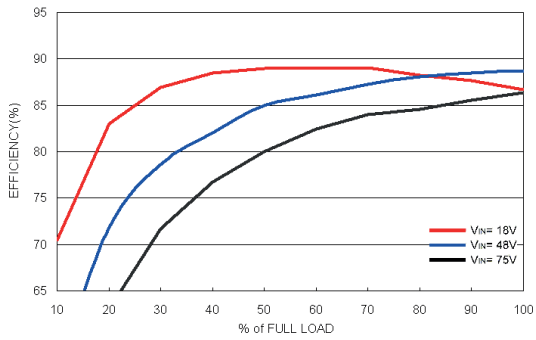


Using ON/OFF Voltage Start-Up and Vout Rise Characteristic
Vin=Vin(nom), Full Load

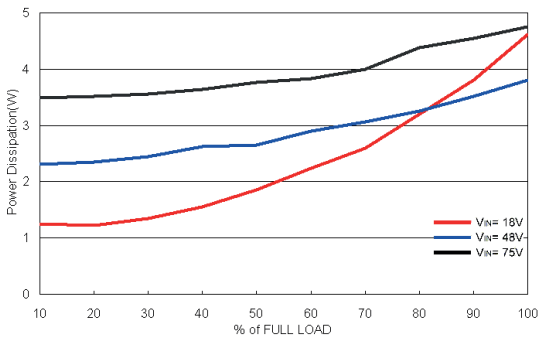


Conduction Emission of EN55022 Class A
Vin=Vin(nom), Full Load

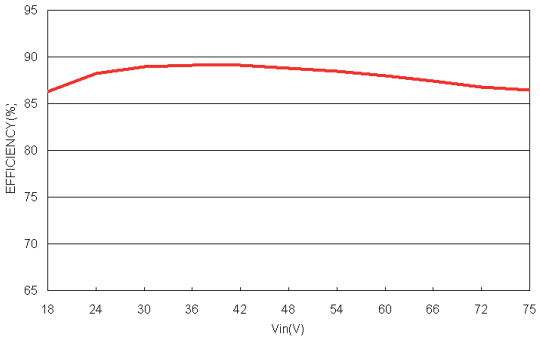
All test conditions are at 25°C.The figures are identical for PMC30-48D05W



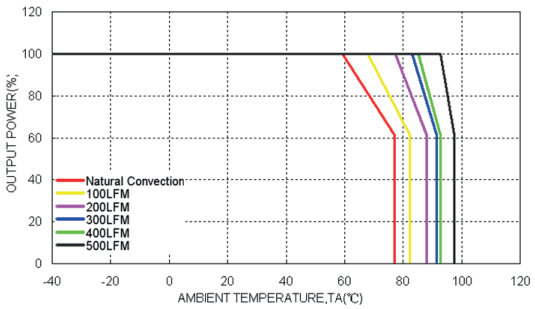
Efficiency Versus Output Current



Power Dissipation Versus Output Current

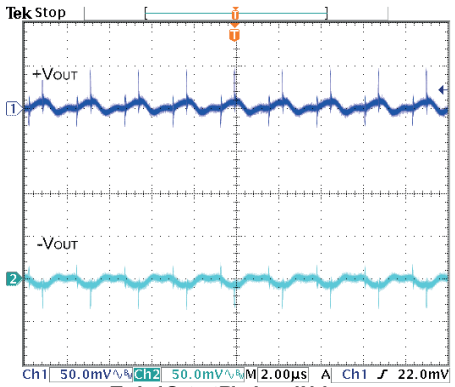


Efficiency Versus Input Voltage. Full Load

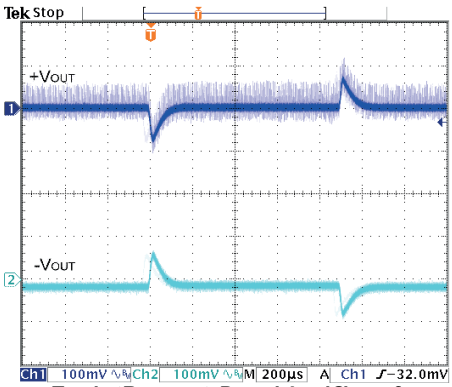


Derating Output Current Versus Ambient Temperature and Airflow Vin=Vin(nom)

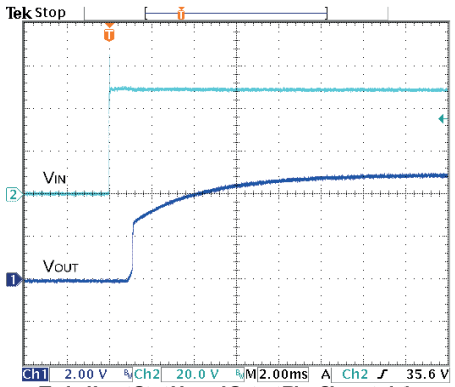
All test conditions are at 25°C.The figures are identical for PMC30-48D05W



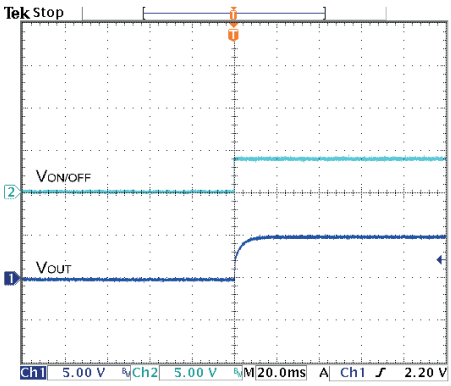
Typical Output Ripple and Noise.
Vin=Vin(nom), Full Load



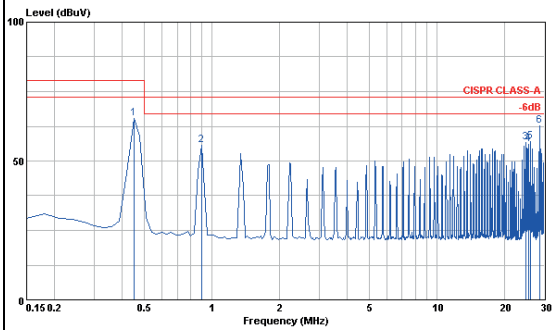
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load ; Vin=Vin(nom)



Typical Input Start-Up and Output Rise Characteristic
Vin=Vin(nom), Full Load

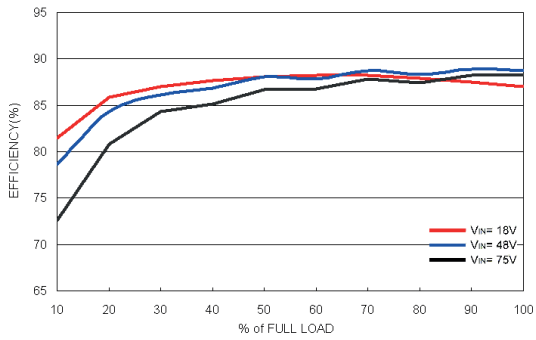


Using ON/OFF Voltage Start-Up and Vout Rise Characteristic
Vin=Vin(nom), Full Load

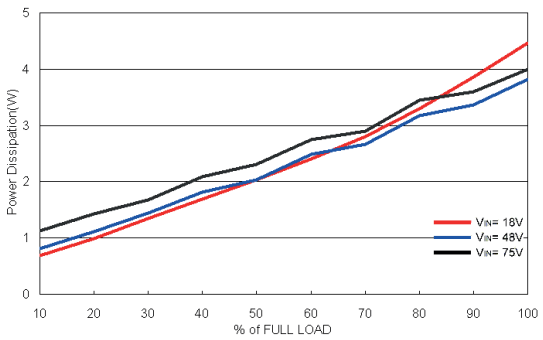


Conduction Emission of EN55022 Class A
Vin=Vin(nom), Full Load

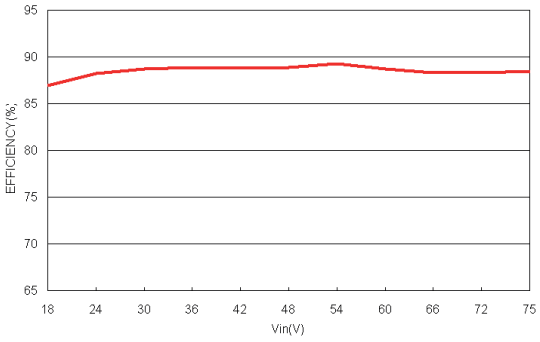
All test conditions are at 25°C.The figures are identical for PMC30-48D12W



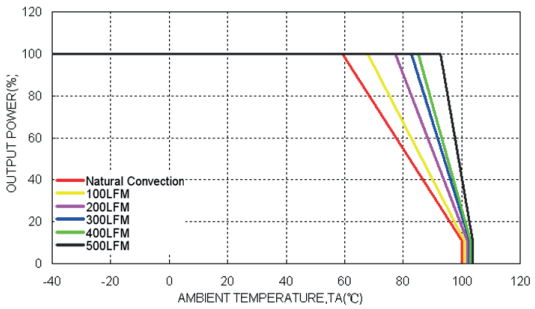
Efficiency Versus Output Current



Power Dissipation Versus Output Current

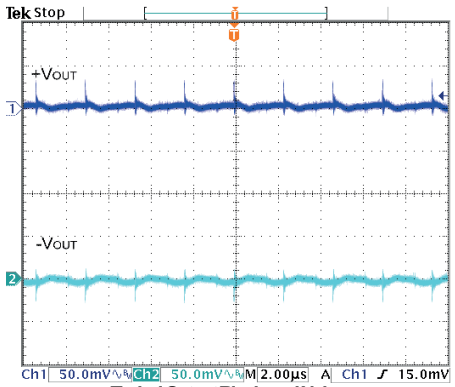


Efficiency Versus Input Voltage. Full Load

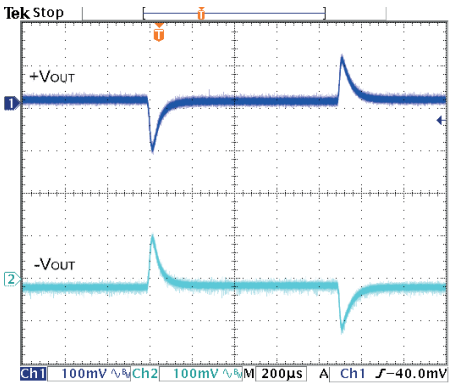


Derating Output Current Versus Ambient Temperature and Airflow Vin=Vin(nom)

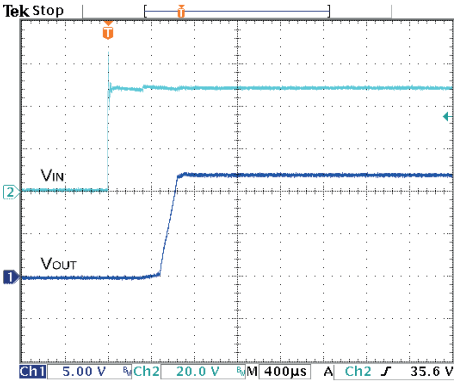
All test conditions are at 25°C.The figures are identical for PMC30-48D12W



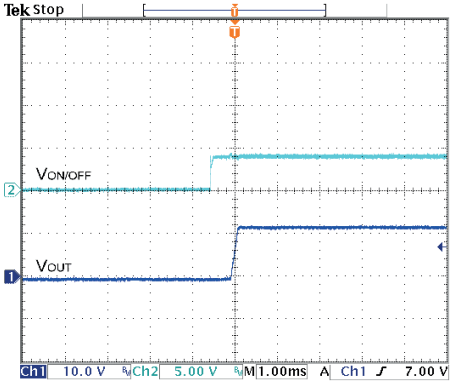
Typical Output Ripple and Noise.
Vin=Vin(nom), Full Load



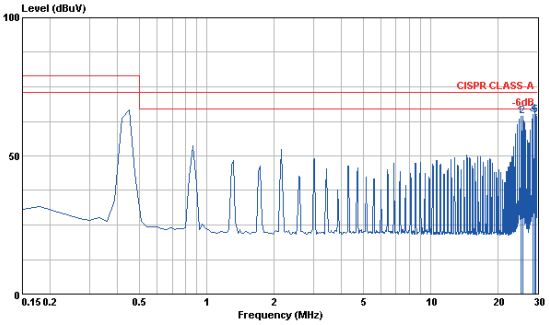
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load ; Vin=Vin(nom)



Typical Input Start-Up and Output Rise Characteristic
Vin=Vin(nom), Full Load

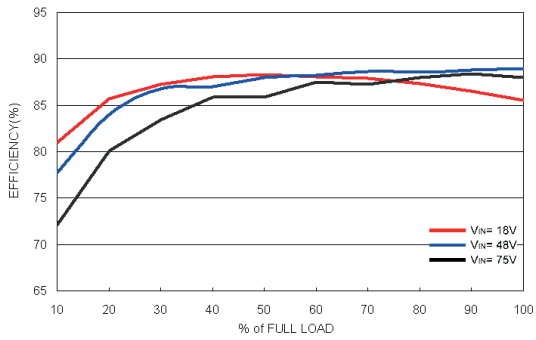


Using ON/OFF Voltage Start-Up and Vout Rise Characteristic
Vin=Vin(nom), Full Load

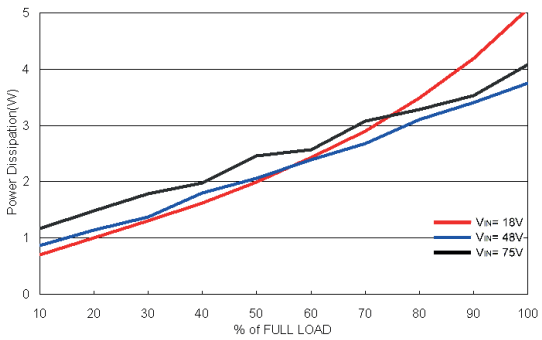


Conduction Emission of EN55022 Class A
Vin=Vin(nom), Full Load

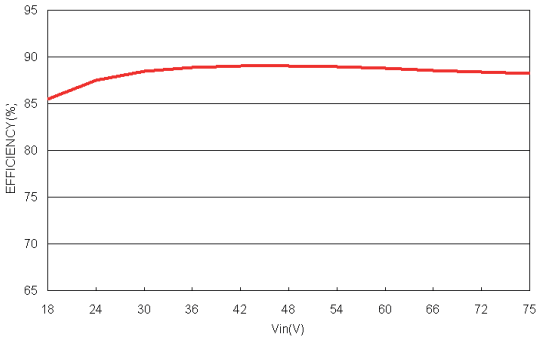
All test conditions are at 25°C.The figures are identical for PMC30-48D15W



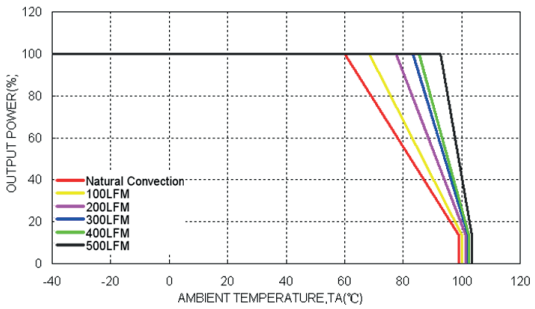
Efficiency Versus Output Current



Power Dissipation Versus Output Current

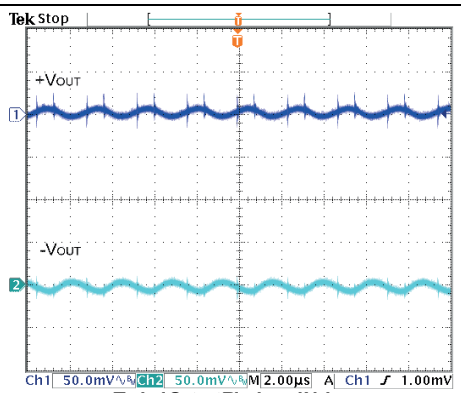


Efficiency Versus Input Voltage. Full Load

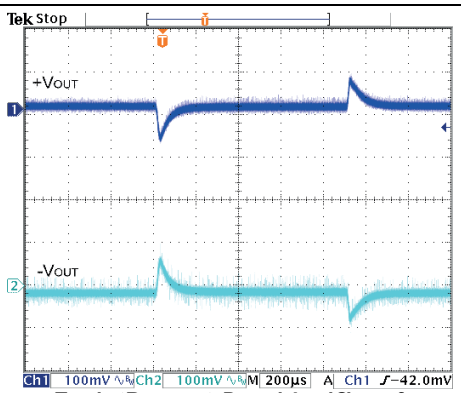


Derating Output Current Versus Ambient Temperature and Airflow Vin=Vin(nom)

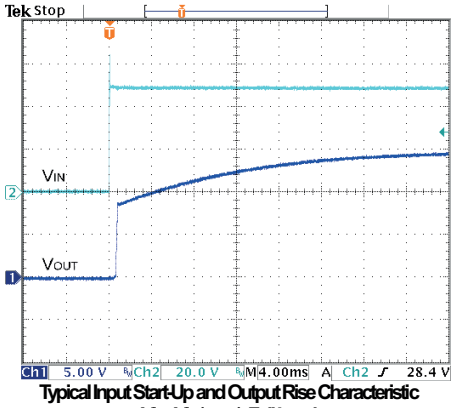
All test conditions are at 25°C.The figures are identical for PMC30-48D15W



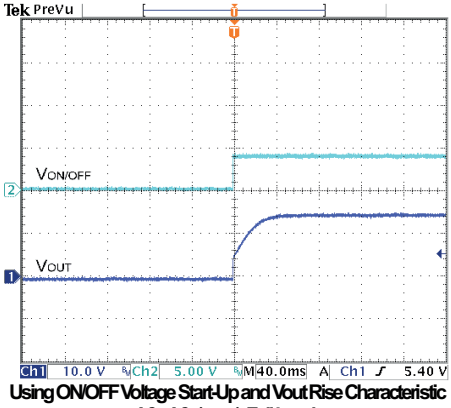
Typical Output Ripple and Noise.
Vin=Vin(nom), Full Load



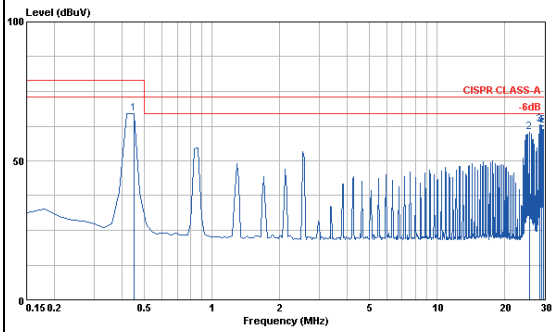
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load ; Vin=Vin(nom)



Typical Input Start-Up and Output Rise Characteristic
Vin=Vin(nom), Full Load



Using ON/OFF Voltage Start-Up and Vout Rise Characteristic
Vin=Vin(nom), Full Load



Conduction Emission of EN55022 Class A
Vin=Vin(nom), Full Load

Input Source Impedance

The power module should be connected to a low impedance input source. Highly inductive source impedance can affect the stability of the power module. Input external L-C filter is recommended to minimize input reflected ripple current. The inductor is simulated source impedance of 12μH and capacitor is Nippon chemi-con KY series 47μF/100V. The capacitor must as close as possible to the input terminals of the power module for lower impedance.

Output Over Current Protection

When excessive output currents occur in the system, circuit protection is required on all power supplies. Normally, overload current is maintained at approximately 150 percent of rated current for T31W-D SERIES.

Hiccup-mode is a method of operation in a power supply whose purpose is to protect the power supply from being damaged during an over-current fault condition. It also enables the power supply to restart when the fault is removed. There are other ways of protecting the power supply when it is over-loaded, such as the maximum current limiting or current foldback methods.

One of the problems resulting from over current is that excessive heat may be generated in power devices; especially MOSFET and Schottky diodes and the temperature of those devices may exceed their specified limits. A protection mechanism has to be used to prevent those power devices from being damaged.

The operation of hiccup is as follows. When the current sense circuit sees an over-current event, the controller shuts off the power supply for a given time and then tries to start up the power supply again. If the over-load condition has been removed, the power supply will start up and operate normally; otherwise, the controller will see another over-current event and shut off the power supply again, repeating the previous cycle. Hiccup operation has none of the drawbacks of the other two protection methods, although its circuit is more complicated because it requires a timing circuit. The excess heat due to overload lasts for only a short duration in the hiccup cycle, hence the junction temperature of the power devices is much lower.

The hiccup operation can be done in various ways. For example, one can start hiccup operation any time an over-current event is detected; or prohibit hiccup during a designated start-up is usually larger than during normal operation and it is easier for an over-current event is detected; or prohibit hiccup during a designated start-up interval (usually a few milliseconds). The reason for the latter operation is that during start-up, the power supply needs to provide extra current to charge up the output capacitor. Thus the current demand during start-up is usually larger than during normal operation and it is easier for an over-current event to occur. If the power supply starts to hiccup once there is an over-current, it might never start up successfully. Hiccup mode protection will give the best protection for a power supply against over current situations, since it will limit the average current to the load at a low level, so reducing power dissipation and case temperature in the power devices.

Output Over Voltage Protection

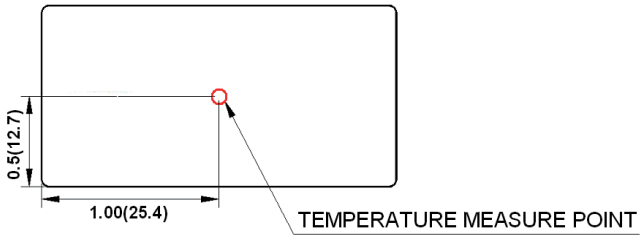
The output over-voltage protection consists of output Zener diode that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over-voltage protection threshold, then the Zener diode clamps the output voltage.

Short Circuitry Protection

Continuous, hiccup and auto-recovery mode. During short circuit, converter still shut down. The average current during this condition will be very low and the device can be safety in this condition.

Thermal Consideration

The power module operates in a variety of thermal environments. However, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding environment. Proper cooling can be verified by measuring the point as the figure below. The temperature at this location should not exceed 105°C. When Operating, adequate cooling must be provided to maintain the test point temperature at or below 105°C. Although the maximum point Temperature of the power modules is 105°C, you can limit this Temperature to a lower value for extremely high reliability. °C

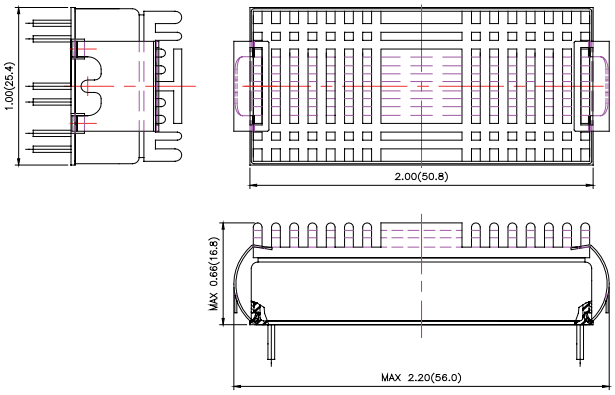


TOP VIEW

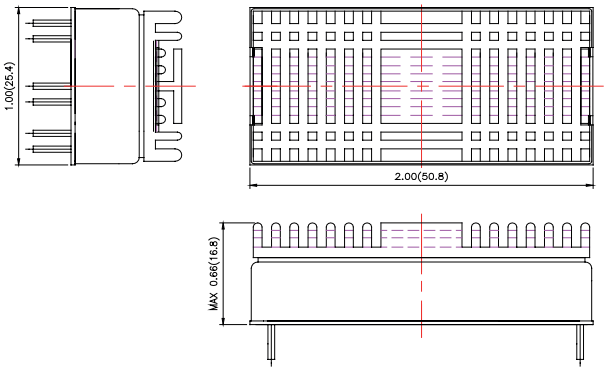
Heat-Sink Considerations

Equip heat-sink (7G-0020C-F) for lower temperature and higher reliability of the module. There are two types for choosing.

Suffix - HC: Heat-sink + Clamp



Suffix - HS: Heat-sink



Remote On/Off Control

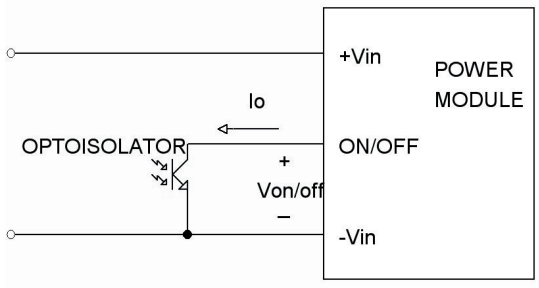
With no suffix, the positive logic remote ON/OFF control circuit is included. Ex.: PMC30-24D05W

Turns the module ON during logic High on the CTRL pin and turns OFF during logic Low. The CTRL pin is an open collector/drain logic input signal (Vctrl) that referenced to GND. If not using the remote on/off feature, please open circuit between CTRL pin and –input pin to turn the module on.

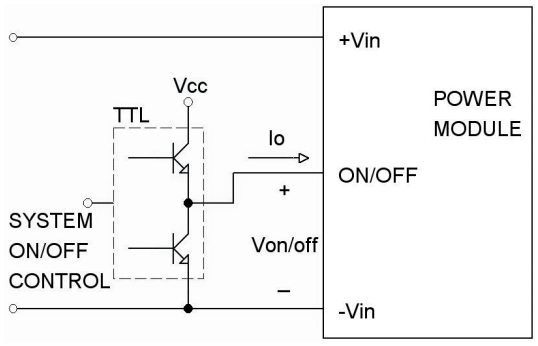
With suffix –N, the positive logic remote ON/OFF control circuit is included. Ex.: PMC30-24D05W-N

Turns the module ON during logic Low on the CTRL pin and turns OFF during logic High. The CTRL pin is an open collector/drain logic input signal (Von/off) that referenced to GND. If not using the remote on/off feature, please short circuit between CTRL pin and –input pin to turn the module on.

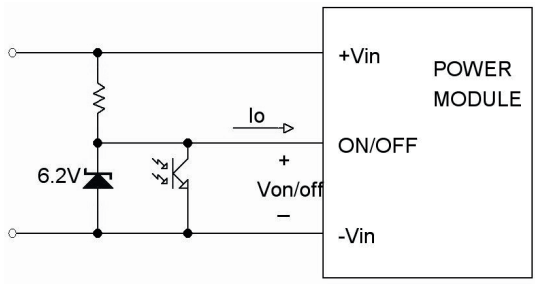
Remote ON/OFF Implementation Circuits



Isolated-Closure Remote ON/OFF

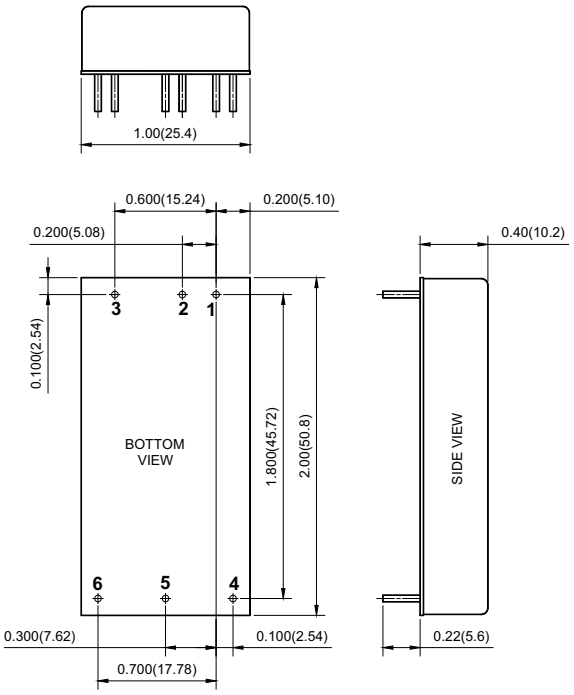


Level Control Using TTL Output



Level Control Using Line Voltage

Mechanical Data

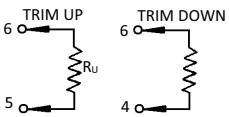


Pin Connection

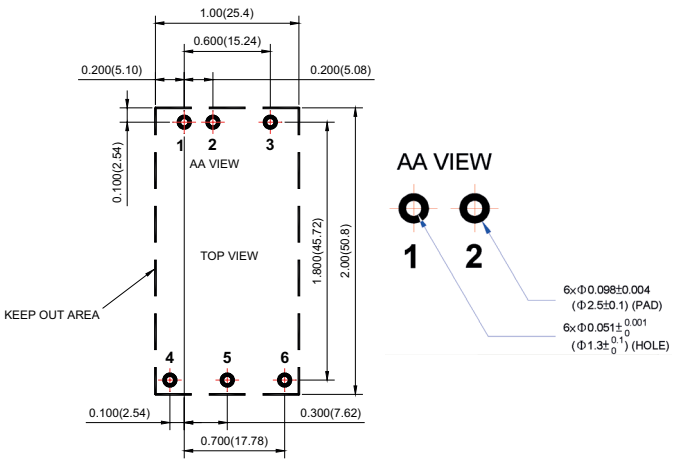
Pin	Define
1	+INPUT
2	-INPUT
3	CTRL
4	+OUTPUT
5	-OUTPUT
6	TRIM

External Output Trimming

Output can be externally trimmed by using the method shown below.



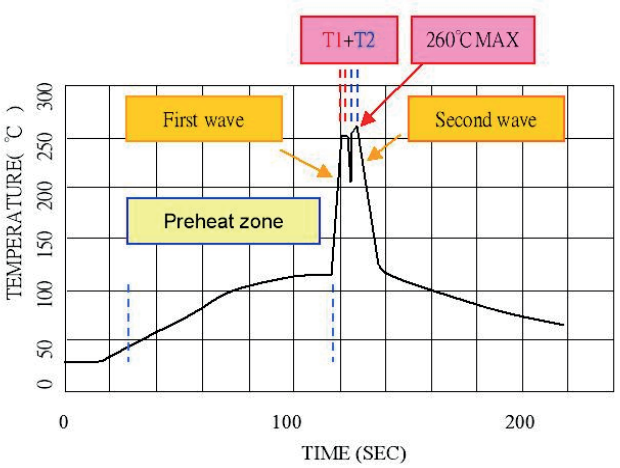
Recommended Pad Layout



1. All dimensions in Inch (mm)
   Tolerance: X.XX ±0.02(X.X±0.5)
   X.XXX±0.01 (X.XX±0.25)
2. Pin pitch tolerance ±0.01(0.25)
3. Pin dimension tolerance ±0.004 (0.1)

Soldering Considerations

Lead free wave solder profile for DIP type.



Zone	Reference Parameter
Preheat zone	Rise temp. speed : 3°C/ sec max.
	Preheat temp. : 100~130°C
Actual heating	Peak temp. : 250~260°C
	Peak time (T1+T2 time) : 4~6 sec

Reference Solder: Sn-Ag-Cu , Sn-Cu
Hand Welding: Soldering iron: Power 90W
Welding Time: 2~4 sec
Temp.: 380~400°C

Safety and Installation Instruction

Fusing Consideration

Caution: This power module is not internally fused. An input line fuse must always be used.

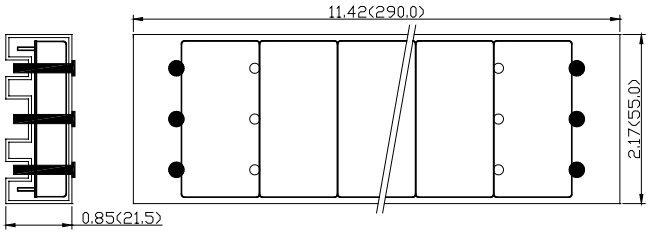
This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture. To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse. The safety agencies require a slow-blow fuse with maximum rating of 10A Based on the information provided in this data sheet on Inrush energy and maximum dc input current; the same type of fuse with lower rating can be used. Refer to the fuse manufacturer's data for further information.

MTBF and Reliability

The MTBF of T31W DUAL-SERIES of DC/DC converters has been calculated using MIL-HDBK 217F @Ta=25°C, FULL LOAD. The resulting figure for MTBF is 1.288×10^6 hours.

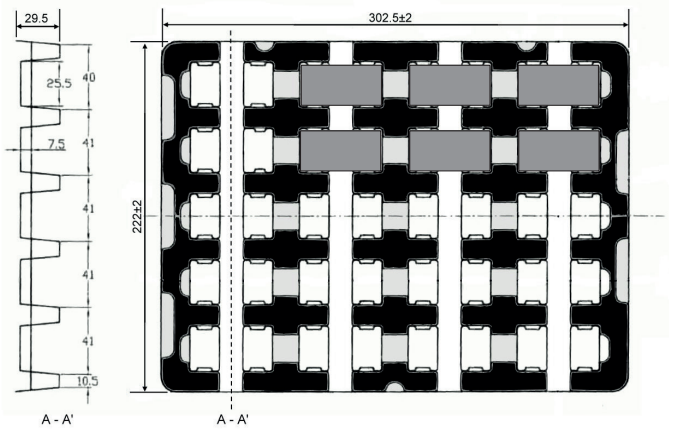
Packing Information

TUBE



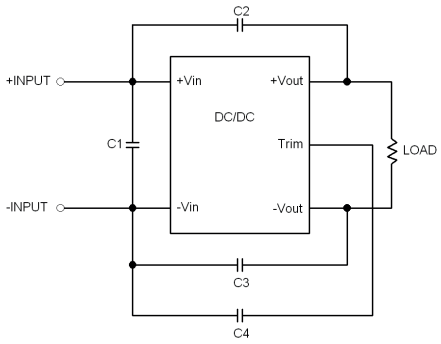
All dimensions in inch(mm)
10 pcs per tube.

TRAY

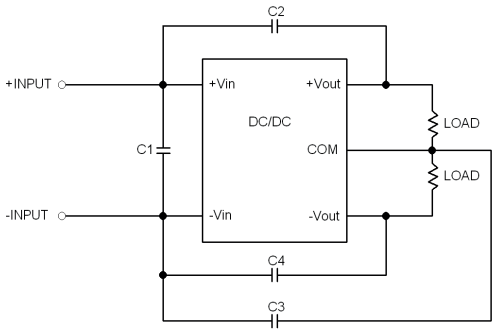


20 pcs per tray.

Recommended external EMI filter for EN55022 Class A



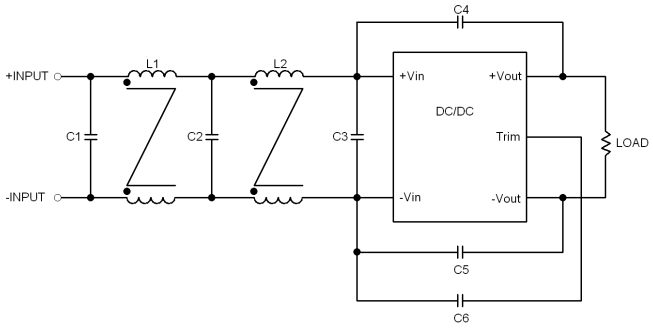
Single Output



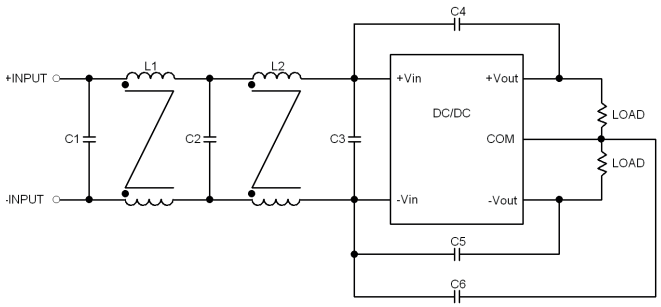
Dual Output

Model	C1	C2, C3, C4
PMC30-24□□□W	4.7μF/50V	1000pF/2kV
	1812 MLCC	1808 MLCC
PMC30-48□□□W	2.2μF/100V	1000pF/2kV
	1812 MLCC	1808 MLCC

Recommended external EMI filter for EN55022 Class B



Single Output



Dual Output

Model	C1, C2, C3	C4, C5, C6	L1	L2
PMC30-24□□□W	4.7μF/50V	1000pF/2kV	33.3μH	55μH
	1812 MLCC	1808 MLCC	Common Choke	Common Choke
			PMT-075	PMT-076
PMC30-48□□□W	2.2μF/100V	1000pF/2kV	33.3μH	55μH
	1812 MLCC	1808 MLCC	Common Choke	Common Choke
			PMT-075	PMT-076