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POWERBOX Industrial Line
T10 Series
10W 2:1 and 4:1 Single Output
DC/DC Converter
Manual

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Introduction

The T10 single output series offer 10 watts of output power from a 2 X 1 X 0.4 inch package. It has 2:1 wide input voltage of 9~18VDC, 18~36VDC and 36~75VDC. And features 1600VDC of isolation, short circuit and over voltage protection, as well as six sided shielding. All models are particularly suited to telecommunications, industrial, mobile telecom and test equipment applications.

DC/DC Converter Features

- Single output up to 2A
- 10 watts maximum output power
- 2:1 wide input voltage range of 9~18, 18~36 and 36~75VDC
- Six-sided continuous shield
- High efficiency up to 87%
- Low profile 2.00x1.000.40 inch (50.8x25.4x10.2 mm)
- Fixed switching frequency
- RoHS directive compliant
- No minimum load required
- Input to output isolation 1600VDC
- Operating case temperature range 100°C max
- Output over-voltage protection
- Over-current protection, auto-recovery
- Output short circuit protection

Options

- Heat-sink available for extended operation
- Remote on/off and logic configuration
- M1 or M2 version
- M1: operating temp.= -40~+85°C (non-derating)
- M2: operating temp.= -40~+85°C (with derating)

Output Specifications

Parameters	Model	Min	Typ	Max	Unit
Output voltage (Vin(nom); full load; Ta=25°C)	□□S33	3.267	3.3	3.333	VDC
	□□S05	4.95	5.1	5.05	VDC
	□□S12	11.88	12	12.12	VDC
	□□S15	14.85	15	15.15	VDC
Output regulation					
Line (Vin(min) to Vin(max); full load)	All	-0.2		+0.2	%
Load (0% to 100% of full load)	All	-0.5		+0.5	%
Output ripple and noise					
Peak to peak (5Hz to 20MHz bandwidth)	All		50	75	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(nom); Ta=25°C)					
Load step change from 75% to 100% or 100 to 75% of full load					
Peak deviation	All		200		mV
Setting time (Vo<10% peak deviation)	All		250		µs
Output current	□□S33	0		2000	mA
	□□S05	0		2000	mA
	□□S12	0		830	mA
	□□S15	0		670	mA
Output over current protection	All		130	150	% of FL
Output short circuit protection	All	Hiccup, automatics recovery			

Input Specifications

Parameters	Model	Min	Typ	Max	Unit
Operating input voltage	12S□□	9	12	18	VDC
	24S□□	18	24	36	VDC
	48S□□	36	48	75	VDC
Input voltage					
Continuous	12S□□			18	VDC
	24S□□			36	VDC
	48S□□			75	VDC
Transient (100mS, max)	12S□□			36	VDC
	24S□□			50	VDC
	48S□□			100	VDC
Input current (Max value at Vin=Vin(nom), full load)	12S33			724	mA
	12S05			1082	mA
	12S12			1037	mA
	12S15			1046	mA
	24S33			362	mA
	24S05			534	mA
	24S12			519	mA
	24S15			523	mA
	48S33			181	mA
	48S05			260	mA
	48S12			253	mA
	48S15			252	mA
Input standby current (Typ. value at Vin(nom); no load)	12S33		17		mA
	12S05		21		mA
	12S12		38		mA
	12S15		36		mA
	24S33		15		mA
	24S05		22		mA
	24S12		18		mA
	24S15		36		mA
	48S33		11		mA
	48S05		14		mA
	48S12		14		mA
	48S15		10		mA
Input reflected ripple current (5 to 20MHz, 12μH source impedance)	All		30		mAp-p
Start up time (Vin(nom) and constant resistive load)					
Power up	All		20		ms
Remote on/off (the CTRL pin voltage is referenced to negative input)					
Positive logic					
CTRL pin high voltage (remote ON)	Suffix-P	3.5		12	VDC
CTRL pin low voltage (remote OFF)	Suffix-P	0		1.2	VDC
Negative logic					
CTRL pin high voltage (remote ON)	Suffix-N	0		1.2	VDC
CTRL pin low voltage (remote OFF)	Suffix-N	3.5		12	VDC
Remote off input current	All		20		mA
Input current of remote control pin	All	-0.5		1	mA

General Specifications

Parameters	Model	Min	Typ	Max	Unit
Efficiency (Vin(nom), full load; Ta=25°C)	12S33		80		%
	12S05		81		%
	12S12		84		%
	12S15		84		%
	24S33		80		%
	24S05		82		%
	24S12		84		%
	24S15		84		%
	48S33		80		%
	48S05		84		%
	48S12		86		%
	48S15		87		%
Isolation voltage (1 minute)					
Input to output	All	1600			VDC
Input (output) to case	All	1600			VDC
Isolation resistance	All	1			GΩ
Isolation capacitance	All			300	pF
Switching frequency	All	270	300	330	kHz
Weight	All		27.0		g
MTBF MIL-HDBK-217F	All		3.342×10^6		hours
Case material	Nickel-coated copper				
Base material	Non-conductive black plastic				
Potting material	Epoxy (UL94 V-0)				
Dimensions	2.00 X 1.00 X 0.40 Inch (50.8 X 25.4 X 10.2 mm)				

Environmental Specifications

Parameters	Model	Min	Typ	Max	Unit
Operating ambient temperature					
Standard (with derating) *	All	-25		85	°C
M1 (non-derating) *	All	-40		85	°C
M2 (with derating) *	All	-40		85	°C
Operating case temperature	All			100	°C
Storage temperature range	All	-55		105	°C
Thermal impedance	All	Natural convection		12	°C/W
	All	Natural convection with heatsink		10	°C/W
Thermal shock	All	MIL-STD-810F			
Vibration	All	MIL-STD-810F			
Relative humidity	All	5		95	% RH

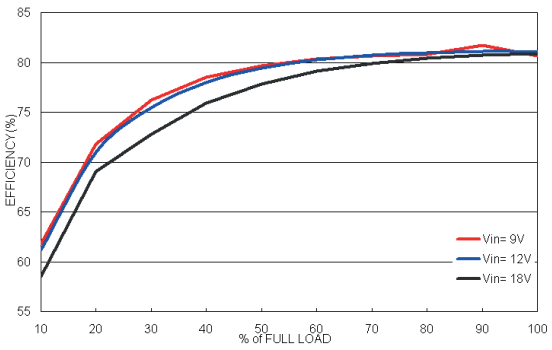
*Test condition with vertical direction by natural convection (20LFM).

EMC Characteristics

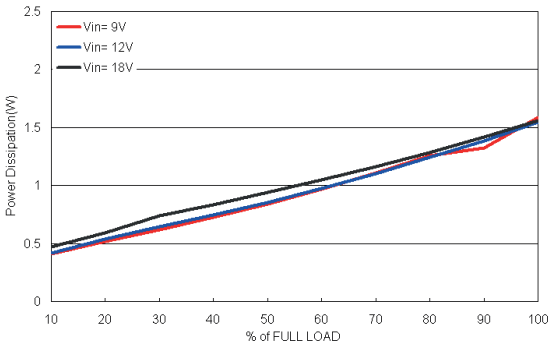
Parameters	Standard	Condition		Level
EMI [1)]	EN55022			Class A, Class B
ESD	EN61000-4-2	Air	±8kV	Perf. Criteria B
		Contact	±6kV	
Radiated Immunity	EN61000-4-3		10V/m	Perf. Criteria A
Fast transient [2)]	EN61000-4-4		±2kV	Perf. Criteria B
Surge	EN61000-4-5		±2kV	Perf. Criteria B
Power frequency magnetic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

Note:
1. The standard module meets EN55022 Class A and Class B with external components.
For further information, please contact Powerbox.
2. An external input filter capacitor is required if the module has to meet EN61000-4-4, EN61000-4-5.
The filter capacitor Power Mate suggest: Nippon chemi-con KY series, 220μF/100V, ESR 48mΩ.

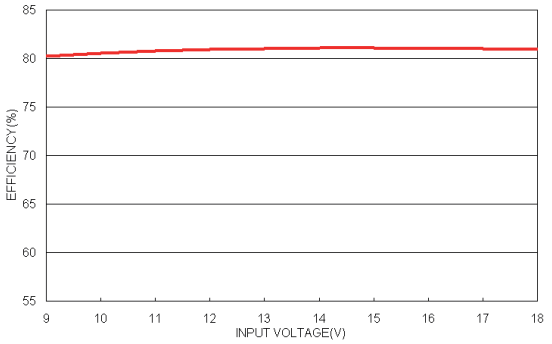
All test conditions are at 25°C.The figures are identical for PME10-12S33



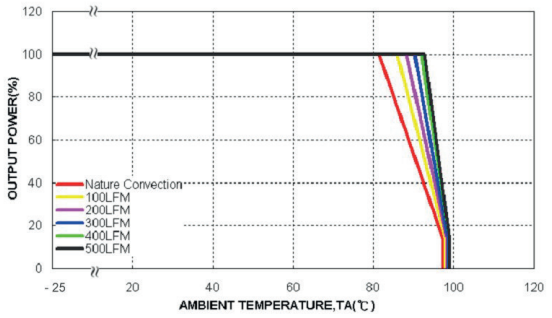
Efficiency versus Output Current



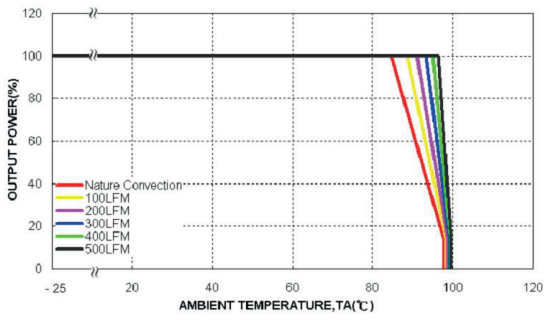
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load

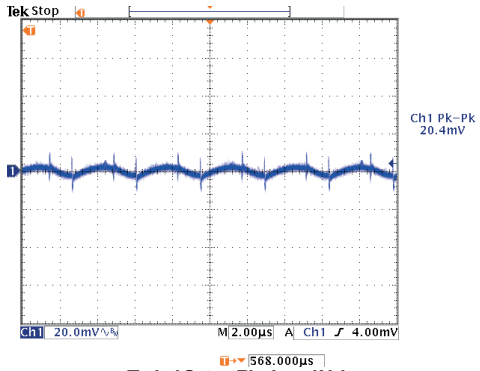


Derating Output Current versus Ambient Temperature and Airflow Vin = Vin(nom)

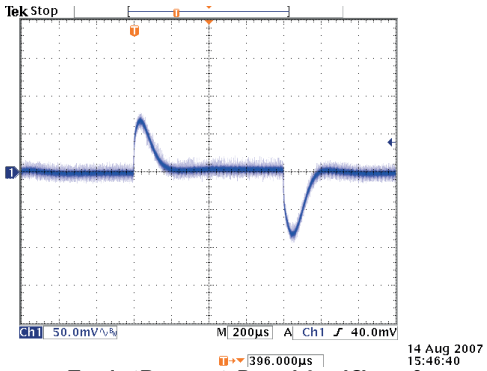


Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, Vin = Vin(nom)

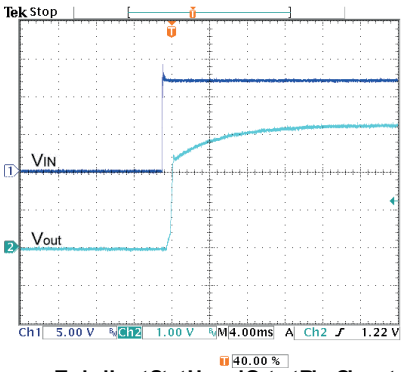
All test conditions are at 25°C.The figures are identical for PME10-12S33



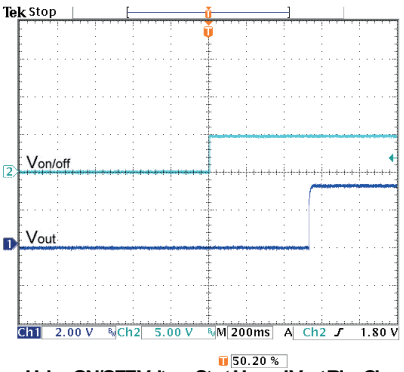
Typical Output Ripple and Noise.
Vin = Vin(nom), Full Load



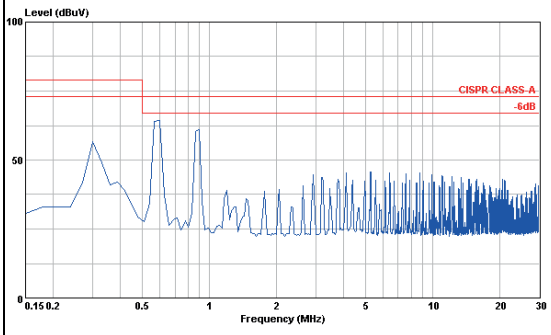
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load , Vin = Vin(nom)



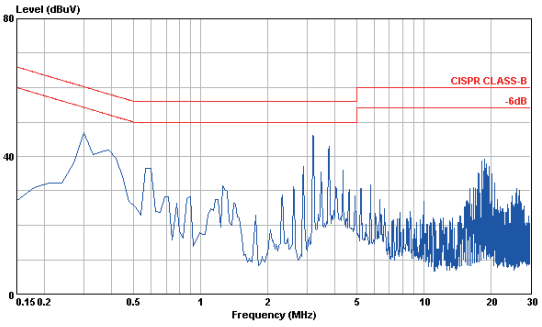
Typical Input Start-Up and Output Rise Characteristic
Vin = Vin(nom) , Full Load



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

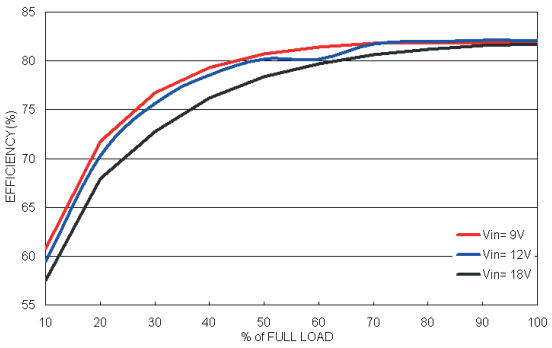


Conduction Emission of EN55022 Class A
Vin = Vin(nom) , Full Load

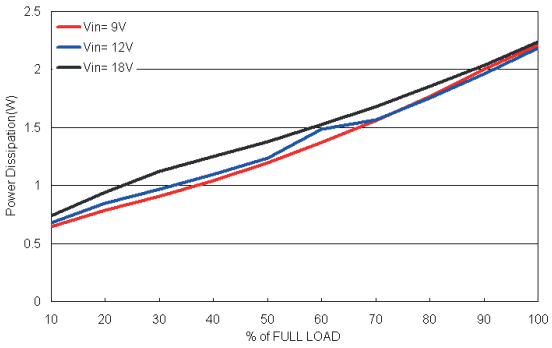


Conduction Emission of EN55022 Class B
Vin = Vin(nom) , Full Load

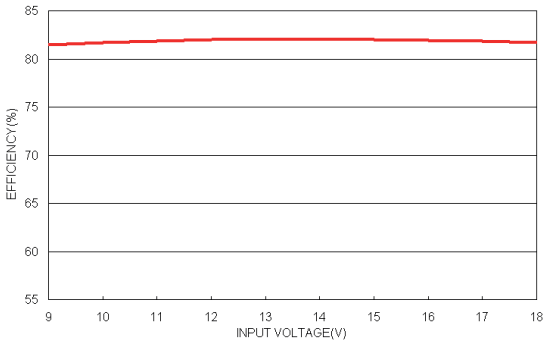
All test conditions are at 25°C.The figures are identical for PME10-12S05



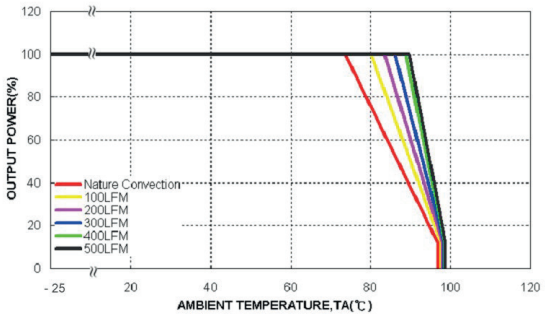
Efficiency versus Output Current



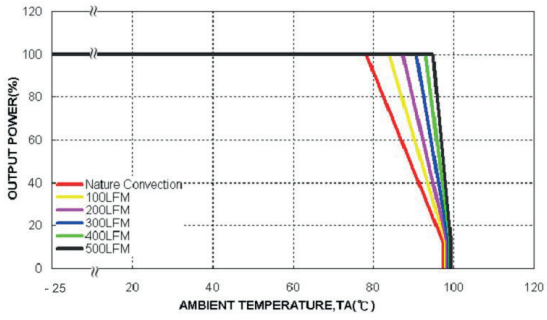
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load

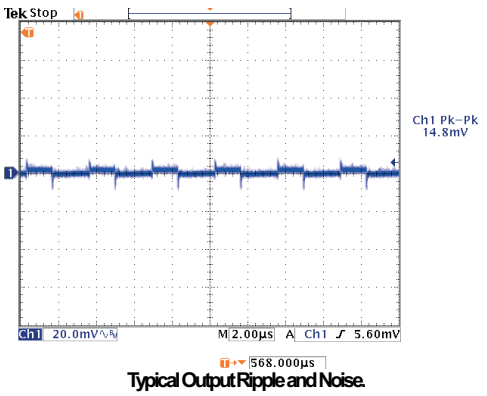


Derating Output Current versus Ambient Temperature and Airflow Vin = Vin(nom)

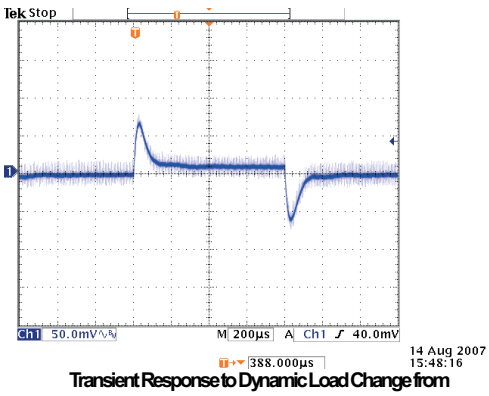


Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, Vin = Vin(nom)

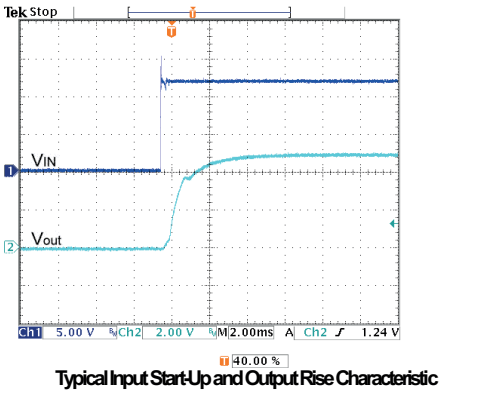
All test conditions are at 25°C.The figures are identical for PME10-12S05



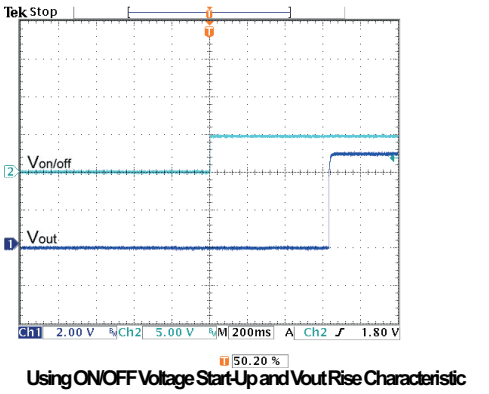
Typical Output Ripple and Noise.
Vin = Vin(nom), Full Load



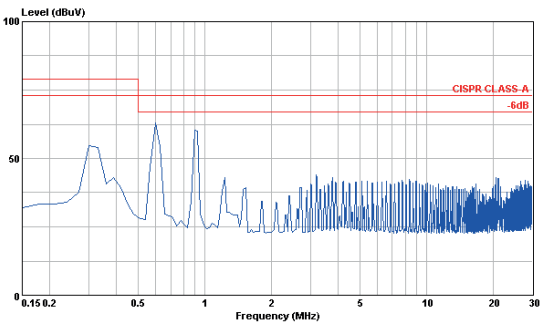
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load, Vin = Vin(nom)



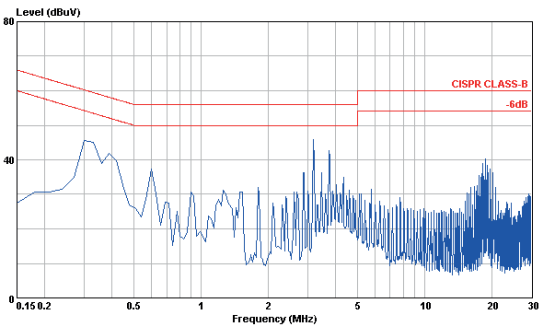
Typical Input Start-Up and Output Rise Characteristic
Vin = Vin(nom), Full Load



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

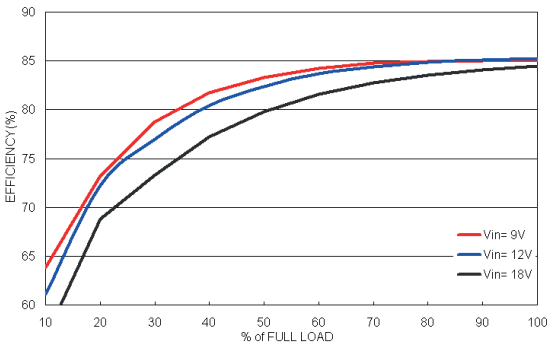


Conduction Emission of EN55022 Class A
Vin = Vin(nom), Full Load

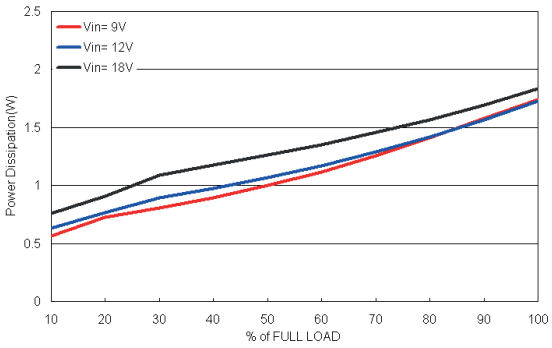


Conduction Emission of EN55022 Class B
Vin = Vin(nom), Full Load

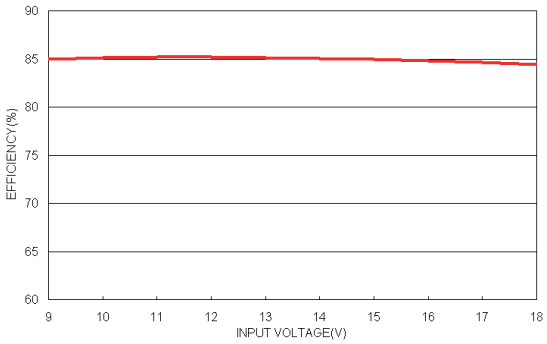
All test conditions are at 25°C.The figures are identical for PME10-12S12



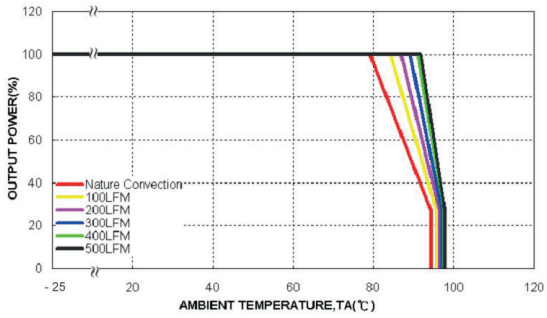
Efficiency versus Output Current



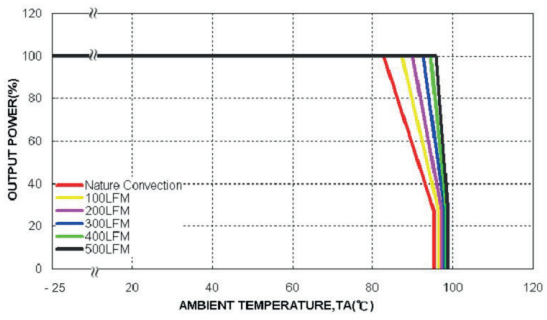
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load

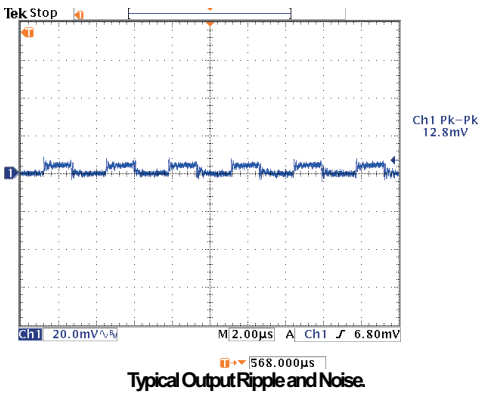


Derating Output Current versus Ambient Temperature and Airflow Vin = Vin(nom)

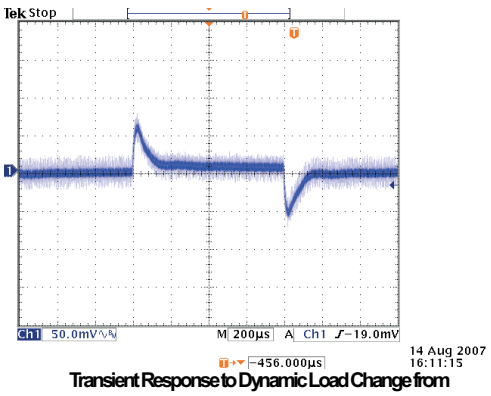


Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, Vin = Vin(nom)

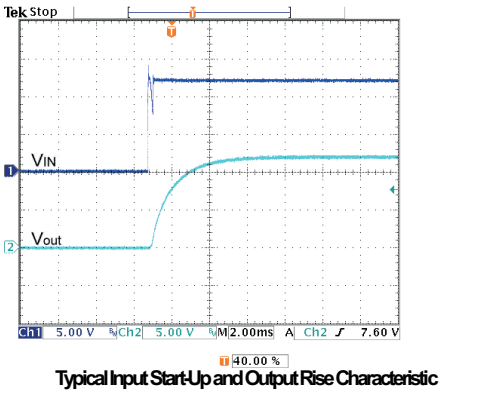
All test conditions are at 25°C.The figures are identical for PME10-12S12



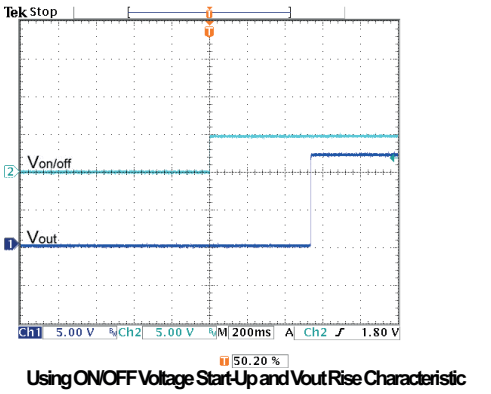
Typical Output Ripple and Noise.
Vin = Vin(nom), Full Load



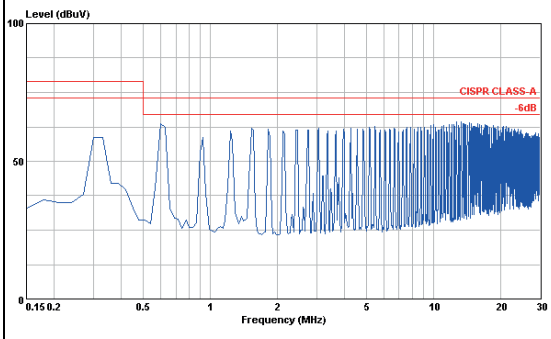
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load, Vin = Vin(nom))



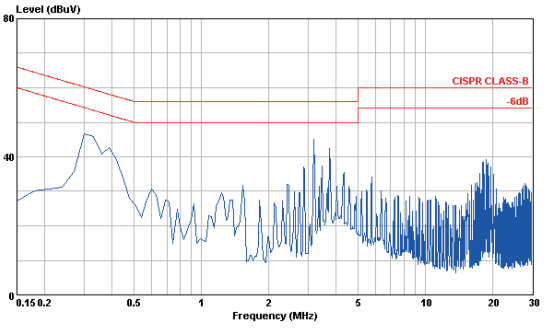
Typical Input Start-Up and Output Rise Characteristic
Vin = Vin(nom), Full Load



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

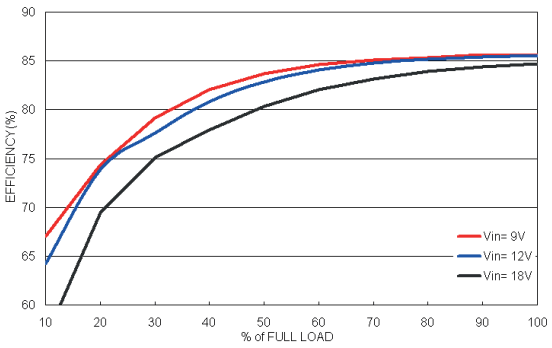


Conduction Emission of EN55022 Class A
Vin = Vin(nom), Full Load

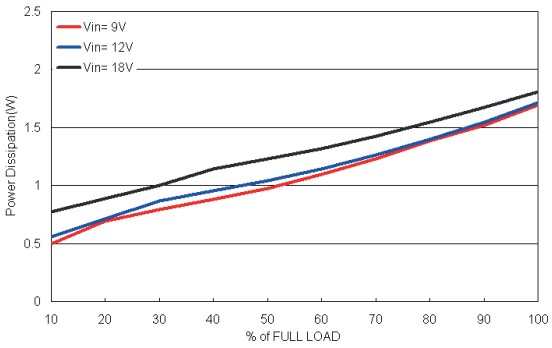


Conduction Emission of EN55022 Class B
Vin = Vin(nom), Full Load

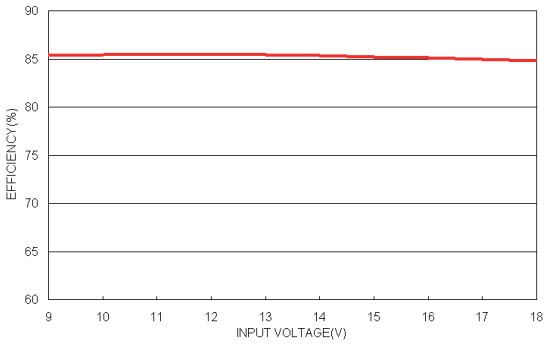
All test conditions are at 25°C.The figures are identical for PME10-12S15



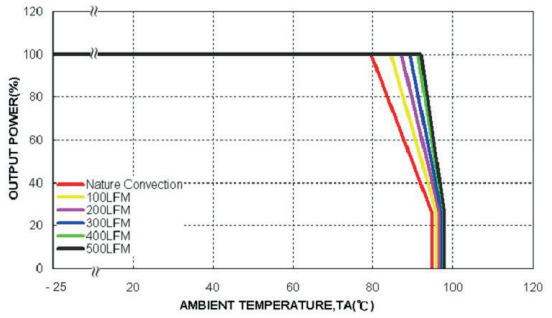
Efficiency versus Output Current



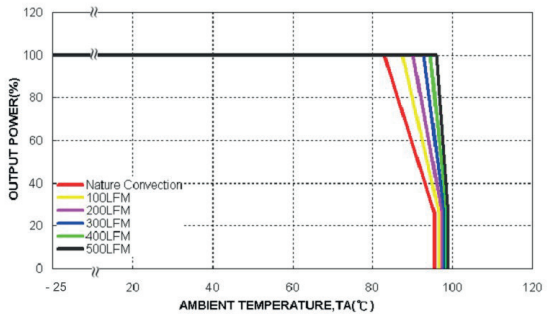
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load

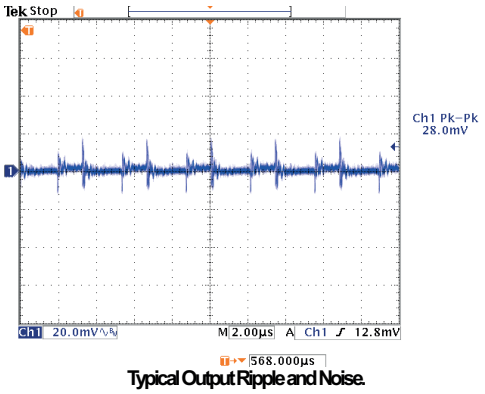


Derating Output Current versus Ambient Temperature and Airflow Vin = Vin(nom)

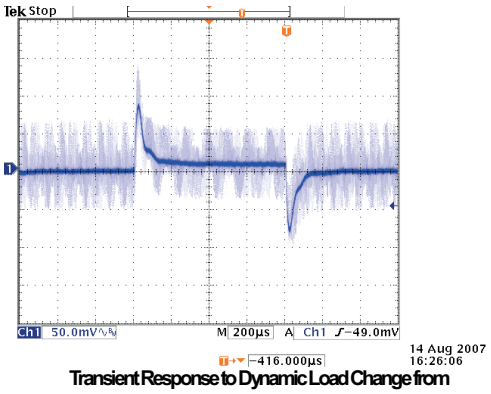


Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, Vin = Vin(nom)

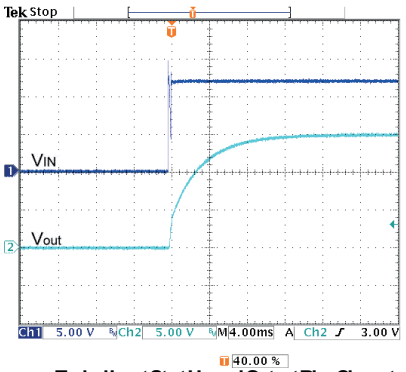
All test conditions are at 25°C.The figures are identical for PME10-12S15



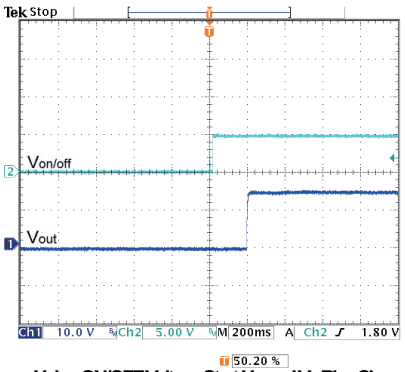
Typical Output Ripple and Noise.
Vin = Vin(nom), Full Load



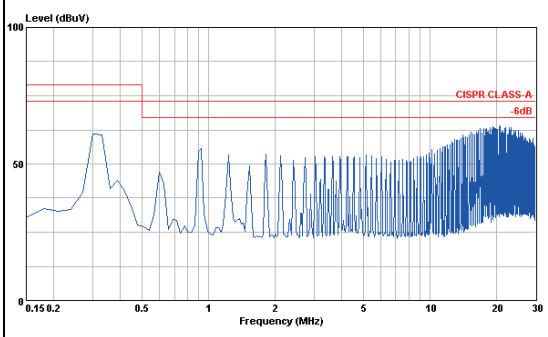
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load, Vin = Vin(nom)



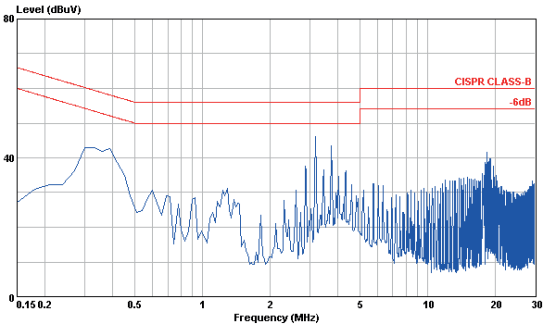
Typical Input Start-Up and Output Rise Characteristic
Vin = Vin(nom), Full Load



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

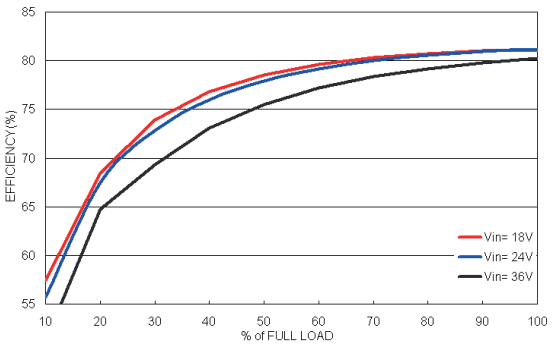


Conduction Emission of EN55022 Class A
Vin = Vin(nom), Full Load

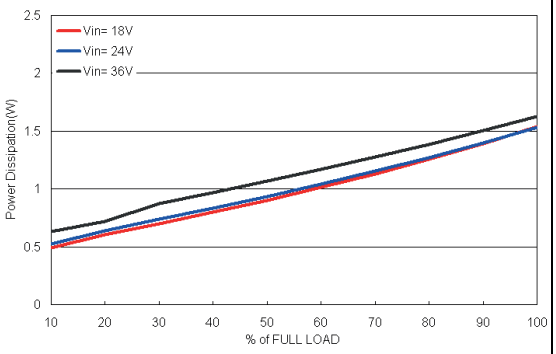


Conduction Emission of EN55022 Class B
Vin = Vin(nom), Full Load

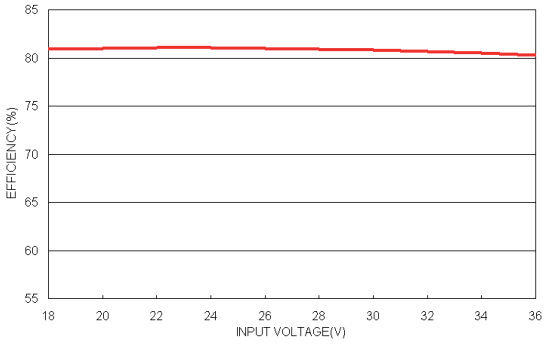
All test conditions are at 25°C.The figures are identical for PME10-24S33



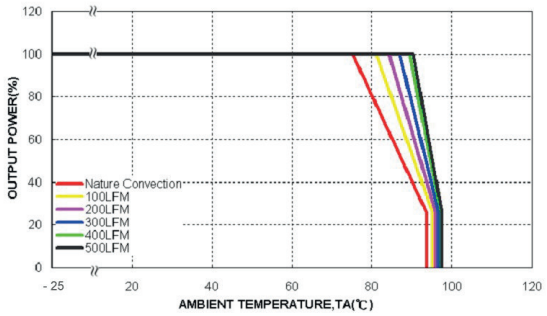
Efficiency versus Output Current



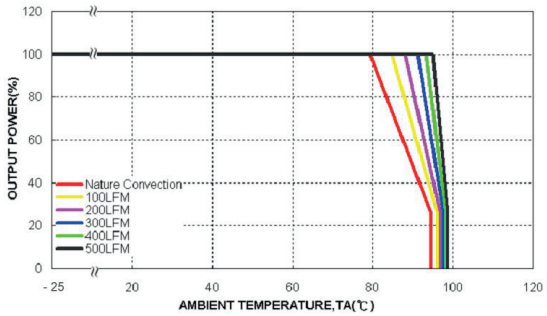
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load

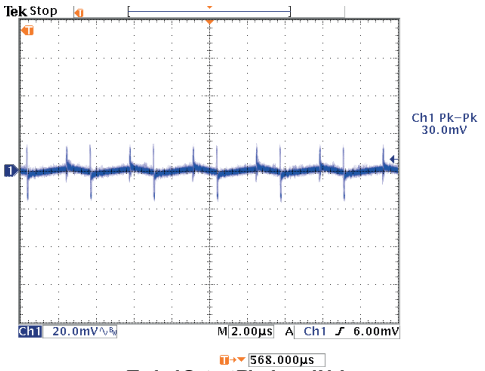


Derating Output Current versus Ambient Temperature and Airflow Vin = Vin(nom)

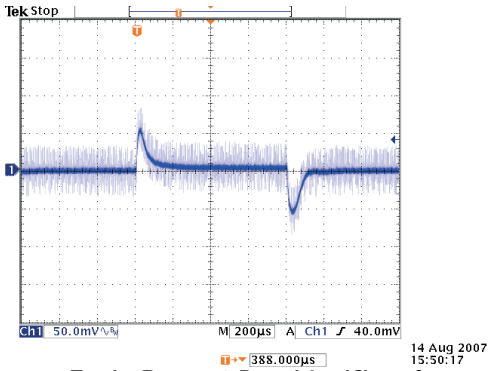


Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, Vin = Vin(nom)

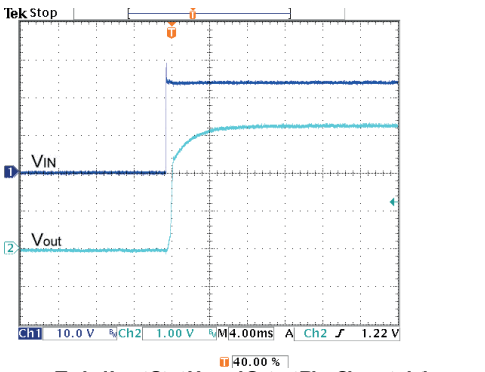
All test conditions are at 25°C.The figures are identical for PME10-24S33



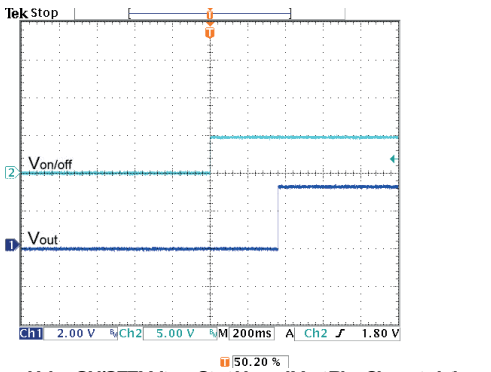
Typical Output Ripple and Noise.
Vin = Vin(nom), Full Load



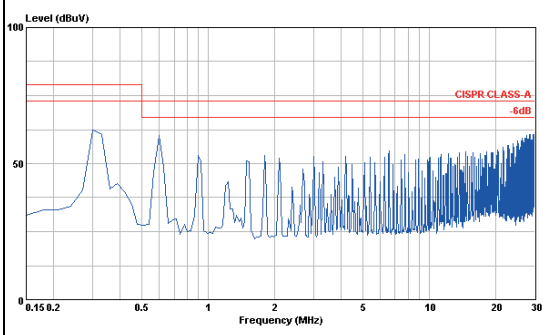
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load, Vin = Vin(nom)



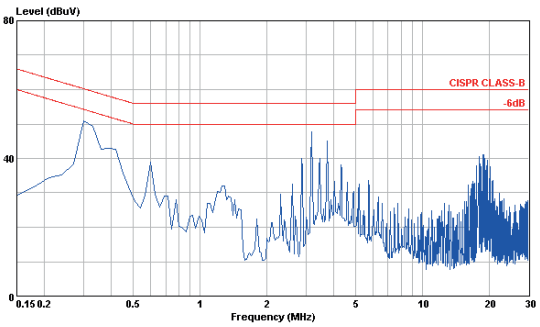
Typical Input Start-Up and Output Rise Characteristic
Vin = Vin(nom), Full Load



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

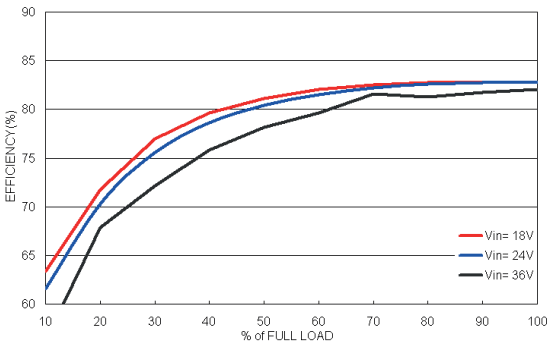


Conduction Emission of EN55022 Class A
Vin = Vin(nom), Full Load

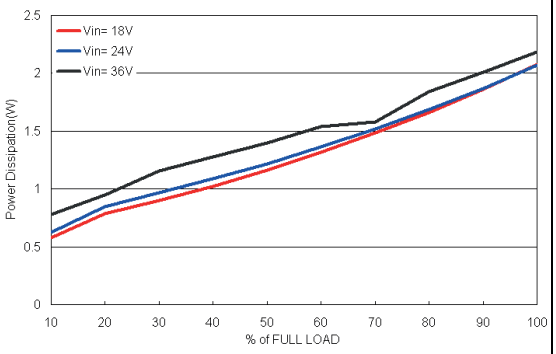


Conduction Emission of EN55022 Class B
Vin = Vin(nom), Full Load

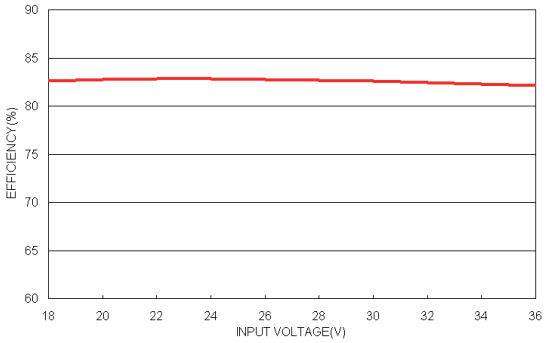
All test conditions are at 25°C.The figures are identical for PME10-24S05



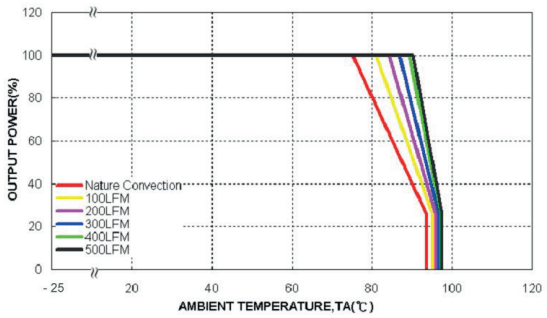
Efficiency versus Output Current



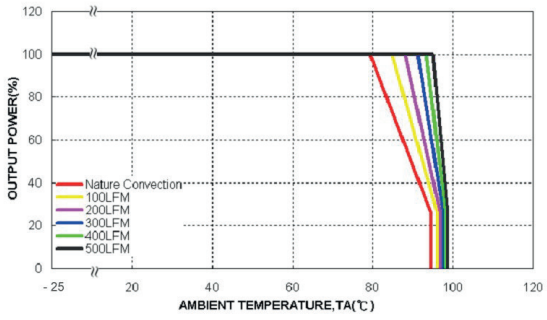
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load

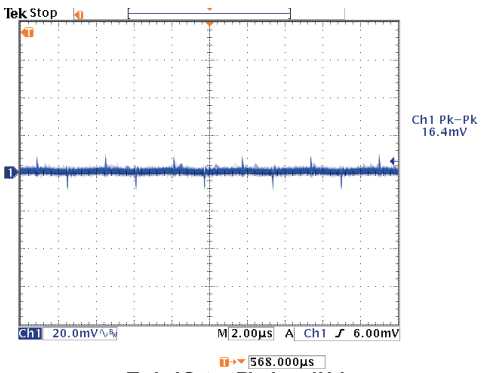


Derating Output Current versus Ambient Temperature and Airflow Vin = Vin(nom)

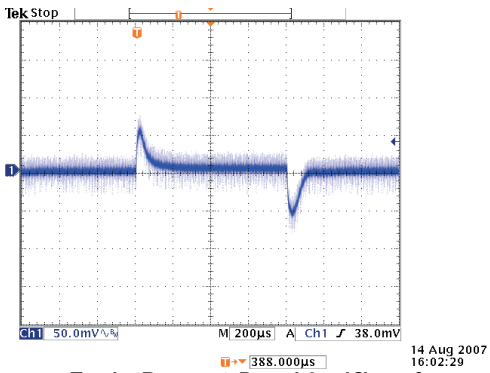


Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, Vin = Vin(nom)

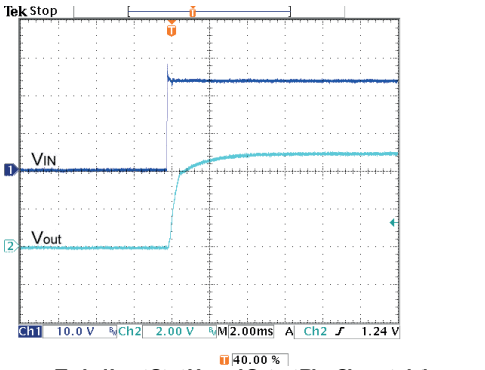
All test conditions are at 25°C.The figures are identical for PME10-24S05



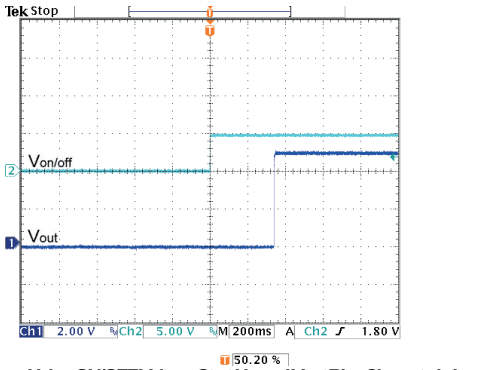
Typical Output Ripple and Noise.
Vin = Vin(nom) , Full Load



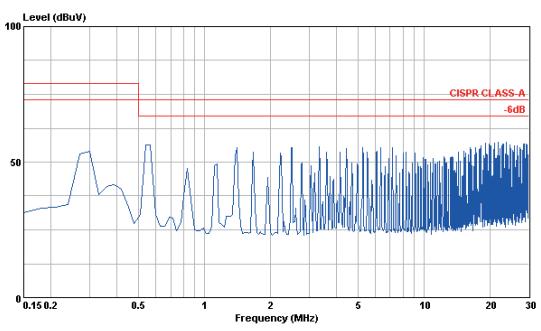
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load , Vin = Vin(nom)



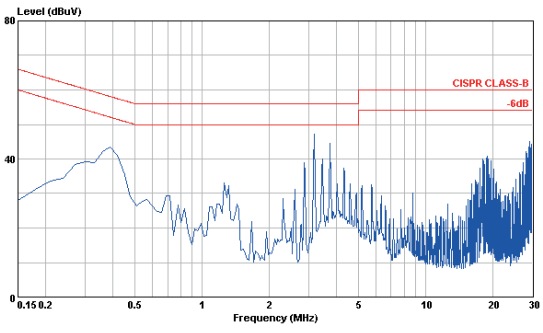
Typical Input Start-Up and Output Rise Characteristic
Vin = Vin(nom) , Full Load



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

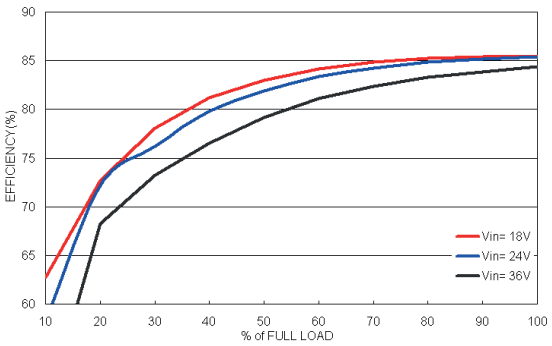


Conduction Emission of EN55022 Class A
Vin = Vin(nom) , Full Load

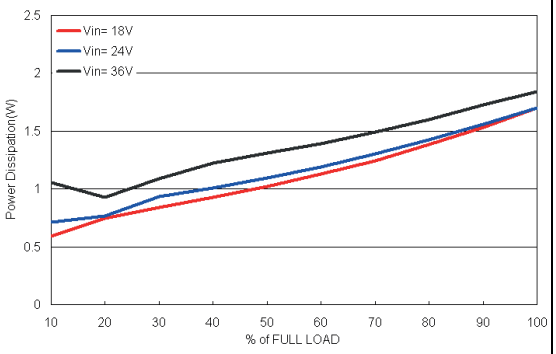


Conduction Emission of EN55022 Class B
Vin = Vin(nom) , Full Load

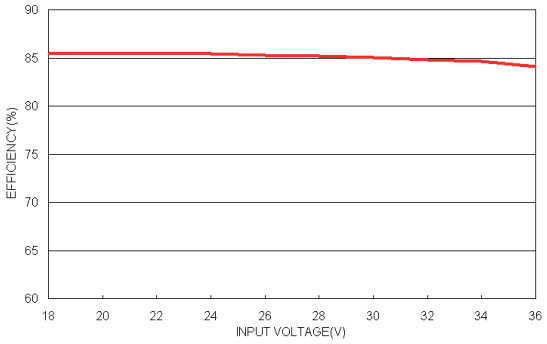
All test conditions are at 25°C.The figures are identical for PME10-24S12



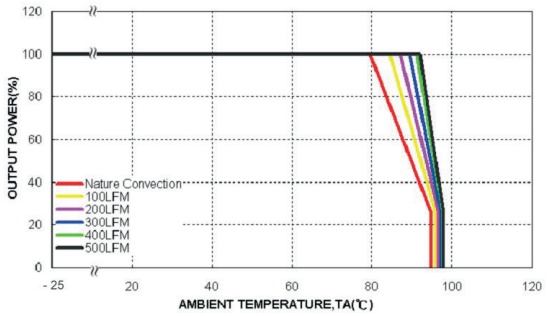
Efficiency versus Output Current



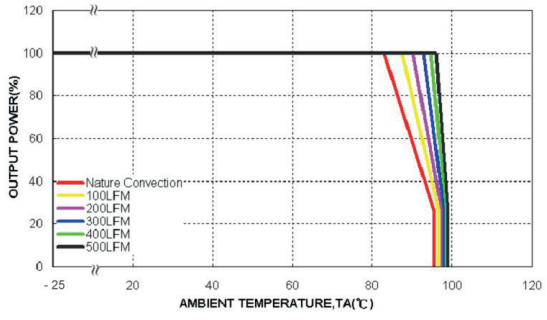
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load

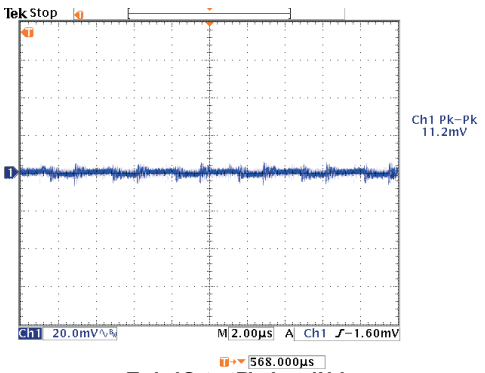


Derating Output Current versus Ambient Temperature and Airflow Vin = Vin(nom)

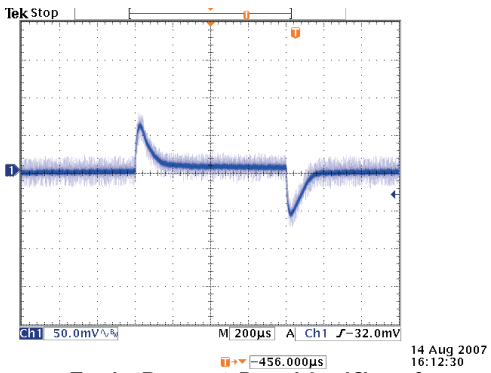


Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, Vin = Vin(nom)

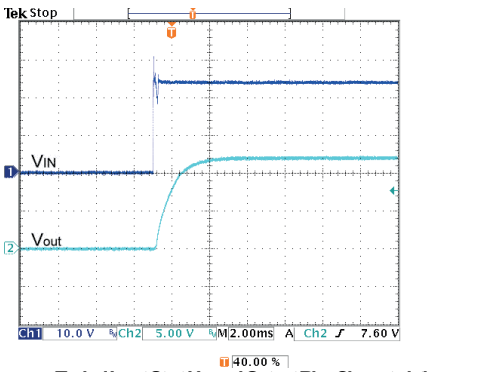
All test conditions are at 25°C.The figures are identical for PME10-24S12



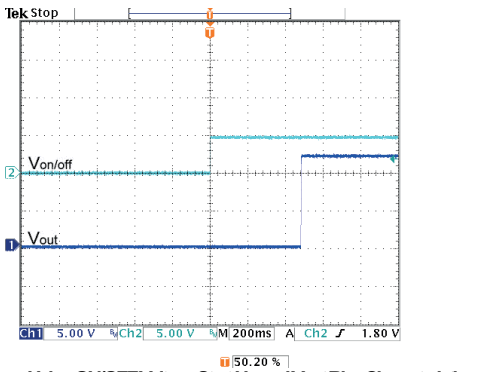
Typical Output Ripple and Noise.
Vin = Vin(nom), Full Load



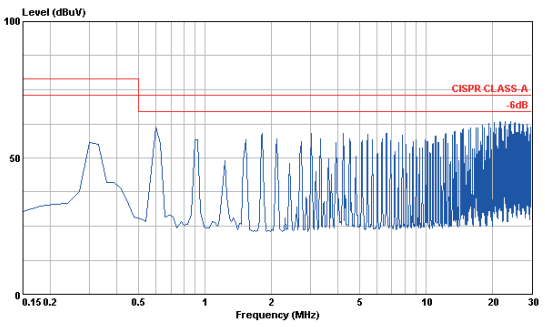
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load, Vin = Vin(nom)



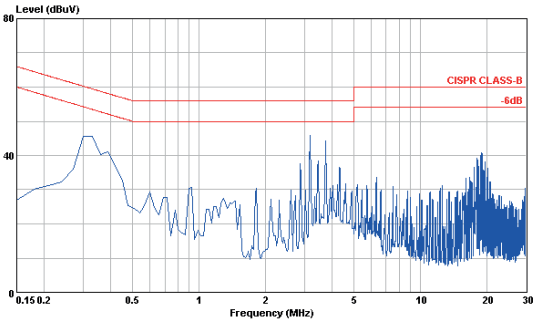
Typical Input Start-Up and Output Rise Characteristic
Vin = Vin(nom), Full Load



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

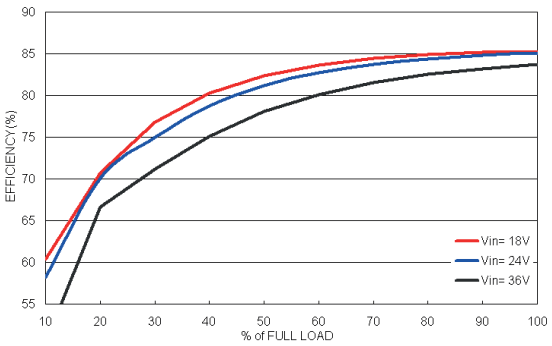


Conduction Emission of EN55022 Class A
Vin = Vin(nom), Full Load

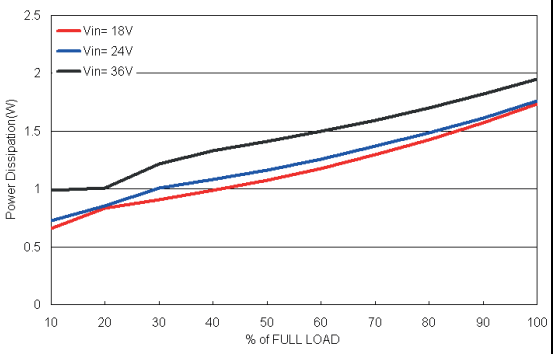


Conduction Emission of EN55022 Class B
Vin = Vin(nom), Full Load

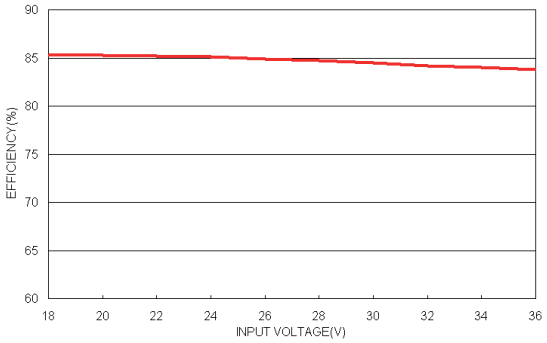
All test conditions are at 25°C.The figures are identical for PME10-24S15



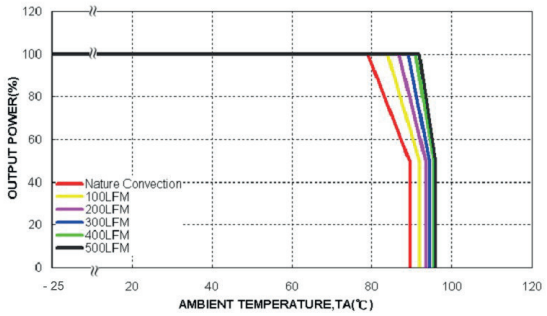
Efficiency versus Output Current



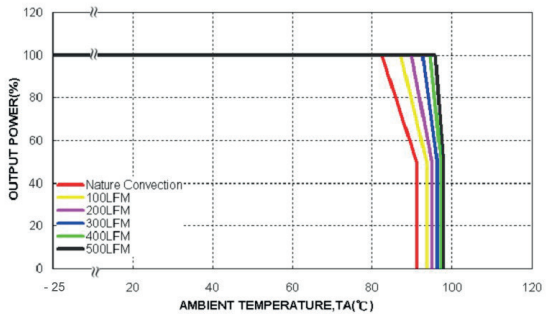
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load

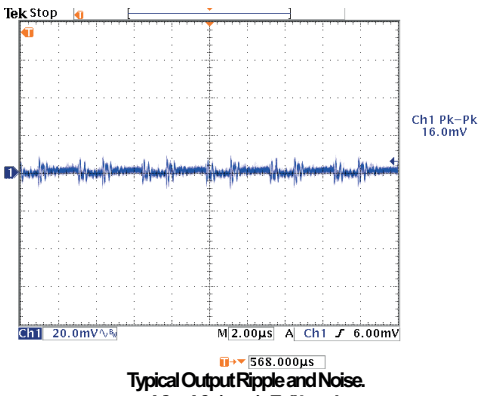


Derating Output Current versus Ambient Temperature and Airflow Vin = Vin(nom)

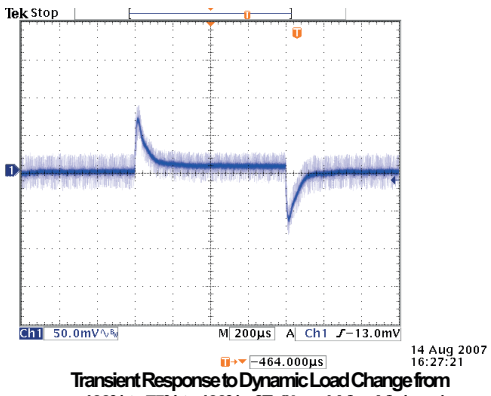


Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, Vin = Vin(nom)

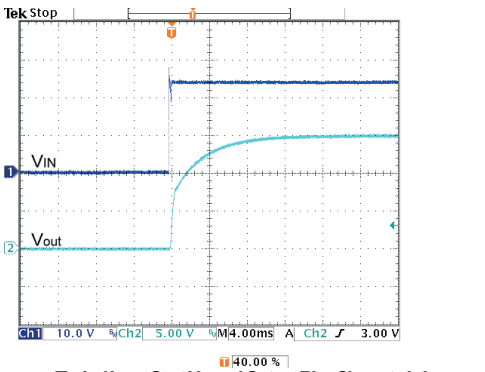
All test conditions are at 25°C.The figures are identical for PME10-24S15



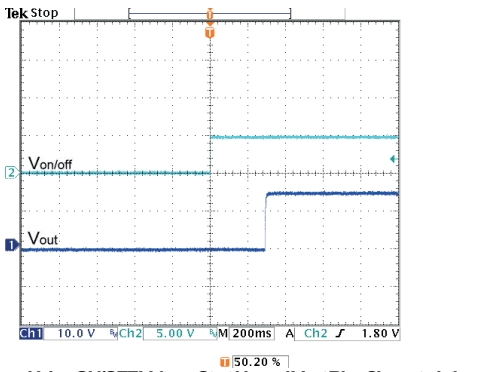
Typical Output Ripple and Noise.
Vin = Vin(nom), Full Load



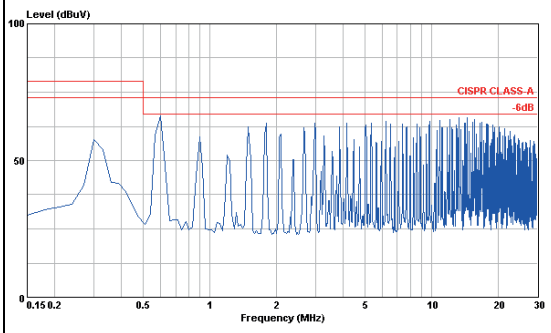
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load, Vin = Vin(nom)



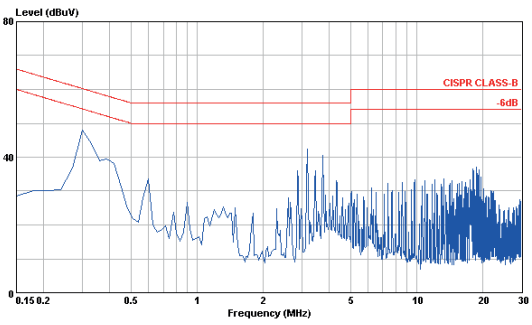
Typical Input Start-Up and Output Rise Characteristic
Vin = Vin(nom), Full Load



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

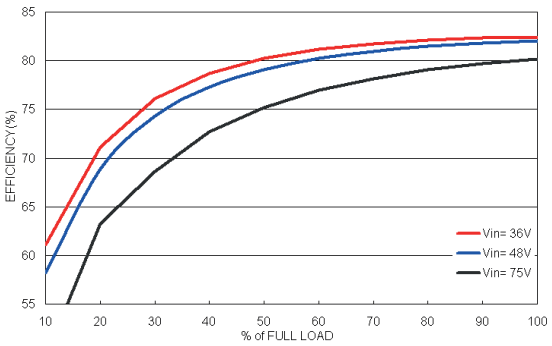


Conduction Emission of EN55022 Class A
Vin = Vin(nom), Full Load

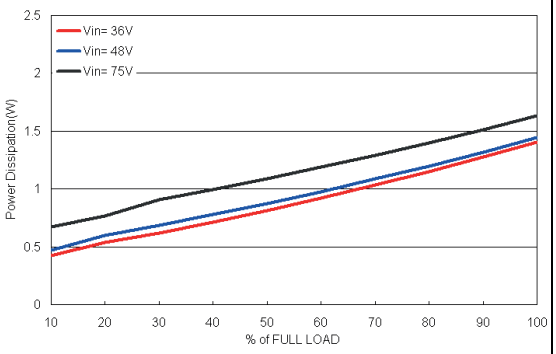


Conduction Emission of EN55022 Class B
Vin = Vin(nom), Full Load

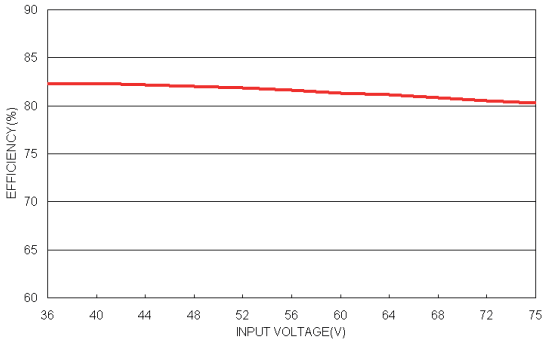
All test conditions are at 25°C.The figures are identical for PME10-48S33



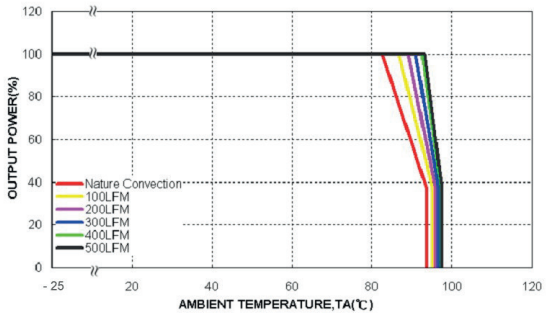
Efficiency versus Output Current



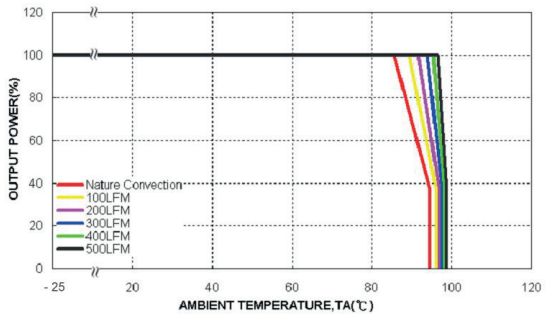
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load

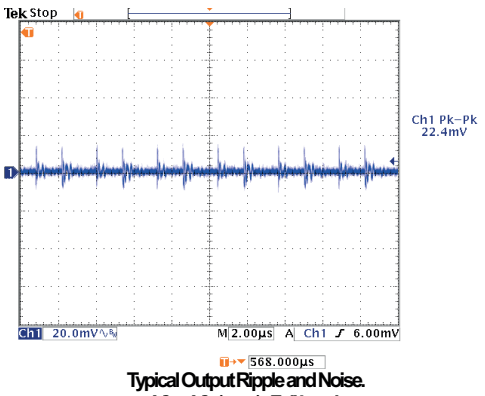


Derating Output Current versus Ambient Temperature and Airflow Vin = Vin(nom)

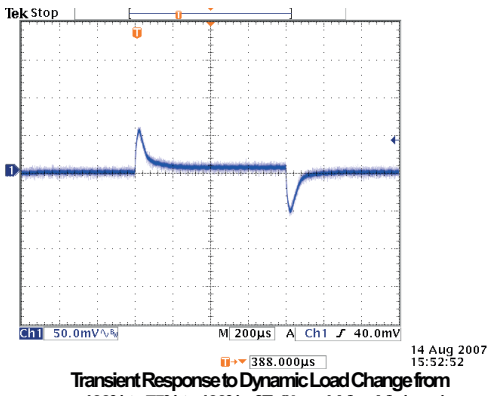


Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, Vin = Vin(nom)

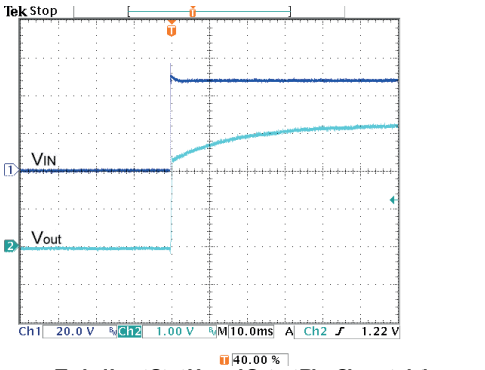
All test conditions are at 25°C.The figures are identical for PME10-48S33



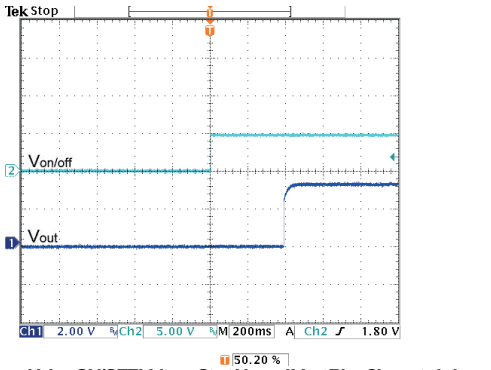
Typical Output Ripple and Noise.
Vin = Vin(nom), Full Load



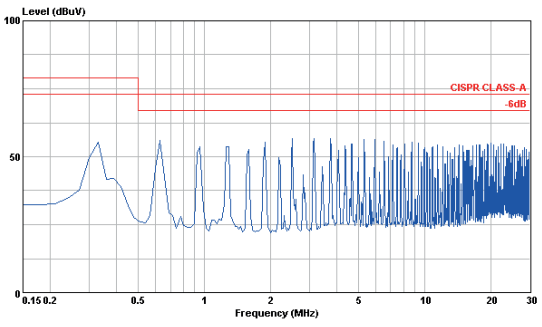
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load, Vin = Vin(nom)



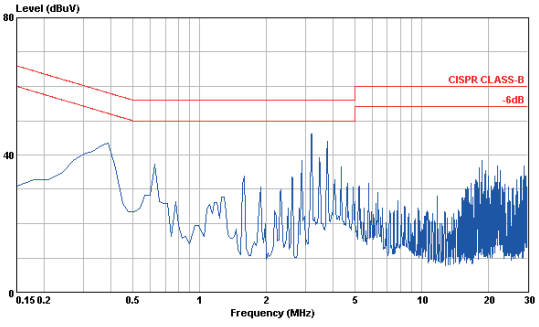
Typical Input Start-Up and Output Rise Characteristic
Vin = Vin(nom), Full Load



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

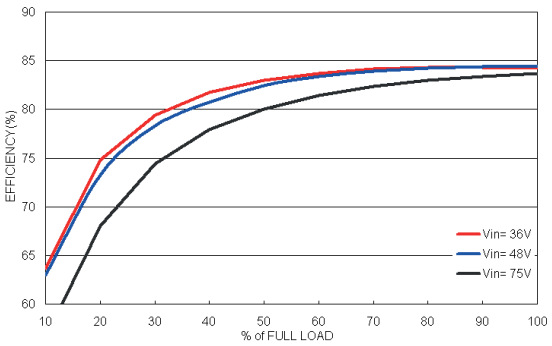


Conduction Emission of EN55022 Class A
Vin = Vin(nom), Full Load

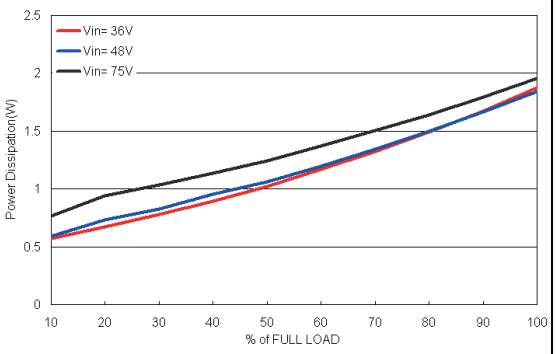


Conduction Emission of EN55022 Class B
Vin = Vin(nom), Full Load

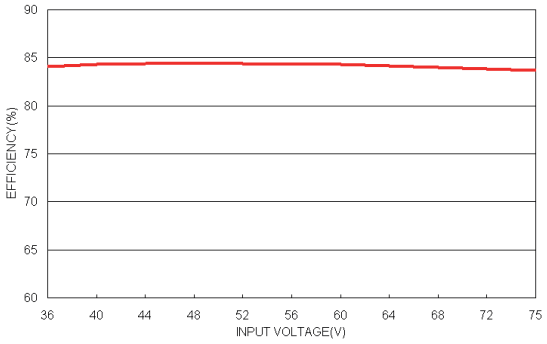
All test conditions are at 25°C.The figures are identical for PME10-48S05



Efficiency versus Output Current

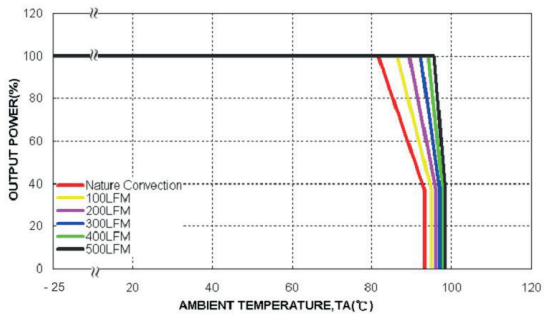


Power Dissipation versus Output Current

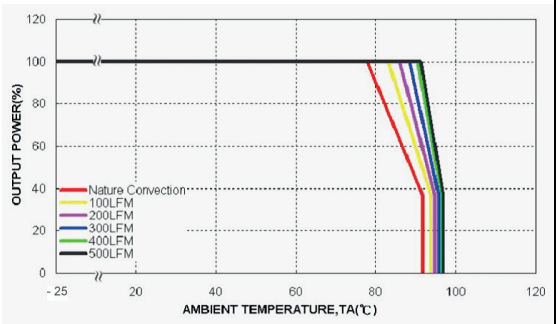


Efficiency versus Input Voltage. Full Load

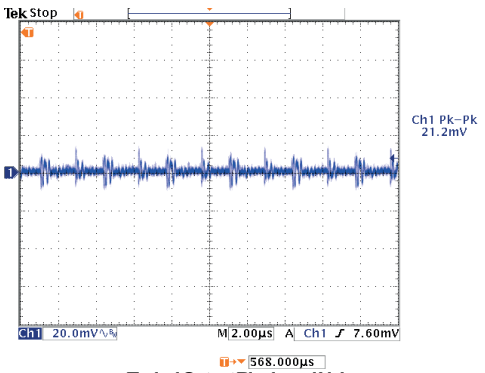
Derating Output Current versus Ambient Temperature and Airflow Vin = Vin(nom)



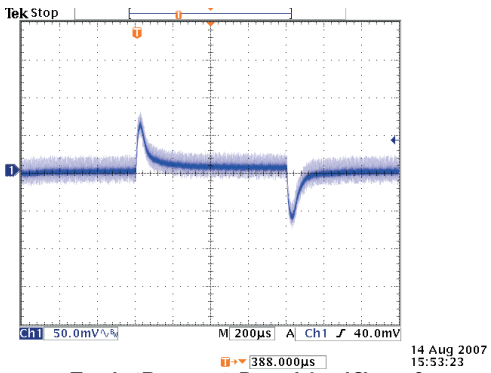
Derating Output Current Versus Ambient Temperature with Heat-Sink and Airflow,Vin = Vin(nom)



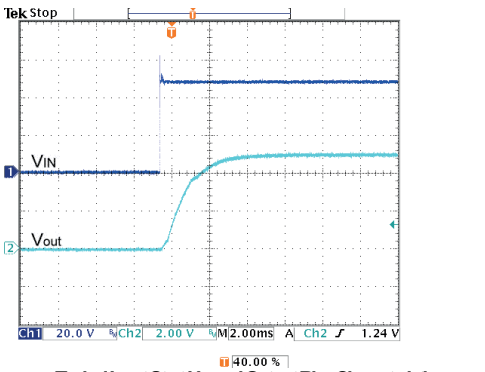
All test conditions are at 25°C.The figures are identical for PME10-48S05



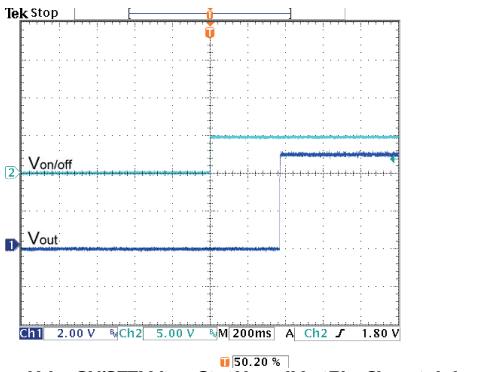
Typical Output Ripple and Noise.
Vin = Vin(nom), Full Load



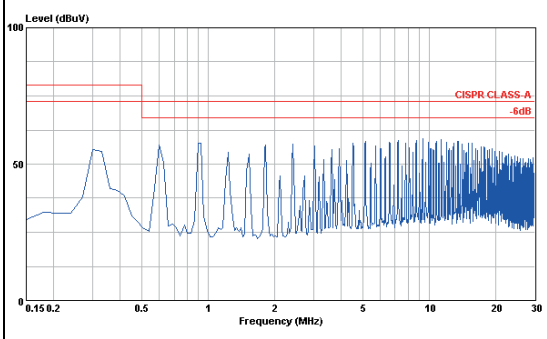
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load, Vin = Vin(nom)



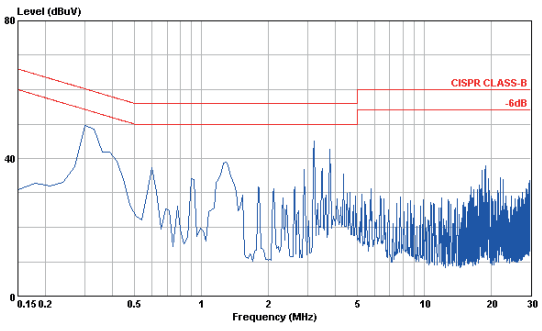
Typical Input Start-Up and Output Rise Characteristic
Vin = Vin(nom), Full Load



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

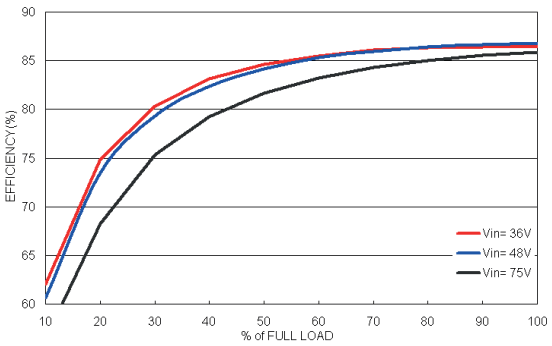


Conduction Emission of EN55022 Class A
Vin = Vin(nom), Full Load

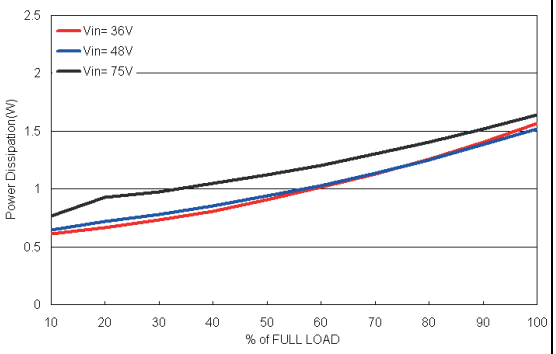


Conduction Emission of EN55022 Class B
Vin = Vin(nom), Full Load

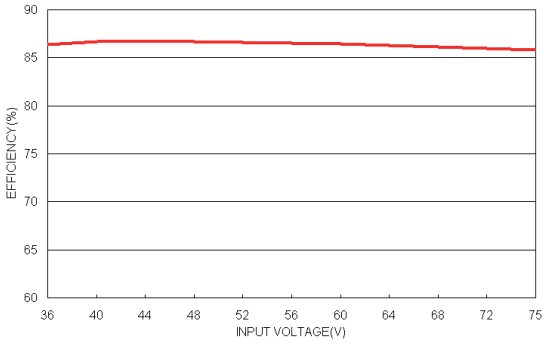
All test conditions are at 25°C.The figures are identical for PME10-48S12



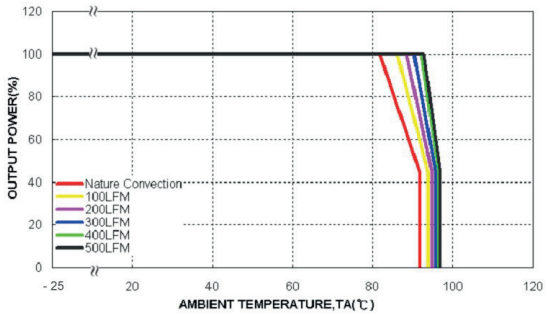
Efficiency versus Output Current



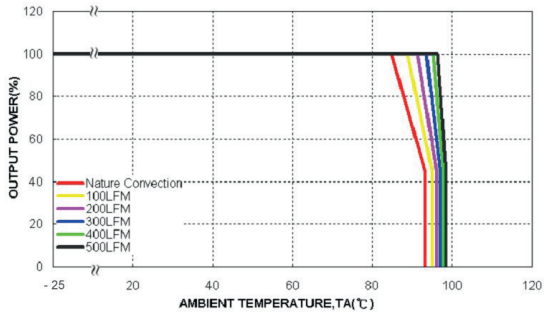
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load

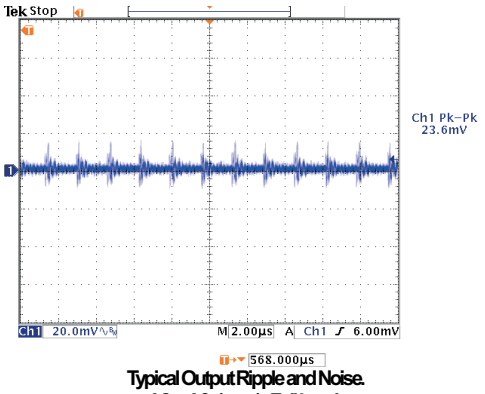


Derating Output Current versus Ambient Temperature and Airflow Vin = Vin(nom)

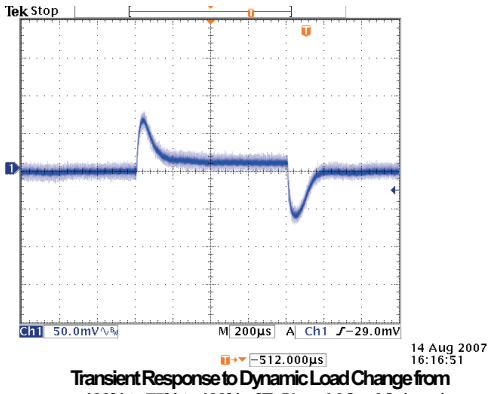


Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, Vin = Vin(nom)

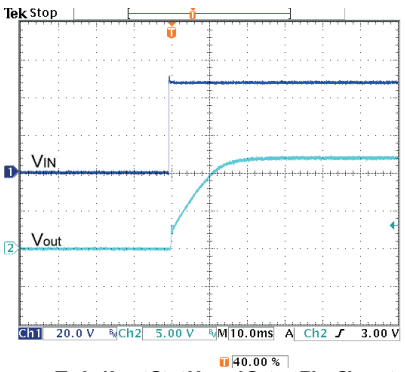
All test conditions are at 25°C.The figures are identical for PME10-48S12



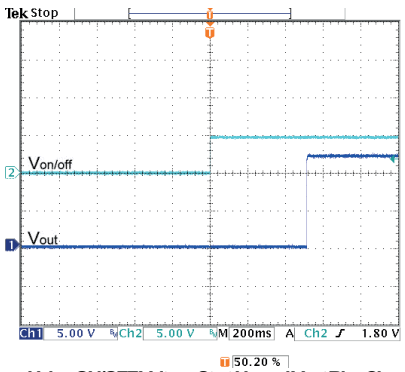
Typical Output Ripple and Noise.
Vin = Vin(nom), Full Load



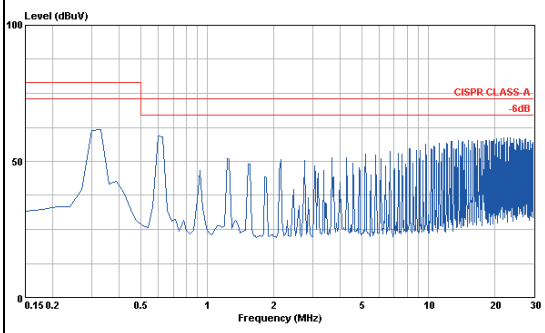
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load, Vin = Vin(nom)



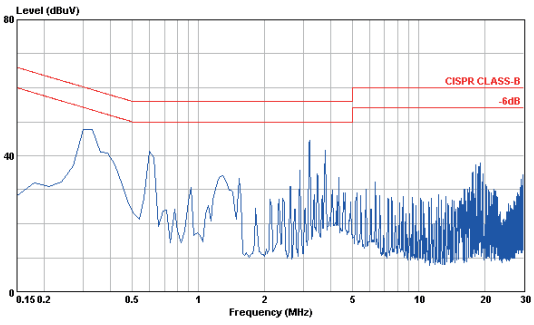
Typical Input Start-Up and Output Rise Characteristic
Vin = Vin(nom), Full Load



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

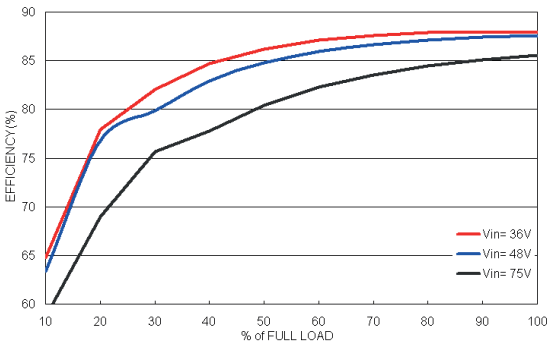


Conduction Emission of EN55022 Class A
Vin = Vin(nom), Full Load

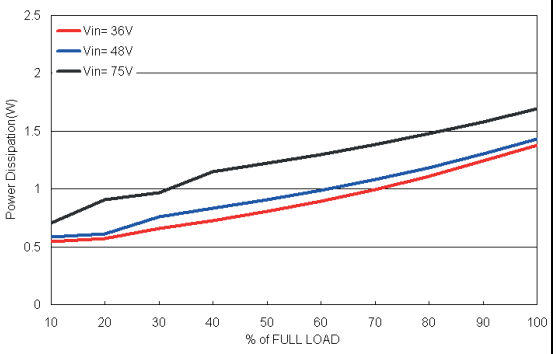


Conduction Emission of EN55022 Class B
Vin = Vin(nom), Full Load

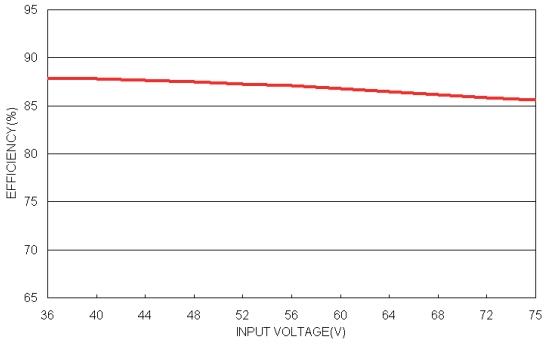
All test conditions are at 25°C.The figures are identical for PME10-48S15



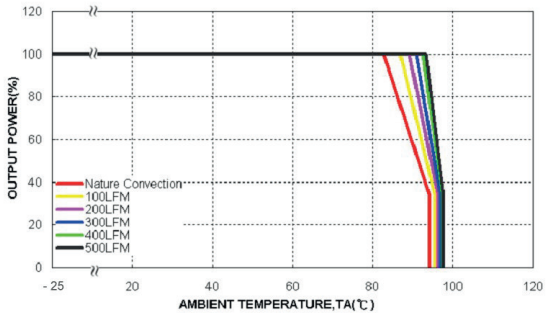
Efficiency versus Output Current



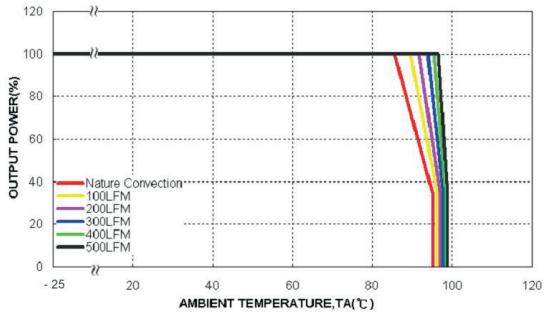
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load

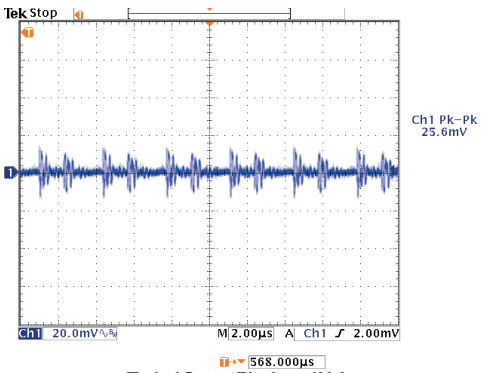


Derating Output Current versus Ambient Temperature and Airflow Vin = Vin(nom)

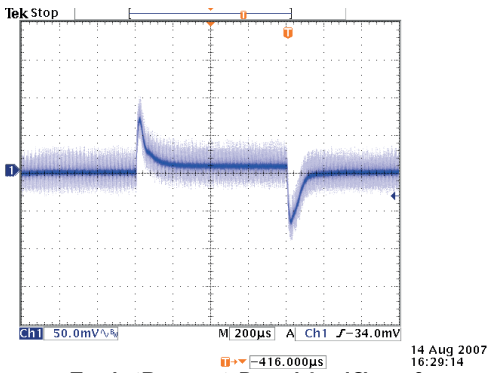


Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, Vin = Vin(nom)

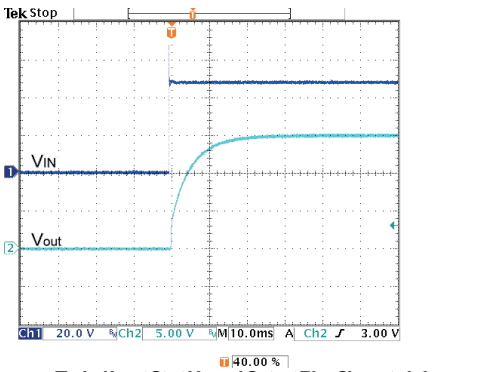
All test conditions are at 25°C.The figures are identical for PME10-48S15



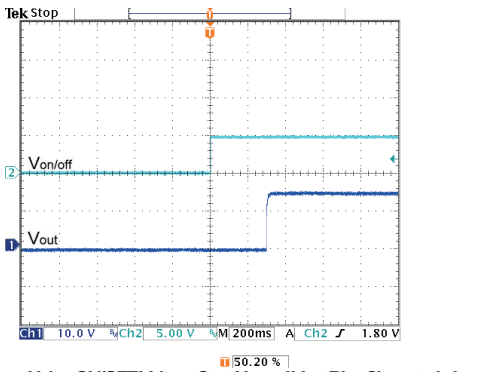
Typical Output Ripple and Noise.
Vin = Vin(nom), Full Load



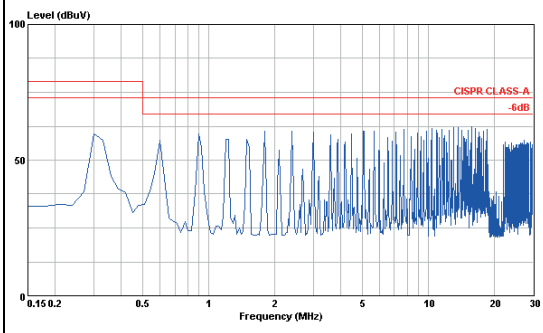
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load, Vin = Vin(nom)



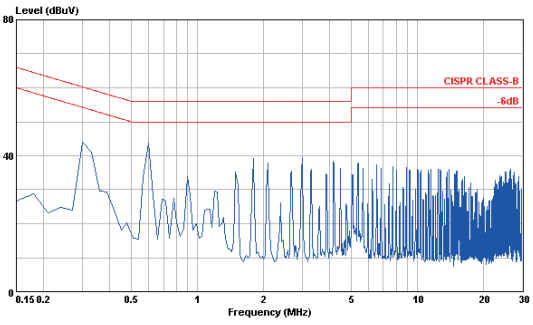
Typical Input Start-Up and Output Rise Characteristic
Vin = Vin(nom), Full Load



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



Conduction Emission of EN55022 Class B
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 100μF/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 130 percent of rated current for T10-S 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

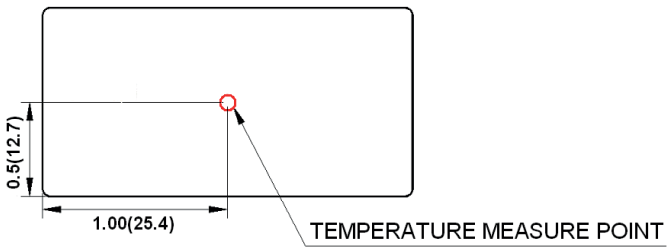
The output over-voltage protection consists of output Zener diode that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over-voltage protection threshold, then the Zener diode clamps the output voltage.

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 100°C. When Operating, adequate cooling must be provided to maintain the test point temperature at or below 100°C. Although the maximum point Temperature of the power modules is 100°C, you can limit this Temperature to a lower value for extremely high reliability.



TOP VIEW

Remote On/Off Control

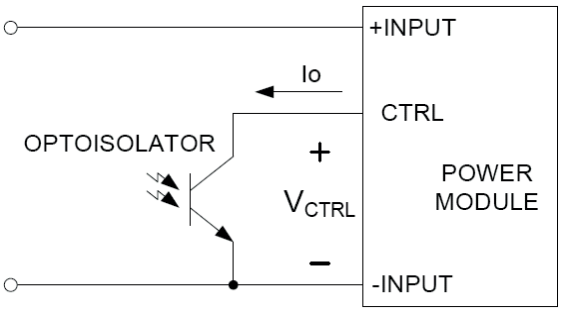
Remote control is an optional feature.

Positive logic:
Turns the module On during logic High on the CTRL pin and turns Off during logic Low.

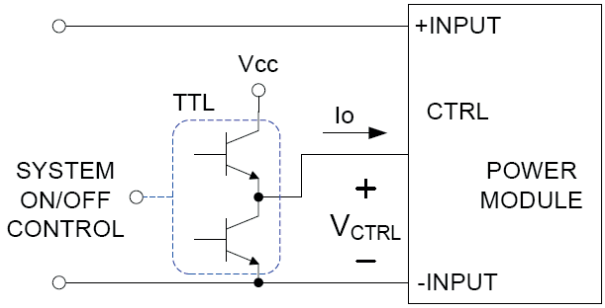
Negative logic:
Turns the module On during logic Low on the CTRL pin and turns Off during logic High.

The CTRL pin is an open collector/drain logic input signal (Von/off) that referenced to -INPUT

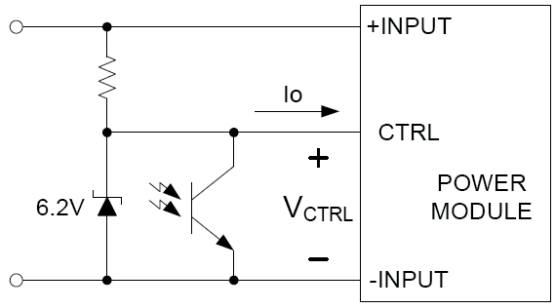
Remote On/Off Implementation



Isolated-Closure Remote ON/OFF



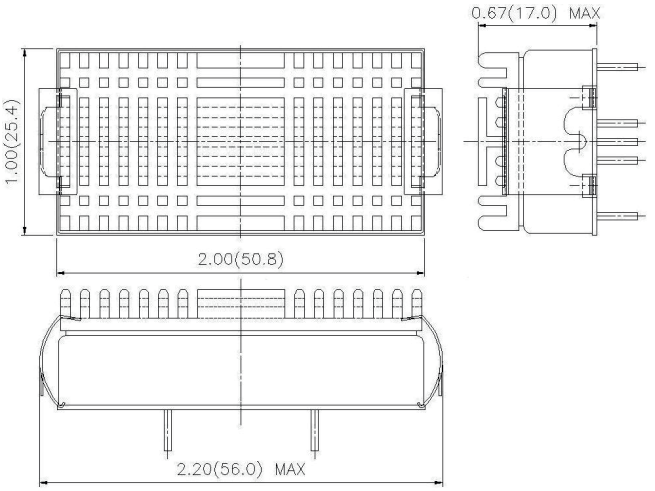
Level Control Using TTL Output



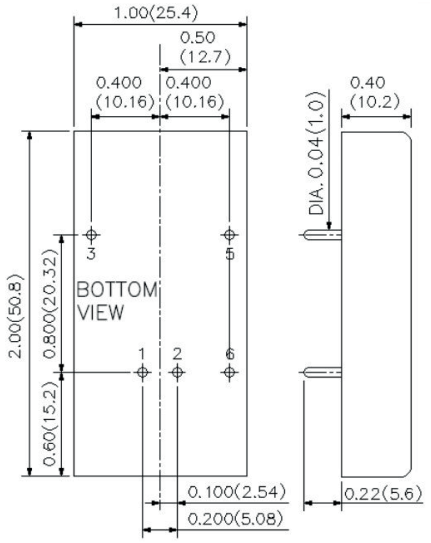
Level Control Using Line Voltage

Heat-sink

Equip Heat-sink (7G-0020C-F) for lower temperature and higher reliability of the module. Considering space and air-flow is the way to choose which heat-sink is needed.



Mechanical Drawing

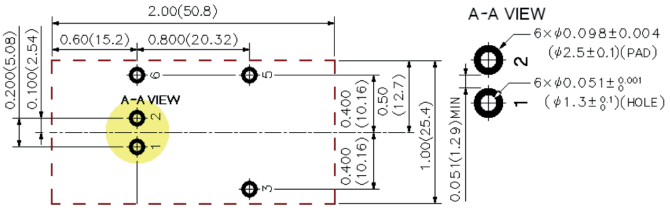


Pin Connection

Pin	Define
1	+ INPUT
2	- INPUT
3	+ OUTPUT
5	- OUTPUT
6	CTRL (Option)

1. All dimensions in inch (mm)
2. Tolerance :x.xx±0.02 (x.x±0.5)
x.xxx±0.01 (x.xx±0.25)
3. Pin pitch tolerance ±0.01 (0.25)
4. Pin dimension tolerance ±0.0014(0.35)

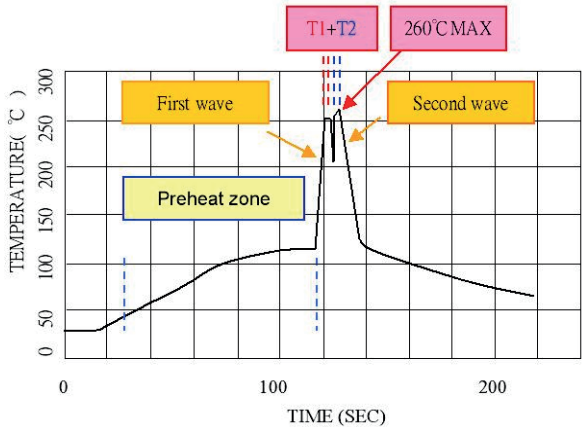
Recommended Pad Layout



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)

Soldering and Reflow Considerations

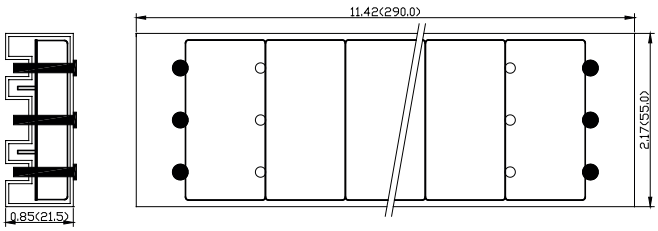
Lead free wave solder profile for T10 series



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

Packing Information



Safety and Installation Instruction

Fusing Consideration

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

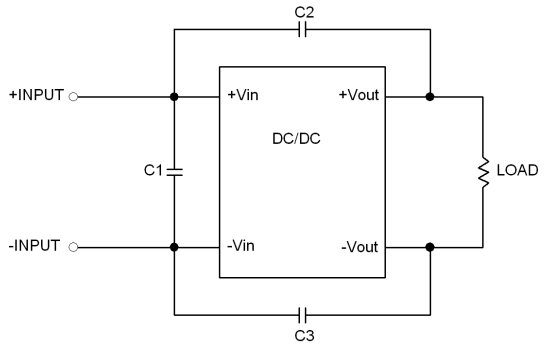
Caution: This power module is not internally fused. An input line fuse must always be used.

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 5A. 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.

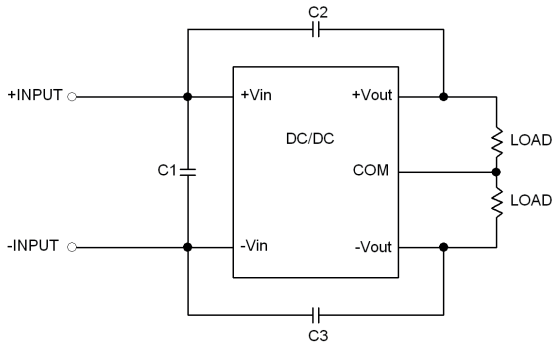
MTBF and Reliability

The MTBF of T10 SINGLE-SERIES of DC/DC converters has been calculated using MIL-HDBK 217F @Ta=25°C, FULL LOAD. The resulting figure for MTBF is 3.342×10^6 hours.

Recommended external EMI filter for EN55022 Class A



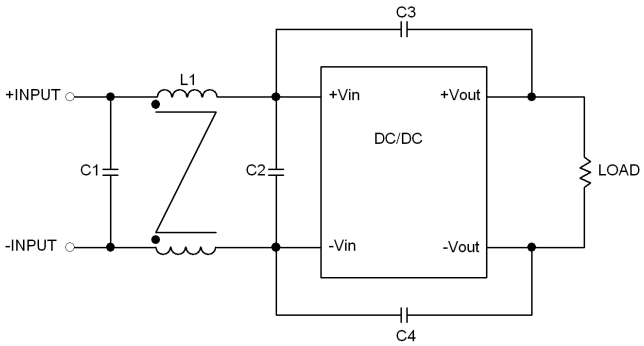
Single Output



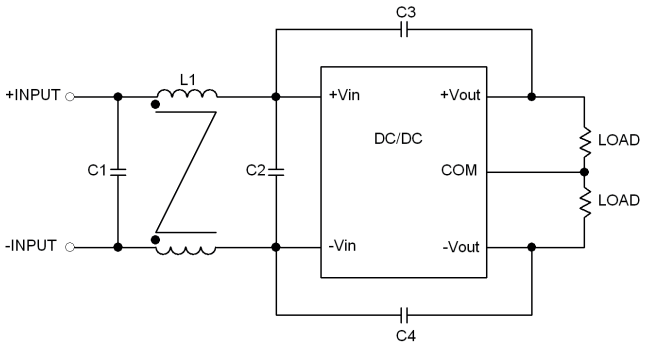
Dual Output

Model	C1	C2	C3
PME10-12□□□	2.2μF/25V	1000pF/2kV	1000pF/2kV
	1206 MLCC	1808 MLCC	1808 MLCC
PME10-24□□□	N/A	1000pF/2kV	1000pF/2kV
		1808 MLCC	1808 MLCC
PME10-48□□□	N/A	1000pF/2kV	1000pF/2kV
		1808 MLCC	1808 MLCC

Recommended external EMI filter for EN55022 Class B



Single Output



Dual Output

Model	C1	C2	C3	L1
PME10-12□□□	3.3μF/50V	N/A	1000pF/2kV	325μH
	1812 MLCC		1808 MLCC	Common Shoke PMT-050
PME10-24□□□	2.2μF/50V	N/A	1000pF/2kV	325μH
	1812 MLCC		1808 MLCC	Common Shoke PMT-050
PME10-48□□□	2.2μF/100V	2.2μF/100V	1000pF/2kV	325μH
	1812 MLCC	1812 MLCC	1808 MLCC	Common Shoke PMT-050