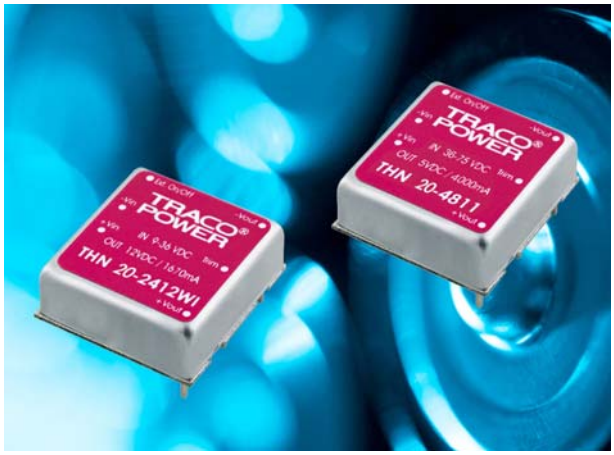
THN 20WI Series

Application Note

DC/DC Converter 9 to 36Vdc and 18 to 75Vdc input voltage, 20 Watt Output Power; 3.3 to 15Vdc Single Output and ±12Vdc to ±15Vdc Dual Output



cULus
Pending

Features

- 20 watts maximum output power
- Ultra low quiescent current
- Single output current up to 4.5A
- 4:1 ultra wide input voltage range of 9-36Vdc and 18-75 Vdc
- Six-sided continuous shield
- Meet EN55022 CLASS A without external components
- Industry standard pin-out THN 15WI series compatible
- High efficiency up to 90%
- Low profile: 25.4 x 25.4 x 9.9mm (1.0 x 1.0 x 0.39 inch)
- Fixed switching frequency
- RoHS directive compliant
- No minimum load
- Input to output isolation: 1500Vdc, min
- Input under-voltage protection
- Output over-voltage protection
- Over-current protection, auto-recovery
- Output short circuit protection
- Remote ON/OFF control
- Adjustable output voltage

Options

- Positive remote ON/OFF
- ON/OFF control function
- Trim function
- Heat sinks available for extended operation

Applications

- Wireless Network
- Telecom/Datacom
- Industry Control System
- Measurement
- Semiconductor Equipment

General Description

THN 20WI single output DC/DC converters provide up to 20 watts of output power in an industry standard package and footprint. These units are specifically designed to meet the power needs of low profile. All models feature with 4:1 ultra wide input voltage of 9 – 36Vdc and 18 – 75Vdc, comprehensively protected against over-current, over- voltage and input under-voltage protection conditions, and adjustable output voltage.

Table of contents

Absolute Maximum Rating				
Parameter	**Model**	**Min**	**Max**	**Unit**
Input Voltage				
Continuous	THN 20-24xxWI		36	Vdc
	THN 20-48xxWI		75	
Transient (1sec max.)	THN 20-24xxWI		50	
	THN 20-48xxWI		100	
Operating Ambient Temperature (with derating)	All	-40	+101	°C
Operating Case Temperature			+105	°C
Storage Temperature	All	-55	+125	°C

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

Output Specification					
Parameter	**Model**	**Min**	**Typ**	**Max**	**Unit**
Output Voltage Range	THN 20-xx10WI	3.267	3.3	3.333	Vdc
(V_{in} = $V_{in\,nom}$; Full Load; T_A = 25°C)	THN 20-xx11WI	4.95	5	5.05	
	THN 20-xx12WI	11.88	12	12.12	
	THN 20-xx13WI	14.85	15	15.15	
	THN 20-xx22WI	±11.88	±12	±12.12	
	THN 20-xx23WI	±14.85	±15	±15.15	
Voltage Adjustability (See Page 33)	All	-10		+10	%
Output Regulation					%
Line ($V_{in\,min}$ to $V_{in\,max}$ at Full Load)	All	-0.2		+0.2	
Load (0% to 100% of Full Load)		-0.2		+0.2	
Load (10% to 90% of Full Load)		-0.1		+0.1	
Cross Regulation Asymmetrical Load 25% / 100% of Full Load	Dual Output	-5%		+5%	%
Output Ripple & Noise (See Page 29)	THN 20-xx10WI		75		mV_{Pk-Pk}
Peak-to-Peak (20MHz bandwidth)	THN 20-xx11WI		75		
(Measured with a 1µF M/C X7R and a 10µF T/C)	THN 20-xx12WI		100		
	THN 20-xx13WI		100		
	THN 20-xx22WI		100		
	THN 20-xx23WI		100		
Temperature Coefficient	All	-0.02		+0.02	%/°C
Output Voltage Overshoot ($V_{in\,min}$ to $V_{in\,max}$; Full Load ; T_A = 25°C)	All			5	% V_{OUT}
Dynamic Load Response (V_{in} = $V_{in\,nom}$; T_A = 25°C) Load step change from 75% to 100% or 100 to 75% of Full Load					
Peak Deviation	All		350		mV
Setting Time (V_{OUT} < 10% peak deviation)	All		250		µS
Output Current	THN 20-xx10WI	0		4500	mA
	THN 20-xx11WI	0		4000	
	THN 20-xx12WI	0		1670	
	THN 20-xx13WI	0		1330	
	THN 20-xx22WI	0		±833	
	THN 20-xx23WI	0		±667	

Output Specification (Continued)					
Parameter	**Model**	**Min**	**Typ**	**Max**	**Unit**
Output Capacitor Load	THN 20-xx10WI			7000	Vdc
	THN 20-xx11WI			5000	
	THN 20-xx12WI			850	
	THN 20-xx13WI			700	
	THN 20-xx22WI			±500	
	THN 20-xx23WI			±350	
Output Over Voltage Protection	THN 20-xx10WI	3.7		5.4	Vdc
(Voltage Clamped)	THN 20-xx11WI	5.6		7.0	
	THN 20-xx12WI	13.5		19.6	
	THN 20-xx13WI	16.8		20.5	
	THN 20-xx22WI	±13.5		±19.6	
	THN 20-xx23WI	±16.8		±20.5	
Output Over Current Protection	All		150		% FL.
Output Short Circuit Protection	All	Hiccup, Automatic recovery			

Input Specification					
Parameter	**Model**	**Min**	**Typ**	**Max**	**Unit**
Operating Input Voltage	THN 20-24xxWI	9	24	36	Vdc
	THN 20-48xxWI	18	48	75	
Input Standby Current	THN 20-2410WI		6		mA
(Typical value at $V_{in} = V_{in\,nom}$; No Load)	THN 20-2411WI		6		
	THN 20-2412WI		6		
	THN 20-2413WI		6		
	THN 20-2422WI		6		
	THN 20-2423WI		6		
	THN 20-4810WI		4		
	THN 20-4811WI		4		
	THN 20-4812WI		4		
	THN 20-4813WI		4		
	THN 20-4822WI		4		
	THN 20-4823WI		4		
Under Voltage Lockout Turn-on Threshold	THN 20-24xxWI			9	Vdc
	THN 20-48xxWI			18	
Under Voltage Lockout Turn-off Threshold	THN 20-24xxWI		8		Vdc
	THN 20-48xxWI		16		
Input Reflected Ripple Current (See Page 29) (5 to 20MHz, 12µH source impedance)	All		30		mA_{Pk-Pk}
Start Up Time ($V_{in} = V_{in\,nom}$ and constant resistive load)					
Power up	All			30	mS
Remote ON/OFF				30	
Remote ON/OFF Control (See Page 35) (The ON/OFF pin voltage is referenced to $-V_{IN}$)					
Negative Logic DC-DC ON (Short)	All	0		1.2	Vdc
DC-DC OFF (Open)		3		15	
Positive Logic DC-DC ON (Open)		3		15	
DC-DC OFF (Short)		0		1.2	
Remote Off Input Current	All		2.0		mA
Input Current of Remote Control Pin	All	-0.5		1.0	mA

General Specification					
Parameter	**Model**	**Min**	**Typ**	**Max**	**Unit**
Efficiency (See Page 29) (V_{in} = $V_{in\,nom}$; Full Load; T_A = 25°C)	THN 20-2410WI THN 20-2411WI THN 20-2412WI THN 20-2413WI THN 20-2422WI THN 20-2423WI THN 20-4810WI THN 20-4811WI THN 20-4812WI THN 20-4813WI THN 20-4822WI THN 20-4823WI		86 89 89 89 89 90 87 89 89 90 89 90		%
Isolation Voltage (for 60 seconds) Input to Output Input (Output) to Case	All	 1500 1000			Vdc
Isolation Resistance	All	1			GΩ
Isolation Capacitance	All			1500	pF
Switching Frequency	All		330		KHz
Weight	All		15		g
MTBF (See Page 39) Bellcore TR-NWT-000332, T_C = 40°C MIL-HDBK-217F	All		 1'766'000 553'000		hours
Case Material	Nickel-coated copper				
Base Material	FR4 PCB				
Potting Material	Silicon (UL94-V0)				
Dimensions	1.0 X 1.0 X 0.39 Inch (25.4 X 25.4 X 9.9mm)				

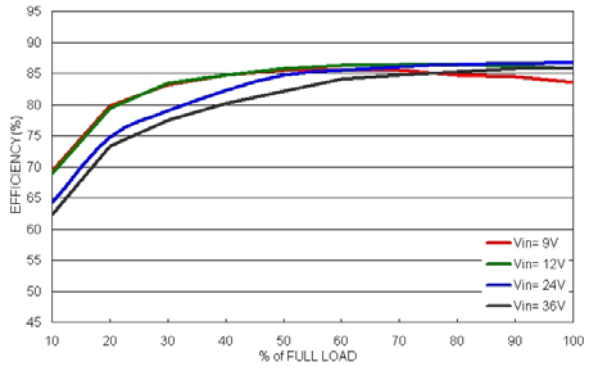
Environmental Specifications	
Thermal shock	MIL-STD-810F
Vibration	MIL-STD-810F
Relative humidity	5% to 95% RH

EMC Characteristics			
EMI (See Page 30 - 32)	EN 55022		Class B
ESD	EN 61000-4-2	Air ±8KV Contact ±6KV	Performance Criteria A
Radiated immunity	EN 61000-4-3	10 V/m	Performance Criteria A
Fast transient*	EN 61000-4-4	±2KV	Performance Criteria A
Surge*	EN 61000-4-5	±2KV	Performance Criteria A
Conducted immunity	EN 61000-4-6	10 $V_{r.m.s}$	Performance Criteria A

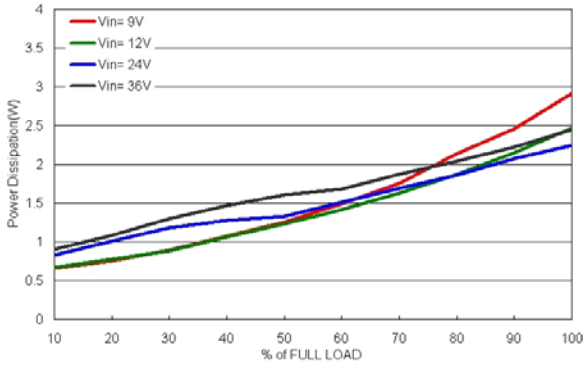
* An external input filter capacitor is required if the module has to meet EN 61000-4-4, EN 61000-4-5.
We suggest to use following filter capacitor: Nippon Chemi-Con KY series, 220µF/100V, ESR 48mΩ.

Characteristic Curves

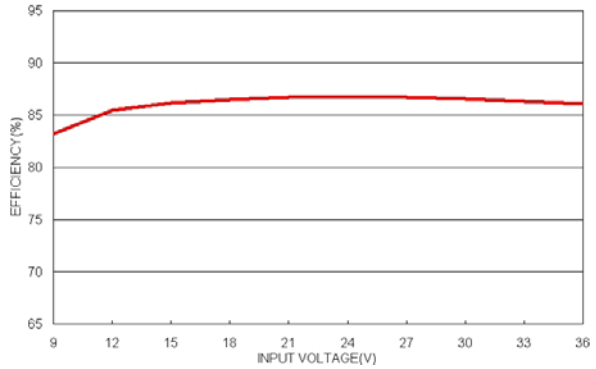
All test conditions are at 25°C. The figures are identical for THN 20-2410WI



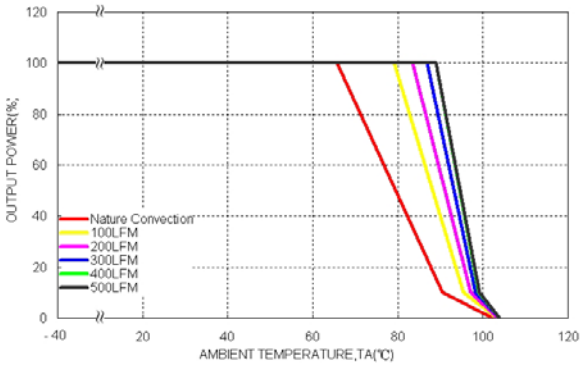
Efficiency versus Output Current



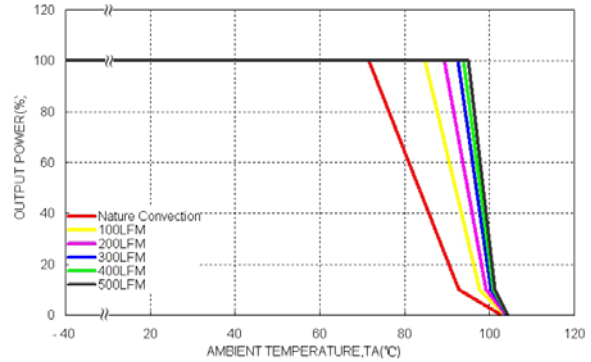
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



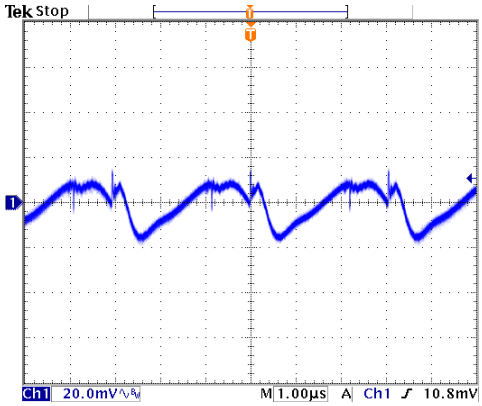
Derating Output Current versus Ambient Temperature with Airflow, $V_{in} = V_{in\,nom}$



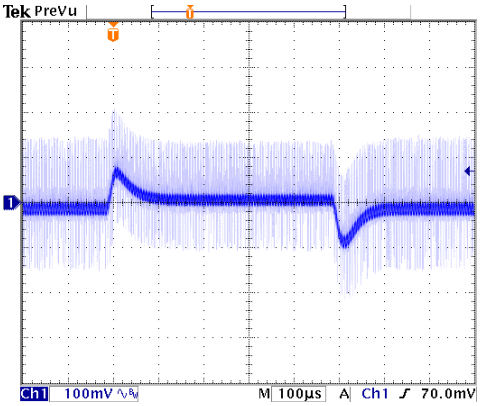
Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

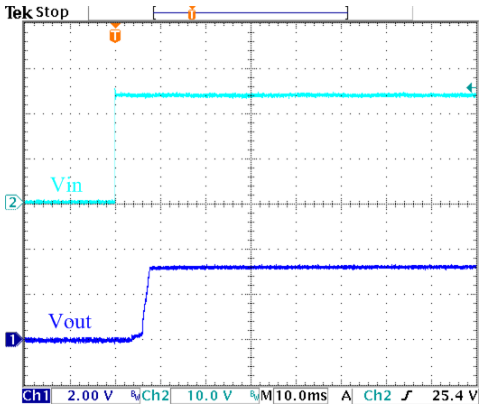
All test conditions are at 25°C. The figures are identical for THN 20-2410WI



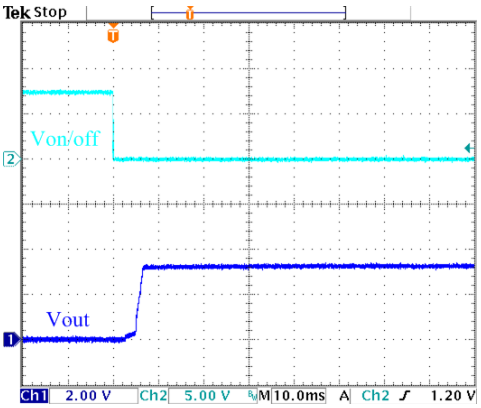
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$, Full Load



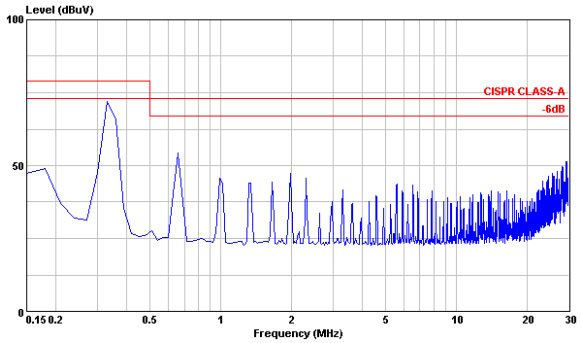
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load; $V_{in} = V_{in\,nom}$



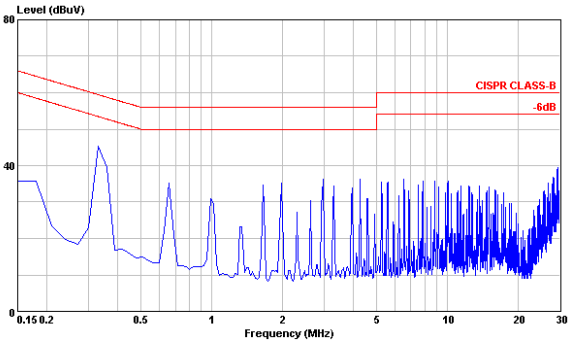
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



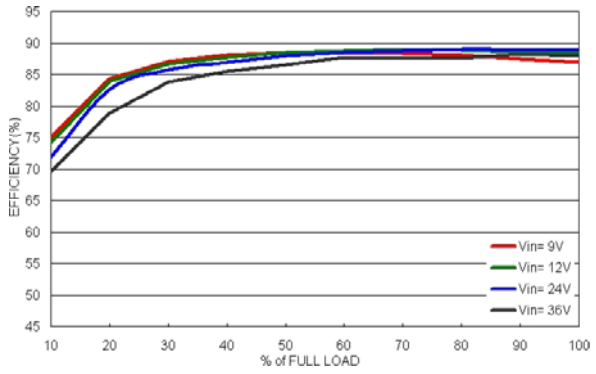
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$, Full Load



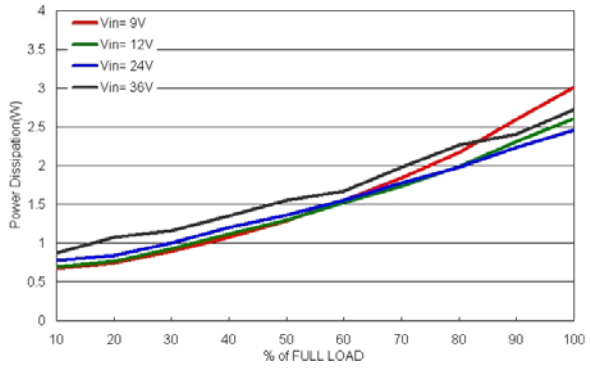
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$, Full Load

Characteristic Curves (Continued)

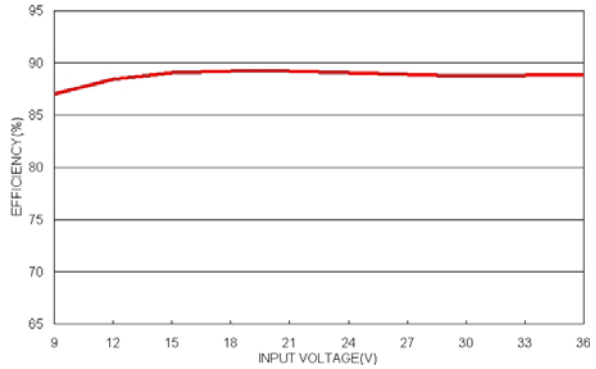
All test conditions are at 25°C. The figures are identical for THN 20-2411WI



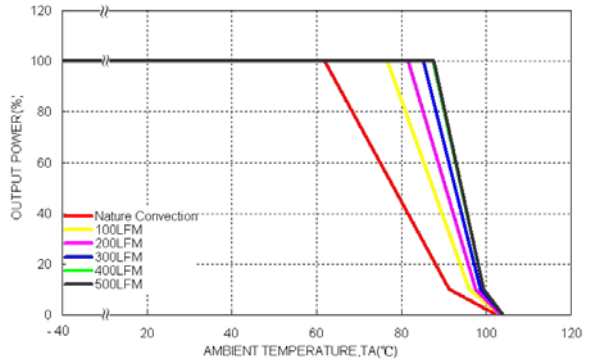
Efficiency versus Output Current



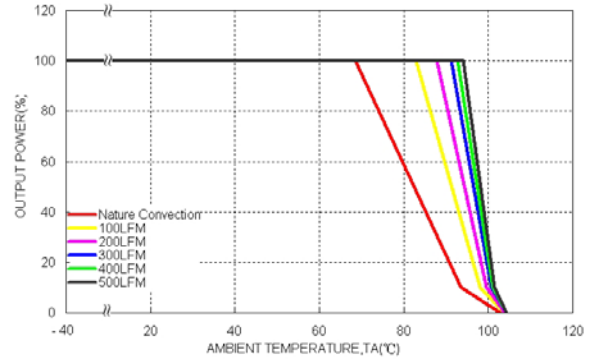
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



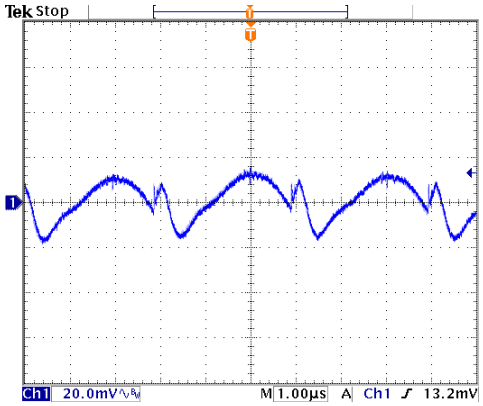
Derating Output Current versus Ambient Temperature with Airflow, $V_{in} = V_{in\,nom}$



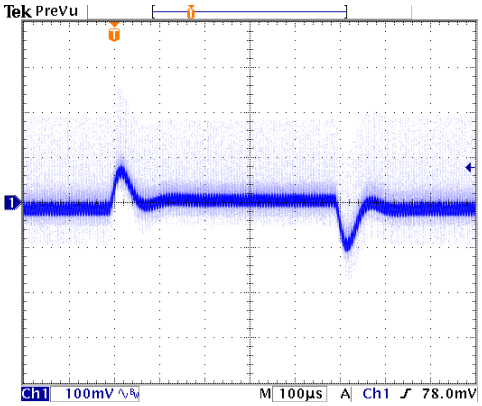
Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

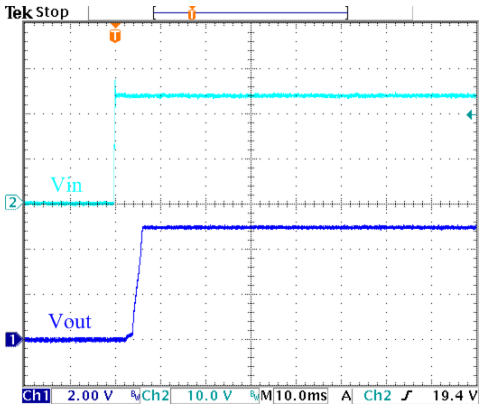
All test conditions are at 25°C. The figures are identical for THN 20-2411WI



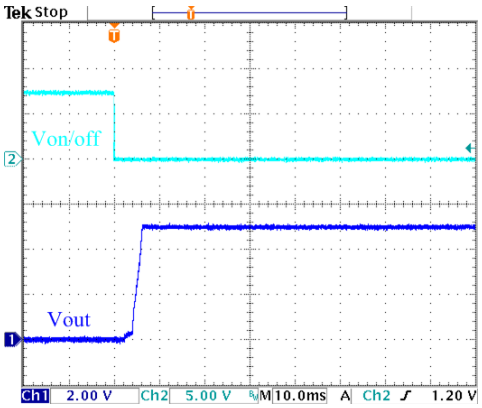
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$, Full Load



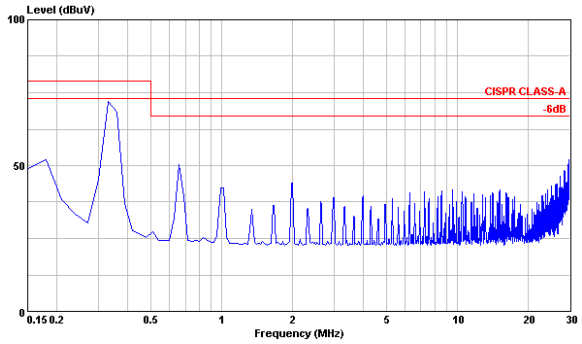
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load; $V_{in} = V_{in\,nom}$



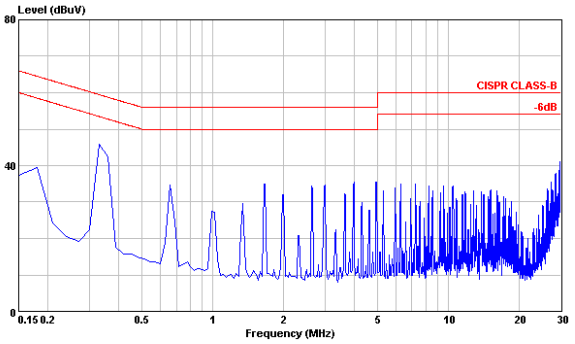
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



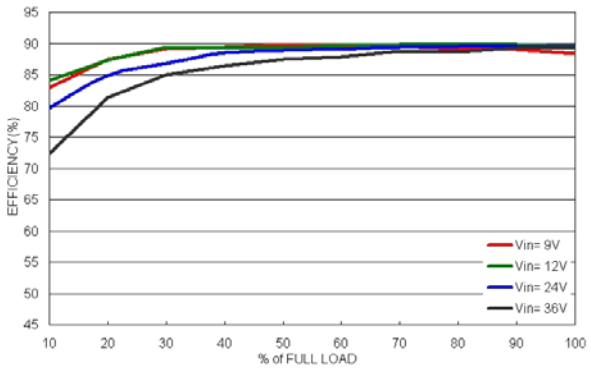
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$, Full Load



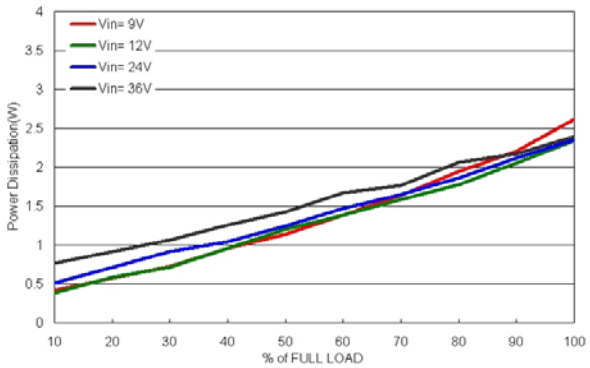
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$, Full Load

Characteristic Curves (Continued)

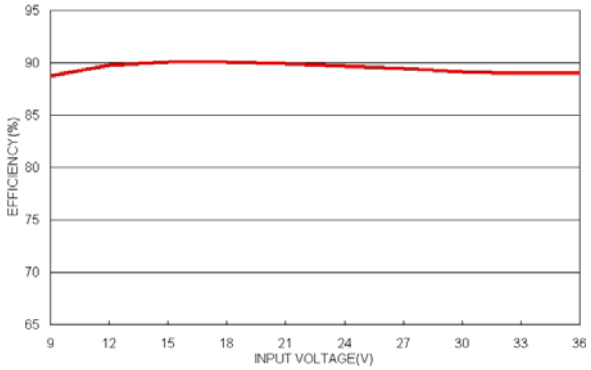
All test conditions are at 25°C. The figures are identical for THN 20-2412WI



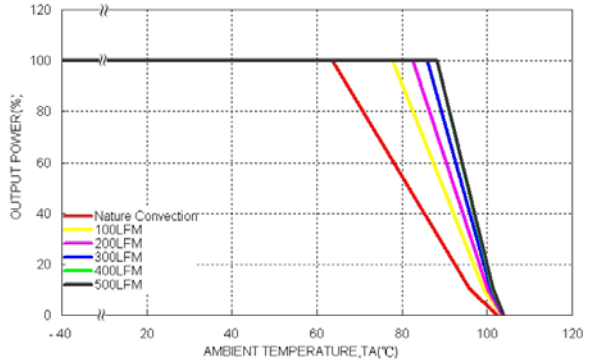
Efficiency versus Output Current



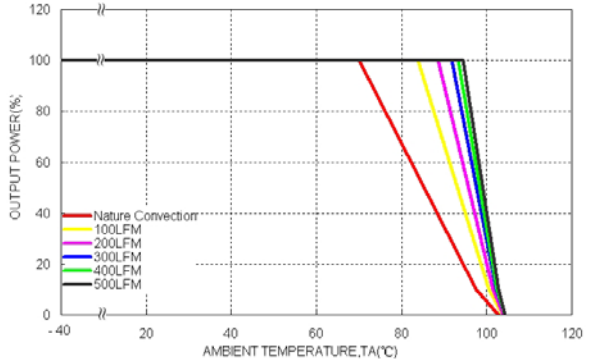
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



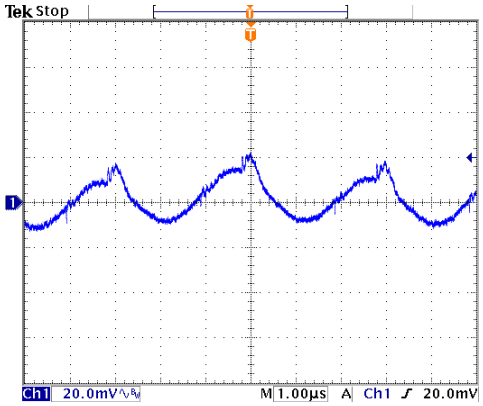
Derating Output Current versus Ambient Temperature with Airflow, $V_{in} = V_{in\,nom}$



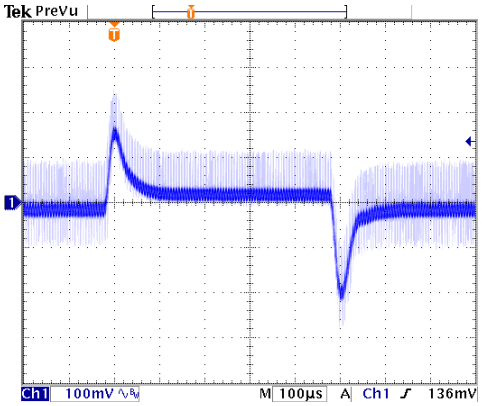
Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

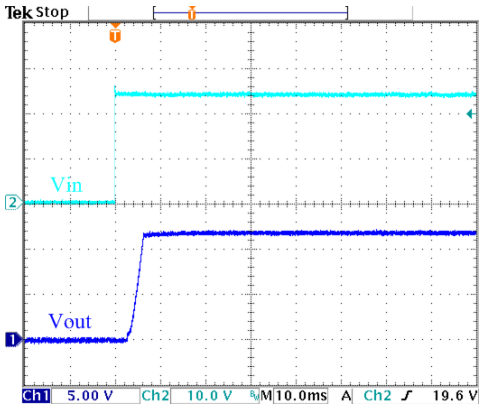
All test conditions are at 25°C. The figures are identical for THN 20-2412WI



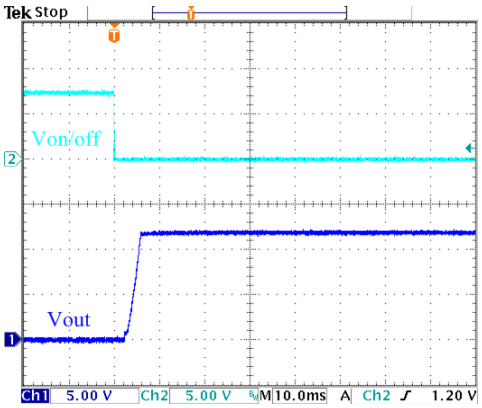
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$, Full Load



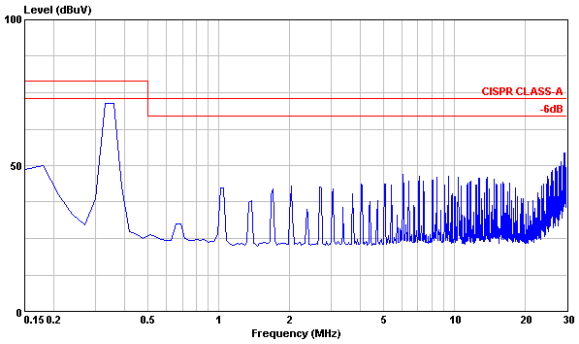
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load; $V_{in} = V_{in\,nom}$



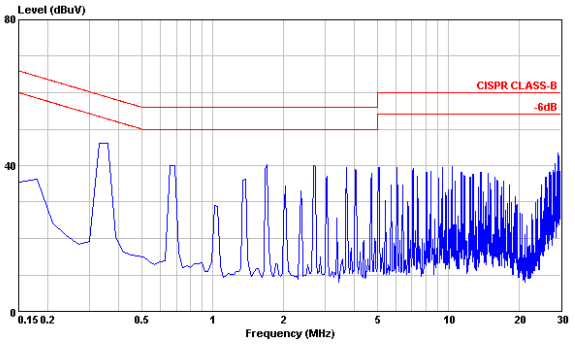
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



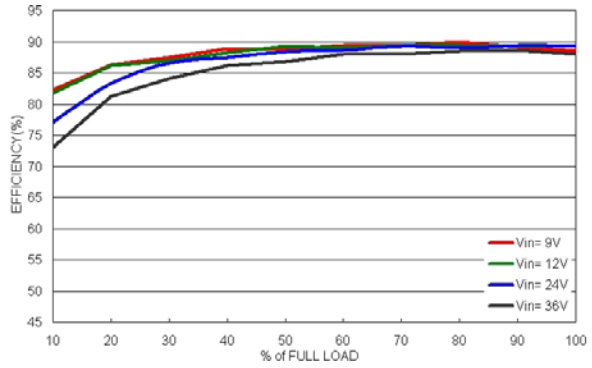
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$, Full Load



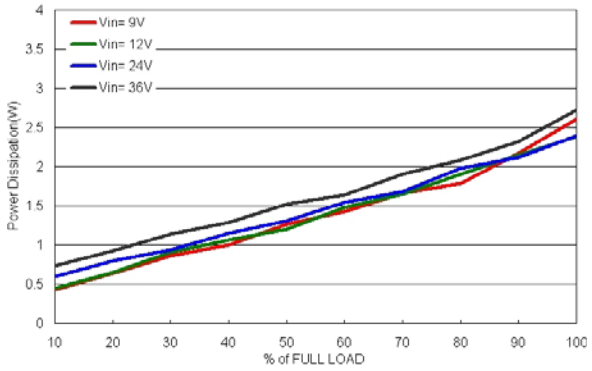
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$, Full Load

Characteristic Curves (Continued)

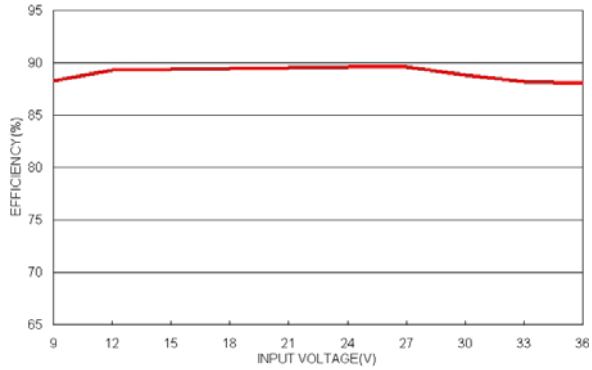
All test conditions are at 25°C. The figures are identical for THN 20-2413WI



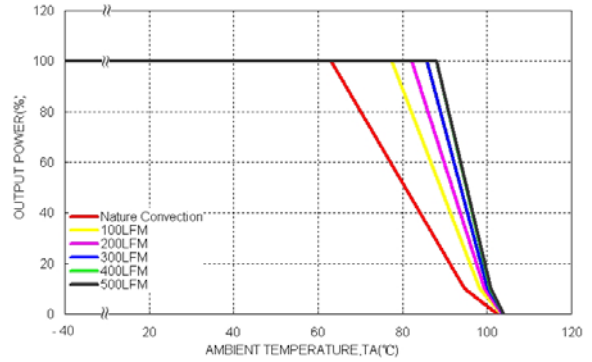
Efficiency versus Output Current



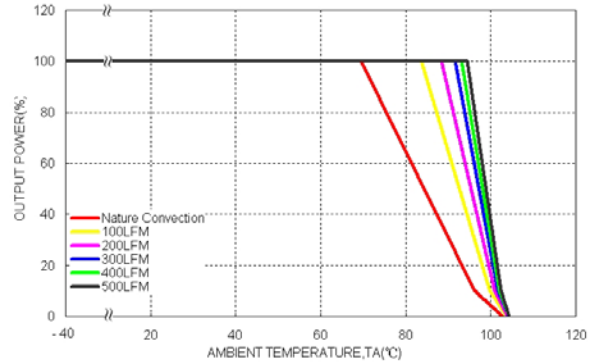
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



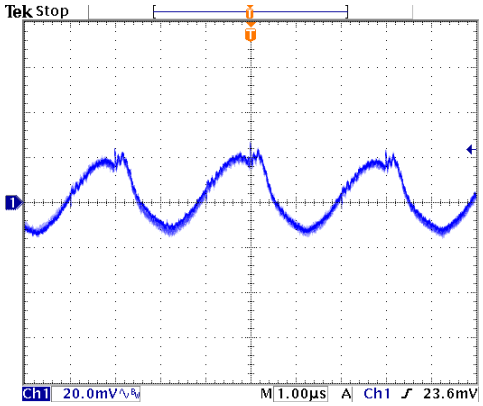
Derating Output Current versus Ambient Temperature with Airflow, $V_{in} = V_{in\,nom}$



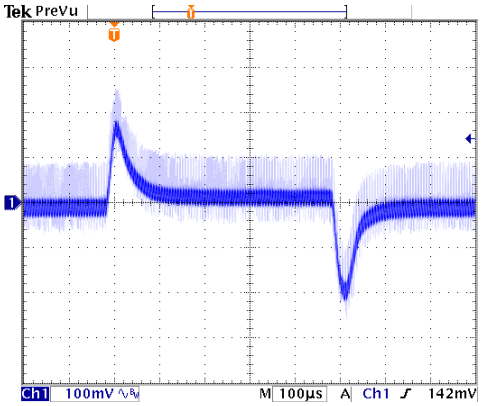
Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

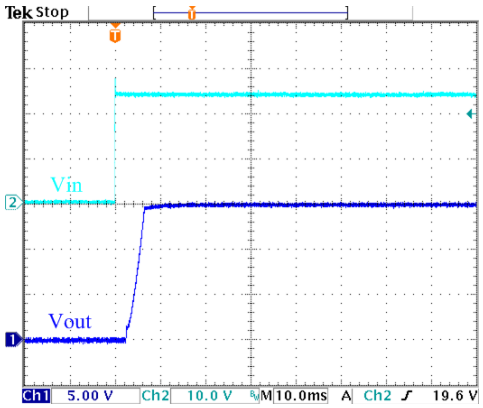
All test conditions are at 25°C. The figures are identical for THN 20-2413WI



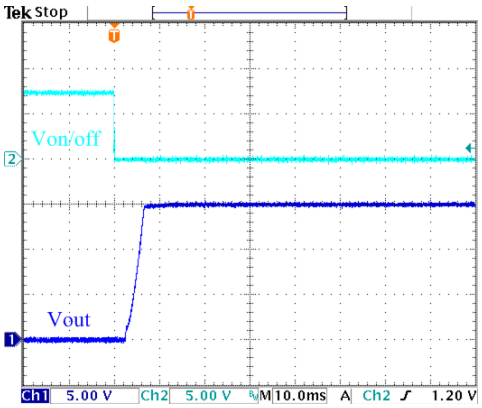
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$, Full Load



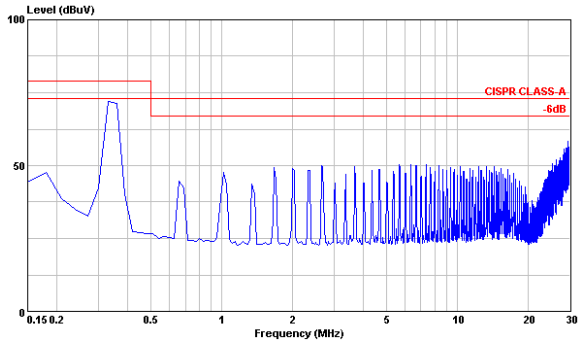
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load; $V_{in} = V_{in\,nom}$



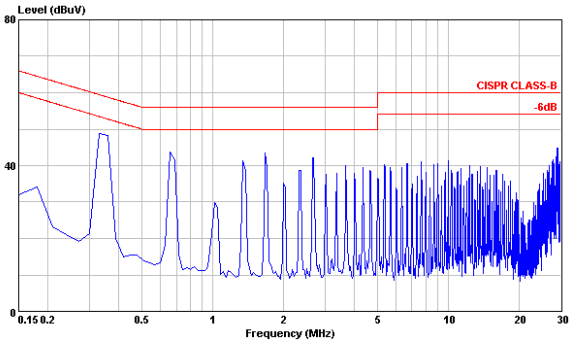
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



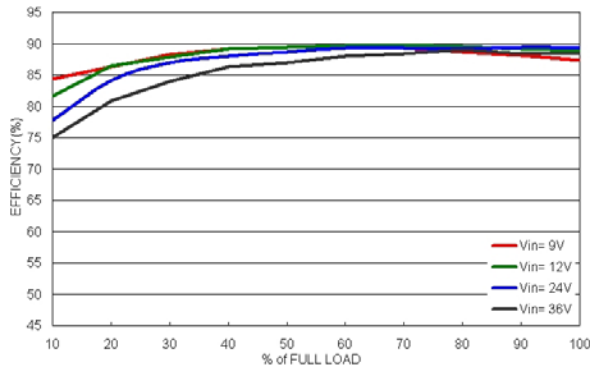
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$, Full Load



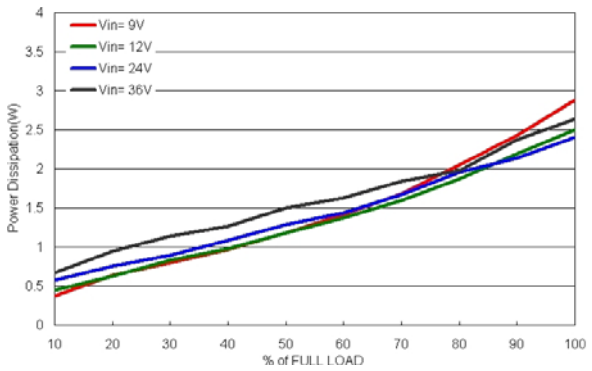
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$, Full Load

Characteristic Curves (Continued)

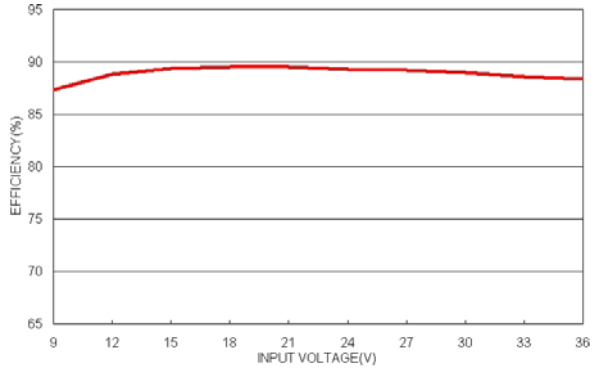
All test conditions are at 25°C. The figures are identical for THN 20-2422WI



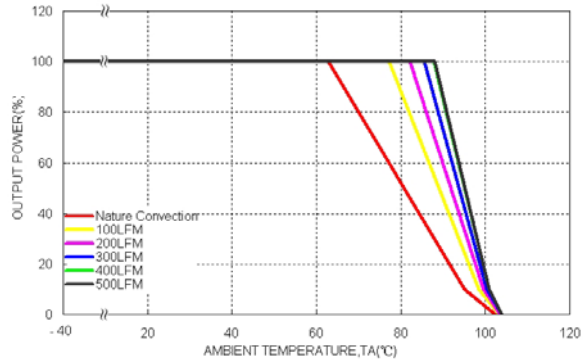
Efficiency versus Output Current



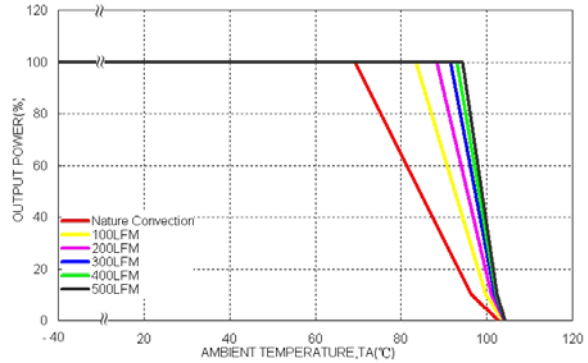
Power Dissipation versus Output Current



Efficiency versus Input Voltage, Full Load



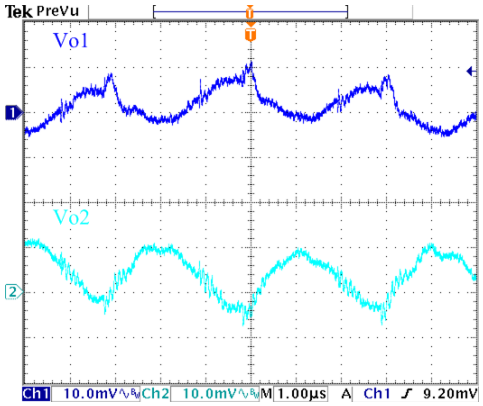
Derating Output Current versus Ambient Temperature with Airflow, $V_{in} = V_{in\,nom}$



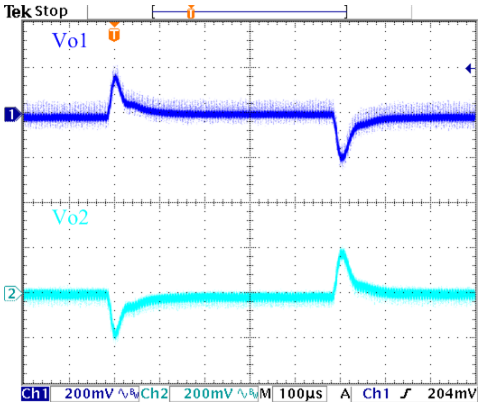
Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

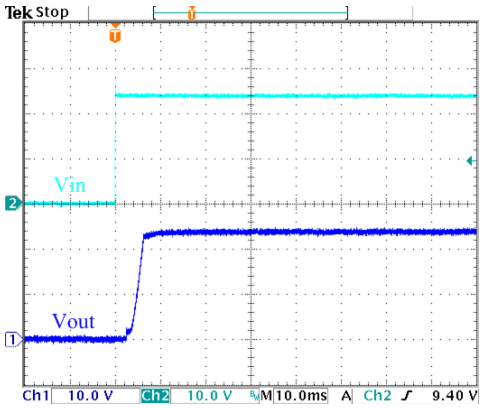
All test conditions are at 25°C. The figures are identical for THN 20-2422WI



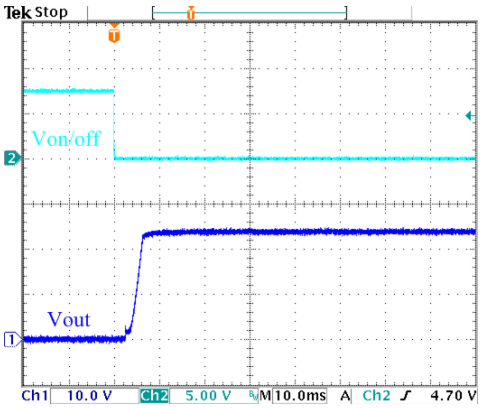
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$, Full Load



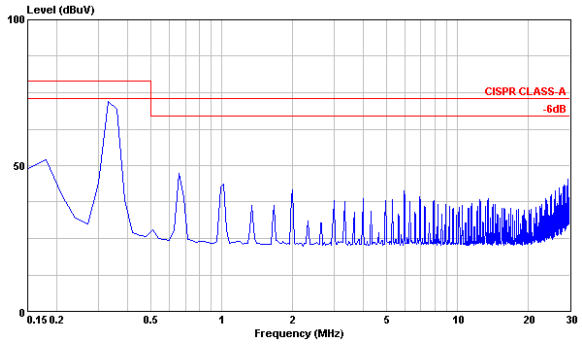
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load; $V_{in} = V_{in\,nom}$



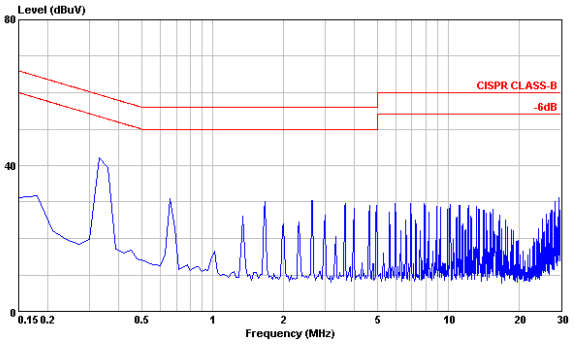
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



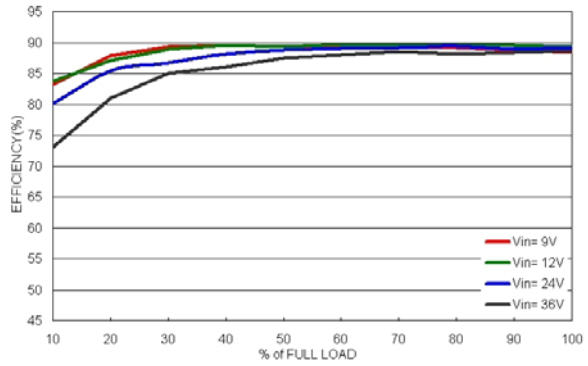
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$, Full Load



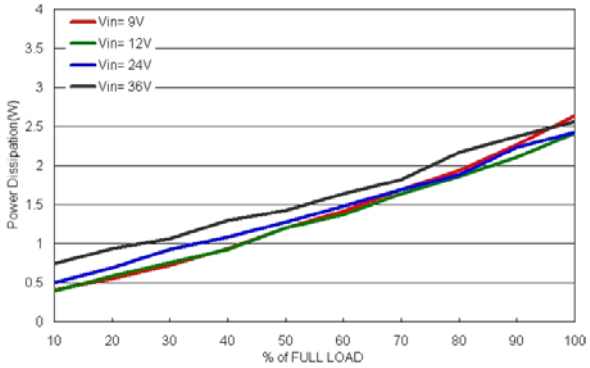
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$, Full Load

Characteristic Curves (Continued)

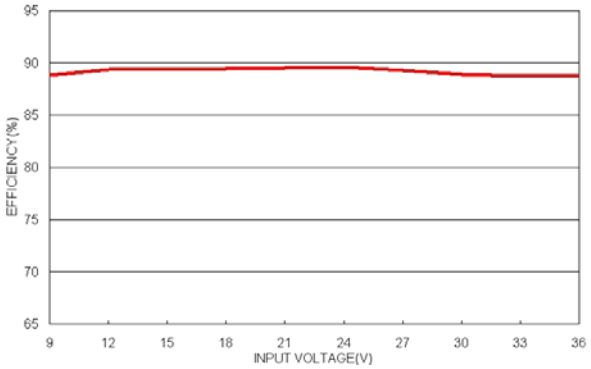
All test conditions are at 25°C. The figures are identical for THN 20-2423WI



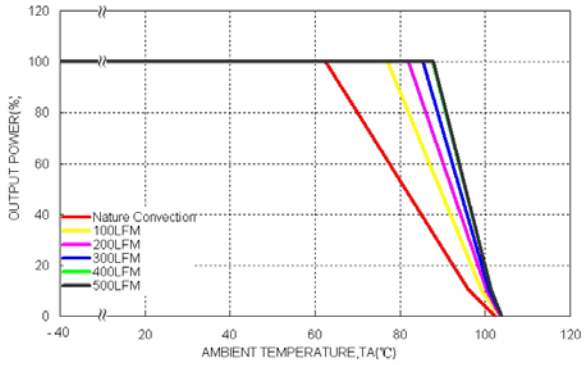
Efficiency versus Output Current



Power Dissipation versus Output Current

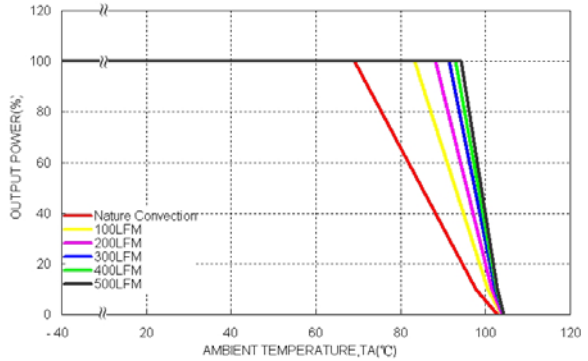


Efficiency versus Input Voltage. Full Load



Derating Output Current versus Ambient Temperature with Airflow

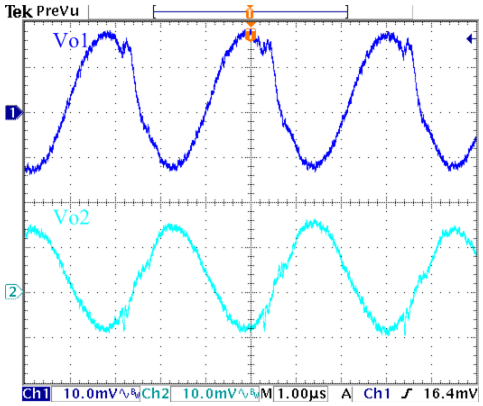
$V_{in} = V_{in\,nom}$



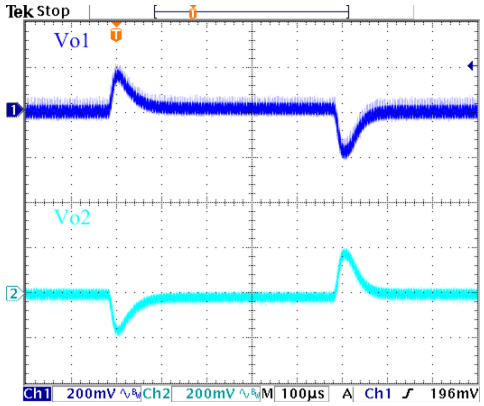
Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

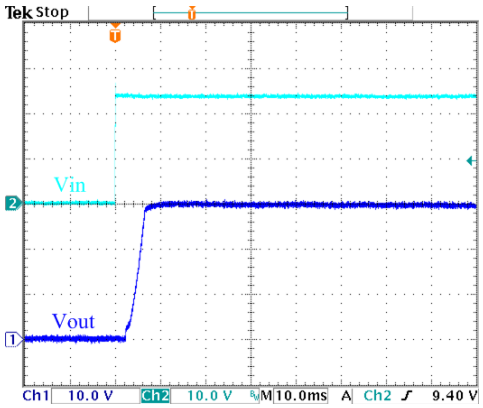
All test conditions are at 25°C. The figures are identical for THN 20-2423WI



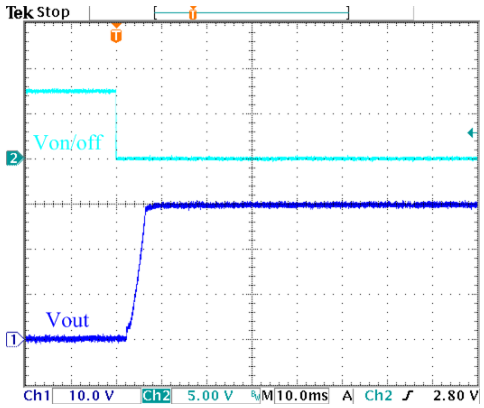
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$, Full Load



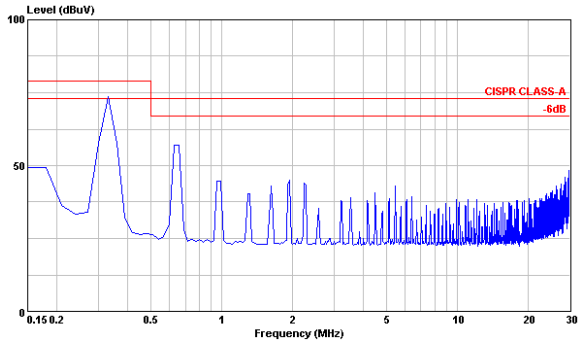
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load ; $V_{in} = V_{in\,nom}$



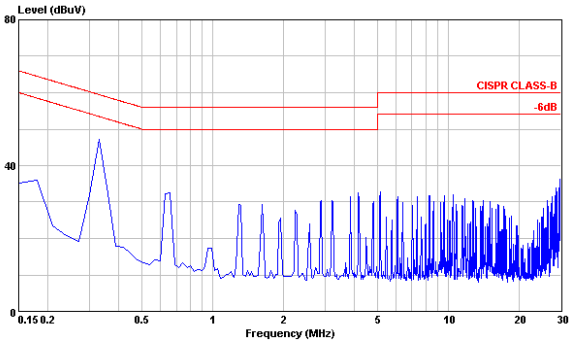
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



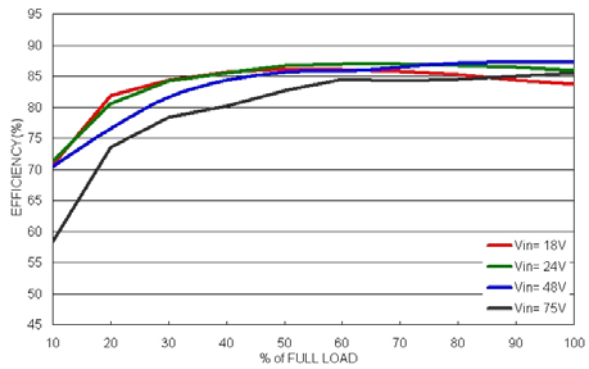
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$, Full Load



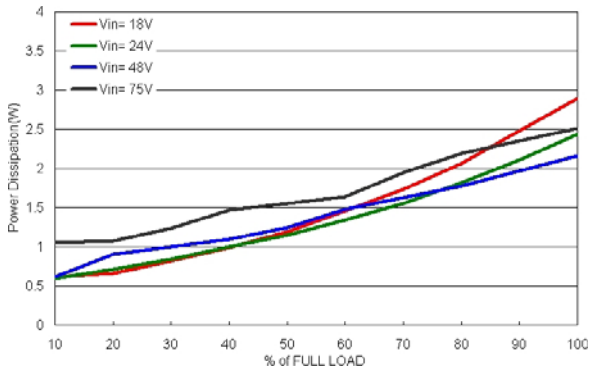
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$, Full Load

Characteristic Curves (Continued)

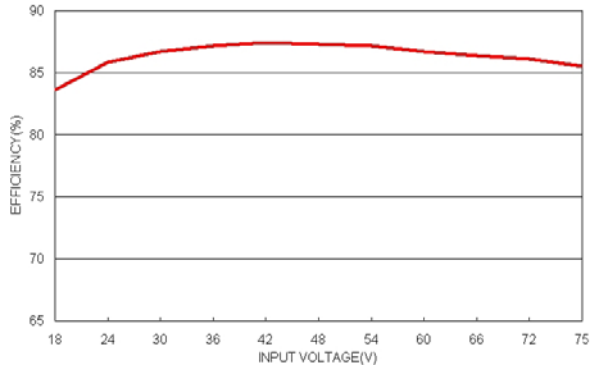
All test conditions are at 25°C. The figures are identical for THN 20-4810WI



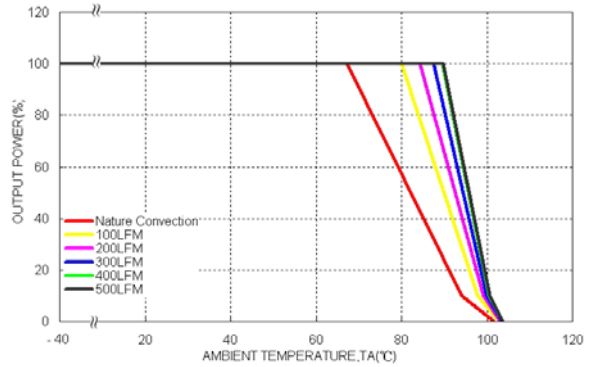
Efficiency versus Output Current



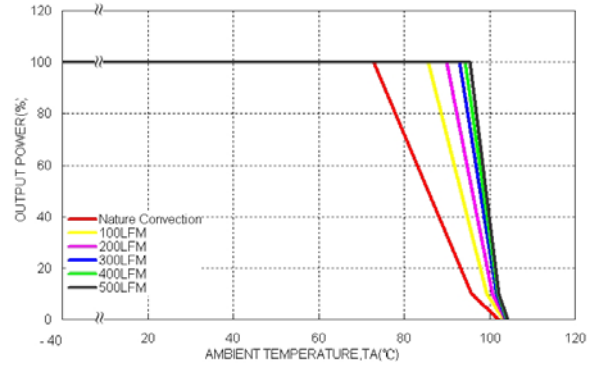
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



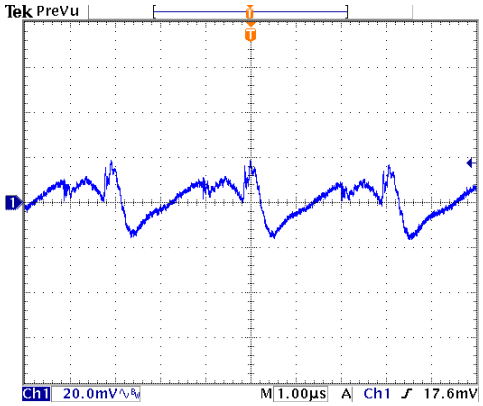
Derating Output Current versus Ambient Temperature with Airflow, $V_{in} = V_{in\,nom}$



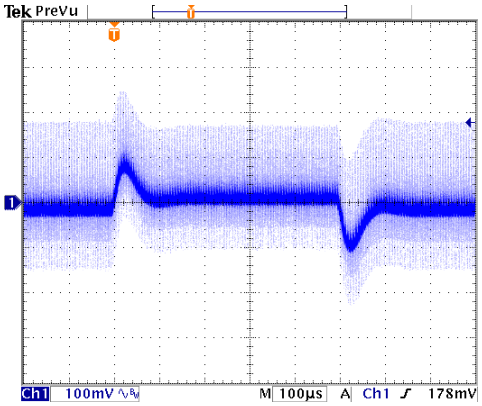
Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

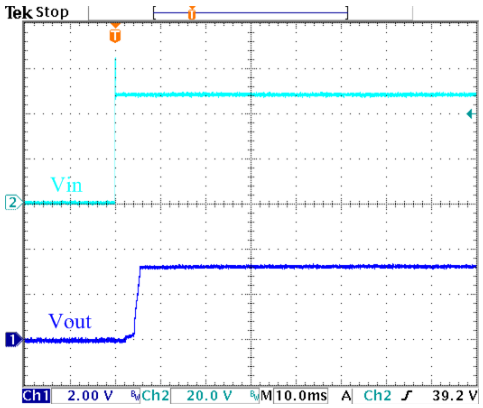
All test conditions are at 25°C. The figures are identical for THN 20-4810WI



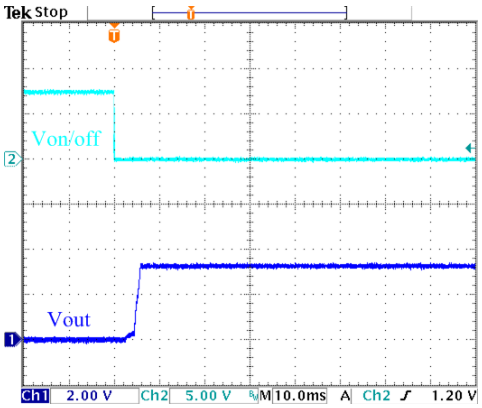
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$, Full Load



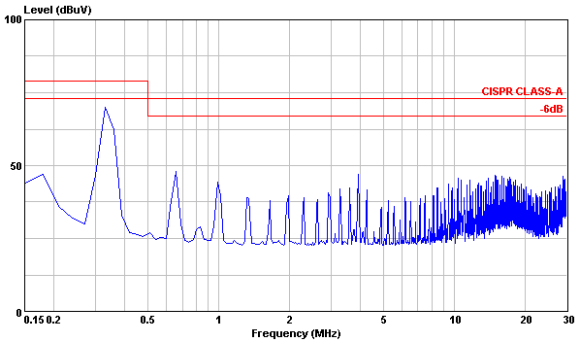
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load; $V_{in} = V_{in\,nom}$



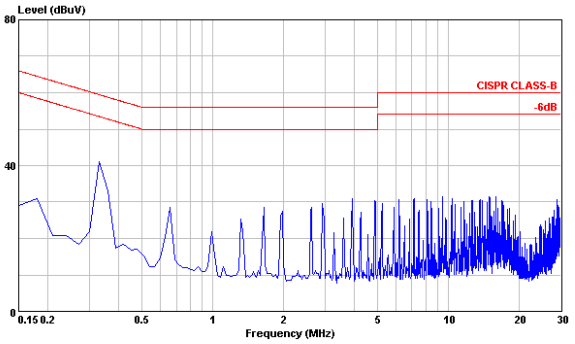
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



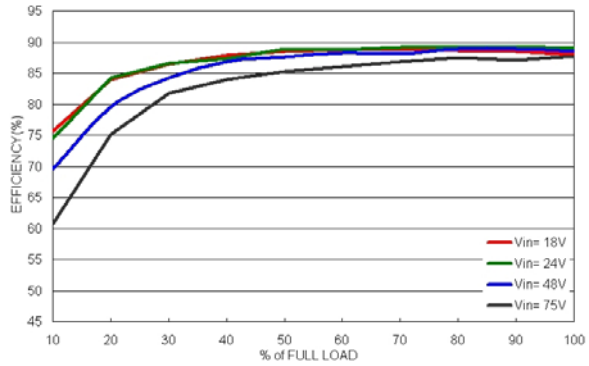
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$, Full Load



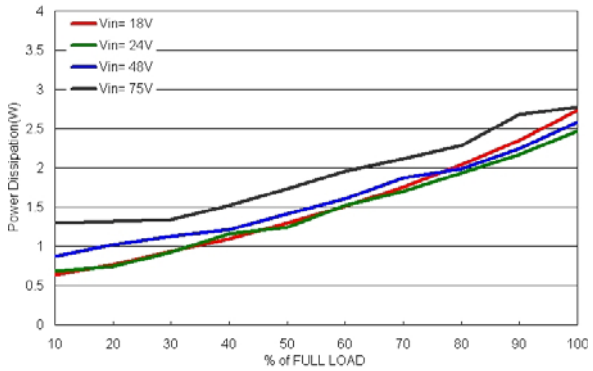
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$, Full Load

Characteristic Curves (Continued)

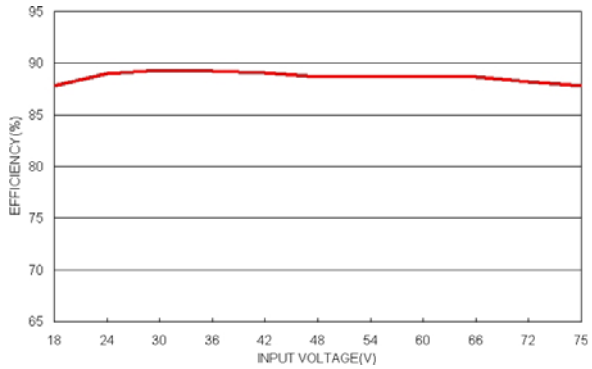
All test conditions are at 25°C. The figures are identical for THN 20-4811WI



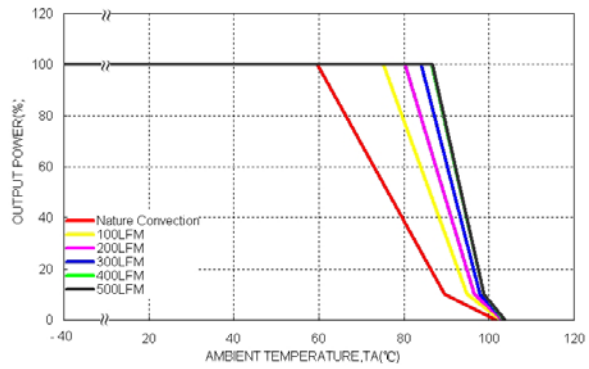
Efficiency versus Output Current



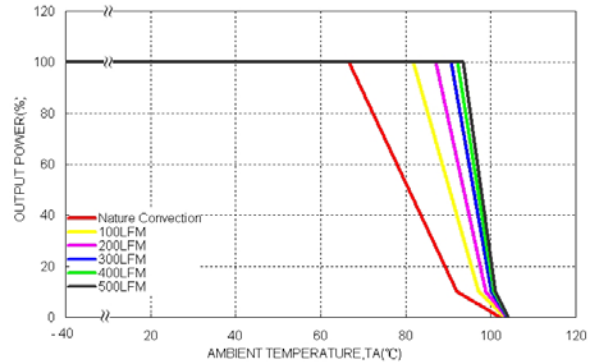
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



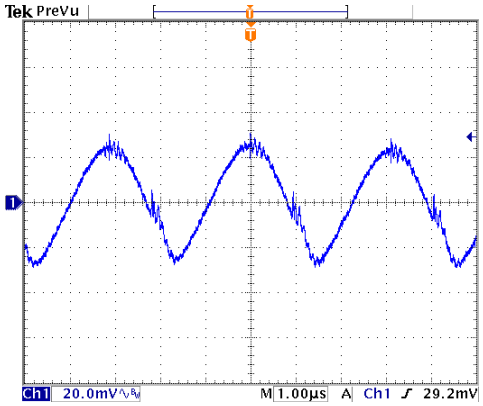
Derating Output Current versus Ambient Temperature with Airflow, $V_{in} = V_{in\,nom}$



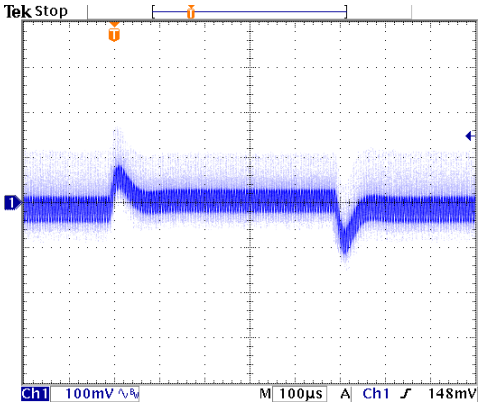
Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

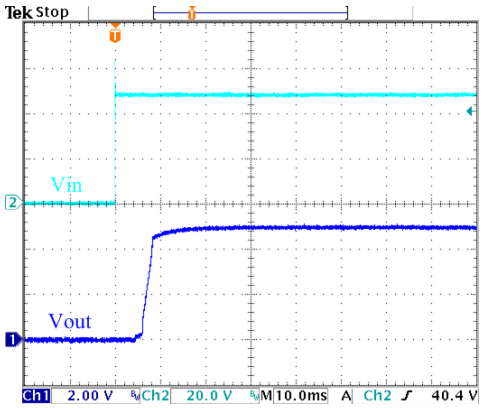
All test conditions are at 25°C. The figures are identical for THN 20-4811WI



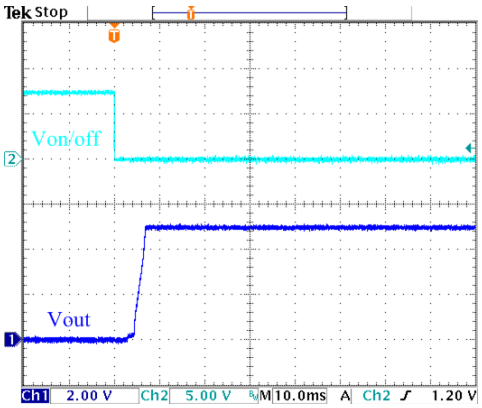
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$, Full Load



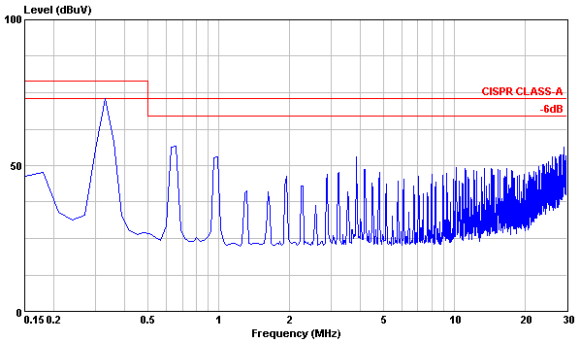
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load; $V_{in} = V_{in\,nom}$



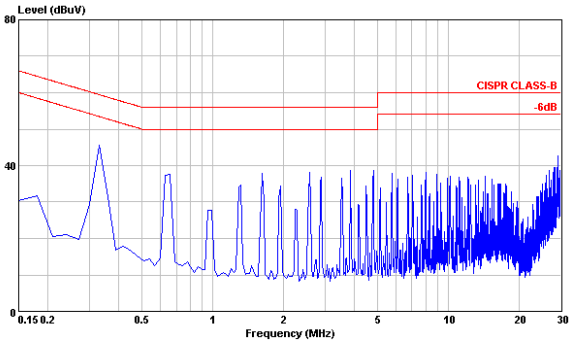
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\,nom}$; Full Load



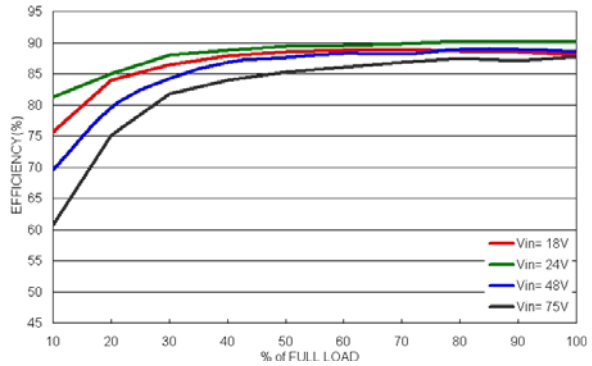
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$, Full Load



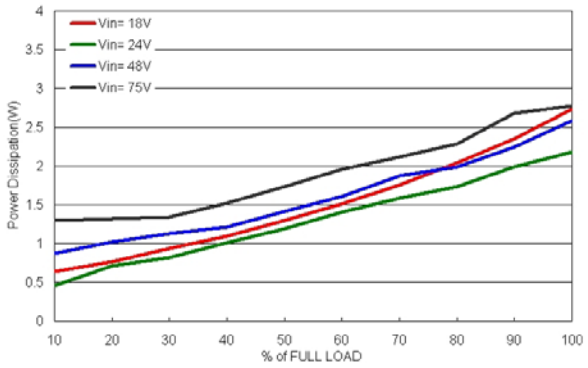
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$, Full Load

Characteristic Curves (Continued)

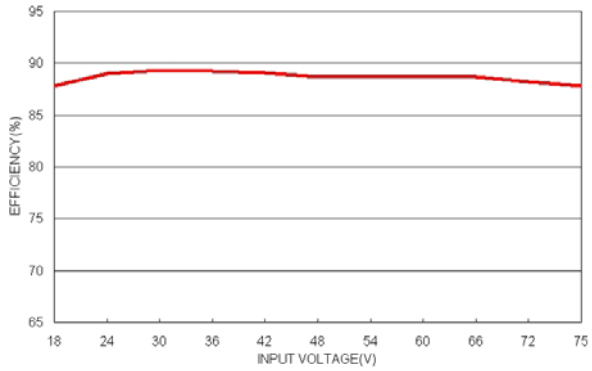
All test conditions are at 25°C. The figures are identical for THN 20-4812WI



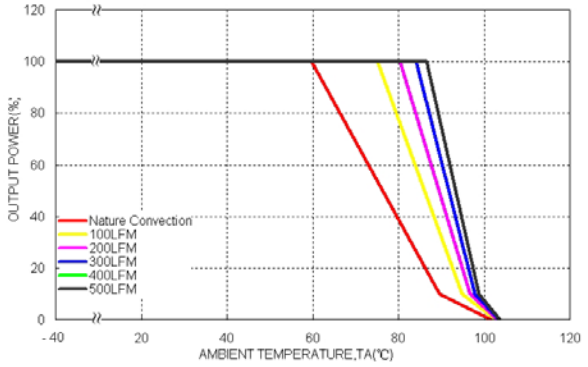
Efficiency versus Output Current



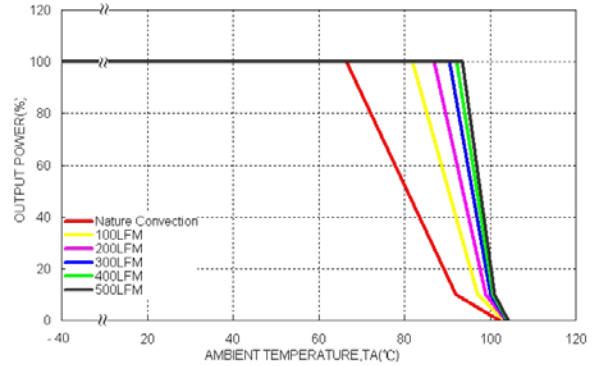
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



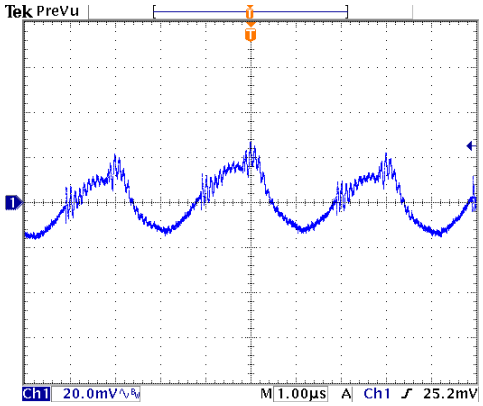
Derating Output Current versus Ambient Temperature with Airflow, $V_{in} = V_{in\,nom}$



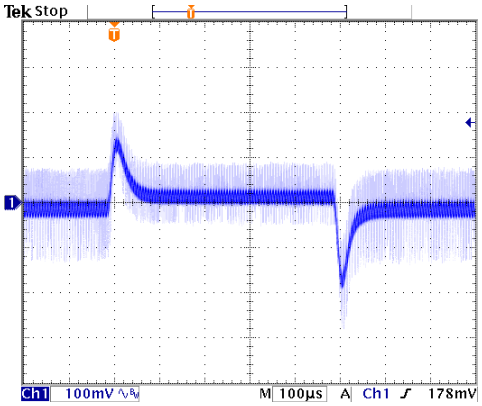
Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

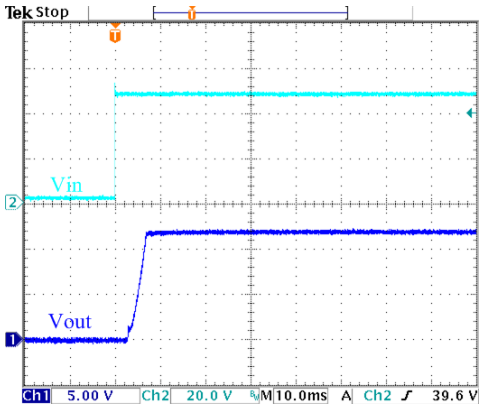
All test conditions are at 25°C. The figures are identical for THN 20-4812WI



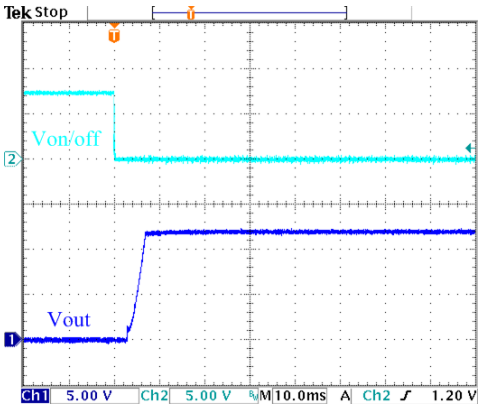
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$, Full Load



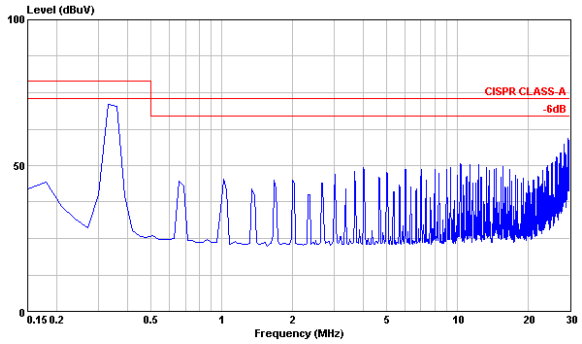
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load; $V_{in} = V_{in\,nom}$



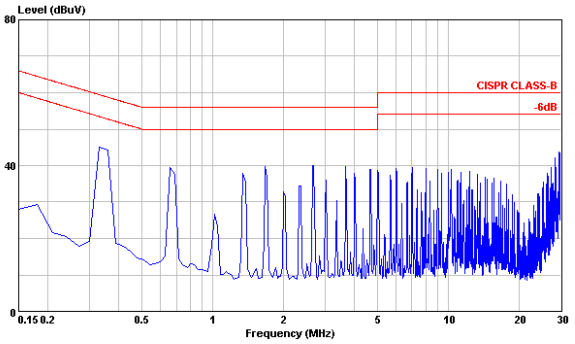
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



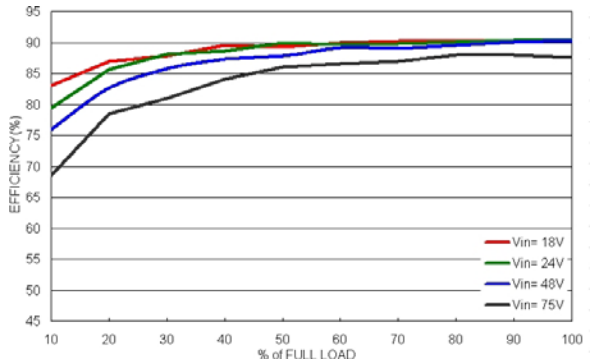
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$, Full Load



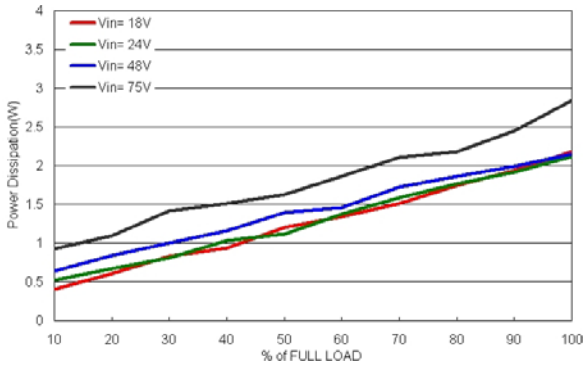
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$, Full Load

Characteristic Curves (Continued)

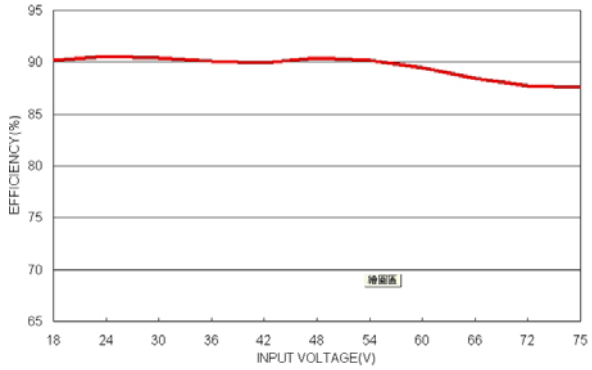
All test conditions are at 25°C. The figures are identical for THN 20-4813WI



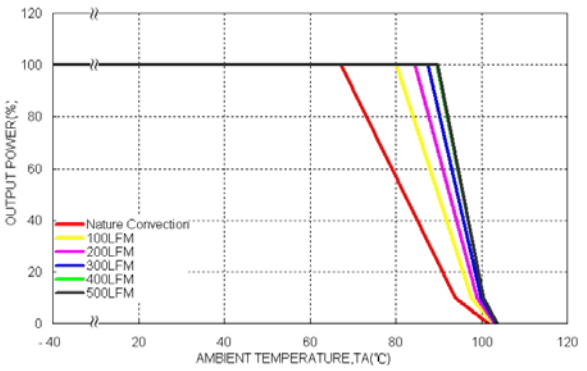
Efficiency versus Output Current



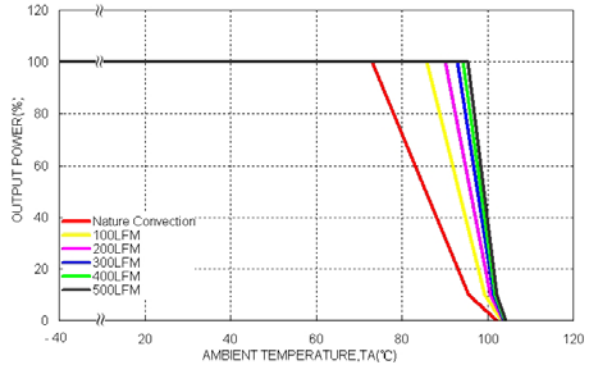
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



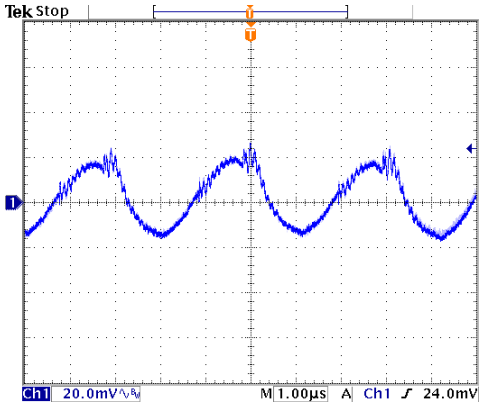
Derating Output Current versus Ambient Temperature with Airflow, $V_{in} = V_{in\,nom}$



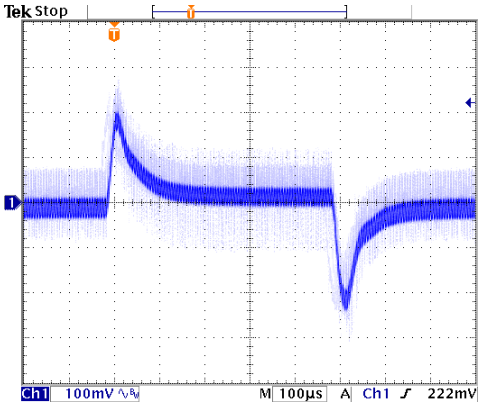
Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

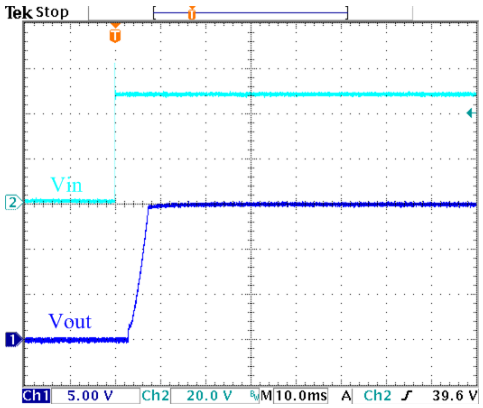
All test conditions are at 25°C. The figures are identical for THN 20-4813WI



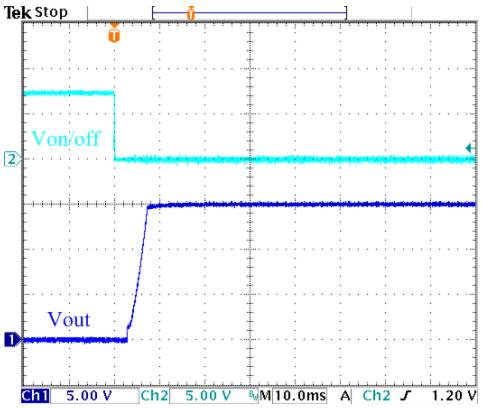
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$, Full Load



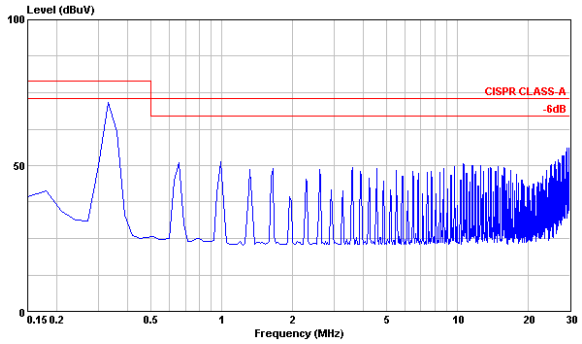
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load; $V_{in} = V_{in\,nom}$



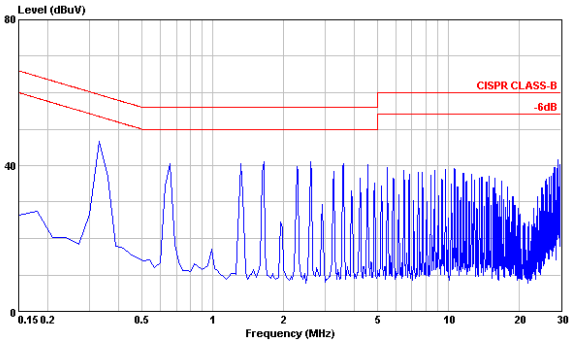
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



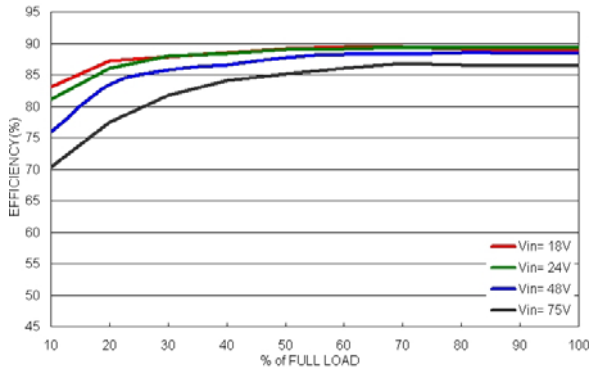
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$, Full Load



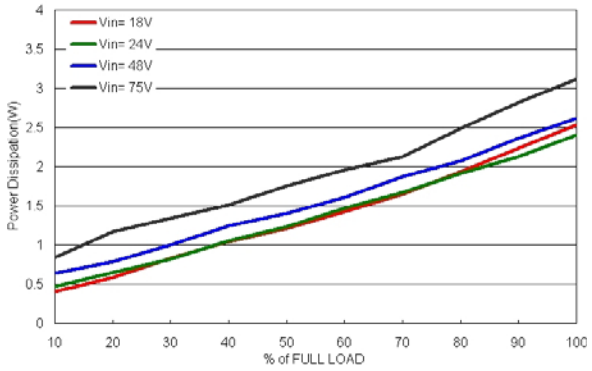
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$, Full Load

Characteristic Curves (Continued)

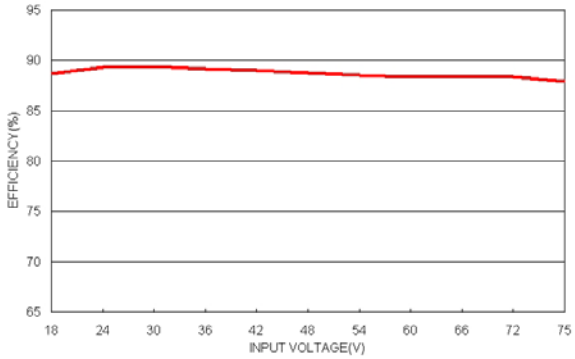
All test conditions are at 25°C. The figures are identical for THN 20-4822WI



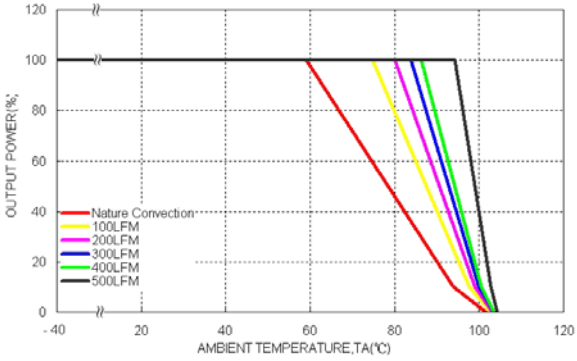
Efficiency versus Output Current



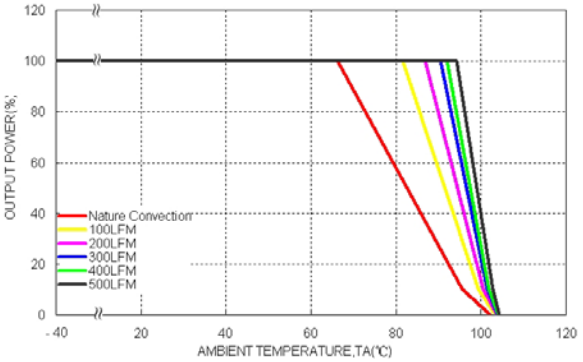
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



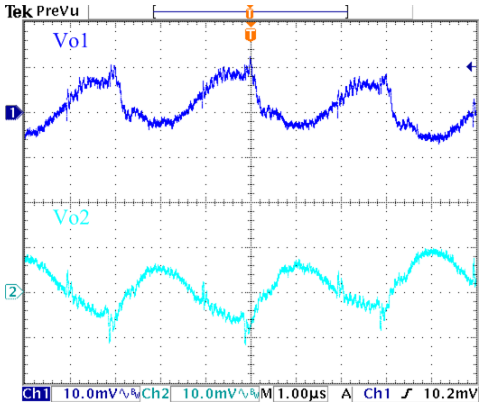
Derating Output Current versus Ambient Temperature with Airflow, $V_{in} = V_{in\,nom}$



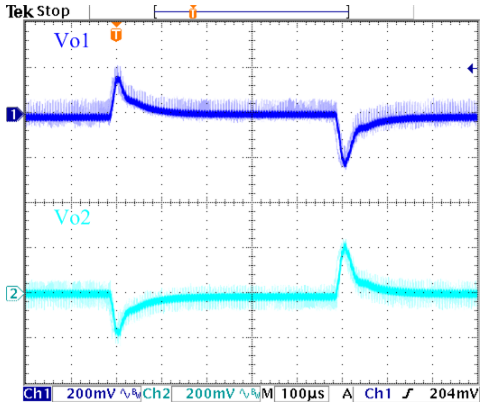
Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

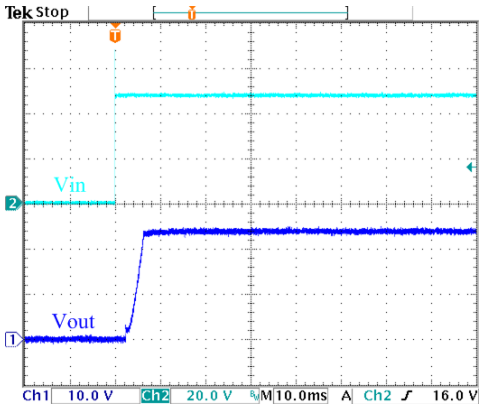
All test conditions are at 25°C. The figures are identical for THN 20-4822WI



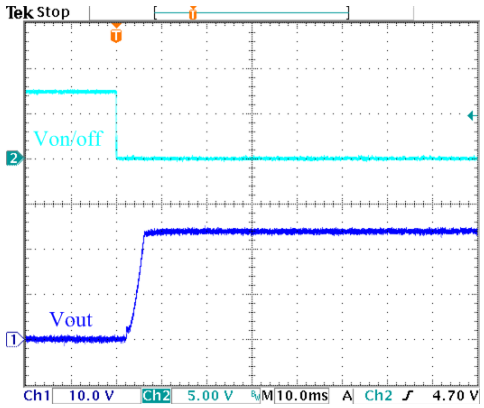
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$, Full Load



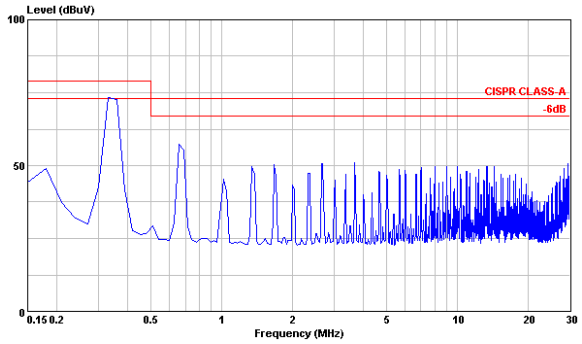
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load; $V_{in} = V_{in\,nom}$



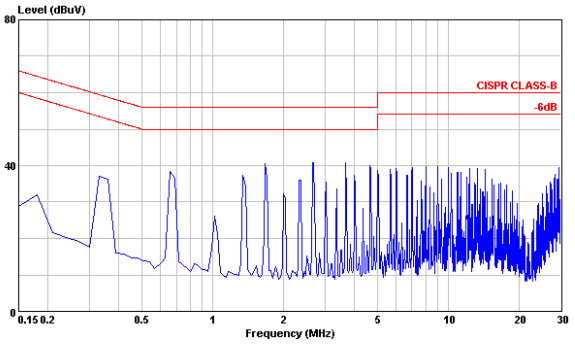
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



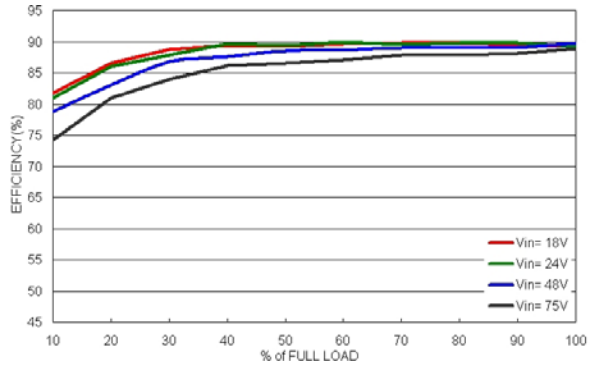
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$, Full Load



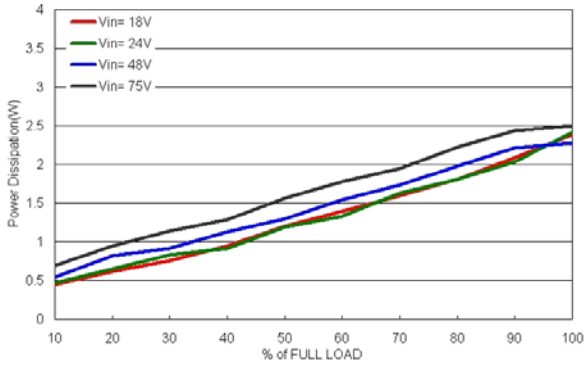
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$, Full Load

Characteristic Curves (Continued)

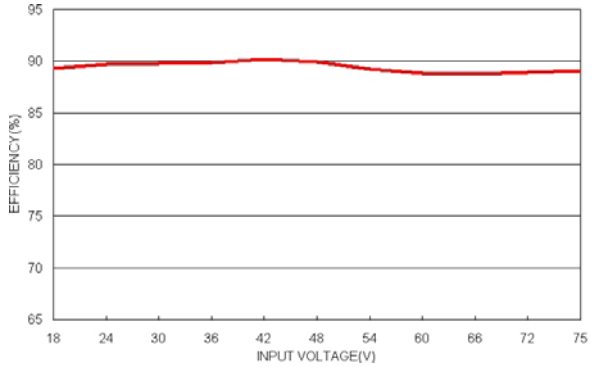
All test conditions are at 25°C. The figures are identical for THN 20-4823WI



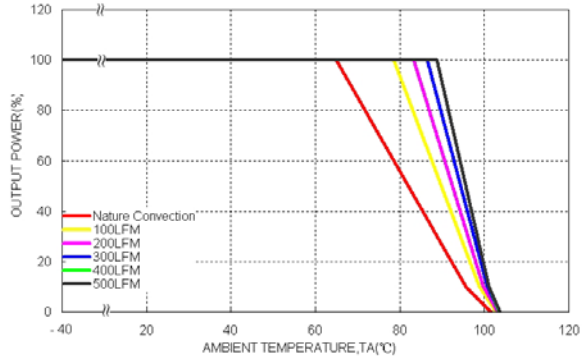
Efficiency versus Output Current



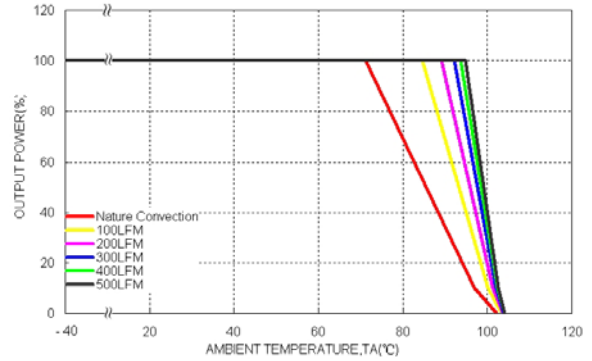
Power Dissipation versus Output Current



Efficiency versus Input Voltage. Full Load



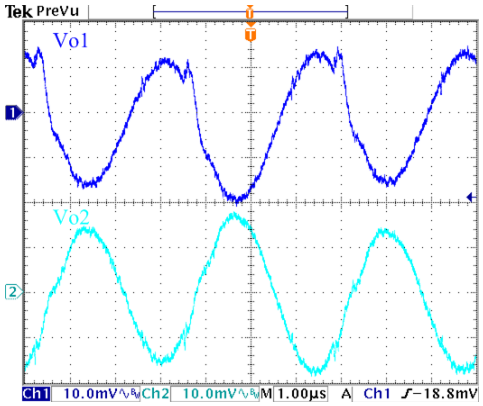
Derating Output Current versus Ambient Temperature with Airflow, $V_{in} = V_{in\,nom}$



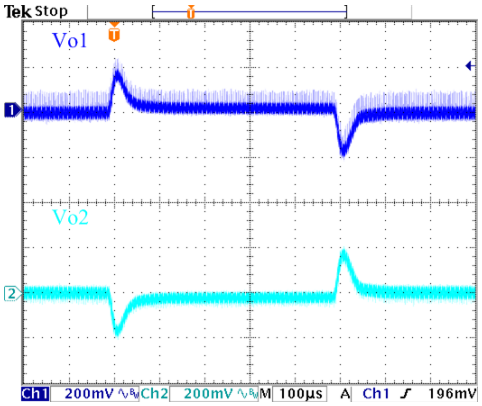
Derating Output Current Versus Ambient Temperature with Heat Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

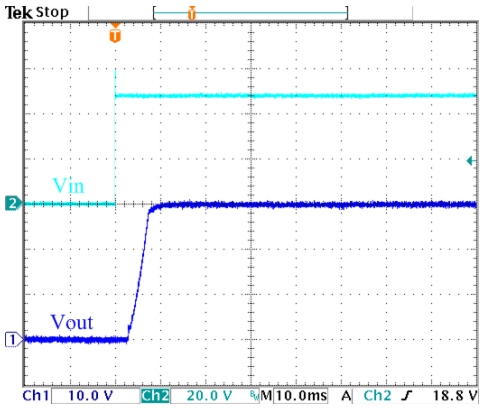
All test conditions are at 25°C. The figures are identical for THN 20-4823WI



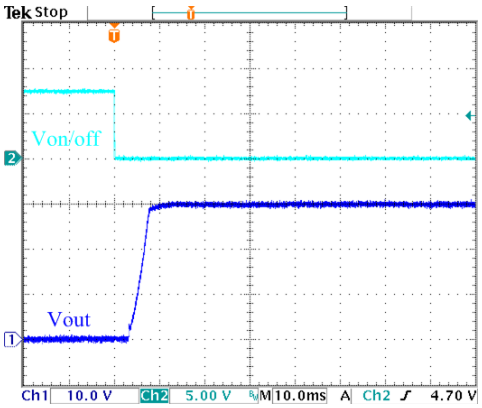
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$, Full Load



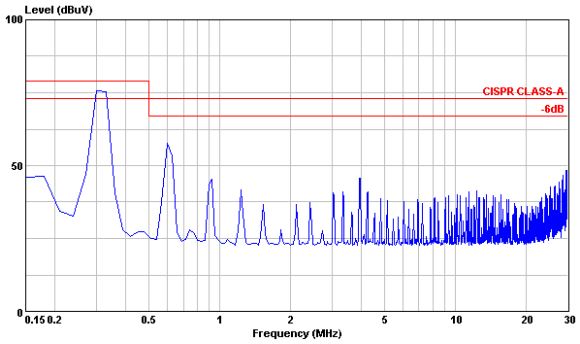
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load; $V_{in} = V_{in\,nom}$



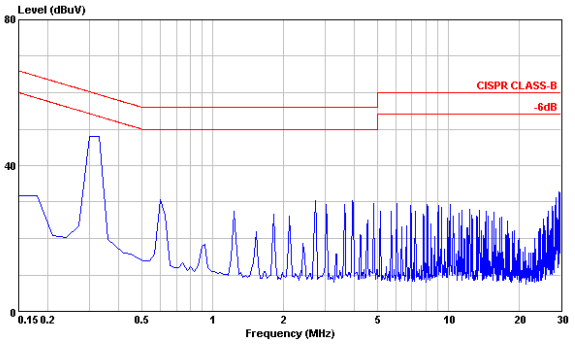
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\,nom}$, Full Load



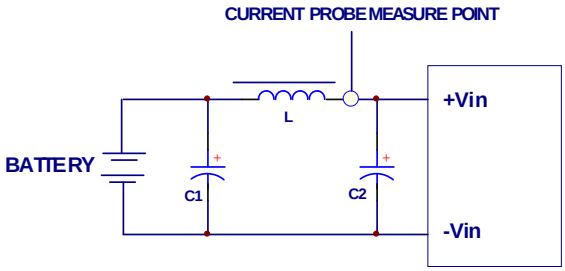
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$, Full Load



Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$, Full Load

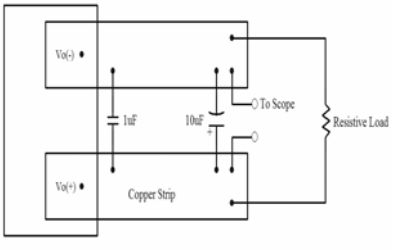
Testing Configurations

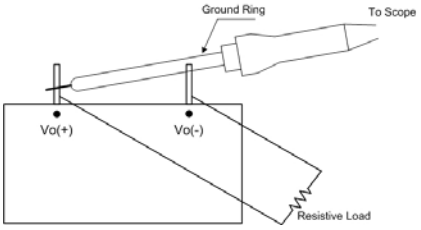
Input reflected-ripple current measurement test up



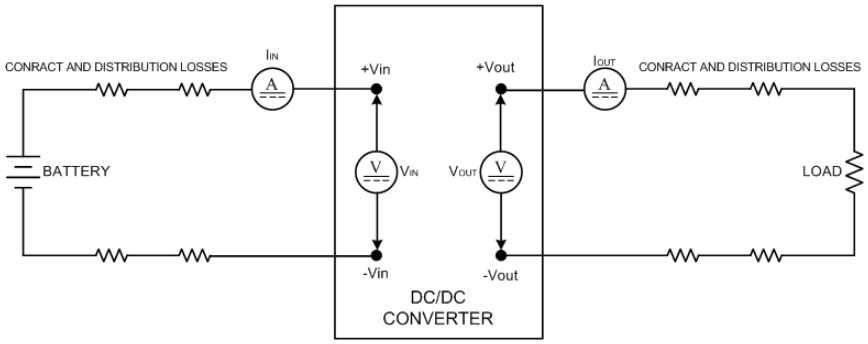
Component	Value	Voltage	Reference
L	12µH	----	----
C1	10µF	100V	Aluminum Electrolytic Capacitor
C2	10µF	100V	Aluminum Electrolytic Capacitor

Peak-to-peak output ripple & noise measurement test up





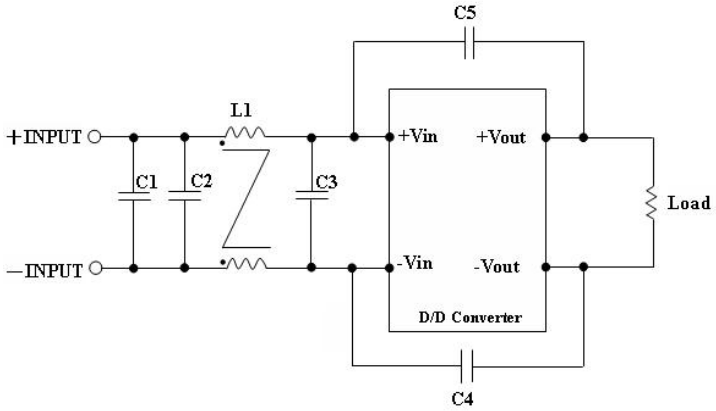
Output voltage and efficiency measurement test up



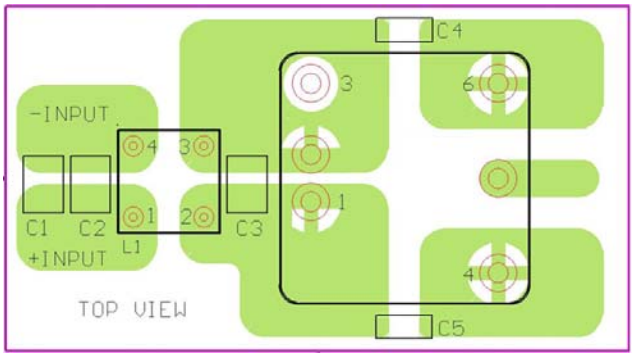
Note: All measurements are taken at the module terminals.

$$Efficiency = \left(\frac{V_o \times I_o}{V_{in} \times I_{in}} \right) \times 100\%$$

EMI Considerations



Suggested schematic to comply with EN55022 Class B limits



Recommended layout with input filter

To comply with EN55022 CLASS B following components are recommended:

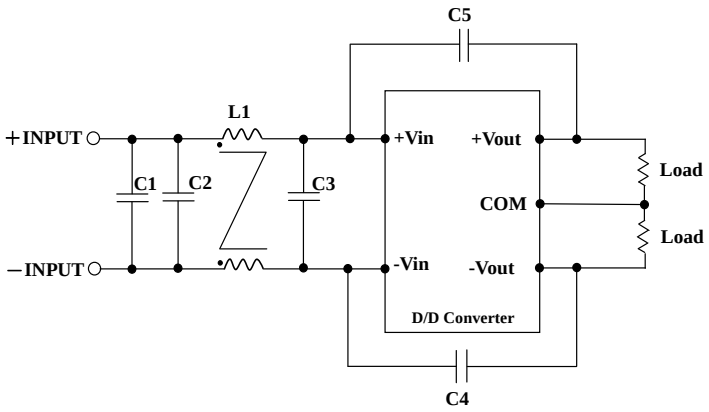
THN 20-24xxWI

Component	Value	Voltage	Reference
C1	4.7µF	50V	1812 MLCC
C2, C3	----	----	----
C4, C5	470pF	2KV	1808 MLCC
L1	325µH	----	Common Choke, P/N: TCK-050

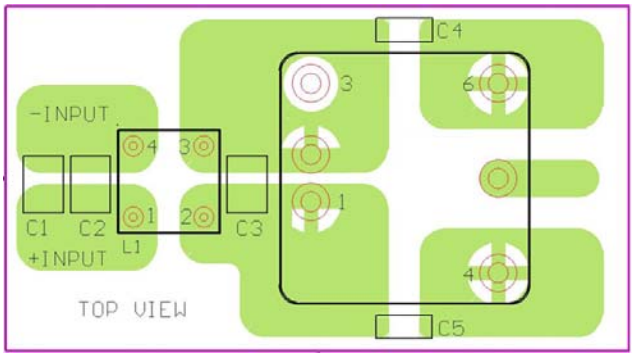
THN 20-48xxWI

Component	Value	Voltage	Reference
C1, C3	2.2µF	100V	1812 MLCC
C2	2.2µF	100V	1812 MLCC
C4, C5	1000pF	2KV	1808 MLCC
L1	325µH	----	Common Choke, P/N: TCK-050

EMI Considerations



Suggested schematic to comply with EN55022 Class B limits



Recommended layout with input filter

To comply with EN55022 CLASS B following components are recommended:

THN 20-242xWI

Component	Value	Voltage	Reference
C1	4.7µF	50V	1812 MLCC
C2, C3	----	----	----
C4, C5	470pF	2KV	1808 MLCC
L1	325µH	----	Common Choke, P/N: TCK-050

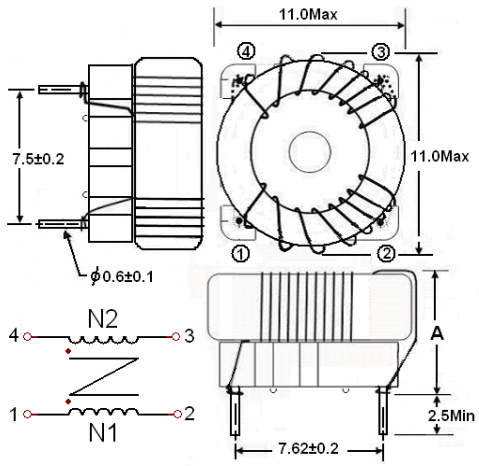
THN 20-482xWI

Component	Value	Voltage	Reference
C1, C2	2.2µF	100V	1812 MLCC
C3	2.2µF	100V	1812 MLCC
C4, C5	1000pF	2KV	1808 MLCC
L1	325µH	----	Common Choke, P/N: TCK-050

EMI Considerations (Continued)

This Common Choke L1 has been define as follow：

- TCK-050
  L: 325mH ±35% / DCR: 35Ω, max
  A (Height): 8.8 mm, Max
- Test condition：100KHz / 100mV
- Recommended through hole：Φ0.8mm
- All dimensions in millimeters



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 C-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 KZE-series 10μF/100V & 10μF/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 about 150 percent of rated current for THN 20WI single output 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.

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.

Output Over Voltage Protection

The output over-voltage protection consists of a Zener diode that monitors the output voltage on the feedback loop. If the voltage on the output terminals exceeds the over-voltage protection threshold, then the Zener diode will send a current signal to the control IC to limiting the output voltage.

Output Voltage Adjustment

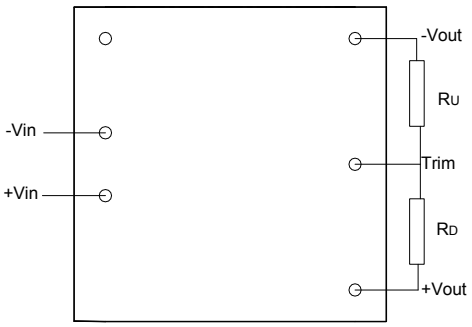
Output voltage set point adjustment allows the user to increase or decrease the output voltage set point of a module. This is accomplished by connecting an external resistor between the TRIM pin and either the Vo (+) or Vo (-) pins. With an external resistor between the TRIM and Vo (-) pin, the output voltage set point increases. With an external resistor between the TRIM and Vo (+) pin, the output voltage set point decreases.

- **Trim up equation**

$$R_U = \left[\frac{G \times L}{\left(V_{O,up} - L - K\right)} - H \right] \Omega$$

- **Trim down equation**

$$R_D = \left[\frac{\left(V_{O,down} - L\right) \times G}{\left(V_O - V_{O,down}\right)} - H \right] \Omega$$



- **Trim constants**

Module	G	H	K	L
THN 20-xx10WI	5110	2050	0.8	2.5
THN 20-xx11WI	5110	2050	2.5	2.5
THN 20-xx12WI	10000	5110	9.5	2.5
THN 20-xx13WI	10000	5110	12.5	2.5

TRIM TABLE

THN 20-xx10WI

Trim up (%)	1	2	3	4	5	6	7	8	9	10
V_{OUT} (Volts)=	3.333	3.366	3.399	3.432	3.465	3.498	3.531	3.564	3.597	3.630
R_U (KΩ)=	385.071	191.511	126.990	94.730	75.374	62.470	53.253	46.340	40.963	36.662
Trim down (%)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
V_{OUT} (Volts)=	3.267	3.234	3.201	3.168	3.135	3.102	3.069	3.036	3.003	2.970
R_D (KΩ)=	116.719	54.779	34.133	23.810	17.616	13.486	10.537	8.325	6.604	5.228

THN 20-xx11WI

Trim up (%)	1	2	3	4	5	6	7	8	9	10
V_{OUT} (Volts)=	5.050	5.100	5.150	5.200	5.250	5.300	5.350	5.400	5.450	5.500
R_U (KΩ)=	253.450	125.700	83.117	61.825	49.050	40.533	34.450	29.888	26.339	23.500
Trim down (%)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
V_{OUT} (Volts)=	4.950	4.900	4.850	4.800	4.750	4.700	4.650	4.600	4.550	4.500
R_D (KΩ)=	248.340	120.590	78.007	56.715	43.940	35.423	29.340	24.778	21.229	18.390

THN 20-xx12WI

Trim up (%)	1	2	3	4	5	6	7	8	9	10
V_{OUT} (Volts)=	12.120	12.240	12.360	12.480	12.600	12.720	12.840	12.960	13.080	13.200
R_U (KΩ)=	203.223	99.057	64.334	46.973	36.557	29.612	24.652	20.932	18.038	15.723
Trim down (%)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
V_{OUT} (Volts)=	11.880	11.760	11.640	11.520	11.400	11.280	11.160	11.040	10.920	10.800
R_D (KΩ)=	776.557	380.723	248.779	182.807	143.223	116.834	97.985	83.848	72.853	64.057

THN 20-xx13WI

Trim up (%)	1	2	3	4	5	6	7	8	9	10
V_{OUT} (Volts)=	15.150	15.300	15.450	15.600	15.750	15.900	16.050	16.200	16.350	16.500
R_U (KΩ)=	161.557	78.223	50.446	36.557	28.223	22.668	18.700	15.723	13.409	11.557
Trim down (%)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
V_{OUT} (Volts)=	14.850	14.700	14.550	14.400	14.250	14.100	13.950	13.800	13.650	13.500
R_D (KΩ)=	818.223	401.557	262.668	193.223	151.557	123.779	103.938	89.057	77.483	68.223

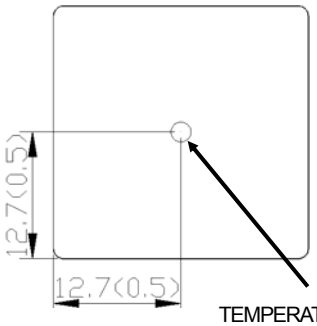
Short Circuitry Protection

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.

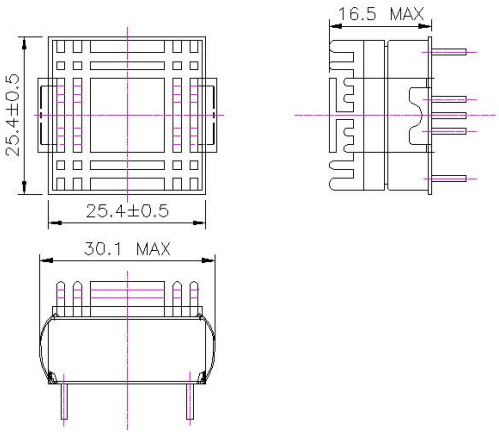


Heat Sink Consideration

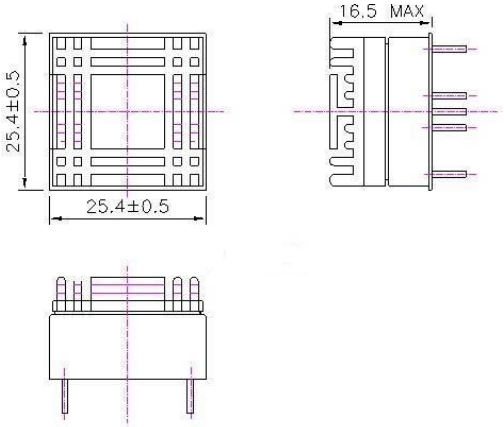
Equip heat sink for lower temperature and higher reliability of the module. Considering space and air-flow is the way to choose which heat sink is needed.

There are two types for choosing.

Suffix –HC: Heat Sink + Clamp



Suffix –HS: Heat Sink

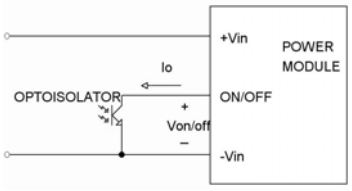


All dimensions in millimeters

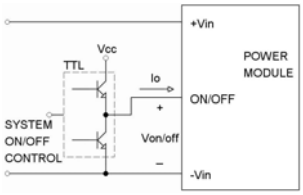
Remote ON/OFF Control

The Remote ON/OFF Pin is controlled DC/DC power module to turn on and off; the user must use a switch to control the logic voltage high or low level of the pin referenced to $-V_{in}$. The switch can be open collector transistor, FET and Photo-Couple. The switch must be capable of sinking up to 1mA at low-level logic Voltage. High-level logic of the ON/OFF signal maximum voltage is allowable leakage current of the switch at 15V is 50μA.

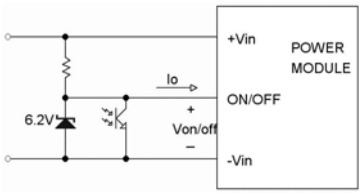
Remote ON/OFF Implementation Circuits



Isolated-Closure Remote ON/OFF



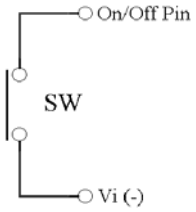
Level Control Using TTL Output



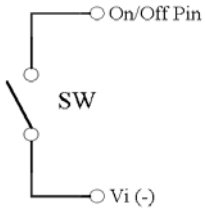
Level Control Using Line Voltage

There are two remote control options available, positive logic and negative logic.

a. The Positive logic structure turned on of the DC/DC module when the ON/OFF pin is at high-level logic and low-level logic is turned off it.

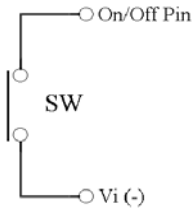


When THN 20WI module is turned off at Low-level logic

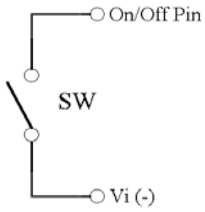


When THN 20WI module is turned on at High-level logic

b. The Negative logic structure turned on of the DC/DC module when the ON/OFF pin is at low-level logic and turned off when at high-level logic.

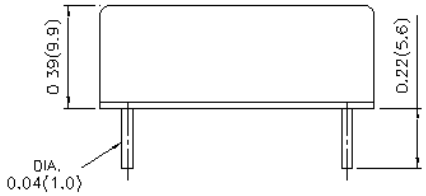


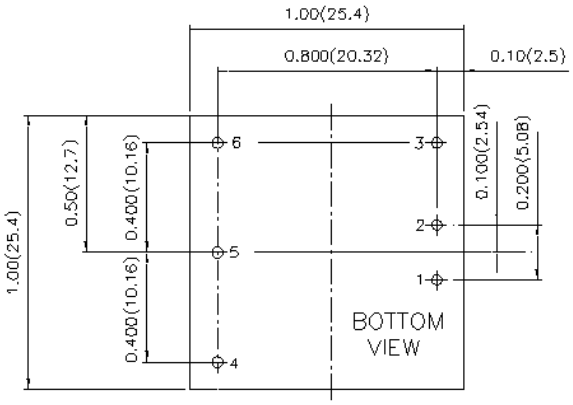
When THN 20WI module is turned on at Low-level logic



When THN 20WI module is turned off at High-level logic

Mechanical Data



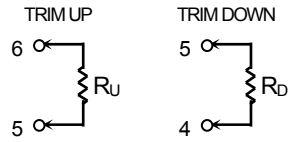


PIN CONNECTION	
PIN	THN 20WI SERIES
1	+ INPUT
2	- INPUT
3	ON/OFF
4	+VOUT
5	TRIM
6	-VOUT

1. All dimensions in Inches (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)

EXTERNAL OUTPUT TRIMMING

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

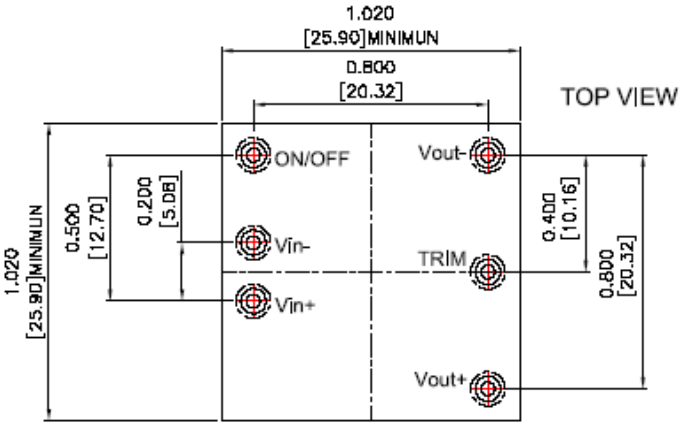


PRODUCT STANDARD TABLE	
Option	Suffix
Positive remote ON/OFF (Standard)	
Negative remote ON/OFF	-N
Without ON/OFF pin	-B
Negative remote ON/OFF without TRIM pin	-C
Without ON/OFF & TRIM pin	-D
Positive remote ON/OFF without TRIM pin	-E

Recommended Pad Layout

Recommeded Pad Layout

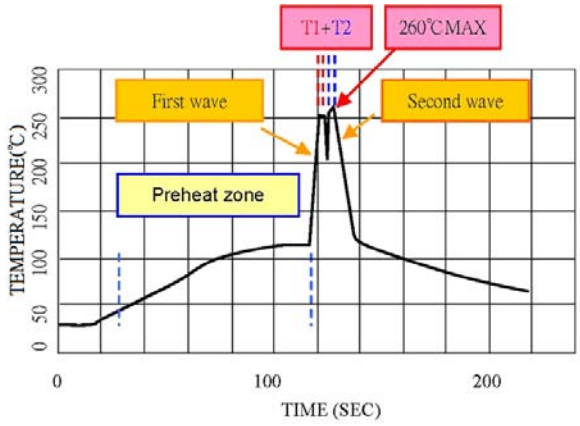
ALL Dimensions in inches (millimeters)
Tolerances:xx.xxx in ±0.010 in (xx.xx mm±0.25mm)



PAD SIZE (LEAD FREE RECOMMENDED)
PIN THROUGH HOLE: ⌀ 0.047in(1.2mm)
TOP VIEW PAD: ⌀ 0.079in(2.0mm)
BOTTOM VIEW PAD: ⌀ 0.118in(3.0mm)

Soldering Considerations

Lead free wave solder profile for THN 20WI-SERIES

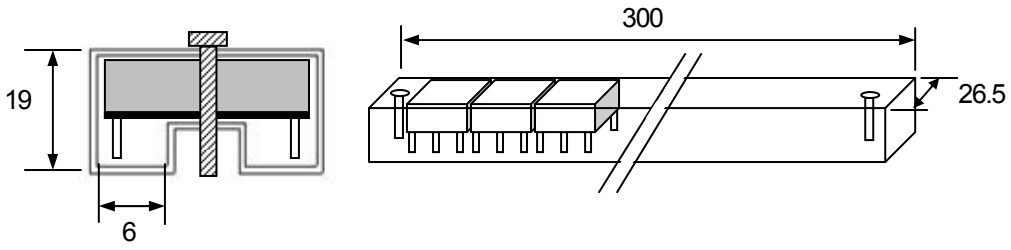


Zone	Reference Parameter.
Preheat zone	Rise temperature speed: 3°C/sec max. Preheat temperature: 100~130°C
Actual heating	Peak temperature: 250~260°C Peak time (T1+T2 time): 4~6 sec

Reference Solder: Sn-Ag-Cu; Sn-Cu

Hand Welding: Soldering iron: Power 90W
Welding Time: 2～4 sec
Temperature: 380～400 ℃

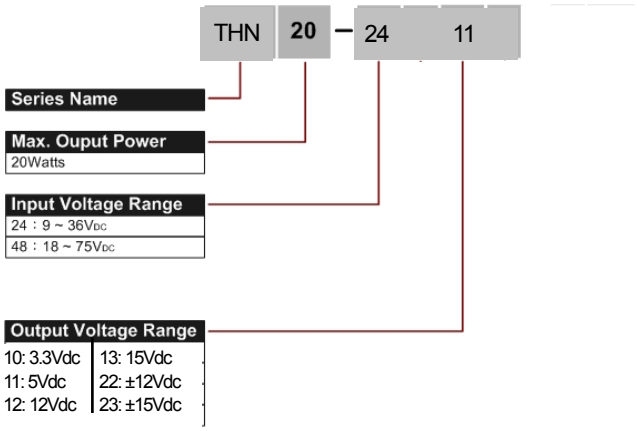
Packaging Information



All dimensions in millimeters

10 PCS per TUBE

Part Number Structure



Model Number	Input Range	Output Voltage	Output Current Full Load	No Load [1] Input Current	Efficiency [2] (%)
THN 20-2410WI	9 – 36Vdc	3.3Vdc	4500mA	6mA	86
THN 20-2411WI	9 – 36Vdc	5Vdc	4000mA	6mA	89
THN 20-2412WI	9 – 36Vdc	12Vdc	1670mA	6mA	89
THN 20-2413WI	9 – 36Vdc	15Vdc	1330mA	6mA	89
THN 20-2422WI	9 – 36Vdc	±12Vdc	±833mA	6mA	89
THN 20-2423WI	9 – 36Vdc	±15Vdc	±667mA	6mA	90
THN 20-4810WI	18 – 75Vdc	3.3Vdc	4500mA	6mA	87
THN 20-4811WI	18 – 75Vdc	5Vdc	4000mA	6mA	89
THN 20-4812WI	18 – 75Vdc	12Vdc	1670mA	6mA	89
THN 20-4813WI	18 – 75Vdc	15Vdc	1330mA	6mA	90
THN 20-4822WI	18 – 75Vdc	±12Vdc	±833mA	6mA	89
THN 20-4823WI	18 – 75Vdc	±15Vdc	±667mA	6mA	90

Note 1. Typical value at nominal input voltage and no load.
Note 2. Typical value at nominal input voltage and full load.

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 4A for THN 20-24xxWI modules and 2A for THN 20-48xxWI modules. 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 THN 20WI SERIES of DC/DC converters has been calculated using

Bellcore TR-NWT-000332 Case I: 50% stress, Operating Temperature at 40°C (Ground fixed and controlled environment). The resulting figure for MTBF is 1'766'000 hours.

MIL-HDBK 217F NOTICE2 FULL LOAD, Operating Temperature at 25°C. The resulting figure for MTBF is 553'000 hours.