TRACO® POWER

TEN 30-WIN Series

Application Note

DC/DC Converter 9 to 36Vdc or 18 to 75Vdc Input and 30 Watt Output Power
3.3 to 15Vdc Single Outputs ±5Vdc to ±15Vdc Dual Outputs and 3.3V/5Vdc & ±12/±15VdcTriple Outputs

c UL® US
E188913

Complete TEN 30-WIN datasheet can be downloaded at:
http://www.tracopower.com/products/ten30win.pdf

Features
- RoHS compliant
- Single output up to 8.5A, Dual and Triple Output Converters
- Six-sided continuous shield
- No minimum load required (except Triple Output Version)
- High power density
- High efficiency up to 91%
- Small size 50.8×25.4×10.2 mm 2.00×1.00×0.40 inch)
- Input to output isolation (1600VDC)
- 4:1 ultra wide input voltage range
- Fixed switching frequency
- Input under-voltage protection
- Output over-voltage protection
- Over-current protection
- Output short circuit protection
- Remote on/off
- Case grounding

Options
- Heatsink

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

General Description
The TEN 30WIN series offer 30 watts of output power from a 2 x 1.6 x 0.4 inch package. TEN 30WIN series have 4:1 ultra wide input voltage of 9 – 36Vdc, 18 – 75Vdc. The TEN 30WIN series features 1500VDC of isolation, short circuit protection, over-voltage protection, over-current protection and six sided shielding. All models are particularly suited to telecommunications, industrial, mobile telecom and test equipment applications.

Table of contents

Absolute Maximum Rating				
Parameter	**Model**	**Min**	**Max**	**Unit**
Input Voltage Continuous Transient (for 100ms max.)	 TEN 30-24xxWIN TEN 30-48xxWIN TEN 30-24xxWIN TEN 30-48xxWIN		 36 75 50 100	Vdc
Operating Ambient Temperature without derating with derating	All	-40 +50	+50 +85	°C
Operating Case Temperature	All		+105	°C
Storage Temperature	All	-55	+105	°C

Output Specification					
Parameter	**Model**	**Min**	**Nominal**	**Max**	**Unit**
Output Voltage (V_{in} = $V_{in\ nom}$; Full Load; T_A = 25°C)	TEN 30-xx07WIN TEN 30-xx09WIN TEN 30-xx10WIN TEN 30-xx11WIN TEN 30-xx12WIN TEN 30-xx13WIN TEN 30-xx21WIN TEN 30-xx22WIN TEN 30-xx23WIN TEN 30-xx33WIN TEN 30-xx34WIN TEN 30-xx31WIN TEN 30-xx32WIN	1.485 2.475 3.267 5.049 11.88 14.85 ±4.950 ±11.88 ±14.85 3.267 / ±11.40 3.267 / ±14.25 4.950 / ±11.40 4.950 / ±14.25	1.5 2.5 3.3 5.1 12 15 ±5 ±12 ±15 3.3 / ±12.0 3.3 / ±15.0 5.0 / ±12.0 5.0 / ±15.0	1.515 2.525 3.333 5.151 12.12 15.15 ±5.15 ±12.12 ±15.15 3.333 / ±12.60 3.333 / ±15.75 5.050 / ±12.60 5.050 / ±15.75	Vdc
Voltage adjustability (see page 45 page 46)	Single Output only	-10		+10	%
Output Regulation Line ($V_{in\ min}$ to $V_{in\ max}$ at Full Load)	 Single & Dual output Triple output (Main) Triple output (Auxiliary)	 -0.2 -1.0 -5.0		 +0.2 +1.0 +5.0	% V_{out}
Output Regulation Load (0% to 100% of Full Load) Load (0% to 100% of Full Load) Load ($I_{out\ min}$ to 100% of Full Load)	 Single output Dual Output Triple output (Main) Triple output (Auxiliary)	 -0.5 -1.0 -2.0 -5.0		 +0.5 +1.0 +2.0 +5.0	% V_{out}
Cross Regulation Asymmetrical Load 25% / 100% of Full Load	Dual Output	-5.0		+5.0	% V_{out}
Output Ripple & Noise (see page 42) Peak-to-Peak (5Hz to 20MHz bandwidth) (Measured with a 1µF/50V MLCC)	TEN 30-xx07WIN TEN 30-xx09WIN TEN 30-xx10WIN TEN 30-xx11WIN TEN 30-xx12WIN TEN 30-xx13WIN TEN 30-xx21WIN TEN 30-xx22WIN TEN 30-xx23WIN TEN 30-xx33WIN TEN 30-xx34WIN TEN 30-xx31WIN TEN 30-xx32WIN		 50 / 75 50 / 75 50 / 75 50 / 75	100 100 100 100 150 150 100 150 150	mV pk-pk

Output Specification (Continued)					
Parameter	**Model**	**Min**	**Nominal**	**Max**	**Unit**
Temperature Coefficient	All	-0.02		+0.02	% V_{out} /°C
Output Voltage Overshoot ($V_{in\,min}$ to $V_{in\,max}$; Full Load; T_A = 25°C)	All		0	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		300		mV
Setting Time (V_{out} < 10% peak deviation)	All		250		µs
Output Current	TEN 30-xx07WIN	0		8500	mA
	TEN 30-xx09WIN	0		8000	
	TEN 30-xx10WIN	0		7500	
	TEN 30-xx11WIN	0		6000	
	TEN 30-xx12WIN	0		2500	
	TEN 30-xx13WIN	0		2000	
	TEN 30-xx21WIN	0		±3000	
	TEN 30-xx22WIN	0		±1250	
	TEN 30-xx23WIN	0		±1000	
	TEN 30-xx33WIN	500 / ±42		5000 / ±416	
	TEN 30-xx34WIN	500 / ±33		5000 / ±333	
	TEN 30-xx31WIN	400 / ±42		4000 / ±416	
	TEN 30-xx32WIN	400 / ±33		4000 / ±333	
Output Over Voltage Protection (Zener diode clamp)	TEN 30-xx07WIN		2.0		Vdc
	TEN 30-xx09WIN		3.3		
	TEN 30-xx10WIN		3.9		
	TEN 30-xx11WIN		6.2		
	TEN 30-xx12WIN		15		
	TEN 30-xx13WIN		18		
	TEN 30-xx21WIN		6.2		
	TEN 30-xx22WIN		15		
	TEN 30-xx23WIN		18		
	TEN 30-xx33WIN		3.9 / 15		
	TEN 30-xx34WIN		3.9 / 18		
	TEN 30-xx31WIN		6.2 / 15		
	TEN 30-xx32WIN		6.2 / 18		
Output Over Current Protection	All		150		% FL.
Output Short Circuit Protection	All	Hiccup, automatics recovery			

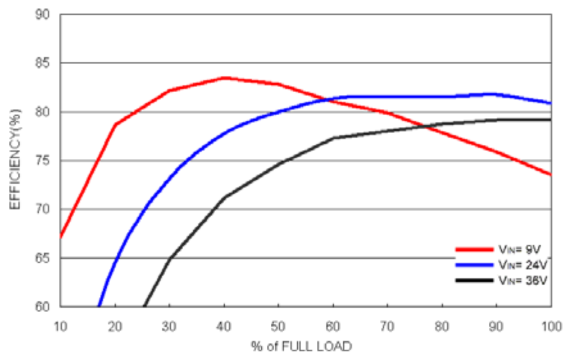
Input Specification					
Parameter	**Model**	**Min**	**Nominal**	**Max**	**Unit**
Operating Input Voltage	TEN 30-24xxWIN TEN 30-48xxWIN	9 18	24 48	36 75	Vdc
Under Voltage Lockout Turn-on Threshold	TEN 30-24xxWIN TEN 30-48xxWIN		9 18		Vdc
Under Voltage Lockout Turn-off Threshold	TEN 30-24xxWIN TEN 30-48xxWIN		8 16		Vdc
Input reflected ripple current (see page 42) (5 to 20MHz, 12µH source impedance)	All		20		mA pk-pk
Start Up Time (V_{in} = $V_{in\ nom}$ and constant resistive load) Power up Remote ON/OFF	All		30 30		ms
Input Current (Maximum value at V_{in} = $V_{in\ nom}$; Full Load)	TEN 30-2407WIN			700	mA
	TEN 30-2409WIN			1054	
	TEN 30-2410WIN			1258	
	TEN 30-2411WIN			1517	
	TEN 30-2412WIN			1471	
	TEN 30-2413WIN			1471	
	TEN 30-2421WIN			1488	
	TEN 30-2422WIN			1506	
	TEN 30-2423WIN			1506	
	TEN 30-2433WIN			1330	
	TEN 30-2434WIN			1330	
	TEN 30-2431WIN			1488	
	TEN 30-2432WIN			1488	
	TEN 30-4807WIN			350	
	TEN 30-4809WIN			520	
	TEN 30-4810WIN			629	
	TEN 30-4811WIN			759	
	TEN 30-4812WIN			727	
	TEN 30-4813WIN			718	
	TEN 30-4821WIN			744	
	TEN 30-4822WIN			744	
	TEN 30-4823WIN			744	
	TEN 30-4833WIN			665	
	TEN 30-4834WIN			665	
	TEN 30-4831WIN			744	
	TEN 30-4832WIN			744	

Input Specification					
Parameter	**Model**	**Min**	**Nominal**	**Max**	**Unit**
Input Standby current	TEN 30-2407WIN		70		mA
(Typical value at $V_{in} = V_{in\,nom}$; No Load)	TEN 30-2409WIN		70		
	TEN 30-2410WIN		70		
	TEN 30-2411WIN		105		
	TEN 30-2412WIN		20		
	TEN 30-2413WIN		30		
	TEN 30-2421WIN		90		
	TEN 30-2422WIN		25		
	TEN 30-2423WIN		25		
	TEN 30-2433WIN		105		
	TEN 30-2434WIN		105		
	TEN 30-2431WIN		105		
	TEN 30-2432WIN		105		
	TEN 30-4807WIN		30		
	TEN 30-4809WIN		45		
	TEN 30-4810WIN		45		
	TEN 30-4811WIN		65		
	TEN 30-4812WIN		60		
	TEN 30-4813WIN		50		
	TEN 30-4821WIN		50		
	TEN 30-4822WIN		15		
	TEN 30-4823WIN		15		
	TEN 30-4833WIN		55		
	TEN 30-4834WIN		55		
	TEN 30-4831WIN		55		
	TEN 30-4832WIN		55		
Remote ON/OFF Control (see page 48)					
(The On/Off pin voltage is referenced to $-V_{in}$)					
Positive logic	All				
On/Off pin High Voltage (Remote ON)		3.0		12	Vdc
On/Off pin Low Voltage (Remote OFF)		0		1.2	Vdc
Remote Off Stand by Input Current	All		3		mA
Input Current of Remote Control Pin	All	-0.5		0.5	mA

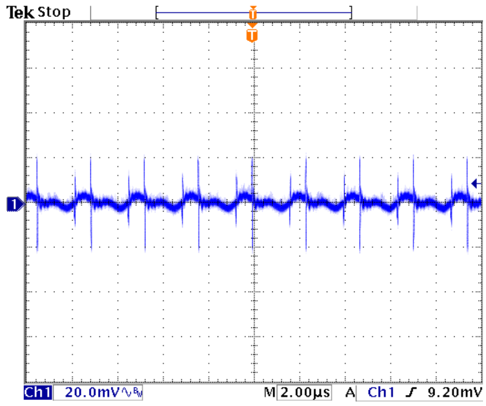
General Specification					
Parameter	**Model**	**Min**	**Nominal**	**Max**	**Unit**
Efficiency (see page 42) (V_{in} = $V_{in\,nom}$; Full Load; T_A = 25°C)	TEN 30-2407WIN TEN 30-2409WIN TEN 30-2410WIN TEN 30-2411WIN TEN 30-2412WIN TEN 30-2413WIN TEN 30-2421WIN TEN 30-2422WIN TEN 30-2423WIN TEN 30-2433WIN TEN 30-2434WIN TEN 30-2431WIN TEN 30-2432WIN TEN 30-4807WIN TEN 30-4809WIN TEN 30-4810WIN TEN 30-4811WIN TEN 30-4812WIN TEN 30-4813WIN TEN 30-4821WIN TEN 30-4822WIN TEN 30-4823WIN TEN 30-4833WIN TEN 30-4834WIN TEN 30-4831WIN TEN 30-4832WIN		80.0 83.0 86.0 88.0 89.0 89.0 88.0 87.0 87.0 87.0 87.0 88.0 88.0 80.0 84.0 86.0 88.0 90.0 91.0 88.0 88.0 88.0 87.0 87.0 88.0 88.0		%
Case grounding	All	Connect case to $-V_{in}$ with decoupling Y cap.			
Isolation voltage Input to Output (for 60 seconds) Input to Case, Output to Case (for 60 seconds)	All	1500 1500			Vdc
Isolation resistance	All	1			GΩ
Isolation capacitance	All			1500	pF
Switching Frequency	Single & Dual output Triple output		430 400		KHz
Weight	All		30.5		g
MTBF Bellcore TR-NWT-000332, TC = 40°C MIL-STD-217F	All		3.17×10^6 4.35×10^5		hours
Over temperature protection (see page 46)	All		115		°C

Characteristic Curves

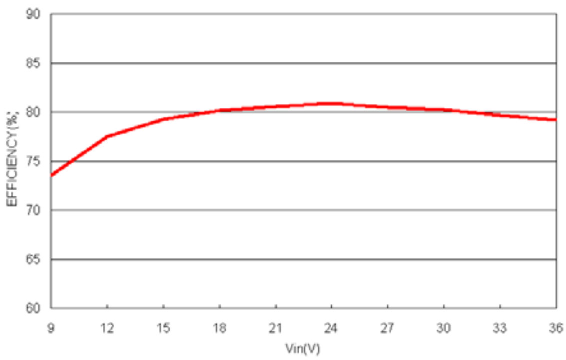
All test conditions are at 25°C.The figures are identical for TEN 30-2407WIN



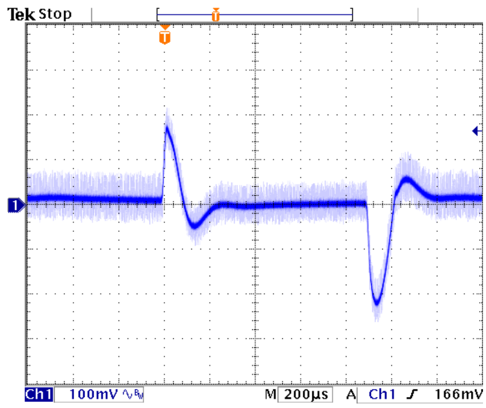
Efficiency Versus Output Current



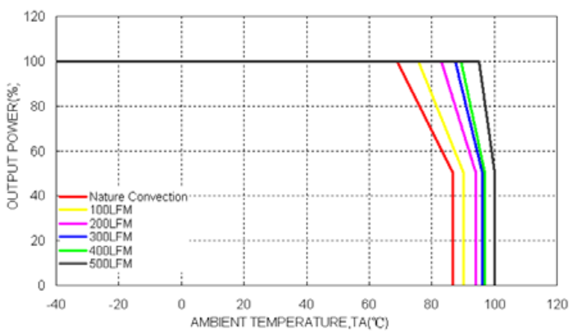
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$; Full Load



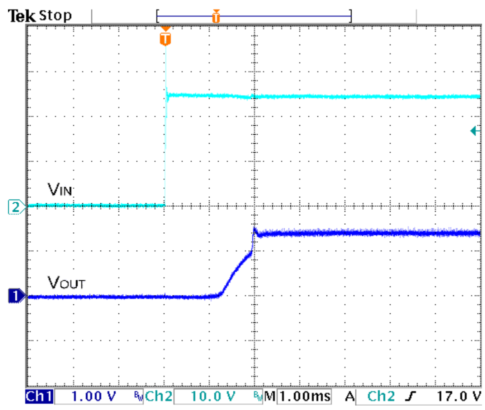
Efficiency Versus Input Voltage. Full Load



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



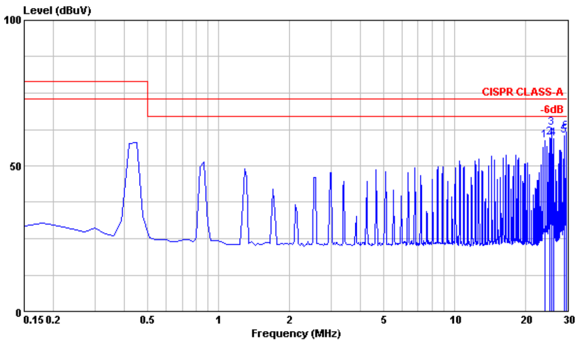
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\,nom}$



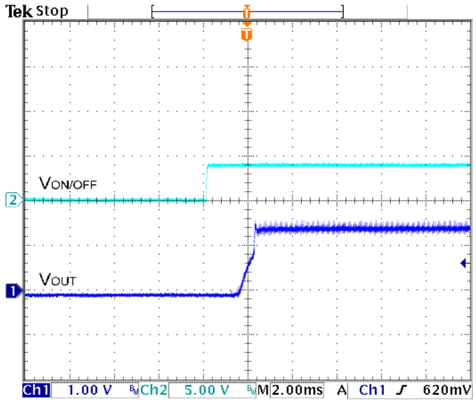
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$; Full Load

Characteristic Curves

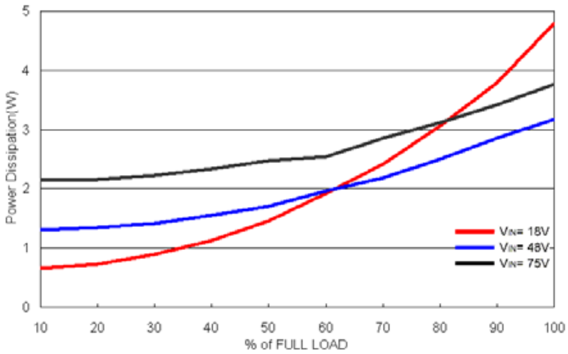
All test conditions are at 25°C.The figures are identical for TEN 30-2407WIN (Continued)



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



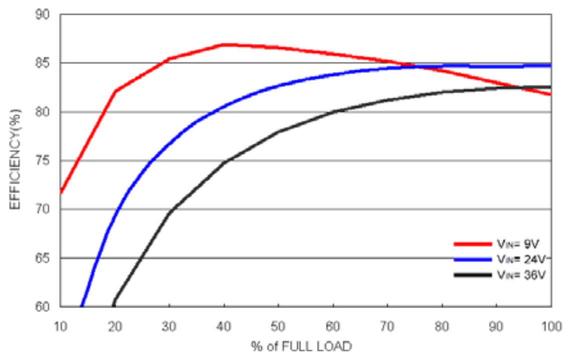
Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\ nom}$; Full Load



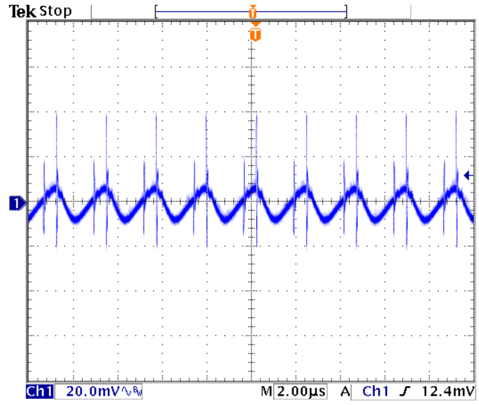
Power Dissipation Versus Output Current

Characteristic Curves

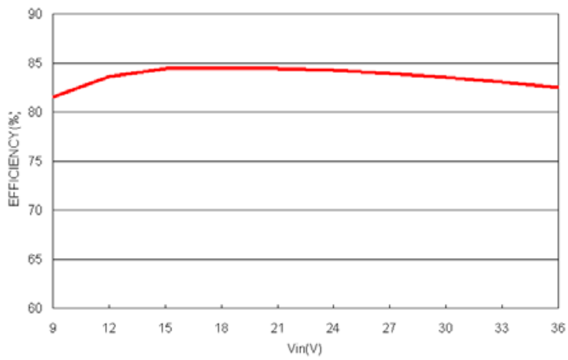
All test conditions are at 25°C.The figures are identical for TEN 30-2409WIN



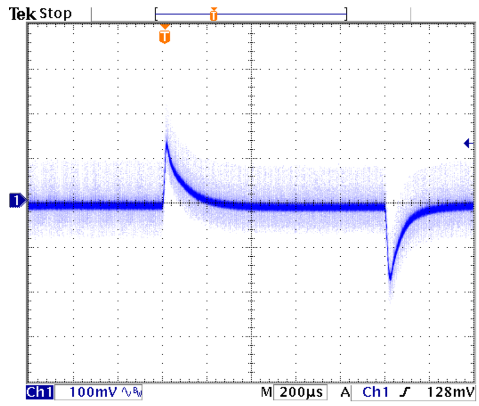
Efficiency Versus Output Current



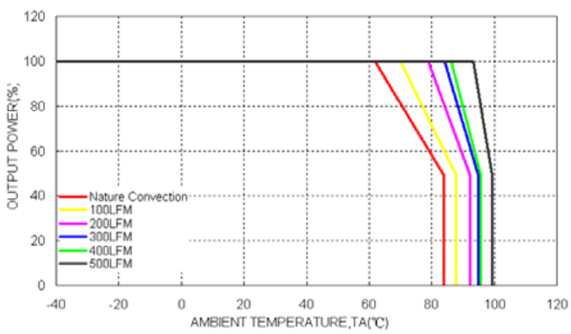
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$; Full Load



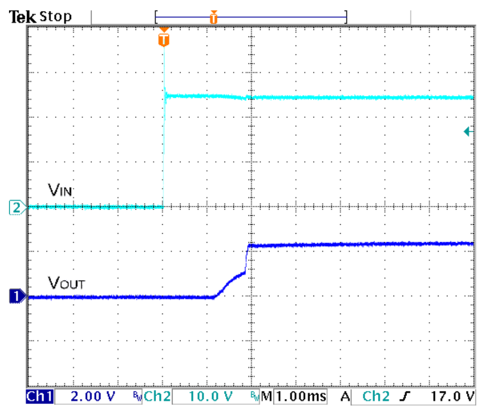
Efficiency Versus Input Voltage. Full Load



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



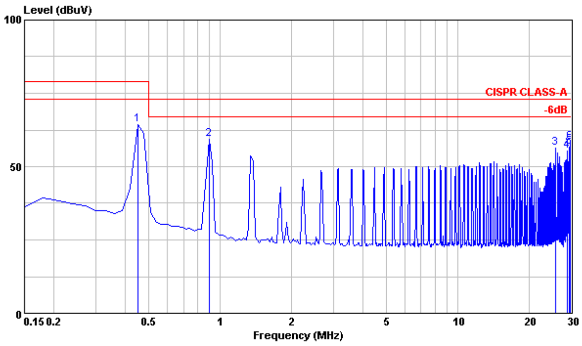
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\,nom}$



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

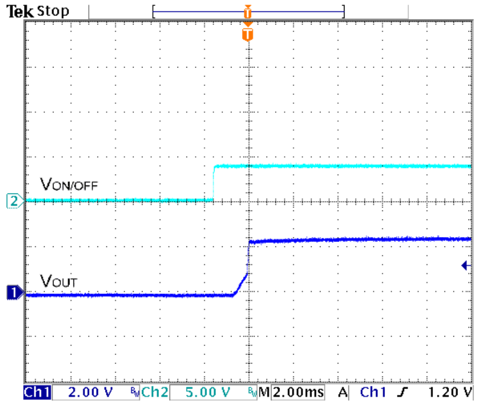
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-2409WIN (Continued)



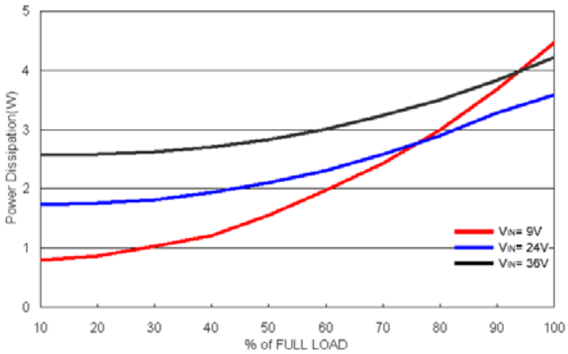
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\,nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

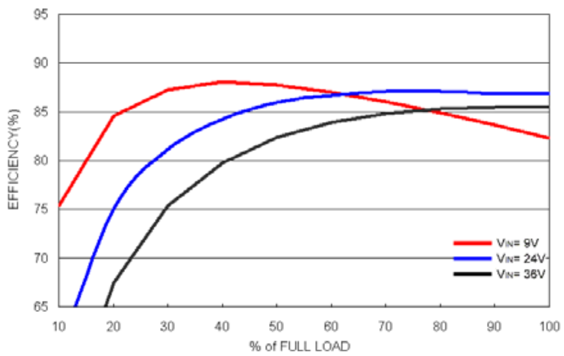
$V_{in} = V_{in\,nom}$; Full Load



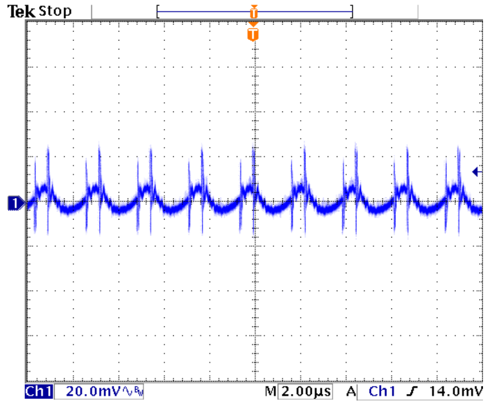
Power Dissipation Versus Output Current

Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-2410WIN

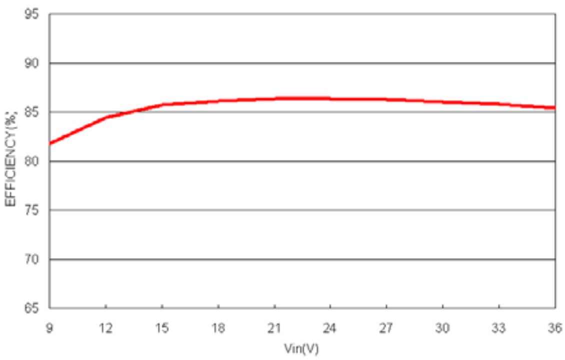


Efficiency Versus Output Current

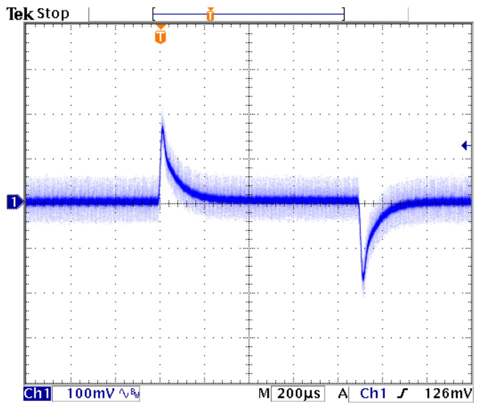


Typical Output Ripple and Noise.

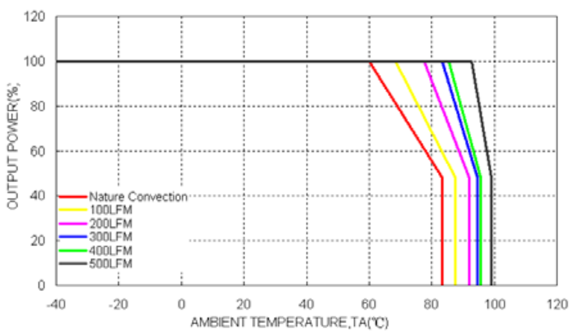
$V_{in} = V_{in\,nom}$; Full Load



Efficiency Versus Input Voltage. Full Load

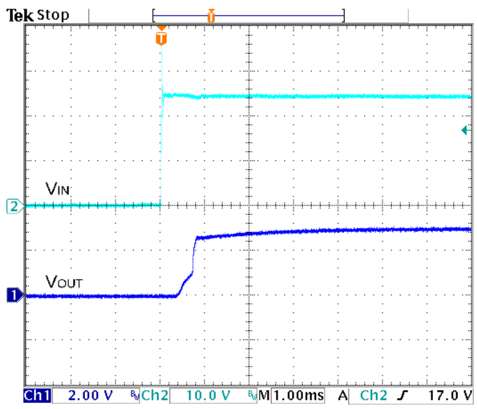


Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load ; $V_{in} = V_{in\,nom}$



Derating Output Current Versus Ambient Temperature and Airflow

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

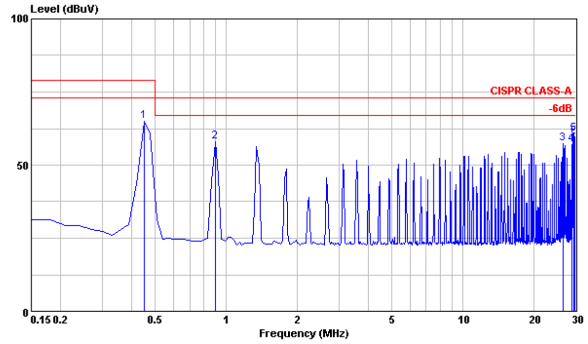


Typical Input Start-Up and Output Rise Characteristic

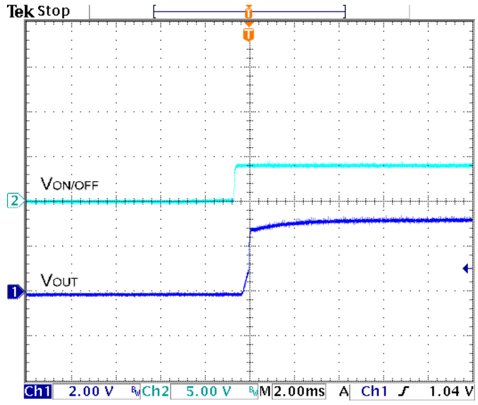
$V_{in} = V_{in\,nom}$; Full Load

Characteristic Curves

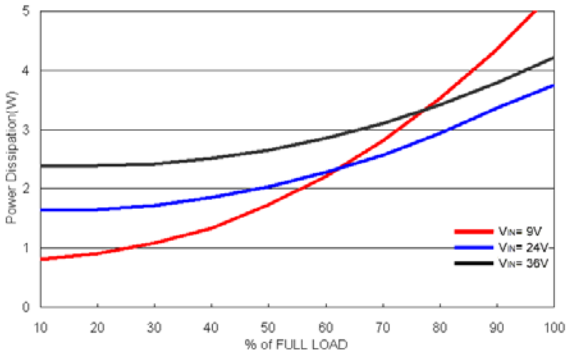
All test conditions are at 25°C.The figures are identical for TEN 30-2410WIN (Continued)



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



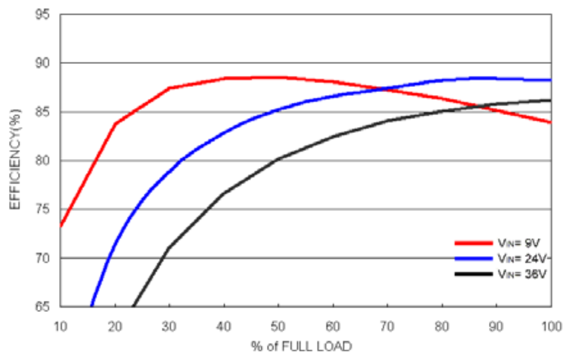
Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\ nom}$; Full Load



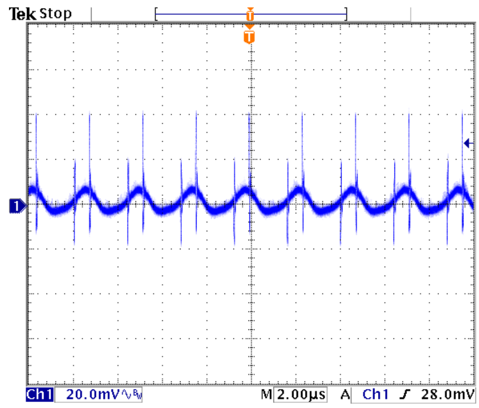
Power Dissipation Versus Output Current

Characteristic Curves

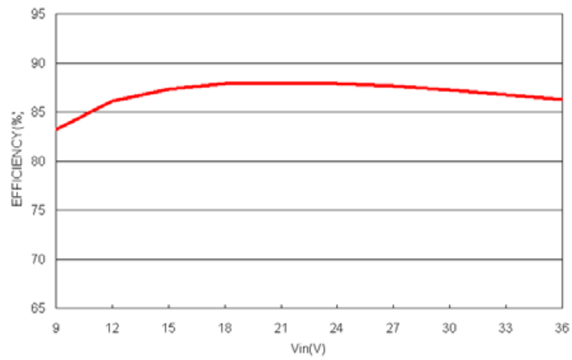
All test conditions are at 25°C.The figures are identical for TEN 30-2411WIN



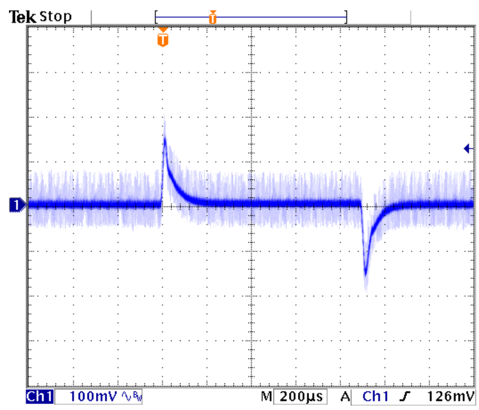
Efficiency Versus Output Current



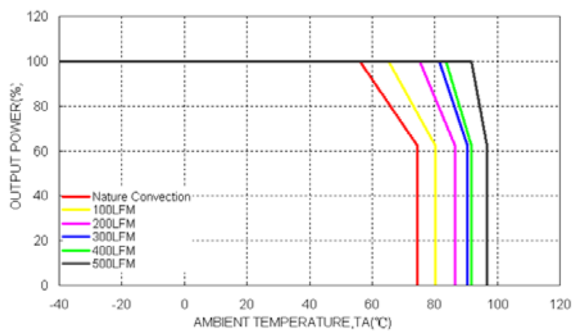
Typical Output Ripple and Noise.
$V_{in} = V_{in\ nom}$; Full Load



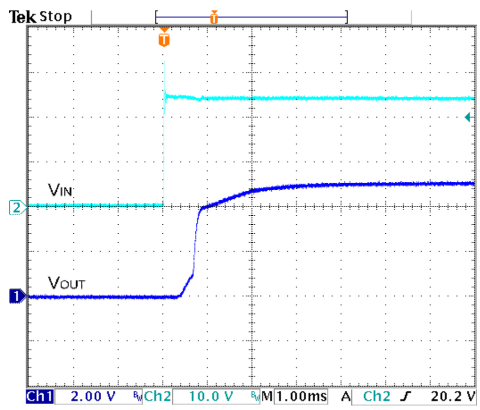
Efficiency Versus Input Voltage. Full Load



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



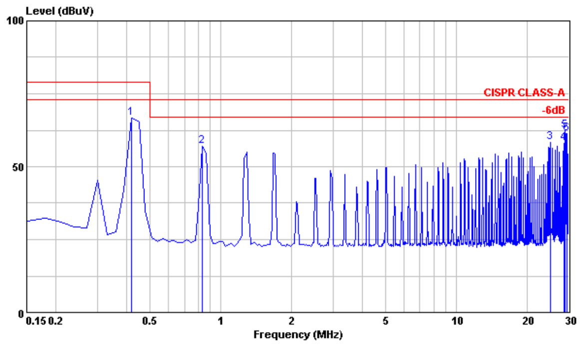
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\ nom}$



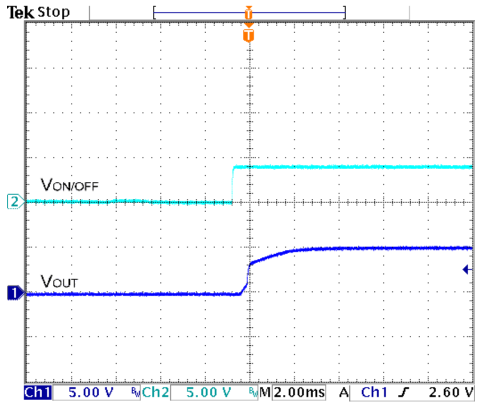
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

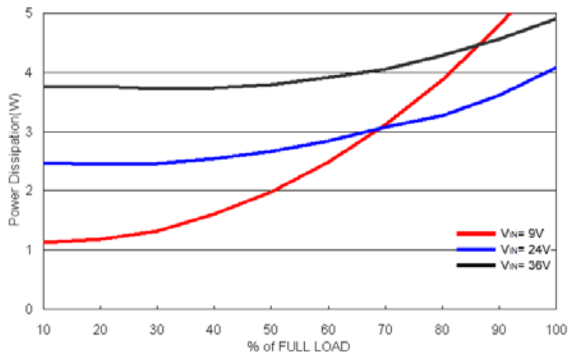
All test conditions are at 25°C.The figures are identical for TEN 30-2411WIN (Continued)



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



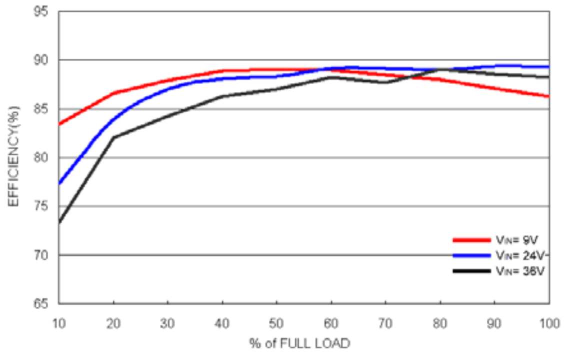
Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic
$V_{in} = V_{in\,nom}$; Full Load



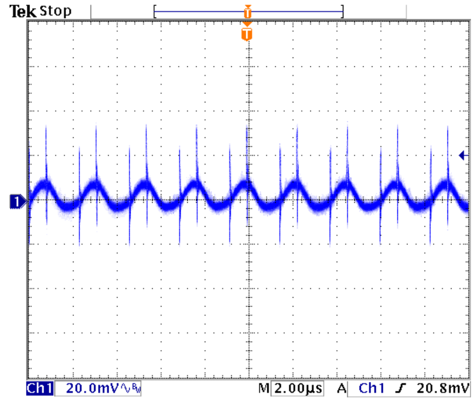
Power Dissipation Versus Output Current

Characteristic Curves

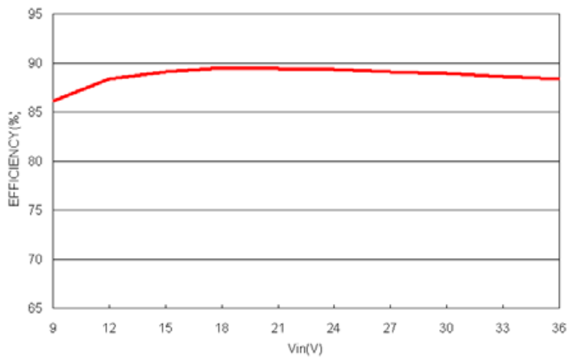
All test conditions are at 25°C.The figures are identical for TEN 30-2412WIN



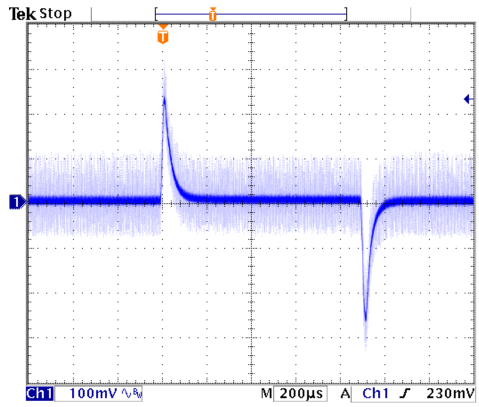
Efficiency Versus Output Current



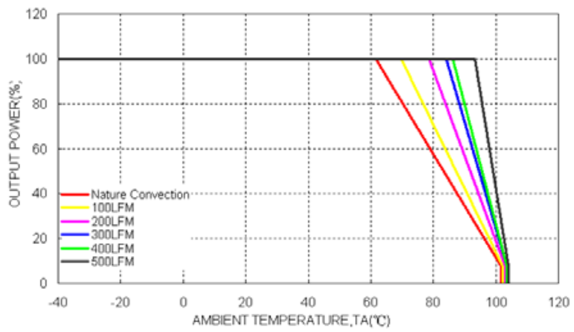
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$; Full Load



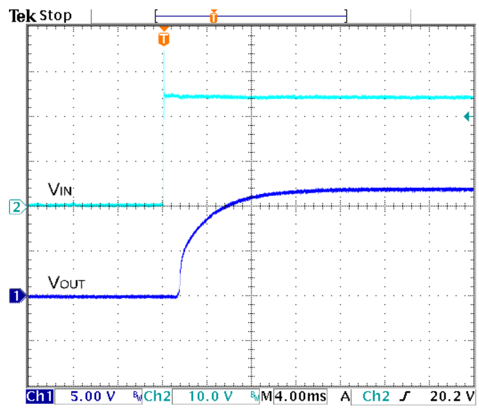
Efficiency Versus Input Voltage. Full Load



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



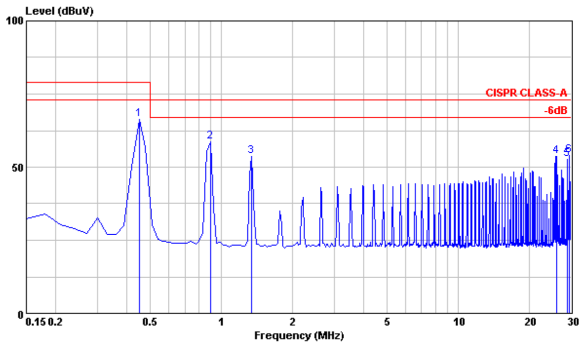
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\,nom}$



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

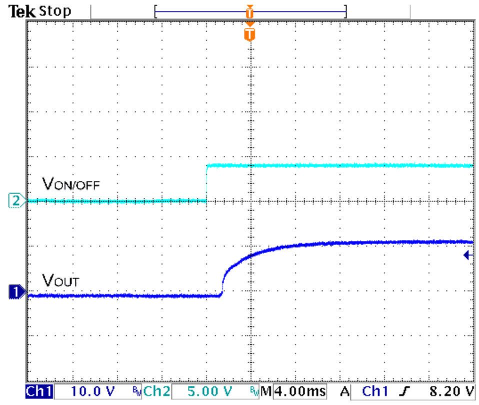
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-2412WIN (Continued)



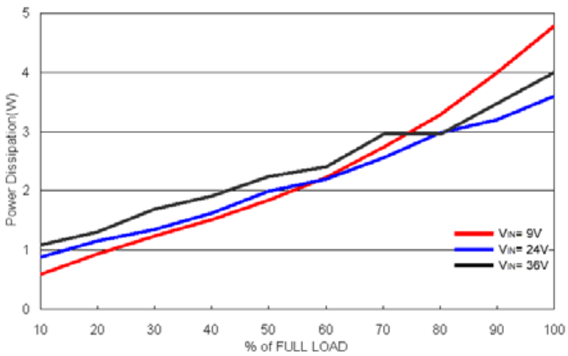
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\ nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

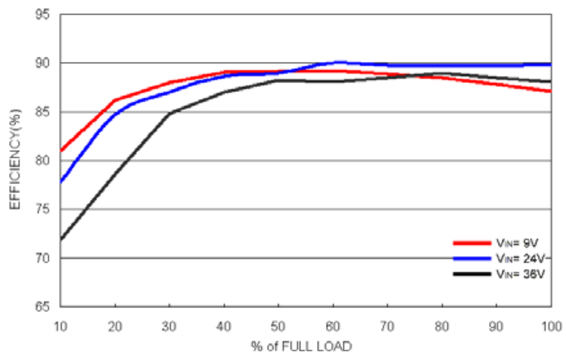
$V_{in} = V_{in\ nom}$; Full Load



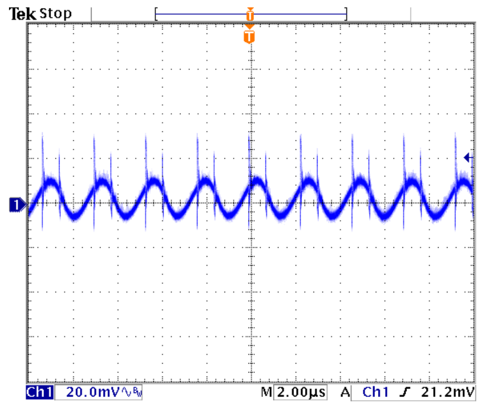
Power Dissipation Versus Output Current

Characteristic Curves

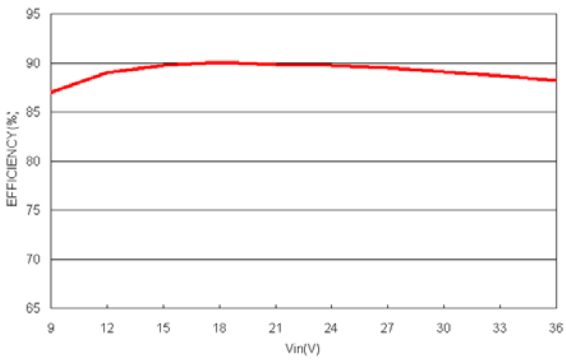
All test conditions are at 25°C.The figures are identical for TEN 30-2413WIN



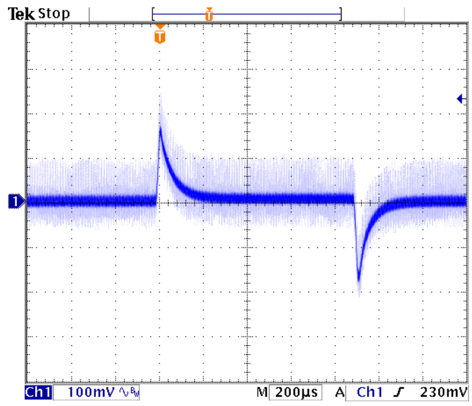
Efficiency Versus Output Current



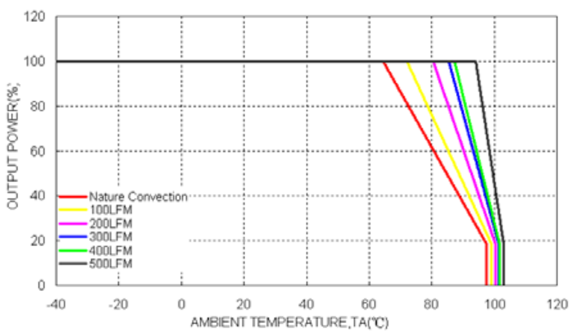
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$; Full Load



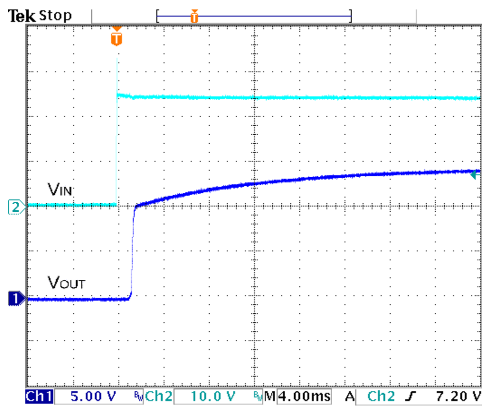
Efficiency Versus Input Voltage. Full Load



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



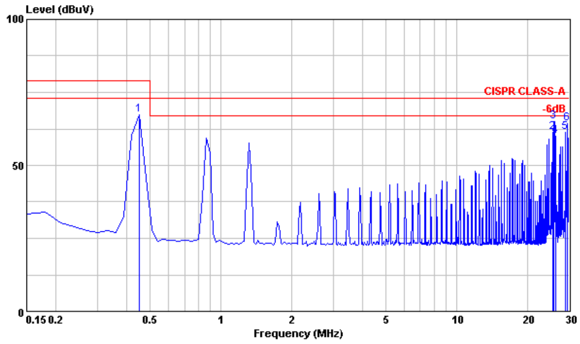
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\,nom}$



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

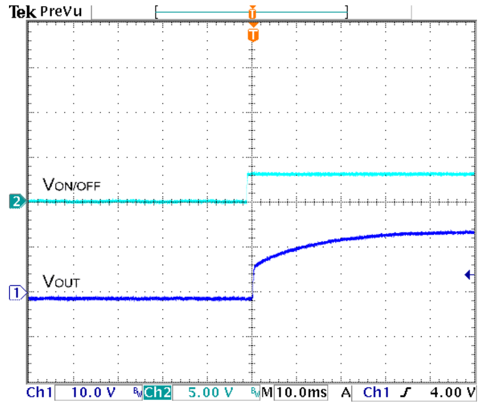
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-2413WIN (Continued)



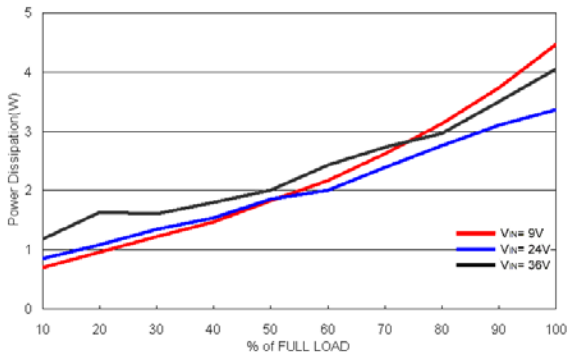
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\ nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

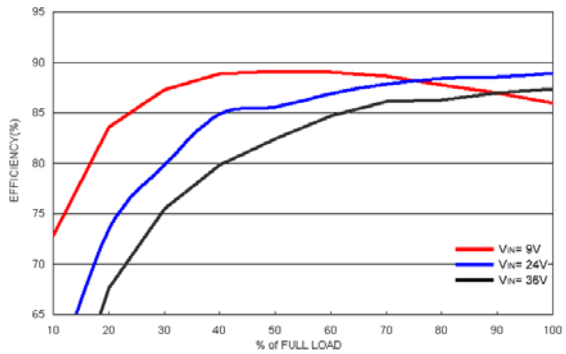
$V_{in} = V_{in\ nom}$; Full Load



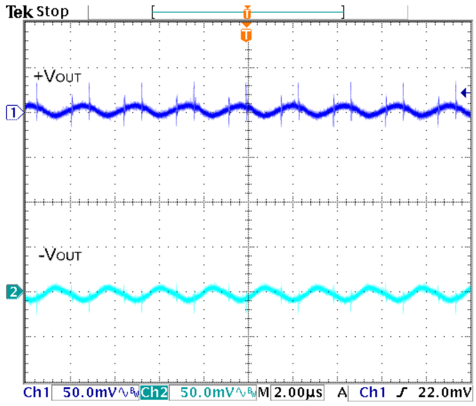
Power Dissipation Versus Output Current

Characteristic Curves

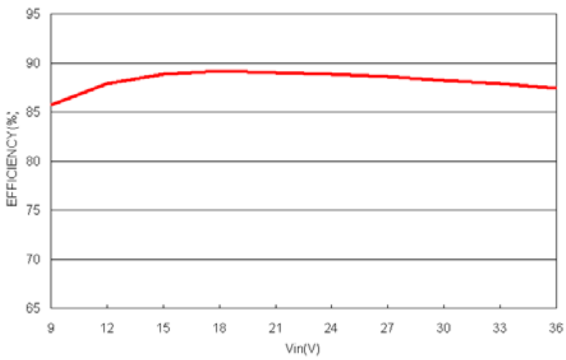
All test conditions are at 25°C.The figures are identical for TEN 30-2421WIN



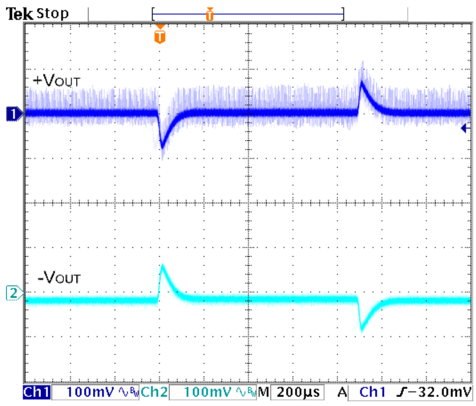
Efficiency Versus Output Current



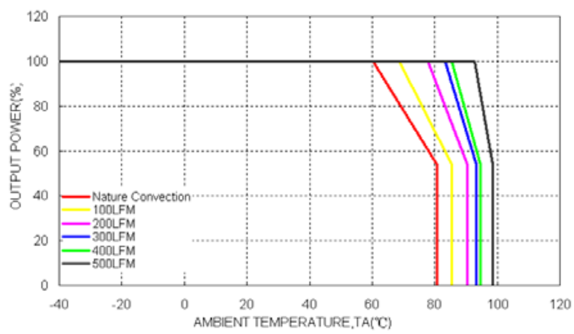
Typical Output Ripple and Noise.
$V_{in} = V_{in\ nom}$; Full Load



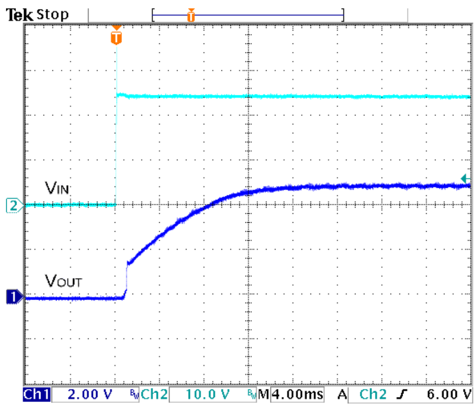
Efficiency Versus Input Voltage. Full Load



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



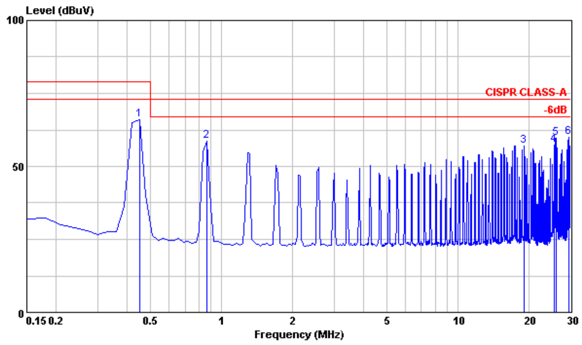
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\ nom}$



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

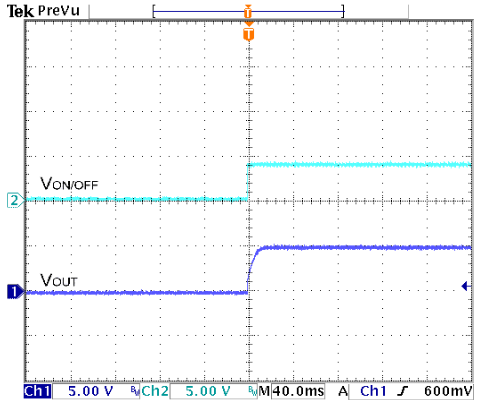
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-2421WIN (Continued)



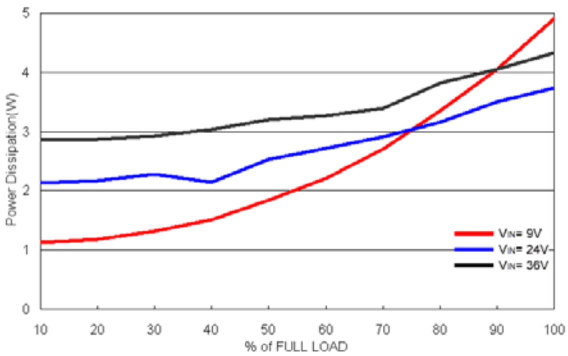
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\ nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

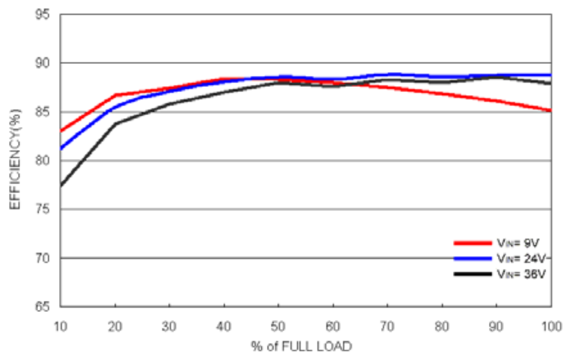
$V_{in} = V_{in\ nom}$; Full Load



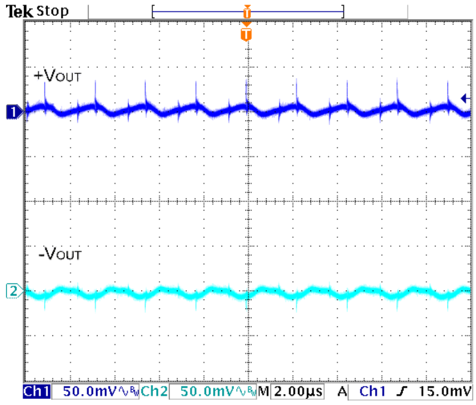
Power Dissipation Versus Output Current

Characteristic Curves

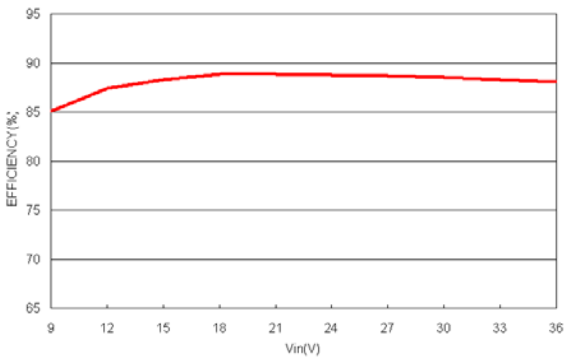
All test conditions are at 25°C.The figures are identical for TEN 30-2422WIN



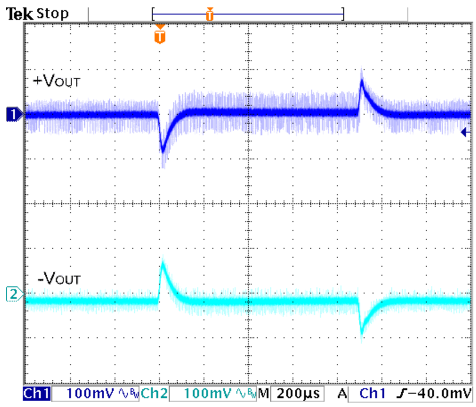
Efficiency Versus Output Current



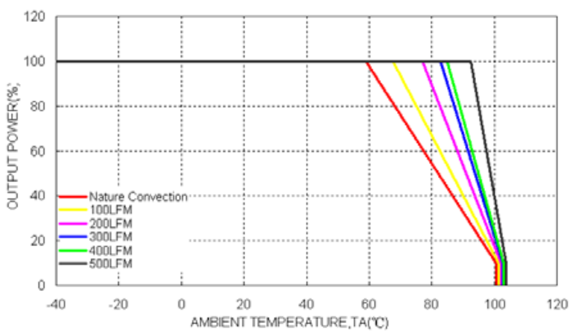
Typical Output Ripple and Noise.
$V_{in} = V_{in\ nom}$; Full Load



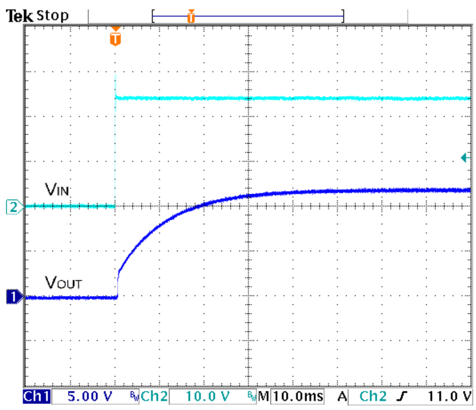
Efficiency Versus Input Voltage. Full Load



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



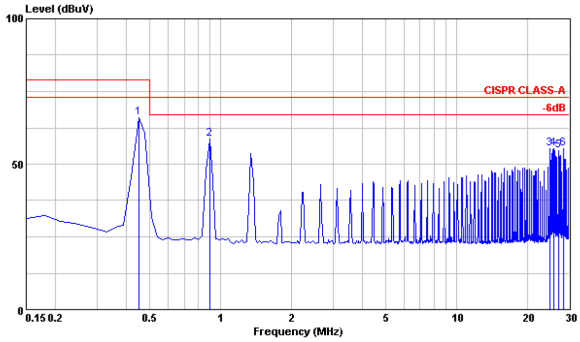
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\ nom}$



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

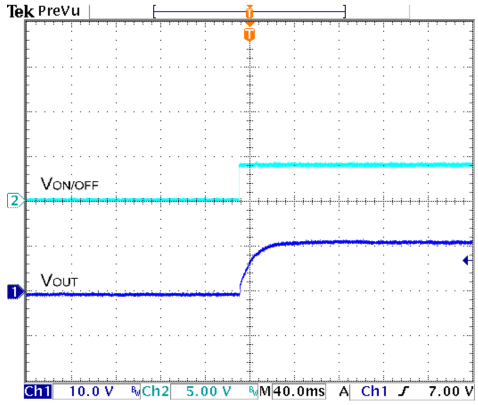
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-2422WIN (Continued)



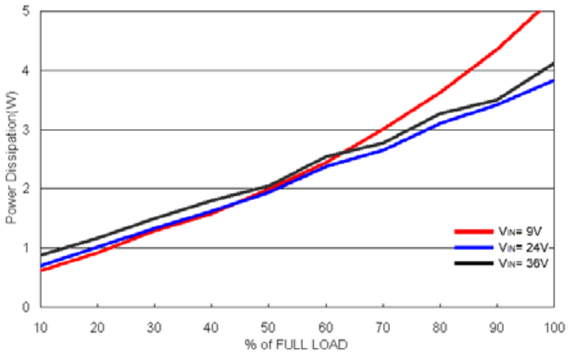
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\ nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

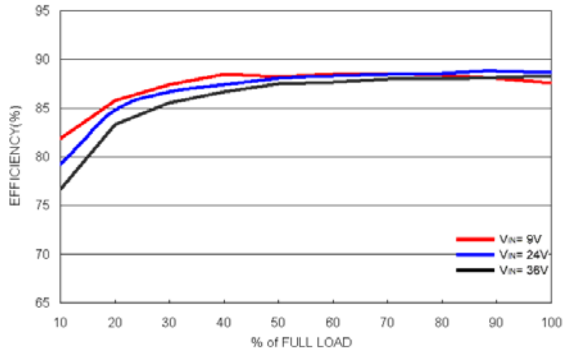
$V_{in} = V_{in\ nom}$; Full Load



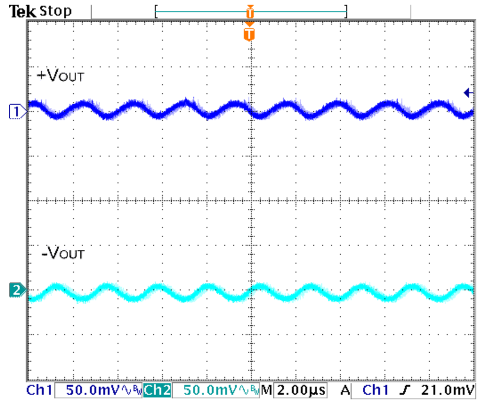
Power Dissipation Versus Output Current

Characteristic Curves

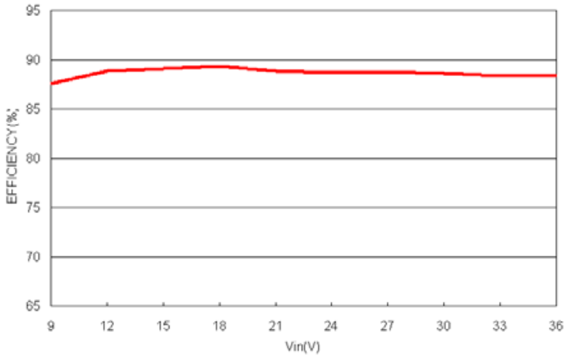
All test conditions are at 25°C.The figures are identical for TEN 30-2423WIN



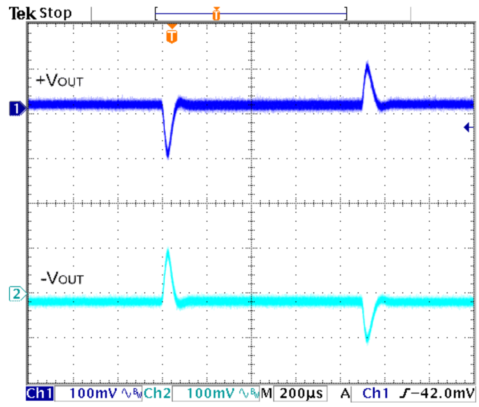
Efficiency Versus Output Current



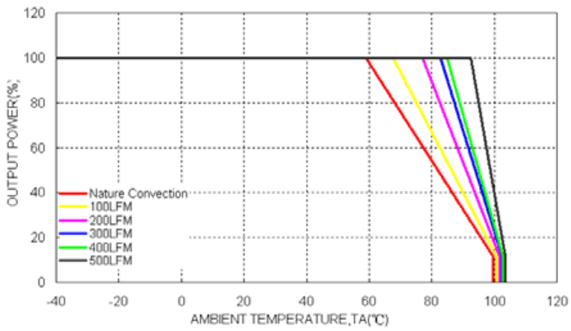
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$; Full Load



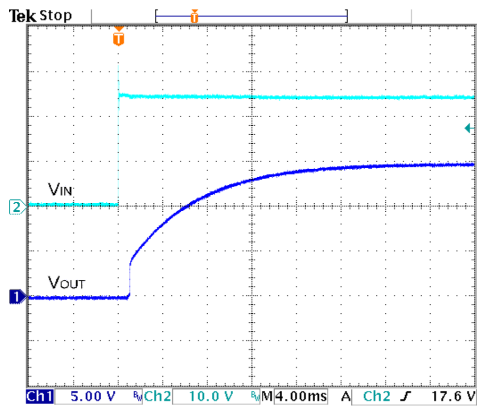
Efficiency Versus Input Voltage. Full Load



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



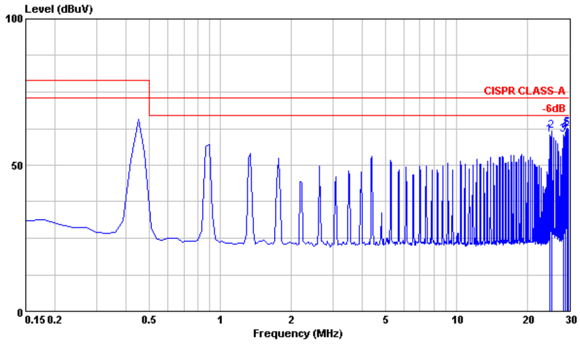
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\,nom}$



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

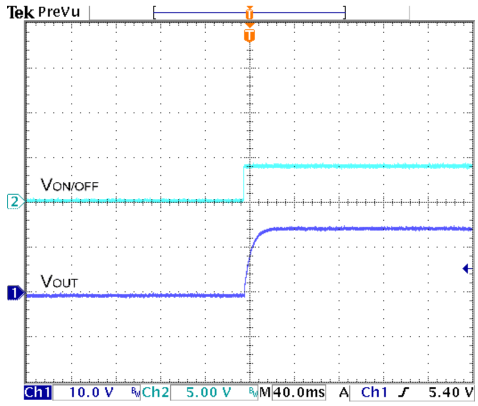
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-2423WIN (Continued)



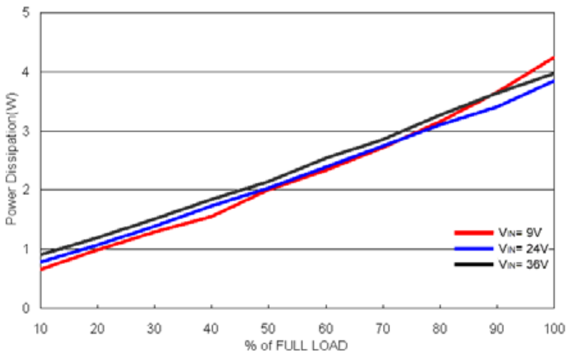
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\ nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

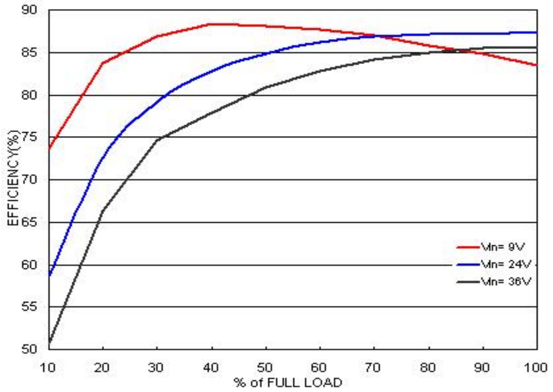
$V_{in} = V_{in\ nom}$; Full Load



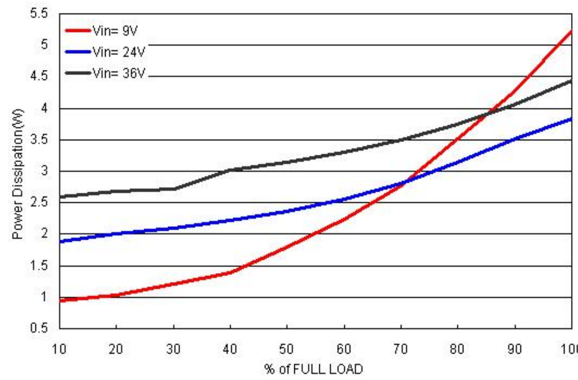
Power Dissipation Versus Output Current

Characteristic Curves

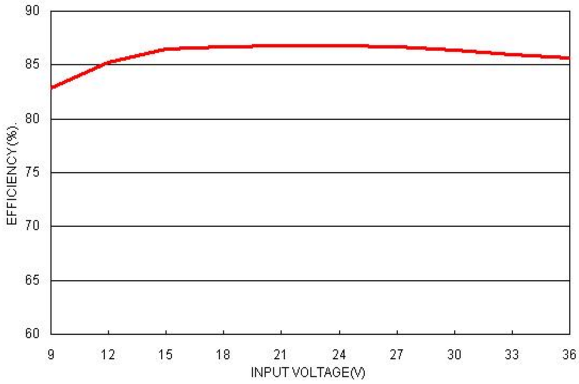
All test conditions are at 25°C. The figures are identical for TEN 30-2433WIN



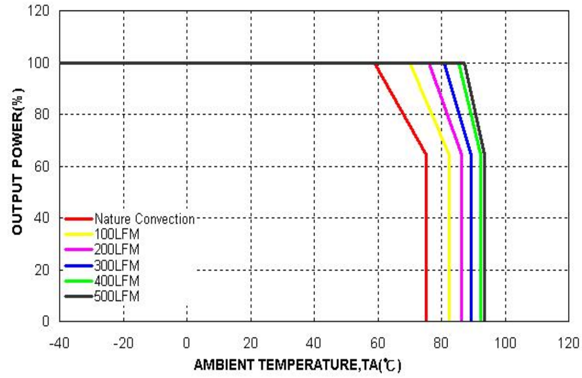
Efficiency Versus Output Current



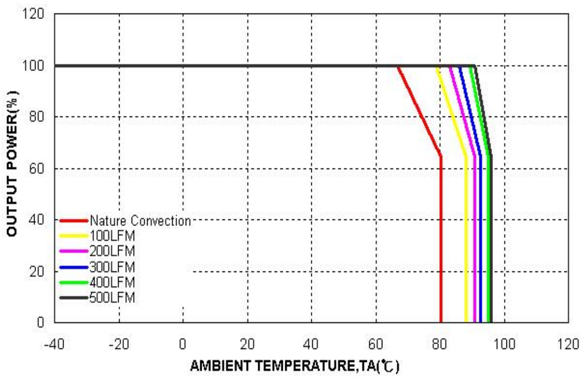
Power Dissipation Versus Output Current



Efficiency Versus Input Voltage. Full Load



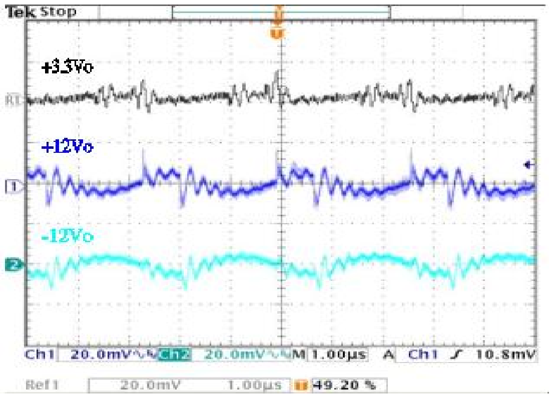
Derating Output Current Versus Ambient Temperature and Airflow $V_{in} = V_{in\,nom}$



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

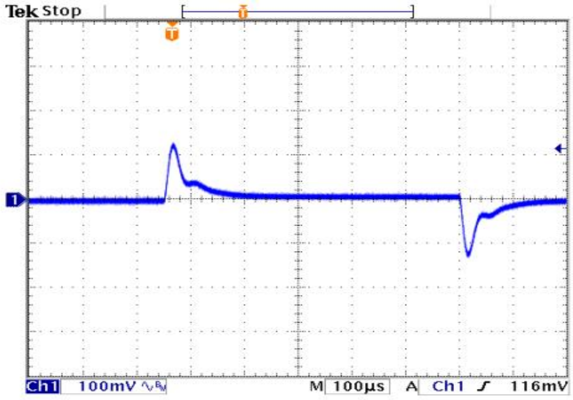
Characteristic Curves (Continued)

All test conditions are at 25°C. The figures are identical for TEN 30-2433WIN

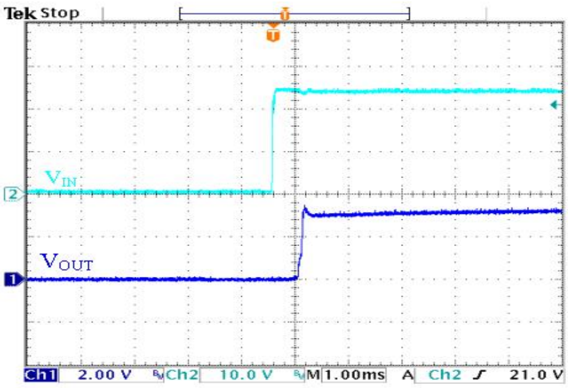


Typical Output Ripple and Noise.

$V_{in} = V_{in\,nom}$; Full Load

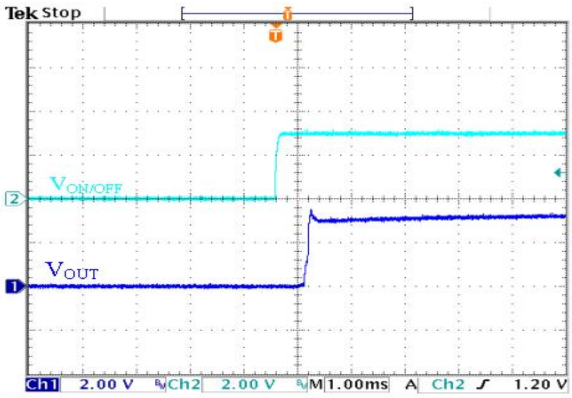


Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load ; $V_{in} = V_{in\,nom}$



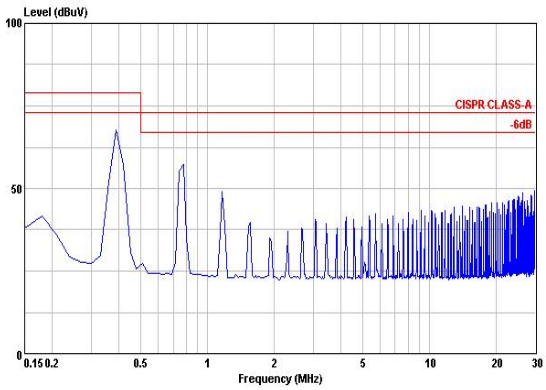
Typical Input Start-Up and Output Rise Characteristic

$V_{in} = V_{in\,nom}$; Full Load



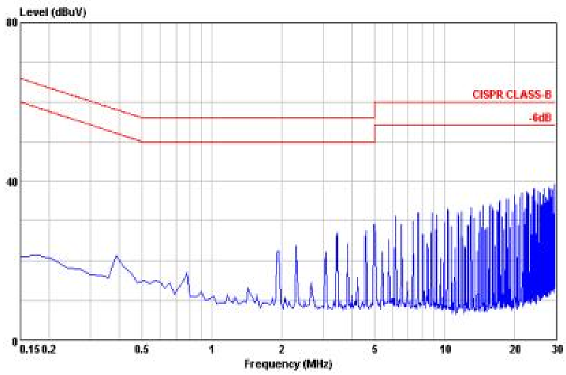
Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

$V_{in} = V_{in\,nom}$; Full Load



Conduction Emission of EN55022 Class A

$V_{in} = V_{in\,nom}$; Full Load

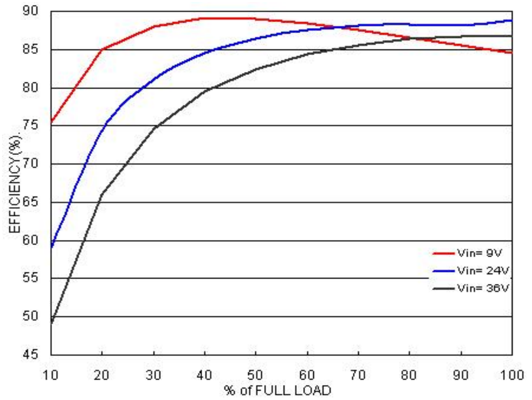


Conduction Emission of EN55022 Class B

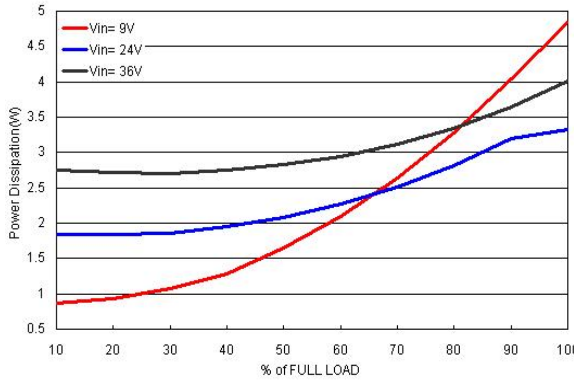
$V_{in} = V_{in\,nom}$; Full Load

Characteristic Curves (Continued)

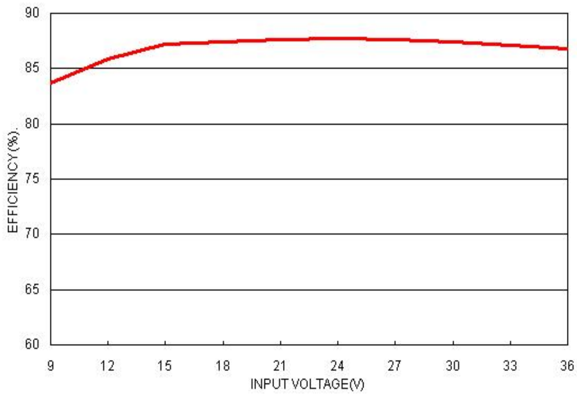
All test conditions are at 25°C. The figures are identical for TEN 30-2434WIN



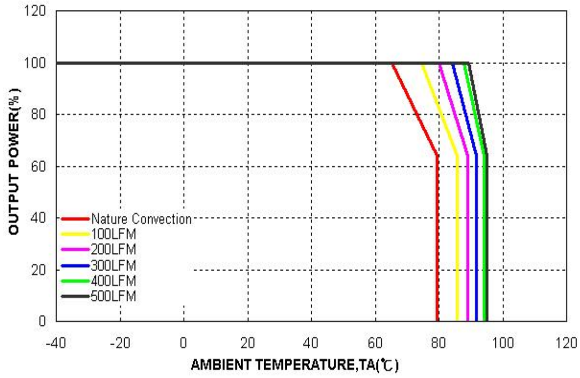
Efficiency Versus Output Current



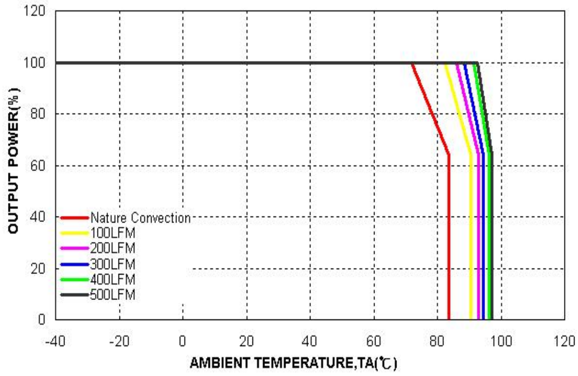
Power Dissipation Versus Output Current



Efficiency Versus Input Voltage. Full Load



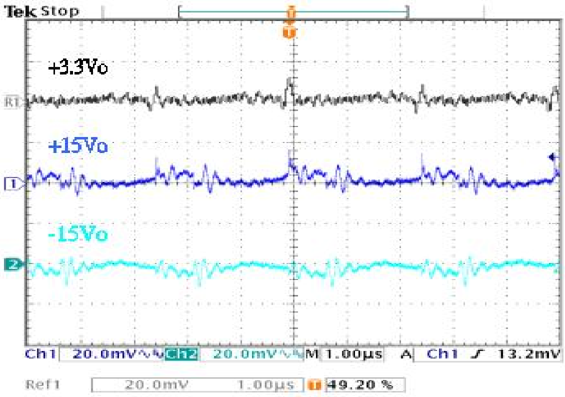
Derating Output Current Versus Ambient Temperature and Airflow $V_{in} = V_{in\,nom}$



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

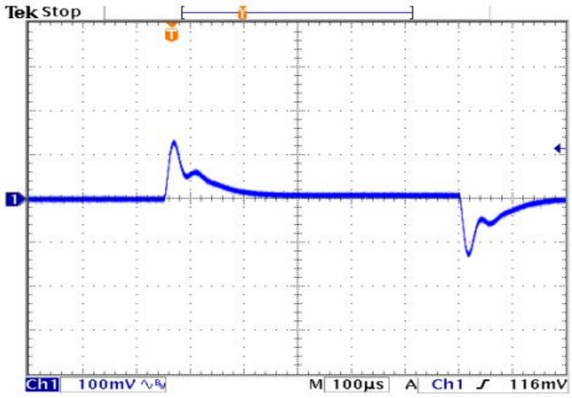
Characteristic Curves (Continued)

All test conditions are at 25°C. The figures are identical for TEN 30-2434WIN

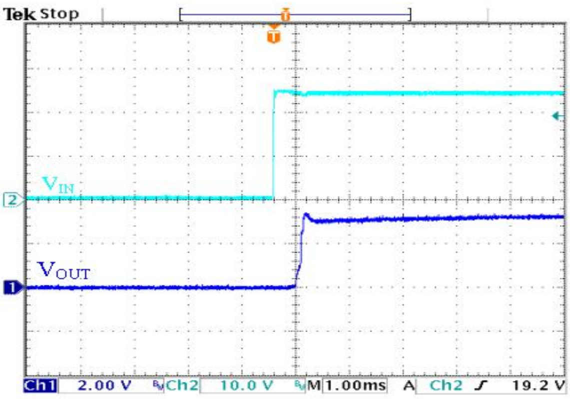


Typical Output Ripple and Noise.

$V_{in} = V_{in\,nom}$; Full Load

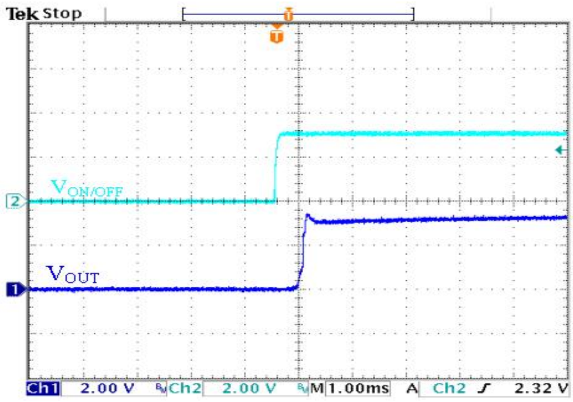


Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load ; $V_{in} = V_{in\,nom}$



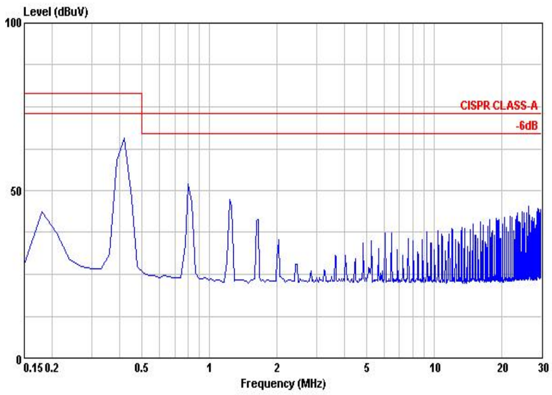
Typical Input Start-Up and Output Rise Characteristic

$V_{in} = V_{in\,nom}$; Full Load



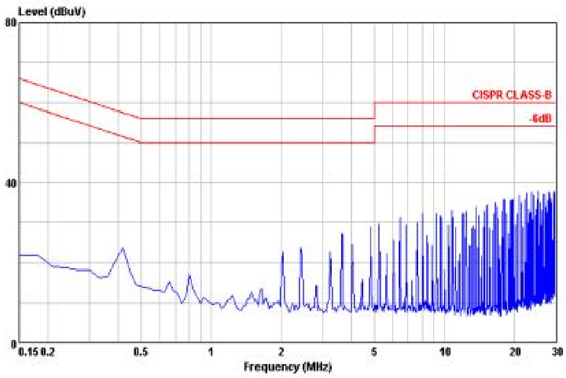
Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

$V_{in} = V_{in\,nom}$; Full Load



Conduction Emission of EN55022 Class A

$V_{in} = V_{in\,nom}$; Full Load

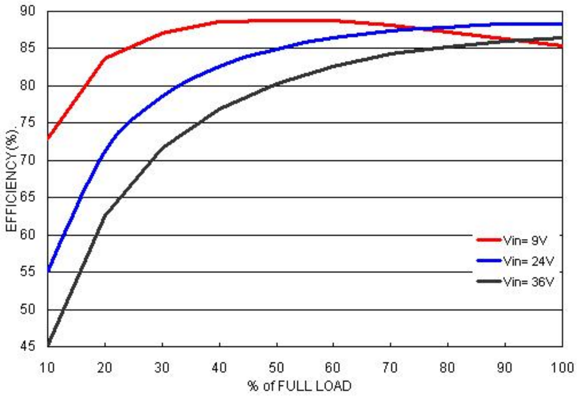


Conduction Emission of EN55022 Class B

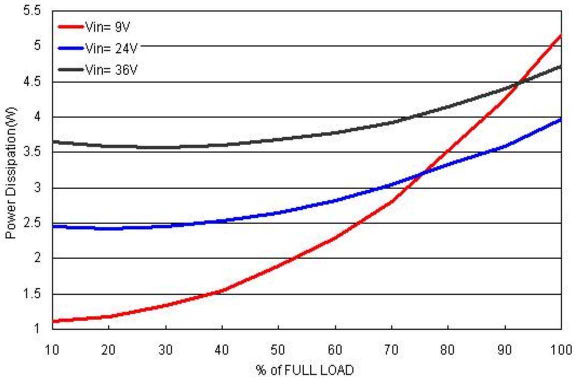
$V_{in} = V_{in\,nom}$; Full Load

Characteristic Curves (Continued)

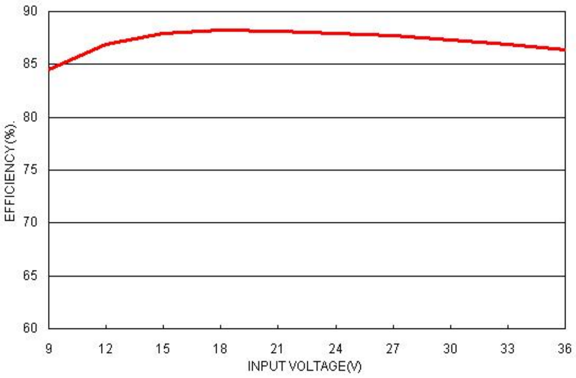
All test conditions are at 25°C. The figures are identical for TEN 30-2431WIN



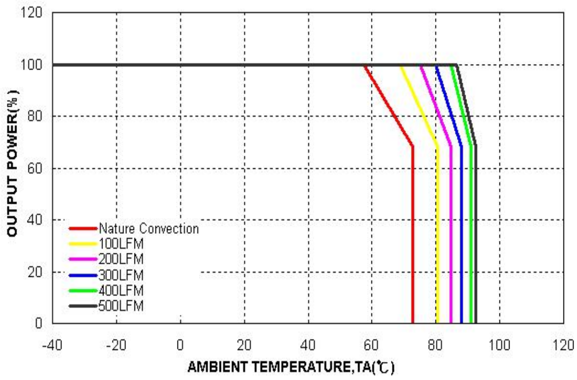
Efficiency Versus Output Current



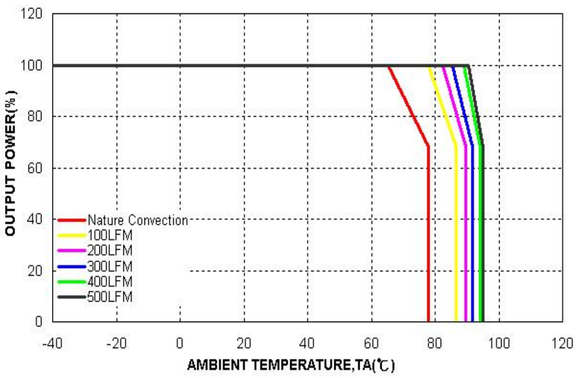
Power Dissipation Versus Output Current



Efficiency Versus Input Voltage. Full Load



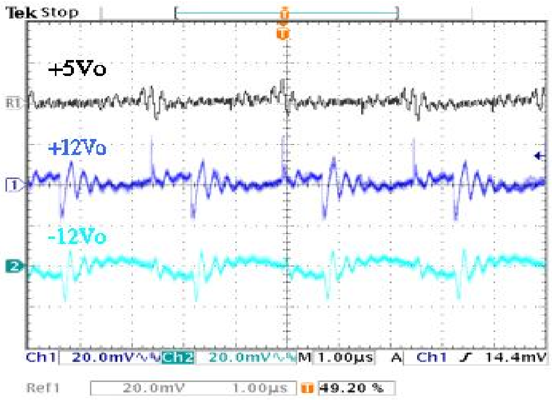
Derating Output Current Versus Ambient Temperature and Airflow $V_{in} = V_{in\,nom}$



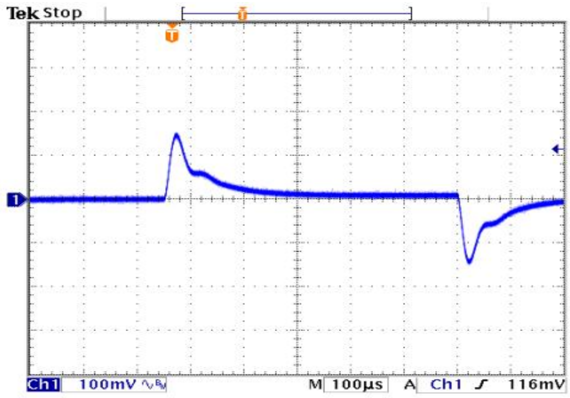
Derating Output Current Versus Ambient Temperature with Heat-Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

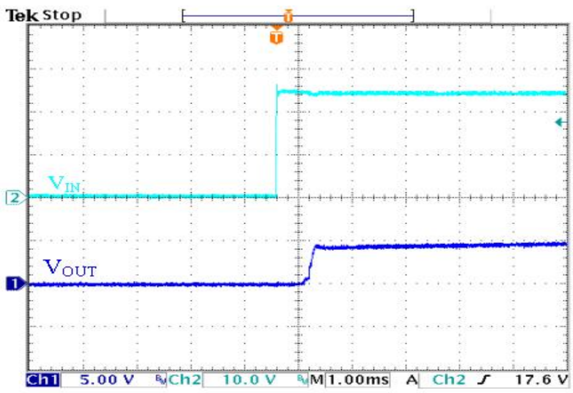
All test conditions are at 25°C. The figures are identical for TEN 30-2431WIN



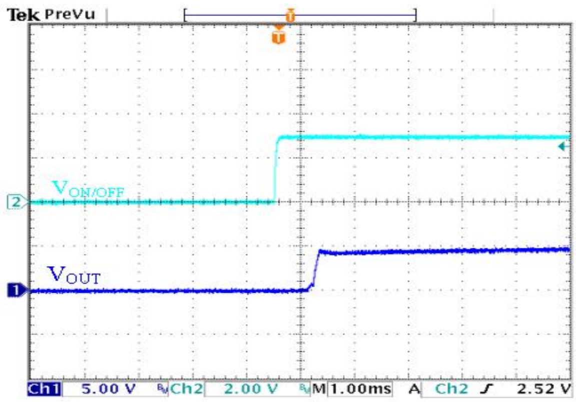
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$; Full Load



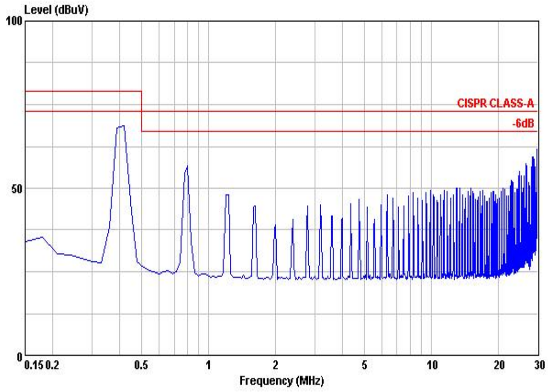
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load ; $V_{in} = V_{in\,nom}$



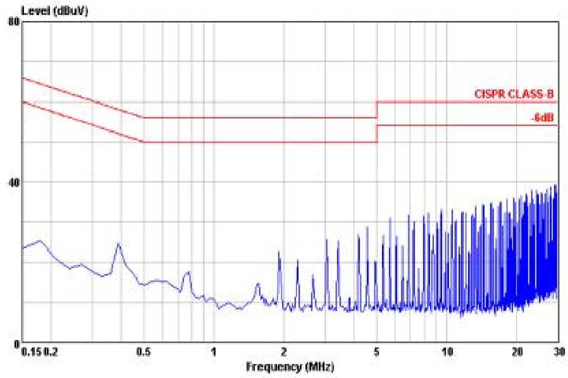
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$; Full Load



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



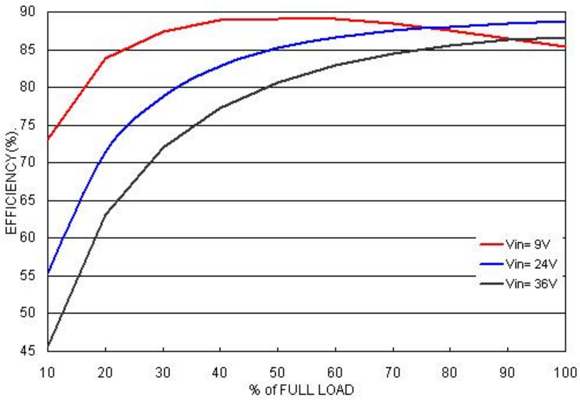
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$; Full Load



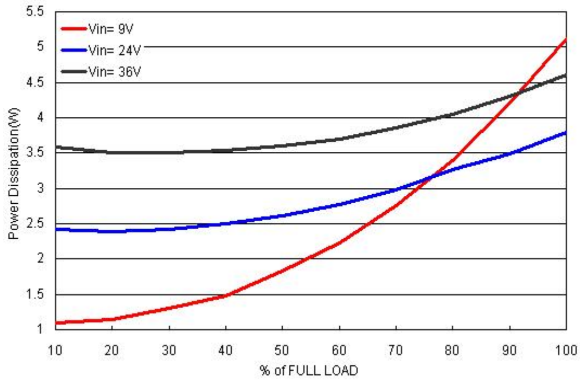
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$; Full Load

Characteristic Curves (Continued)

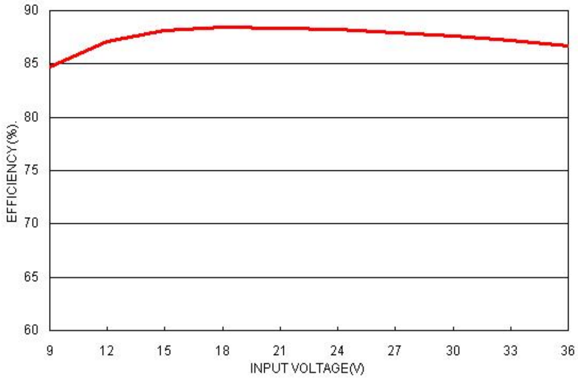
All test conditions are at 25°C. The figures are identical for TEN 30-2432WIN



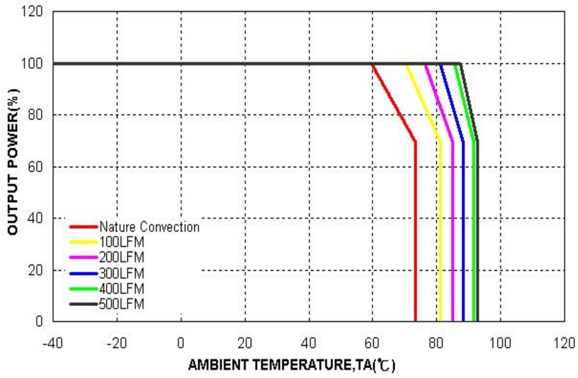
Efficiency Versus Output Current



Power Dissipation Versus Output Current

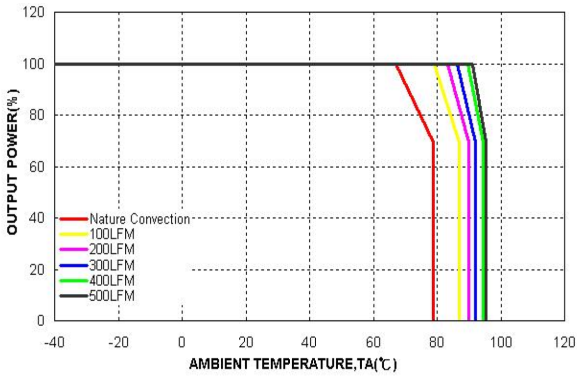


Efficiency Versus Input Voltage. Full Load



Derating Output Current Versus Ambient Temperature and Airflow

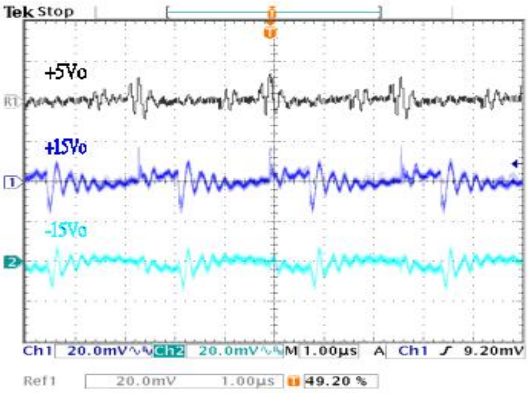
$V_{in} = V_{in\,nom}$



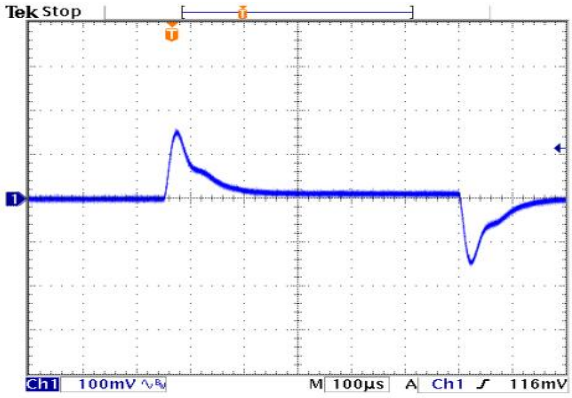
Derating Output Current Versus Ambient Temperature with Heat-Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

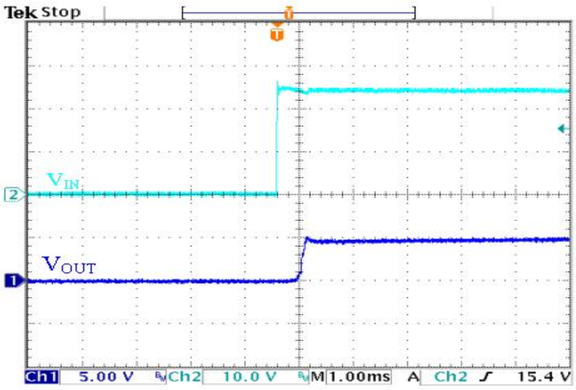
All test conditions are at 25°C. The figures are identical for TEN 30-2432WIN



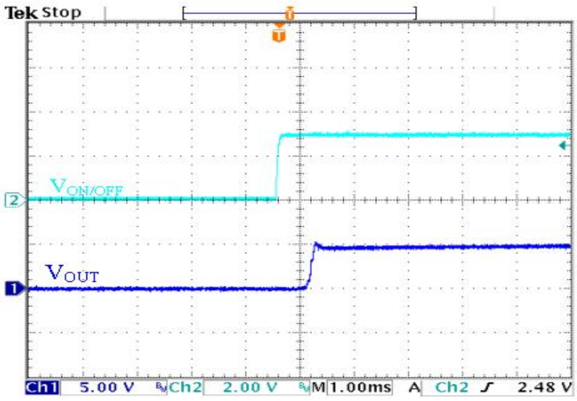
Typical Output Ripple and Noise.
$V_{in} = V_{in\ nom}$; Full Load



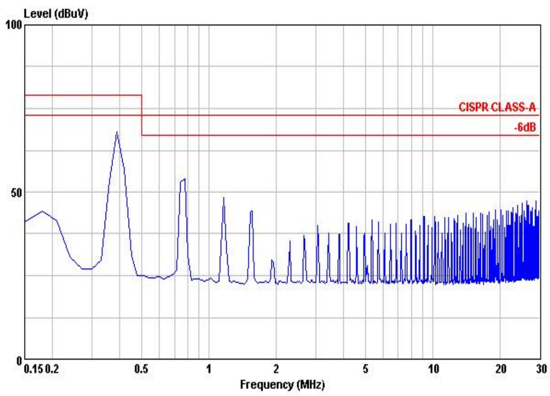
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load ; $V_{in} = V_{in\ nom}$



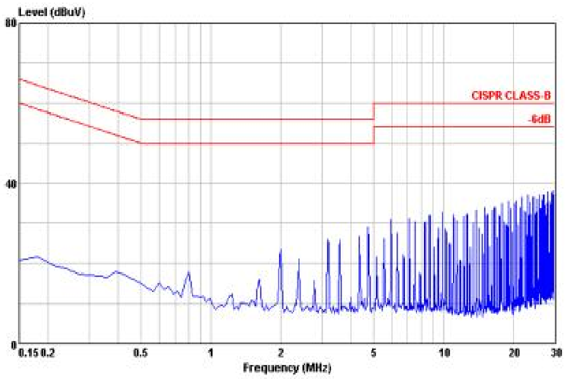
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\ nom}$; Full Load



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



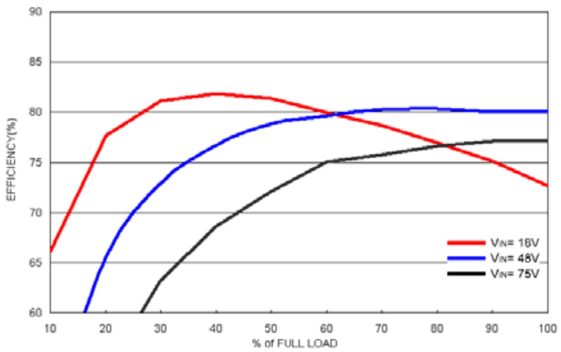
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\ nom}$; Full Load



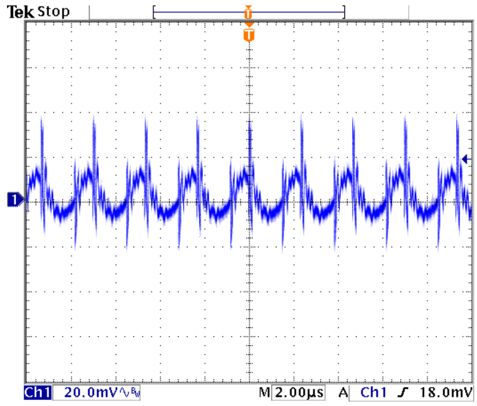
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-4807WIN

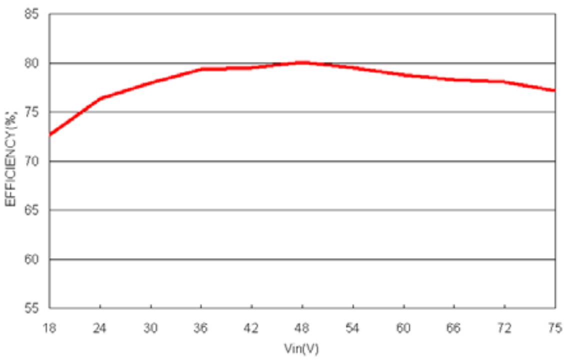


Efficiency Versus Output Current

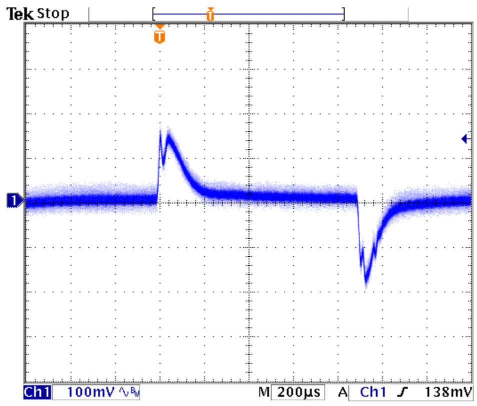


Typical Output Ripple and Noise.

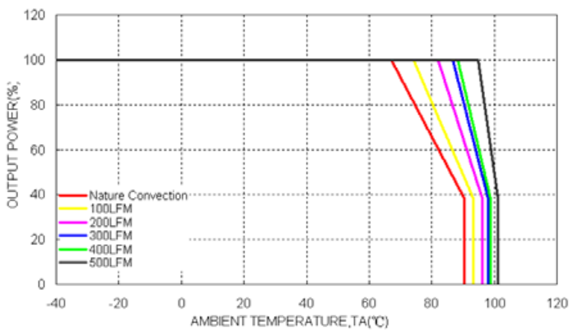
$V_{in} = V_{in\,nom}$; Full Load



Efficiency Versus Input Voltage. Full Load

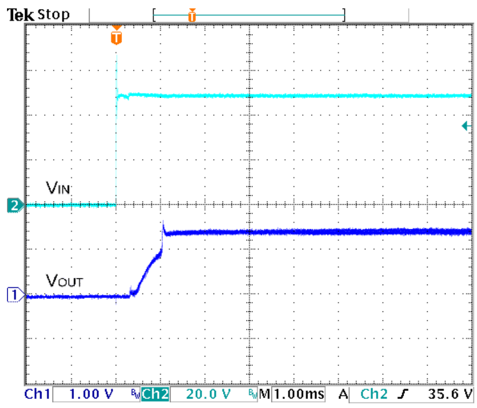


Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load ; $V_{in} = V_{in\,nom}$



Derating Output Current Versus Ambient Temperature and Airflow

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

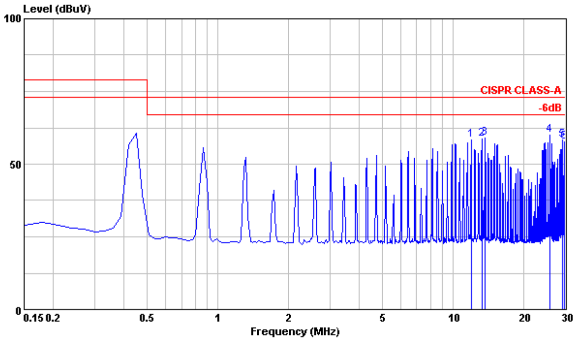


Typical Input Start-Up and Output Rise Characteristic

$V_{in} = V_{in\,nom}$; Full Load

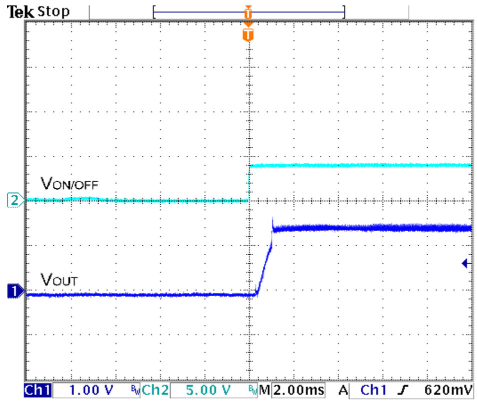
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-4807WIN (Continued)



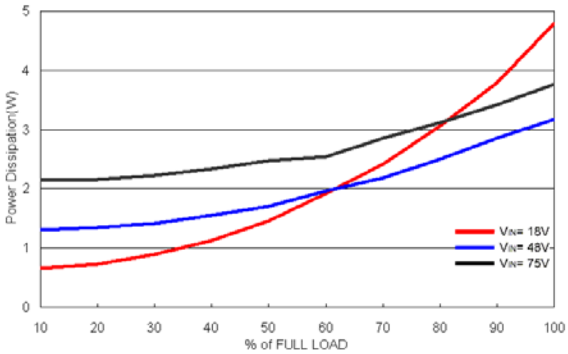
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\ nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

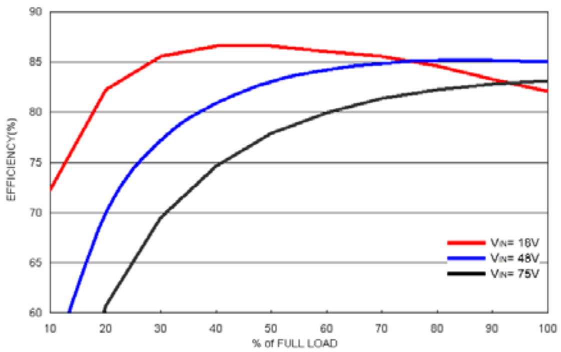
$V_{in} = V_{in\ nom}$; Full Load



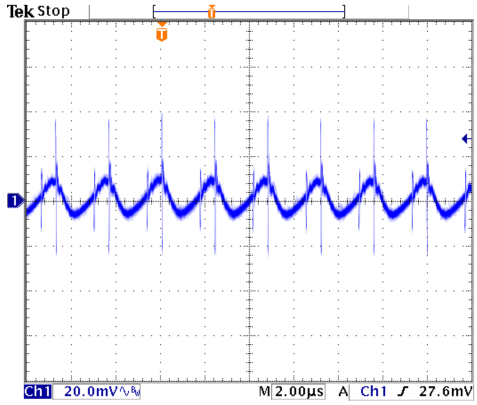
Power Dissipation Versus Output Current

Characteristic Curves

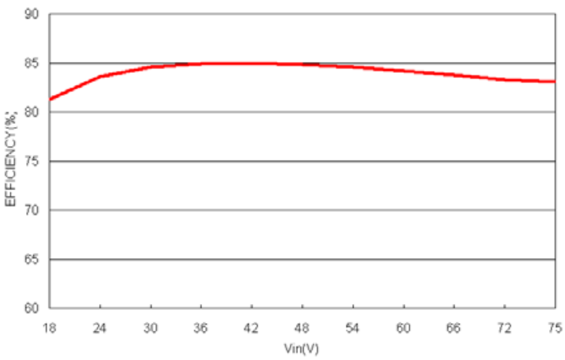
All test conditions are at 25°C.The figures are identical for TEN 30-4809WIN



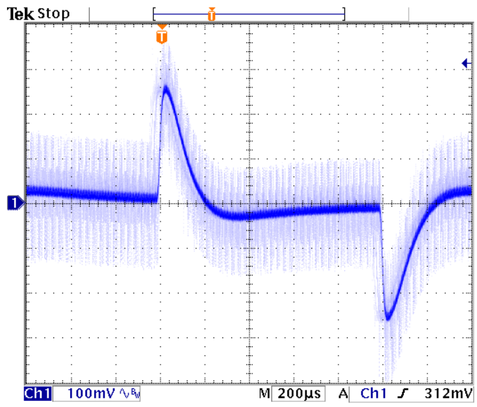
Efficiency Versus Output Current



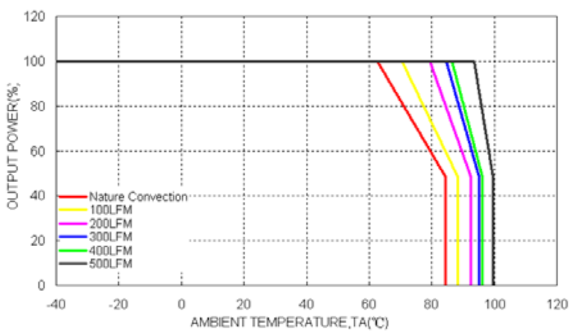
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$; Full Load



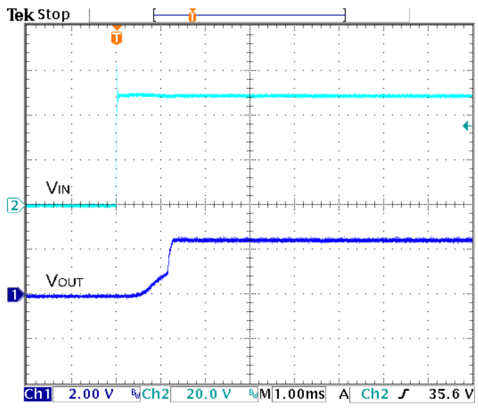
Efficiency Versus Input Voltage. Full Load



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



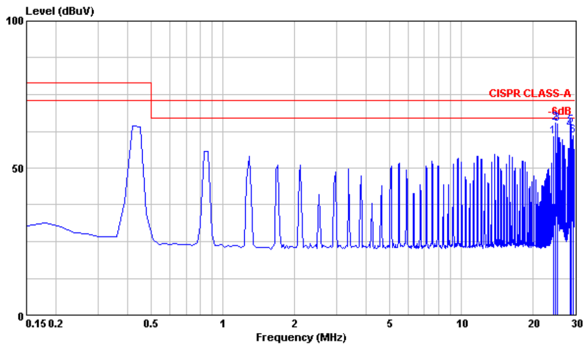
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\,nom}$



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

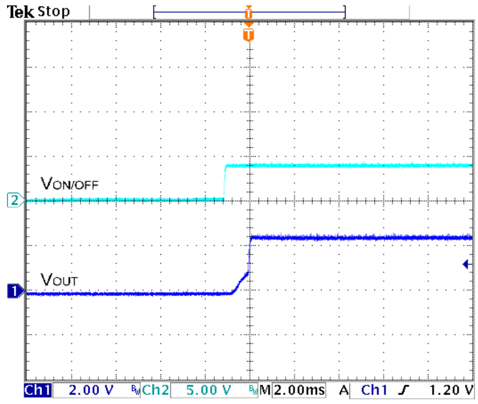
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-4809WIN(Continued)



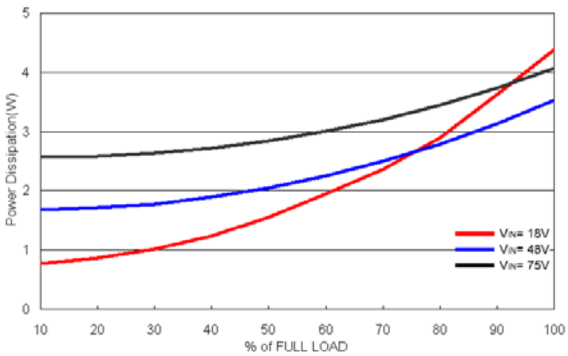
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\,nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

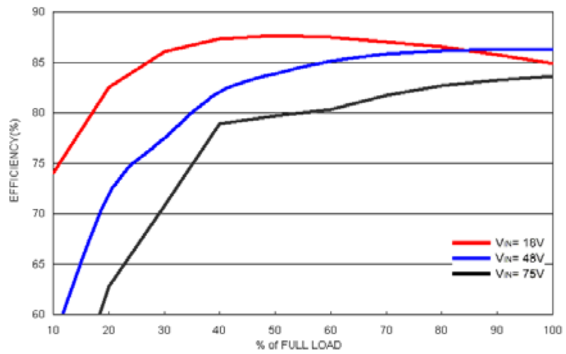
$V_{in} = V_{in\,nom}$; Full Load



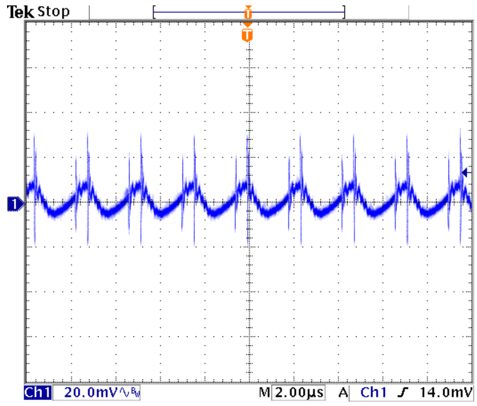
Power Dissipation Versus Output Current

Characteristic Curves

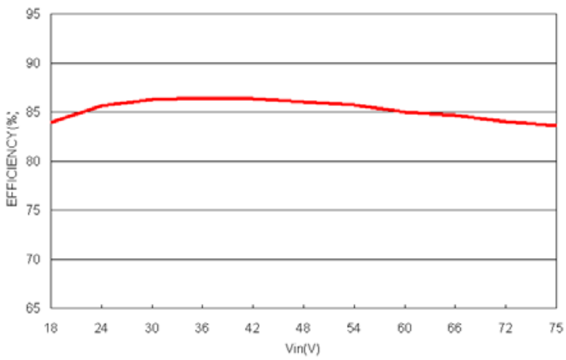
All test conditions are at 25°C.The figures are identical for TEN 30-4810WIN



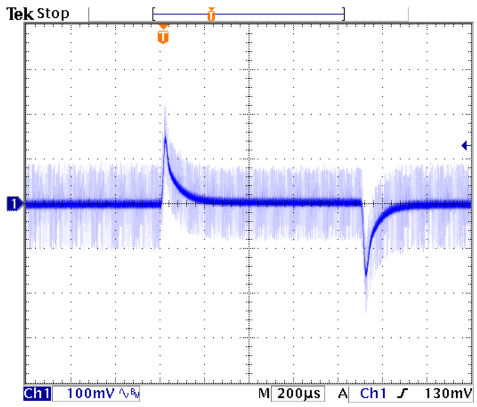
Efficiency Versus Output Current



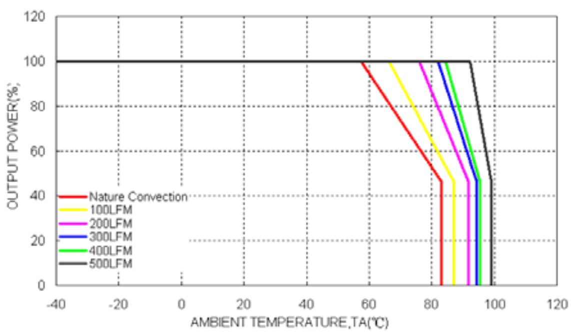
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$; Full Load



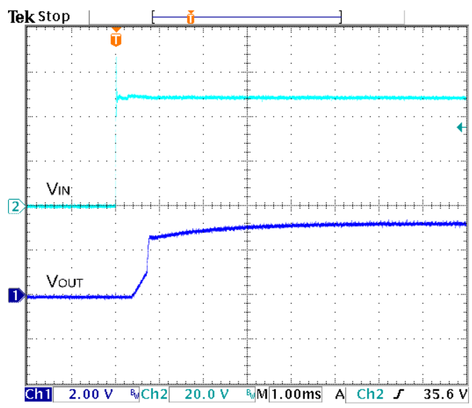
Efficiency Versus Input Voltage. Full Load



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



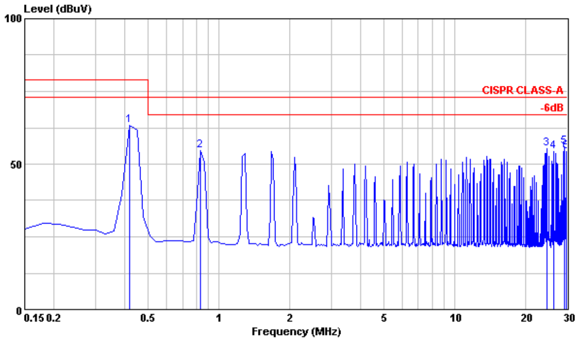
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\,nom}$



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

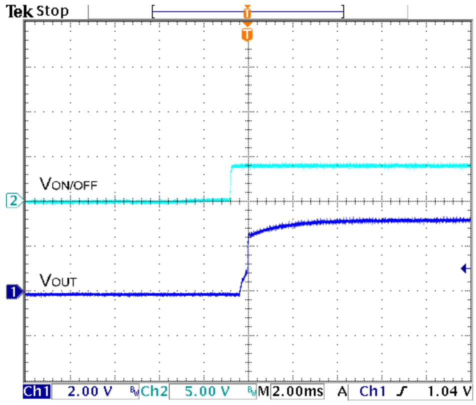
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-4810WIN (Continued)



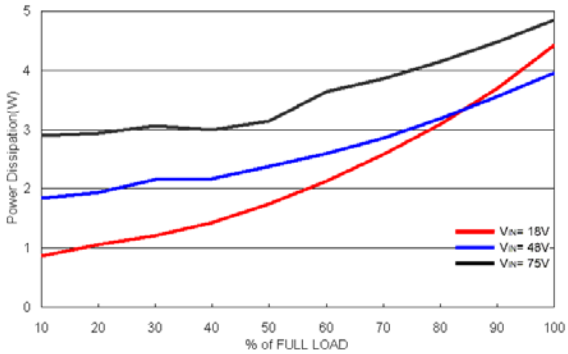
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\ nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

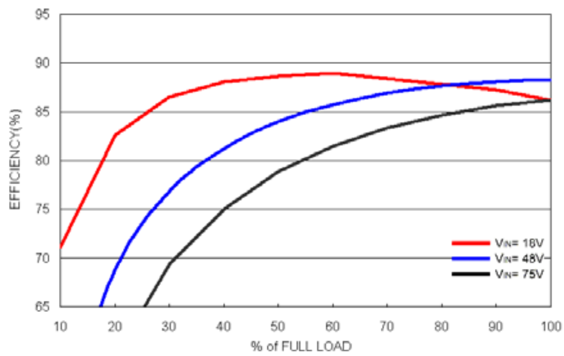
$V_{in} = V_{in\ nom}$; Full Load



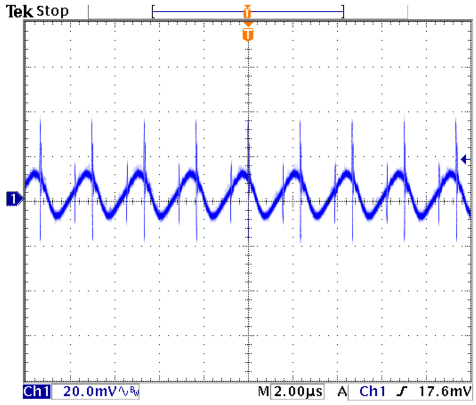
Power Dissipation Versus Output Current

Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-4811WIN

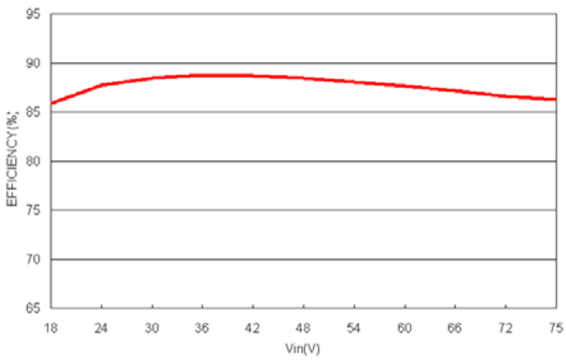


Efficiency Versus Output Current

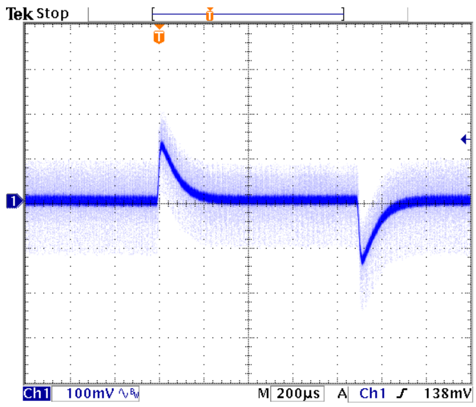


Typical Output Ripple and Noise.

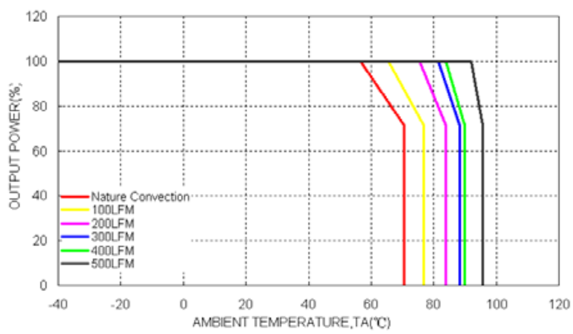
$V_{in} = V_{in\ nom}$; Full Load



Efficiency Versus Input Voltage. Full Load

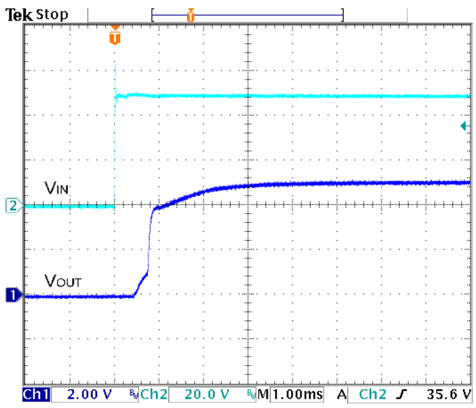


Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load ; $V_{in} = V_{in\ nom}$



Derating Output Current Versus Ambient Temperature and Airflow

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

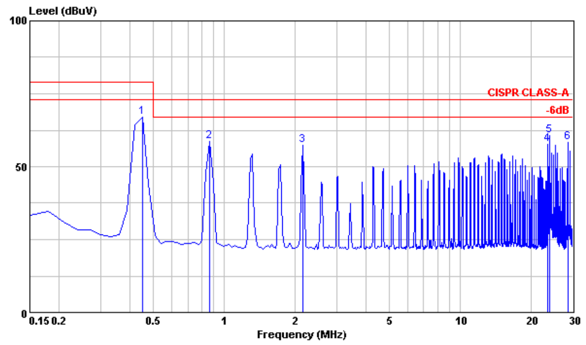


Typical Input Start-Up and Output Rise Characteristic

$V_{in} = V_{in\ nom}$; Full Load

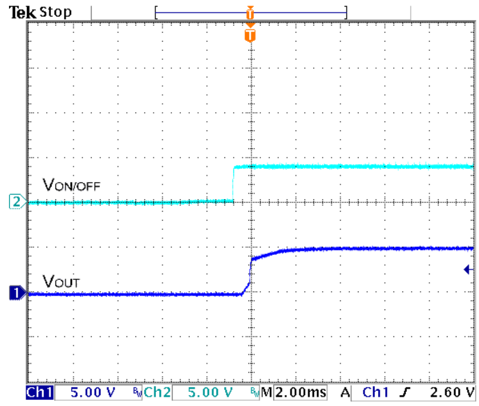
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-4811WIN (Continued)



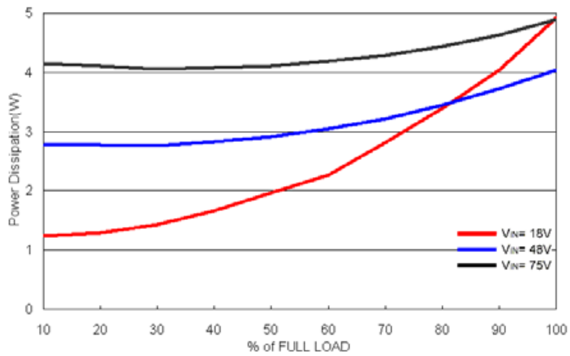
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\,nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

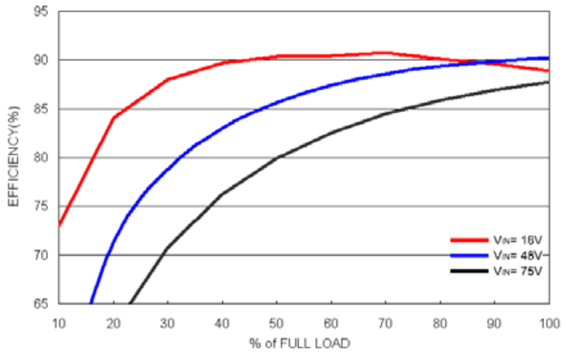
$V_{in} = V_{in\,nom}$; Full Load



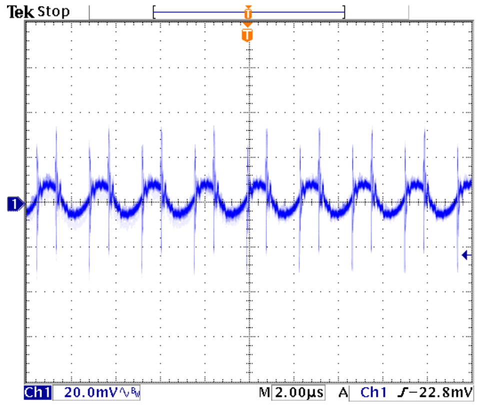
Power Dissipation Versus Output Current

Characteristic Curves

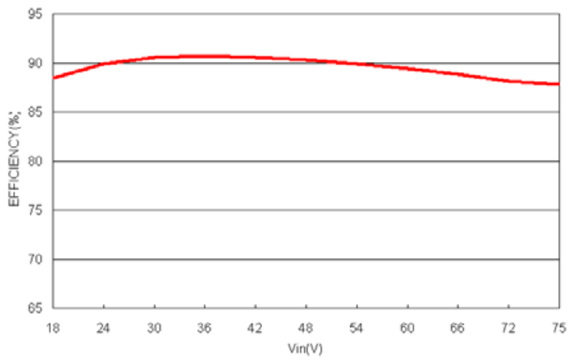
All test conditions are at 25°C.The figures are identical for TEN 30-4812WIN



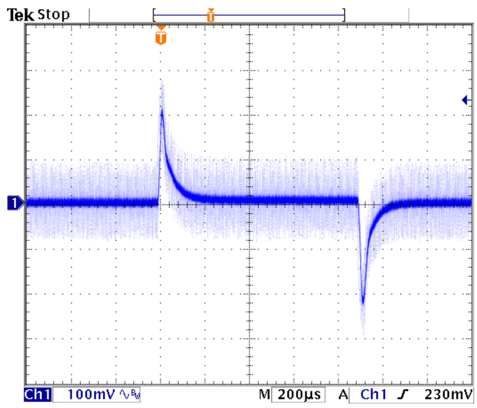
Efficiency Versus Output Current



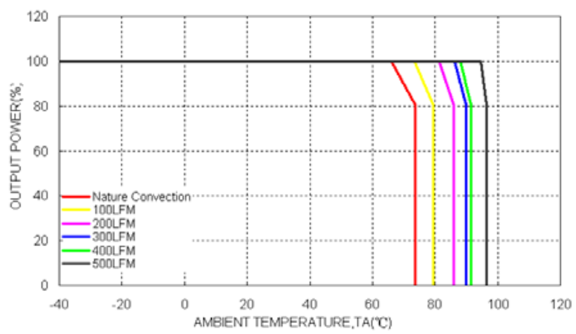
Typical Output Ripple and Noise.
$V_{in} = V_{in\ nom}$; Full Load



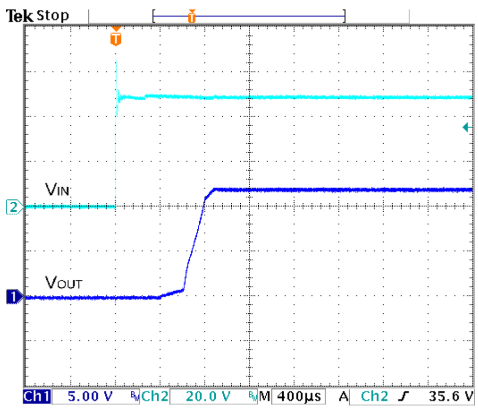
Efficiency Versus Input Voltage. Full Load



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



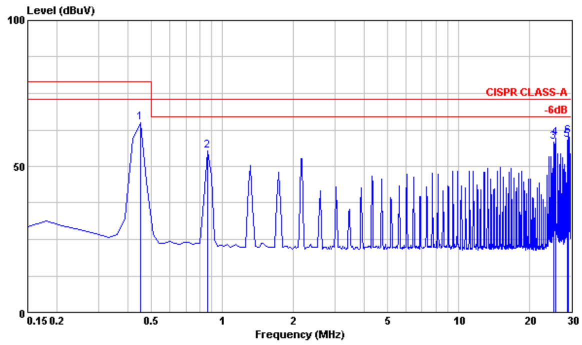
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\ nom}$



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

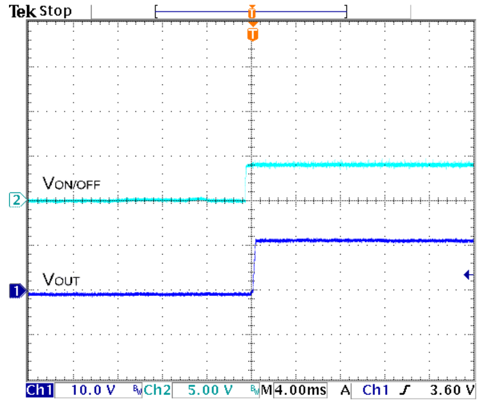
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-4812WIN (Continued)



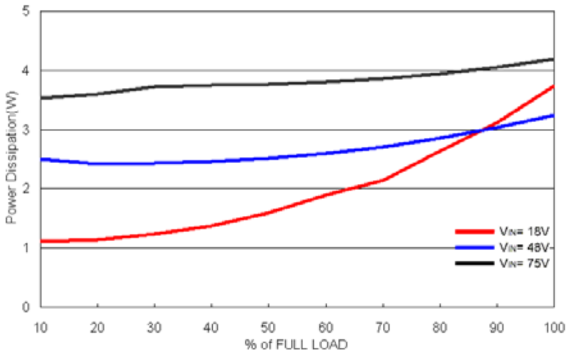
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\ nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

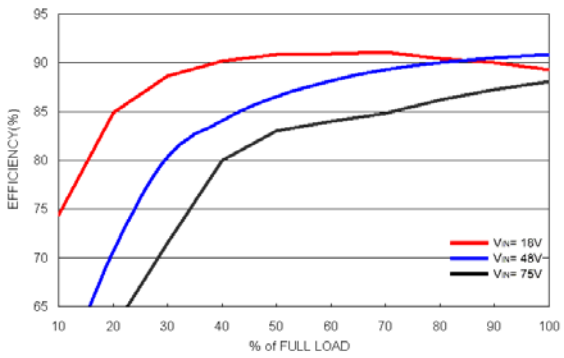
$V_{in} = V_{in\ nom}$; Full Load



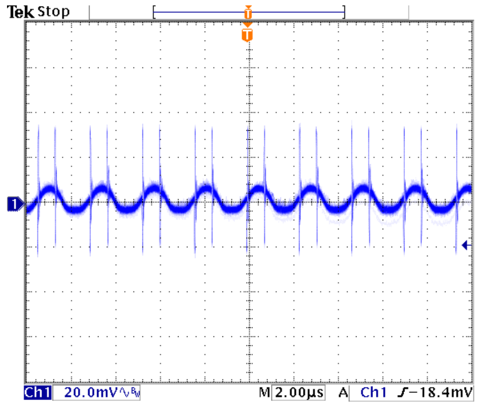
Power Dissipation Versus Output Current

Characteristic Curves

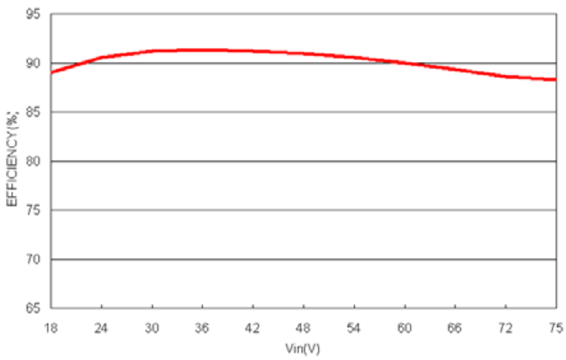
All test conditions are at 25°C.The figures are identical for TEN 30-4813WIN



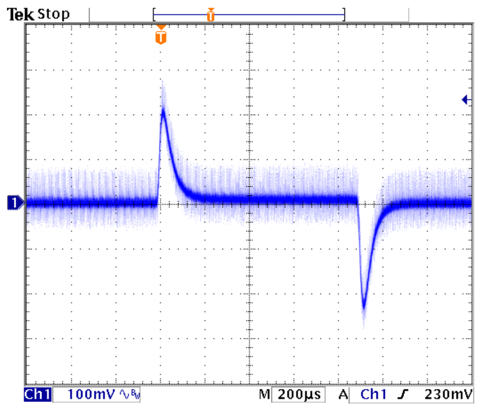
Efficiency Versus Output Current



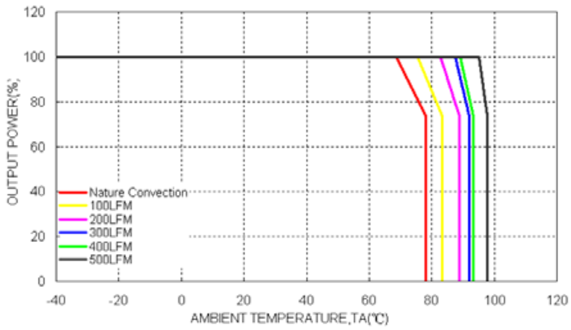
Typical Output Ripple and Noise.
$V_{in} = V_{in\ nom}$; Full Load



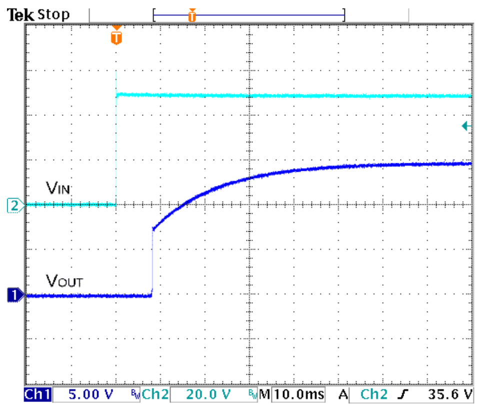
Efficiency Versus Input Voltage. Full Load



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



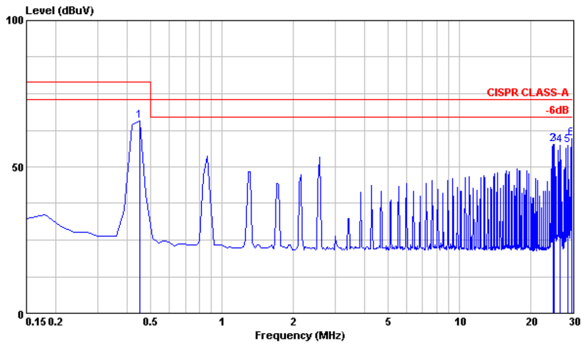
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\ nom}$



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

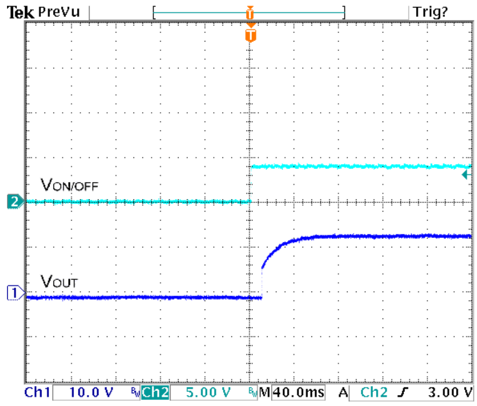
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-4813WIN (Continued)



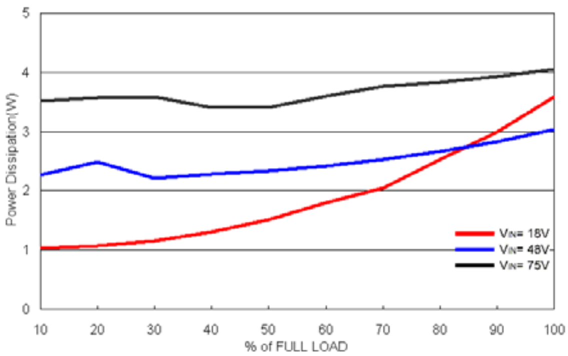
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\ nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

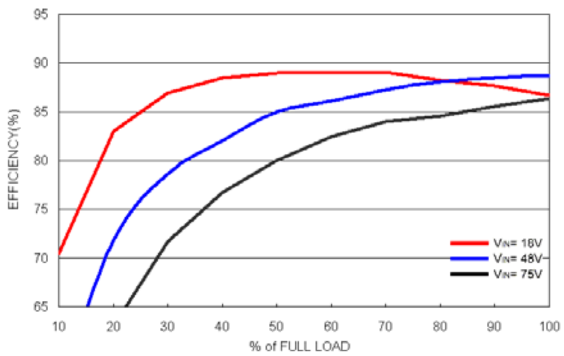
$V_{in} = V_{in\ nom}$; Full Load



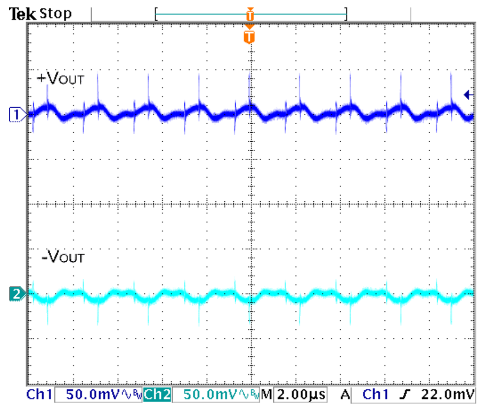
Power Dissipation Versus Output Current

Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-4821WIN

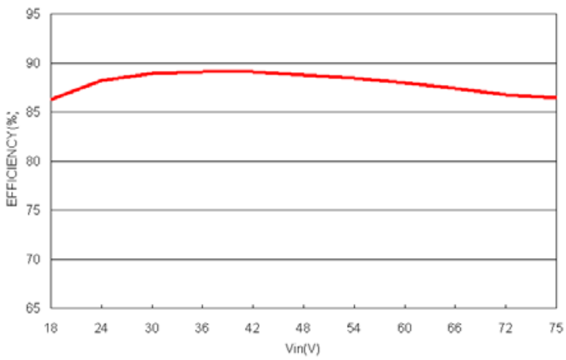


Efficiency Versus Output Current

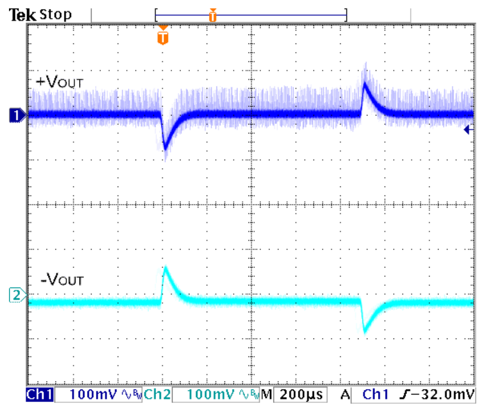


Typical Output Ripple and Noise.

$V_{in} = V_{in\,nom}$; Full Load

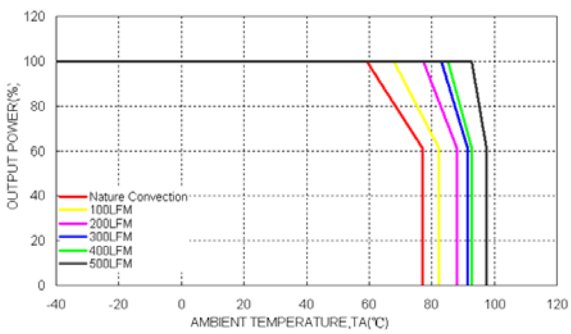


Efficiency Versus Input Voltage. Full Load



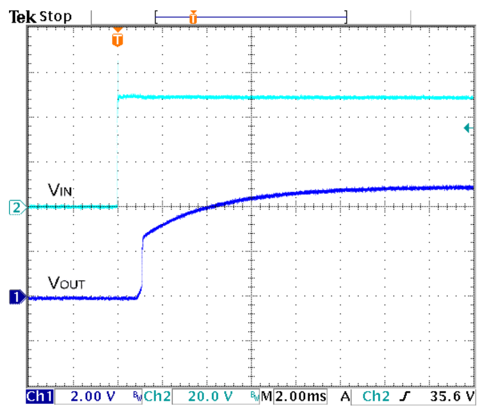
Transient Response to Dynamic Load Change from

100% to 75% to 100% of Full Load ; $V_{in} = V_{in\,nom}$



Derating Output Current Versus Ambient Temperature and Airflow

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

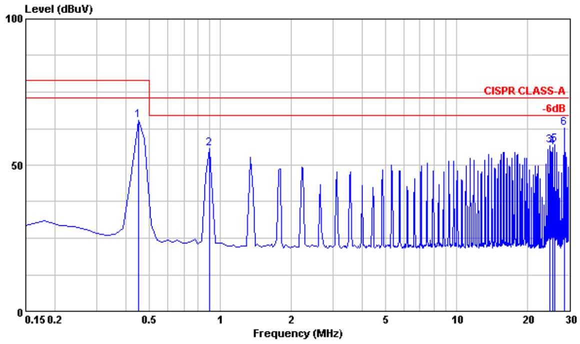


Typical Input Start-Up and Output Rise Characteristic

$V_{in} = V_{in\,nom}$; Full Load

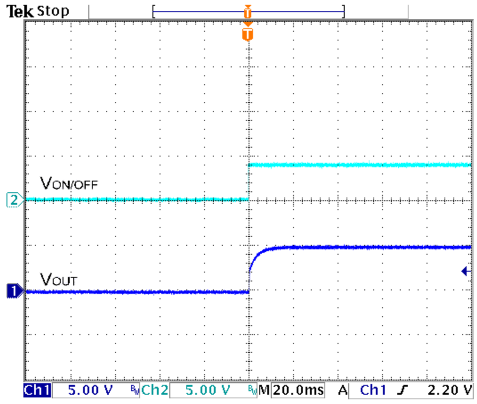
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-4821WIN (Continued)



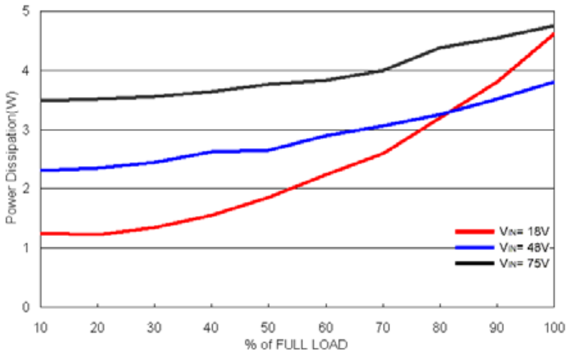
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\,nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

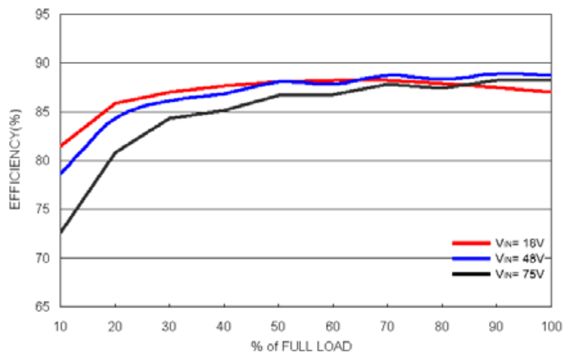
$V_{in} = V_{in\,nom}$; Full Load



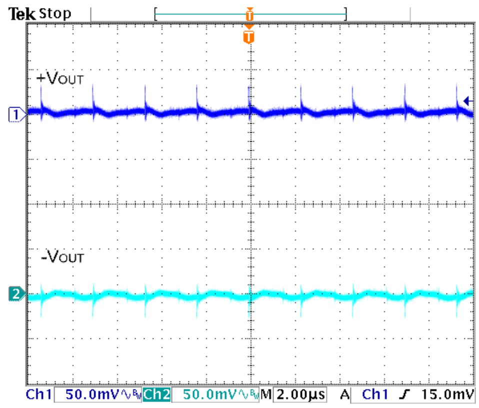
Power Dissipation Versus Output Current

Characteristic Curves

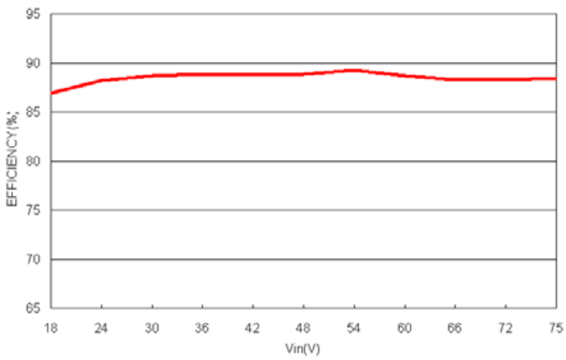
All test conditions are at 25°C.The figures are identical for TEN 30-4822WIN



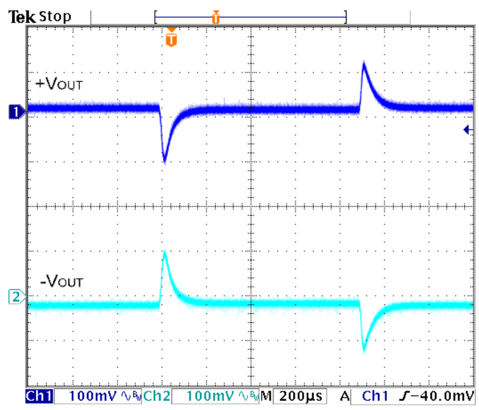
Efficiency Versus Output Current



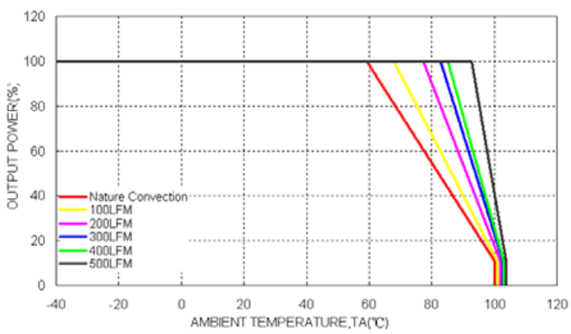
Typical Output Ripple and Noise.
$V_{in} = V_{in\ nom}$; Full Load



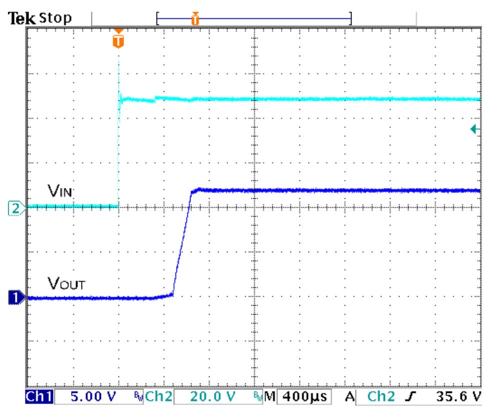
Efficiency Versus Input Voltage. Full Load



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



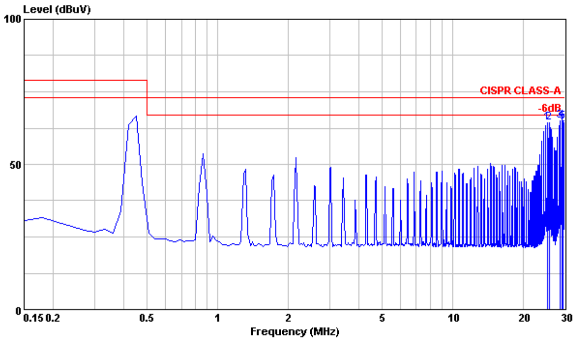
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\ nom}$



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

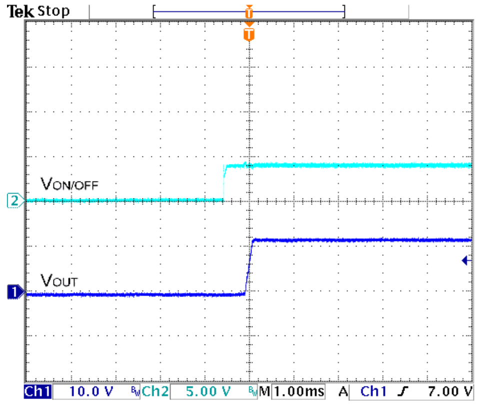
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-4822WIN (Continued)



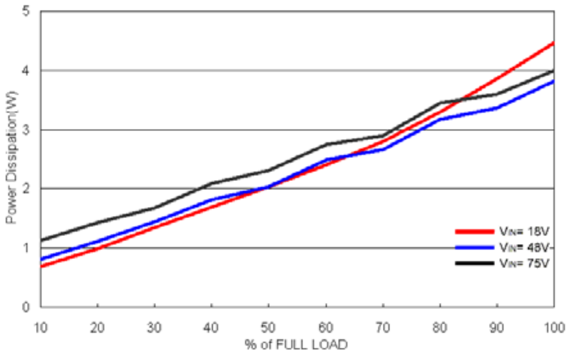
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\ nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

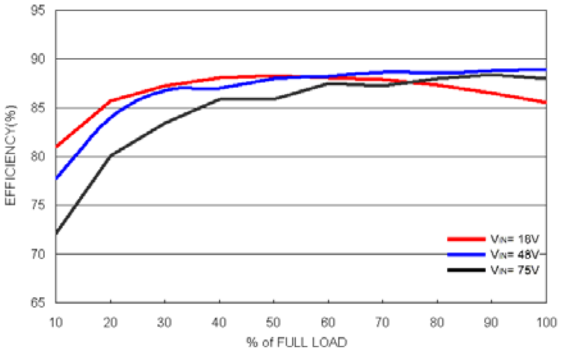
$V_{in} = V_{in\ nom}$; Full Load



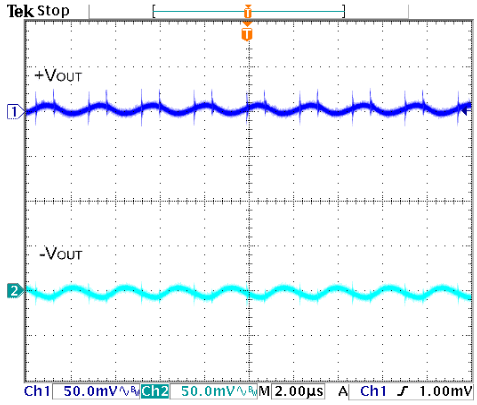
Power Dissipation Versus Output Current

Characteristic Curves

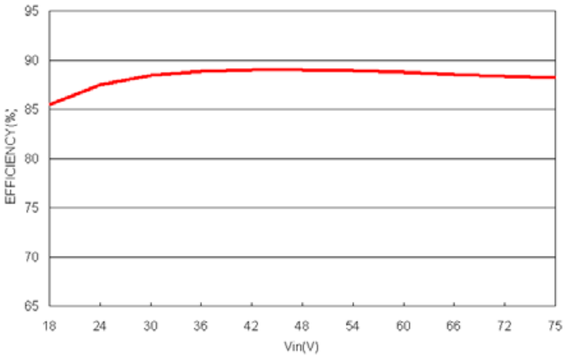
All test conditions are at 25°C.The figures are identical for TEN 30-4823WIN



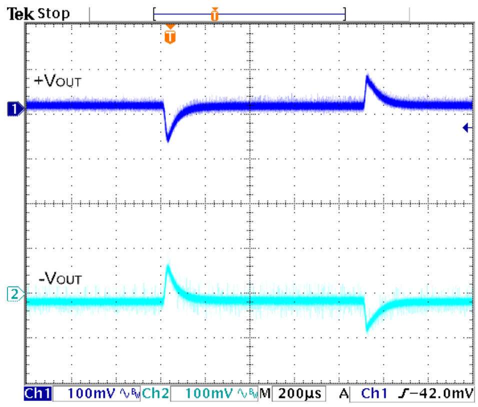
Efficiency Versus Output Current



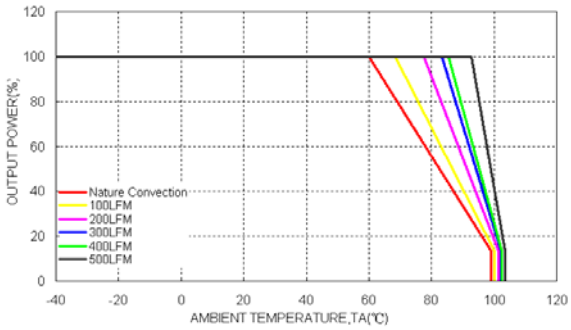
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$; Full Load



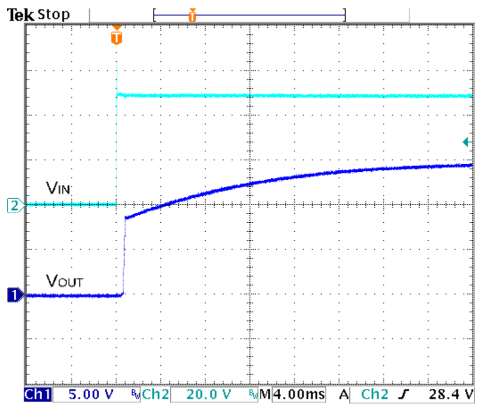
Efficiency Versus Input Voltage. Full Load



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



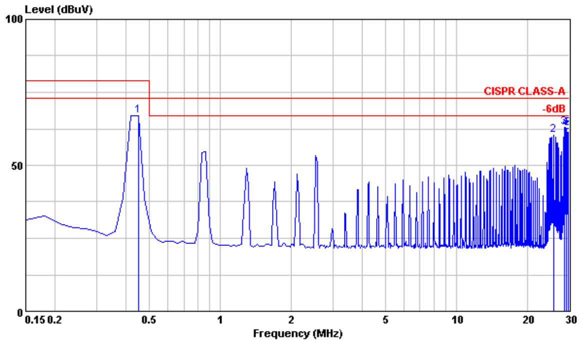
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\,nom}$



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

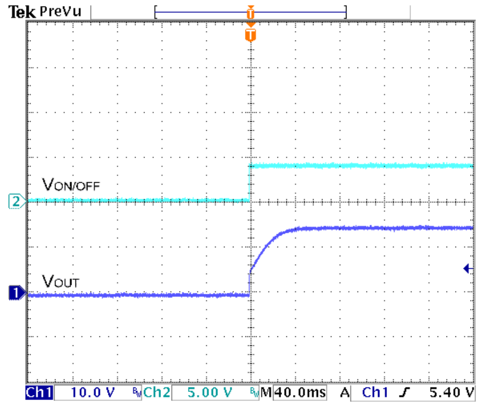
Characteristic Curves

All test conditions are at 25°C.The figures are identical for TEN 30-4823WIN (Continued)



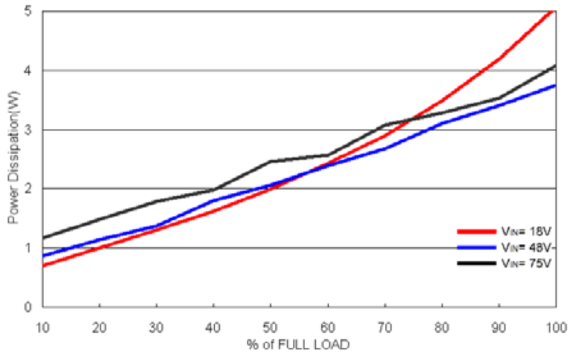
Conduction Emission of EN55022 Class A

$V_{in} = V_{in\ nom}$; Full Load



Using ON/OFF Voltage Start-Up and V_{out} Rise Characteristic

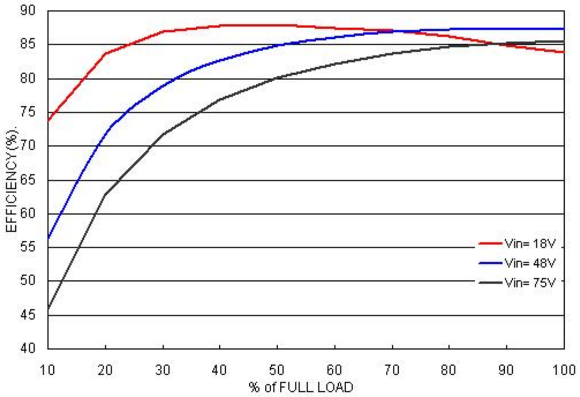
$V_{in} = V_{in\ nom}$; Full Load



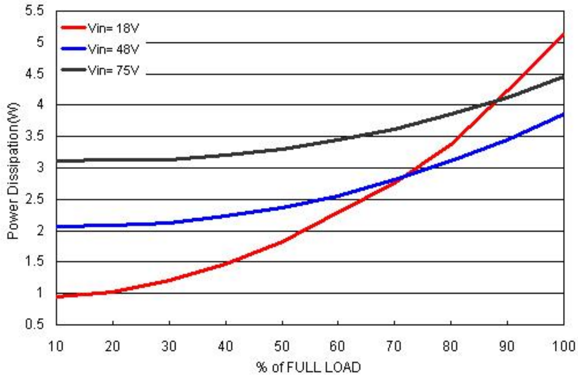
Power Dissipation Versus Output Current

Characteristic Curves (Continued)

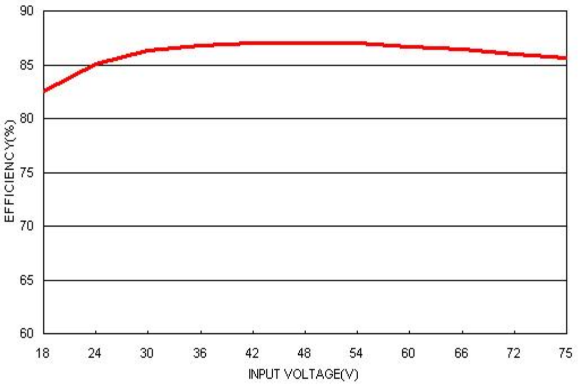
All test conditions are at 25°C. The figures are identical for TEN 30-4833WIN



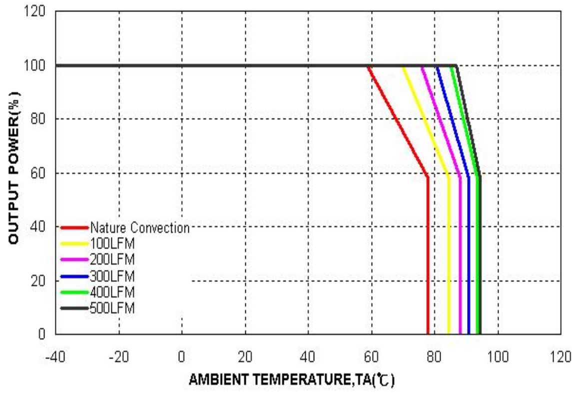
Efficiency Versus Output Current



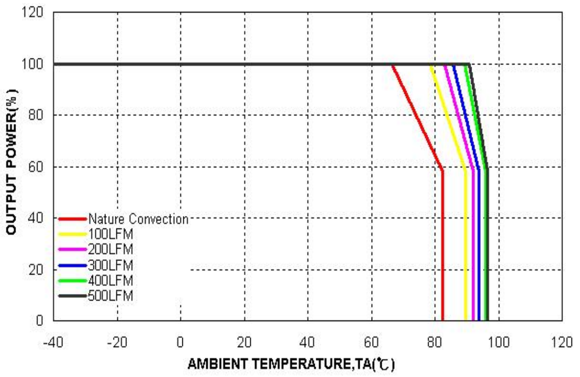
Power Dissipation Versus Output Current



Efficiency Versus Input Voltage. Full Load



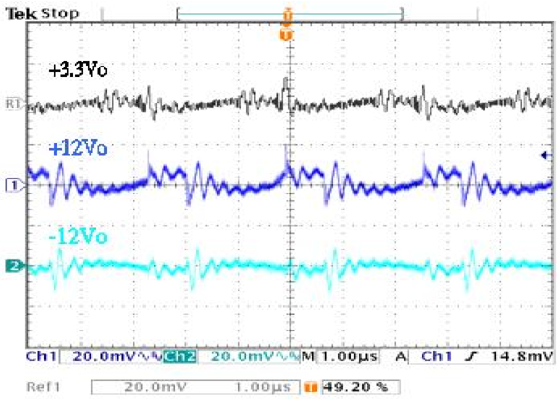
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\,nom}$



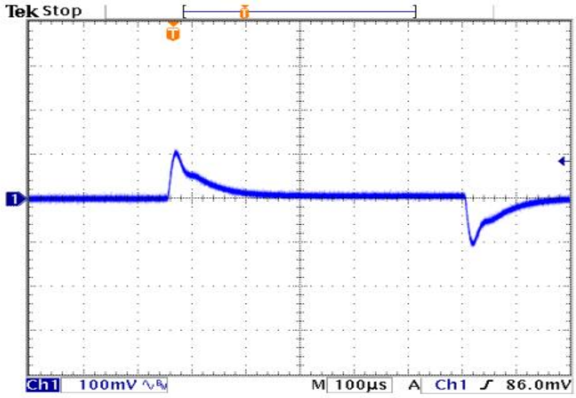
Derating Output Current Versus Ambient Temperature with Heat-Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

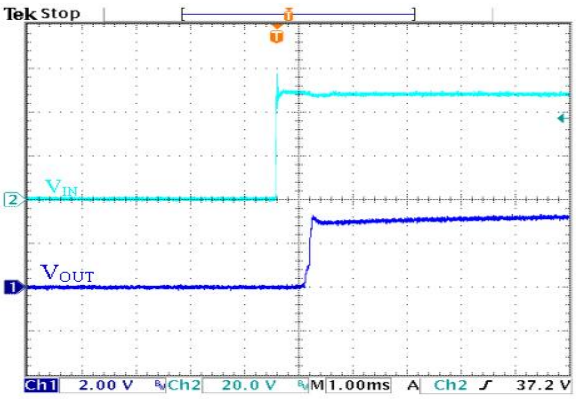
All test conditions are at 25°C. The figures are identical for TEN 30-4833WIN



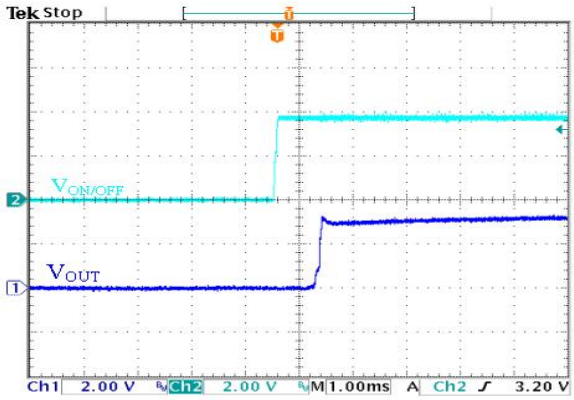
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$; Full Load



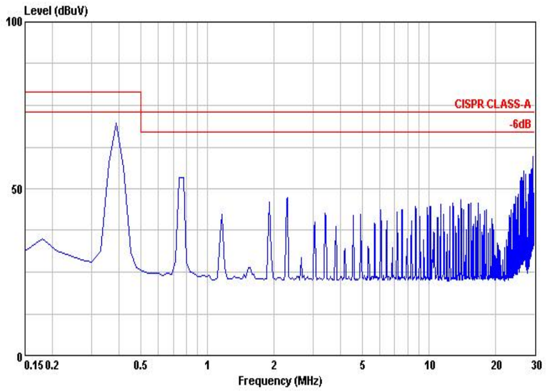
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load ; $V_{in} = V_{in\,nom}$



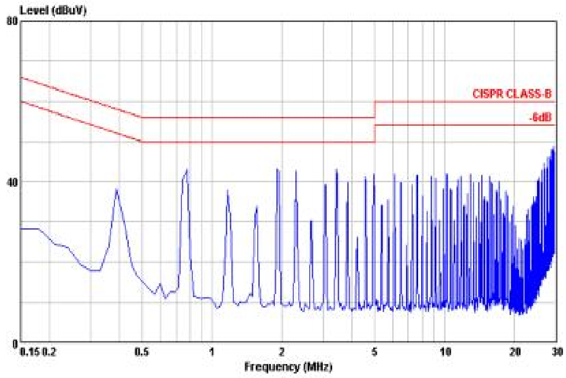
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$; Full Load



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



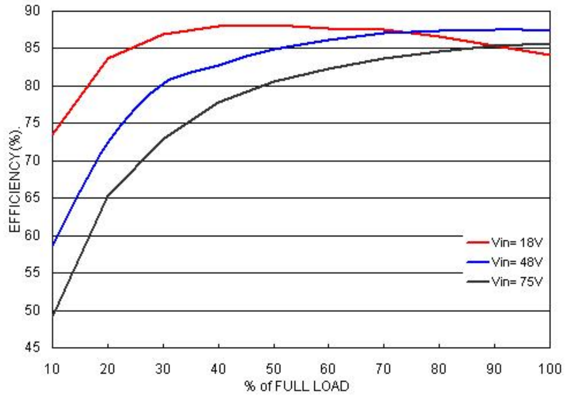
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$; Full Load



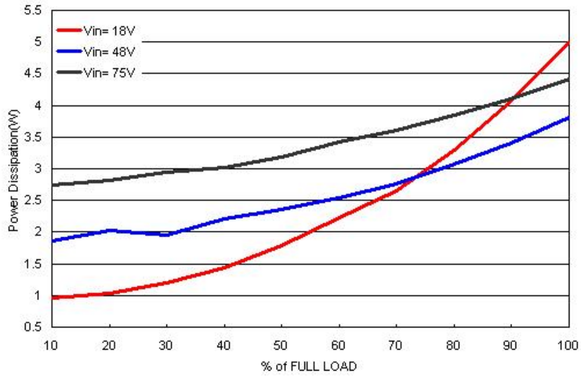
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$; Full Load

Characteristic Curves (Continued)

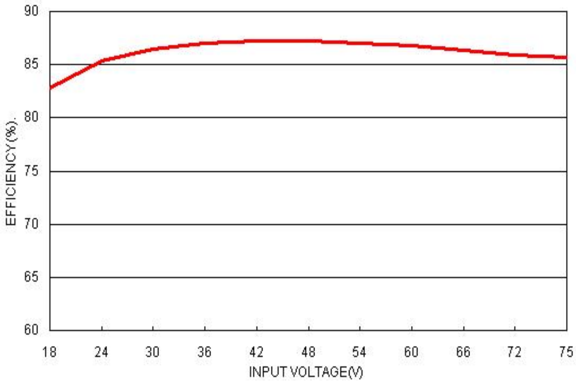
All test conditions are at 25°C. The figures are identical for TEN 30-4834WIN



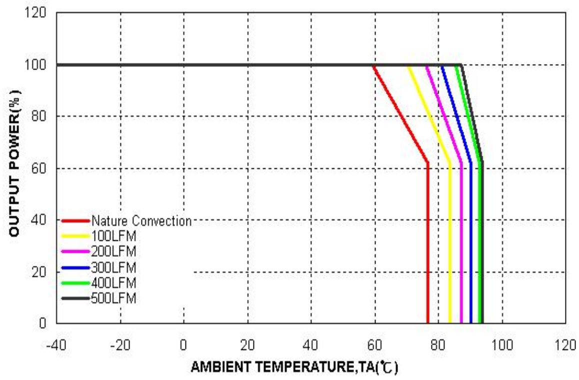
Efficiency Versus Output Current



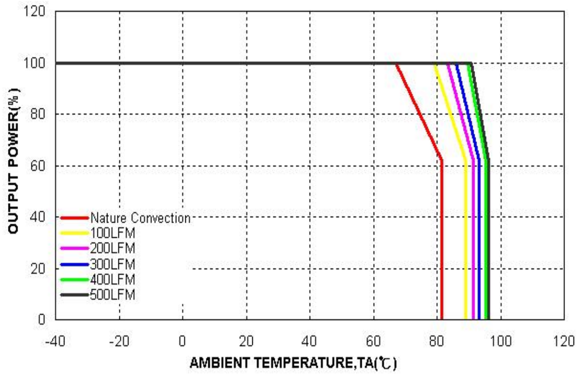
Power Dissipation Versus Output Current



Efficiency Versus Input Voltage. Full Load



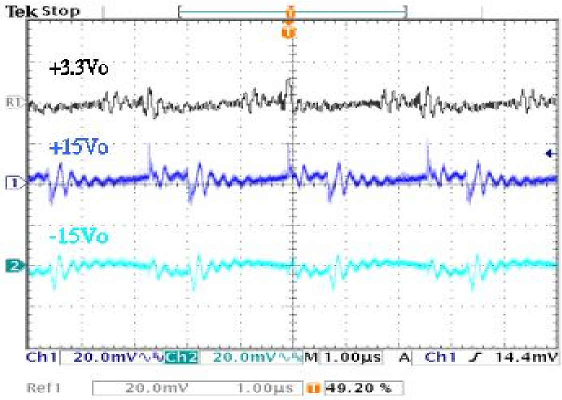
Derating Output Current Versus Ambient Temperature and Airflow $V_{in} = V_{in\ nom}$; Full Load



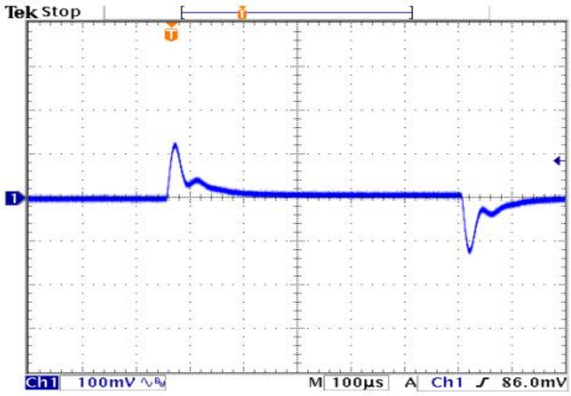
Derating Output Current Versus Ambient Temperature with Heat-Sink and Airflow, $V_{in} = V_{in\ nom}$

Characteristic Curves (Continued)

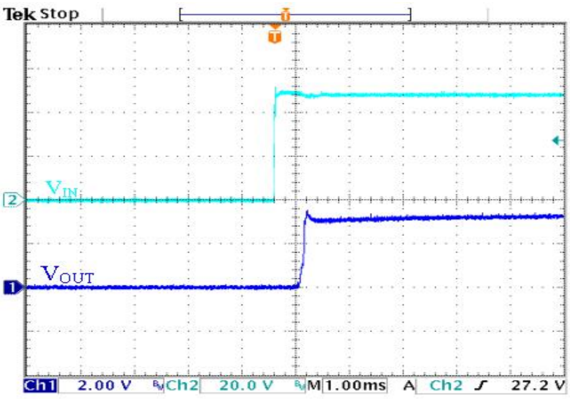
All test conditions are at 25°C. The figures are identical for TEN 30-4834WIN



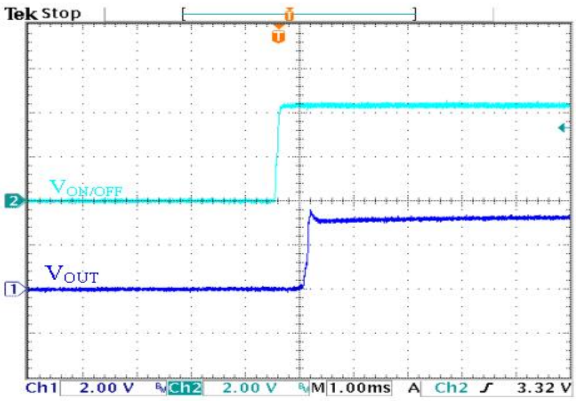
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$; Full Load



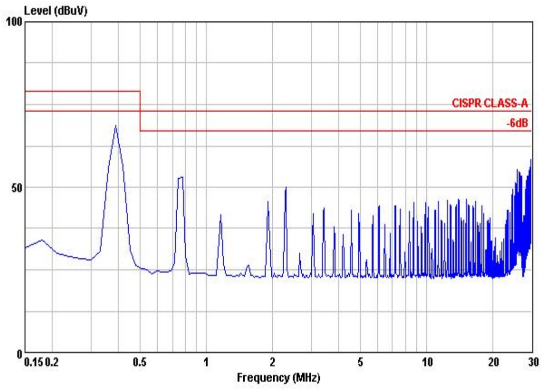
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load ; $V_{in} = V_{in\,nom}$



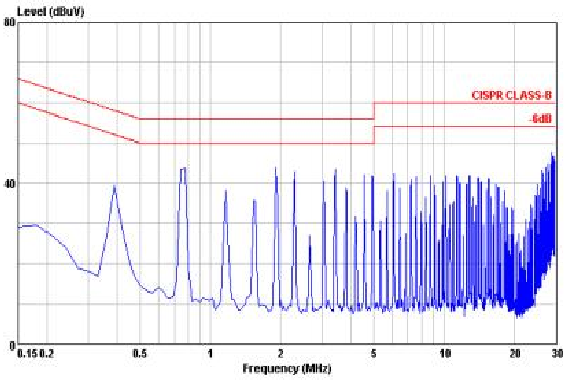
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$; Full Load



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



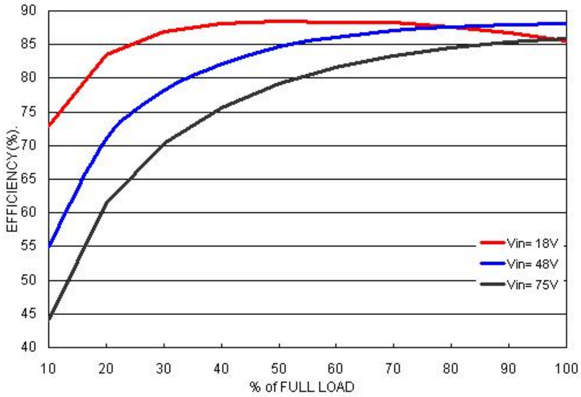
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$; Full Load



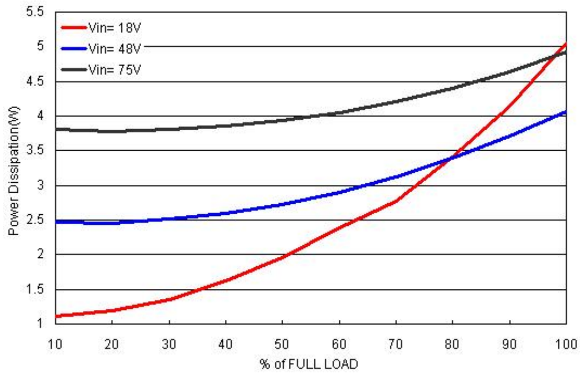
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$; Full Load

Characteristic Curves (Continued)

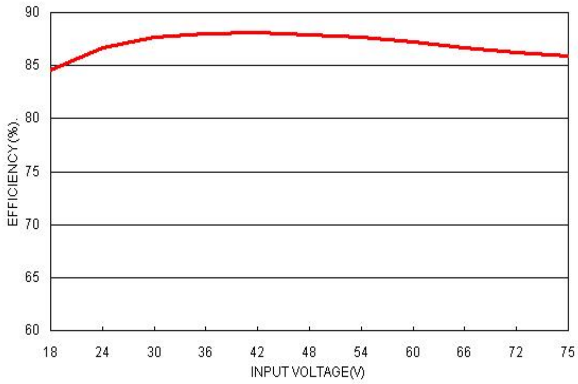
All test conditions are at 25°C. The figures are identical for TEN 30-4831WIN



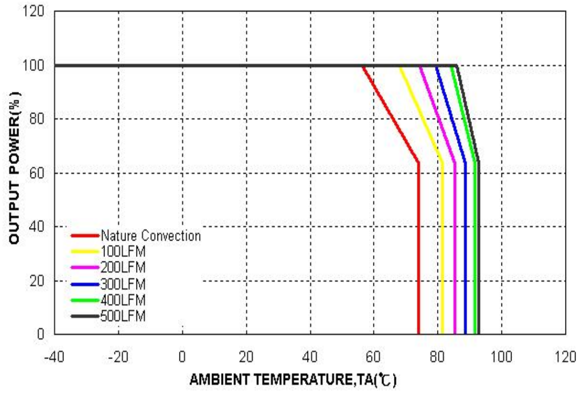
Efficiency Versus Output Current



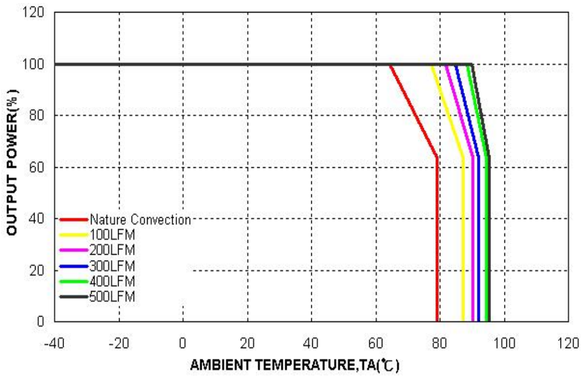
Power Dissipation Versus Output Current



Efficiency Versus Input Voltage. Full Load



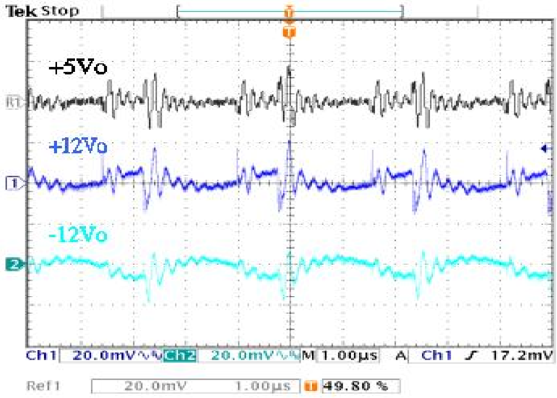
Derating Output Current Versus Ambient Temperature and Airflow $V_{in} = V_{in\,nom}$; Full Load



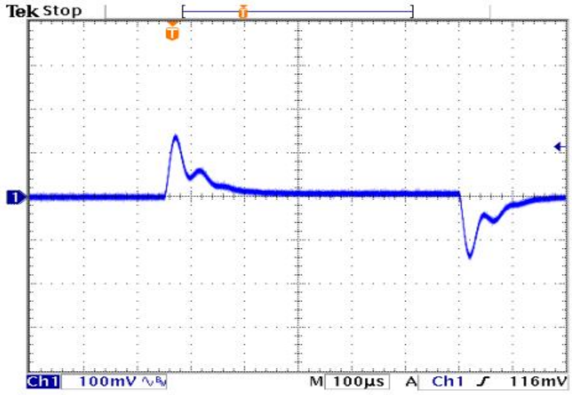
Derating Output Current Versus Ambient Temperature with Heat-Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

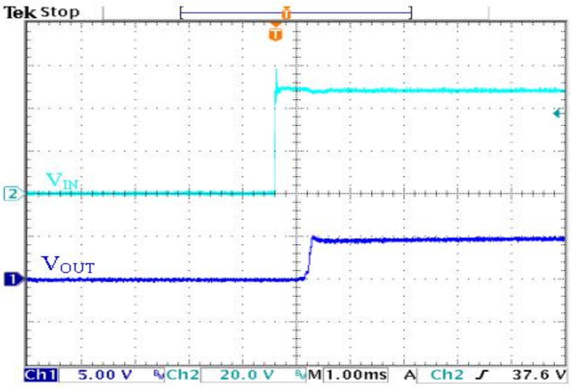
All test conditions are at 25°C. The figures are identical for TEN 30-4831WIN



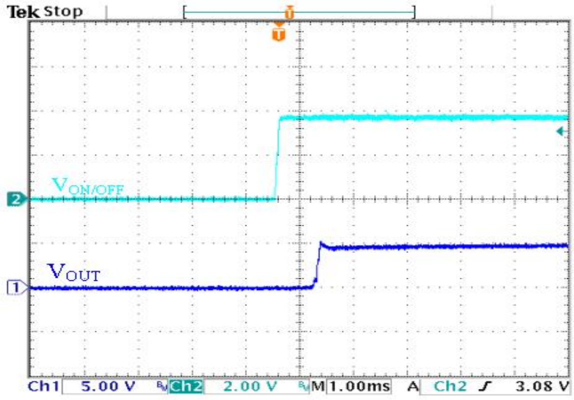
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$; Full Load



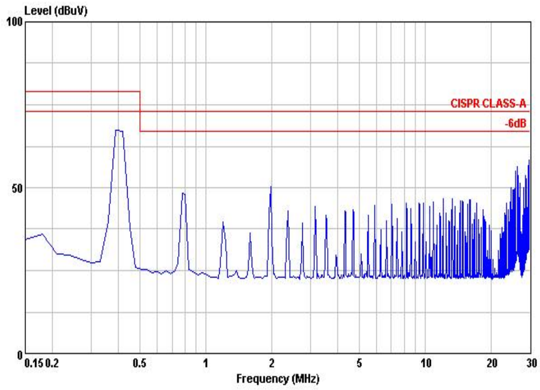
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load ; $V_{in} = V_{in\,nom}$



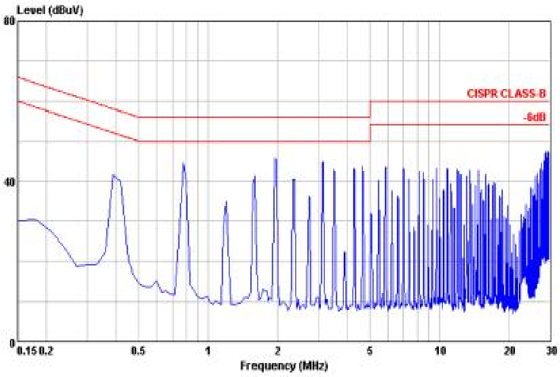
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$; Full Load



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



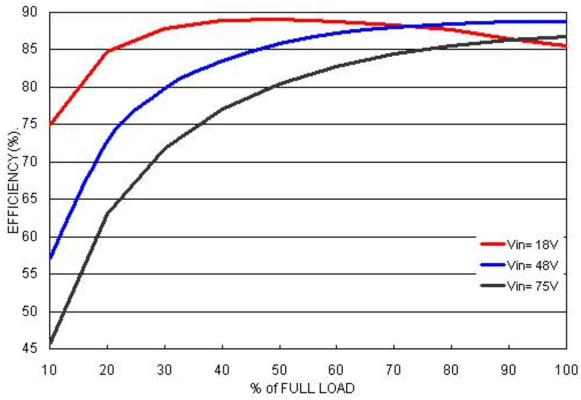
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$; Full Load



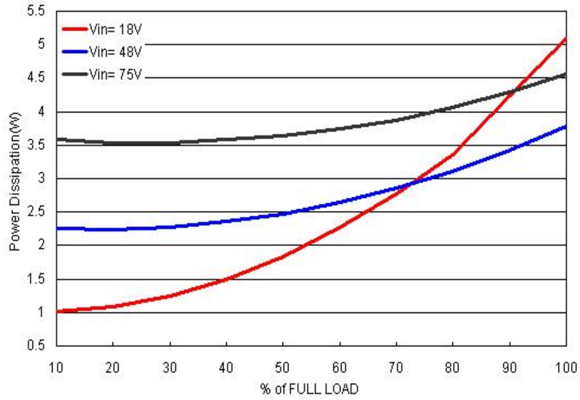
Conduction Emission of EN55022 Class B
$V_{in} = V_{in\,nom}$; Full Load

Characteristic Curves (Continued)

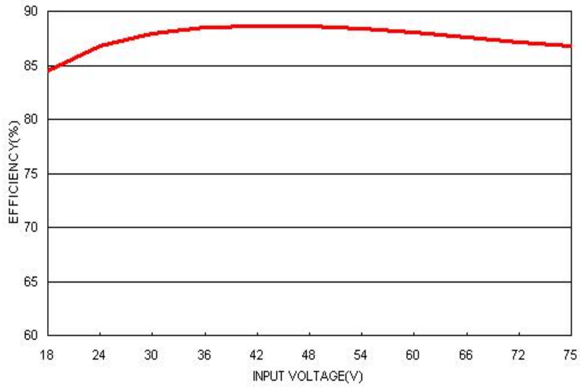
All test conditions are at 25°C. The figures are identical for TEN 30-4832WIN



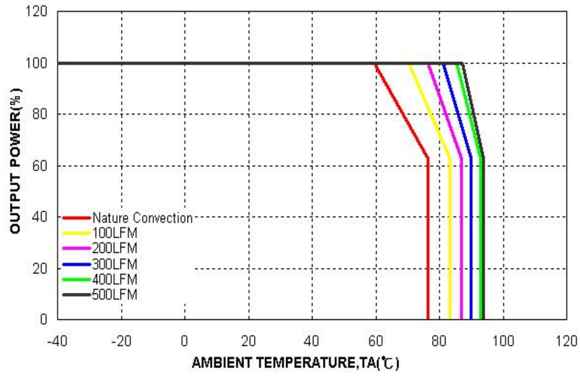
Efficiency Versus Output Current



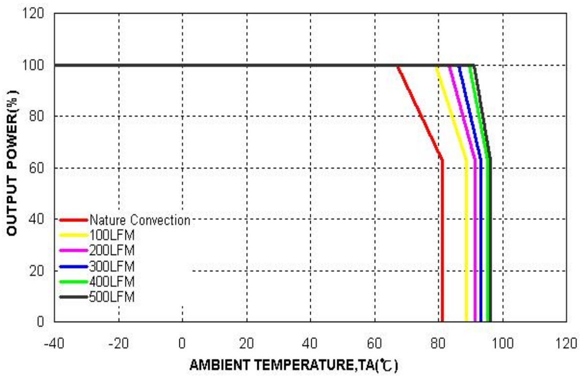
Power Dissipation Versus Output Current



Efficiency Versus Input Voltage. Full Load



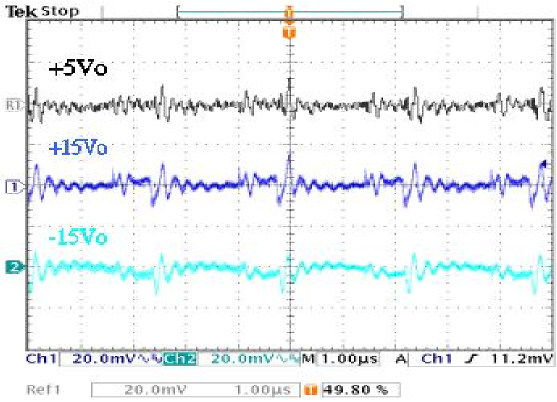
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in} = V_{in\,nom}$



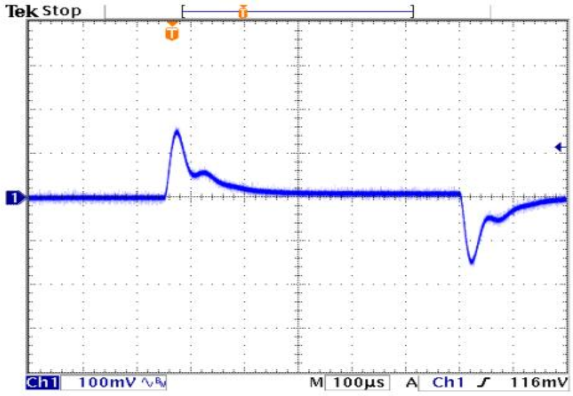
Derating Output Current Versus Ambient Temperature with Heat-Sink and Airflow, $V_{in} = V_{in\,nom}$

Characteristic Curves (Continued)

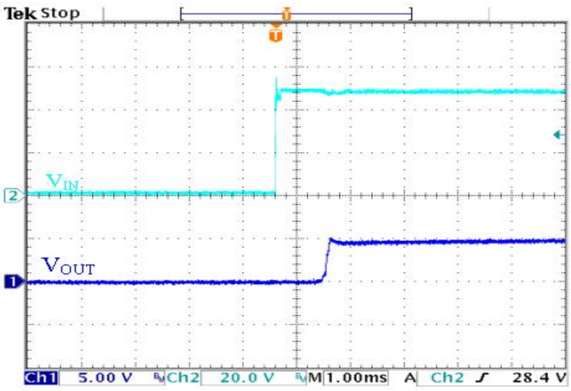
All test conditions are at 25°C. The figures are identical for TEN 30-4832WIN



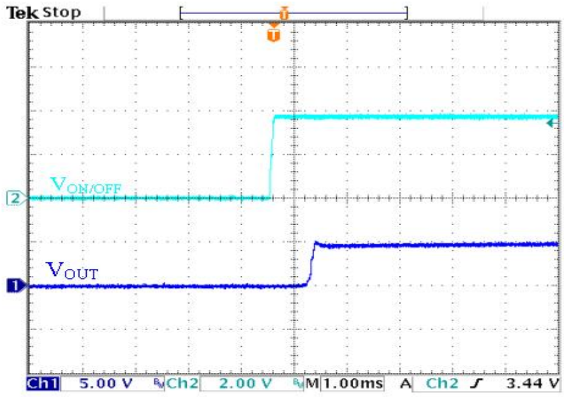
Typical Output Ripple and Noise.
$V_{in} = V_{in\,nom}$; Full Load



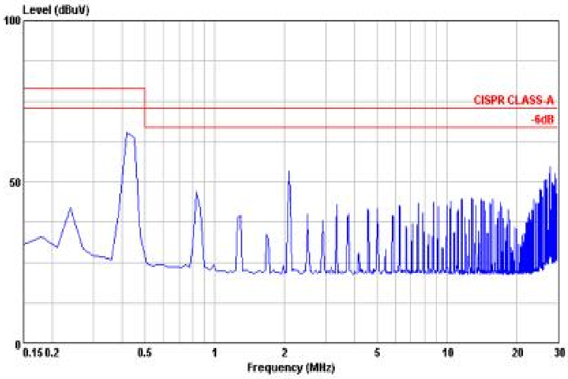
Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load ; $V_{in} = V_{in\,nom}$



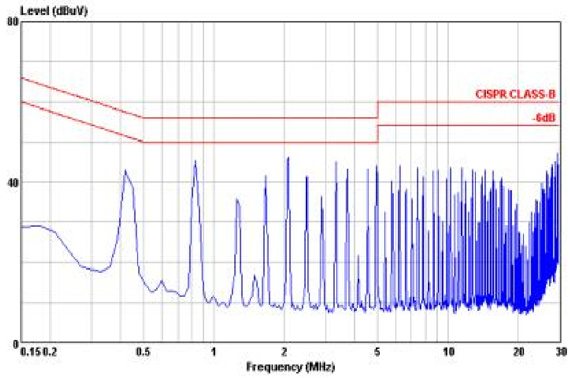
Typical Input Start-Up and Output Rise Characteristic
$V_{in} = V_{in\,nom}$; Full Load



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



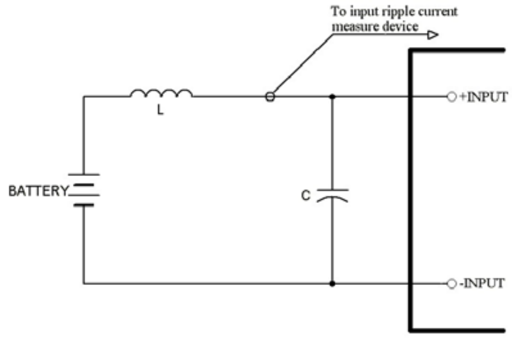
Conduction Emission of EN55022 Class A
$V_{in} = V_{in\,nom}$; Full Load



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

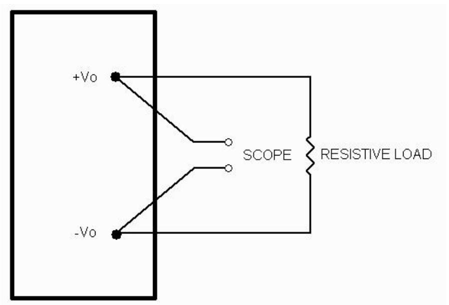
Testing Configurations

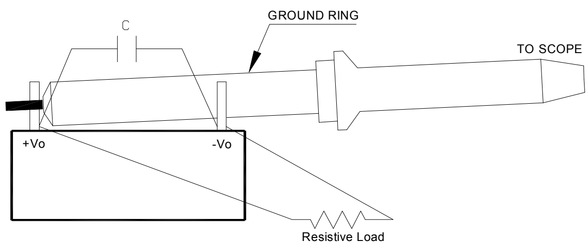
Input reflected-ripple current measurement test up



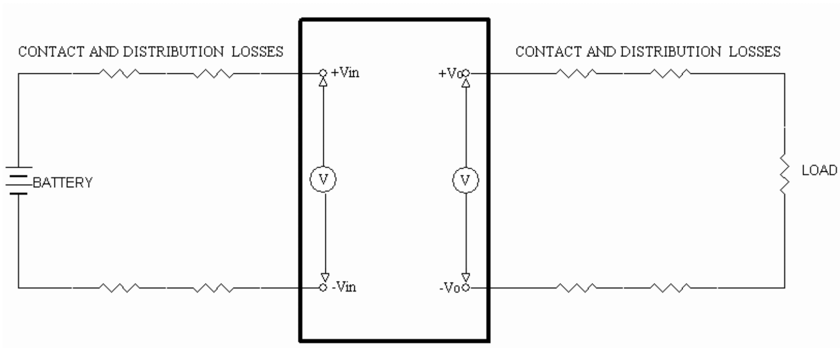
Component	Value	Voltage	Reference
L	12µH	—	—
C	47µF	100V	Aluminum Electrolytic Capacitor

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





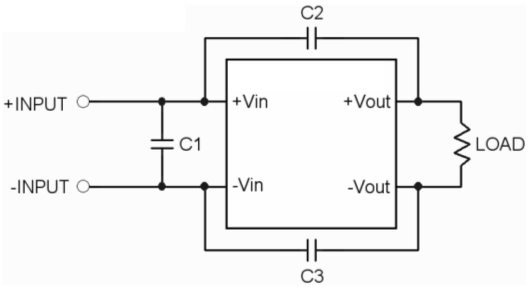
Output voltage and efficiency measurement test up



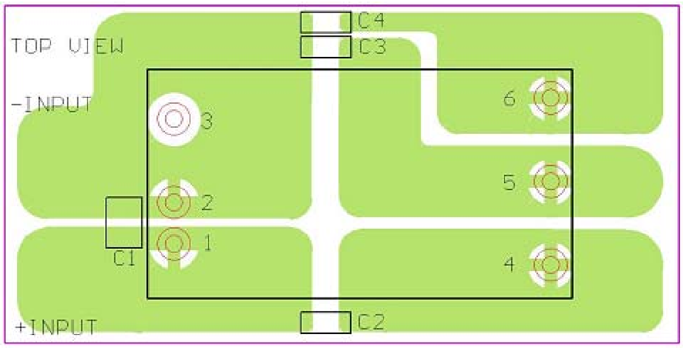
Note: All measurements are taken at the module terminals.

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

EMC considerations



Suggested Schematic to comply with EN55022 Conducted Noise Class A



recommended PCB Layout with Input Filter

To comply with conducted noise according to EN55022 CLASS A following components are recommended:

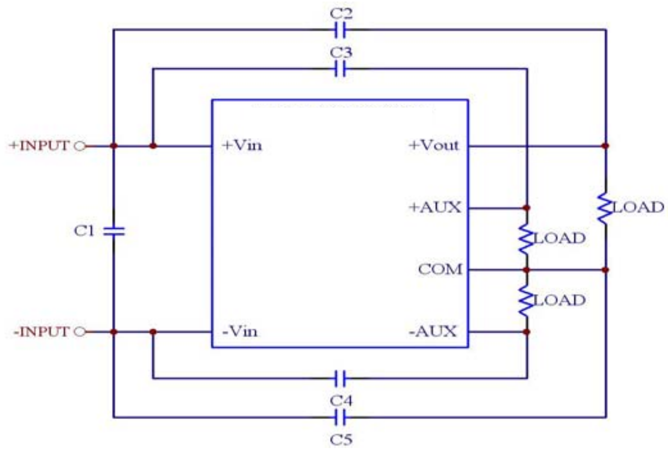
TEN 30-241xWIN & TEN 30-242xWIN

Component	Value	Voltage	Reference
C1	4.7µF	50V	1812 MLCC
C2, C3	1000pF	2KV	1206 MLCC

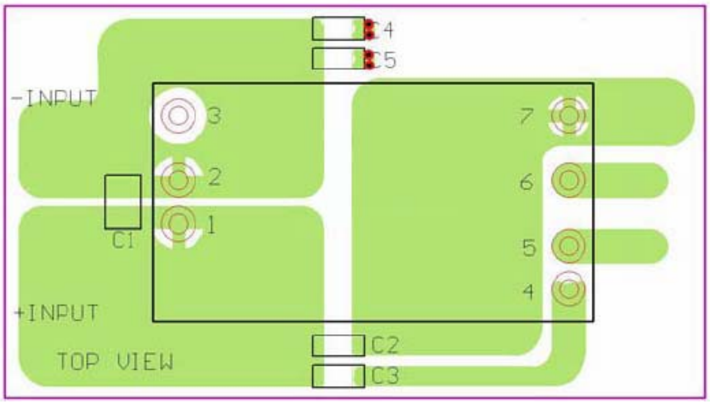
TEN 30-481xWIN & TEN 30-482xWIN

Component	Value	Voltage	Reference
C1	2.2µF	100V	1812 MLCC
C2, C3	1000pF	2KV	1206 MLCC

EMC considerations



Suggested Schematic to comply with EN55022 Conducted Noise Class A



recommended Layout with Input Filter

To comply with conducted noise according to EN55022 CLASS A following components are recommended:

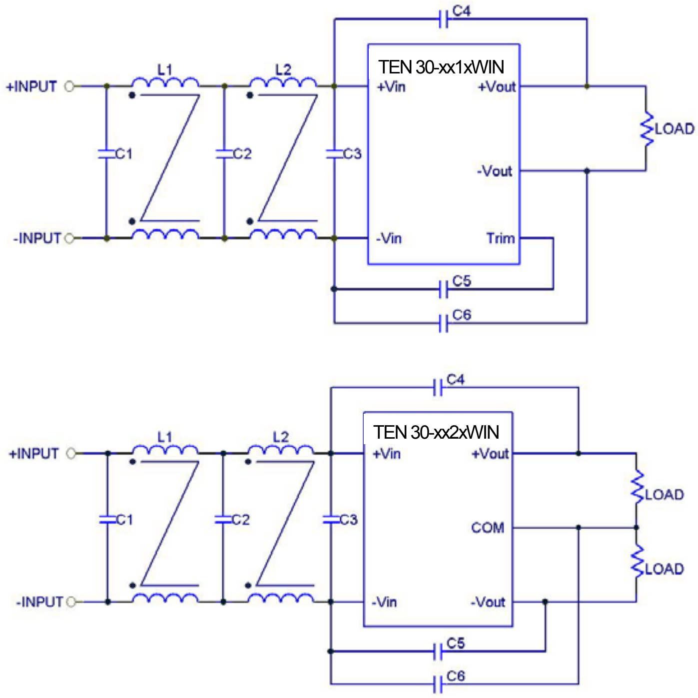
TEN 30-243xWIN

Component	Value	Voltage	Reference
C1	4.7µF	50V	1812 MLCC
C2, C3, C4, C5	1000pF	3KV	1808 MLCC

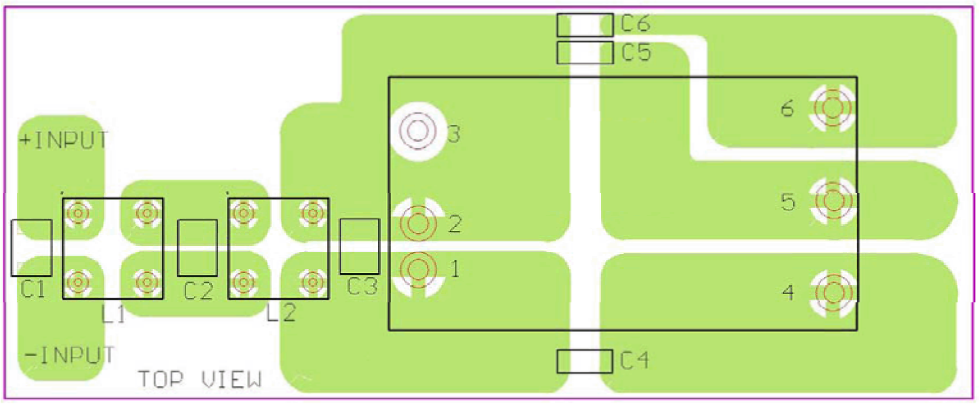
TEN 30-483xWIN

Component	Value	Voltage	Reference
C1	2.2µF	100V	1812 MLCC
C2, C3, C4, C5	1000pF	3KV	1808 MLCC

EMC considerations (Continued)



Suggested Schematic to comply with EN55022 Conducted Noise Class B



recommended Layout with Input Filter

To comply with conducted noise according to EN55022 CLASS B following components are recommended:

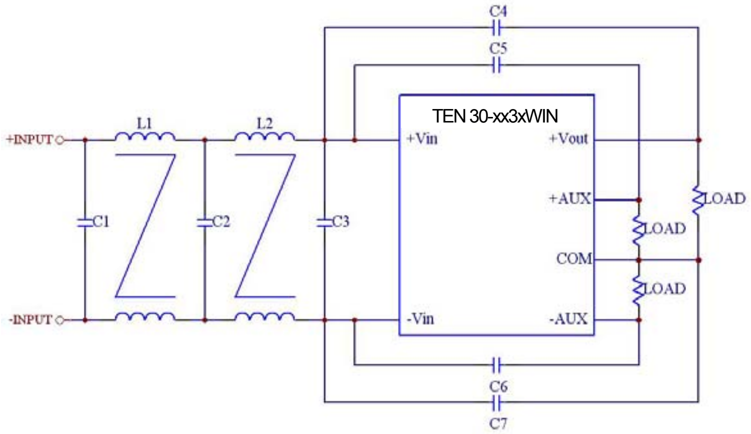
TEN 30-241xWIN & TEN 30-242xWIN

Component	Value	Voltage	Reference
C1, C2, C3	4.7µF	50V	1812 MLCC
C4, C5, C6	1000pF	2KV	1808 MLCC
L1	33.33µH	—	Common Choke, P/N: TCK-075
L2	55.23µH	—	Common Choke, P/N: TCK-076

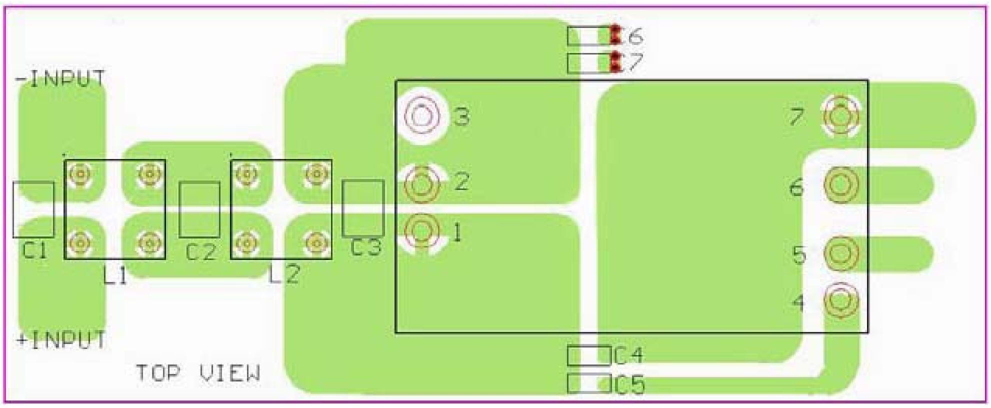
TEN 30-481xWIN & TEN 30-482xWIN

Component	Value	Voltage	Reference
C1, C2, C3	2.2µF	100V	1812 MLCC
C4, C5, C6	1000pF	3KV	1808 MLCC
L1	33.33µH	—	Common Choke, P/N: TCK-075
L2	55.23µH	—	Common Choke, P/N: TCK-076

EMC considerations (Continued)



Suggested Schematic to comply with EN55022 Conducted Noise Class B



recommended Layout with Input Filter

To comply with conducted noise according to EN55022 CLASS B following components are required:

TEN 30-243xWIN

Component	Value	Voltage	Reference
C1, C2, C3	4.7µF	50V	1812 MLCC
C4, C5, C7	150pF	2KV	1206 MLCC
C6	1000pF	3KV	1808 MLCC
L1'	450µH	—	Common Choke, P/N: TCK-048
L2'	145µH	—	Common Choke, P/N: TCK-051

TEN 30-483xWIN

Component	Value	Voltage	Reference
C1, C2, C3	2.2µF	100V	1812 MLCC
C4, C5, C7	150pF	2KV	1206 MLCC
C6	1000pF	3KV	1808 MLCC
L1'	450µH	—	Common Choke, P/N: TCK-048
L2'	145µH	—	Common Choke, P/N: TCK-051

EMC Considerations (Continued)

Specs of Common Mode Choke L1 for TEN 30-241xWIN and TEN 30-242xWIN see following:

- TCK-075
  L: 33.33µH ±35% / DCR: 10mΩ, max
  A height: 8.8mm, Max

Specs of Common Mode Choke L2 for TEN 30-481xWIN and TEN 30-482xWIN see following:

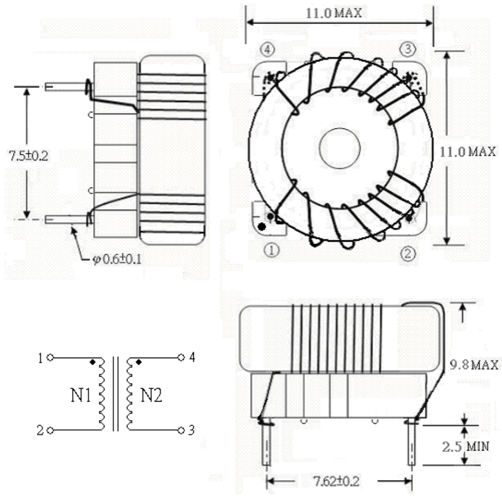
- TCK-076
  L: 53.23µH ±35% / DCR: 7mΩ, max
  A height: 8.8mm, Max

Specs of Common Mode Choke L1' for TEN 30-243xWIN see following:

- TCK-048
  L: 450µH ±35% / DCR: 25mΩ, max
  A height: 9.8mm, Max

Specs of Common Mode Choke L2' for TEN 30-483xWIN see following:

- TCK-051
  L: 145µH ±35% / DCR: 20mΩ, max
  A height: 9.8mm, 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 L-C filter is recommended to minimize input reflected ripple current. The inductor is simulated source impedance of 12µH and capacitor is Nippon Chemi-con KY series 47µF/100V. The capacitor must as close as possible to the input terminals of the power module for lower impedance.

Output Over Current Protection

When excessive output currents occur in the system, circuit protection is required on all power supplies and converter. Normally, overload current is maintained at approximately 150 percent of rated current for TEN 30WIN SERIES.

Hiccup-mode is a method of operation in a power supply and/or converter whose purpose is to protect the power supply or converter from being damaged during an over-current fault condition. It also enables the power supply or converter to restart when the fault is removed. There are other ways of protecting the power supply or converter against over-loaded conditions, such as the constant 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 Shottky 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 converter for a given time and then tries to restart the converter again. If the over-load condition has been removed, the converter will restart and operate normally; otherwise, the controller will see another over-current event and shut off the converter 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 converter 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 converter 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 converter 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

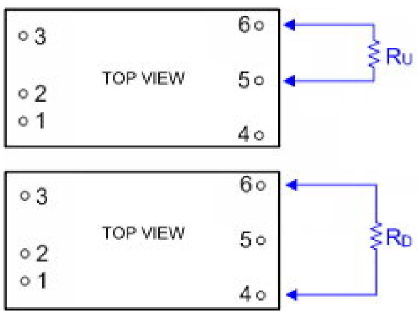
The output over-voltage protection consists of output Zener diode that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over-voltage protection threshold, then the Zener diode clamps the output voltage.

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 will be safe in this condition.

Output Voltage Adjustment → Single Output Converter only

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 $+V_{out}$ or $–V_{out}$ pins. With an external resistor between the TRIM and $–V_{out}$ pin, the output voltage set point increases. With an external resistor between the TRIM and $+V_{out}$ pin, the output voltage set point decreases.



TRIM TABLE

TEN 30-xx07WIN

Trim up [%]	1	2	3	4	5	6	7	8	9	10
V_{OUT} [Vdc] =	1.515	1.530	1.545	1.560	1.575	1.590	1.605	1.620	1.635	1.650
R_U [kΩ] =	4.578	2.065	1.227	0.808	0.557	0.389	0.270	0.180	0.110	0.054
Trim down [%]	1	2	3	4	5	6	7	8	9	10
V_{OUT} [Vdc] =	1.485	1.470	1.455	1.440	1.425	1.410	1.395	1.380	1.365	1.350
R_D [kΩ] =	5.704	2.571	1.527	1.005	0.692	0.483	0.334	0.222	0.135	0.065

TEN 30-xx09WIN

Trim up [%]	1	2	3	4	5	6	7	8	9	10
V_{OUT} [Vdc] =	2.525	2.550	2.575	2.600	2.625	2.650	2.675	2.700	2.725	2.750
R_U [kΩ] =	37.076	16.675	9.874	6.474	4.434	3.074	2.102	1.374	0.807	0.354
Trim down [%]	1	2	3	4	5	6	7	8	9	10
V_{OUT} [Vdc] =	2.475	2.450	2.425	2.400	2.375	2.350	2.325	2.300	2.275	2.250
R_D [kΩ] =	49.641	22.481	13.428	8.902	6.186	4.375	3.082	2.112	1.358	0.754

Output Voltage Adjustment (Continuous)

TEN 30-xx10WIN

Trim up [%]	1	2	3	4	5	6	7	8	9	10
V_{OUT} [Vdc] =	3.333	3.366	3.399	3.432	3.465	3.498	3.531	3.564	3.597	3.630
R_U [kΩ] =	57.930	26.165	15.577	10.283	7.106	4.988	3.476	2.341	1.459	0.753
Trim down [%]	1	2	3	4	5	6	7	8	9	10
V_{OUT} [Vdc] =	3.267	3.234	3.201	3.168	3.135	3.102	3.069	3.036	3.003	2.970
R_D [kΩ] =	69.470	31.235	18.490	12.117	8.294	5.745	3.924	2.559	1.497	0.647

TEN 30-xx11WIN

Trim up [%]	1	2	3	4	5	6	7	8	9	10
V_{OUT} [Vdc] =	5.151	5.202	5.253	5.304	5.355	5.406	5.457	5.508	5.559	5.610
R_U [kΩ] =	38.135	17.368	10.446	6.985	4.908	3.524	2.535	1.793	1.217	0.755
Trim down [%]	1	2	3	4	5	6	7	8	9	10
V_{OUT} [Vdc] =	5.049	4.998	4.947	4.896	4.845	4.794	4.743	4.692	4.641	4.590
R_D [kΩ] =	47.191	21.431	12.844	8.551	5.975	4.258	3.031	2.111	1.396	0.823

TEN 30-xx12WIN

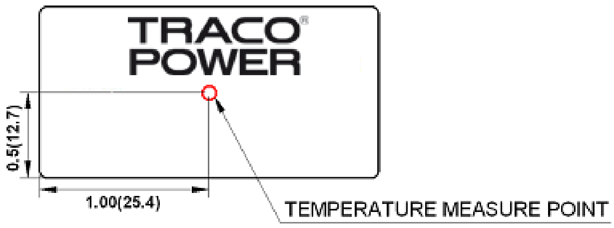
Trim up [%]	1	2	3	4	5	6	7	8	9	10
V_{OUT} [Vdc] =	12.120	12.240	12.360	12.480	12.600	12.720	12.840	12.960	13.080	13.200
R_U [kΩ] =	367.908	165.954	98.636	64.977	44.782	31.318	21.701	14.488	8.879	4.391
Trim down [%]	1	2	3	4	5	6	7	8	9	10
V_{OUT} [Vdc] =	11.880	11.760	11.640	11.520	11.400	11.280	11.160	11.040	10.920	10.800
R_D [kΩ] =	460.992	207.946	123.597	81.423	56.118	39.249	27.199	18.162	11.132	5.509

TEN 30-xx13WIN

Trim up [%]	1	2	3	4	5	6	7	8	9	10
V_{OUT} [Vdc] =	15.150	15.300	15.450	15.600	15.750	15.900	16.050	16.200	16.350	16.500
R_U [kΩ] =	404.184	180.592	106.061	68.796	46.437	31.531	20.883	12.898	6.687	1.718
Trim down [%]	1	2	3	4	5	6	7	8	9	10
V_{OUT} [Vdc] =	14.850	14.700	14.550	14.400	14.250	14.100	13.950	13.800	13.650	13.500
R_D [kΩ] =	499.816	223.408	131.272	85.204	57.563	39.136	25.974	16.102	8.424	2.282

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.

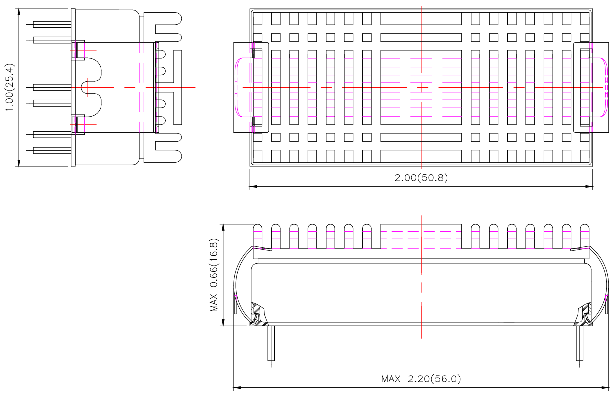


Measurement shown in inches (mm)

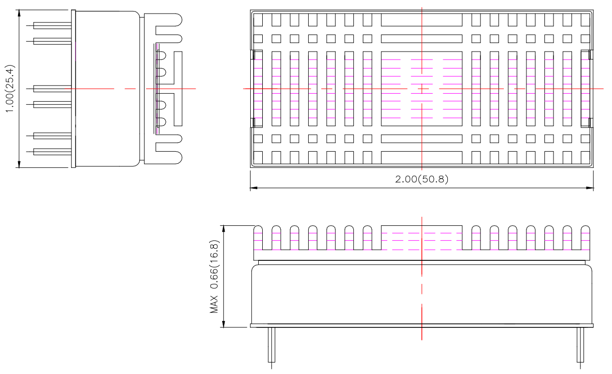
TOP VIEW

Heat Sink Consideration

Equip heat-sink for lower temperature and higher reliability of the module.
There are two types for choosing.
Suffix – HC: Heatsink + Clamp



Suffix –HS: Heatsink



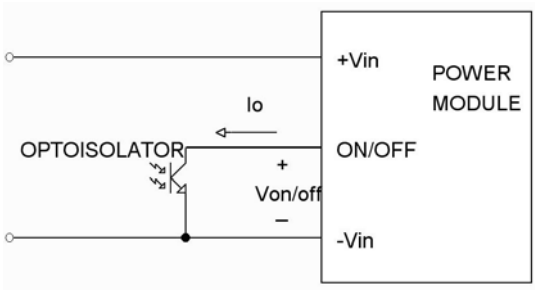
Measurement shown in inches and (millimetres)

Remote ON/OFF Control

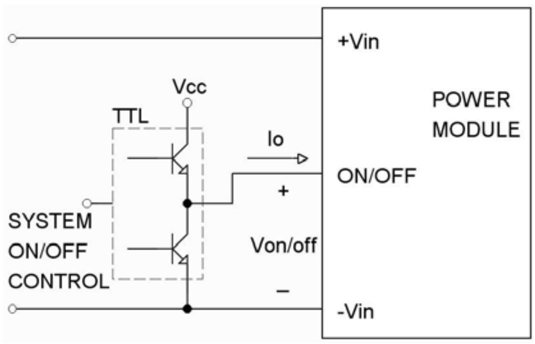
With no suffix, the positive logic remote ON/OFF control circuit is included. E.g.: TEN 30-2411WIN
Turns the module ON during logic High on the On/Off pin and turns OFF during logic Low. The On/Off pin is an open collector/drain logic input signal (Von/off) that referenced to GND. If not using the remote on/off feature, please open circuit between on/off pin and $-V_{in}$ pin to turn the module on.

With suffix -N, the negative logic remote ON/OFF control circuit is included. E.g.: TEN 30-2411WIN-N
Turns the module ON during logic Low on the On/Off pin and turns OFF during logic High. The On/Off pin is an open collector/drain logic input signal (Von/off) that referenced to GND. If not using the remote on/off feature, please short circuit between on/off pin and $-V_{in}$ pin to turn the module on.

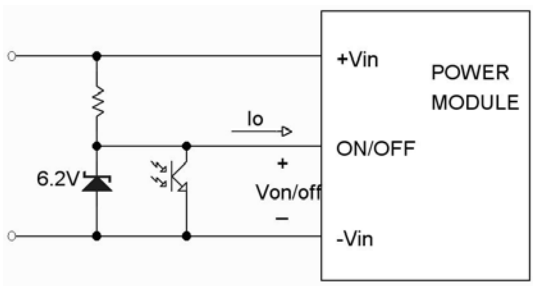
Remote ON/OFF Implementation



Isolated-Closure Remote ON/OFF

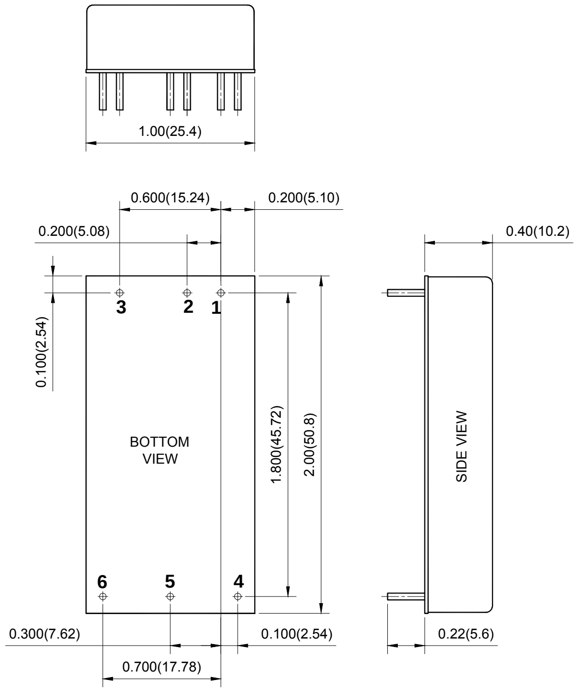


Level Control Using TTL Output



Level Control Using Line Voltage

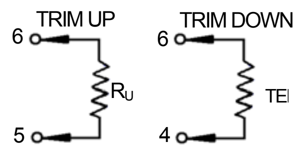
Mechanical Data of Single & Dual Output Converter



PIN CONNECTION		
Pin	Single	Dual
	Description	Description
1	+ Input	+ Input
2	- Input	- Input
3	Remote on/off	Remote on/off
4	+Output	+Output
5	- Output	Common
6	Trim	- Output

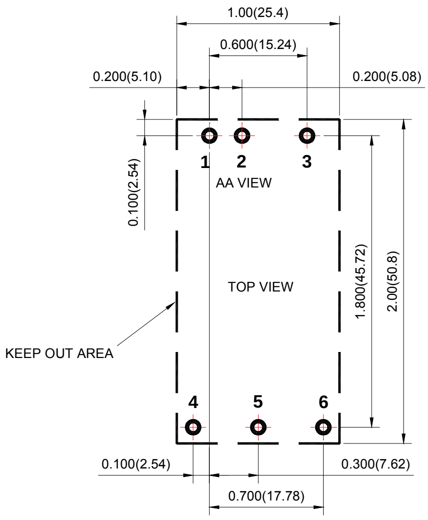
EXTERNAL UTPUT TRIMMING
Single Output only!

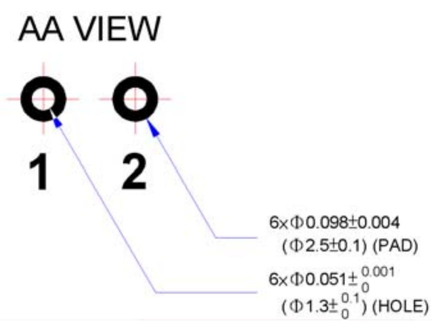
Output can be externally trimmed by using the method shown below.



1. All dimensions in Inches (mm)
   Tolerance: x.xx ±0.02” (x.x ±0.5)
   x.xxx ±0.01” (x.xx ±0.25mm)
2. Pin pitch tolerance: ±0.01” (±0.25mm)
3. Pin dimension tolerance: ±0.004” (±0.1mm)

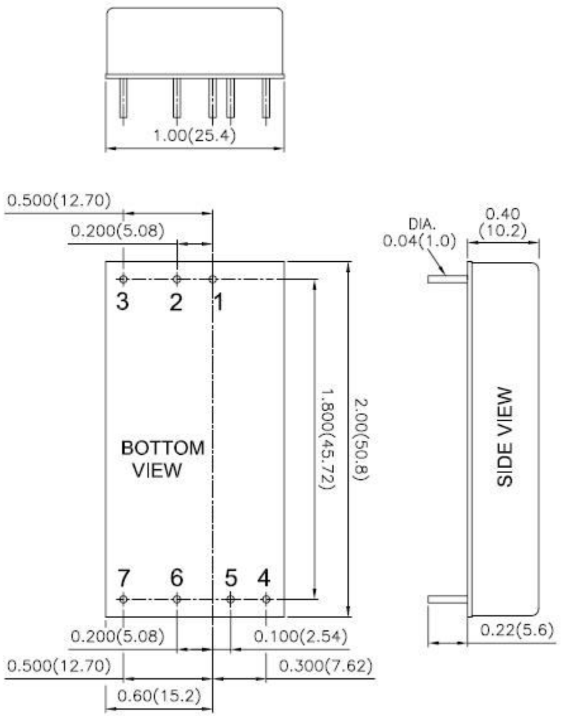
Recommended Pad Layout for Single & Dual Output Converter





1. All dimensions in Inches (mm)
   Tolerance: x.xx ±0.02” (x.x ±0.5)
   x.xxx ±0.01” (x.xx ±0.25mm)
2. Pin pitch tolerance: ±0.01” (±0.25mm)
3. Pin dimension tolerance: ±0.004” (±0.1mm)

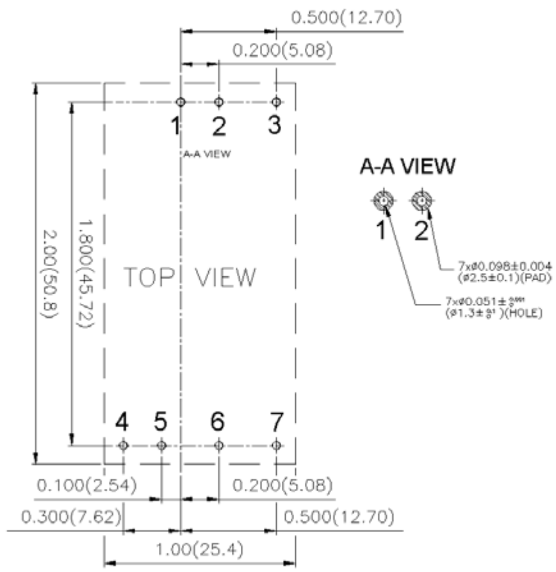
Mechanical Data of Triple Output Converter



PIN CONNECTION	
PIN	Description
1	+ Input
2	- Input
3	Remote on/off
4	+Auxiliary
5	- Auxiliary
6	Common
7	+Output

1. All dimensions in Inches (mm)
   Tolerance: x.xx ±0.02" (x.x ±0.5)
   x.xxx ±0.01" (x.xx ±0.25mm)
2. Pin pitch tolerance: ±0.01" (±0.25mm)
3. Pin dimension tolerance: ±0.004" (±0.1mm)

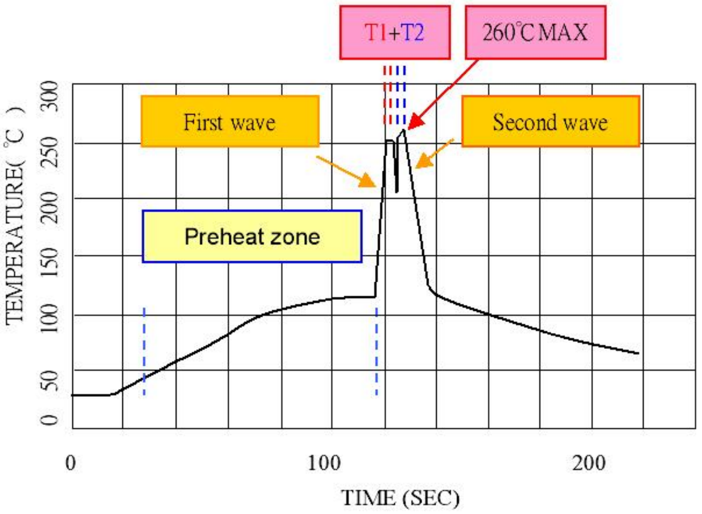
Recommended Pad Layout for Triple Output Converter



1. All dimensions in Inches (mm)
   Tolerance: x.xx ±0.02" (x.x ±0.5)
   x.xxx ±0.01" (x.xx ±0.25mm)
2. Pin pitch tolerance: ±0.01" (±0.25mm)
3. Pin dimension tolerance: ±0.004" (±0.1mm)

Soldering and Reflow Considerations

Lead free wave solder profile for TEN 30WIN Series.

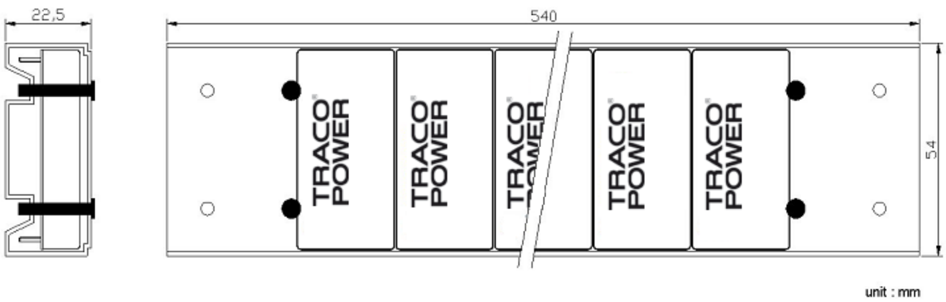


Zone	Reference Parameter
Preheat zone	Rise temp. speed: 3°C/ seconds max. Preheat temp.: 100 ~ 130°C
Actual heating	Peak temp.: 250 ~ 260°C Peak time (T1+T2 time): 4 ~ 6 seconds

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

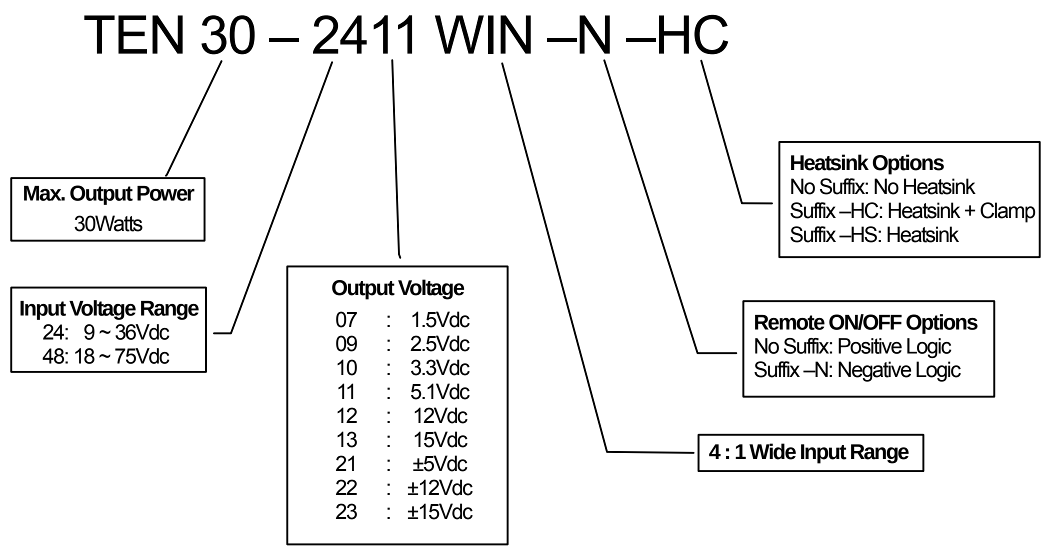
Packaging Information

TUBE



10 PCS per TUBE

Part Number Structure



Model Number	Input Range	Output Voltage	Max. Output Current	Input Current at Full Load (1)	Efficiency (2) (%)
TEN 30-2407WIN	9 – 36Vdc	1.5 Vdc	8500mA	700mA	80
TEN 30-2409WIN	9 – 36Vdc	2.5 Vdc	8000mA	1054mA	83
TEN 10-2410WIN	9 – 36Vdc	3.3 Vdc	7500mA	1258mA	86
TEN 30-2411WIN	9 – 36Vdc	5 .1Vdc	6000mA	1517mA	88
TEN 30-2412WIN	9 – 36Vdc	12 Vdc	2500mA	1471mA	89
TEN 30-2413WIN	9 – 36Vdc	15 Vdc	2000mA	1471mA	89
TEN 30-2421WIN	9 – 36Vdc	±5 Vdc	±3000mA	1488mA	88
TEN 30-2422WIN	9 – 36Vdc	±12 Vdc	±1250mA	1506mA	87
TEN 30-2423WIN	9 – 36Vdc	±15 Vdc	±1000mA	1506mA	87
TEN 30-2433WIN	9 – 36Vdc	3.3Vdc / ±12Vdc	+5000mA / ±420mA	1330mA	87
TEN 30-2434WIN	9 – 36Vdc	3.3Vdc / ±15Vdc	+5000mA / ±330mA	1330mA	87
TEN 30-2431WIN	9 – 36Vdc	5.0Vdc / ±12Vdc	+4000mA / ±420mA	1488mA	88
TEN 30-2432WIN	9 – 36Vdc	5.0Vdc / ±15Vdc	+4000mA / ±330mA	1488mA	88
TEN 30-4807WIN	18 – 75Vdc	1.5 Vdc	8500mA	350mA	80
TEN 30-4809WIN	18 – 75Vdc	2.5 Vdc	8000mA	520mA	84
TEN 10-4810WIN	18 – 75Vdc	3.3 Vdc	7500mA	629mA	86
TEN 30-4811WIN	18 – 75Vdc	5 .1Vdc	6000mA	759mA	88
TEN 30-4812WIN	18 – 75Vdc	12 Vdc	2500mA	727mA	90
TEN 30-4813WIN	18 – 75Vdc	15 Vdc	2000mA	718mA	91
TEN 30-4821WIN	18 – 75Vdc	±5 Vdc	±3000mA	744mA	88
TEN 30-4822WIN	18 – 75Vdc	±12 Vdc	±1250mA	744mA	88
TEN 30-4823WIN	18 – 75Vdc	±15 Vdc	±1000mA	744mA	88
TEN 30-4833WIN	18 – 75Vdc	3.3Vdc / ±12Vdc	+5000mA / ±420mA	665mA	87
TEN 30-4834WIN	18 – 75Vdc	3.3Vdc / ±15Vdc	+5000mA / ±330mA	665mA	87
TEN 30-4831WIN	18 – 75Vdc	5.0Vdc / ±12Vdc	+4000mA / ±420mA	744mA	88
TEN 30-4832WIN	18 – 75Vdc	5.0Vdc / ±15Vdc	+4000mA / ±330mA	744mA	88

Note 1. Maximum value at nominal input voltage and full load of standard type.
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 normal-blow fuse with maximum rating of 10A. Based on the information provided in this data sheet on Inrush energy and maximum dc input current; the same type of fuse with lower rating can be used. Refer to the fuse manufacturer's data for further information.

MTBF and Reliability

The MTBF of TEN 30WIN-SERIES has been calculated according to:

Bellcore TR-NWT-000332 Case I: 50% stress, Operating Temperature at 40°C (Ground fixed and controlled environment)

The resulting figure for Single Output Models: MTBF = 3'173'000 hours
The resulting figure for Dual Output Models: MTBF = 3'163'000 hours
The resulting figure for Triple Output Models: MTBF = 2'904'000 hours

MIL-HDBK 217F NOTICE2 FULL LOAD, Operating Temperature at 25°C

The resulting figure for Single Output Models: MTBF = 554'800 hours
The resulting figure for Dual Output Models: MTBF = 434'700 hours
The resulting figure for Triple Output Models: MTBF = 318'400 hours