TEN 6WIN Series

6W, Ultra-Wide Input Range DIP, Single & Dual Output DC/DC Converters

Features

- DIP-24 Plastic Package
- Ultra-wide 4:1 Input Range
- High Efficiency up to 84%
- Operating Temp. Range -40°C to +85°C
- Overload Protection
- I/O-isolation 1500VDC (opt. 3000VDC)
- Input Filter meets EN 55022,class A and FCC, level A
- 3 Years Product Warranty

Applications

- Distributed power architectures
- Workstations
- Computer equipment
- Communications equipment

General Description

The TRACO TEN 6WIN series is a new range of high performance dc-dc converter modules with 6W output power, featuring ultra-wide 4:1 input voltage ranges and tight output voltage regulation. The product comes in a DIP-24 package with industry standard footprint.
Excellent efficiency allows an operation temperature range of -40°C to +85°C . Standard features include overload protection. Typical applications for these cost optimized converters are battery powered equipment, instrumentation, datacom and industrial electronics.

Table of contents

Absolute Maximum Rating				
Parameter	**Model**	**Min**	**Max**	**Unit**
Input Voltage				
Input Surge Voltage (1sec.)	TEN 6-24xxWIN	---	50	VDC
	TEN 6-48xxWIN	---	100	
Operating Ambient Temperature				
Without Derating	All	-40	+70	℃
With Derating		-40	+85	
Operating Case Temperature	All	---	+100	℃
Storage Temperature	All	-50	+125	℃

Output Specification					
Parameter	**Model**	**Min**	**Nominal**	**Max**	**Unit**
Output Voltage (V_{in}=$V_{in\ nom}$; Full Load; T_A=25℃)	TEN 6-xx10WIN	3.234	3.3	3.366	VDC
	TEN 6-xx11WIN	4.9	5	5.1	
	TEN 6-xx12WIN	11.76	12	12.24	
	TEN 6-xx13WIN	14.7	15	15.3	
	TEN 6-xx15WIN	23.52	24	24.48	
	TEN 6-xx21WIN	±4.9	±5	±5.1	
	TEN 6-xx22WIN	±11.76	±12	±12.24	
	TEN 6-xx23WIN	±14.7	±15	±15.3	
Output Regulation					
Line ($V_{in\ min}$ to $V_{in\ max}$ at Full Load)			±0.1	±0.5	%
Output Regulation					
Load (0% to 100% of Full Load)			±0.6	±1.2	%
Output Ripple & Noise					
Peak-to-Peak (20MHz bandwidth)	All		50	80	mV_{P-P}
Temperature Coefficient	All	---	±0.01	±0.02	%/℃
Output Voltage Overshoot ($V_{in\ min}$ to $V_{in\ max}$; Full Load; T_A = 25℃)	All	---	---	5	%
Dynamic Load Response (V_{in} = $V_{in\ nom}$; T_A =25℃ Load step change form form 75% to 100% or 100% to 75% of full Load)	All				
Peak Deviation			±3	---	%
Recovery Time (V_{out} < 10% peak deviation)			300	600	µS
Output Current	TEN 6-xx10WIN	0	---	1200	mA
	TEN 6-xx11WIN	0	---	1200	
	TEN 6-xx12WIN	0	---	500	
	TEN 6-xx13WIN	0	---	400	
	TEN 6-xx15WIN	0	---	250	
	TEN 6-xx21WIN	0	---	±500	
	TEN 6-xx22WIN	0	---	±250	
	TEN 6-xx23WIN	0	---	±200	
Output Over Current Protection	All	110	150	---	%FL
Output Short Circuit Protection	All	Continuous			

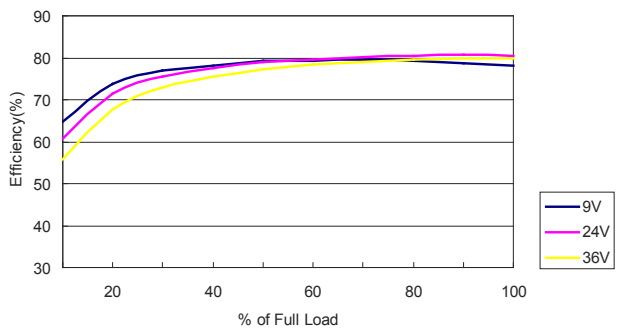
Input Specification					
Parameter	**Model**	**Min**	**Nominal**	**Max**	**Unit**
Operating Input Voltage	TEN 6-24xxWIN	9	24	36	VDC
	TEN 6-48xxWIN	18	48	75	
Under Voltage Lockout Turn-on Threshold	TEN 6-24xxWIN	7	8	9	VDC
	TEN 6-48xxWIN	14	16	18	
Under Voltage Lockout Turn-off Threshold	TEN 6-24xxWIN	---	---	8.5	VDC
	TEN 6-48xxWIN	---	---	16	
Input reflected ripple current	TEN 6-24xxWIN	---	20	---	mA_{P-P}
(5 to 20MHz, 4.7µH source impedance)	TEN 6-48xxWIN	---	15	---	
Input Current (V_{in} = $V_{in\ nom}$; Full Load)	TEN 6-2410WIN	---	214	---	mA
	TEN 6-2411WIN	---	313	---	
	TEN 6-2412WIN	---	298	---	
	TEN 6-2413WIN	---	298	---	
	TEN 6-2415WIN	---	298	---	
	TEN 6-2421WIN	---	260	---	
	TEN 6-2422WIN	---	298	---	
	TEN 6-2423WIN	---	298	---	
	TEN 6-4810WIN	---	107	---	
	TEN 6-4811WIN	---	156	---	
	TEN 6-4812WIN	---	149	---	
	TEN 6-4813WIN	---	149	---	
	TEN 6-24815WIN	---	149	---	
	TEN 6-4821WIN	---	130	---	
	TEN 6-4822WIN	---	149	---	
	TEN 6-4823WIN	---	149	---	
Input current (Typical value at V_{in} = $V_{in\ nom}$; No Load)	TEN 6-2410WIN	---	20	---	mA
	TEN 6-2411WIN				
	TEN 6-2412WIN				
	TEN 6-2413WIN				
	TEN 6-2415WIN				
	TEN 6-2421WIN				
	TEN 6-2422WIN				
	TEN 6-2423WIN				
	TEN 6-4810WIN	---	10	---	
	TEN 6-4811WIN				
	TEN 6-4812WIN				
	TEN 6-4813WIN				
	TEN 6-4815WIN				
	TEN 6-4821WIN				
	TEN 6-4822WIN				
	TEN 6-4823WIN				

General Specification					
Parameter	**Model**	**Min**	**Nominal**	**Max**	**Unit**
Efficiency (V_{in} =$V_{in\ nom}$; Full Load; T_A =25℃)	TEN 6-2410WIN	---	77	---	%
	TEN 6-2411WIN	---	80	---	
	TEN 6-2412WIN	---	84	---	
	TEN 6-2413WIN	---	84	---	
	TEN 6-2415WIN	---	84	---	
	TEN 6-2421WIN	---	80	---	
	TEN 6-2422WIN	---	84	---	
	TEN 6-2423WIN	---	84	---	
	TEN 6-4810WIN	---	77	---	
	TEN 6-4811WIN	---	80	---	
	TEN 6-4812WIN	---	84	---	
	TEN 6-4813WIN	---	84	---	
	TEN 6-4815WIN	---	84	---	
	TEN 6-4821WIN	---	80	---	
	TEN 6-4822WIN	---	84	---	
	TEN 6-4823WIN	---	84	---	
Isolation voltage Input to Output (for 60 seconds)	Standard	1500	---	---	VDC
	Suffix -HI (Note)	3000	---	---	VDC
Isolation resistance	All	1000	---	---	MΩ
Isolation capacitance		---	1000	---	pF
Switching Frequency		---	330	---	KHz
MTBF MIL-STD-217F, T_A =+25℃,Ground Benign		800	---	---	K Hours

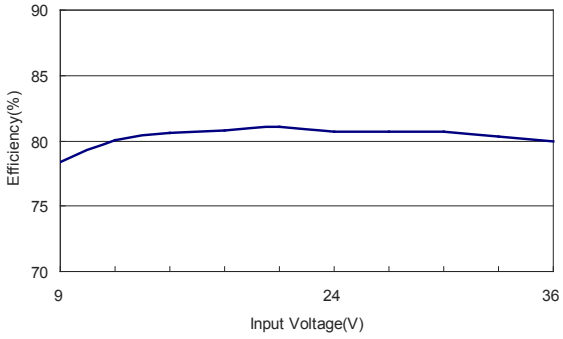
Note:
To order the converter at 3KVDC isolation, please add a **suffix -HI** (e.g. TEN 6-2412WIN-HI) to order code.

Characteristic Curves

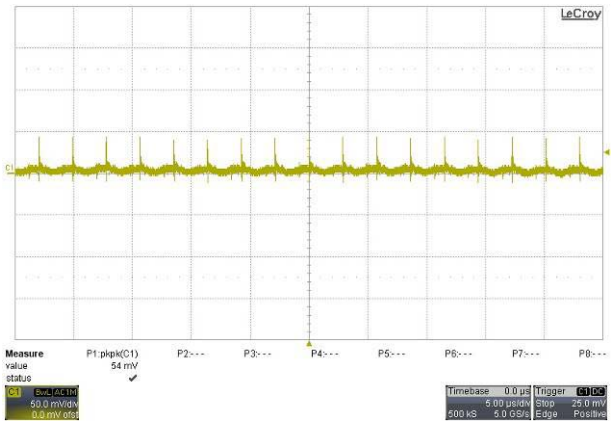
All test conditions are at 25°C The figures are identical for TEN 6-2410WIN



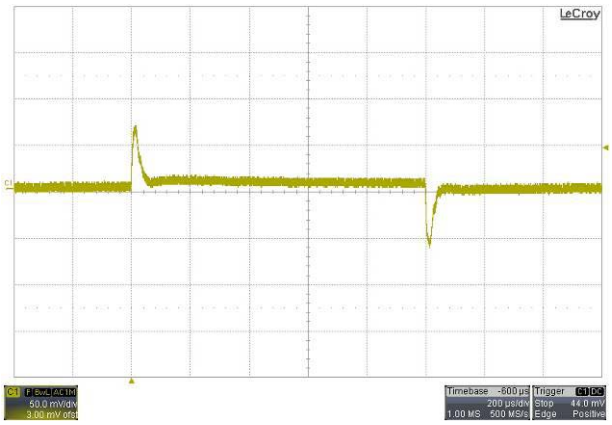
Efficiency Versus Output Current



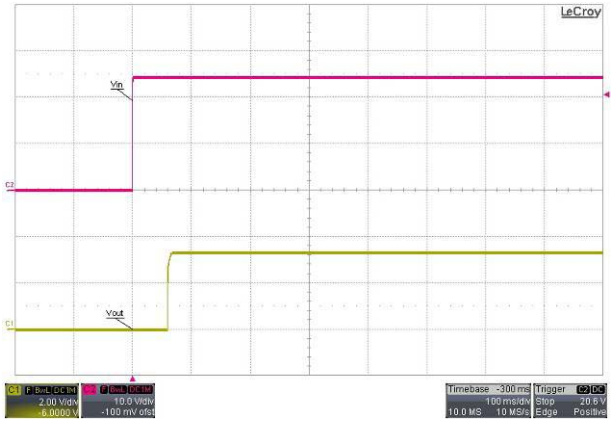
Efficiency Versus Input Voltage. Full Load



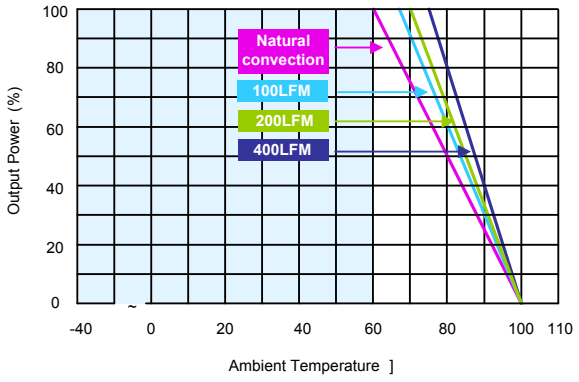
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



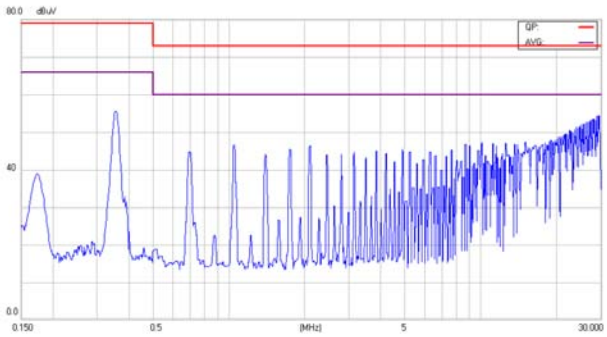
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

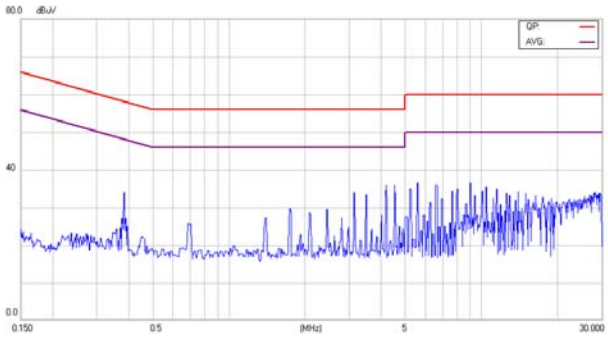
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-2410WIN (Continued)



Conduction Emission of EN55022 Class A

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

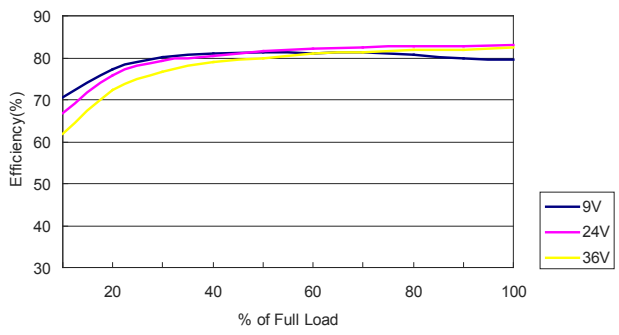


Conduction Emission of EN55022 Class B

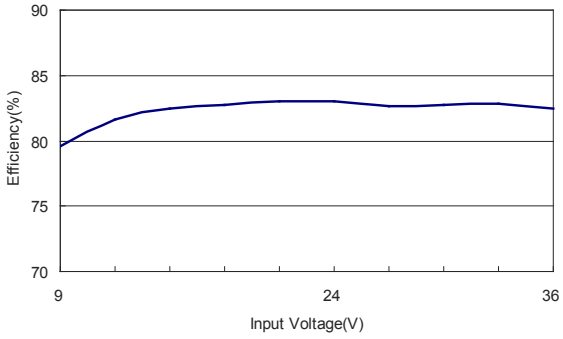
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

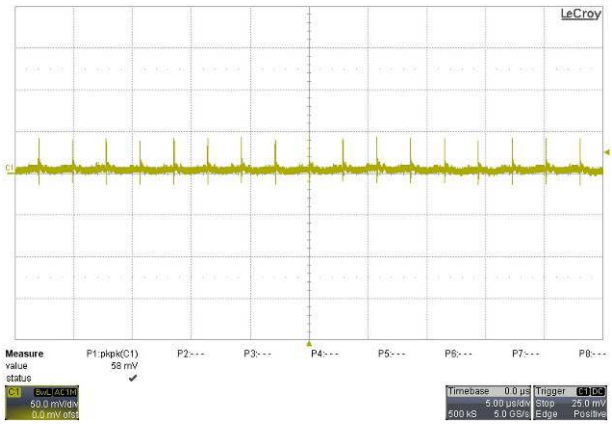
All test conditions are at 25°C The figures are identical for TEN 6-2411WIN



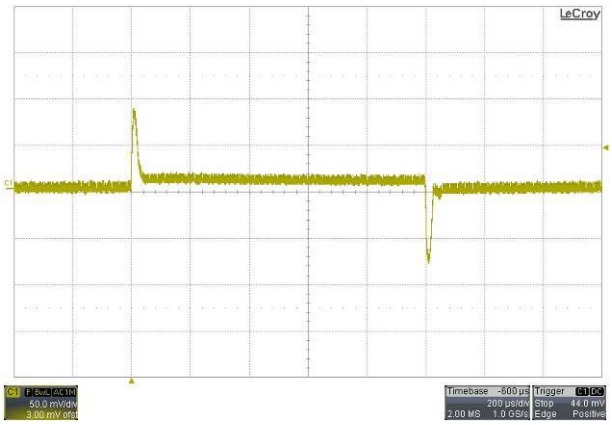
Efficiency Versus Output Current



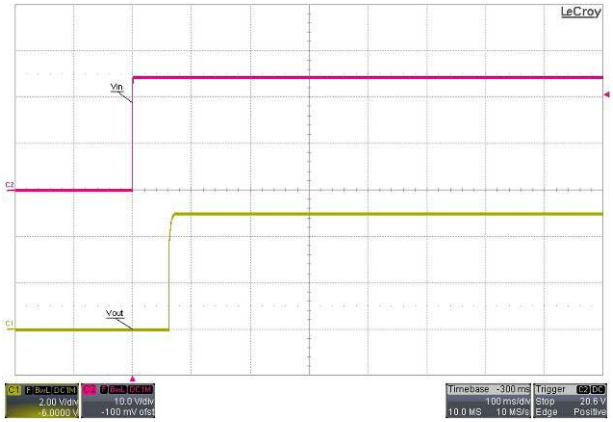
Efficiency Versus Input Voltage. Full Load



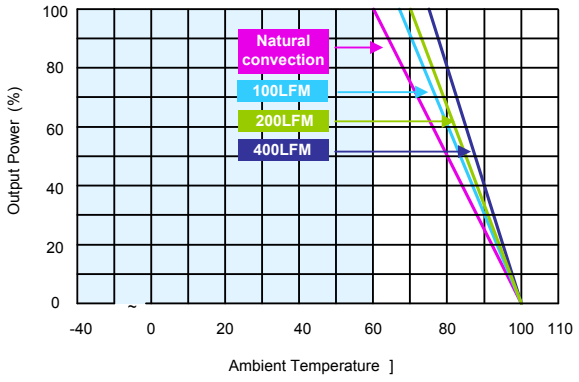
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



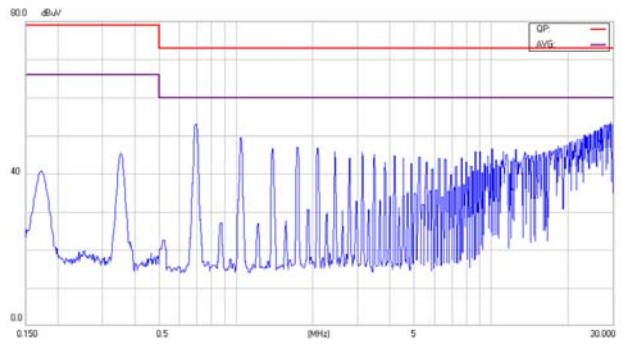
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

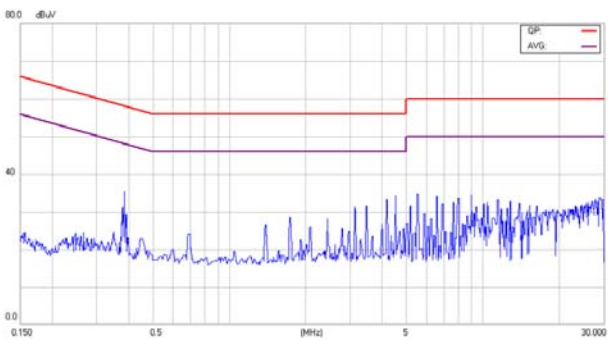
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-2411WIN (Continued)



Conduction Emission of EN55022 Class A

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

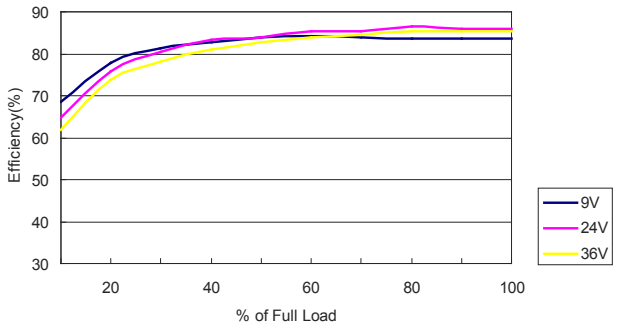


Conduction Emission of EN55022 Class B

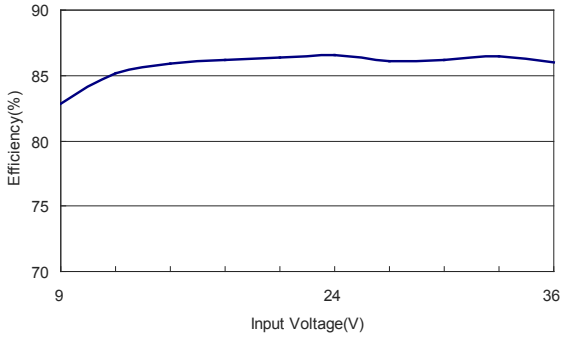
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

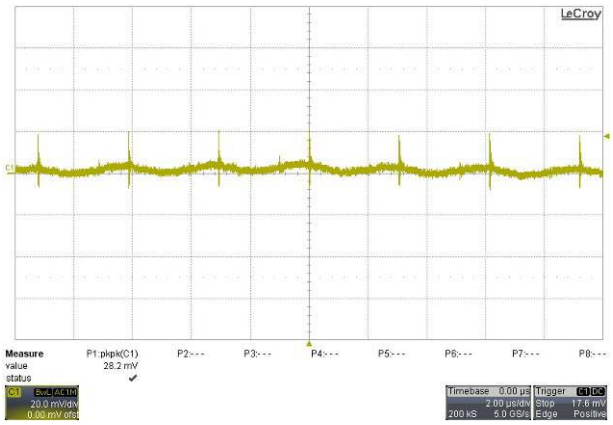
All test conditions are at 25°C The figures are identical for TEN 6-2412WIN



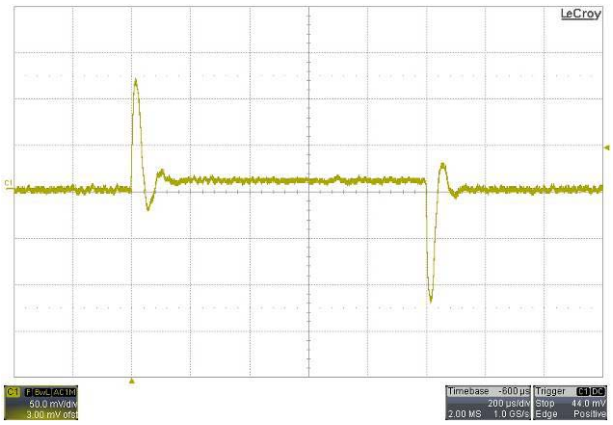
Efficiency Versus Output Current



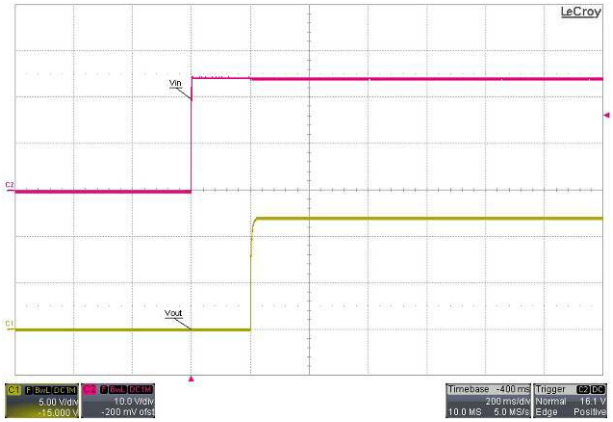
Efficiency Versus Input Voltage. Full Load



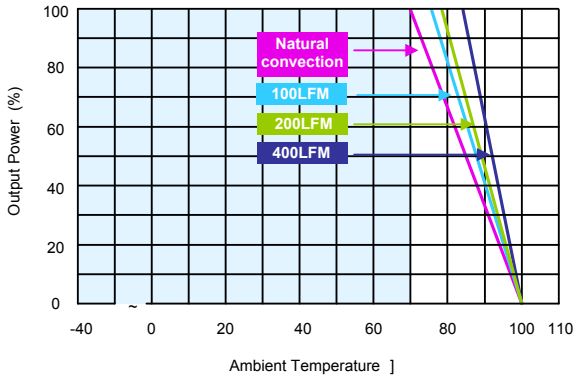
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



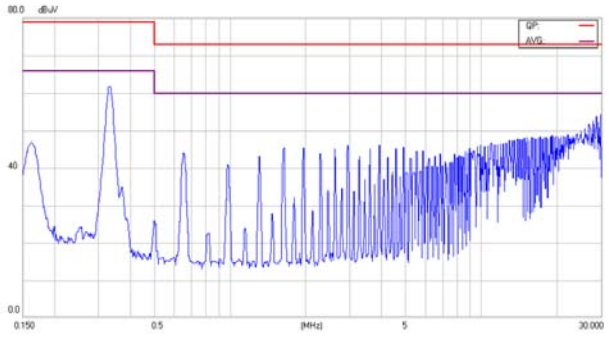
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

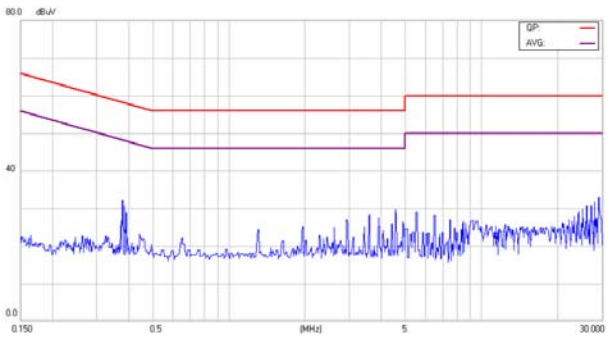
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-2412WIN (Continued)



Conduction Emission of EN55022 Class A

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

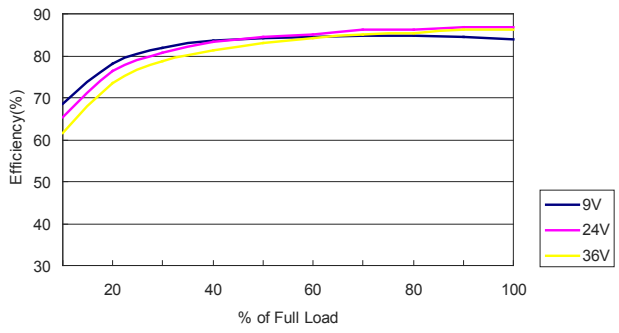


Conduction Emission of EN55022 Class B

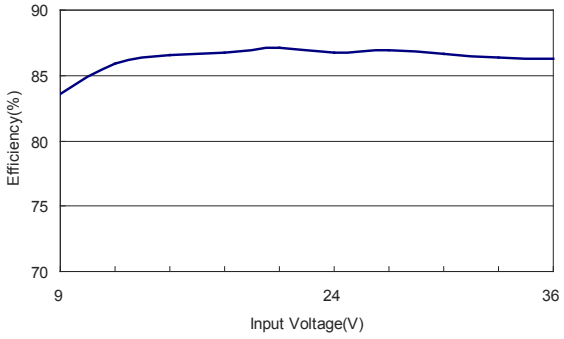
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

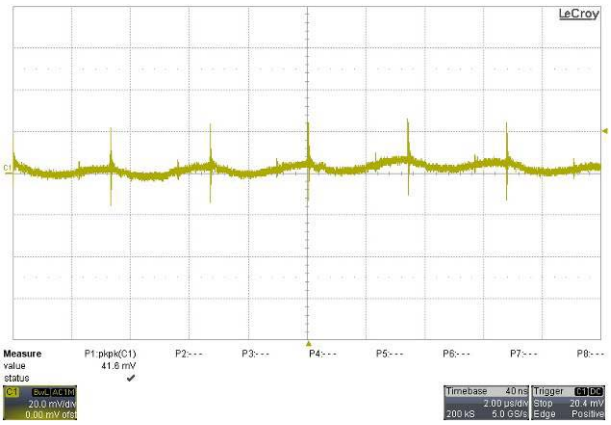
All test conditions are at 25°C The figures are identical for TEN 6-2413WIN



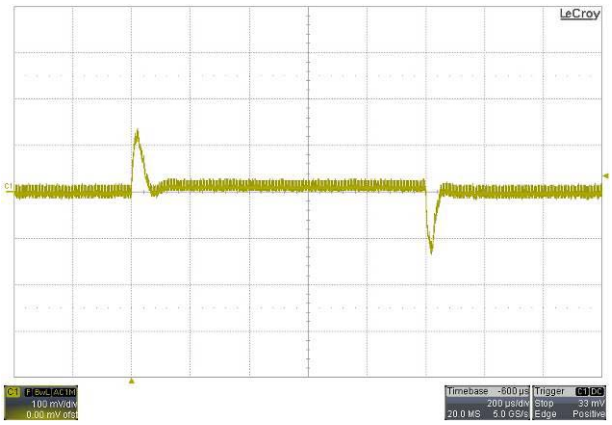
Efficiency Versus Output Current



Efficiency Versus Input Voltage. Full Load

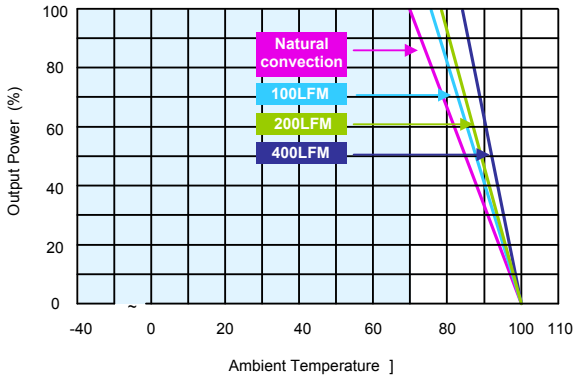


Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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

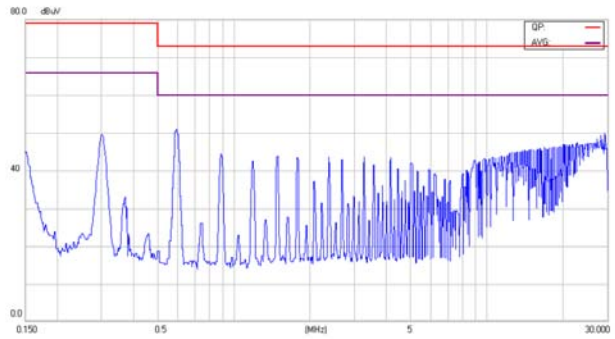
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

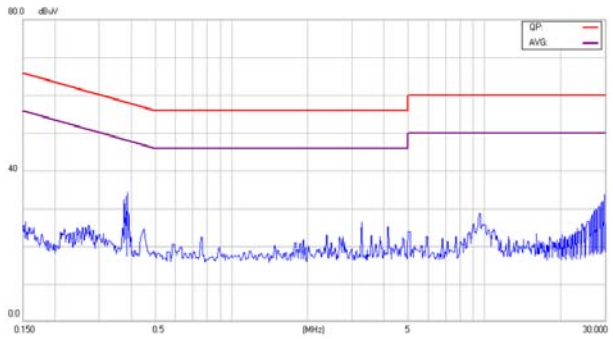
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-2413WIN (Continued)



Conduction Emission of EN55022 Class A

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

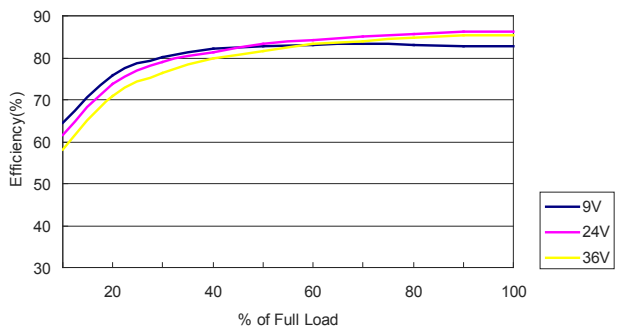


Conduction Emission of EN55022 Class B

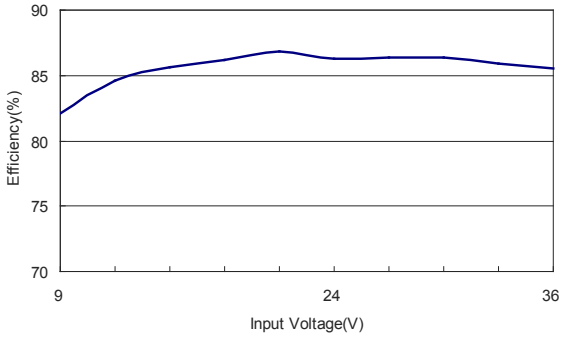
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

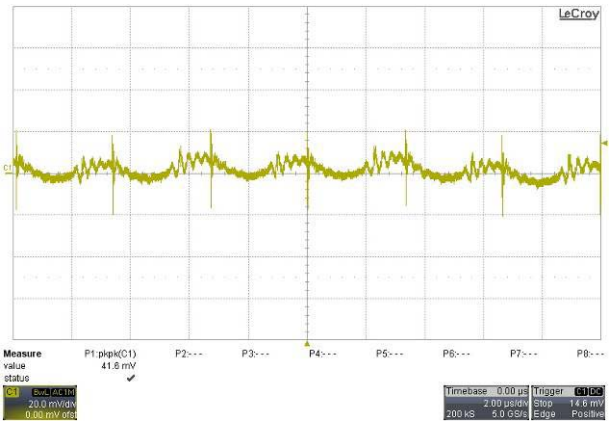
All test conditions are at 25°C The figures are identical for TEN 6-2415WIN



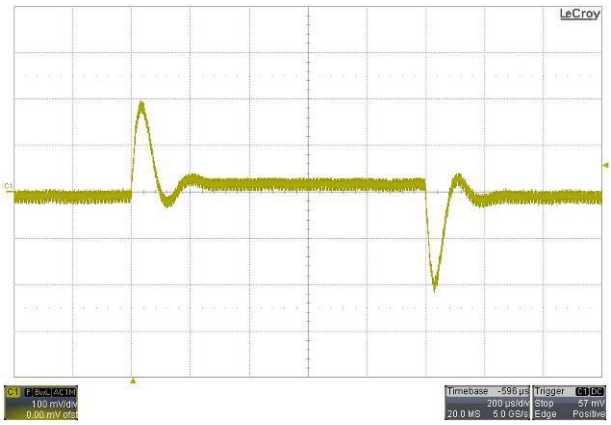
Efficiency Versus Output Current



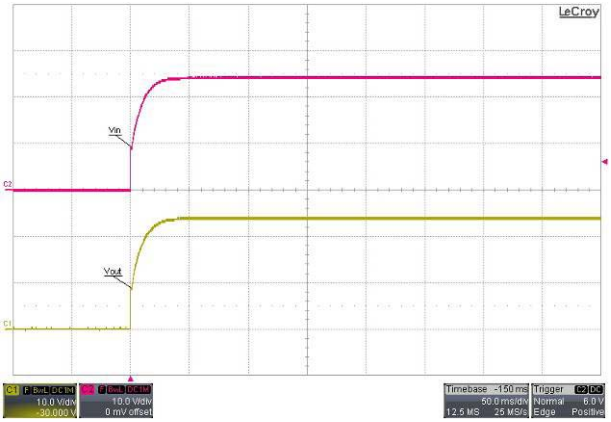
Efficiency Versus Input Voltage. Full Load



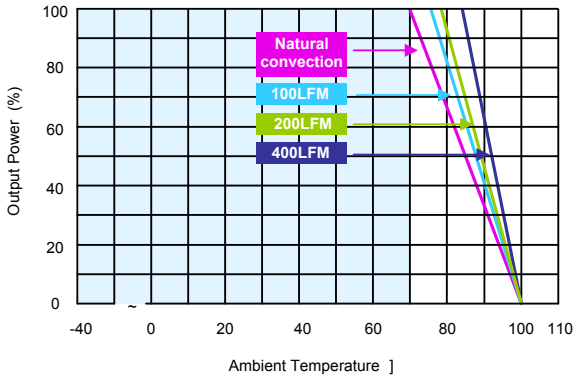
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



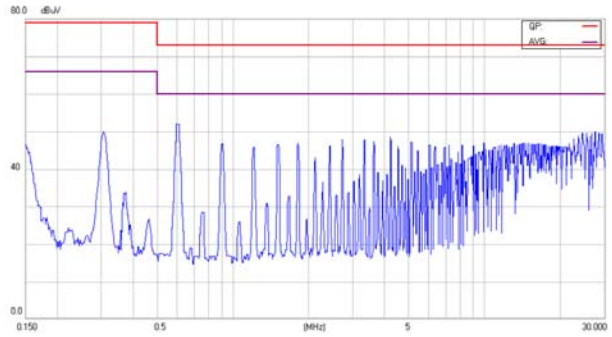
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

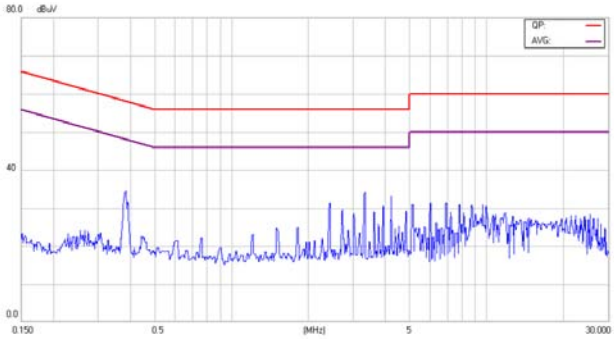
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-2415WIN (Continued)



Conduction Emission of EN55022 Class A

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

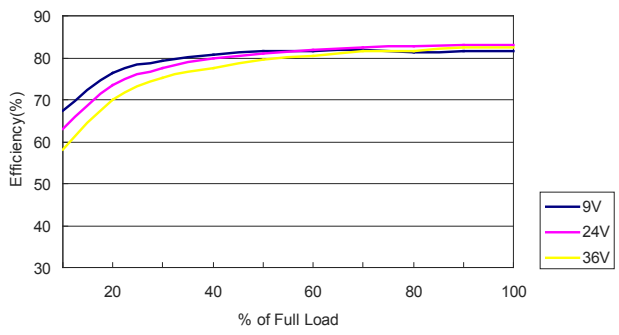


Conduction Emission of EN55022 Class B

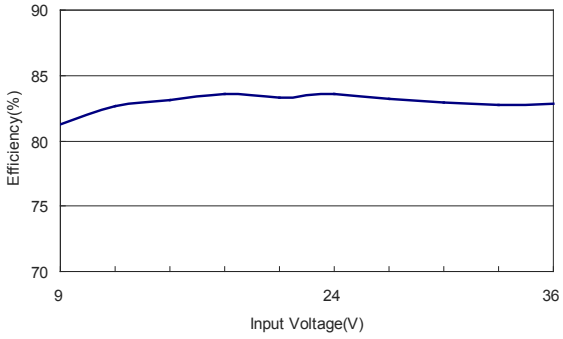
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

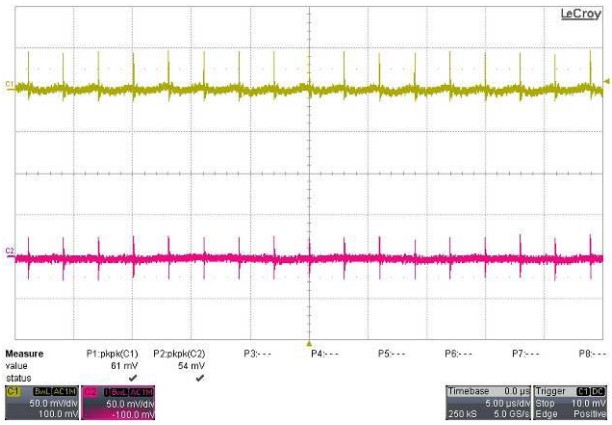
All test conditions are at 25°C The figures are identical for TEN 6-2421WIN



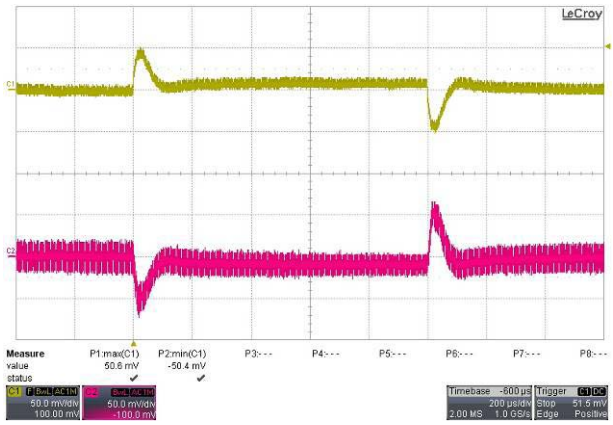
Efficiency Versus Output Current



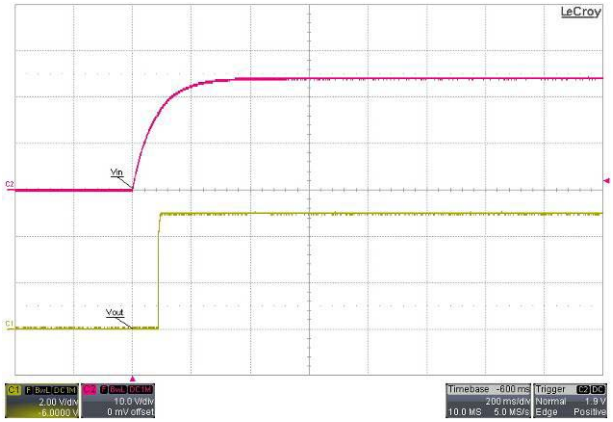
Efficiency Versus Input Voltage. Full Load



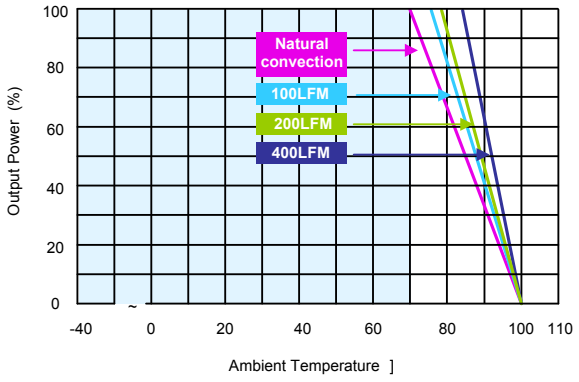
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



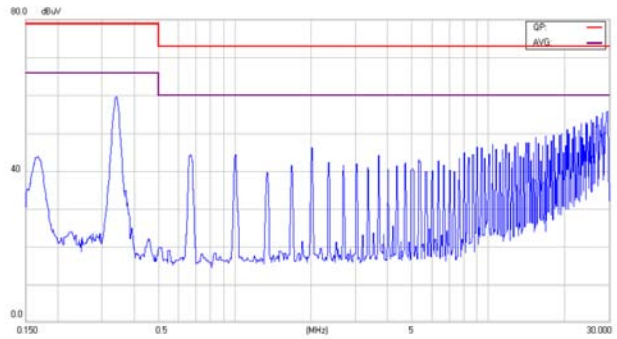
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

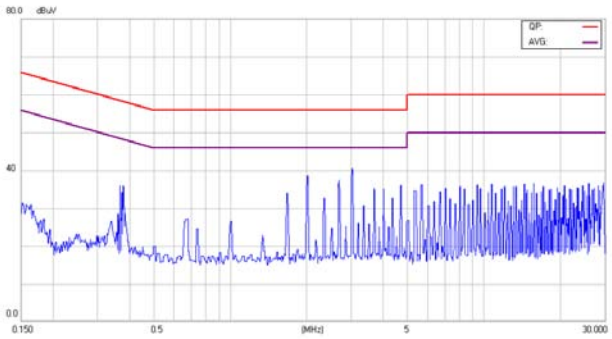
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-2421WIN (Continued)



Conduction Emission of EN55022 Class A

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

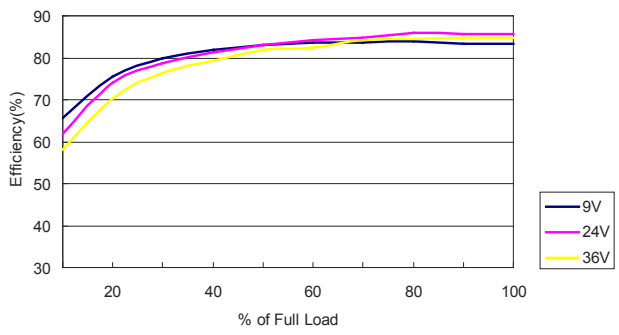


Conduction Emission of EN55022 Class B

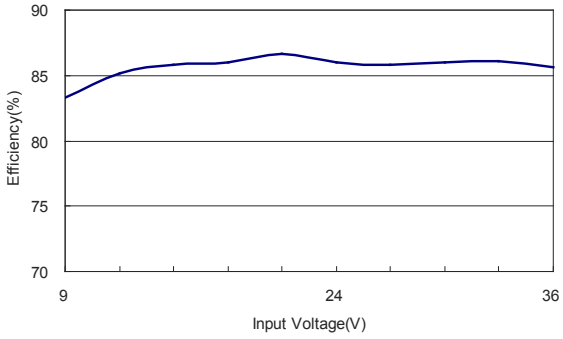
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

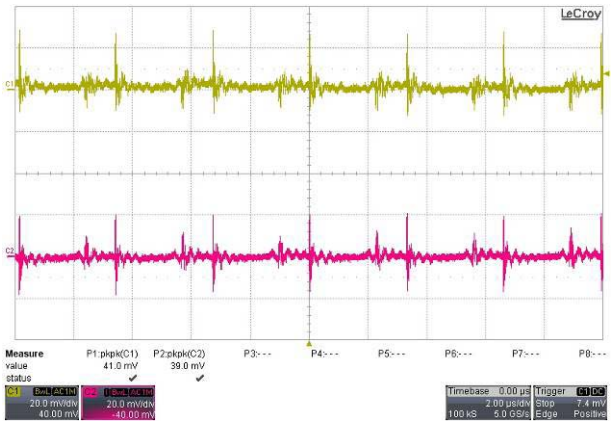
All test conditions are at 25°C The figures are identical for TEN 6-2422WIN



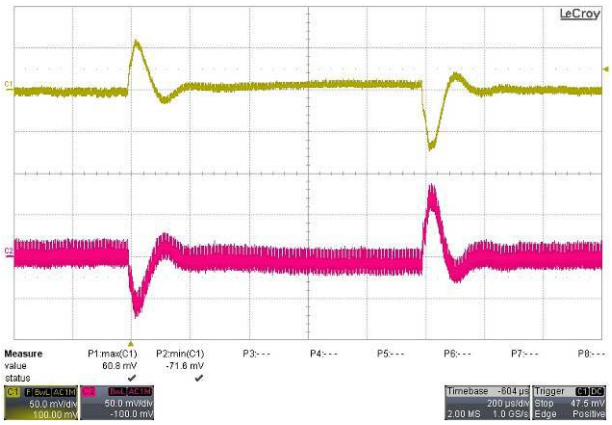
Efficiency Versus Output Current



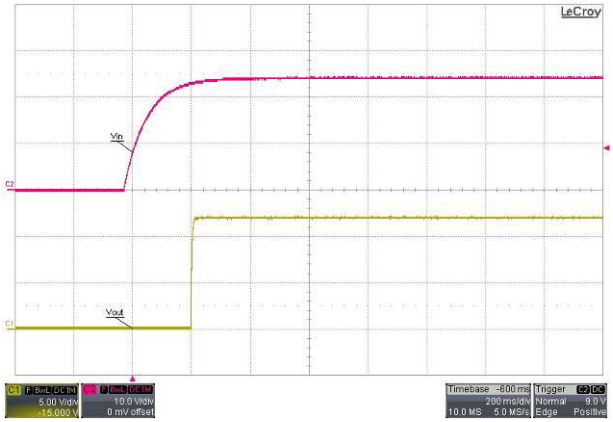
Efficiency Versus Input Voltage. Full Load



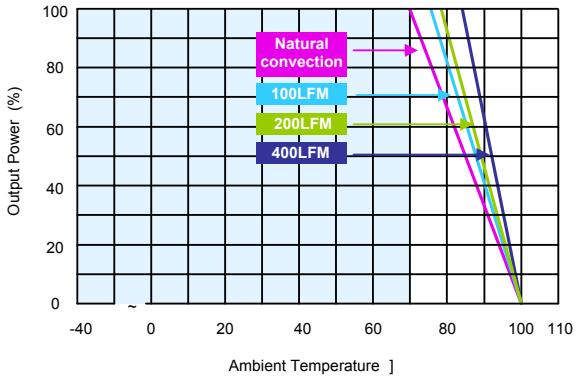
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



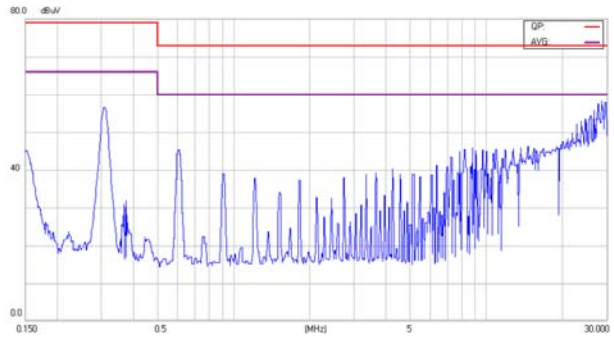
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

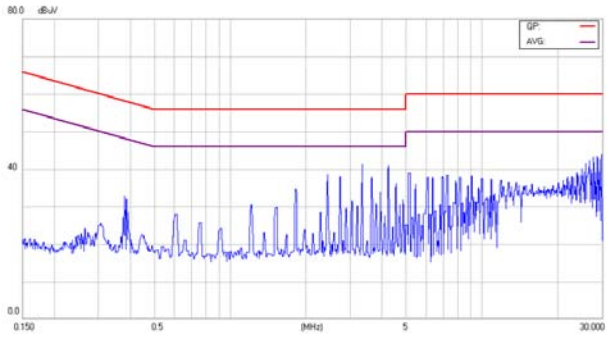
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-2422WIN (Continued)



Conduction Emission of EN55022 Class A

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

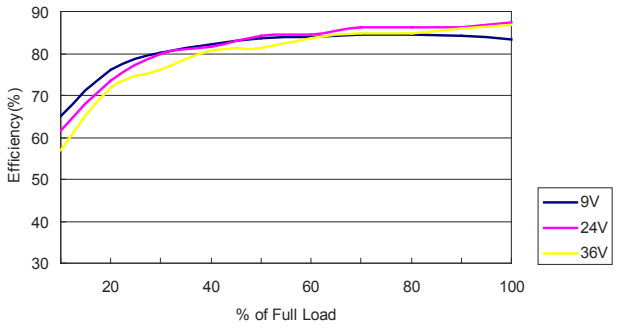


Conduction Emission of EN55022 Class B

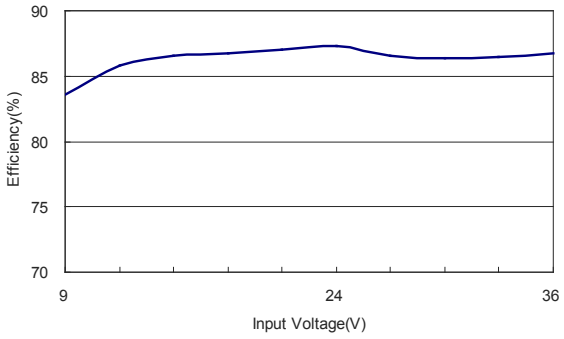
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

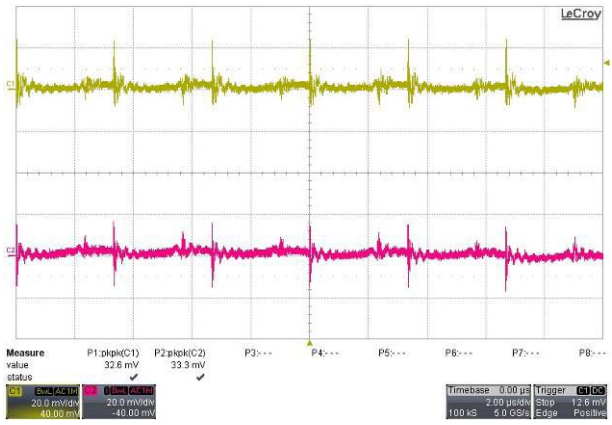
All test conditions are at 25°C The figures are identical for TEN 6-2423WIN



Efficiency Versus Output Current

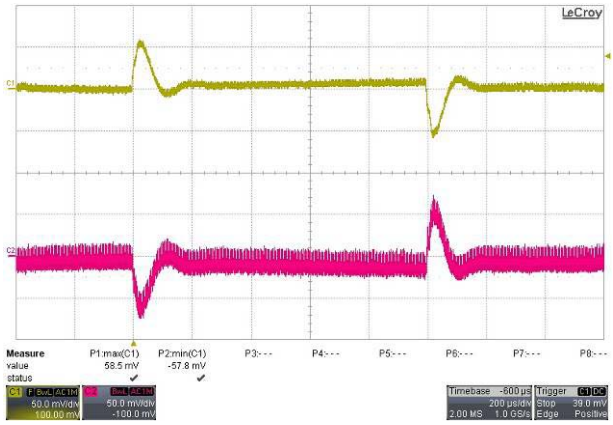


Efficiency Versus Input Voltage. Full Load

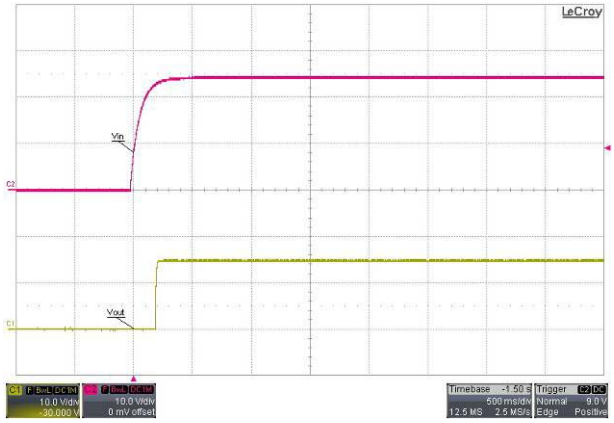


Typical Output Ripple and Noise.

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

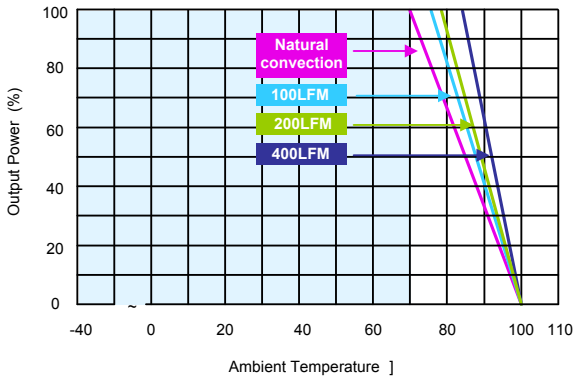


Transient Response to Dynamic Load Change from 100% to 75% of Full Load ; V_{in} =$V_{in\ nom}$



Typical Input Start-Up and Output Rise Characteristic

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

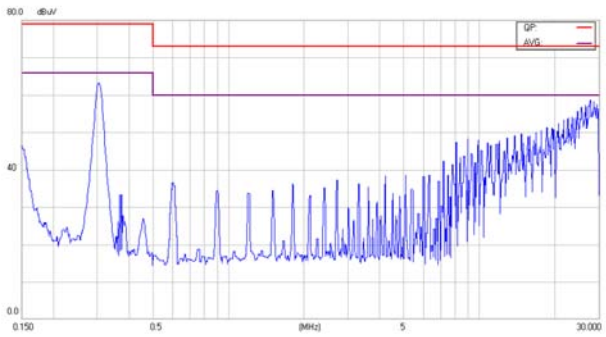


Derating Output Current Versus Ambient Temperature and Airflow

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

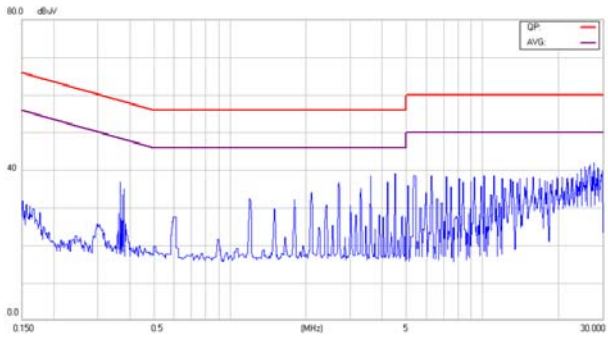
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-2423WIN (Continued)



Conduction Emission of EN55022 Class A

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

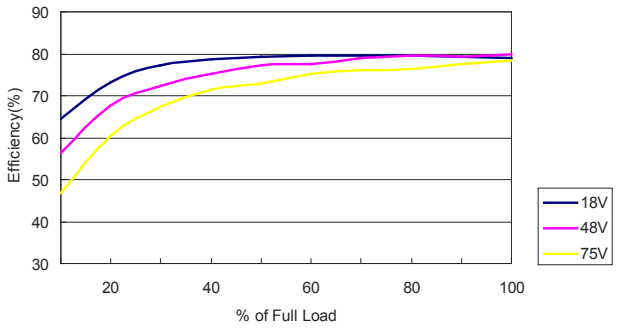


Conduction Emission of EN55022 Class B

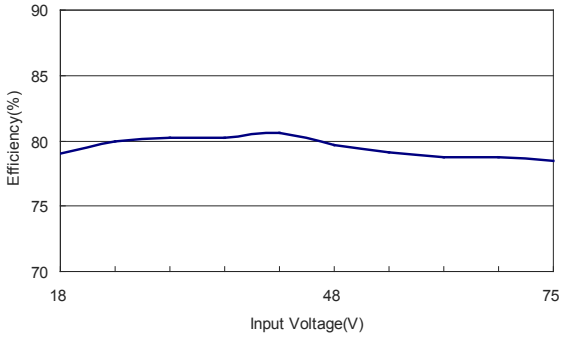
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

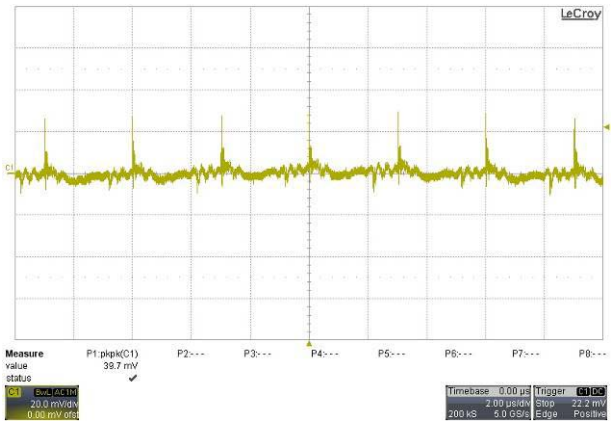
All test conditions are at 25°C The figures are identical for TEN 6-4810WIN



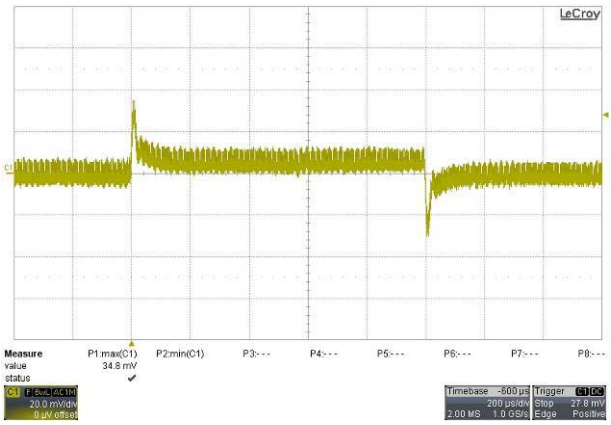
Efficiency Versus Output Current



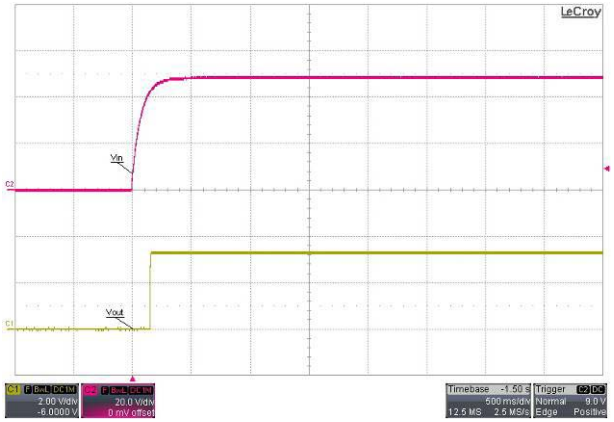
Efficiency Versus Input Voltage. Full Load



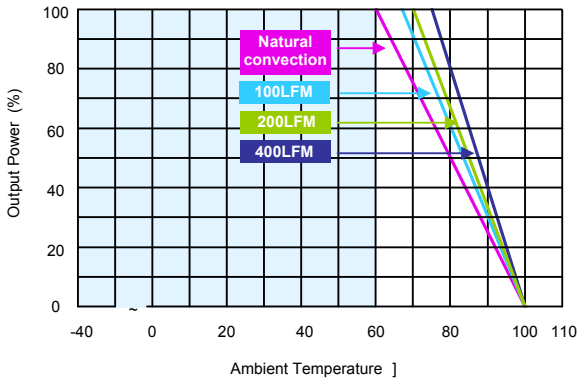
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



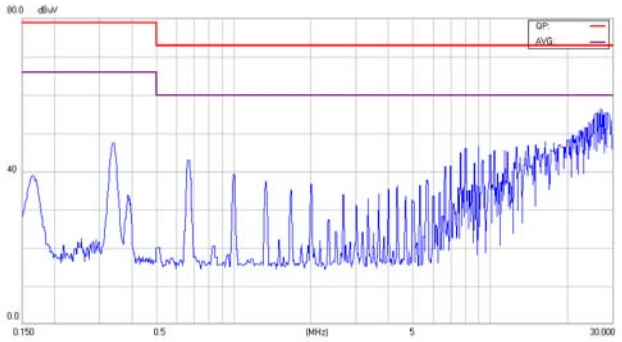
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

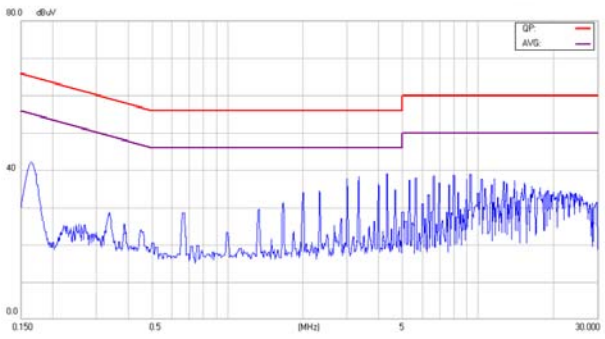
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-4810WIN (Continued)



Conduction Emission of EN55022 Class A

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

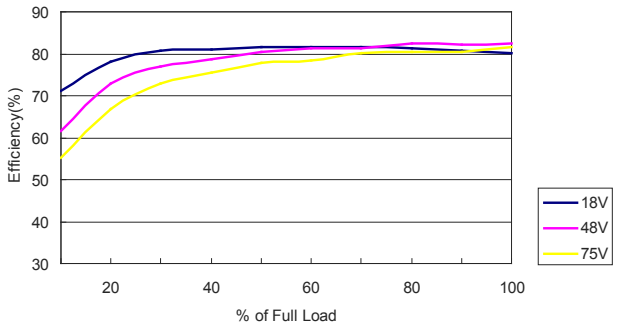


Conduction Emission of EN55022 Class B

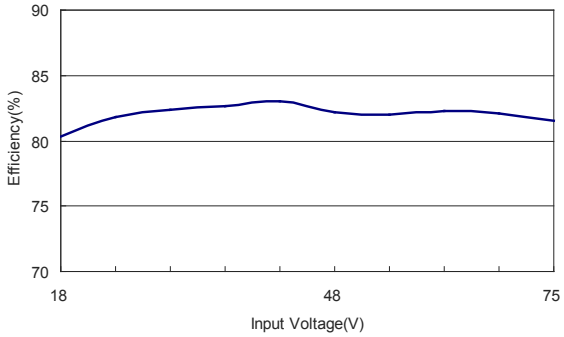
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

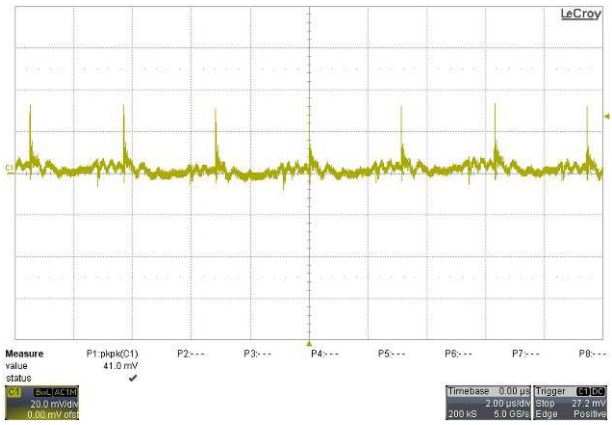
All test conditions are at 25°C The figures are identical for TEN 6-4811WIN



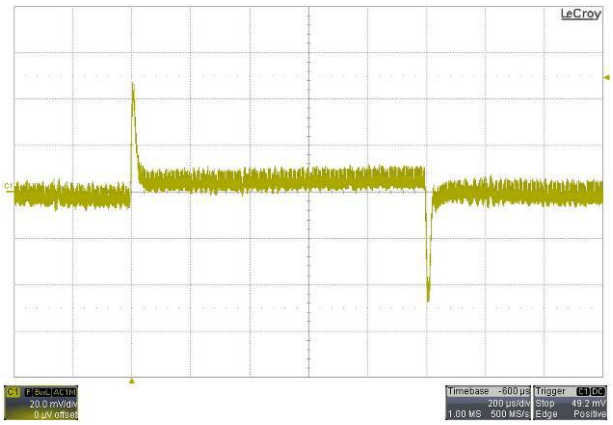
Efficiency Versus Output Current



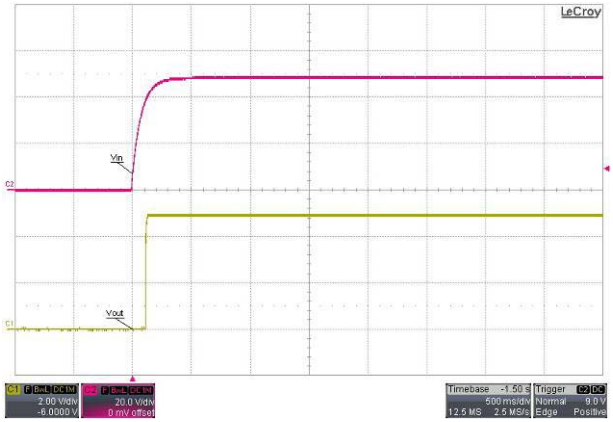
Efficiency Versus Input Voltage. Full Load



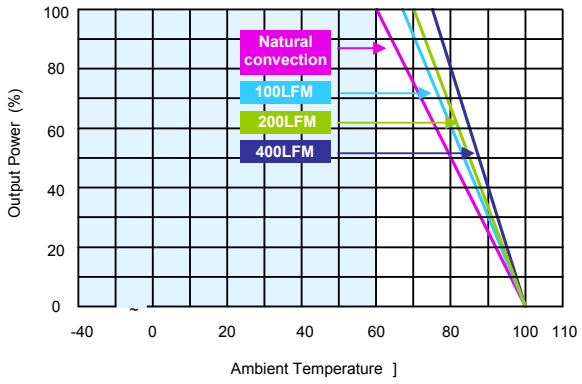
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



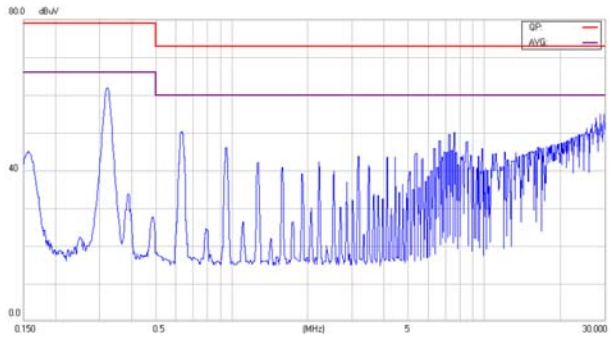
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

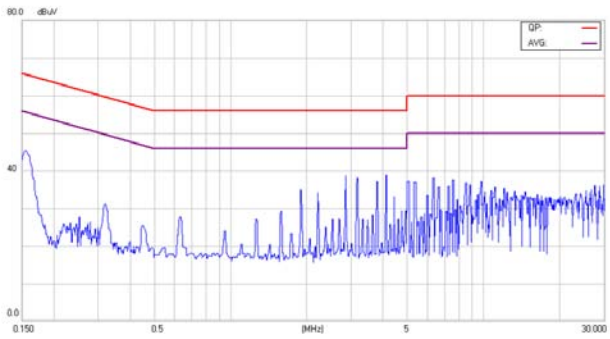
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-4811WIN (Continued)



Conduction Emission of EN55022 Class A

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

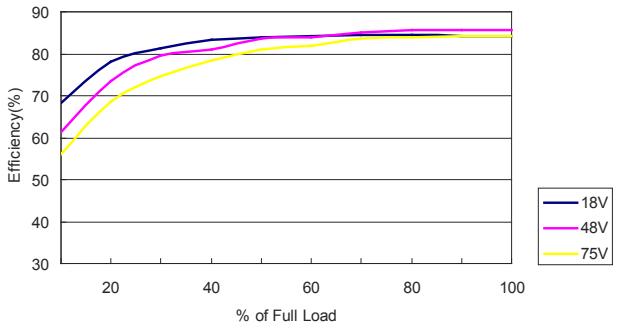


Conduction Emission of EN55022 Class B

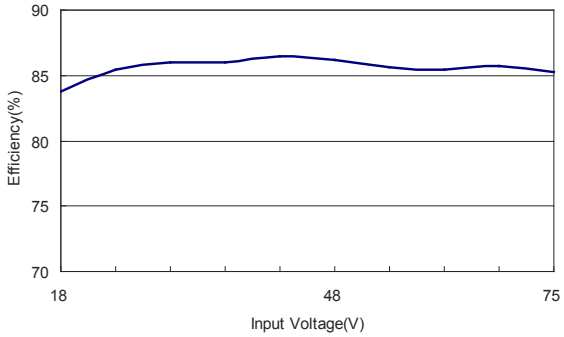
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

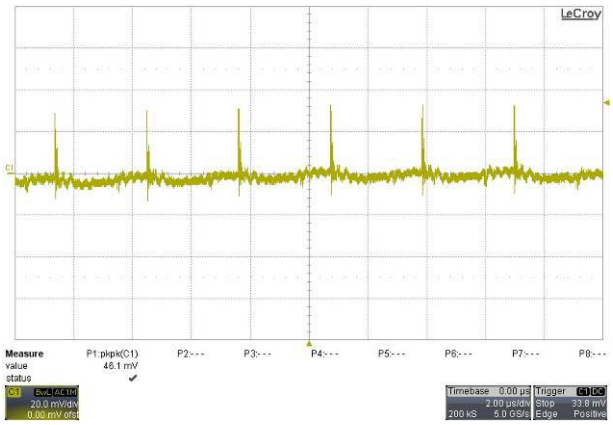
All test conditions are at 25°C The figures are identical for TEN 6-4812WIN



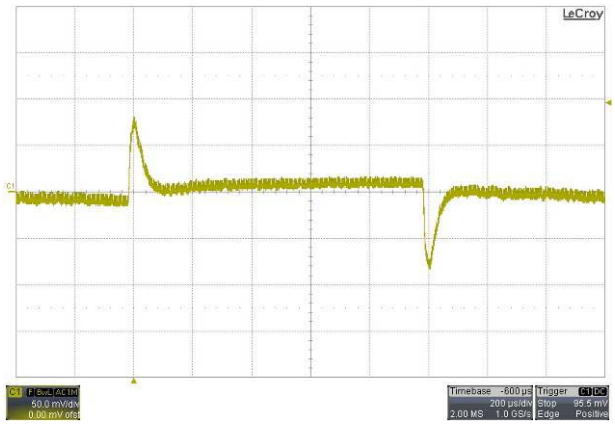
Efficiency Versus Output Current



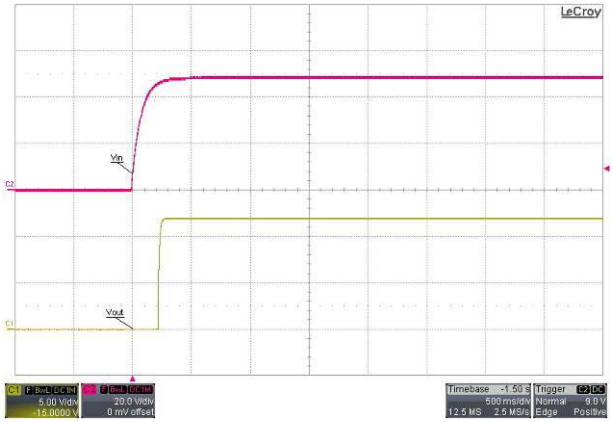
Efficiency Versus Input Voltage. Full Load



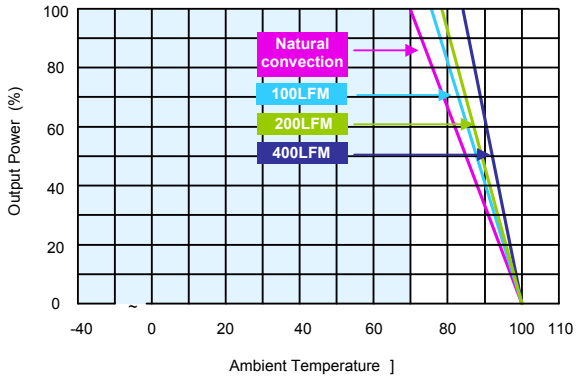
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



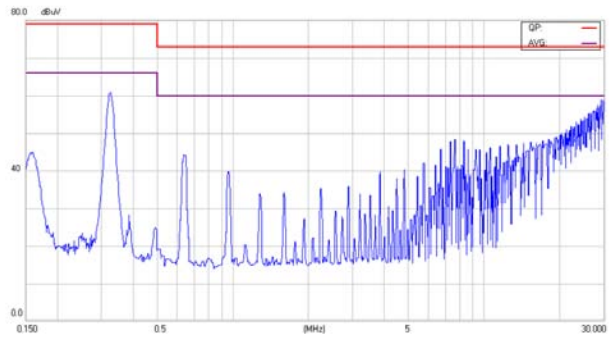
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

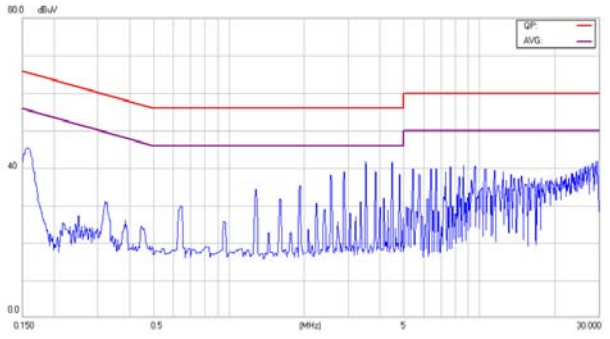
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-4812WIN (Continued)



Conduction Emission of EN55022 Class A

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

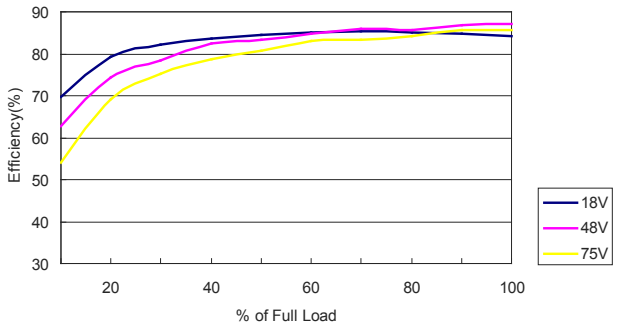


Conduction Emission of EN55022 Class B

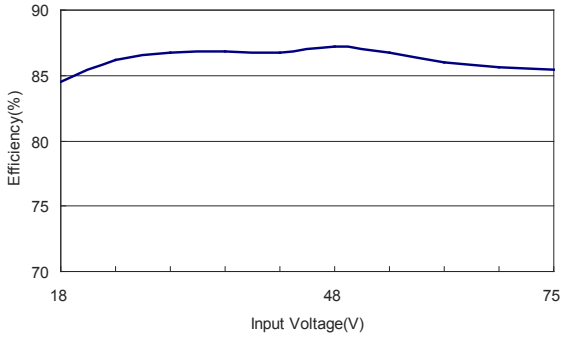
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

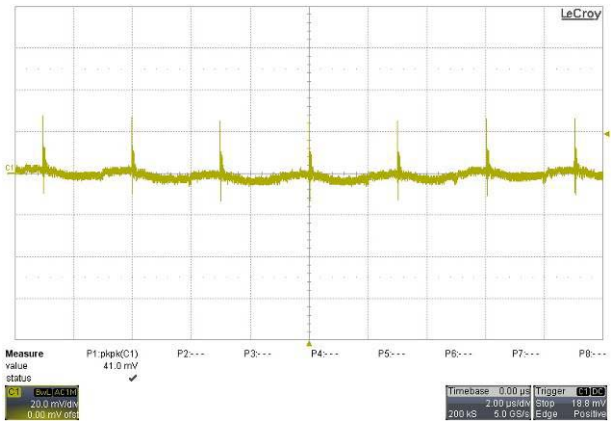
All test conditions are at 25°C The figures are identical for TEN 6-4813WIN



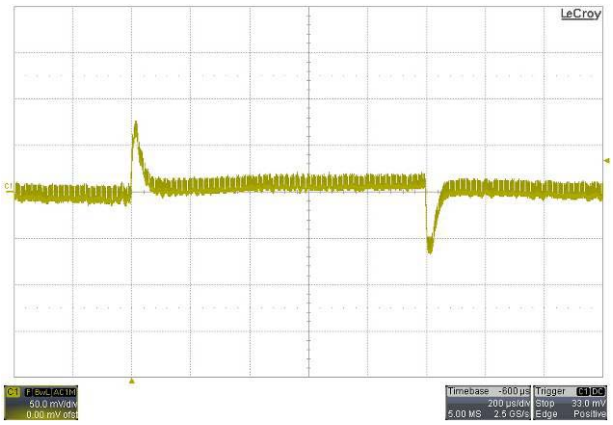
Efficiency Versus Output Current



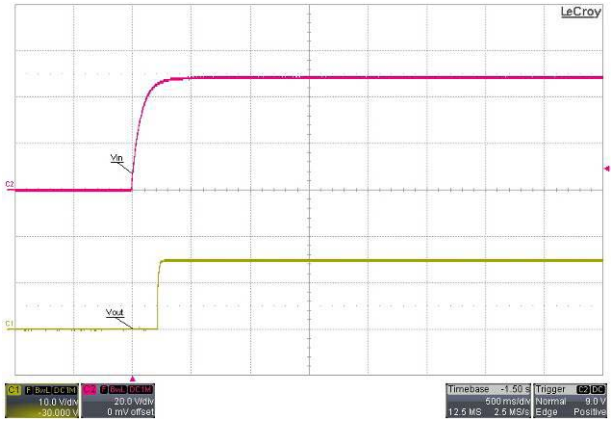
Efficiency Versus Input Voltage. Full Load



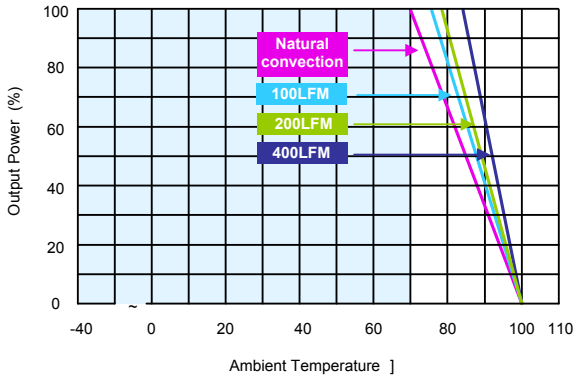
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



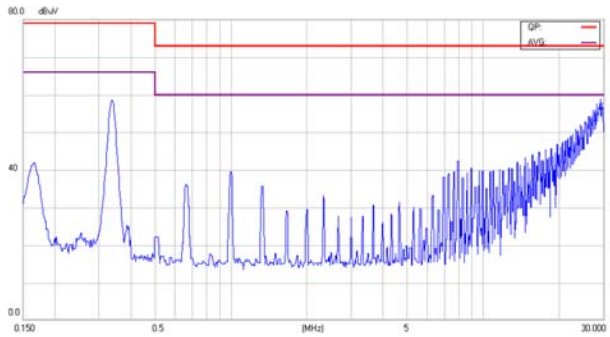
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

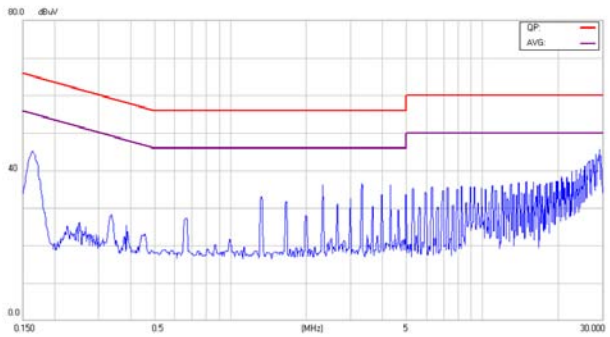
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-4813WIN (Continued)



Conduction Emission of EN55022 Class A

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

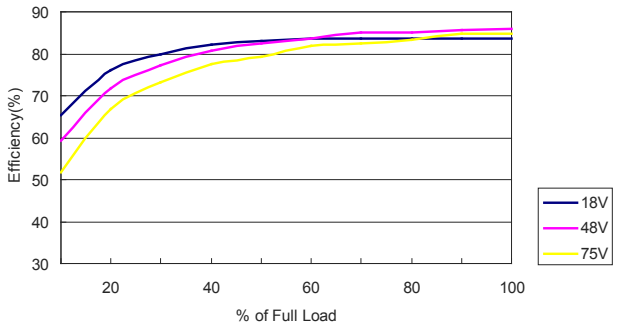


Conduction Emission of EN55022 Class B

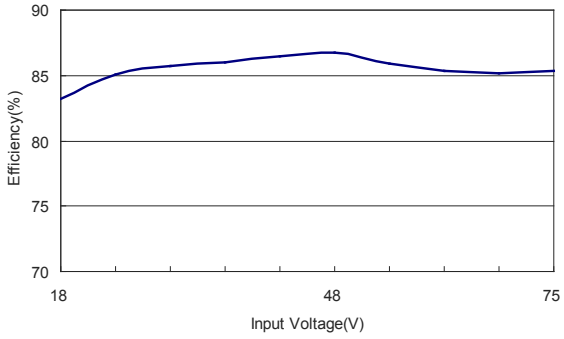
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

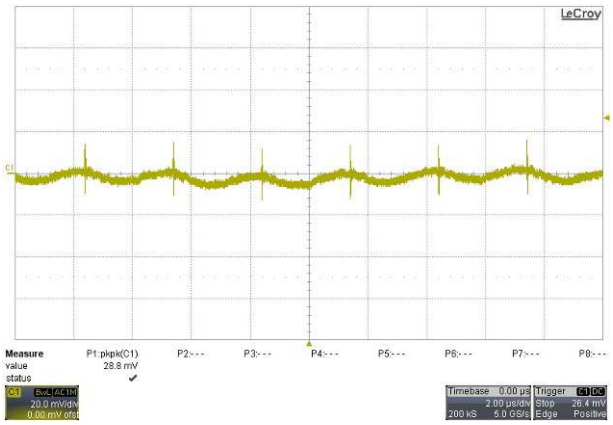
All test conditions are at 25°C The figures are identical for TEN 6-4815WIN



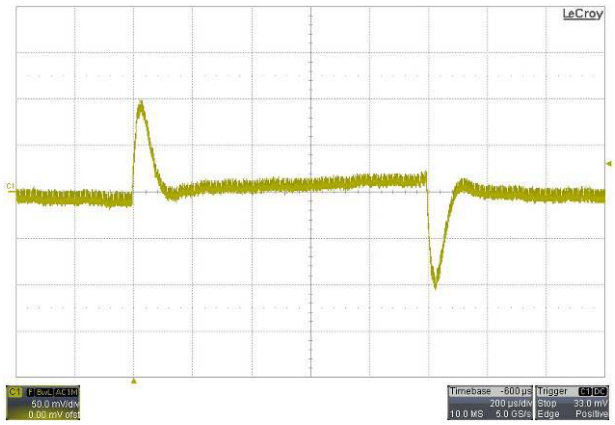
Efficiency Versus Output Current



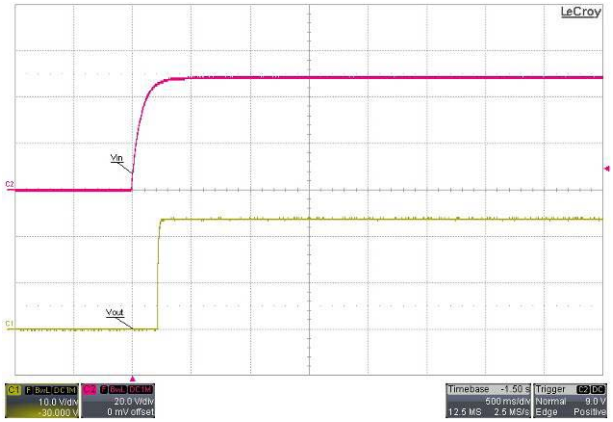
Efficiency Versus Input Voltage. Full Load



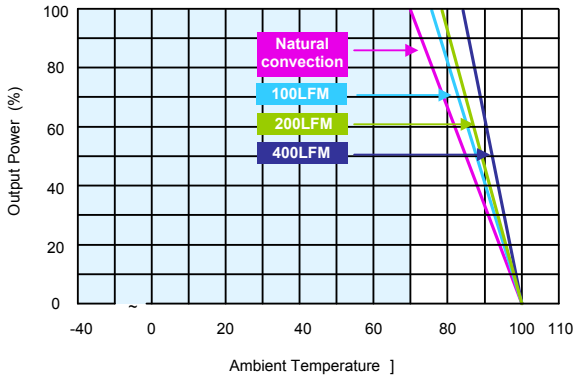
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



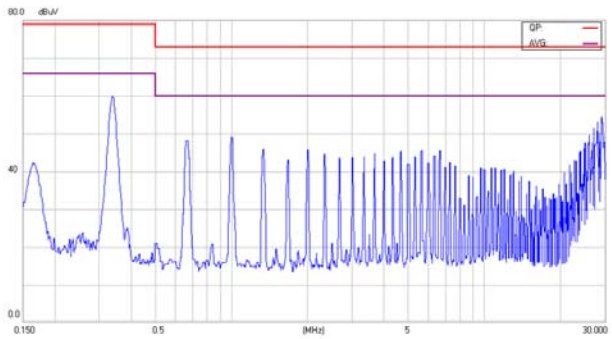
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

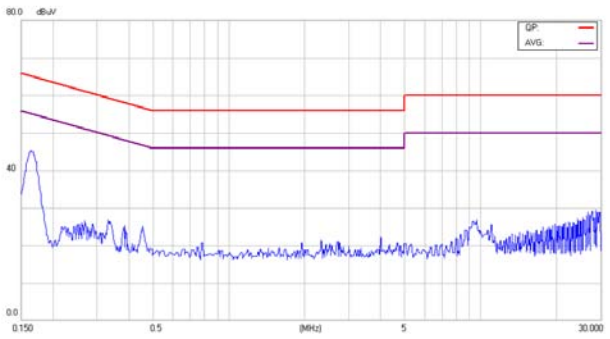
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-4815WIN (Continued)



Conduction Emission of EN55022 Class A

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

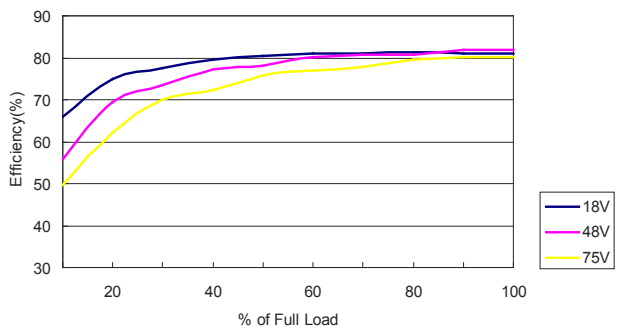


Conduction Emission of EN55022 Class B

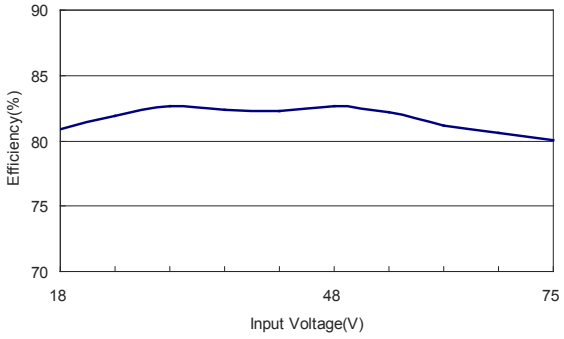
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

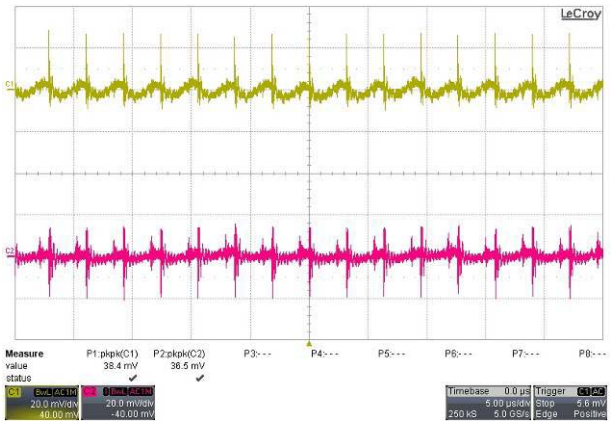
All test conditions are at 25°C The figures are identical for TEN 6-4821WIN



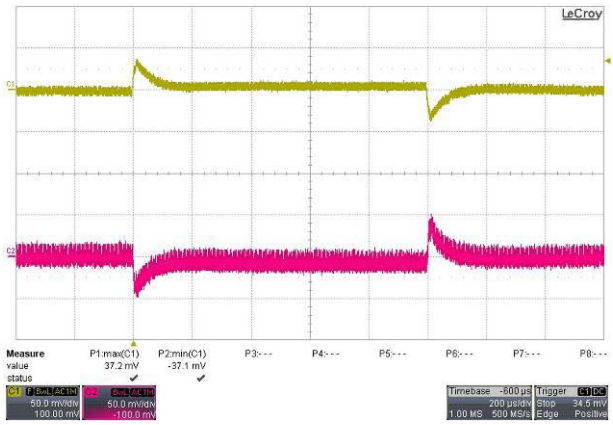
Efficiency Versus Output Current



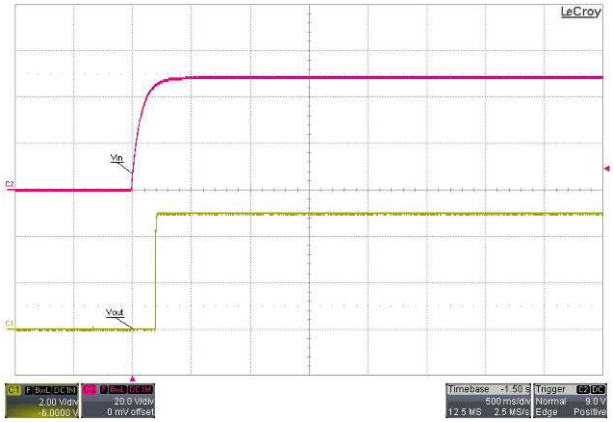
Efficiency Versus Input Voltage. Full Load



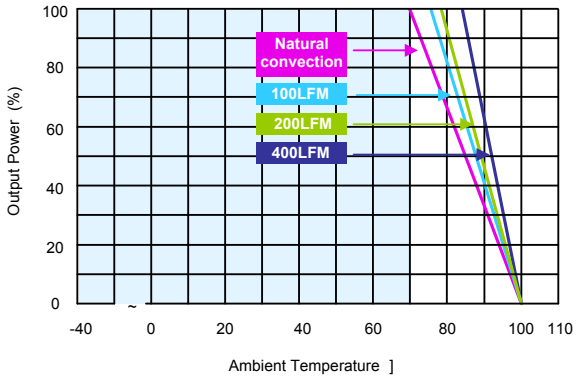
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



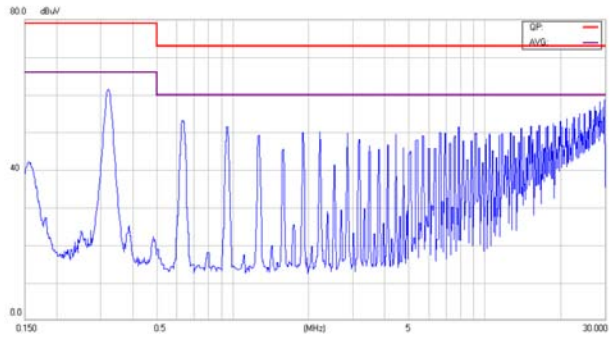
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

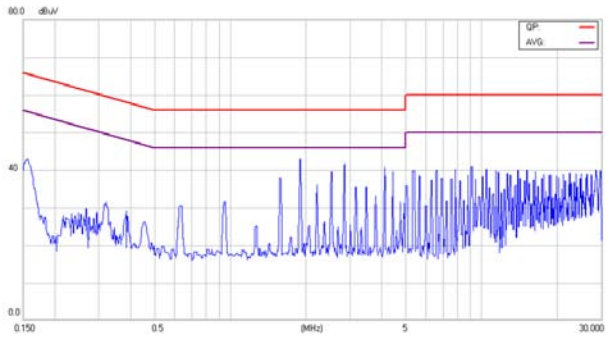
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-4821WIN (Continued)



Conduction Emission of EN55022 Class A

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

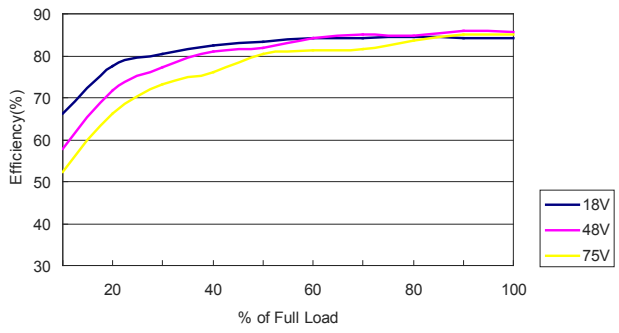


Conduction Emission of EN55022 Class B

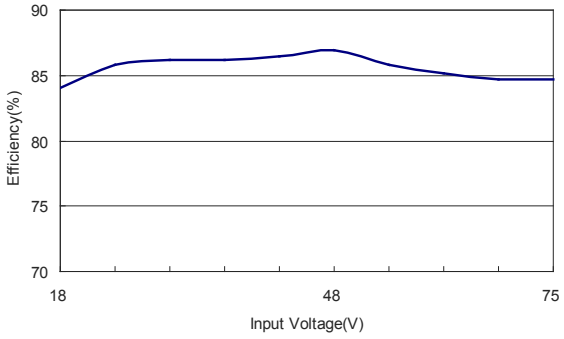
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

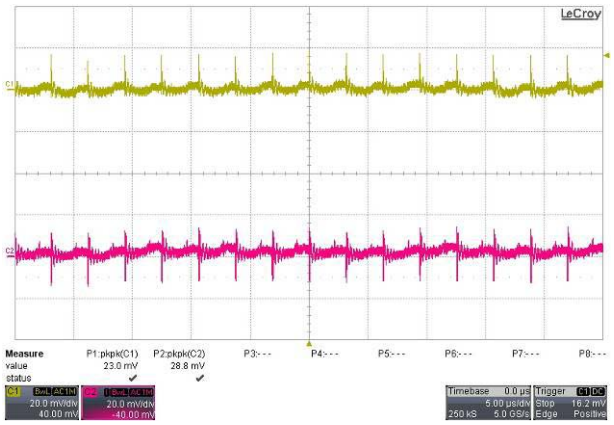
All test conditions are at 25°C The figures are identical for TEN 6-4822WIN



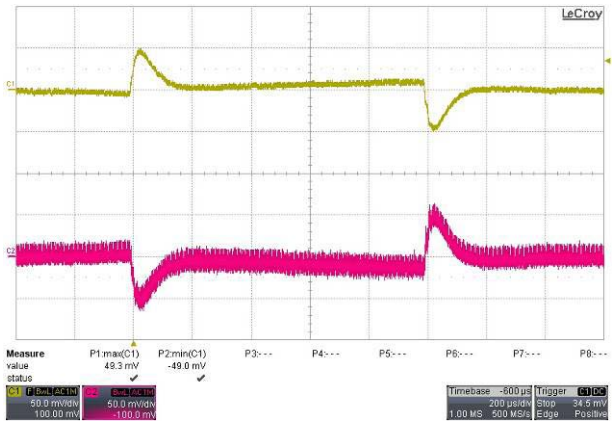
Efficiency Versus Output Current



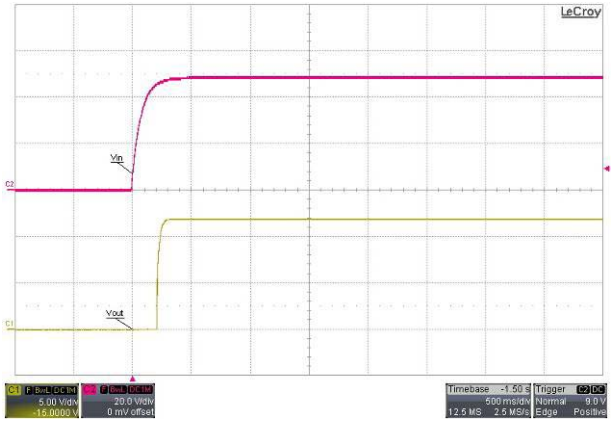
Efficiency Versus Input Voltage. Full Load



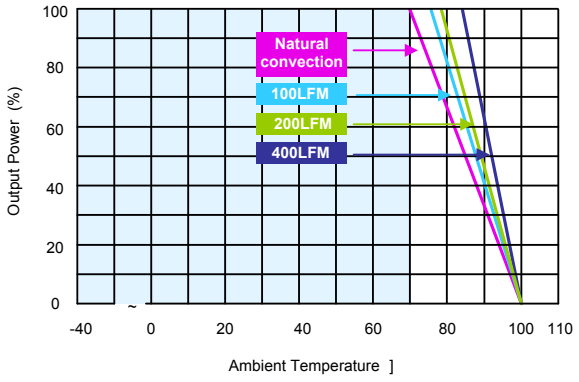
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



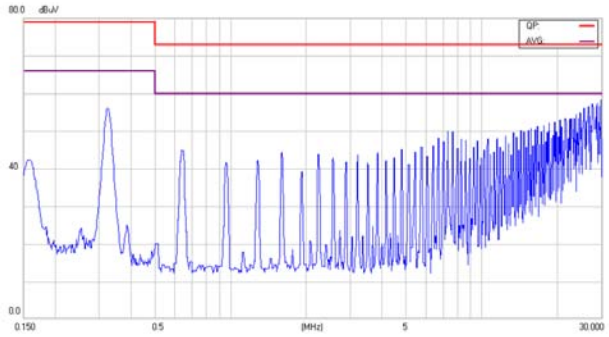
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

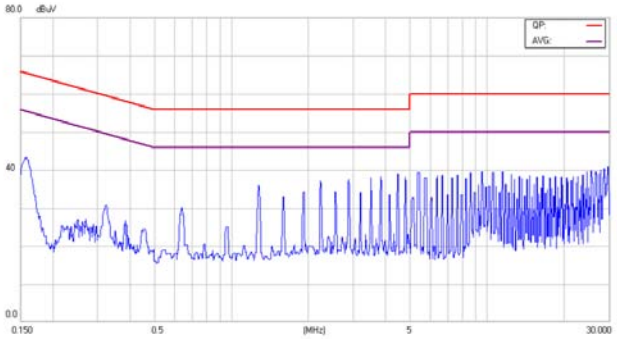
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-4822WIN (Continued)



Conduction Emission of EN55022 Class A

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

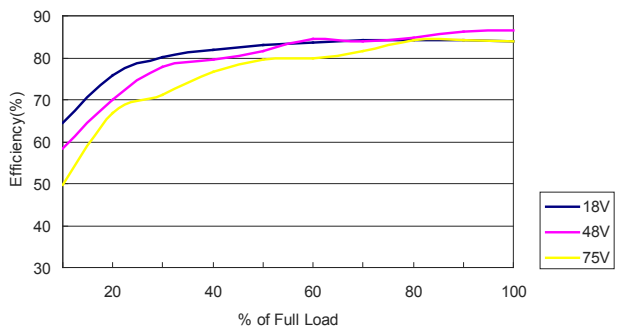


Conduction Emission of EN55022 Class B

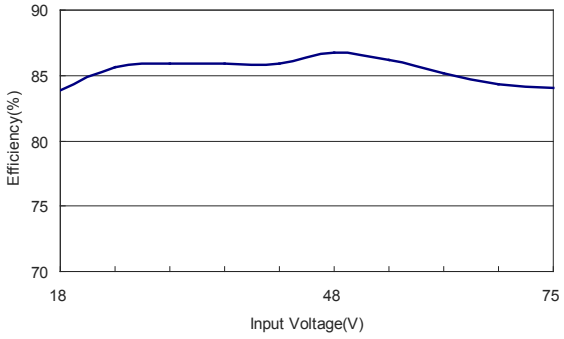
V_{in} =$V_{in\ nom}$; Full Load

Characteristic Curves

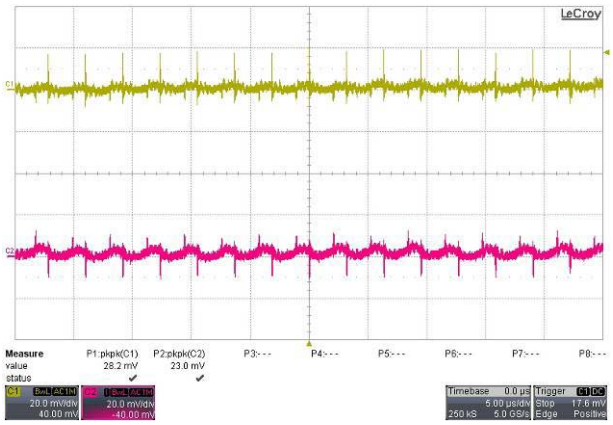
All test conditions are at 25°C The figures are identical for TEN 6-4823WIN



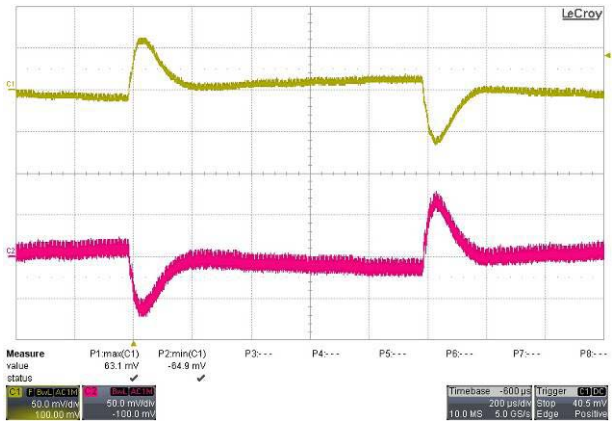
Efficiency Versus Output Current



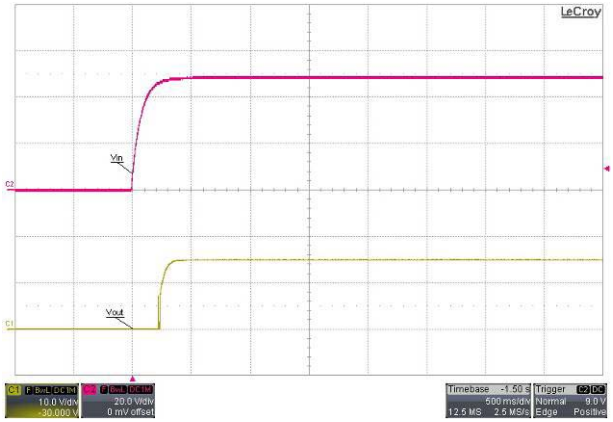
Efficiency Versus Input Voltage. Full Load



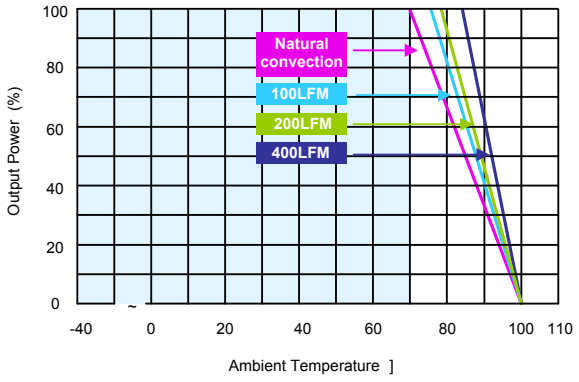
Typical Output Ripple and Noise.
V_{in} =$V_{in\ nom}$; Full Load; T_A



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



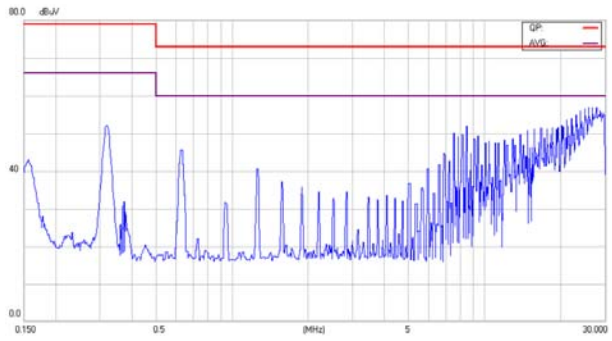
Typical Input Start-Up and Output Rise Characteristic
V_{in} =$V_{in\ nom}$; Full Load



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

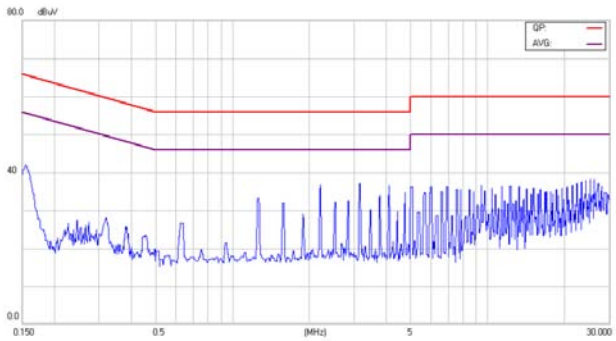
Characteristic Curves

All test conditions are at 25°C The figures are identical for TEN 6-4823WIN (Continued)



Conduction Emission of EN55022 Class A

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

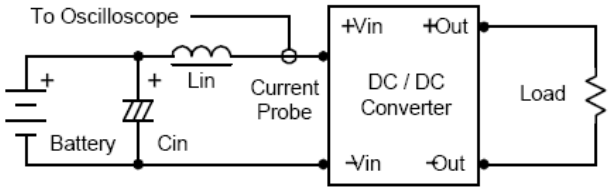


Conduction Emission of EN55022 Class B

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

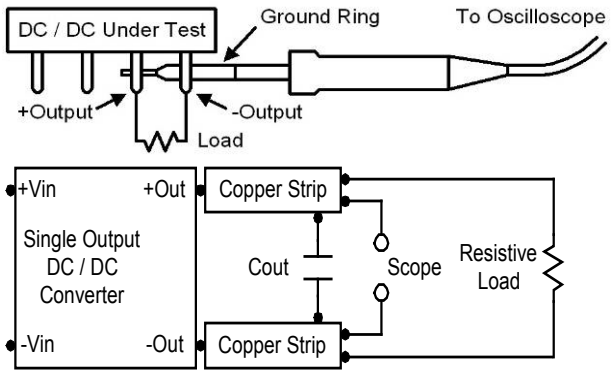
Testing Configurations

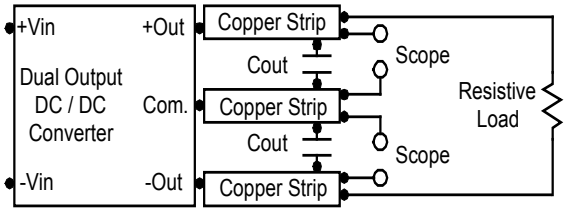
Input reflected-ripple current measurement test up



Component	Value	Reference
L	4.7µH	-----
C	220µF (ESR<1.0Ω at 100KHz)	Aluminum Electrolytic Capacitor

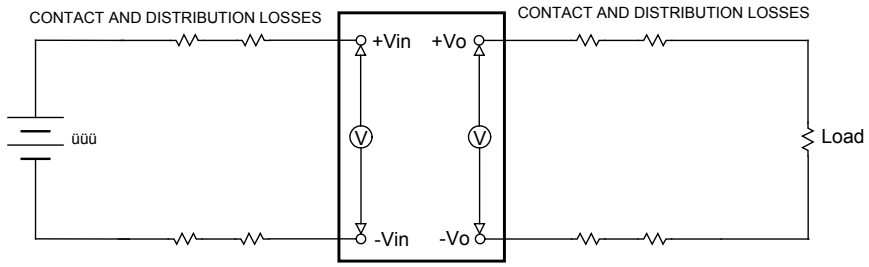
Peak-to-peak output ripple & noise measurement test up



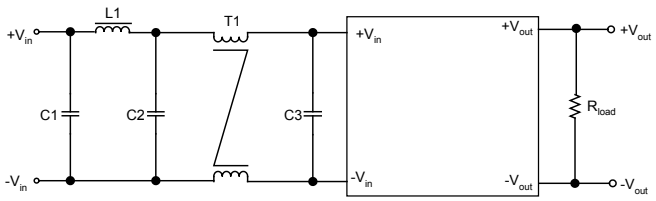


Output voltage and efficiency measurement test up

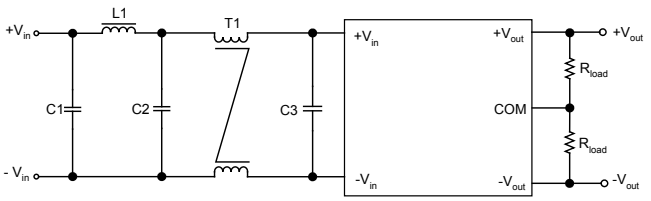
$$Efficiency = \left(\frac{V_{out} \times I_{out}}{V_{in} \times I_{in}} \right) \times 100\% = [\%]$$



EMC considerations

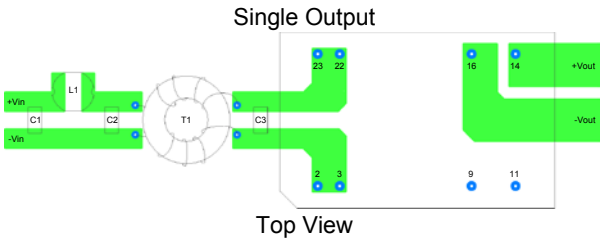


For TEN 6 Single Output

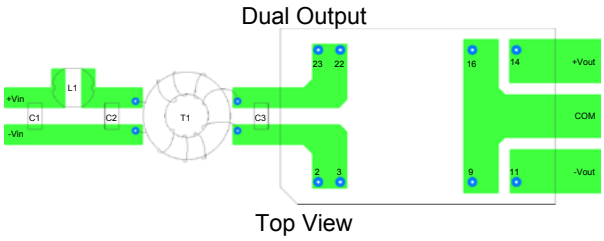


For TEN 6 Dual Output

Recommended circuit to comply EN55022 Class B Limits



For TEN 6 Single Output



For TEN 6 Dual Output

Recommended PCB Layout with Input Filter

To: comply with EN55022 CLASS B following components are needed:

Model	Component	Value
TEN 6-24XXWIN	C1,C2,C3	4.7µF/50V 1206 X7R
	L1	4.7µH SCD0403T/1.7A
	T1	0.64mH; Common choke,core:T10*2.5*5 H5B2/HPN155φ0.37*16T
TEN 6-48XXWIN	C1,C2,C3	1µF/50V 1206 X7R
	L1	4.7µH SCD0403T/1.7A
	T1	0.81mH; Common choke,core:T10*2.5*5 H5B2/HPN155φ0.37*18T

Input Source Impedance

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module.
In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.
Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0 Ω at 100 KHz) capacitor of a 4.7μF for the 24V input devices and a 2.2μF for the 48V devices.

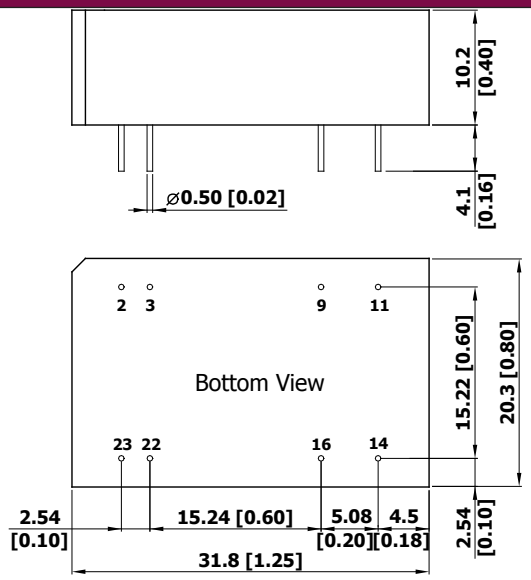
Output Over Current Protection

To provide protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure current limiting for an unlimited duration. At the point of current-limit inception, the unit shifts from voltage control to current control. The unit operates normally once the output current is brought back into its specified range.

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.

Mechanical Dimensions

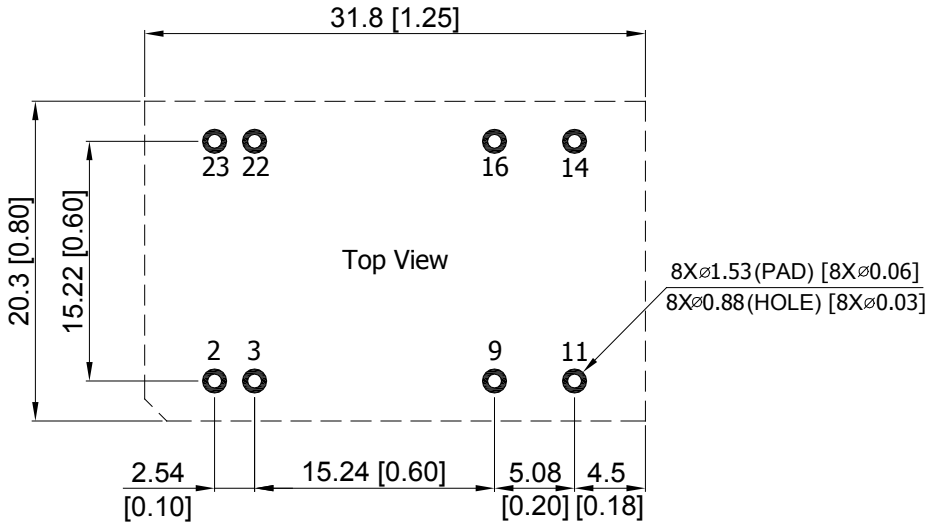


Pin Connections		
Pin	Single Output	Dual Output
2	-Vin	-Vin
3	-Vin	-Vin
9	No Pin	Common
11	NC	-Vout
14	+Vout	+Vout
16	-Vout	Common
22	+Vin	+Vin
23	+Vin	+Vin

1. All dimensions in mm (inches)
Tolerance: X.X±0.25 (X.XX±0.01")
X.XX±0.13 (X.XXX±0.005")
2. Pin diameter <-> 0.5 ±0.05 (0.02±0.002)

Weight:12.7g

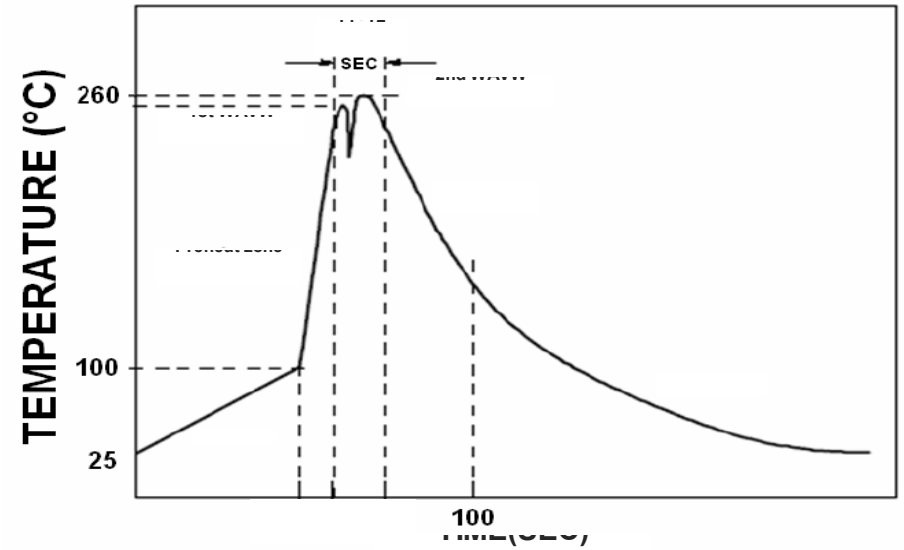
Recommended Pad Layout for Single & Dual Output Converter



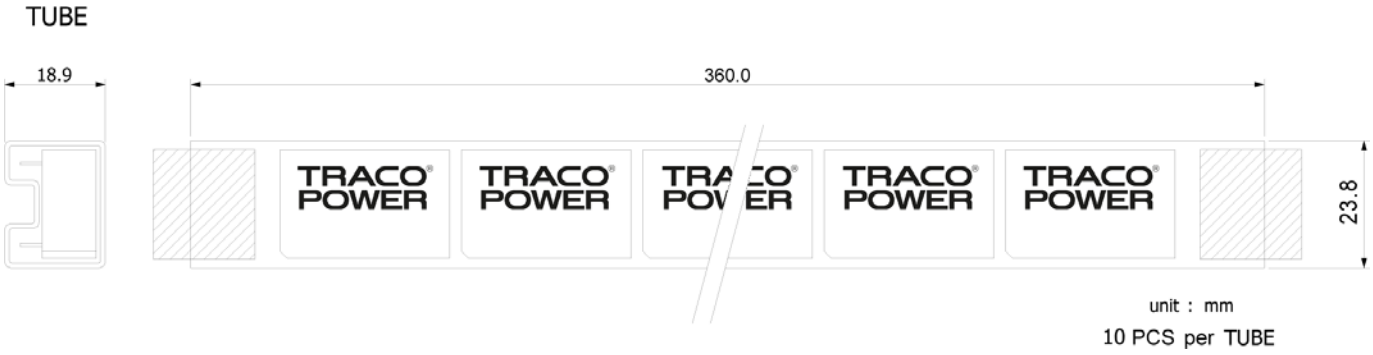
1.All dimensions in mm (inches)
Tolerance: x.x ±0.25mm (x.xx ±0.01")
x.xx ±0.13mm (x.xxx ±0.005")
2. Pin diameter <-> 0.5 ±0.05 (0.02±0.002")

Soldering and Reflow Considerations

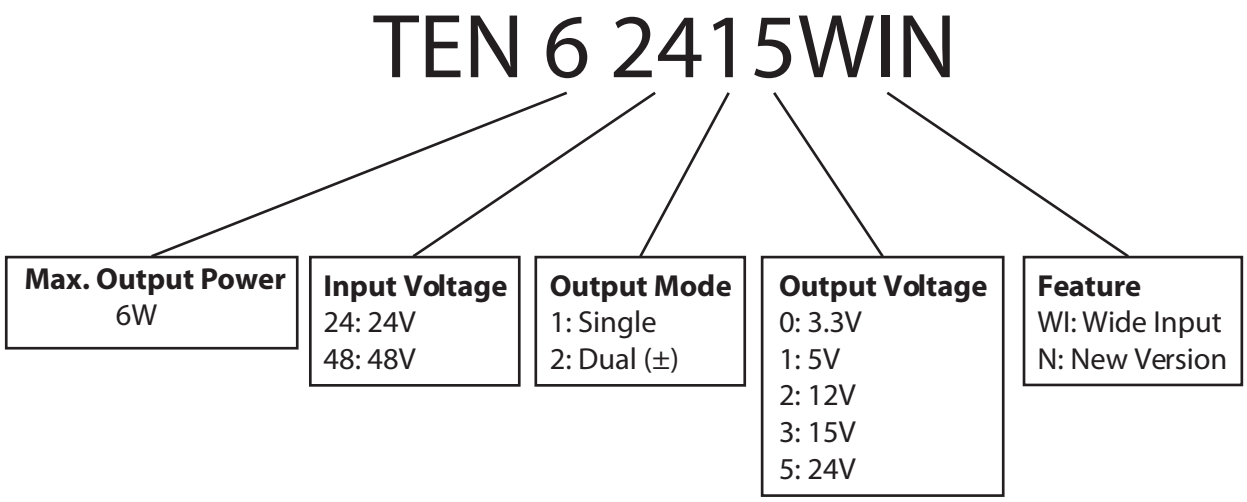
Lead free wave solder profile for TEN 6WIN Series



Packaging Information



Part Number Structure



Model Number	Input Range (VDC)	Output Voltage (VDC)	Max. Output Current (mA)	Input Current at Full Load[1] (mA)	Efficiency[2] (%)
TEN 6-2410WIN	9-36	3.3	1200	214	77
TEN 6-2411WIN	9-36	5	1200	313	80
TEN 6-2412WIN	9-36	12	500	298	84
TEN 6-2413WIN	9-36	15	400	298	84
TEN 6-2415WIN	9-36	24	250	298	84
TEN 6-2421WIN	9-36	±5	±500	260	80
TEN 6-2422WIN	9-36	±12	±250	298	84
TEN 6-2423WIN	9-36	±15	±200	298	84
TEN 6-4810WIN	18-75	3.3	1200	107	77
TEN 6-4811WIN	18-75	5	1200	156	80
TEN 6-4812WIN	18-75	12	500	149	84
TEN 6-4813WIN	18-75	15	400	149	84
TEN 6-4815WIN	18-75	24	250	149	84
TEN 6-4821WIN	18-75	±5	±500	130	80
TEN 6-4822WIN	18-75	±12	±250	149	84
TEN 6-4823WIN	18-75	±15	±200	149	84

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 in 24Vin, 48Vin with maximum rating of 1500mA, 800mA. 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 6WIN series of DC/DC converters has been calculated using
MIL-HDBK 217F NOTICE2, Operating Ambient Temperature 25C, Ground Benign.

Unit	Model	MTBF
Hours	TEN 6-2410WIN	1,019,056
	TEN 6-2411WIN	1,037,344
	TEN 6-2412WIN	1,057,641
	TEN 6-2413WIN	988,142
	TEN 6-2415WIN	1,104,606
	TEN 6-2421WIN	1,031,034
	TEN 6-2422WIN	1,076,774
	TEN 6-2423WIN	1,073,307
	TEN 6-4810WIN	917,684
	TEN 6-4811WIN	1,004,117
	TEN 6-4812WIN	1,089,443
	TEN 6-4813WIN	1,149,161
	TEN 6-4815WIN	1,107,910
	TEN 6-4821WIN	996,810
	TEN 6-4822WIN	1,055,632
	TEN 6-4823WIN	1,104,606

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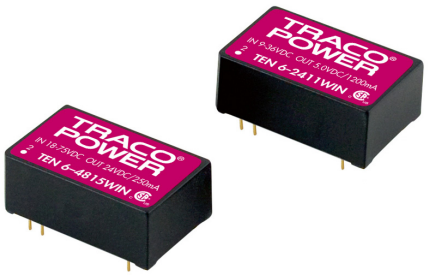
DC/DC Converters

TEN 6WIN Series, 6 Watt

IEC 60950-1 UL 60950-1

Features

- Wide 4:1 input voltage range
- High efficiency
- Operating temperature range –40°C to +85°C
- No minimum load required
- Models with 1'500 VDC and 3'000 VDC I/O isolation (functional insulation)
- Input filter meets EN 55022, class A
- Overload protection
- DIP-24 plastic package
- Industry standard pinout
- 3-year product warranty



The TEN-6WIN series is designed for an optimized cost/performance ratio of DC/DC converters with output power of 6 Watt.
General features like no minimum load requirement, overload protection, internal filter for EN55022 class A and high efficiency make these converters easy to design in. With the popular DIP-24 standard package they are also a drop in replacement for many cost critical applications.

Models

Order code		Input voltage	Output voltage	Output current	Efficiency typ.
1'500 VDC isolation	3'000 VDC isolation	range		max.	
TEN 6-2410WIN	**TEN 6-2410WIN-HI**		3.3 VDC	1200 mA	77 %
TEN 6-2411WIN	**TEN 6-2411WIN-HI**		5 VDC	1200 mA	80 %
TEN 6-2412WIN	**TEN 6-2412WIN-HI**		12 VDC	500 mA	84 %
TEN 6-2413WIN	**TEN 6-2413WIN-HI**	**9 – 36 VDC**	15 VDC	400 mA	84 %
TEN 6-2415WIN	**TEN 6-2415WIN-HI**	(24 VDC nominal)	24 VDC	250 mA	84 %
TEN 6-2421WIN	**TEN 6-2421WIN-HI**		±5 VDC	±500 mA	80 %
TEN 6-2422WIN	**TEN 6-2422WIN-HI**		±12 VDC	±250 mA	84 %
TEN 6-2423WIN	**TEN 6-2423WIN-HI**		±15 VDC	±200 mA	84 %
TEN 6-4810WIN	**TEN 6-4810WIN-HI**		3.3 VDC	1200 mA	77 %
TEN 6-4811WIN	**TEN 6-4811WIN-HI**		5 VDC	1200 mA	80 %
TEN 6-4812WIN	**TEN 6-4812WIN-HI**		12 VDC	500 mA	84 %
TEN 6-4813WIN	**TEN 6-4813WIN-HI**	**18 – 75 VDC**	15 VDC	400 mA	84 %
TEN 6-4815WIN	**TEN 6-4815WIN-HI**	(48 VDC nominal)	24 VDC	250 mA	84 %
TEN 6-4821WIN	**TEN 6-4821WIN-HI**		± 5 VDC	±500 mA	80 %
TEN 6-4822WIN	**TEN 6-4822WIN-HI**		±12 VDC	±250 mA	84 %
TEN 6-4823WIN	**TEN 6-4823WIN-HI**		±15 VDC	±200 mA	84 %

Input Specifications

Input current at no load	24 Vin models:	20 mA typ.
	48 Vin models:	10 mA typ.
Input current at full load	24 Vin, 3.3VDC models:	215 mA typ.
	24 Vin other models:	300 mA typ.
	48 Vin, 3.3VDC models:	110 mA typ.
	48 Vin other models:	150 mA typ.
Recommended input fuse (slow blow)	24 Vin models:	1500 mA
	48 Vin models:	800 mA
Start-up voltage / under voltage shut down	24 Vin models:	9 VDC / 8.5 VDC (or lower)
	48 Vin models:	18 VDC / 16 VDC (or lower)
Surge voltage (1 sec. max.)	24 Vin models:	50 V max.
	48 Vin models:	100 V max.
Conducted noise		EN 55022 class A

Output Specifications

Voltage set accuracy		±2 %
Regulation	– Input variation Vin min. to Vin max.	0.5 % max.
	– Load variation 0 – 100 % single output models:	1.2 % max.
	dual output models balanced load:	1.2 % max.
	dual output models 50%/100% unbalanced load:	3.0 % max.
Minimum load		not required
Temperature coefficient		±0.02 %/K
Ripple and noise (20 MHz Bandwidth)		80 mVp-p max.
Dynamic load response (change from 75 % to 100 % load)		±3 % peak variation typ. 300 µS response time typ.
Current limitation		150 % of Iout max. typ., constant power
Short circuit protection		continuous, automatic recovery
Capacitive load	3.3 & 5.0 VDC models:	470 µF max.
	12 & 15 VDC models:	100 µF max.
	24 VDC models:	47 µF max.
	dual output models:	100 µF max. (each output)

General Specifications

Temperature ranges	– Operating	–40°C to +85°C
	– Case temperature	+100°C max.
	– Storage	–50°C to +125°C
Derating	3.3 & 5.0 VDC models:	2.5 %/K above +60°C
	other models:	3.3 %/K above +70°C
Humidity (non condensing)		95 % rel H max.
Reliability, calculated MTBF (MIL-HDBK-217F, at +25°C, ground benign)		>800'000 h
Isolation voltage (input/output, 60 sec., functional insulation)	standard models:	1'500 VDC
	models with suffix -H:	3'000 VDC
Isolation capacitance (input/output, 100 KHz, 1 V)		1000 pF typ.
Isolation resistance (input/output, 500 VDC)		>1'000 M Ohm
Switching frequency		330 kHz typ.

All specifications valid at nominal input voltage, full load and +25°C after warm-up time unless otherwise stated.

General Specifications

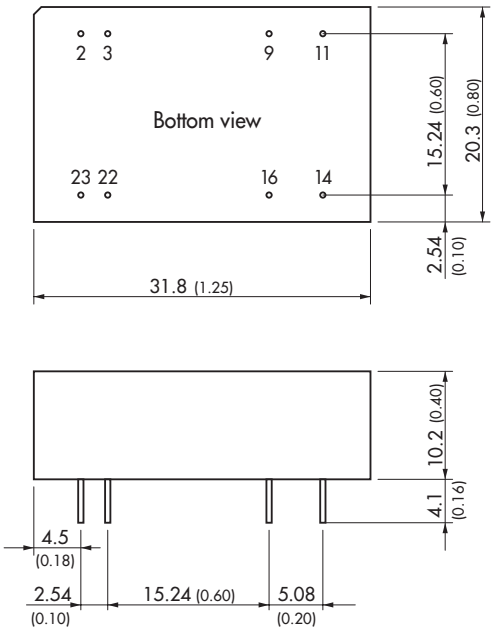
Safety standards		UL/cUL 60950-1, IEC/EN 60950-1
Safety approvals	– CSA certificate according UL 60950-1 – CB test certificate according IEC 60950-1	www.tracopower.com/products/ten6win-csa.pdf www.tracopower.com/products/ten6win-cb.pdf pending
Environmental compliance	– Reach – RoHS	www.tracopower.com/products/ten6win-reach.pdf RoHS directive 2011/65/EU

Physical Specifications

Casing material	non conductive plastic (UL 94V-0-rated)
Potting material	epoxy (XM-2109 & XY-2110, UL 94V-0-rated)
Weight	4.8 g (0.16 oz)
Soldering temperature (1.5mm from case for 10 sec.)	max. 260°C

Application note: www.tracopower.com/products/ten6win-application.pdf

Outline Dimensions



Pin-Out

Pin	Single	Dual
2	–Vin (GND)	–Vin (GND)
3	–Vin (GND)	–Vin (GND)
9	No pin	Common
11	No function	–Vout
14	+Vout	+Vout
16	–Vout	Common
22	+Vin (Vcc)	+Vin (Vcc)
23	+Vin (Vcc)	+Vin (Vcc)

Dimensions in [mm], () = Inch
Pin diameter ⌀ 0.5 ±0.05 (0.02 ±0.002)
Tolerances ±0.25 (±0.01)
Pin pich tolerances ±0.13 (±0.0005)

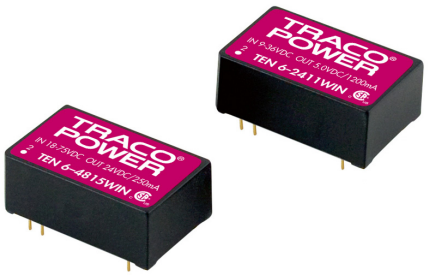
DC/DC Converters

TEN 6WIN Series, 6 Watt

IEC 60950-1 UL 60950-1

Features

- Wide 4:1 input voltage range
- High efficiency
- Operating temperature range –40°C to +85°C
- No minimum load required
- Models with 1'500 VDC and 3'000 VDC I/O isolation (functional insulation)
- Input filter meets EN 55022, class A
- Overload protection
- DIP-24 plastic package
- Industry standard pinout
- 3-year product warranty



The TEN-6WIN series is designed for an optimized cost/performance ratio of DC/DC converters with output power of 6 Watt.
General features like no minimum load requirement, overload protection, internal filter for EN55022 class A and high efficiency make these converters easy to design in. With the popular DIP-24 standard package they are also a drop in replacement for many cost critical applications.

Models

Order code		Input voltage	Output voltage	Output current	Efficiency typ.
1'500 VDC isolation	3'000 VDC isolation	range		max.	
TEN 6-2410WIN	**TEN 6-2410WIN-HI**		3.3 VDC	1200 mA	77 %
TEN 6-2411WIN	**TEN 6-2411WIN-HI**		5 VDC	1200 mA	80 %
TEN 6-2412WIN	**TEN 6-2412WIN-HI**		12 VDC	500 mA	84 %
TEN 6-2413WIN	**TEN 6-2413WIN-HI**	**9 – 36 VDC**	15 VDC	400 mA	84 %
TEN 6-2415WIN	**TEN 6-2415WIN-HI**	(24 VDC nominal)	24 VDC	250 mA	84 %
TEN 6-2421WIN	**TEN 6-2421WIN-HI**		±5 VDC	±500 mA	80 %
TEN 6-2422WIN	**TEN 6-2422WIN-HI**		±12 VDC	±250 mA	84 %
TEN 6-2423WIN	**TEN 6-2423WIN-HI**		±15 VDC	±200 mA	84 %
TEN 6-4810WIN	**TEN 6-4810WIN-HI**		3.3 VDC	1200 mA	77 %
TEN 6-4811WIN	**TEN 6-4811WIN-HI**		5 VDC	1200 mA	80 %
TEN 6-4812WIN	**TEN 6-4812WIN-HI**		12 VDC	500 mA	84 %
TEN 6-4813WIN	**TEN 6-4813WIN-HI**	**18 – 75 VDC**	15 VDC	400 mA	84 %
TEN 6-4815WIN	**TEN 6-4815WIN-HI**	(48 VDC nominal)	24 VDC	250 mA	84 %
TEN 6-4821WIN	**TEN 6-4821WIN-HI**		± 5 VDC	±500 mA	80 %
TEN 6-4822WIN	**TEN 6-4822WIN-HI**		±12 VDC	±250 mA	84 %
TEN 6-4823WIN	**TEN 6-4823WIN-HI**		±15 VDC	±200 mA	84 %

Input Specifications

Input current at no load	24 Vin models:	20 mA typ.
	48 Vin models:	10 mA typ.
Input current at full load	24 Vin, 3.3VDC models:	215 mA typ.
	24 Vin other models:	300 mA typ.
	48 Vin, 3.3VDC models:	110 mA typ.
	48 Vin other models:	150 mA typ.
Recommended input fuse (slow blow)	24 Vin models:	1500 mA
	48 Vin models:	800 mA
Start-up voltage / under voltage shut down	24 Vin models:	9 VDC / 8.5 VDC (or lower)
	48 Vin models:	18 VDC / 16 VDC (or lower)
Surge voltage (1 sec. max.)	24 Vin models:	50 V max.
	48 Vin models:	100 V max.
Conducted noise		EN 55022 class A

Output Specifications

Voltage set accuracy		±2 %
Regulation	– Input variation Vin min. to Vin max.	0.5 % max.
	– Load variation 0 – 100 % single output models:	1.2 % max.
	dual output models balanced load:	1.2 % max.
	dual output models 50%/100% unbalanced load:	3.0 % max.
Minimum load		not required
Temperature coefficient		±0.02 %/K
Ripple and noise (20 MHz Bandwidth)		80 mVp-p max.
Dynamic load response (change from 75 % to 100 % load)		±3 % peak variation typ. 300 µS response time typ.
Current limitation		150 % of Iout max. typ., constant power
Short circuit protection		continuous, automatic recovery
Capacitive load	3.3 & 5.0 VDC models:	470 µF max.
	12 & 15 VDC models:	100 µF max.
	24 VDC models:	47 µF max.
	dual output models:	100 µF max. (each output)

General Specifications

Temperature ranges	– Operating	–40°C to +85°C
	– Case temperature	+100°C max.
	– Storage	–50°C to +125°C
Derating	3.3 & 5.0 VDC models:	2.5 %/K above +60°C
	other models:	3.3 %/K above +70°C
Humidity (non condensing)		95 % rel H max.
Reliability, calculated MTBF (MIL-HDBK-217F, at +25°C, ground benign)		>800'000 h
Isolation voltage (input/output, 60 sec., functional insulation)	standard models:	1'500 VDC
	models with suffix -H:	3'000 VDC
Isolation capacitance (input/output, 100 KHz, 1 V)		1000 pF typ.
Isolation resistance (input/output, 500 VDC)		>1'000 M Ohm
Switching frequency		330 kHz typ.

All specifications valid at nominal input voltage, full load and +25°C after warm-up time unless otherwise stated.

General Specifications

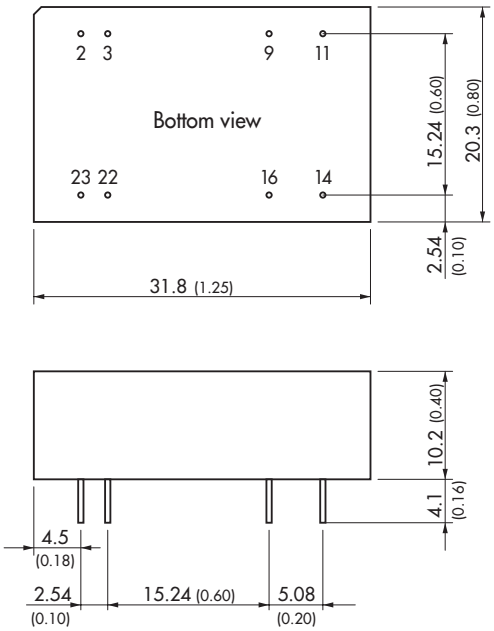
Safety standards		UL/cUL 60950-1, IEC/EN 60950-1
Safety approvals	– CSA certificate according UL 60950-1 – CB test certificate according IEC 60950-1	www.tracopower.com/products/ten6win-csa.pdf www.tracopower.com/products/ten6win-cb.pdf pending
Environmental compliance	– Reach – RoHS	www.tracopower.com/products/ten6win-reach.pdf RoHS directive 2011/65/EU

Physical Specifications

Casing material	non conductive plastic (UL 94V-0-rated)
Potting material	epoxy (XM-2109 & XY-2110, UL 94V-0-rated)
Weight	4.8 g (0.16 oz)
Soldering temperature (1.5mm from case for 10 sec.)	max. 260°C

Application note: www.tracopower.com/products/ten6win-application.pdf

Outline Dimensions



Pin-Out

Pin	Single	Dual
2	–Vin (GND)	–Vin (GND)
3	–Vin (GND)	–Vin (GND)
9	No pin	Common
11	No function	–Vout
14	+Vout	+Vout
16	–Vout	Common
22	+Vin (Vcc)	+Vin (Vcc)
23	+Vin (Vcc)	+Vin (Vcc)

Dimensions in [mm], () = Inch
Pin diameter ⌀ 0.5 ±0.05 (0.02 ±0.002)
Tolerances ±0.25 (±0.01)
Pin pich tolerances ±0.13 (±0.0005)