TRACO POWER

TEN 40 Series

Application Note

DC/DC Converter 18 to 36Vdc or 36 to 75Vdc Input

3.3 to 15Vdc Single Outputs ±12 to ±15Vdc Dual Output and Triple Output, 40W

c UL us
E188913

Complete TEN 40 datasheet can be downloaded at:
http://www.tracopower.com/products/ten40.pdf

Features

- 40 watts maximum output power
- 2:1 wide input voltage range of 18-36 and 36-75VDC
- Six-sided continuous shield
- Case grounding
- High efficiency up to 88%
- Low profile: 50.8×50.8×10.2mm (2.00×2.00×0.40 inch)
- Fixed switching frequency
- RoHS directive compliant
- Input to output isolation: 1500Vdc,min
- Over-temperature protection
- Input under-voltage protection
- Output over-voltage protection
- Over-current protection, auto-recovery
- Output short circuit protection, auto-recovery
- Remote ON/OFF
- Output Voltage adjustment

Options

- Heat sinks available for extended operation

Applications

- Distributed power architectures
- Test equipment
- Computer equipment
- Communications equipment

General Description

The TEN 40 offer 40 Watts of output power from a 2 x 2 x 0.4 inch package without de-rating to 55ºC. The TEN 40 series with 2:1 wide input voltage of 18-36VDC and 36-75VDC and features 1600VDC of isolation, short-circuit and over-voltage protection, as well as six sided shielding. The designed complies with EN60950-1 and UL60950-1. 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	TEN 40-12xx TEN 40-24xx TEN 40-48xx		18 36 75	Vdc
Input Voltage: Transient (100ms)	TEN 40-12xx TEN 40-24xx TEN 40-48xx		25 50 100	
Input Voltage Variation (complies with EST300 132 part 4.4)	All		5	V/ms
Operating Ambient Temperature (with derating)	All	-40	85	°C
Operating Case Temperature		-40	100	°C
Storage Temperature	All	-55	105	°C

Output Specification					
Parameter	Model	Min	Typ	Max	Unit
Output Voltage ($V_{in} = V_{in\,nom}$; Full Load; T_A = 25°C)	TEN 40-xx10 TEN 40-xx11 TEN 40-xx12 TEN 40-xx13 TEN 40-xx20 TEN 40-xx22 TEN 40-xx23 TEN 40-xx31 TEN 40-xx32 TEN 40-xx33 TEN 40-xx34	3.267 4.950 11.880 14.850 +3.267 / +4.950 ±11.880 ±14.850 4.950/±11.400 4.950/±14.250 3.267/±11.400 3.267/±14.250	3.3 5.0 12.0 15.0 +3.3 / +5.0 ±12.0 ±15.0 +5.0 / ±12.0 +5.0 / ±15.0 +3.3 / ±12.0 +3.3 / ±15.0	3.333 5.050 12.120 15.150 +3.333 / +5.050 ±12.120 ±15.150 5.250/±12.600 5.250/±15.750 3.333/±12.600 3.333/±15.750	Vdc
Line Regulation (Vin(min) to Vin(max) at Full Load	main auxiliary			±1 ±5	% Vo
Load Regulation 10% to 100% of Full Load	main auxiliary			±2 ±5	% Vo
Output Ripple & Noise Peak-to-Peak (5Hz to 20MHz bandwidth) Measured with a 104pF/50V MLCC	main auxiliary			50 75	mV pk-pk
Temperature Coefficient	All	-0.02		+0.02	%/°C
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 Setting Time (Vo＜10% peak deviation)	All		250		µs
Output Current	TEN 40-xx10 TEN 40-xx11 TEN 40-xx12 TEN 40-xx13 TEN 40-xx20 TEN 40-xx22 TEN 40-xx23 TEN 40-xx31 TEN 40-xx32 TEN 40-xx33 TEN 40-xx34	0 0 0 0 400 / 400 ±180 ±140 600 / ±0 600 / ±0 600 / ±0 600 / ±0		8000 8000 3333 2666 8000* / 8000* ±1800 ±1400 6000/±400 6000±300 6000/±400 6000±300	mA
Output Over Current Protection	All			150	% FL.
Output Short Circuit Protection	Continuous, automatics recovery				

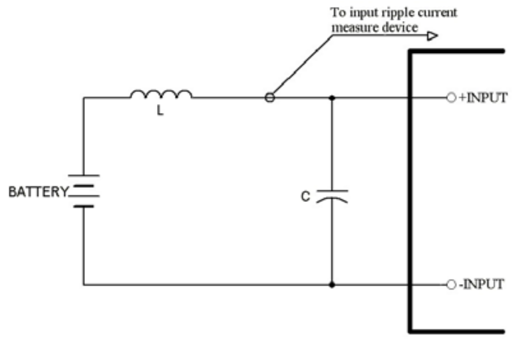
*Caution: Dynamic current allocation, max. 8A total output current for both outputs together. Do not exceed 40W output power in total.

Input Specification					
Parameter	Model	Min	Typ	Max	Unit
Operating Input Voltage	12TXXXX 24TXXXX 48TXXXX	9 18 36	12 24 48	18 36 75	Vdc
Input Current (Maximum value at $V_{in} = V_{in\,nom}$; Full Load)	TEN 40-1210 TEN 40-1211 TEN 40-1212 TEN 40-1213 TEN 40-1220 TEN 40-1222 TEN 40-1223 TEN 40-1233 TEN 40-1234 TEN 40-1231 TEN 40-1232 TEN 40-2410 TEN 40-2411 TEN 40-2412 TEN 40-2413 TEN 40-2420 TEN 40-2422 TEN 40-2423 TEN 40-2433 TEN 40-2434 TEN 40-2431 TEN 40-2432 TEN 40-4810 TEN 40-4811 TEN 40-4812 TEN 40-4813 TEN 40-4820 TEN 40-4822 TEN 40-4823 TEN 40-4833 TEN 40-4834 TEN 40-4831 TEN 40-4832			3445 5456 5582 4444 4452 5783 5622 3063 3000 4024 3963 1685 2500 2525 2561 2195 2823 2745 1512 1481 1989 1958 833 1230 1250 1255 1072 1411 1372 747 732 982 967	mA
Under Voltage Lockout Turn-on Threshold	TEN 40-12xx TEN 40-24xx TEN 40-48xx		9 17.8 36		Vdc
Under Voltage Lockout Turn-off Threshold	TEN 40-12xx TEN 40-24xx TEN 40-48xx		8 16 34		Vdc
Input reflected ripple current (see page 5)	All		40		mAp-p
Start Up Time ($V_{in} = V_{in\,nom}$ and constant resistive load) Power up Remote ON/OFF	All		25 25		ms
Remote ON/OFF Control (see page 8) On/Off pin High Voltage (Module ON) On/Off pin Low Voltage (Module OFF) On/Off pin Low Voltage, input current	All	3.0 0		12 1.2 2.5	Vdc Vdc mA

General Specification					
Parameter	Model	Min	Typ	Max	Unit
Efficiency (see page 17)	TEN 40-1210		87		%
($V_{in} = V_{in\,nom}$; Full Load; T_A = 25°C)	TEN 40-1211		89		
	TEN 40-1212		88		
	TEN 40-1220		86		
	TEN 40-1222		85		
	TEN 40-1223		85		
	TEN 40-1233		84		
	TEN 40-1234		84		
	TEN 40-1231		86		
	TEN 40-1232		86		
	TEN 40-2410		87		
	TEN 40-2411		89		
	TEN 40-2412		88		
	TEN 40-2420		86		
	TEN 40-2422		87		
	TEN 40-2423		87		
	TEN 40-2433		85		
	TEN 40-2434		85		
	TEN 40-2431		87		
	TEN 40-2432		87		
	TEN 40-4810		88		
	TEN 40-4811		90		
	TEN 40-4812		89		
	TEN 40-4820		88		
	TEN 40-4822		87		
	TEN 40-4823		87		
	TEN 40-4833		86		
	TEN 40-4834		86		
	TEN 40-4831		88		
	TEN 40-4832		88		
Isolation voltage					
Input to Output	All	1600			Vdc
Input(Output) to Case		1600			
Isolation resistance	All	1			GΩ
Isolation capacitance	All			1000	pF
Switching Frequency	All		300		KHz
Weight	All		60		g
MTBF					
Bellcore TR-NWT-000332, TC = 40°C	All		1.398×106		hours
MIL-STD-217F			2.380×105		

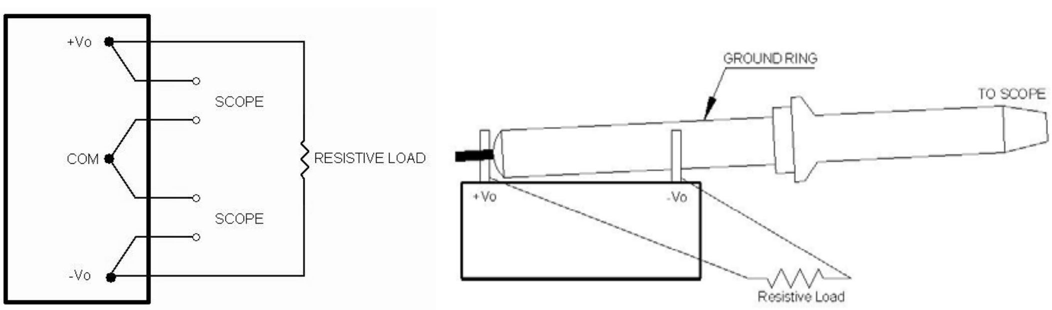
Testing Configurations

Input reflected-ripple current measurement test up

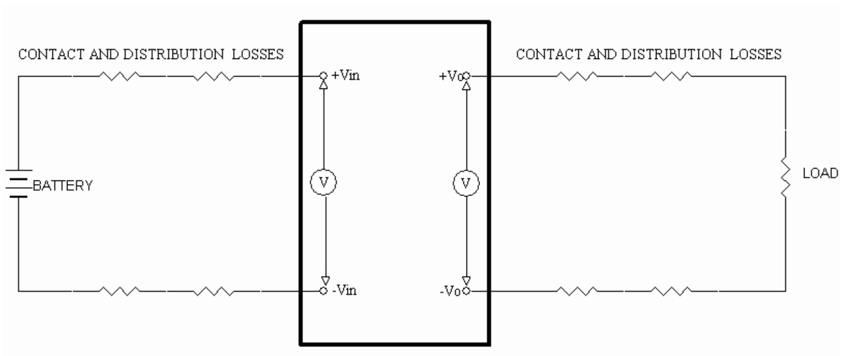


Component	Value	Voltage	Reference
L	12μH	---	---
C	220μF	100V	Aluminum Electrolytic Capacitor

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.

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

Trim Table for Output Voltage adjustment

TEN 40-xx10											
Trim up	1	2	3	4	5	6	7	8	9	10	%
V_{out} =	3.333	3.366	3.399	3.432	3.465	3.498	3.531	3.564	3.597	3.63	Volts
Ru =	57.9599	26.1726	15.5801	10.2844	7.1073	4.9892	3.4764	2.3418	1.4593	0.7533	KΩ
Trim down	1	2	3	4	5	6	7	8	9	10	%
V_{out} =	3.267	3.234	3.201	3.168	3.135	3.102	3.069	3.036	3.003	2.97	Volts
Rd =	69.4348	31.2263	18.4861	12.1153	8.2926	5.7441	3.9236	2.5582	1.4963	0.6467	KΩ

TEN 40-xx11											
Trim up	1	2	3	4	5	6	7	8	9	10	%
V_{out} =	5.05	5.1	5.15	5.2	5.25	5.3	5.35	5.4	5.45	5.5	Volts
Ru =	43.2232	18.1319	10.5959	6.9661	4.8305	3.4240	2.4276	1.6848	1.1097	0.6512	KΩ
Trim down	1	2	3	4	5	6	7	8	9	10	%
V_{out} =	4.95	4.9	4.85	4.8	4.75	4.7	4.65	4.6	4.55	4.5	Volts
Rd =	39.4177	18.9991	11.5799	7.7436	5.3996	3.8189	2.6809	1.8225	1.1519	0.6135	KΩ

TEN 40-xx12											
Trim up	1	2	3	4	5	6	7	8	9	10	
V_{out} =	12.12	12.24	12.36	12.48	12.6	12.72	12.84	12.96	13.08	13.2	Volts
Ru =	1019.4475	257.4148	134.3919	84.0552	56.6768	39.4668	27.6475	19.0290	12.4663	7.3021	KΩ
Trim down	1	2	3	4	5	6	7	8	9	10	%
V_{out} =	11.88	11.76	11.64	11.52	11.4	11.28	11.16	11.04	10.92	10.8	Volts
Rd =	270.2050	149.6275	95.7604	65.2378	45.5871	31.8777	21.7690	14.0070	7.8596	2.8704	KΩ

TEN 40-xx13											
Trim up	1	2	3	4	5	6	7	8	9	10	%
V_{out} =	15.15	15.3	15.45	15.6	15.75	15.9	16.05	16.2	16.35	16.5	Volts
Ru =	455.6690	192.8897	111.4831	71.8484	48.3988	32.9014	21.8975	13.6802	7.3099	2.2269	KΩ
Trim down	1	2	3	4	5	6	7	8	9	10	%
V_{out} =	14.85	14.7	14.55	14.4	14.25	14.1	13.95	13.8	13.65	13.5	Volts
Rd =	449.0121	210.2234	125.3763	81.8946	55.4567	37.6837	24.9156	15.2991	7.7956	1.7777	KΩ

Thermal Consideration

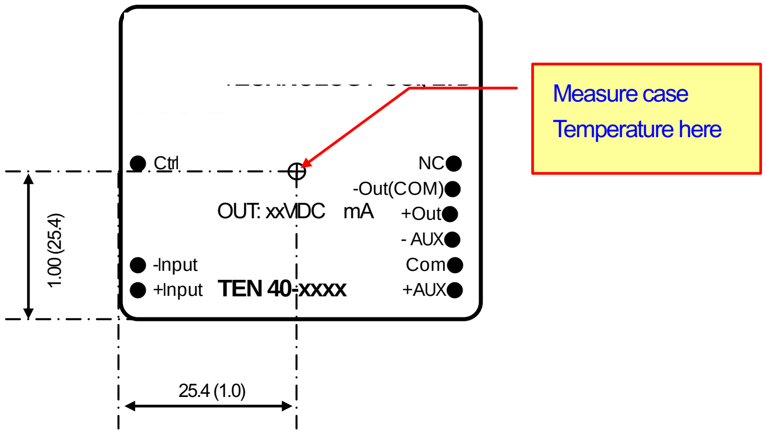
Thermal Consideration

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, convention, and radiation to the surrounding environment. Proper cooling can be verified by measuring the case temperature. The case temperature (Tc) should be measured at the position indicated see figure below.

The temperature at this location should not exceed 100°C. When operating the power module, adequate cooling must be provided to maintain the power module case temperature at or below 100°C. Although the maximum case temperature of the power modules is 100°C, you can limit this temperature to a lower value for extremely high reliability.

Optimum cooling is obtained with forced convention. Some typical thermal resistance numbers are tabulated below:

Thermal resistance vs. air flow chart



Air flow rate	Typical θca	Typical θca with heat-sink
Natural Convention	9.2°C/W	8.7°C/W
20LFM	8.1°C/W	7.6°C/W
200LFM	6.7°C/W	6.2°C/W
300LFM	4.8°C/W	4.4°C/W
400LFM	3.6°C/W	3.2°C/W
500LFM	3.1°C/W	2.8°C/W

These numbers are typical only. The natural convention data was recorded with the case of the unit mounted on a vertical plane. The forced convention data was recorded with the airflow parallel to the top of the case.

Note: Heat sink is optional and P/N: TEN-HS3

Output over current protection

When excessive output currents occur in the system, circuit protection is required on all power supplies. Normally, overload current is maintained at approximately 115~150 percent of rated current for TEN 40.
Hiccup-mode is a method of operation in a power supply whose purpose is to protect the power supply from being damaged during an over-current fault condition. It also enables the power supply to restart when the fault is removed. There are other ways of protecting the power supply when it is over-loaded, such as the maximum current limiting or current foldback methods.
One of the problems resulting from over current is that excessive heat may be generated in power devices; especially MOSFET and 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 power supply for a given time and then tries to start up the power supply again. If the over-load condition has been removed, the power supply will start up and operate normally; otherwise, the controller will see another over-current event and shut off the power supply again, repeating the previous cycle. Hiccup operation has none of the drawbacks of the other two protection methods, although its circuit is more complicated because it requires a timing circuit. The excess heat due to overload lasts for only a short duration in the hiccup cycle, hence the junction temperature of the power devices is much lower.
The hiccup operation can be done in various ways. For example, one can start hiccup operation any time an over-current event is detected; or prohibit hiccup during a designated start-up is usually larger than during normal operation and it is easier for an over-current event is detected; or prohibit hiccup during a designated start-up interval (usually a few milliseconds). The reason for the latter operation is that during start-up, the power supply needs to provide extra current to charge up the output capacitor. Thus the current demand during start-up is usually larger than during normal operation and it is easier for an over-current event to occur. If the power supply starts to hiccup once there is an over-current, it might never start up successfully. Hiccup mode protection will give the best protection for a power supply against over current situations, since it will limit the average current to the load at a low level, so reducing power dissipation and case temperature in the power devices.

Short Circuitry Protection

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

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 KZE series 47µF/100V. The capacitor must as close as possible to the input terminals of the power module for lower impedance.

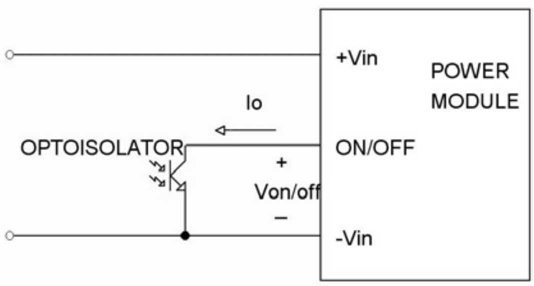
Over Temperature Protection

The power modules operate in a variety of thermal environments; However, sufficient cooling should always be provided to help ensure reliable operation. The over-temperature protection consists of circuitry that provides protection from thermal damage. If the temperature exceeds the over-temperature Threshold the module will shut down. For reliable operation this temperature should not exceed 100℃ the output power of the module should not exceed the rated power of the module

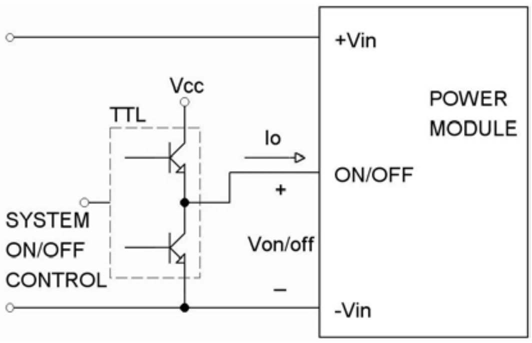
Remote ON/OFF Control

The positive logic remote ON/OFF control circuit is included.
Turns the module ON during a logic High on the On/Off pin and turns OFF during a 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 –input pin to turn the module on.

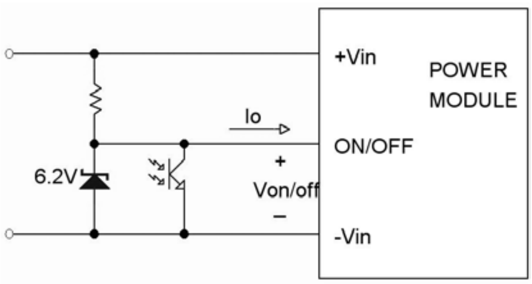
Remote ON/OFF Implementation



Isolated-Closure Remote ON/OFF



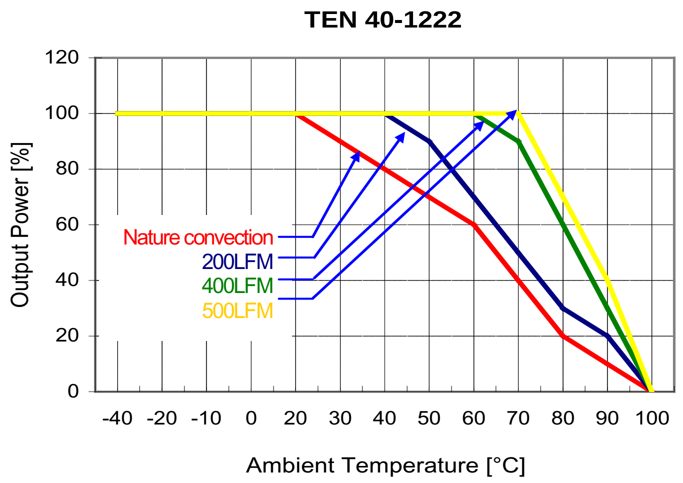
Level Control Using TTL Output

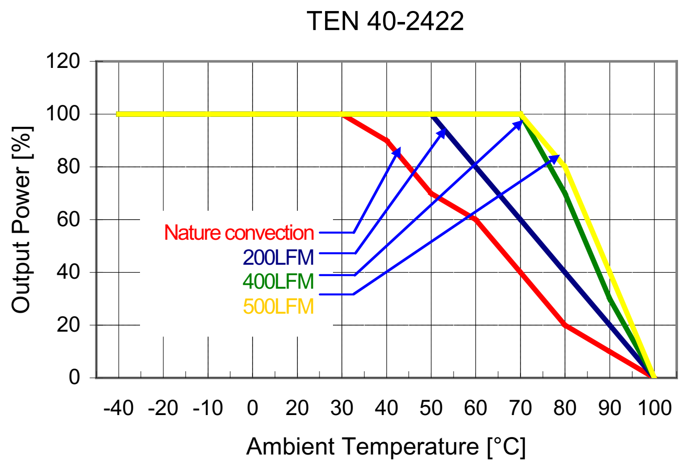


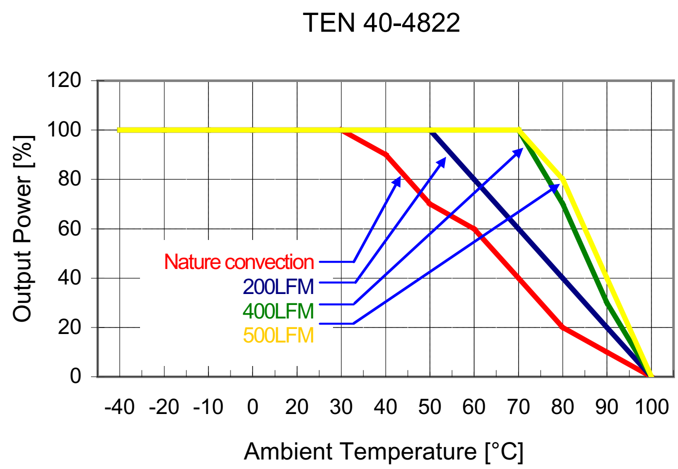
Level Control Using Line Voltage

Characteristic Curve

De-rating curve for TEN 40-1222, TEN 40-2422, TEN 40-4822

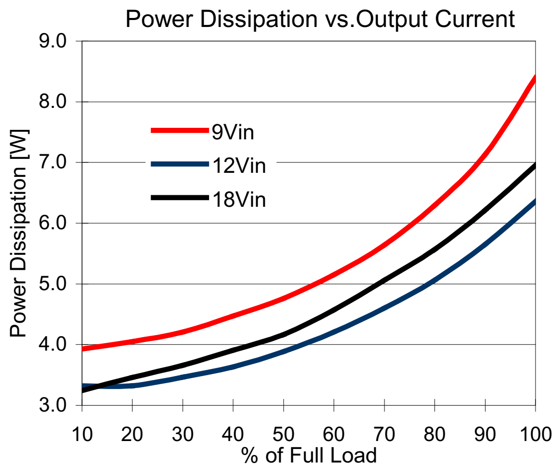


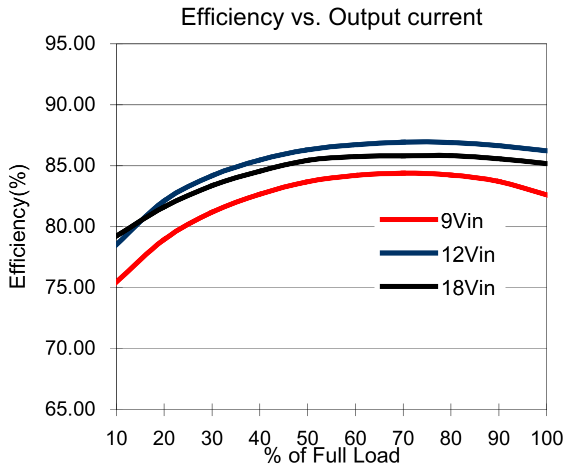


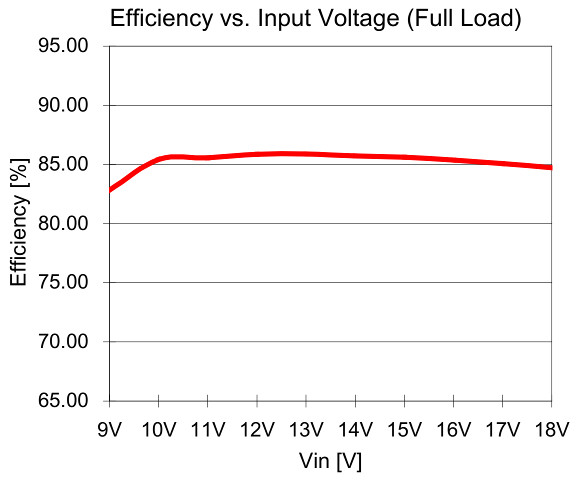


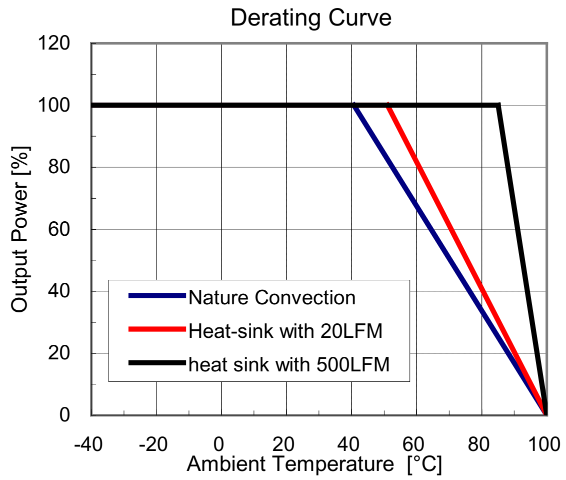
Characteristic Curve

TEN 40-1231









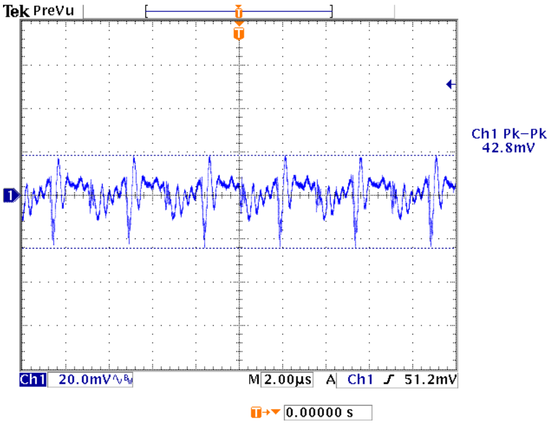
Characteristic Curve

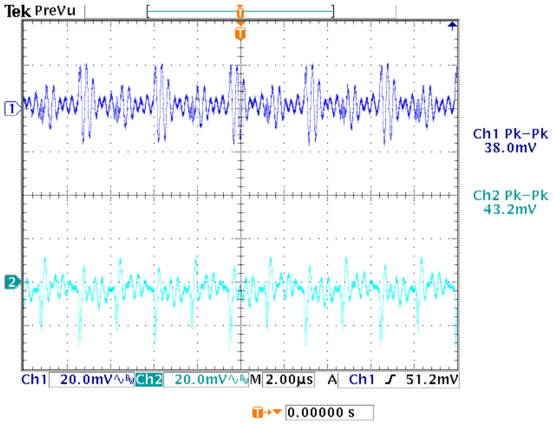
TEN 40-1231

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

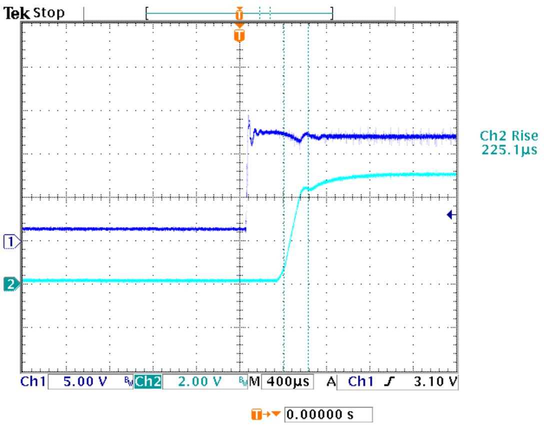
Typical Output Ripple and Noise
$V_{in} = V_{in\,nom}$, Full Load

$V_{out\,1}$ (+5V) = 42.8mV , $V_{out\,2}$ (+12V) = 38.0mV, $V_{out\,3}$ (-12V) = 43.2mV

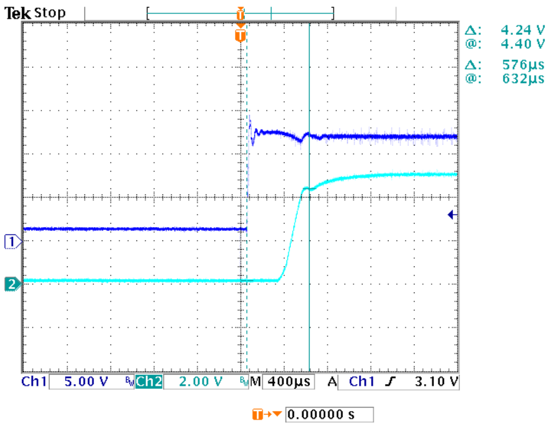




$V_{in} = V_{in\,nom}$, Full Load
Rise Time = 225.1µS

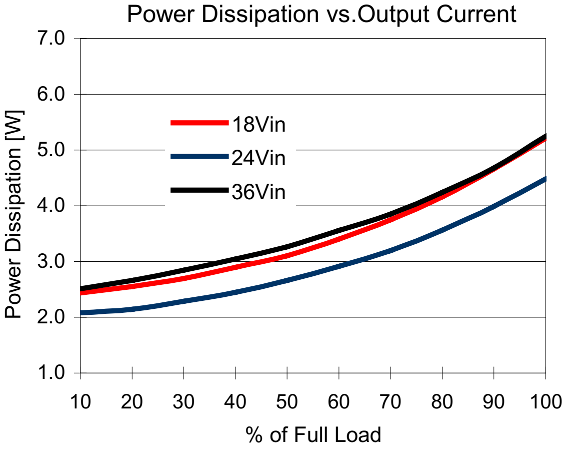


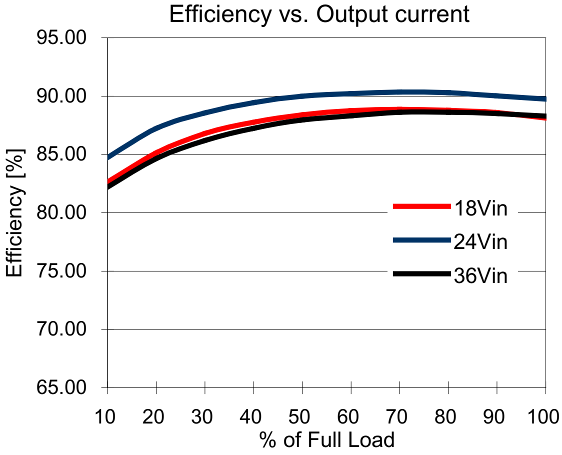
$V_{in} = V_{in\,nom}$, Full Load
Delay Time = 576.0µS

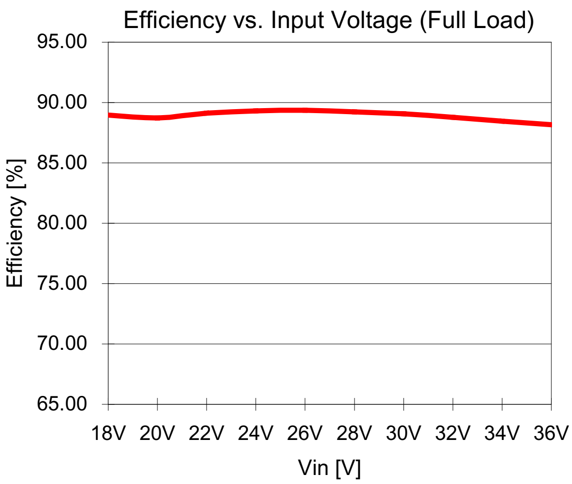


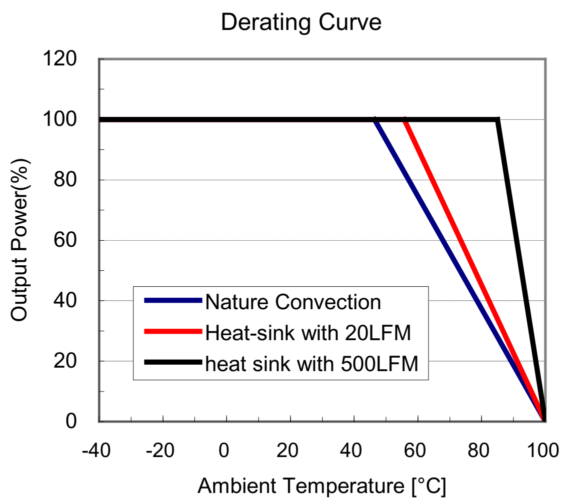
Characteristic Curve

TEN 40-2432









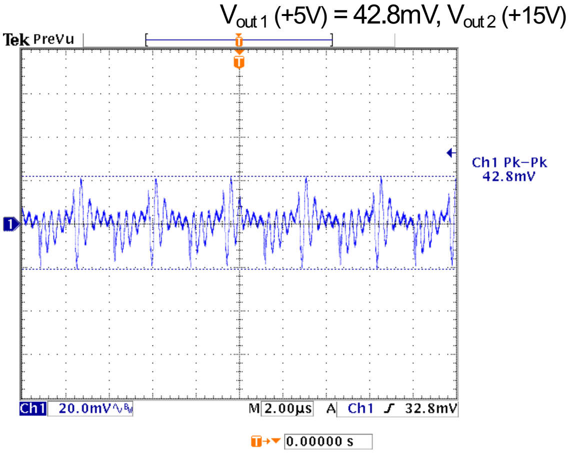
Characteristic Curve

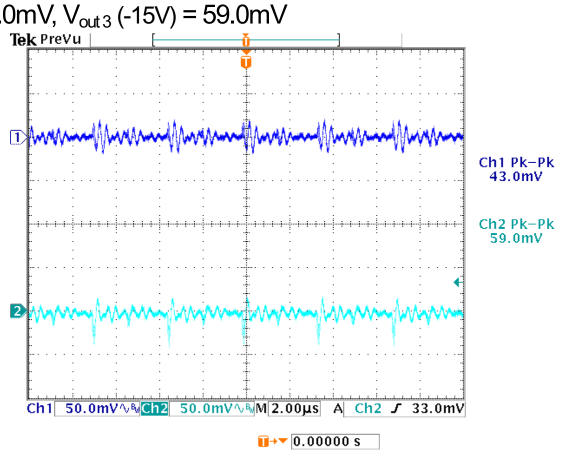
TEN 40-2432

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

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

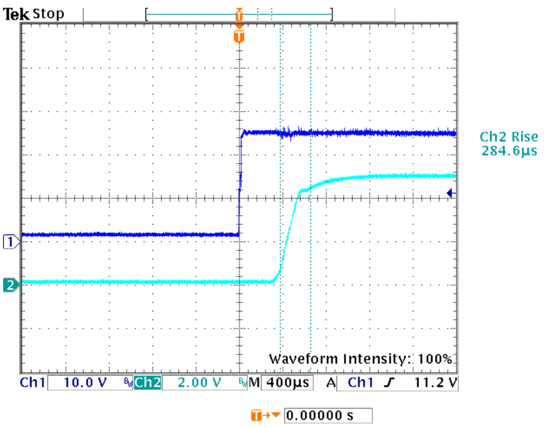
$V_{out\ 1}$ (+5V) = 42.8mV, $V_{out\ 2}$ (+15V) = 43.0mV, $V_{out\ 3}$ (-15V) = 59.0mV

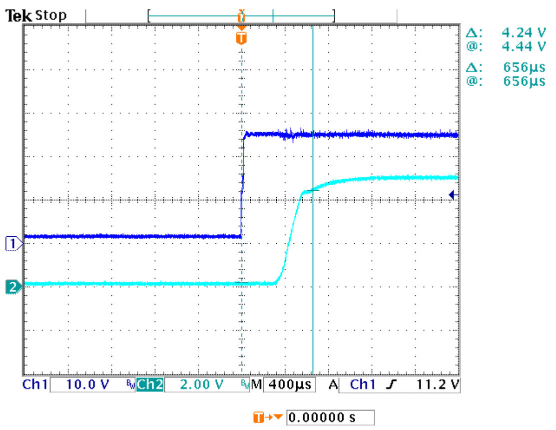




$V_{in} = V_{in\ nom}$, Full Load
Rise Time = 284.6µS

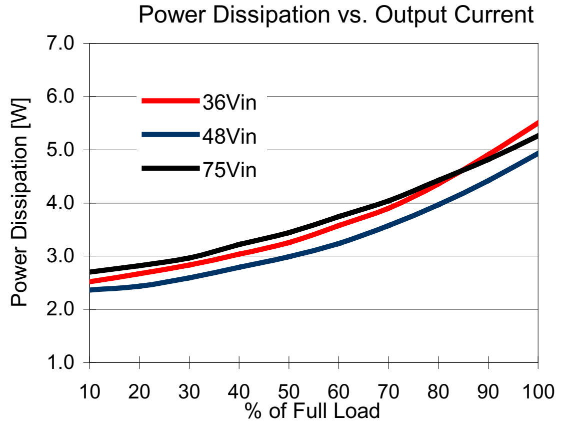
$V_{in} = V_{in\ nom}$, Full Load
Delay Time = 656.0µS

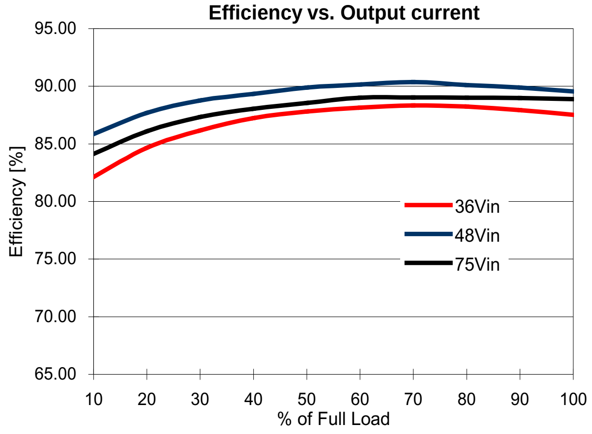


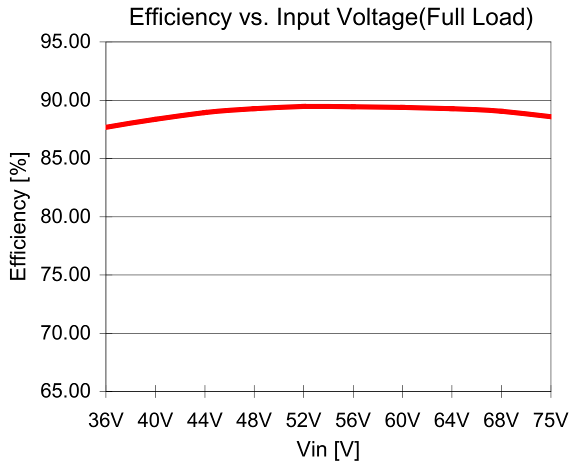


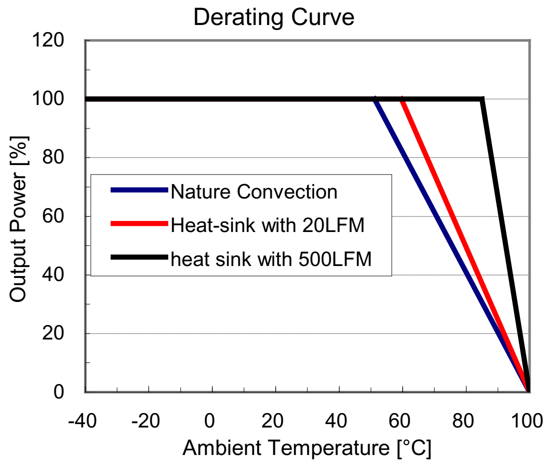
Characteristic Curve

TEN 40-4832









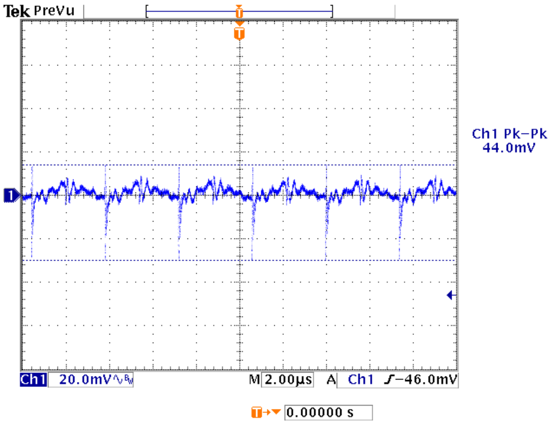
Characteristic Curve

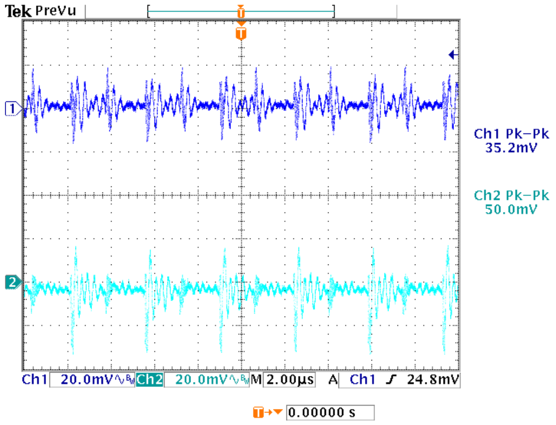
TEN 40-4832

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

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

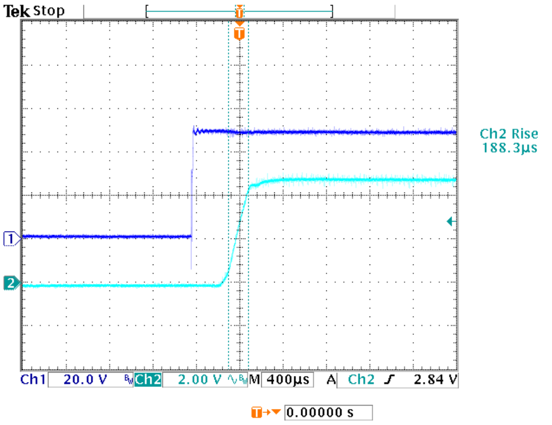
$V_{out\,1}$ (+5V) = 44.0mV; $V_{out\,2}$ (+15V) = 35.2mV; $V_{out\,3}$ (-15V) = 50.0mV

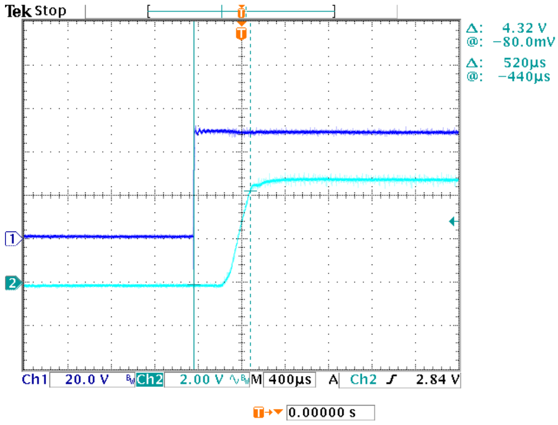




$V_{in} = V_{in\,nom}$, Full Load
Rise Time=188.3µS

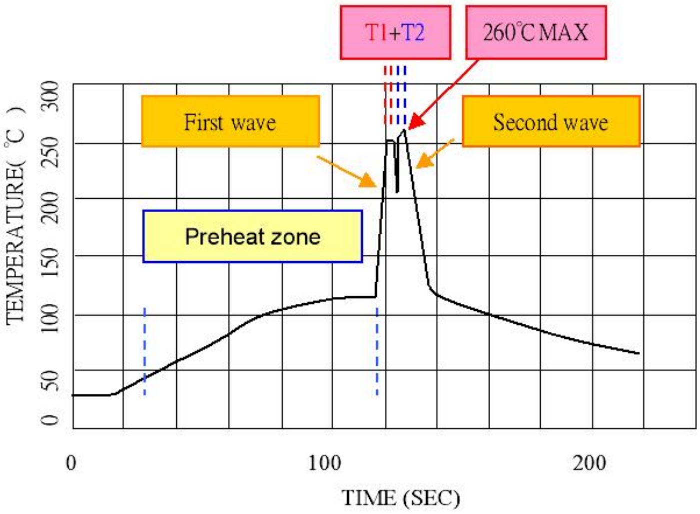
$V_{in} = V_{in\,nom}$, Full Load
Delay Time= 520.0µS





Soldering and Reflow Considerations

Lead free wave solder profile for TEN 40



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

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

Hand Welding:

Soldering iron: Power 90W
Welding Time: 2~4 sec
Temp.: 380~400°C

Part Number Structure

TEN 40 –XX XX

Max. Output Power:
40Watts

Input Voltage Range:
12: 9 ~ 18V
24: 18 ~ 36V
48: 36 ~ 75V

Output Voltage

10	:	+3.3Vdc
11	:	+5.0Vdc
12	:	+12.0Vdc
20	:	+3.3Vdc / +5.0Vdc
22	:	±12.0Vdc
23	:	±15.0Vdc
31	:	+5Vdc / ±12Vdc
32	:	+5Vdc / ±15Vdc
33	:	+3.3Vdc / ±12Vdc
34	:	+3.3Vdc / ±15Vdc

Model Number	Input Voltage Range	Output Voltage	Min. Output Current	Max. Output Current	**Input Current
TEN 40-1210	9 – 18 Vdc	+3.3Vdc	0mA	8000mA	3445mA
TEN 40-1211	9 – 18 Vdc	+5.0Vdc	0mA	8000mA	5456mA
TEN 40-1212	9 – 18 Vdc	+12.0Vdc	0mA	3333mA	5582mA
TEN 40-1220	9 – 18 Vdc	+3.3Vdc / +5.0Vdc	*400mA / 400mA	*8000mA / 8000mA	4444mA
TEN 40-1222	9 – 18 Vdc	±12.0Vdc	±125mA	±1250mA	5783mA
TEN 40-1223	9 – 18 Vdc	±15.0Vdc	±100mA	±1000mA	5622mA
TEN 40-1233	9 – 18 Vdc	+3.3Vdc / ±12 Vdc	600mA / ±40mA	6000mA / ±400mA	3063mA
TEN 40-1234	9 – 18 Vdc	+3.3Vdc / ±15 Vdc	600mA / ±30mA	6000mA / ±300mA	3000mA
TEN 40-1231	9 – 18 Vdc	+5 Vdc/ ±12 Vdc	600mA / ±40mA	6000mA / ±400mA	4024mA
TEN 40-1232	9 – 18 Vdc	+5Vdc / ±15 Vdc	600mA / ±30mA	6000mA / ±300mA	3963mA
TEN 40-2410	18 – 36 Vdc	+3.3Vdc	0mA	8000mA	1685mA
TEN 40-2411	18 – 36 Vdc	+5.0Vdc	0mA	8000mA	2500mA
TEN 40-2412	18 – 36 Vdc	+12.0Vdc	0mA	3333mA	2525mA
TEN 40-2420	18 – 36 Vdc	+3.3Vdc / +5.0Vdc	*400mA / 400mA	*8000mA / 8000mA	2195mA
TEN 40-2422	18 – 36 Vdc	±12.0Vdc	±125mA	±1250mA	2823mA
TEN 40-2423	18 – 36 Vdc	±15.0Vdc	±100mA	±1000mA	2745mA
TEN 40-2433	18 – 36 Vdc	+3.3Vdc / ±12 Vdc	600mA / ±40mA	6000mA / ±400mA	1512mA
TEN 40-2434	18 – 36 Vdc	+3.3Vdc / ±15 Vdc	600mA / ±30mA	6000mA / ±300mA	1481mA
TEN 40-2431	18 – 36 Vdc	+5 Vdc/ ±12 Vdc	600mA / ±40mA	6000mA / ±400mA	1989mA
TEN 40-2432	18 – 36 Vdc	+5Vdc / ±15 Vdc	600mA / ±30mA	6000mA / ±300mA	1958mA
TEN 40-4810	36 – 75 Vdc	+3.3Vdc	0mA	8000mA	833mA
TEN 40-4811	36 – 75 Vdc	+5.0Vdc	0mA	8000mA	1230mA
TEN 40-4812	36 – 75 Vdc	+12.0Vdc	0mA	3333mA	1250mA
TEN 40-4820	36 – 75 Vdc	+3.3Vdc / +5.0Vdc	*400mA / 400mA	*8000mA / 8000mA	1072mA
TEN 40-4822	36 – 75 Vdc	±12.0Vdc	±125mA	±1250mA	1411mA
TEN 40-4823	36 – 75 Vdc	±15.0Vdc	±100mA	±1000mA	1372mA
TEN 40-4833	36 – 75 Vdc	+3.3Vdc / ±12 Vdc	6000mA / ±400mA	6000mA / ±400mA	747mA
TEN 40-4834	36 – 75 Vdc	+3.3Vdc / ±15 Vdc	6000mA / ±300mA	6000mA / ±300mA	732mA
TEN 40-4831	36 – 75 Vdc	+5Vdc / ±12 Vdc	6000mA / ±400mA	6000mA / ±400mA	982mA
TEN 40-4832	36 – 75 Vdc	+5Vdc / ±15 Vdc	6000mA / ±300mA	6000mA / ±300mA	967mA

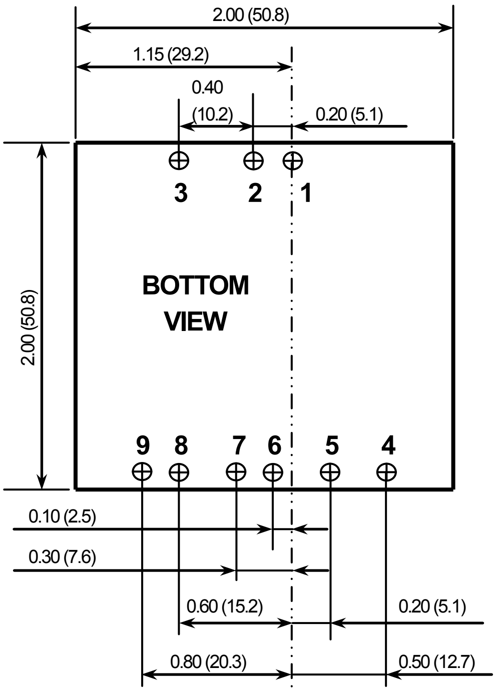
* Dynamic current allocation. Max 8A total output current for both outputs together

** Maximum Input Current $I_{In} = (V_{out} \times I_{out}) / (EFF \times V_{In})$ or $I_{In} = ((V_{out1} \times I_{out1}) + (V_{out2} \times I_{out2})) / (EFF \times V_{In})$ or $I_{In} = ((V_{out1} \times I_{out1}) + (V_{out2} \times I_{out2}) + (V_{out3} \times I_{out3})) / (EFF \times V_{In})$

Mechanical Data

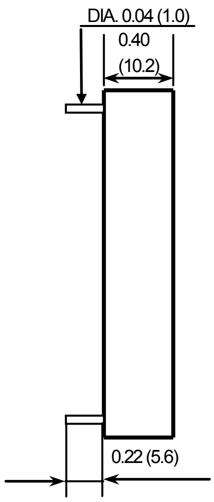
Dimensions are in millimeters and (inches)
Tolerances: xxx in. ± 0.020 in. (x.x mm ± 0.02mm)
xxx in. ± 0.015 in. (x.x mm ± 0.015mm)
Pin Pitch Tolerance ±0.014(0.35)

Bottom View



1. All dimensions in Inches (mm)
2. Pin pitch tolerance ±0.014(0.35)

Side View



PIN CONNECTION	
PIN	TRIPLE
1	+INPUT
2	-INPUT
3	CTRL
4	+AUX
5	COMMON
6	-AUX
7	+OUTPUT
8	-OUTPUT(COM)
9	NC

Safety and Installation Instruction

Isolation consideration

The TEN 40 series features 1.6k Volt DC isolation from input to output, input to case, and output to case. The input to output resistance is greater than 10^9 megohms. Nevertheless, if the system using the power module needs to receive safety agency approval, certain rules must be followed in the design of the system using the model. In particular, all of the creepage and clearance requirements of the end-use safety requirement must be observed. These documents include UL-1950, EN60950 and CSA 22.2-950, although specific applications may have other or additional requirements.

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 a 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 5 A. 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 40 series of DC/DC converters has been calculated using

The MTBF of TEN 40 series of DC/DC converters has been calculated using

1. MIL-HDBK-217F under the following conditions:

   Nominal Input Voltage

   $I_{out} = I_{out\,max}$

   $T_A = 25^{\circ}C$

   The resulting figure for MTBF is 292'400 hours single and dual output.

   The resulting figure for MTBF is 364'600 hours triple output.

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

   The resulting figure for MTBF is 1'398'000 hours.