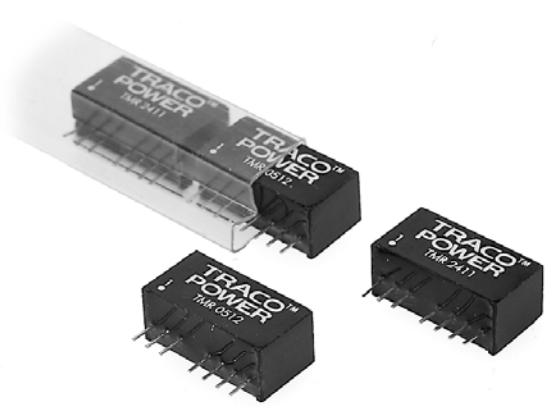
TMR 2 Series Application Note

DC/DC Converter 4.5 to 9Vdc, 9 to 18Vdc, 18 to 36Vdc or 36 to 75 Vdc Input
3.3 to 15Vdc Single Outputs and ±5 to ±15Vdc Dual Outputs, 2 Watt



E188913

Complete TMR-2 datasheet can be downloaded at:
http://www.tracopower.com/products/tmr.pdf

Features

- SIP package: 21.8 x 9.2 x 11.1 mm (0.86 x 0.36 x 0.44inch)
- 2：1 wide input voltage of 4.5-9, 9-18,18-36 and 36-75VDC
- 2 Watts output power
- Low ripple & noise
- UL94-V0 case potting materials
- Input to output isolation: 1000Vdc, for 1 minute
- Operating temperature range: up to 75°C max without derating
- Continuous short circuit protection
- RoHS directive compliant
- External on/off control
- ISO 9001 certified manufacturing facilities
- UL60950-1 Recognized E188913

Applications

- test equipment
- Communication equipment
- Computer equipment
- mobile telecom equipment

General Description

The TMR 2 series offer 2 watts of output power from a 21.8 x 9.2 x 11.1 mm package up to an operating temperature of +75°C without derating and without need of any external components. This product has a 2:1 wide input voltage range of 4.5-9Vdc, 9-18Vdc, 18-36Vdc or 36-75Vdc and features an input to output isolation of 1000Vdc, indefinite short-circuit protection. All models are particularly suited to telecommunications, industrial, mobile telecom and test equipment applications.

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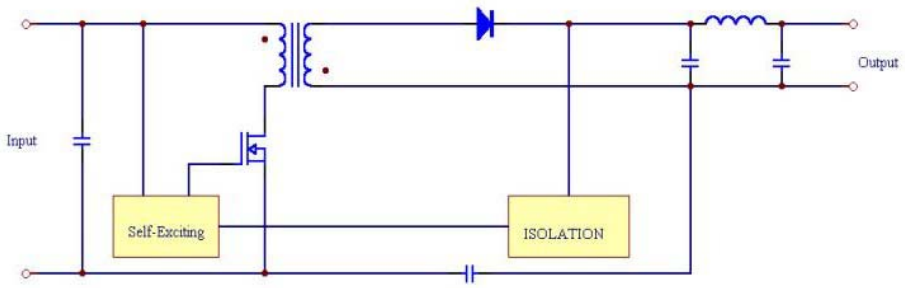
Block Diagram



Absolute Maximum Rating

Parameter		Device	Min	Typ	Max	Unit
Input Voltage	Continuous	TMR 05xx			9	Vdc
		TMR 12xx			18	Vdc
		TMR 24xx			36	Vdc
		TMR 48xx			75	Vdc
	Transient (100ms)	TMR 05xx			15	Vdc
		TMR 12xx			36	Vdc
		TMR 24xx			50	Vdc
		TMR 48xx			100	Vdc
Output power					2	W
Temperature coefficient					±0.1	%/°C

Output Specifications

Parameter	Device	Min	Typ	Max	Unit
Operating Output Range	TMR xx10	3.267	3.300	3.333	Vdc
	TMR xx11	4.950	5.000	5.050	Vdc
	TMR xx09	8.910	9.000	9.090	Vdc
	TMR xx12	11.880	12.000	12.120	Vdc
	TMR xx13	14.850	15.000	15.150	Vdc
	TMR xx21	±4.950	±5.000	±5.050	Vdc
	TMR xx22	±11.880	±12.000	±12.120	Vdc
	TMR xx23	±14.850	±15.000	±15.150	Vdc
Output Current	TMR xx10	50		500	mA
	TMR xx11	40		400	mA
	TMR xx09	22		222	mA
	TMR xx12	17		167	mA
	TMR xx13	13		134	mA
	TMR xx21	±20		±200	mA
	TMR xx22	±8		±83	mA
	TMR xx23	±7		±67	mA
Max. Output Capacitive Load	TMR xx10			2200	µF
	TMR xx11			1000	µF
	TMR xx09			470	µF
	TMR xx12			170	µF
	TMR xx13			110	µF
	TMR xx21			±470	µF
	TMR xx22			±100	µF
	TMR xx23			±47	µF

Output Specifications (continue)					
Parameter	**Device**	**Min**	**Typ**	**Max**	**Unit**
Line Regulation (LL to HL at Full Load)	All			0.5	%
Load Regulation (10% to 100% of Full Load)	TMR xx10 Other single output Dual output			±0.85 ±0.75 ±1.00	%
Cross regulation (Asymmetrical load 25% to 100% of Full Load)				±5.0	
Output Ripple & Noise (20MHz bandwidth)	All			50	mV pk-pk
Transient Response Recovery Time (25% load step change)	All		500		µS

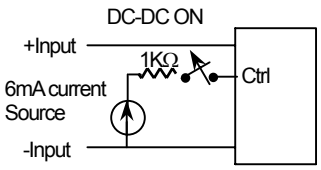
Input Specifications						
Parameter		**Device**	**Min**	**Typ**	**Max**	**Unit**
Input Voltage	Continuous	TMR 05xx	4.5	5.0	9	Vdc
		TMR 12xx	9	12.0	18	Vdc
		TMR 24xx	18	24.0	36	Vdc
		TMR 48xx	36	48.0	75	Vdc
Input Current		TMR 0510			540	mA
(Maximum Value at $V_{in} = V_{in\,nom}$; Full Load)		TMR 0511			615	mA
		TMR 0509			596	mA
		TMR 0512			588	mA
		TMR 0513			582	mA
		TMR 0521			645	mA
		TMR 0522			595	mA
		TMR 0523			598	mA
		TMR 1210			202	mA
		TMR 1211			234	mA
		TMR 1209			222	mA
		TMR 1212			219	mA
		TMR 1213			220	mA
		TMR 1221			242	mA
		TMR 1222			224	mA
		TMR 1223			226	mA
		TMR 2410			102	mA
		TMR 2411			115	mA
		TMR 2409			109	mA
		TMR 2412			109	mA
		TMR 2413			108	mA
		TMR 2421			117	mA
		TMR 2422			112	mA
		TMR 2423			110	mA
		TMR 4810			52	mA
		TMR 4811			60	mA
		TMR 4809			56	mA
		TMR 4812			55	mA
		TMR 4813			55	mA
		TMR 4821			62	mA
		TMR 4822			57	mA
		TMR 4823			57	mA

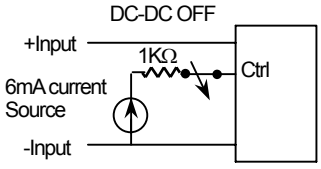
Input Specifications (continue)						
Parameter		**Device**	**Min**	**Typ**	**Max**	**Unit**
Input Standby Current (Typical Value at $V_{in} = V_{in\,nom}$; No Load)		TMR 0510		60		mA
		TMR 0511		55		mA
		TMR 0509		55		mA
		TMR 0512		75		mA
		TMR 0513		40		mA
		TMR 0521		75		mA
		TMR 0522		75		mA
		TMR 0523		90		mA
		TMR 1210		20		mA
		TMR 1211		25		mA
		TMR 1209		25		mA
		TMR 1212		30		mA
		TMR 1213		30		mA
		TMR 1221		50		mA
		TMR 1222		40		mA
		TMR 1223		40		mA
		TMR 2410		10		mA
		TMR 2411		10		mA
		TMR 2409		15		mA
		TMR 2412		15		mA
		TMR 2413		15		mA
		TMR 2421		15		mA
		TMR 2422		20		mA
		TMR 2423		20		mA
		TMR 4810		10		mA
		TMR 4811		10		mA
		TMR 4809		10		mA
		TMR 4812		10		mA
		TMR 4813		10		mA
		TMR 4821		10		mA
		TMR 4822		10		mA
		TMR 4823		12		mA
Input reflected ripple current (It will not damage the device if the capacitor on the input is not equipped)	5V input (100µF)				400	mA pk-pk
	12V input (100µF)				150	mA pk-pk
	24V input (10µF)				380	mA pk-pk
	48V input (10µF)				170	mA pk-pk
Start up time (nominal V_{in} and constant resistive load power up)	Power up			1		mS
	Remote ON/OFF			1		mS
Remote ON/OFF Control (See Page 13) DC-DC ON DC-DC OFF		All	 4	 Open	 8	 mA
Remote Off Input Current		All			2.5	mA

General Specifications					
Parameter	**Device**	**Min**	**Typ**	**Max**	**Unit**
Efficiency	TMR 0510		65		%
at $V_{in\,nom}$ and full load	TMR 0511		69		%
(Please see the testing configurations part)	TMR 0509		71		%
	TMR 0512		72		%
	TMR 0513		73		%
	TMR 0521		66		%
	TMR 0522		71		%
	TMR 0523		71		%
	TMR 1210		72		%
	TMR 1211		75		%
	TMR 1209		79		%
	TMR 1212		80		%
	TMR 1213		80		%
	TMR 1221		73		%
	TMR 1222		78		%
	TMR 1223		78		%
	TMR 2410		71		%
	TMR 2411		76		%
	TMR 2409		80		%
	TMR 2412		80		%
	TMR 2413		81		%
	TMR 2421		75		%
	TMR 2422		78		%
	TMR 2423		80		%
	TMR 4810		70		%
	TMR 4811		74		%
	TMR 4809		78		%
	TMR 4812		80		%
	TMR 4813		79		%
	TMR 4821		75		%
	TMR 4822		77		%
	TMR 4823		77		%
Isolation resistance	All	10^9			Ω
Isolation Capacitance	All		300	1000	pF
Switching Frequency (full load to minimum load)	All	100		650	KHz
Weight	All		4.8		g
MTBF (please see the MTBF and reliability part)	All		5.107×10^6		hours

Remote On/Off Control

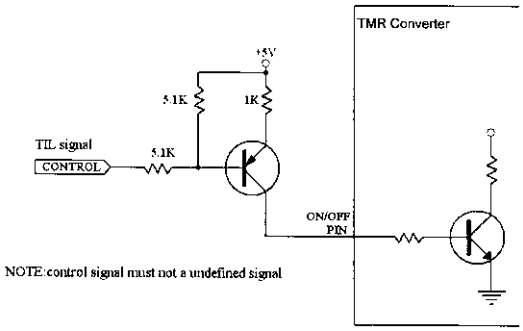
Only one type of remote on/off control is available for TMR. The module will turn on during the ctrl pin left open or high impedance between ctrl pin and -Vin pin. The module will turn off if the control pin is applied with a current of 4~8mA.



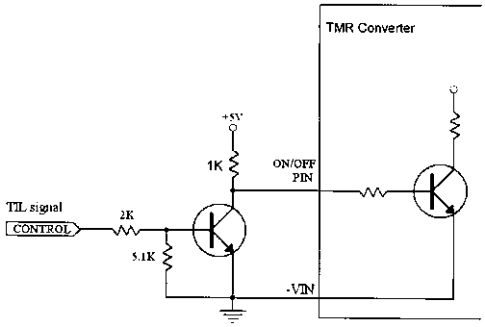


In off condition the input current is app. 1mA max.

Positive Logic:



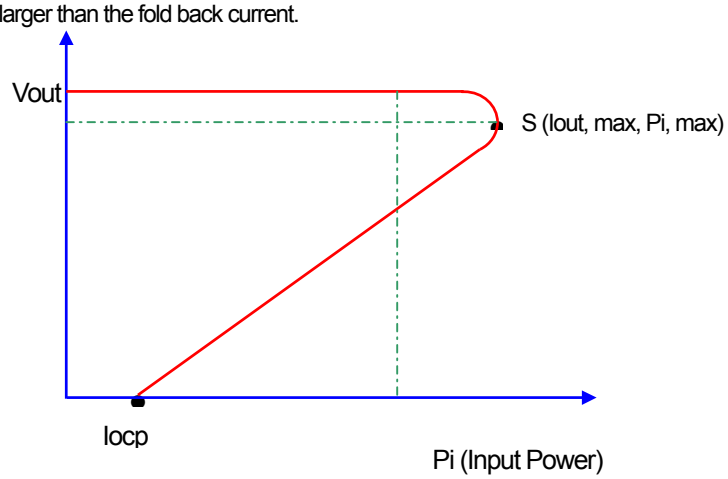
Negative Logic:



Output over current protection

When excessive output currents occur in the system, circuit protection is required on all converters. Normally, overload current is maintained at approximately 115~175% percent of rated current.

The TMR converters have a fold-back over current protection. Fold back current protection reduces the load current during over current condition. The figure below shows a typical curve. Since the over current protection is a fold-back characteristic the highest power dissipation occurs at point S. During start-up this product provides less output current, hence the output rises slower, or the power supply may not start up at all if the load current during start up is larger than the fold back current.



Short Circuitry Protection

Continuous, hiccup and auto-recovery mode. During short circuit, converter will shut down and will switch on again to detect if the short circuit is still present or not. The average current during this condition will be very low and the device will be safe in short circuit condition. Due to that is the TMR converters indefinite short circuit protected.

Solder, clearing, and drying considerations

Soldering

Flow (wave) soldering: 250°C ±10°C less than10 seconds (see below)

Soldering iron: 370°C ±10°C less than 5 seconds

Note: the pin of this product is Tin coated. To assure the solder-ability, modules should be kept in their original shipping containers to provide adequate protection. Also, the storage environment shall be well controlled to protect any oxidation.

Cleaning process

In aqueous cleaning, it is preferred to have an in-line cleaner system consisting of several cleaning stages (pre-wash, wash, rinse, final rinse, and drying). Deionize (DI) water is recommend for aqueous cleaning; the minimum resistive level is 1MΩ-cm.

Tap-water quality varies per region in terms of hardness, chloride, and solid contents; therefore, the use of tap water is not recommended for aqueous cleaning.

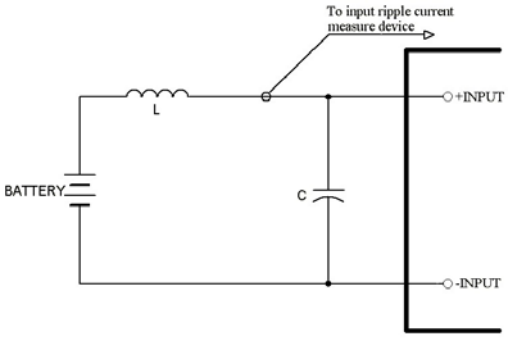
Drying

The drying section of the cleaner system should be equipped with blowers capable of generating 1000cfm -1500cfm of air so that the amount of rinse water left to be dried off with heat is minimal. Handheld air guns are not recommended due the variability and consistency of the operation.

Note: after post-wash, the marking (date code) of converter may fall off. These only impacts the appearance and do not affect the operation of the module.

Testing Configurations

Input reflected-ripple current measurement test up



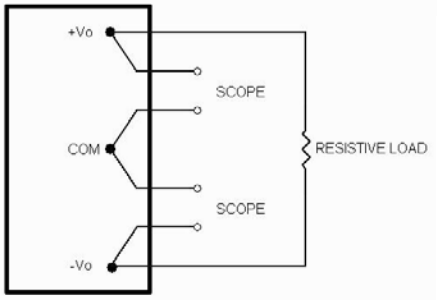
TMR 05xx and TMR 12xx

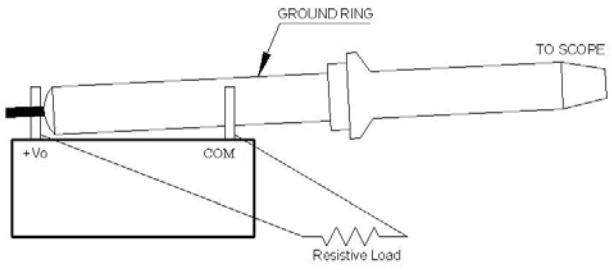
Component	Value	Voltage	Reference
C	100µF	50V	Aluminium Electrolytic Capacitor

TMR 24xx and TMR 48xx

Component	Value	Voltage	Reference
C	10µF	100V	Aluminium Electrolytic Capacitor

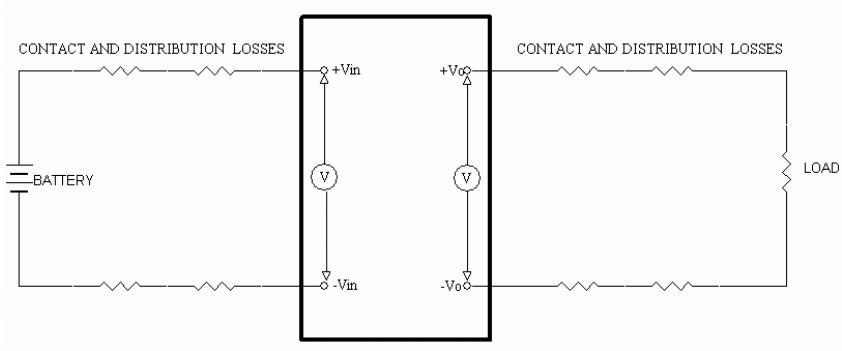
Peak-to-peak output ripple & noise measurement test up





Testing Configurations (continue)

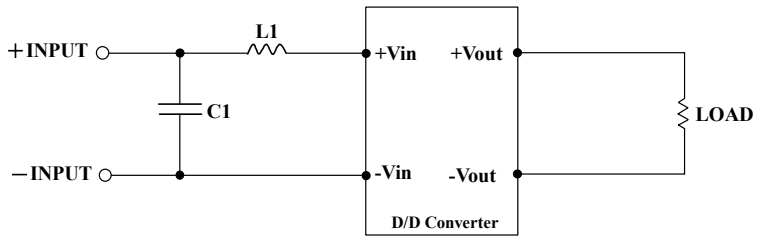
Output voltage and efficiency measurement test up



Note: All measurements are taken at the module terminals.

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

EMC considerations



Suggested Schematic for EN55022 Conducted Emission Class B Limits

To comply with EN55022 CLASS B conducted emissions the following components are recommended:

TMR 05xx and TMR 12xx

Component	Value	Voltage	Reference
C1	22 µF	25V	1812 MLCC Capacitor
L1	3.3 µH	2.0A / 0.06Ω / 0504	SMD Inductor, P/N: TCK-044

TMR 24xx

Component	Value	Voltage	Reference
C1	4.7 µF	50V	1812 MLCC Capacitor
L1	12 µH	1.4A / 0.12Ω / 0504	SMD Inductor, P/N: TCK-062

TMR 48xx

Component	Value	Voltage	Reference
C1	2.2 µF	100V	1812 MLCC Capacitor
L1	27 µH	0.9A / 0.2Ω / 0504	SMD Inductor, P/N: TCK-063

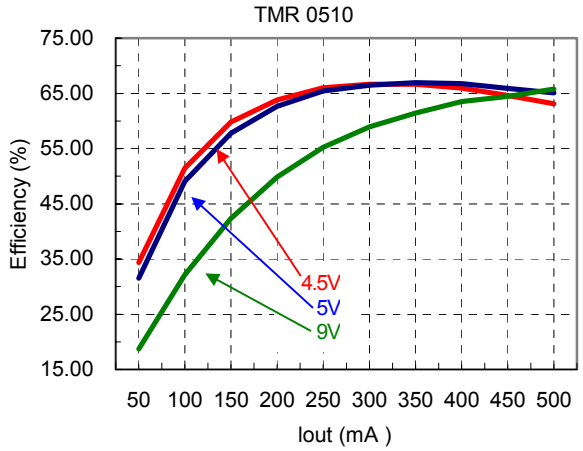
Input Source Impedance

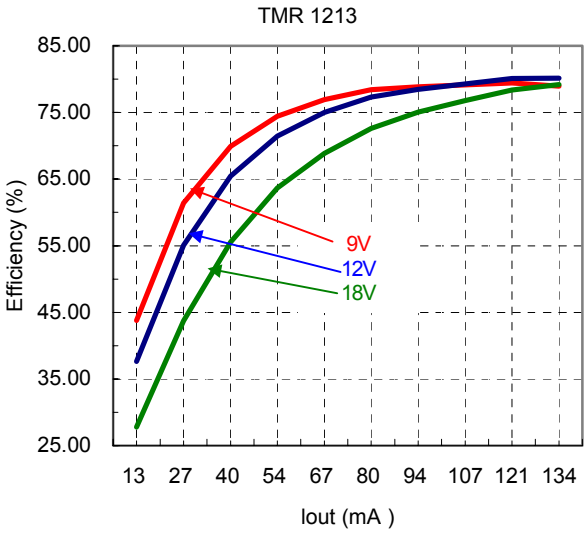
The power module should be connected to a low impedance input source. Highly inductive source impedance can affect the stability of the power module. Input external L-C filter is recommended to minimize input reflected ripple current. The capacitor should be equipped as close as possible to the input terminals of the power module for lower impedance.

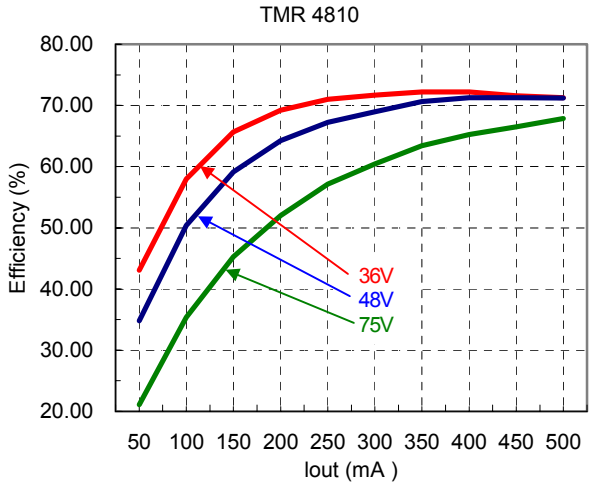
Characteristic Curve

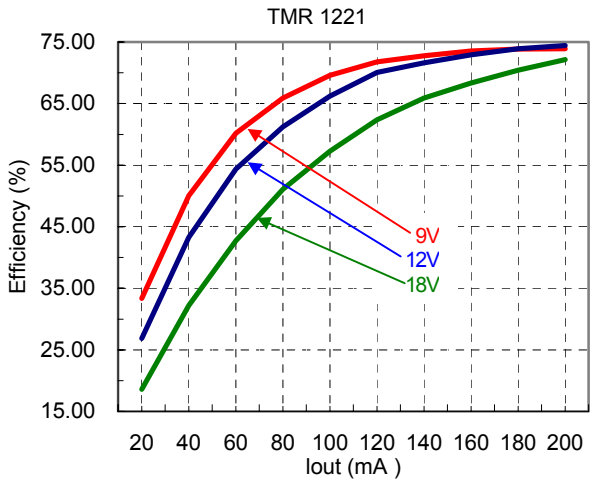
Efficiency

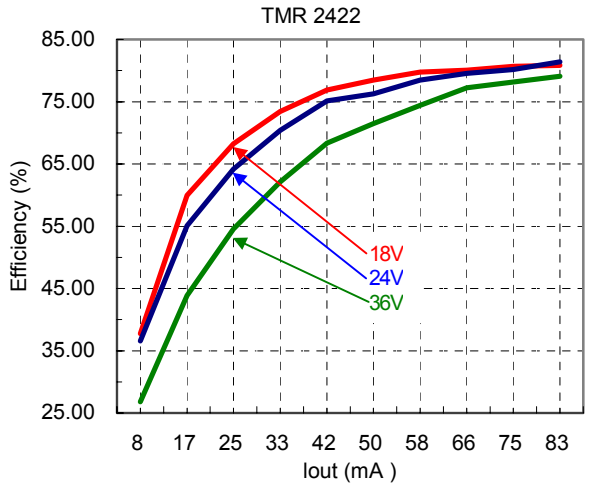
a. Efficiency with load change under different line condition at room temperature

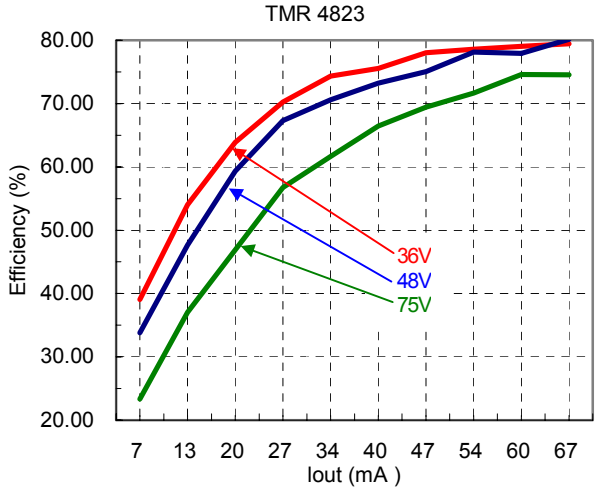




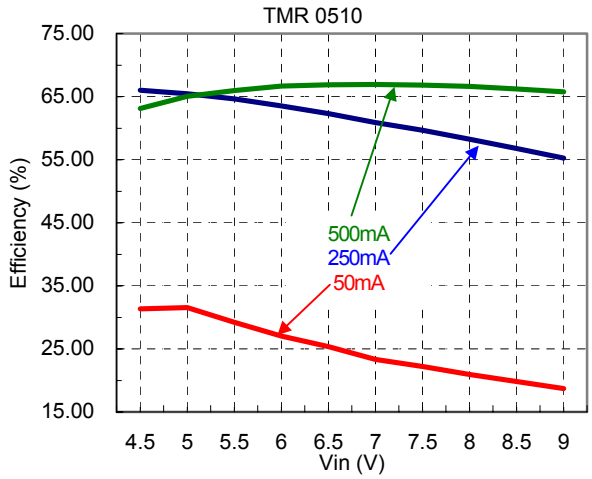


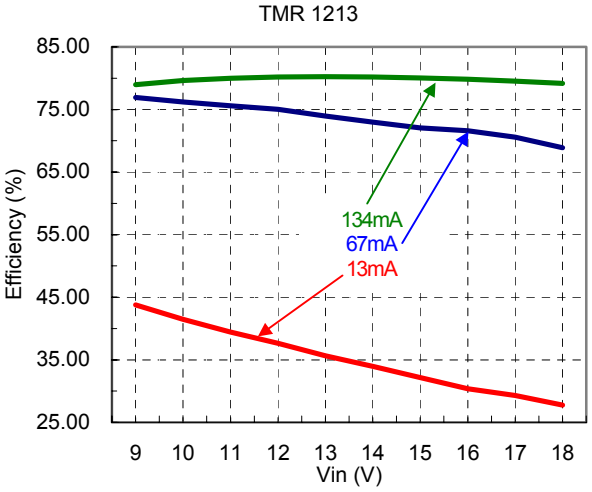

TMR 1221
75.00
65.00
55.00
45.00
35.00
25.00
15.00
Efficiency (%)
20 40 60 80 100 120 140 160 180 200
Iout (mA)
9V
12V
18V

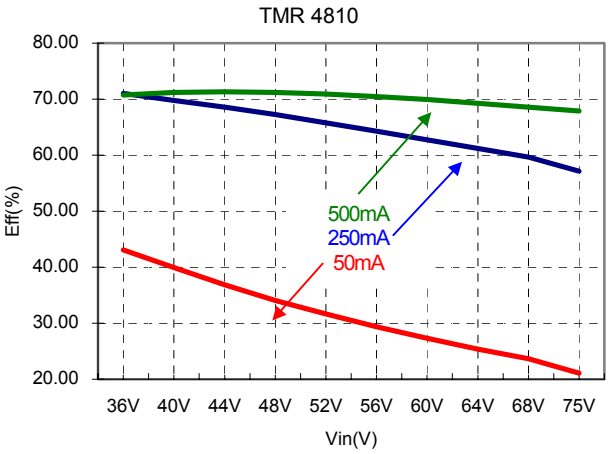

TMR 2422
85.00
75.00
65.00
55.00
45.00
35.00
25.00
Efficiency (%)
8 17 25 33 42 50 58 66 75 83
Iout (mA)
18V
24V
36V

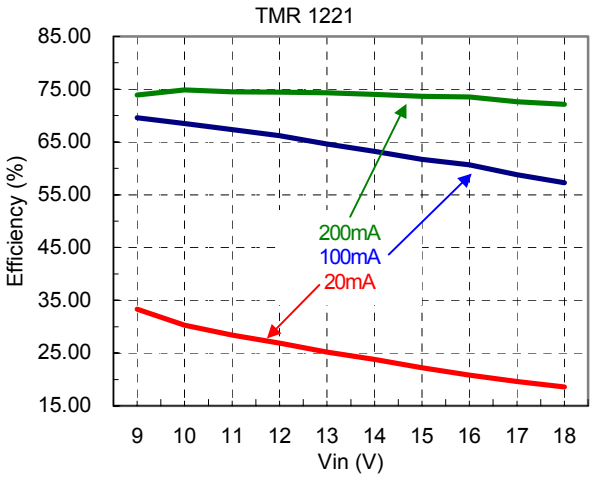

TMR 4823
80.00
70.00
60.00
50.00
40.00
30.00
20.00
Efficiency (%)
7 13 20 27 34 40 47 54 60 67
Iout (mA)
36V
48V
75V

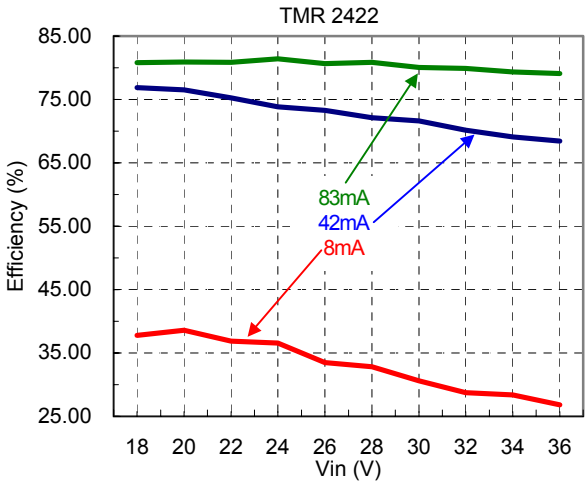
b. Efficiency at input voltage change under different load condition at room temperature

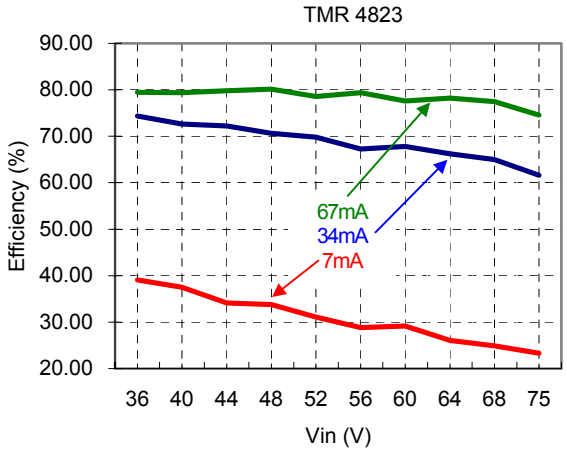




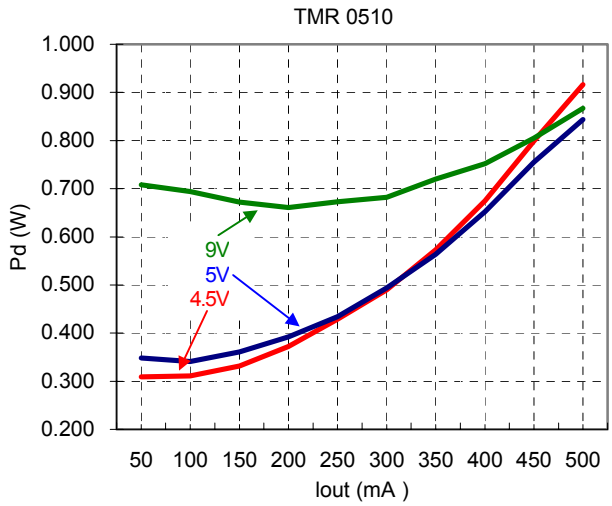


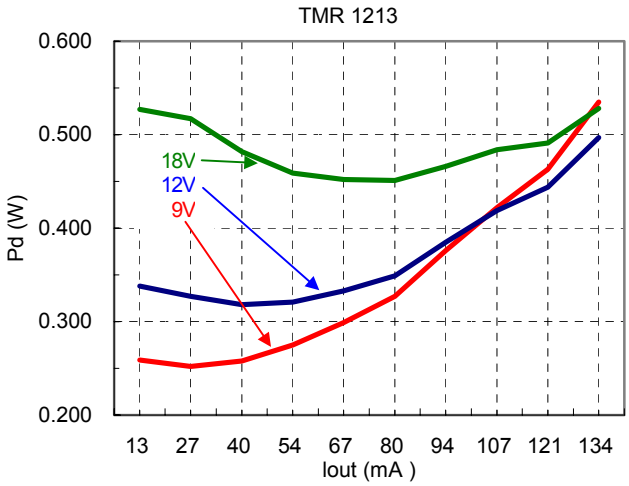

TMR 1221
85.00
75.00
65.00
55.00
45.00
35.00
25.00
15.00
Efficiency (%)
200mA
100mA
20mA
9 10 11 12 13 14 15 16 17 18
Vin (V)

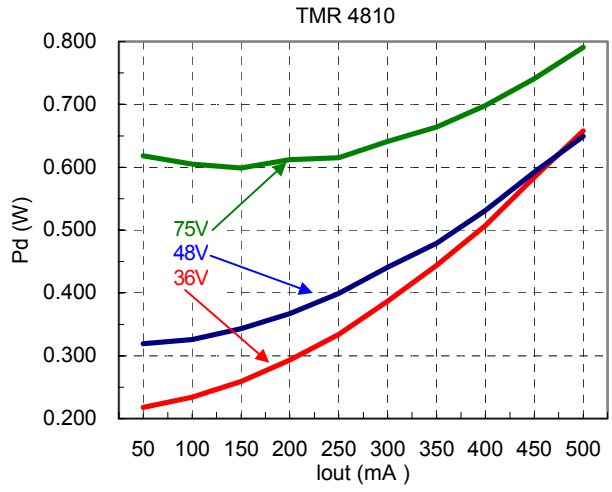

TMR 2422
85.00
75.00
65.00
55.00
45.00
35.00
25.00
Efficiency (%)
83mA
42mA
8mA
18 20 22 24 26 28 30 32 34 36
Vin (V)

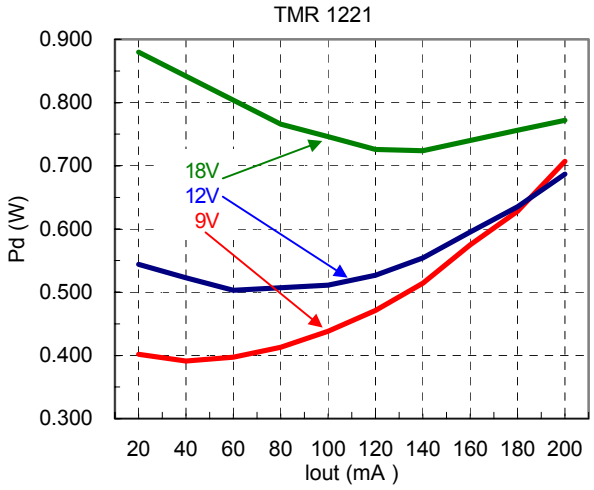

TMR 4823
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
Efficiency (%)
67mA
34mA
7mA
36 40 44 48 52 56 60 64 68 75
Vin (V)

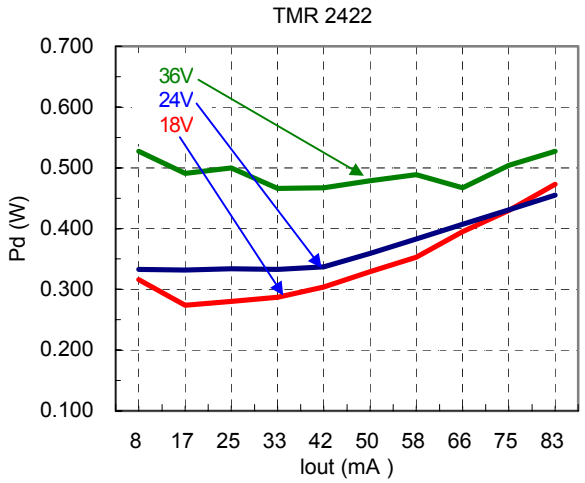
Power dissipation curve

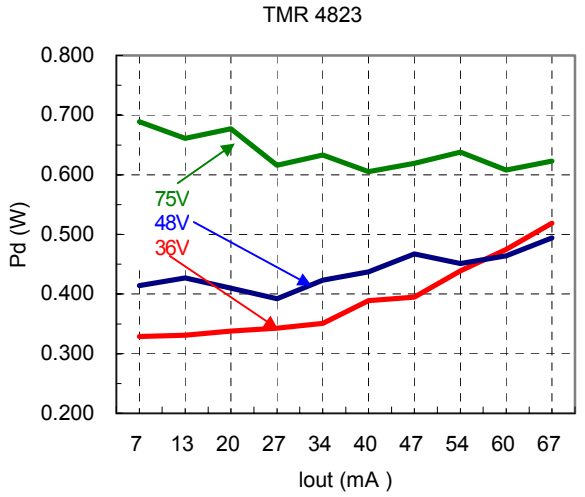






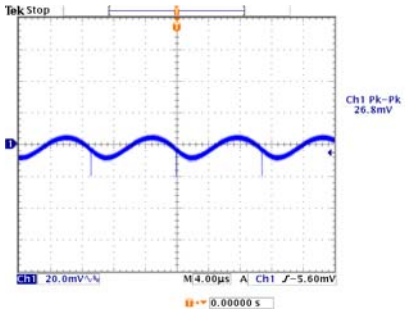

TMR 1221
0.900
0.800
0.700
0.600
0.500
0.400
0.300
Pd (W)
18V
12V
9V
20 40 60 80 100 120 140 160 180 200
Iout (mA)


TMR 2422
0.700
0.600
0.500
0.400
0.300
0.200
0.100
Pd (W)
36V
24V
18V
8 17 25 33 42 50 58 66 75 83
Iout (mA)


TMR 4823
0.800
0.700
0.600
0.500
0.400
0.300
0.200
Pd (W)
75V
48V
36V
7 13 20 27 34 40 47 54 60 67
Iout (mA)

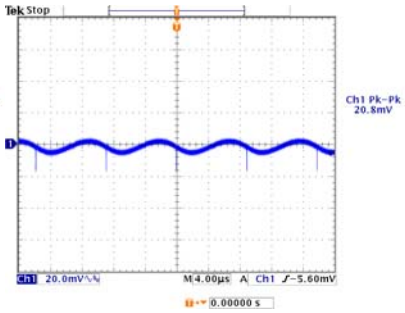
Output ripple & noise

TMR 0510



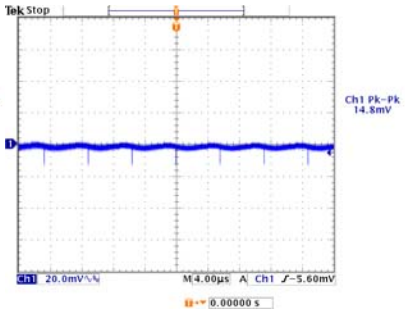
$V_{in\,min}$, Full Load

Output Ripple & Noise = 26.8mV



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

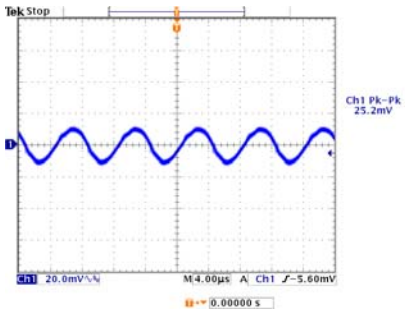
Output Ripple & Noise = 20.8mV



$V_{in\,max}$, Full Load

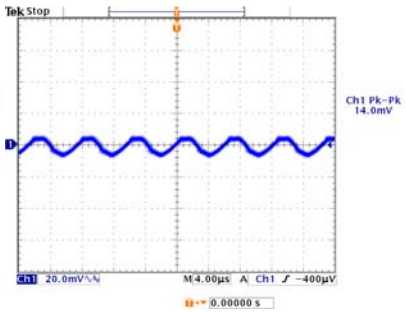
Output Ripple & Noise = 14.8mV

TMR 1213



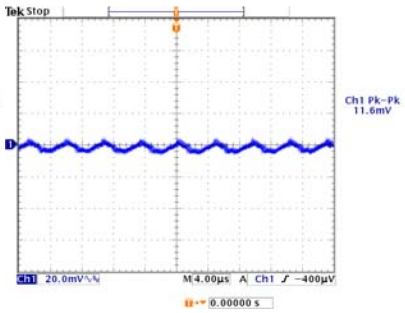
$V_{in\,min}$, Full Load

Output Ripple & Noise = 25.2mV



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

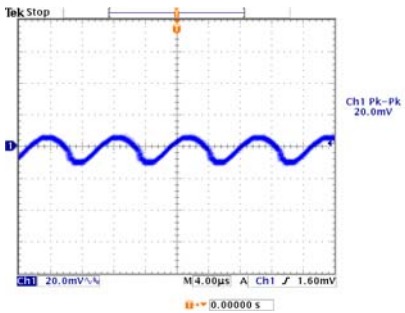
Output Ripple & Noise = 14.0mV



$V_{in\,max}$, Full Load

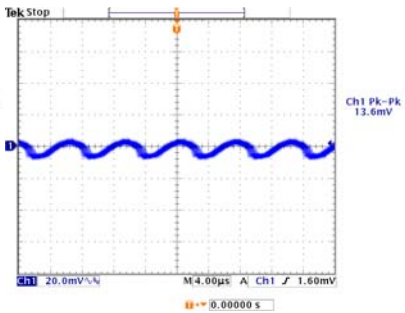
Output Ripple & Noise = 11.6mV

TMR 4810



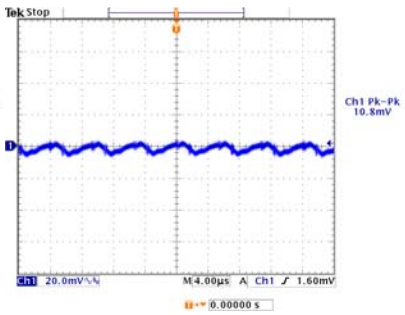
$V_{in\,min}$, Full Load

Output Ripple & Noise = 20.0mV



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

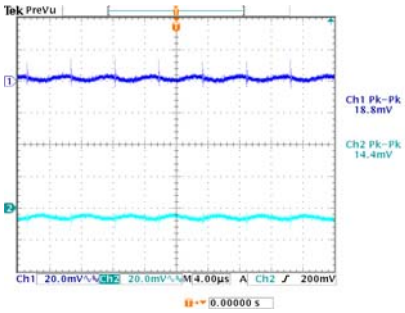
Output Ripple & Noise = 13.6mV



$V_{in\,max}$, Full Load

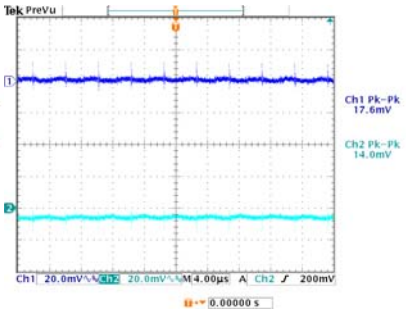
Output Ripple & Noise = 10.8mV

TMR 1221



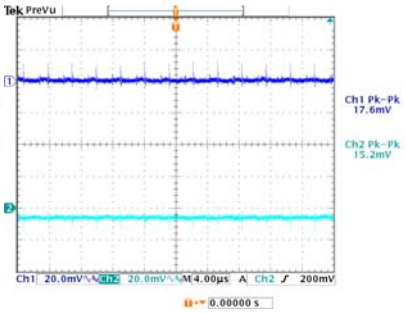
$V_{in\,min}$, Full Load

$+V_{out}$ = 18.8mV / – V_{out} = 14.4mV



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

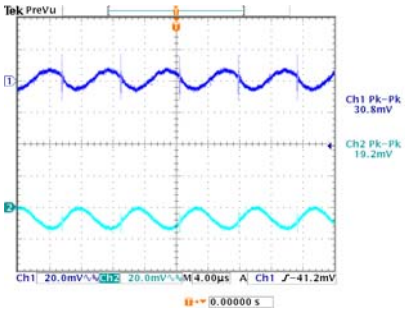
+ V_{out} = 17.6mV / –V_{out} = 14.0mV



$V_{in\,max}$, Full Load

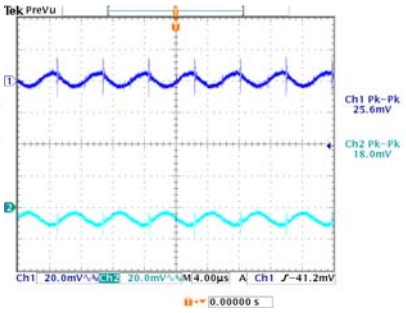
+ V_{out} = 17.6mV / – V_{out} = 15.2mV

TMR 2422



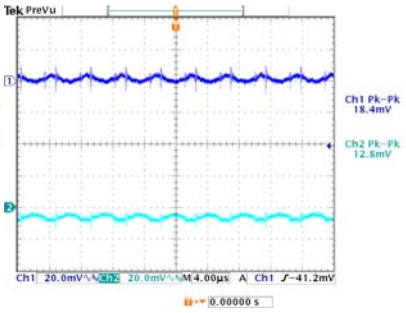
$V_{in\,min}$, Full Load

+ V_{out} = 30.8mV / – V_{out} = 19.2mV



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

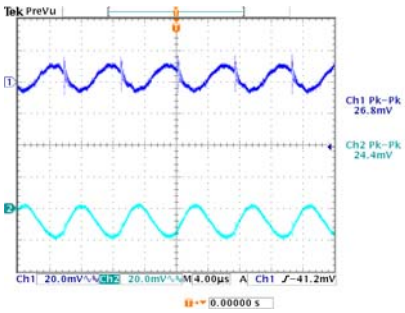
+ V_{out} = 25.6mV / – V_{out} = 18.0mV



$V_{in\,max}$, Full Load

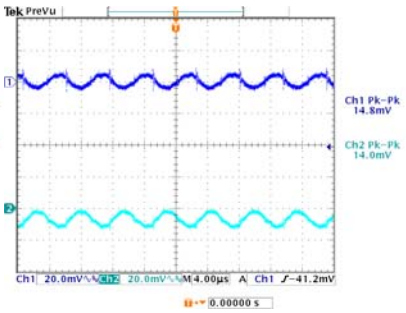
+ V_{out} = 18.4mV / – V_{out} = 12.8mV

TMR 4823



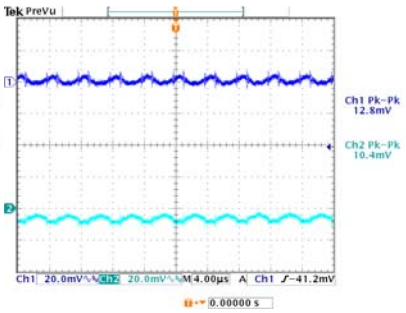
$V_{in\,min}$, Full Load

+ V_{out} = 26.8mV / – V_{out} = 24.4mV



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

+ V_{out} = 14.8mV / – V_{out} = 14.0mV

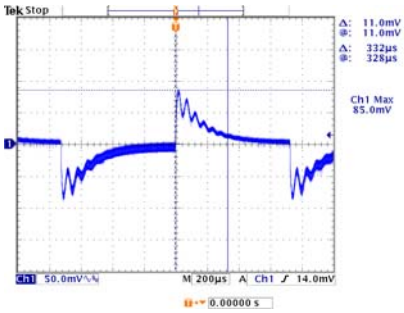


$V_{in\,max}$, Full Load

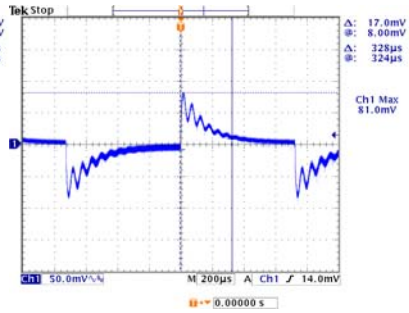
+ V_{out} = 12.8mV / – V_{out} = 10.4mV

Transient Peak and Response

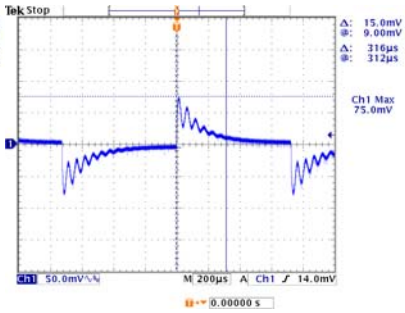
TMR 0510



$V_{in\,min}$, Full Load
Transient Peak 85.0mV
Transient Response 332.0µS

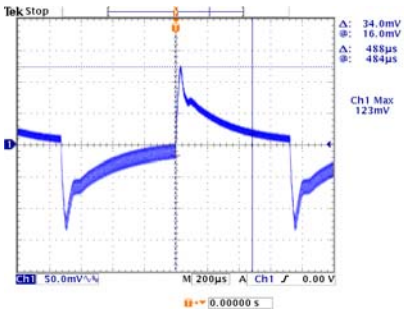


$V_{in\,nom}$, Full Load
Transient Peak 81.0mV
Transient Response 328.0µS

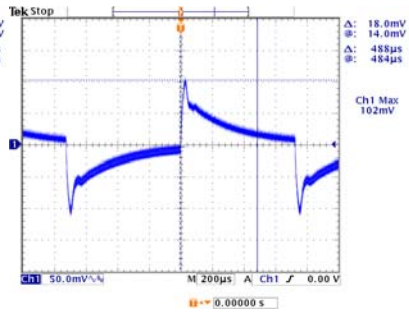


$V_{in\,max}$, Full Load
Transient Peak 75.0mV
Transient Response 316.0µS

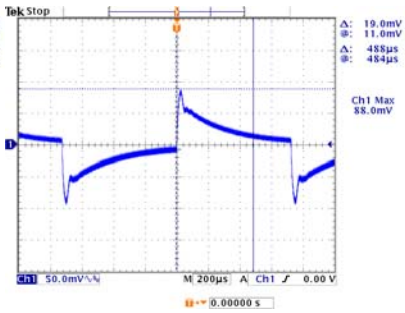
TMR 1213



$V_{in\,min}$, Full Load
Transient Peak 123.0mV
Transient Response 488µS

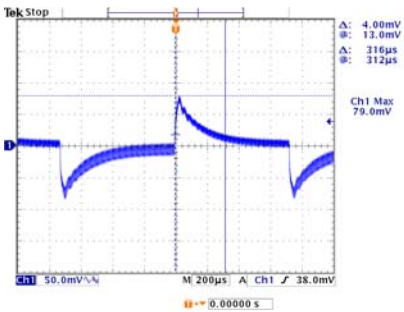


$V_{in\,nom}$, Full Load
Transient Peak 102.0mV
Transient Response 488µS

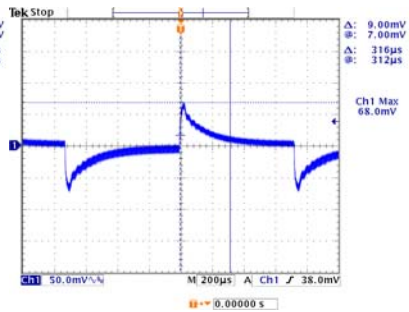


$V_{in\,max}$, Full Load
Transient Peak 88.0mV
Transient Response 488µS

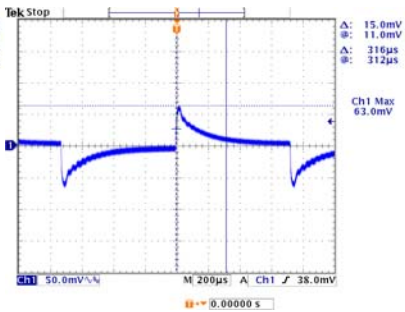
TMR 4810



$V_{in\,min}$, Full Load
Transient Peak 79.0mV
Transient Response 316µS

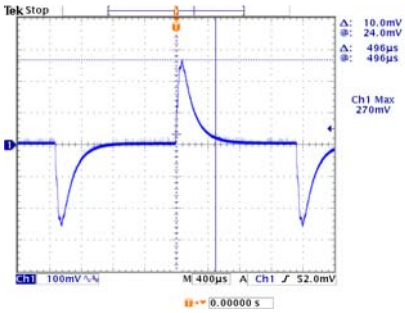


$V_{in\,nom}$, Full Load
Transient Peak 68.0mV
Transient Response 316µS



$V_{in\,max}$, Full Load
Transient Peak 63.0mV
Transient Response 316µS

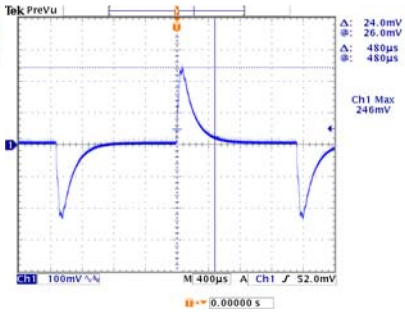
TMR 1221



$V_{in\,min}$, Full Load

Transient Peak 270mV

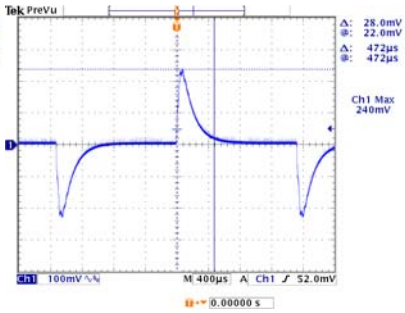
Transient Response 496µS



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

Transient Peak 246mV

Transient Response 480µS

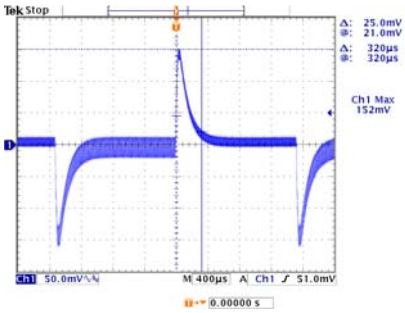


$V_{in\,max}$, Full Load

Transient Peak 240mV

Transient Response 472µS

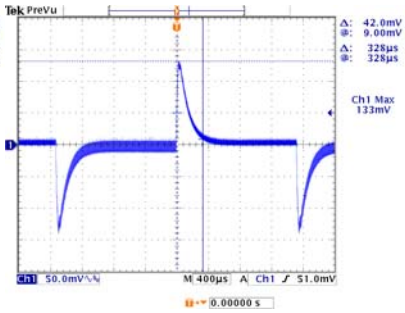
TMR 2422



$V_{in\,min}$, Full Load

Transient Peak 152mV

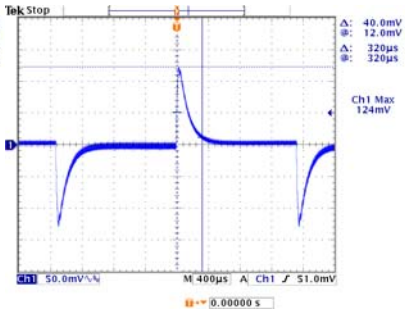
Transient Response 320µS



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

Transient Peak 133mV

Transient Response 328µS

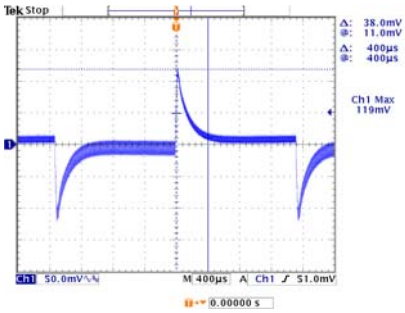


$V_{in\,max}$, Full Load

Transient Peak 124mV

Transient Response 320µS

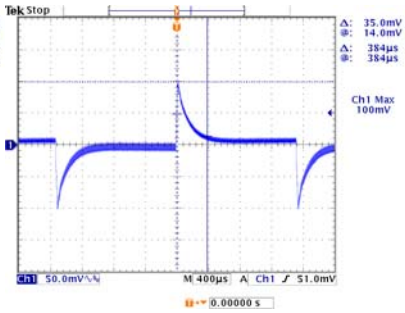
TMR 4823



$V_{in\,min}$, Full Load

Transient Peak 119mV

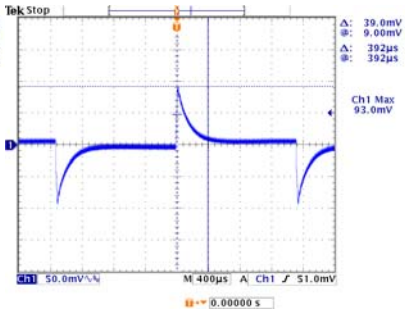
Transient Response 400µS



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

Transient Peak 100mV

Transient Response 384µS



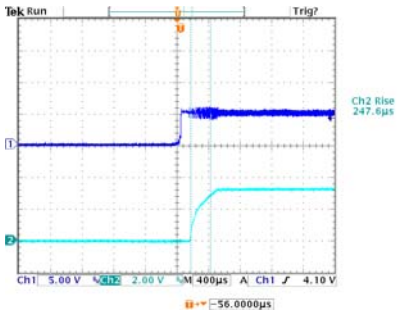
$V_{in\,max}$, Full Load

Transient Peak 93mV

Transient Response 392µS

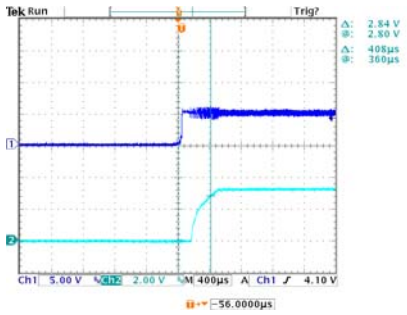
Start-up Time and Rise Time

TMR 0510



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

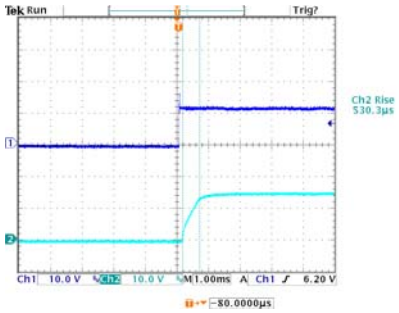
Rise Time = 247.6µS



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

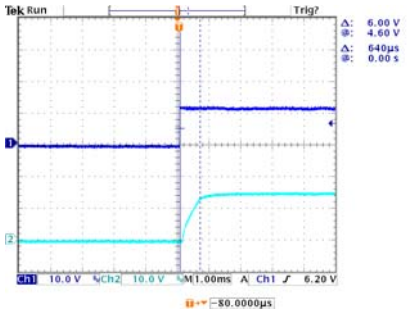
Start-up Time = 408.0µS

TMR 1213



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

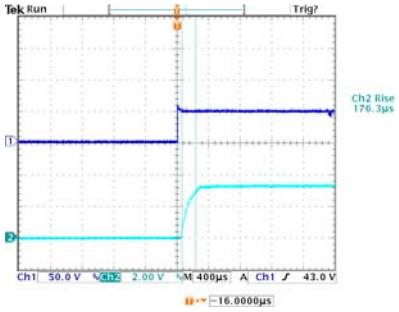
Rise Time = 530.3µS



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

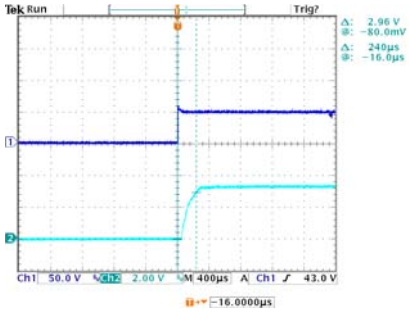
Start-up Time = 640.0µS

TMR 4810



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

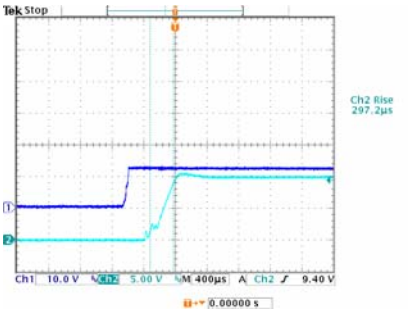
Rise Time = 176.3µS



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

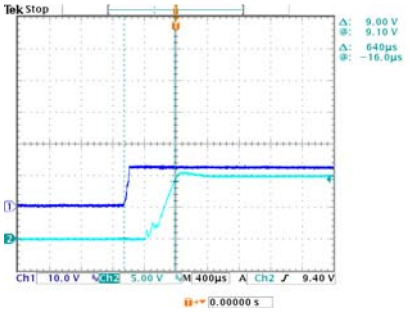
Start-up Time = 240.0µS

TMR 1221



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

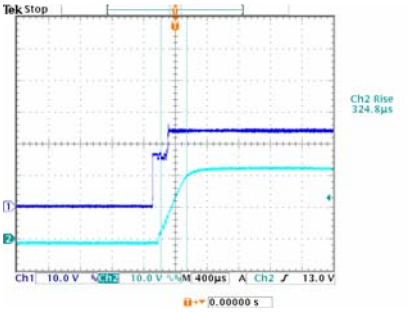
Rise Time = 297.2µS



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

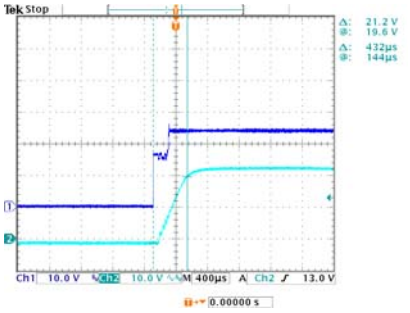
Start-up Time = 640.0µS

TMR 2422



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

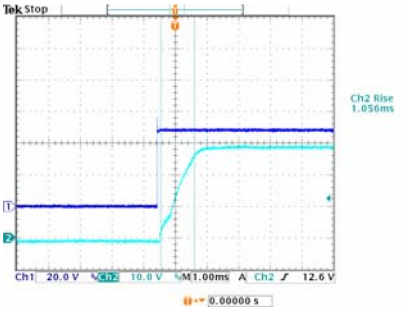
Rise Time = 324.8uS



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

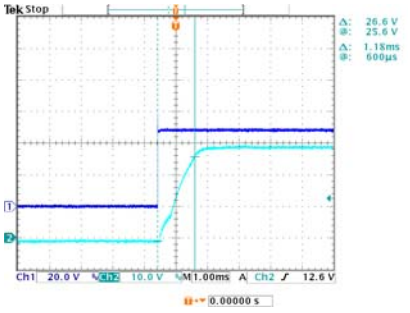
Start-up Time = 432.0uS

TMR 4823



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

Rise Time=1.056mS

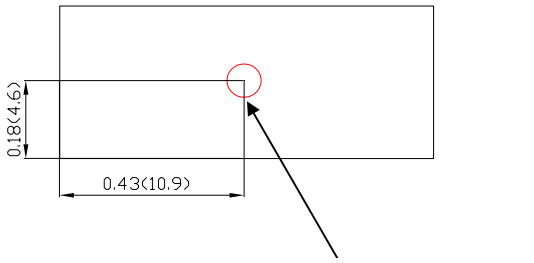


$V_{in\,nom}$, Full Load

Start-up Time= 1.180mS

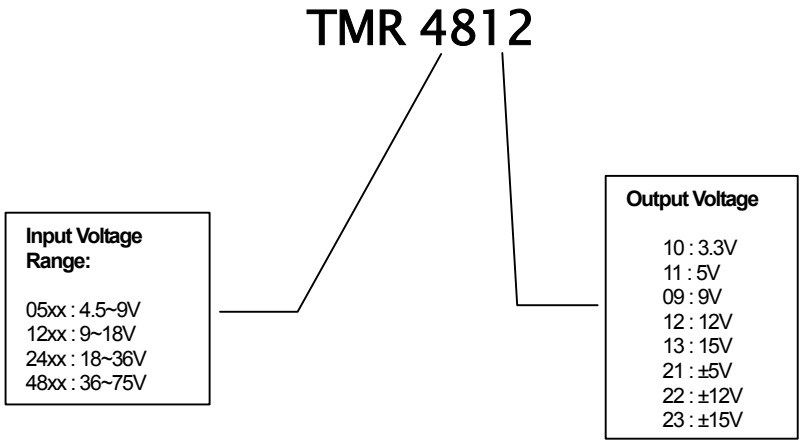
Thermal Consideration

The power module operates in a variety of thermal environments. However, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding Environment. Proper cooling can be verified by measuring the point as shown in the figure below. The temperature at this location should not exceed 100°C. During performance, adequate cooling must be provided to maintain the test point temperature at or below 100°C. Although the maximum point Temperature of the power modules is 100°C, you can limit the case temperature to a lower value for high reliability.



Measurement shown in inches and (millimeters)

Part Number Structure



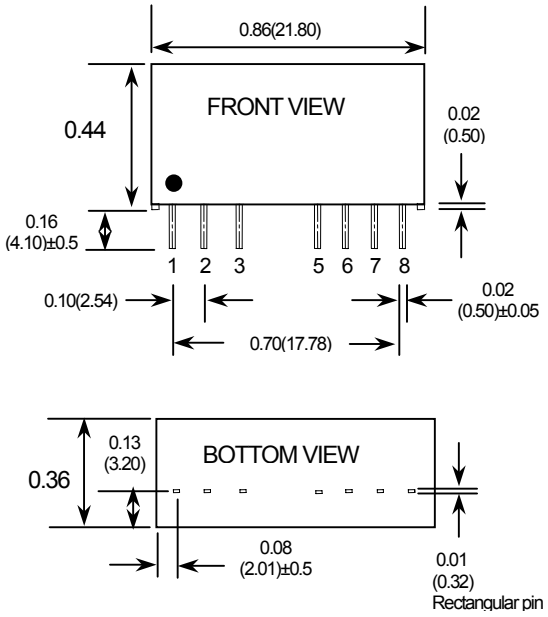
EMC Specifications

	Contact discharge		Air discharge	
EN61000-4-2 ESD (performance criteria B)	level	test voltage (KV)	level	test voltage (KV)
	1	±2	1	±2
	2	±4	2	±4
	3	±6	3	±8
	4	±8	4	±15

EN61000-4-3 RS (performance criteria B)	level	test field strength (V/m)
	1	1
	2	3
	3	10

EMC Specifications (continue)		
EN61000-4-4 EFT (performance criteria B)	open circuit output test voltage ±10%	
	level	power line
	1	±0.5KV
	2	±1.0KV
	3	±2.0KV
	4	±4.0KV
EN61000-4-5 Surge (performance criteria B)	level	open circuit output test voltage ±10%
	1	±0.5KV
	2	±1.0KV
	3	±2.0KV
	4	±4.0KV
EN61000-4-6 CS (performance criteria B)	level	voltage level(EMF)
	1	1V/rms
	2	3V/rms
	3	10V/rms

Mechanical Data



All Dimensions in Inches (mm)
Tolerance: X.XX ±0.02 (X.X ±0.5)
X.XXX ±0.01 (X.XX ±0.25)
Pin Pitch Tolerance ±0.02(0.5)

PIN CONNECTION		
PIN	SINGLE	DUAL OUTPUT
1	- INPUT	- INPUT
2	+ INPUT	+ INPUT
3	CTRL	CTRL
5	NC	NC
6	+ OUTPUT	+ OUTPUT
7	- OUTPUT	COM
8	NC	- OUTPUT

Safety and Installation Instruction

Isolation consideration

The TMR series features 1.0k Volt DC isolation for 60 seconds from input to output, input to case, and output to case. The input to output resistance is greater than 10^9 ohms. Nevertheless, if the system using the TMR converter needs to get safety agency approval, certain rules must be followed in the design of the system. In particular, all of the creepage and clearance requirements of the end-use safety requirement must be observed. These documents include UL60950-1, EN60950-1 and CSA 22.2-60950, although specific applications may have other or additional requirements.

Fusing Consideration

Caution: The TMR converter 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 slow-blow fuse with maximum rating of 6.3 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.

Minimum Load Requirement

25% (of full load) minimum load required to maintain a stable output voltage and to comply with the published specifications. The TMR Series is not getting damaged at no load or low load conditions but at loads below 25% a proper and accurate regulation of the output voltage cannot be ensured. The output voltage drops by app. 10%.

MTBF and Reliability

The MTBF of TMR series has been calculated according to:

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

   Nominal Input Voltage and GB

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

   $T_A = +25°C$

   The resulting figure for MTBF is 2.399×10^6 hours.

2. Bell-core TR-NWT-000332 Case I:

   50% stress, Operating Temperature at 40 °C (Ground fixed and controlled environment)

   The resulting figure for MTBF is 5.107×10^6 hours.