GigaTarzan™ MQ7290S2
Non-isolated 4.5~14VDC input, 0.7~2V output, 50A DC-DC Converter

APPLICATIONS

- ☐ Workstations, servers
- ☐ Desktop computers
- ☐ DSP applications
- ☐ Distributed power architectures
- ☐ Telecommunications equipment
- ☐ Data communications equipment
- ☐ Wireless communications equipment

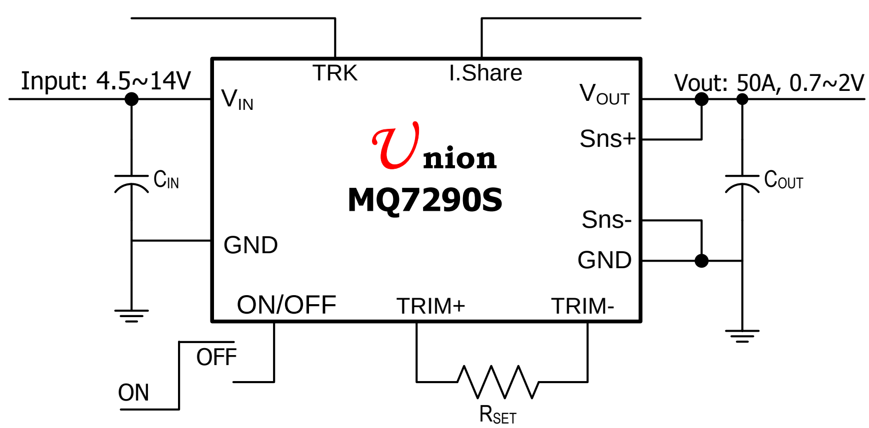
FEATURES

- ➢ Wide operating voltage: 4.5~14V
- ➢ Output Current up to 50A
- ➢ Output voltage ripple: $20mV_{PP}$
- ➢ True differential remote sense
- ➢ ***EZ-Tracking™*** for automatic multi-rail sequence
- ➢ ***SpeedTran™*** optimize transient response (patent pending)
- ➢ Parallel operating with active current sharing (patent pending)
- ➢ Overcurrent /shortcircuit protection
- ➢ Over-temperature protection
- ➢ Remote on/off control – negative logical
- ➢ High reliability: designed to meet 5 million hour MTBF
- ➢ Output voltage remote sense compensation
- ➢ Minimal space on PCB:
  - ☐ 33.0mm x 22.9mm x 10.0mm
  - ☐ 1.30 in x 0.9in x 0.39in
- ➢ UL/IEC/EN60950 compliant
- ➢ RoHS Compliant available

Description

The ***GigaTarzan™*** MQ7290S2 Series Power Modules are non-isolated dc-dc converters that operate over a wide input voltage range of 4.5Vdc to 14Vdc, and provide a precisely (2%) regulated dc output with industry standard pin configuration. Such a module is suitable to application with 5V/12V power supply bus. Inside ***SpeedTran*** reduces systems transient responses overshoot/undershoot with less external capacitor. The modules have a maximum output current rating of 50A at typical full-load efficiency up to 90%. Default features include remote on/off with negative logic and output voltage adjustment, over-current protection, over-temperature protection, parallel operating with active current share, ***EZ-Tracking*** etc.

** *Typical Application Circuit* ***********************************



Performance Specificaons (at TA=+25℃)

Model	Input V_{IN} Range (V)	Output				Efficiency (%)
		I_{OUT} (A)	Trim Range (V)	Regulation		
				Line (%)	Load (%)	
MQ7290S2	4.5~14	50	0.7V~2V	0.5	0.5	90

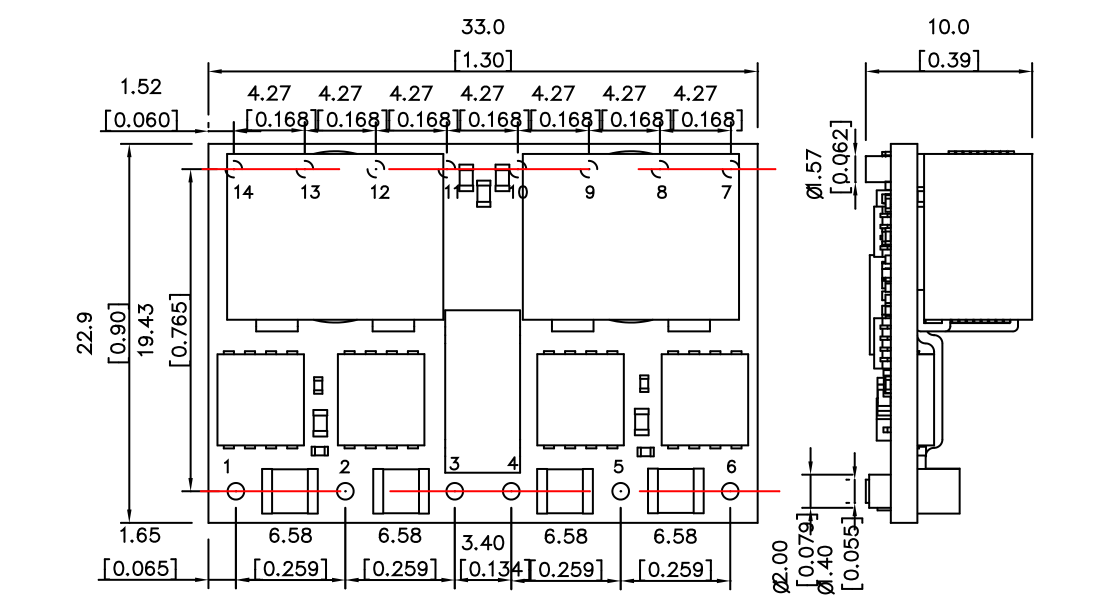
Mechanical Specifications

Dimensions are in millimeters (inches)

Tolerance:

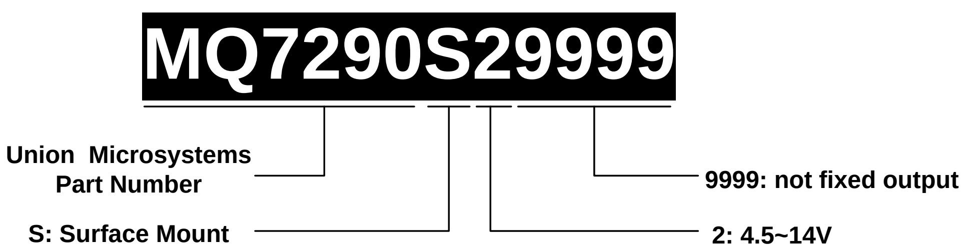
x.xxmm +/-0.5mm (x.xxin. +/-0.02in)

x.xxxmm +/-0.25mm (x.xxxin. +/-0.01in)



PIN	Description
1,6	Vin
2,5	GND
3,4	Vout
7	Track
8	PowerGood
9	Enable
10	Sense-
11	Sense+
12	Trim+
13	Trim-
14	I.Share

Ordering Information



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Absolute Maximum Ratings

Note: These are stress ratings. Exposure of devices to any of these conditions may adversely affect long-term reliability. Proper operation under conditions other than those listed in the Performance Specifications Table is not implied.

Parameter	Symbol	Min	Max	Unit
Input Voltage	V_{IN}	-0.3	16	V
Storage Temperature	T_{STG}	-40	125	℃

MQ7290S2 Electrical Specifications: *(T_A=+25°C)*

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Input Voltage Range		V_{IN}	4.5		14	V
Output Current		Io	0		50	A
Output Voltage Set point	100% load	ΔVo	-2		+2	%
Temperature Regulation	T_A= $T_{A.MIN}$ To $T_{A.MAX}$	-		0.4		$\%V_{O.SET}$
Remote Sense Range					0.5	V
Line Regulation	See each output's corresponding character figure					
Load Regulation						
Output Ripple and Noise Voltage	Io=50A,0~20MHz（***Detail Please see corresponding figure***）					
Transient Response						

General Specifications

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Maximum Capacitive Load	50A resistive load + Aluminum capacitor			TBD		μF
	50A resistive load +Ceramic CAP			TBD		
Overcurrent Protection			75		120	A
Output short-circuit current (average)	All				10	A
Under Voltage Lockout Trip Level	Rising and falling V_{IN}, 3% hysteresis		4.2		4.4	V
Logic High		V_{IH}		3		V
Logic Low		V_{IL}	-0.7		1	V
Start-up Time	50A resistive load, no external output capacitors			4		mS
Switching Frequency		Fo		280		kHz
Operating Temperature	Natural convection		-40		85	℃
Vibration	3 Axes, 5 Min Each	10~55Hz，0.35mm，5g				
	3 Axes, 6 Times Each	Peak Deviation 300g，Settling Time 6mS				
MTBF		5,000,000				Hour

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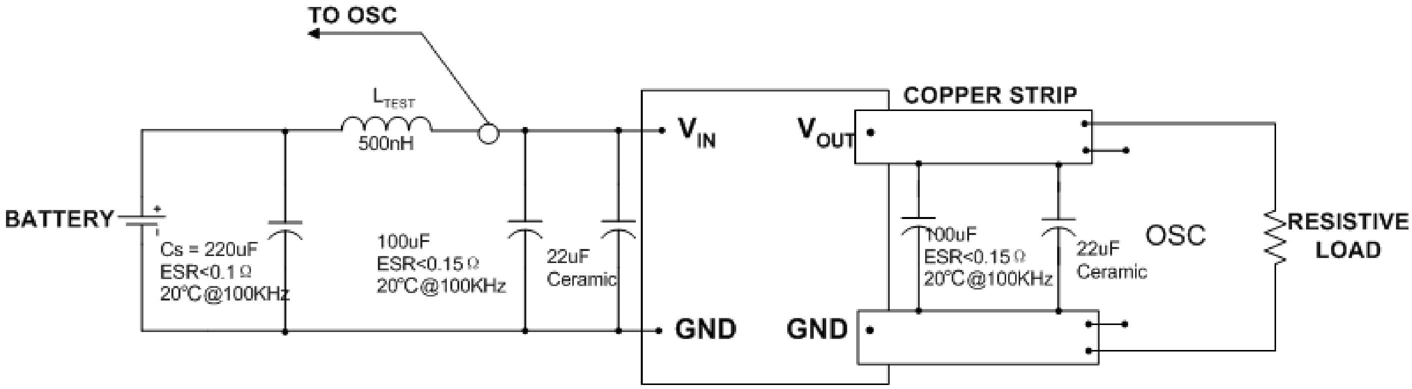
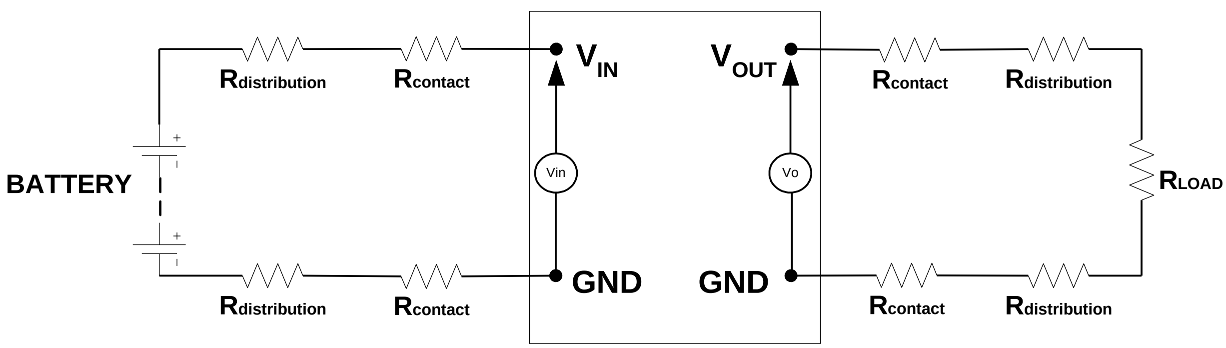
Test Configurations



Test setup for input noise, output noise and ripple

Note:

Output noise is measured with 0.1μF ceramic capacitor connected at the output. OSC measurement should be made using a BNC socket. Position the load between 50mm and 75mm（2in. and 3in）from the tested module.



Test setup for efficiency

Note:

All voltage measurements must be taken at the module's terminals, as shown above. If sockets are needed, Kelvin connections are required at the module terminals to avoid measurement errors due to socket contact resistance.

Technical Notes

Input Voltage Range

The MQ7290S2 Series can be used in a wide variety of applications, esp. most of unregulated 12V intermediate power supply bus system. Its wide input voltage ranges can tolerate worst voltage drop from cheap isolated Brick-type Bus-converter, so it reduces total system cost on power supply.

Return Current Paths

The MQ7290S2 Series are non-isolated DC/DC converters. Their two Common pins (pins 5 and 6) are connected to each other internally. To the extent possible with the intent of minimizing ground loops, input return current should be directed through pin 6 (also referred to as---Input or Input Return), and output return current should be directed through pin 5 (also referred to as---Output or Output Return) as short as possible.

I/O Filtering

All the specifications of the MQ7290S2 Series are tested with specified output capacitors. However, certain input capacitors are necessary to improve the power modules' operating conditions and to reduce the ac impedance. For example, under some conditions, the power modules can't normally start up when fully loaded due to the high ac-impedance input source. External input

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capacitors serve primarily as energy-storage devices. They should be added close to the input pins of the MQ7290S2 and selected for bulk capacitance (at appropriate frequencies), low ESR, and high rms-ripple-current ratings. All external capacitors should have appropriate voltage ratings. To reduce the amount of ripple current fed back to the input supply (input reflected-ripple current), an external L-C filter can be added with the inductance as close to the power module as possible.

MQ7290S2's output ripple and transient response can be improved with the increasing output capacitance. When using output capacitors, take care that the total output capacitance does not exceed MQ7290S2's Maximum Capacitive Load to avoid issuing the module's over-current protection mechanism in the start-up procedure.

When an external L-C filter is added to reduce ripple on load, for best results, the filter components should be mounted close to the load circuit rather than the power module.

When testing the relationship between external capacitors and output voltage noise, the oscilloscope's probe should be applied to the module's end directly with scope probe ground less than 10mm in length。

Input Fusing

The MQ7290S2 Series is not internally fused. Certain applications and/or safety agencies may require the installation of fuses at the inputs of power conversion components. The selection of the fuses should conform to the following：

1. The fuse value should be fast-blow TBDA fuses.
2. Both input traces must be capable of carrying a current of 1.5 ti

Safety Considerations

mes the value of the fuse without opening.

MQ7290S2's are non-isolated DC/DC converters. In general, all DC-DC's must be installed in compliance with relevant safety-agency specifications (usually UL/IEC/EN60950). In particular, for a non-isolated converter's output voltage to meet SELV (safety extra low voltage) requirements, its input must be SELV compliant. If the output needs to be ELV (extra low voltage), the input must be ELV.

Remote Sense

MQ7290S2Power Modules offer a differential output sense function on pin SENSE+ and Sense-. The sense function enables point-of-use regulation for overcoming moderate IR drops in conductors and/or cabling. The sense line carries very little current and consequently requires a minimal cross-sectional-area conductor. As such, it is not a low-impedance point and must be treated with care in layout and cabling. Sense lines should be run adjacent to signals (preferably ground). If the remote sense is not needed the sense pin should be left open or connected to V_{OUT} directly.

Use of trim and sense functions can cause the output voltage to increase, thereby increasing output power beyond the MQ7290S2's specified rating. Therefore:

$$V_{OUT}\text{ (at pins) } \times I_{OUT} \leq P \text{ (rated output power)}$$

ON/OFF Control

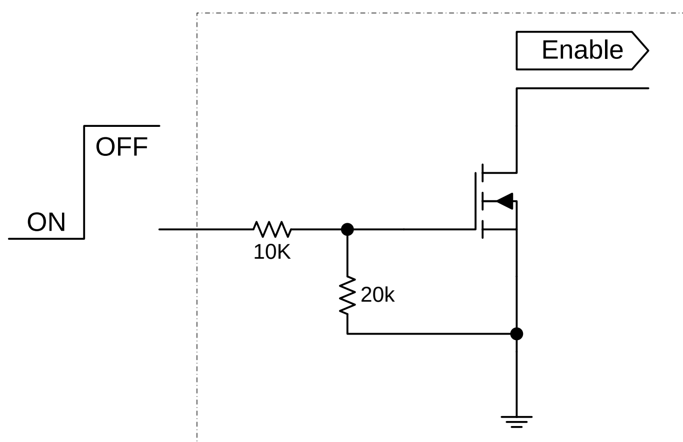

Fig1a. Remote ON/OFF Implementation with External TTL-compatible logic

The MQ7290S2 power modules feature an On/Off pin for remote On/Off operation with negative logic. If not using the remote On/Off pin, leave the pin open (module will be On). The On/Off pin signal (Von/Off) is referenced to ground. Using remote On/Off to switch module on, the low level should be less than 1V; to switch module off, the high level must be greater than 3V.

Output Overvoltage Protection

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MQ7290S2 Series products do not incorporate output over voltage protection. If the operating circuit requires protection against abnormal output voltage, voltage-limiting circuitry must be provided external to the power module.

Output Overcurrent Protection (OCP)

MQ7290S2 incorporates overcurrent and short circuit protection. If the load current exceeds the overcurrent protection setpoint, the MQ7290S2's internal overcurrent-protection circuitry immediately turns off the module, which then goes into Hiccup mode. The unit operates normally once the output current is brought back into its specified range. The typical average output current during hiccup is less than TBDA.

***Caution**: Be careful never to operate MQ7290S2 in a "heavy overload" condition that is between the rated output current and the overcurrent protection setpoint. This can cause permanent damage to the components.*

Overtemperature Protection (OTP)

To ensure MQ7290S2's reliability and avoid damaging its internal components, MQ7290S2 incorporates over-temperature protection circuit。When the temperature of the PCB is above 130℃, the overtemperature protection circuit will be enabled and the module will stop working. When the temperature of the temperature-testing component is below about 100℃, the overtemperature protection circuit will release and the module will automatically recover from shutdown. To avoid permanently damaging components, the surface temperature of MQ7290S2's power components, esp. of the MOSFET (T_{REF} in Fig2) should be ensured below 130℃.

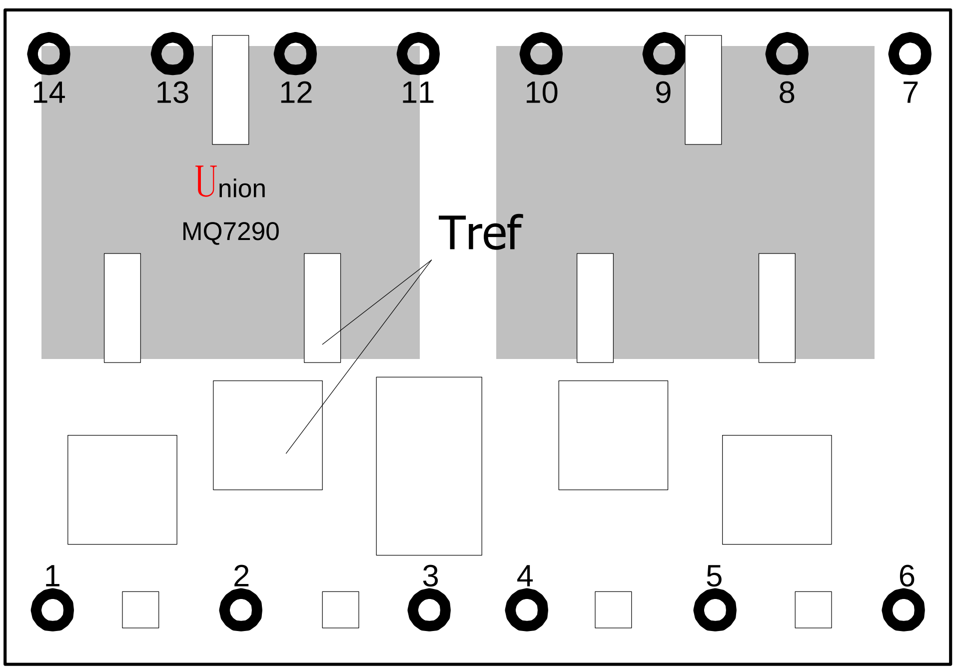

Fig2, Temperature Reference Point

***Note**: The over temperature protection may be issued when MQ7290S2 operates in a "heavy overload" condition for a long time. Thus, the airflow should be improved.*

Output Voltage Trimming

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MQ7290S2's output voltage can be trimmed in certain ranges. See Figure 3 for the 2 programming methods. See Performance Specifications for allowable trim ranges in detail. Also customized products are offered.

Trim with external resistor (Fig3a), the equation as below：

$$R_{TRIM} = \frac{14000}{V_O - 0.7}$$

Resistor values are in kΩ; V_O is desired output voltage.
For examples, to trim output to 1.5V, then

$$R_{TRIM} = \frac{14000}{1.5 - 0.7} = 17500$$

So, R_{TRIM} = 17.4kΩ for standard value.

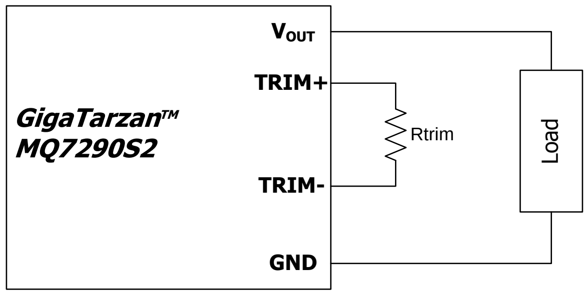

Fig3. Circuit configuration for programming output voltage using external resistor

For most common voltages, the required Trim resistors as Table 1.

Table 1, the required trim resistors R_{TRIM} for most common voltages

Desired Voltages (V)	Rtrim (kΩ)
0.7	Open
1.0	46.6
1.2	28.0
1.5	17.5
1.8	12.7
2.0	10.77

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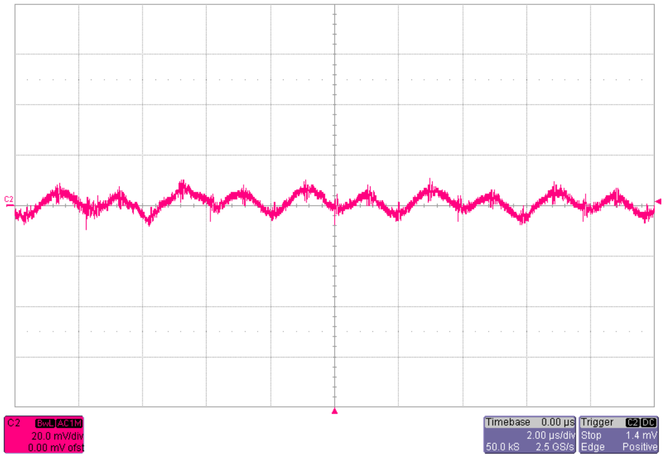
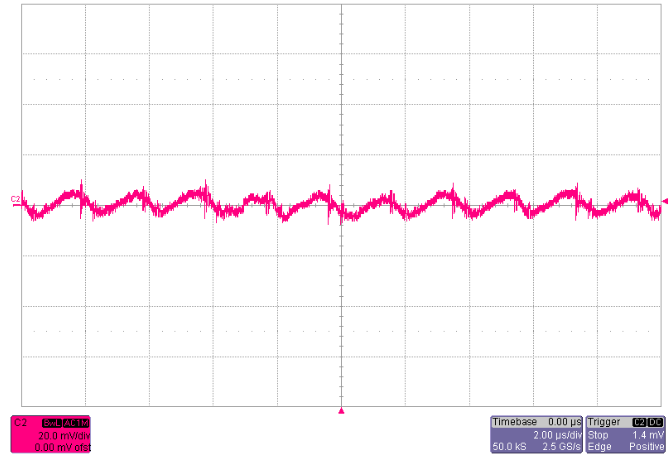
Typical Characteristics – output adjusted to 1V

General conditions:

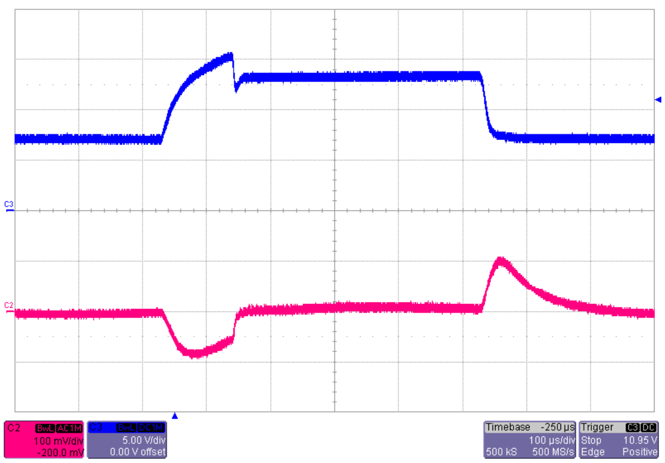
Input filter: 68µF Tan *3, Output filter: 220µF Tan *3



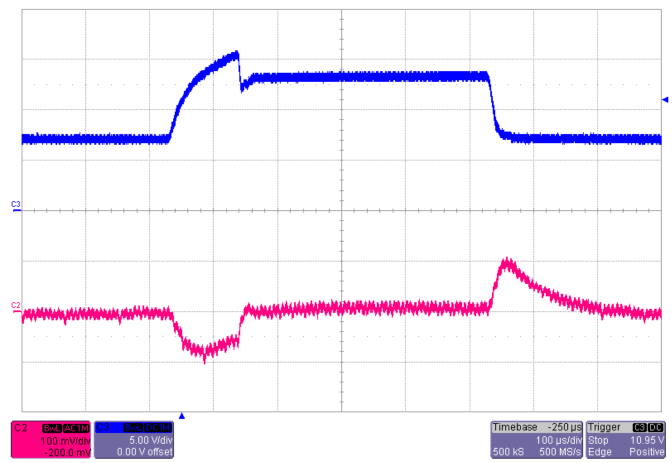
Noise V_{IN}=5V, I_O=50A, 5~20MHz Bandwidth



Noise V_{IN}=12V, I_O=50A, 5~20MHz Bandwidth



Transient Response V_{IN}=5.5V, Step from 25A~50A~25A
Output filter: 820µF POSCAP*3
C3: Load Current   C2: Output Ripple



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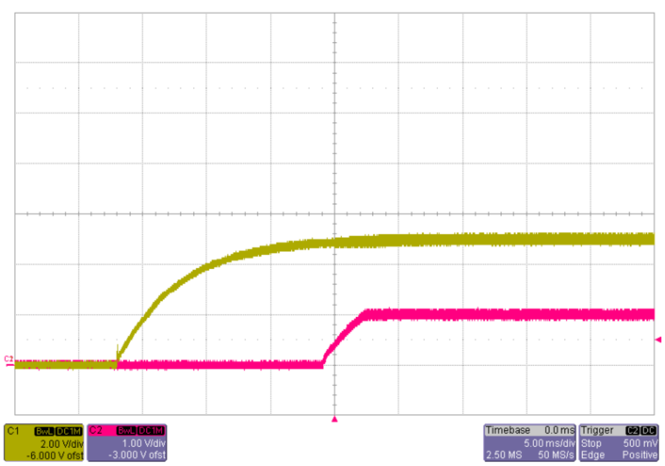
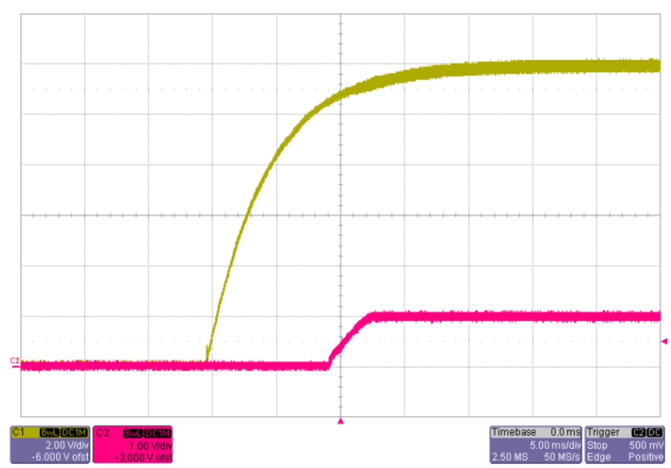
Output filter: 820µF POSCAP*3
C3: Load Current   C2: Output Ripple



Start-up V_{IN}=5V, I_O=50A
C1: Input Voltage   C2: Output Voltage



Start-up V_{IN}=12V, I_O=50A
C1: Input Voltage   C2: Output Voltage

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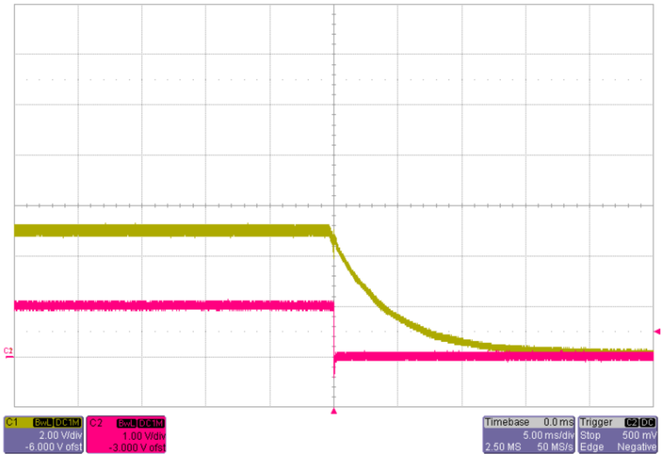
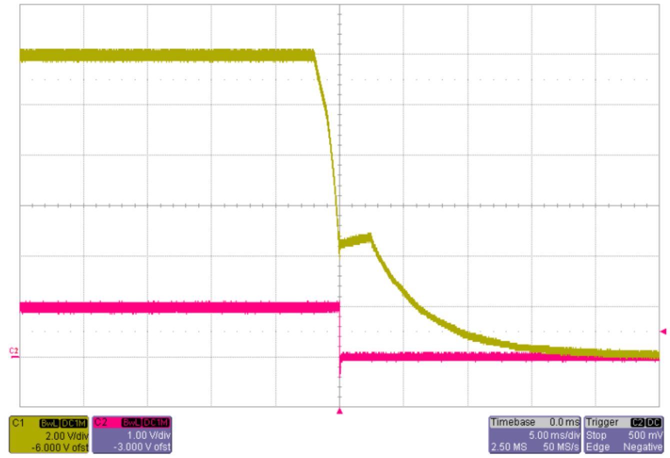
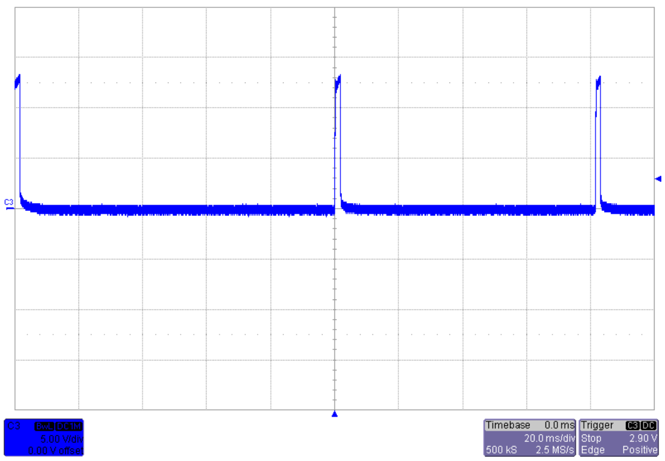


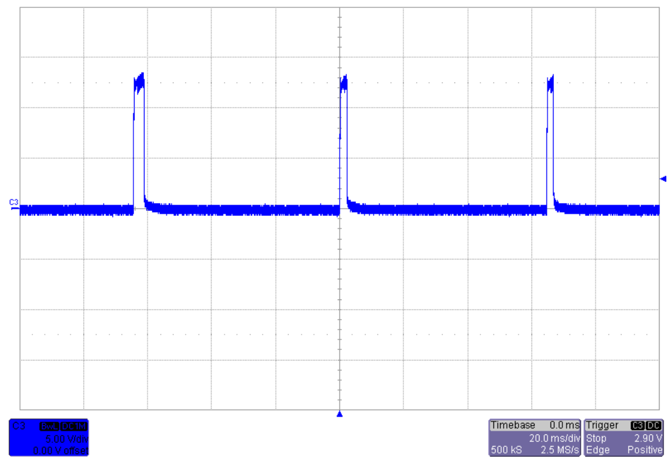
Shut-down V_{IN}=5V, I_O=50A
C1: Input Voltage C2: Output Voltage



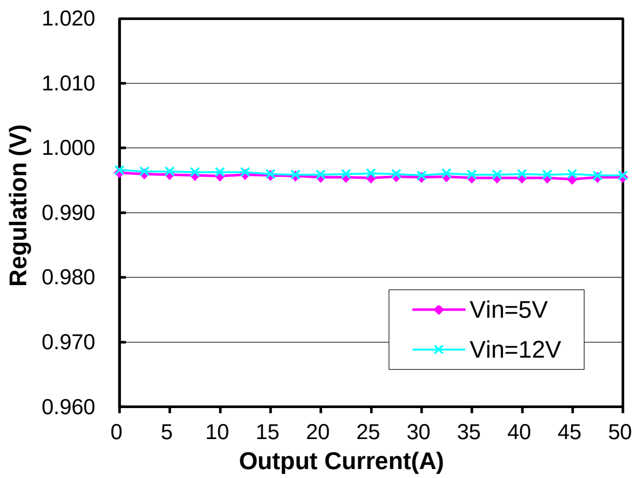
Shut-down V_{IN}=12V, I_O=50A
C1: Input Voltage C2: Output Voltage



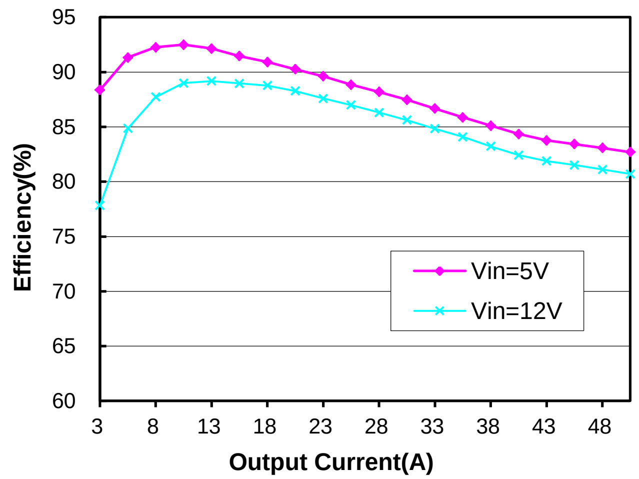
Short-Circuit Output V_{IN}=5V



Short-Circuit Output V_{IN}=12V



Regulation
Output voltage vs. Load Current



Efficiency vs. Load Current

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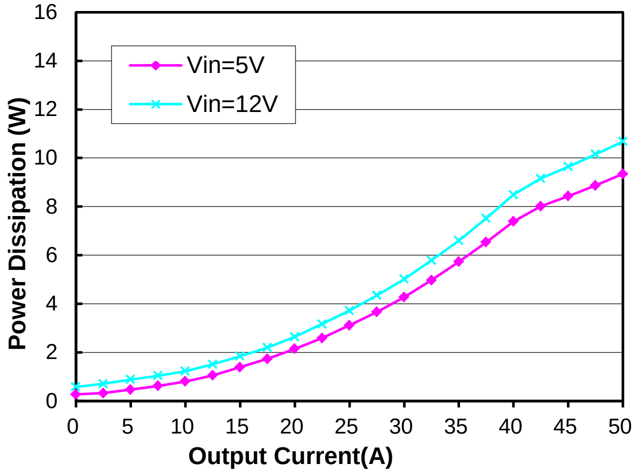
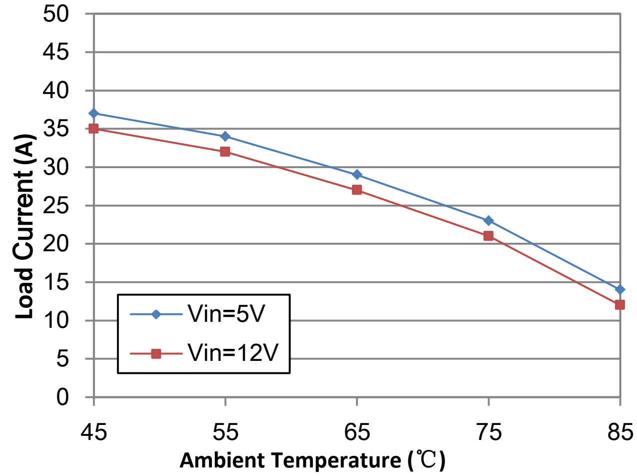


Power Dissipation vs. Load Current



Ambient Temperature VS Load Current

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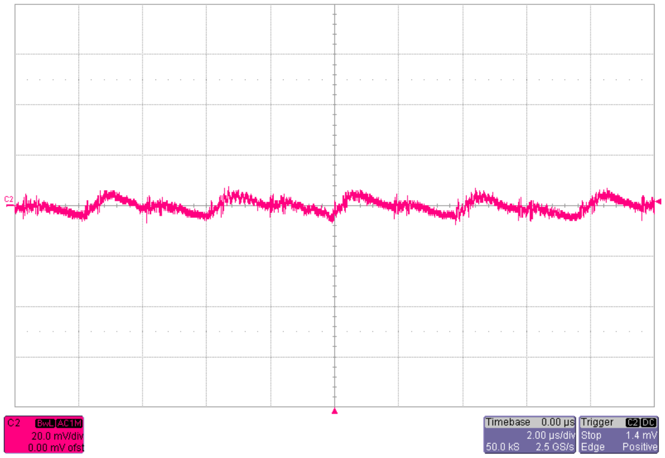
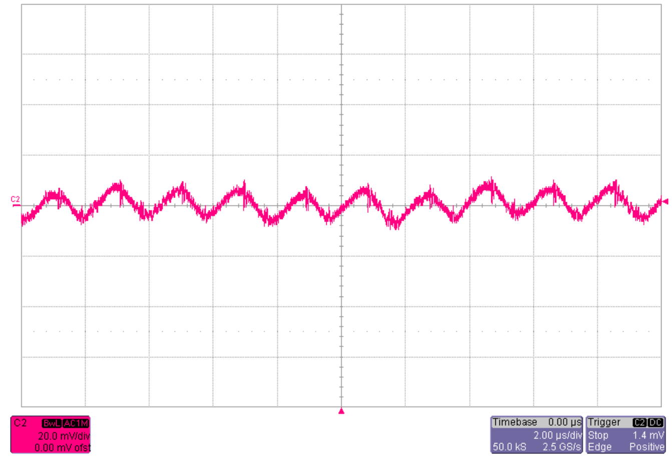
Typical Characteristics – output adjusted to 1.8V

General conditions:

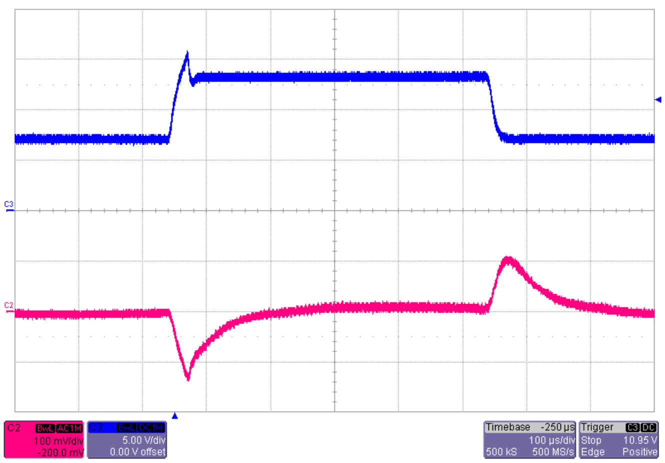
Input filter: 68μF Tan *3,Output filter: 220μF Tan *3



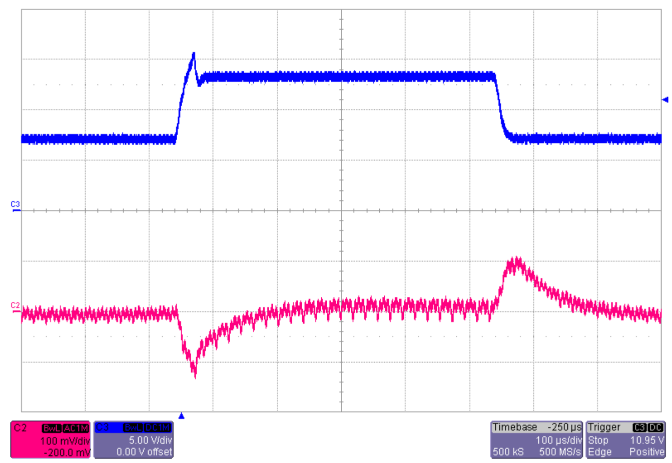
Noise V_{IN}=5V, I_O=50A, 5~20MHz Bandwidth



Noise V_{IN}=12V, I_O=50A, 5~20MHz Bandwidth



Transient Response V_{IN}=5.5V, Step from 25A~50A~25A
Output filter: 820μF POSCAP*3
C3: Load Current   C2: Output Ripple



Transient Response V_{IN}=12V, Step from 25A~50A~25A
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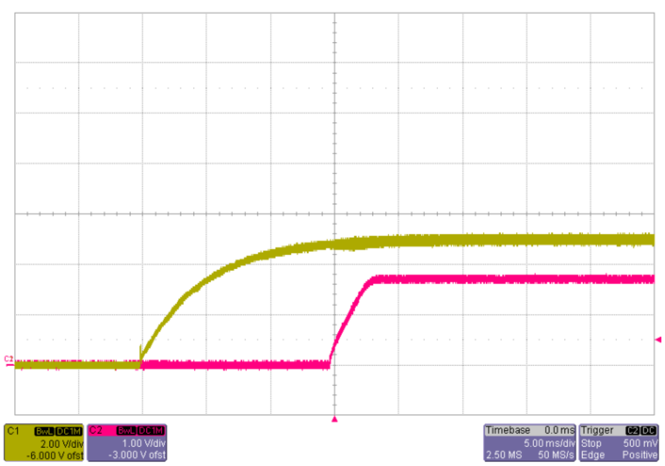
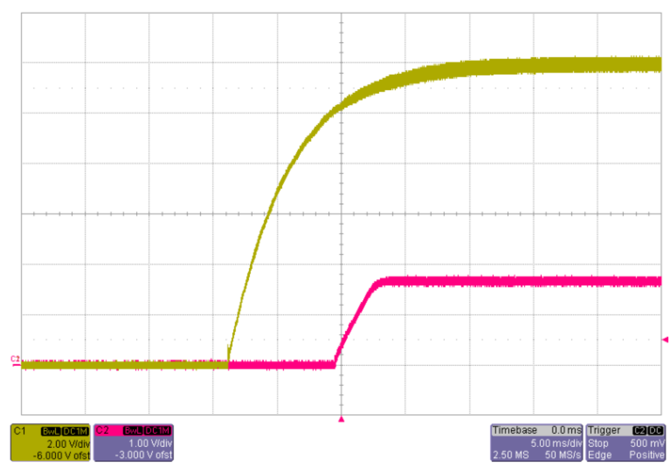


Start-up V_{IN}=5V, I_O=50A
C1: Input Voltage   C2: Output Voltage



Start-up V_{IN}=12V, I_O=50A
C1: Input Voltage   C2: Output Voltage

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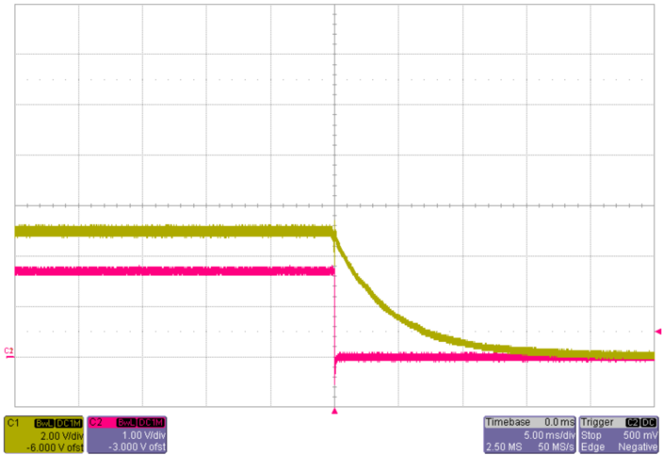
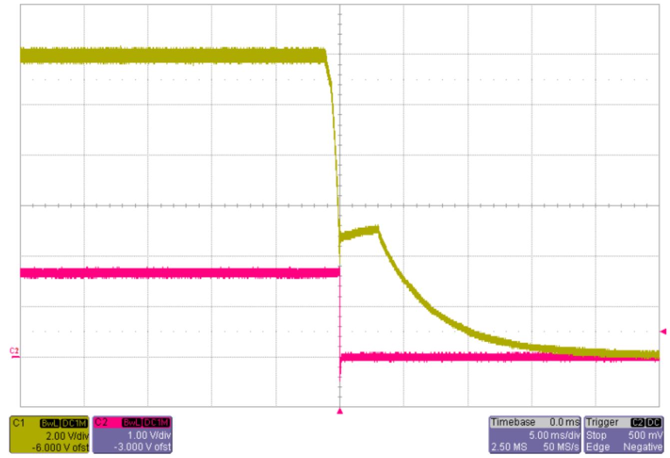
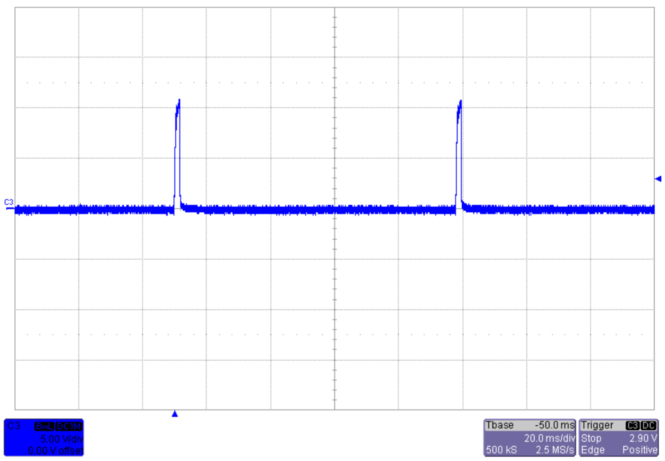


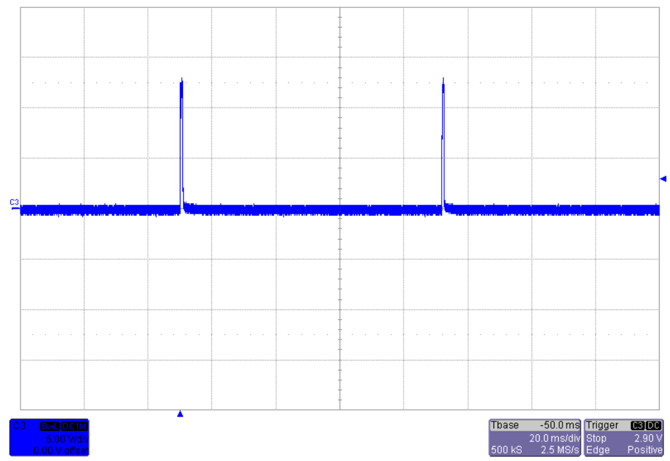
Shut-down V_{IN}=5V, I_O=50A
C1: Input Voltage   C2: Output Voltage



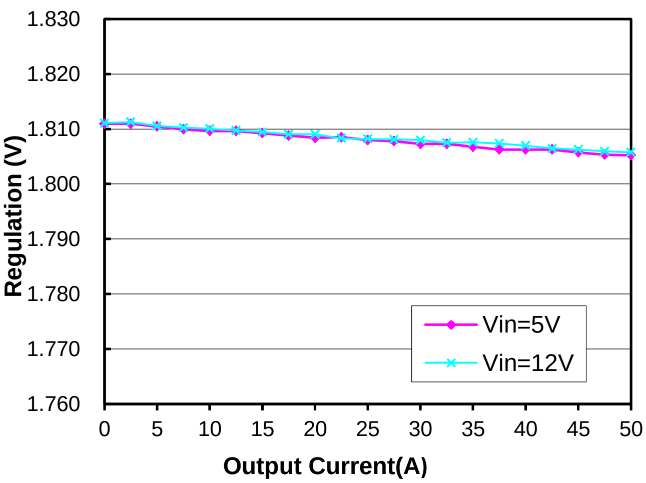
Shut-down V_{IN}=12V, I_O=50A
C1: Input Voltage   C2: Output Voltage



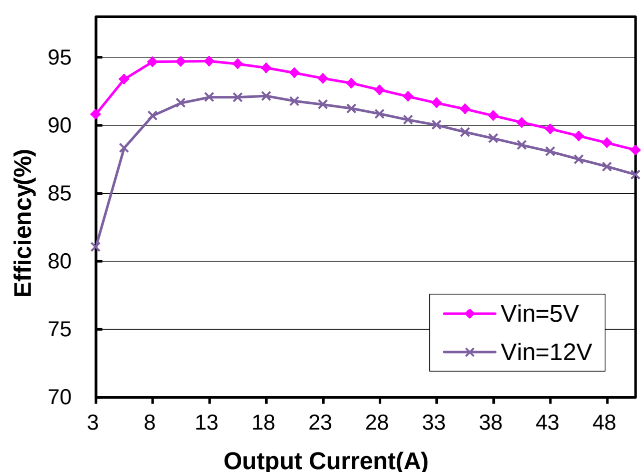
Short-Circuit Output V_{IN}=5V



Short-Circuit Output V_{IN}=12V



Regulation
Output voltage vs. Load Current



Efficiency vs. Load Current

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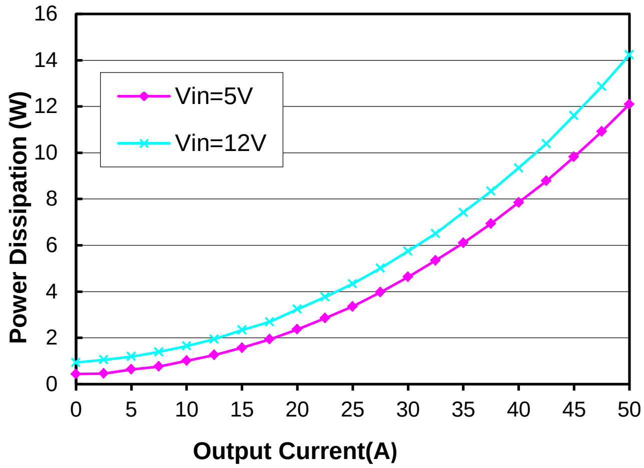
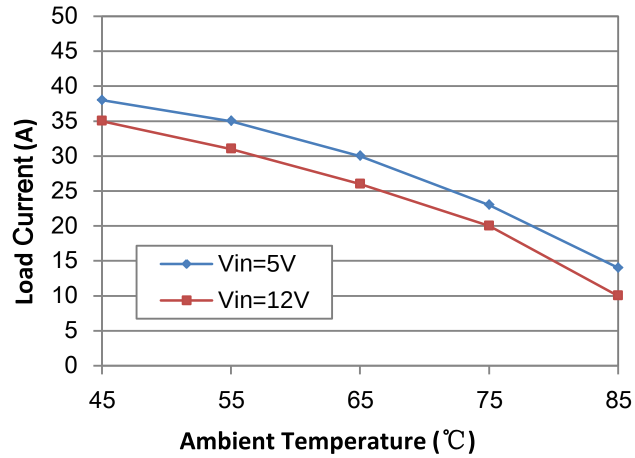


Power Dissipation vs. Load Current



Ambient Temperature VS Load Current

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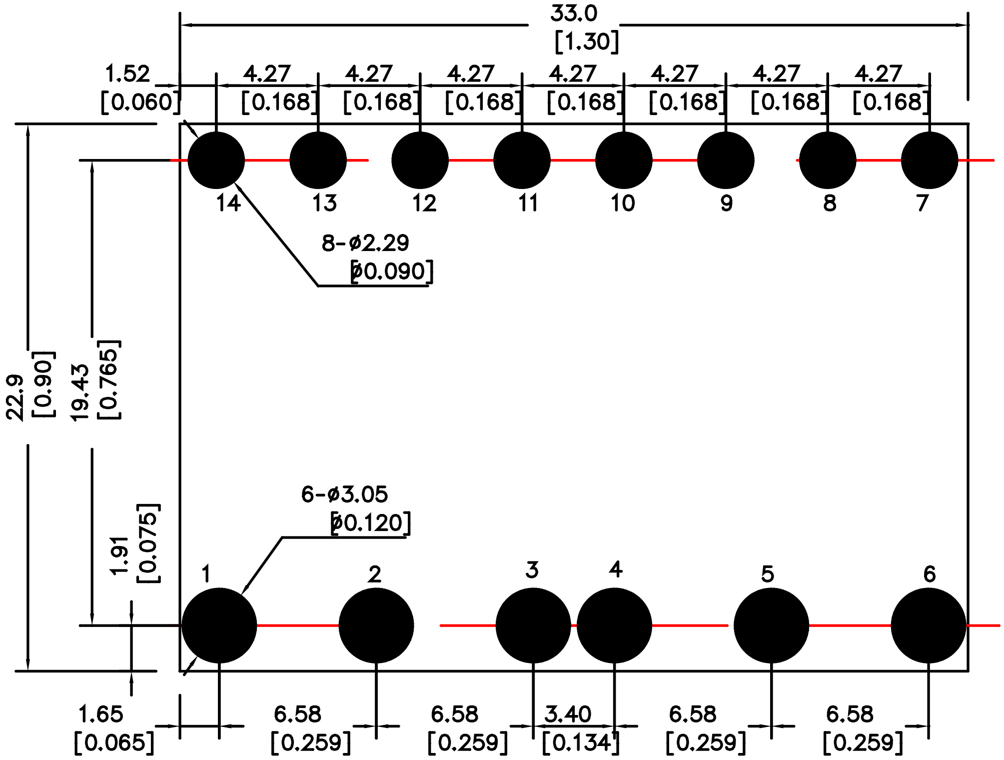
Recommended PAD Pattern

Dimensions are in millimeters (inches)

Tolerance:

x.xxmm +/-0.5mm (x.xxin. +/-0.02in)

x.xxxmm +/-0.25mm (x.xxxin. +/-0.01in)



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Application Notes

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