MQ8100Lx2

Non-isolated 6~14VDC input, 0.8~2V output, 100A with current share DC-DC Converter

APPLICATIONS

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

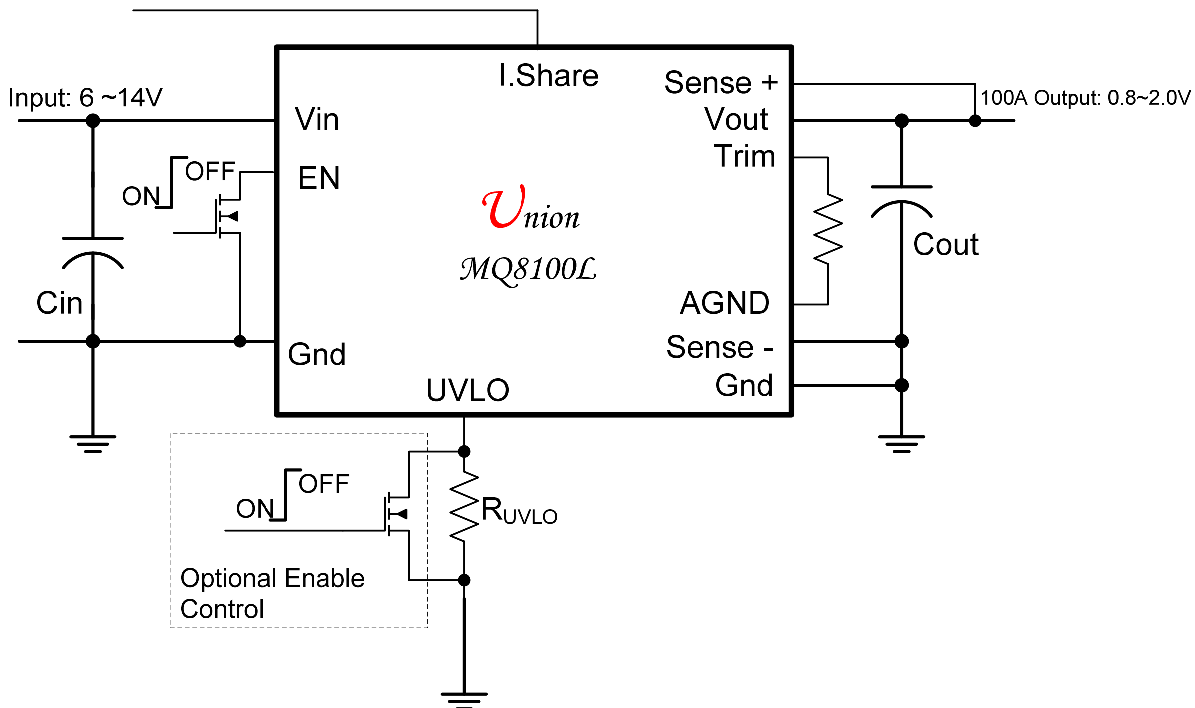
FEATURES

- Unregulated 12V input voltage
- Output Voltage: 0.8V~2V
- Output Current up to 100A
- Output voltage ripple: 40mV$_{PP}$
- High Efficiency 93% (12Vin, 2V output, 80A)
- Remote on/off control
- Overcurrent /shortcircuit protection
- Over-temperature protection
- Remote Sense
- *Parallelized operation up to 5pcs*
- High reliability: designed to meet 5 million hour MTBF
- Minimal space on PCB:
  - ☐ 68.1 mm x 26.5 mm x 10.6 mm or
  - ☐ 2.68 in x 1.05 in x 0.42 in
- Operating Temperature: -40℃~ +85℃
- UL/IEC/EN60950 compliant

Description

The ***MQ8100L2*** series Power Modules are non-isolated dc-dc converters that operate over a wide input voltage range of 6Vdc to 14Vdc and provide a precisely (2%) regulated dc output with industry standard pin configuration. Such a module is suitable to application with unregulated 12V power supply bus. The modules have a maximum output current rating of 100A at typical full-load efficiency over 93%. Standard features include remote on/off with positive logic and output voltage adjustment, over-current protection, over-temperature protection. Option features include through hole or SMD.

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

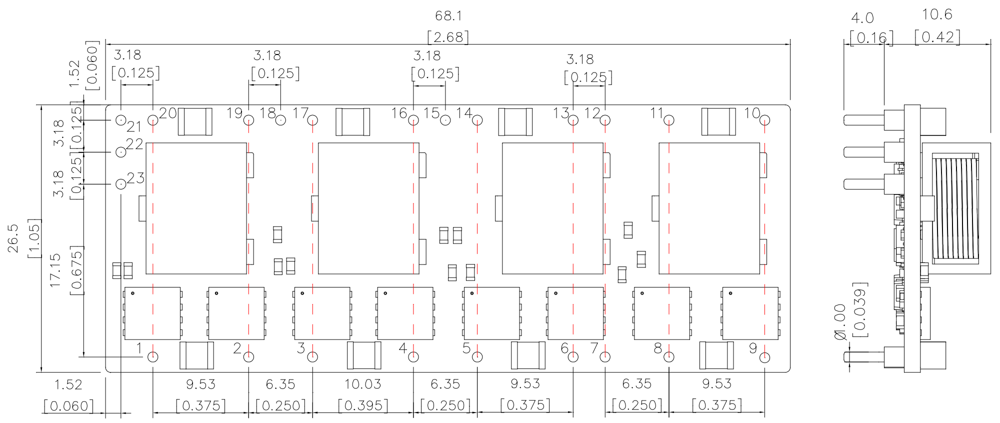


Performance Specifications (at Ta=+25℃)

Model	Input V_{IN} Range (V)	Output				Efficiency (%)
		I_{OUT} (A)	Trim Range (V)	Regulation		
				Line (%)	Load (%)	
MQ8100LT2	6 ~ 14	100	0.8 ~ 2	0.5	0.5	93
MQ8100LS2						

Mechanical Specifications

Dimensions are in mm (inches)



PIN	Description
1,3,5,8,11, 14,17,20	GND
2,4,6,9,	V_{IN}
7	ENABLE
12	UVLO
10,13,16,19	V_{OUT}
15	R.S+
18	R.S-
21	Trim
22	AGND
23	I.Share

Ordering Information

MQ8100LT2

Union Microsystems Power module P/N → MQ8100

L: product series

T: Through Hole Pinout
S: Surface Mount

Input Voltage Range:
2: 6~14V

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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	℃

MQ8100Lx2 Electrical Specifications: *(T_A=+25°C)*

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Input Voltage Range		V_{IN}	6		14	V
Output Current		Io	0		100	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=20A,0~20MHz（***Detail Please see corresponding figure***）					
Transient Response						

General Specifications

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Maximum Capacitive Load	100A resistive load + Aluminum capacitor			TBD		μF
	100A resistive load +Sanyo POSCAP			TBD		
Overcurrent Protection			150		200	A
Output short-circuit current (average)	All				TBD	A
Under Voltage Lockout Trip Level	Input rising			5.5		V
	Input falling			4.5		
Start-up Delay				28		mS
Start-up Time	100A resistive load, no external output capacitors			3.5		mS
Switching Frequency		Fo		1000		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

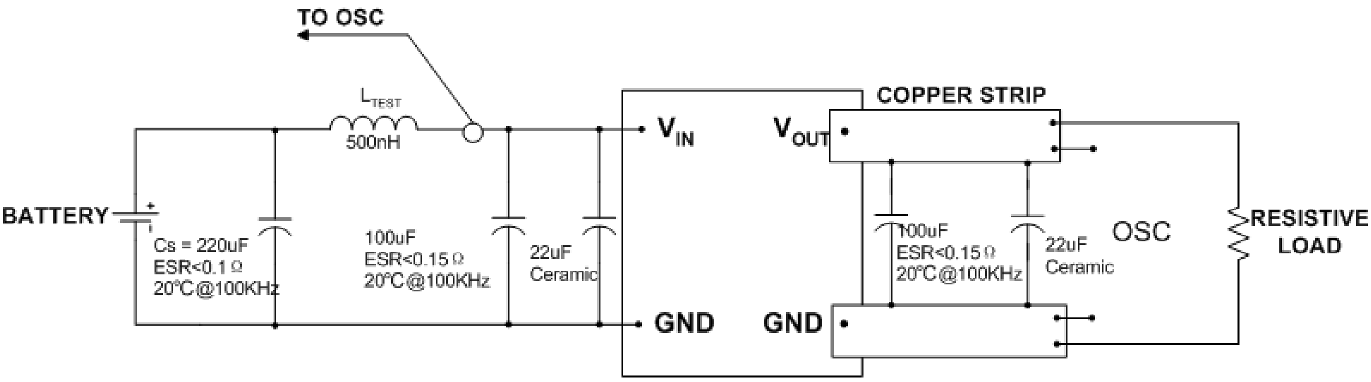

Fig 1 Test setup for input noise, output noise and ripple

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.

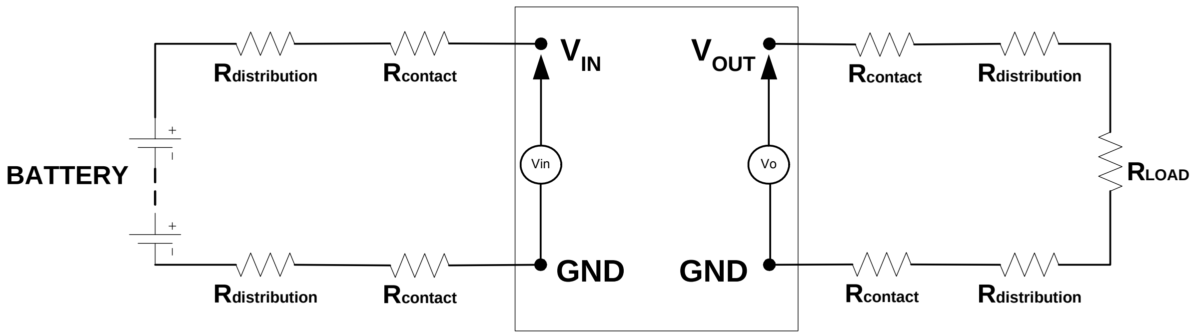

Fig 2 Test setup for efficiency

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 *MQ8100LX2* 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 *MQ8100LX2* Series are non-isolated DC/DC converters. ALL Common pins 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 1,3 (also referred to as---Input or Input Return), and output return current should be directed through pin 7,10 (also referred to as---Output or Output Return) as short as possible.

I/O Filtering

All the specifications of the MQ8100LX2 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 capacitors serve primarily as energy-storage devices. They should be added close to the input pins of the MQ8100LX2 and selected

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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.

MQ8100LX2'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 MQ8100LX2'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 MQ8100LX2 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 selected to be greater than the maximum input current of the modules, which occurs at the minimum input voltage.
2. Use either slow-blow or normal-blow fuses.
3. Both input traces must be capable of carrying a current of 1.5 times the value of the fuse without opening.

Safety Considerations

MQ8100LX2'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

MQ8100LX2 Power Modules offer a positive output sense function on pin 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 MQ8100LX2's specified rating. Therefore:

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

ON/OFF Control

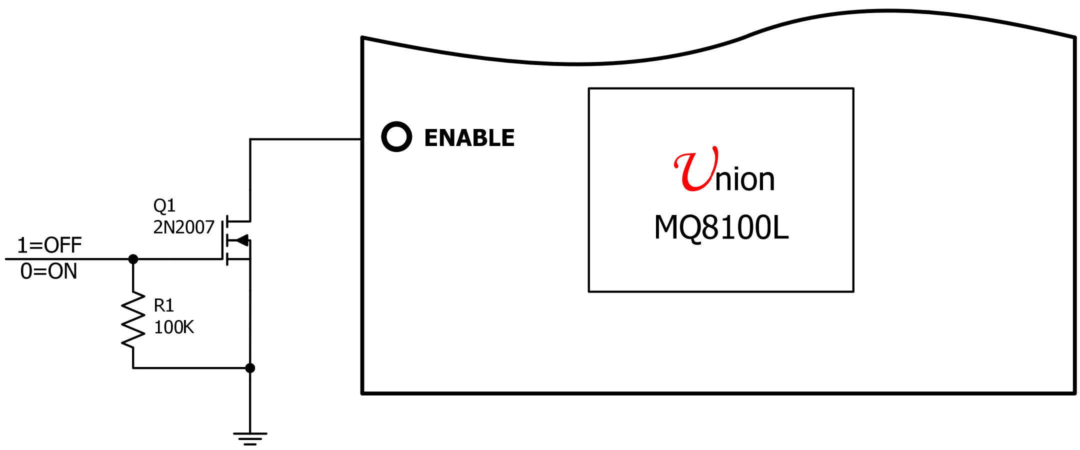

Fig 4, Remote ON/OFF Implementation with Open Drain transistor for positive logic control

The MQ8100LX2 power modules feature an On/Off pin for remote On/Off operation with positive 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. To switch module on

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and off using remote On/Off, refer to Figure 4.

Output Over-voltage Protection

MQ8100LX2 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)

MQ8100LX2 incorporates overcurrent and short circuit protection. If the load current exceeds the overcurrent protection setpoint, the MQ8100LX2'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 5A.

Caution: Be careful never to operate MQ8100LX2 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.

Over-temperature Protection (OTP)

To ensure MQ8100LX2's reliability and avoid damaging its internal components，MQ8100LX2 incorporates over-temperature protection circuit。When the temperature of the PCB is above 130℃, the over temperature protection circuit will be enabled and the module will stop working. When the temperature of the temperature-testing component is below about 100℃, the over temperature protection circuit will release and the module will automatically recover from shutdown. To avoid permanently damaging components, the surface temperature of MQ8100LX2's power components, esp. of the MOSFET (T_{REF} in Fig5) should be ensured below 125℃.

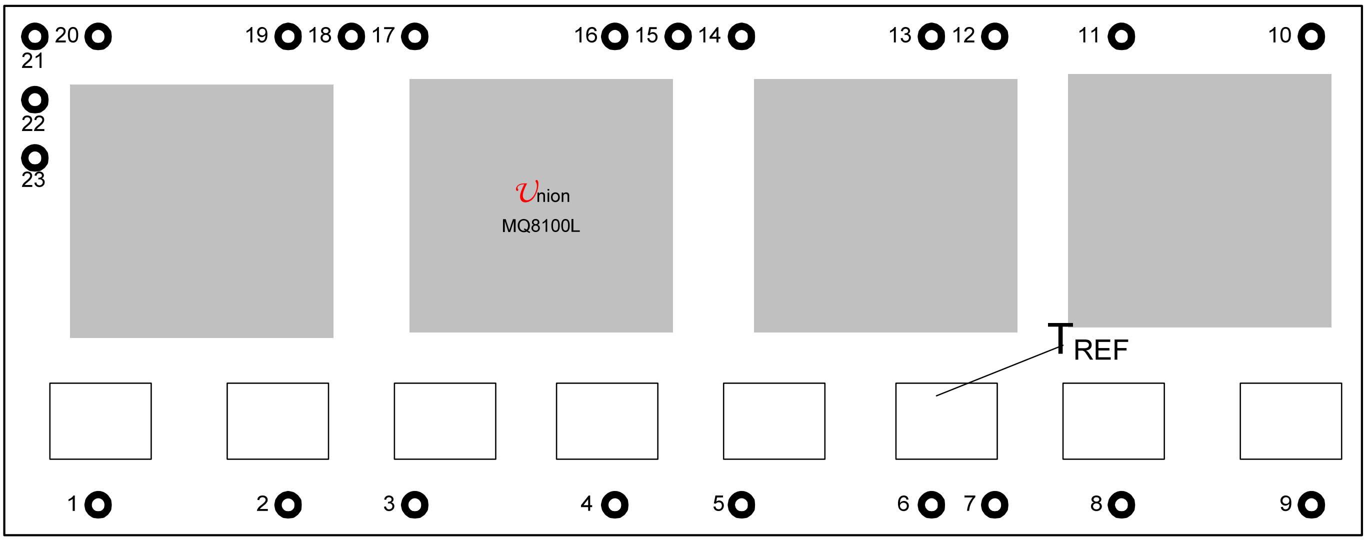

Fig 5, Temperature Reference Point

Note: The over temperature protection may be issued when MQ8100LX2 operates in a "heavy overload" condition for a long time. Thus, the airflow should be improved.

UVLO setting

MQ8100LX2's UVLO threshold can be adjusted by connecting one resistor from UVLO pin to GND. The Resistor for corresponding threshold can be calculated as below:

For MQ8100LX2:

$$R_{UVLO} = \frac{5651}{(V_{TH} - 2.5) * 45.3 - 124.75} - 1$$

Resistor values are in kΩ; V_{TH} is desired UVLO threshold.

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

MQ8100LX2	
V_{TH}	R_{UVLO}
6.0V	166 kΩ
7.5V	54.54 kΩ
8.0V	44.42 kΩ
9.0V	32.3 kΩ
10.0V	25.28 kΩ

Output Voltage Trimming

MQ8100LX2's output voltage can be trimmed in certain ranges. See Figure 7 for the programming method. See performance Specifications for allowable trim ranges in detail. Also customized products are offered.

Trim with external resistor (Fig 7), the equation as below：

For MQ8100LX2:

$$R_{TRIM} = \frac{8000}{V_O - 0.8} - 1696$$

Resistor values are in Ω; V_O is desired output voltage.

If trim the output of MQ8100LX2 to 1.5V, then

$$R_{TRIM} = \frac{8000}{1.5 - 0.8} - 1696 = 9732$$

So, R_{TRIM} =9.76kΩ

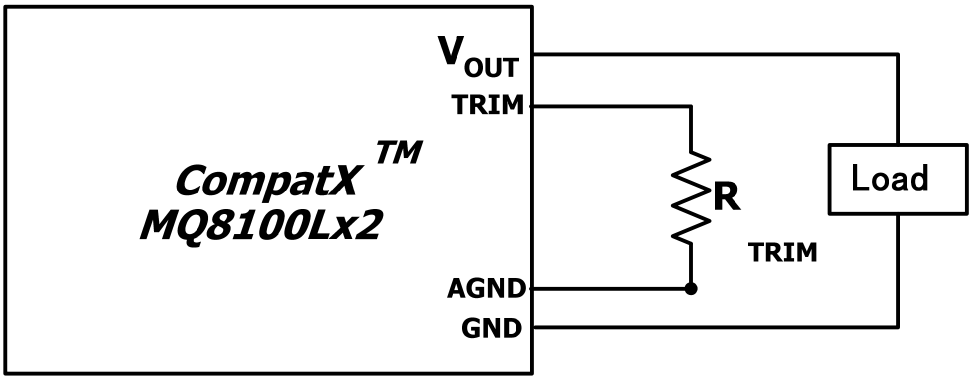

Fig7. Circuit configuration for programming output voltage using external resistor

For most common voltages, the required Trim resistors as Table 2.

Table 2, the required trim resistors R_{TRIM} for most common voltages

MQ8100LX2	
R_{TRIM}	V_{OUT}
Open	0.8V
38.3k	1.0V
18.2k	1.2V
9.76k	1.5V
6.34k	1.8V
4.97k	2.0V

Active Load Sharing

For additional power requirements, the ***MQ8100Lx2*** power module is also available in parallel operation. Up to five modules can be configured, in parallel, with active load sharing. Good layout techniques should be observed when using multiple units in parallel. To implement forced load sharing, the following connections should be made:

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• The I.Share and AGND pins of all units in parallel must be connected together. The path of these connections should be as direct as possible.

• All remote-sense pins should be connected to the power bus at the same point, i.e., connect all the SENSE(+) pins to the (+) side of the bus. Close proximity and directness are necessary for good noise immunity.

Some special considerations apply for design of converters in parallel operation:

• When sizing the number of modules required for parallel operation, take note of the fact that current sharing has some tolerance. In addition, under transient conditions such as a dynamic load change and during startup, all converter output currents will not be equal. To allow for such variation and avoid the likelihood of a converter shutting off due to a current overload, the total capacity of the paralleled system should be no more than 75% of the sum of the individual converters. As an example, for a system of four ***MQ8100Lx2*** converters in parallel, the total current drawn should be less that 75% of (4 x 100A) , i.e. less than 300A.

• All modules should be turned on and off together. This is so that all modules come up at the same time avoiding the problem of one converter sourcing current into the other leading to an overcurrent trip condition. To ensure that all modules come up simultaneously, the on/off pins of all paralleled converters should be tied together and the converters enabled and disabled using the on/off pin.

• The share bus is not designed for redundant operation and the system will be non-functional upon failure of one of the unit when multiple units are in parallel. In particular, if one of the converters shuts down during operation, the other converters may also shut down due to their outputs hitting current limit. In such a situation, unless a coordinated restart is ensured, the system may never properly restart since different converters will try to restart at different times causing an overload condition and subsequent shutdown. This situation can be avoided by having an external output voltage monitor circuit that detects a shutdown condition and forces all converters to shut down and restart together.

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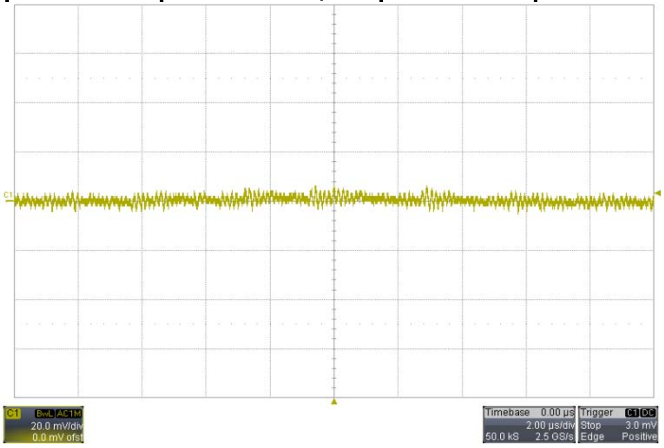
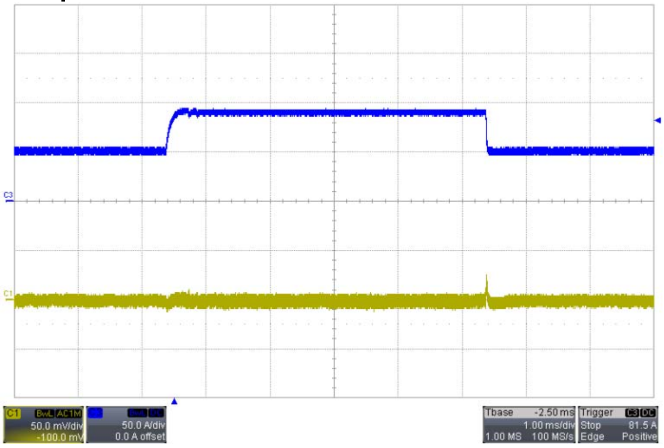
Typical Characteristics – output adjusted to 0.8V

General conditions:

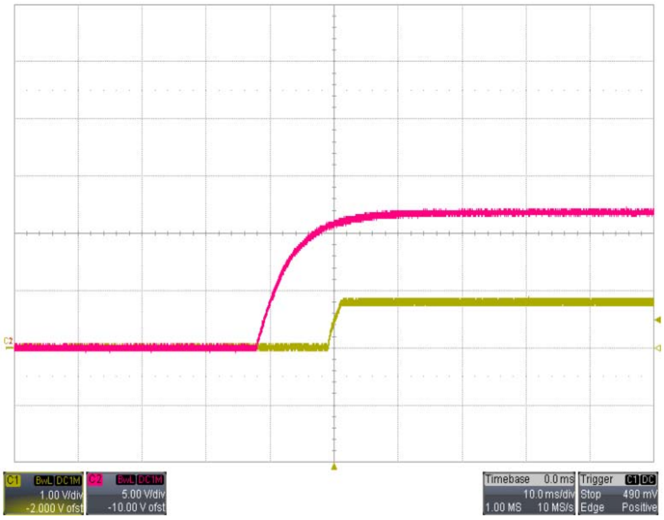
Input filter 270μF*4 AL-CAP, Output filter 470μF *4 POSCAP + 22μF*4 Ceramic



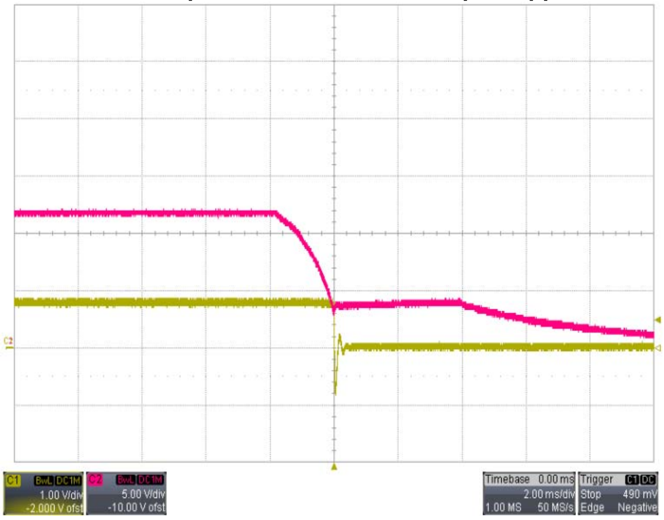
Noise V_{IN}=12V, I_O=100A, 20MHz Bandwidth



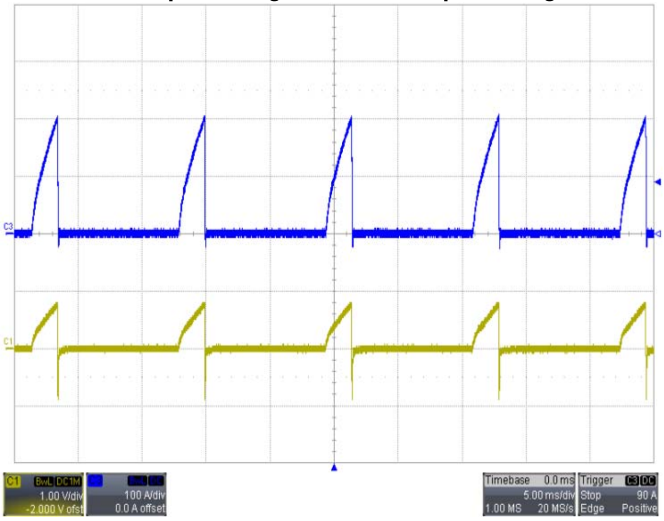
Transient Response V_{IN}=12V, Step from 50A~90A~50A
Blue: Output Current Yellow: Output Ripple



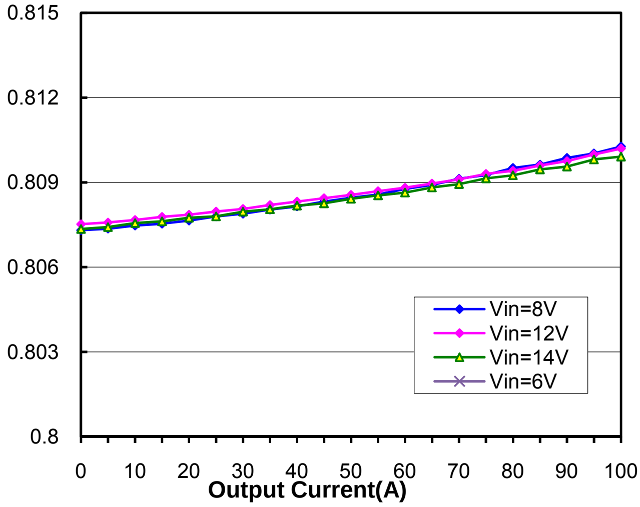
Start-up V_{IN}=12V, I_O=100A
Red: Input Voltage Yellow: Output Voltage



Shut-down V_{IN}=12V, I_O=100A
Red: Input Voltage Yellow: Output Voltage



Short-Circuit Output V_{IN}=12V



Regulation:Output voltage vs. Load Current

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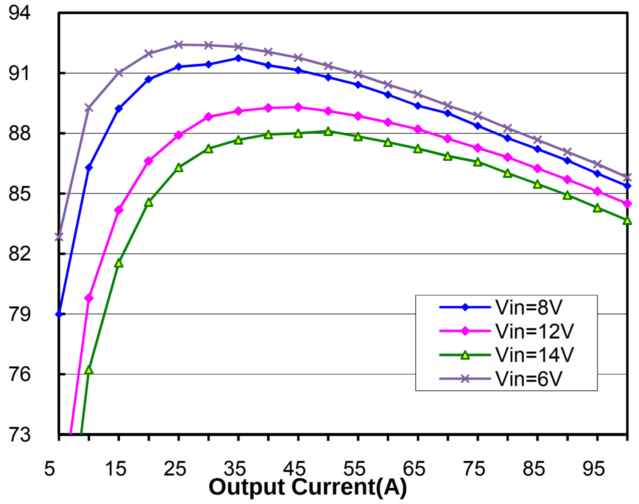
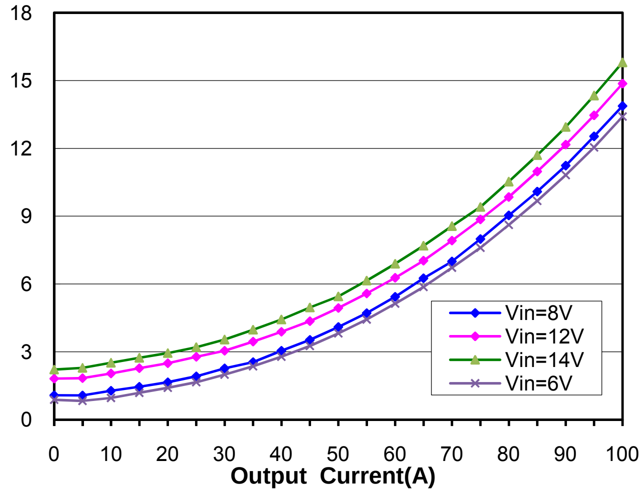
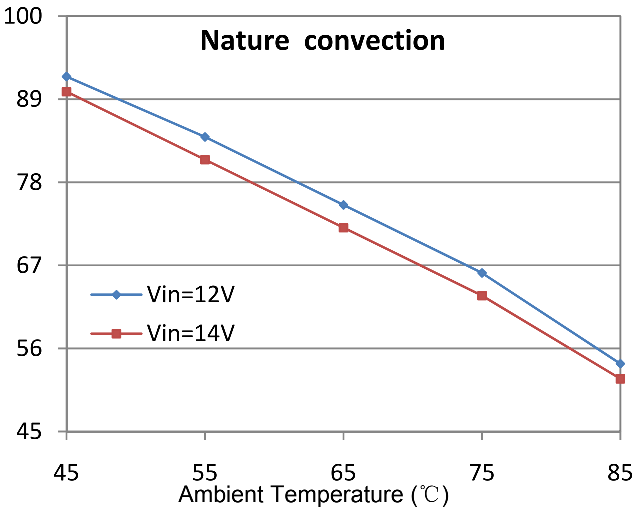


Efficiency vs. Load Current



Power Dissipation vs. Load Current



Ambient Temperature vs. Load Current

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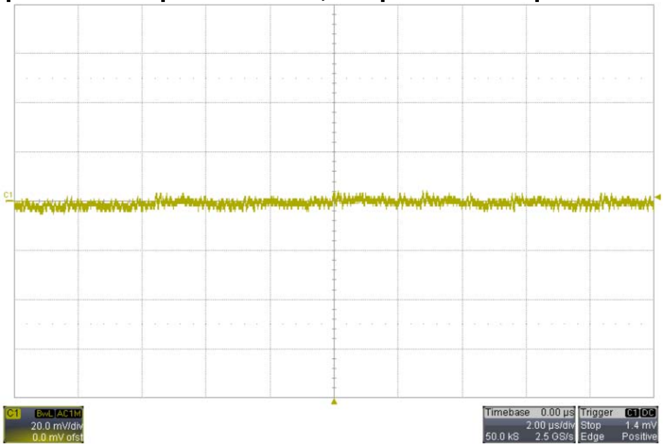
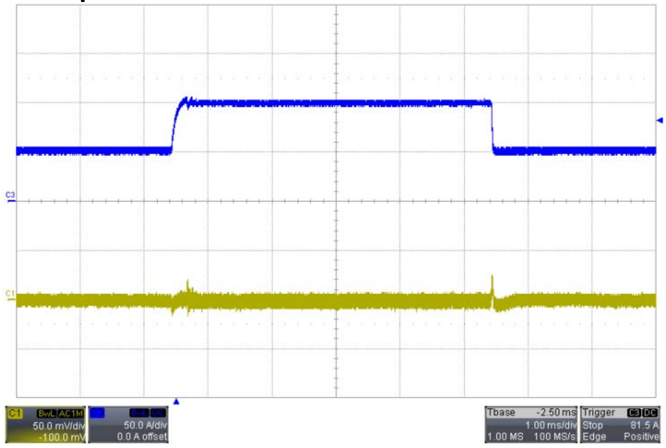
Typical Characteristics – output adjusted to 1.0V

General conditions:

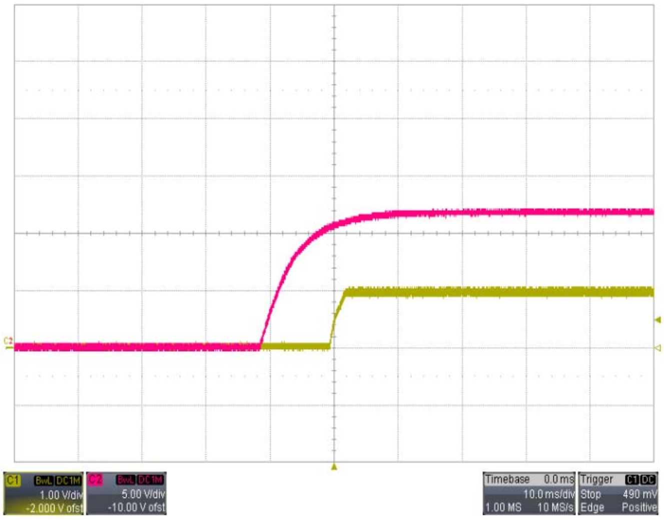
Input filter 270µF*4 AL-CAP, Output filter 470µF *4 POSCAP + 22µF*4 Ceramic



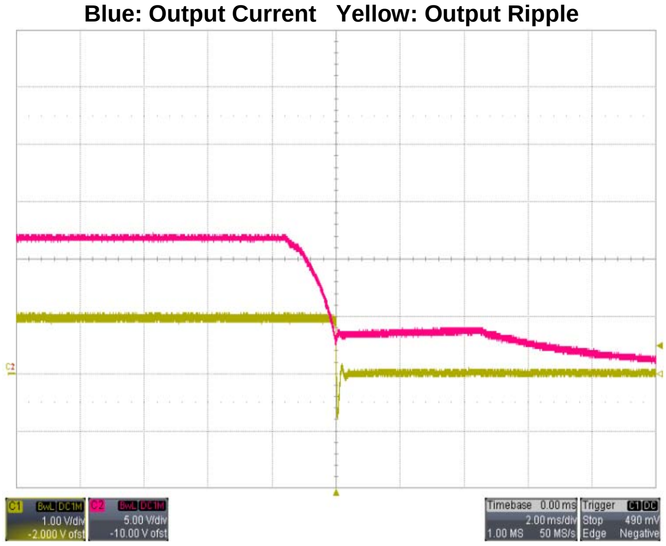
Noise V_{IN}=12V, I_O=100A, 20MHz Bandwidth



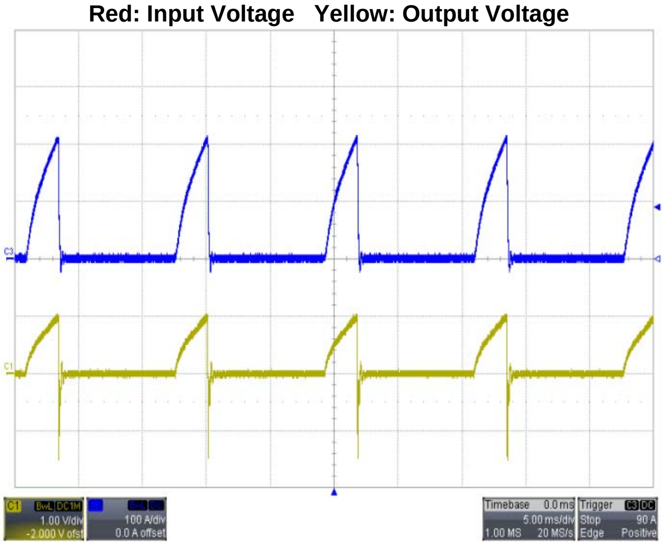
Transient Response V_{IN}=12V, Step from 50A~100A~50A
Blue: Output Current Yellow: Output Ripple



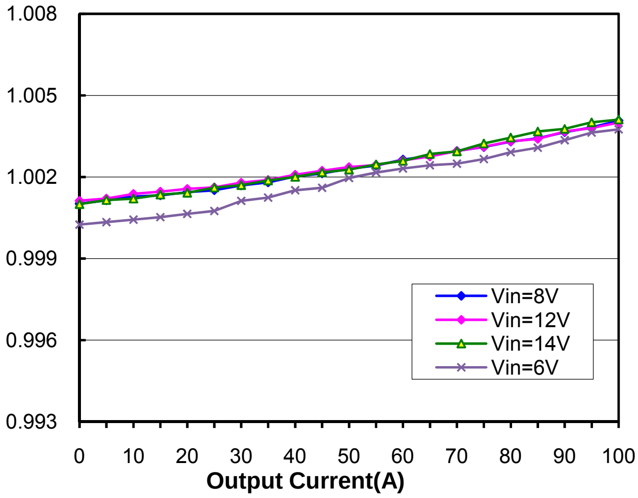
Start-up V_{IN}=12V, I_O=100A
Red: Input Voltage Yellow: Output Voltage



Shut-down V_{IN}=12V, I_O=100A
Red: Input Voltage Yellow: Output Voltage



Short-Circuit Output V_{IN}=12V



Regulation
Output voltage vs. Load Current

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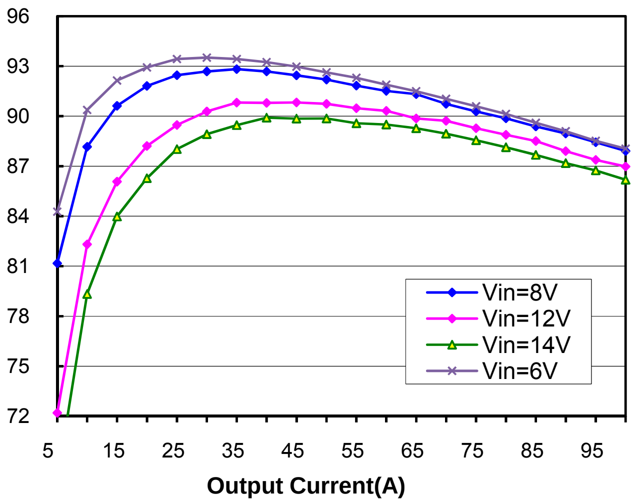
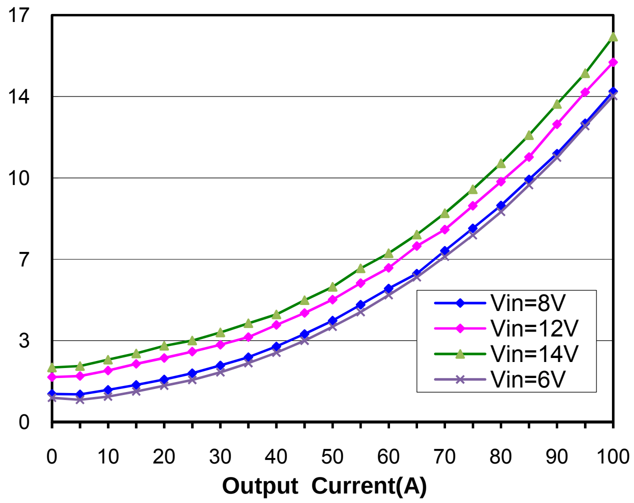
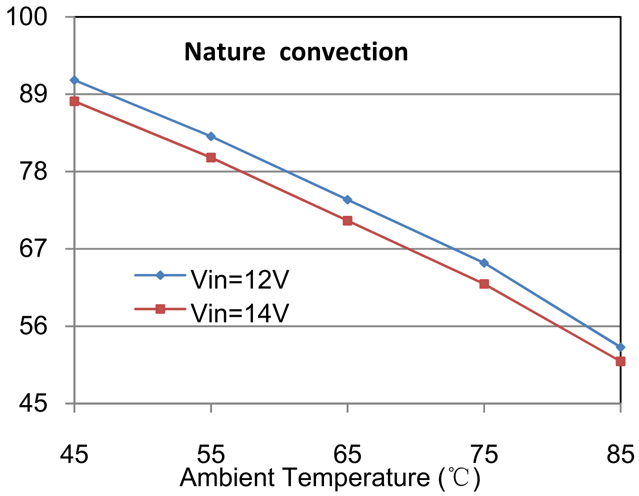


Efficiency vs. Load Current



Power Dissipation vs. Load Current



Ambient Temperature VS Load Current

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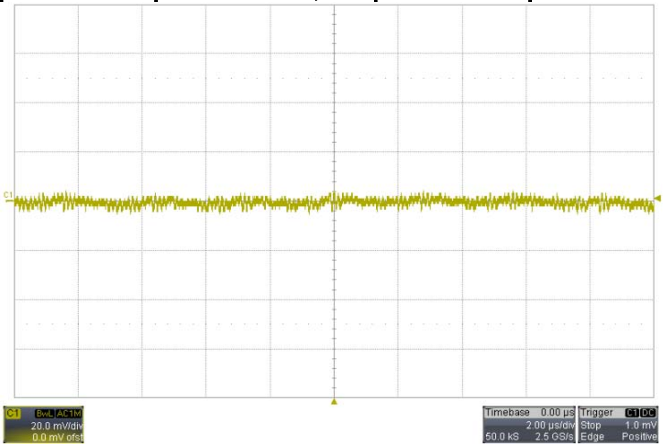
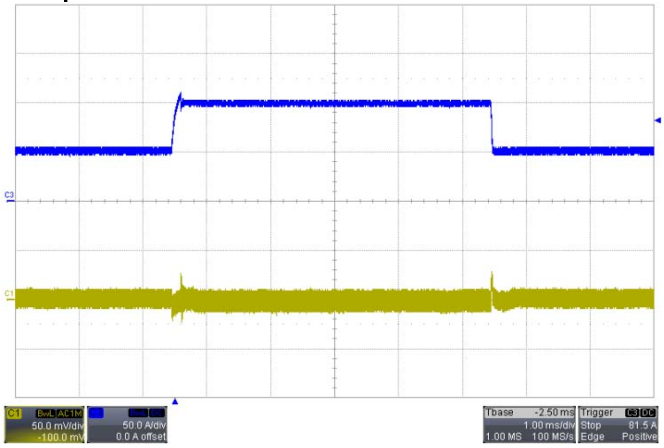
Typical Characteristics – output adjusted to 1.2V

General conditions:

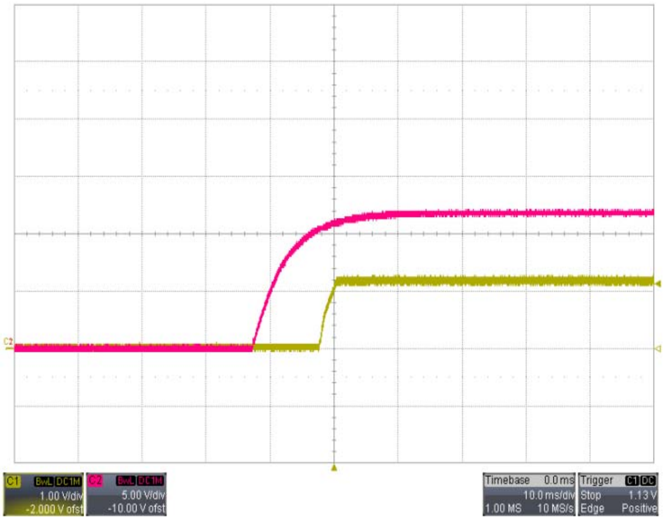
Input filter 270μF*4 AL-CAP, Output filter 470μF *4 POSCAP + 22μF*4 Ceramic



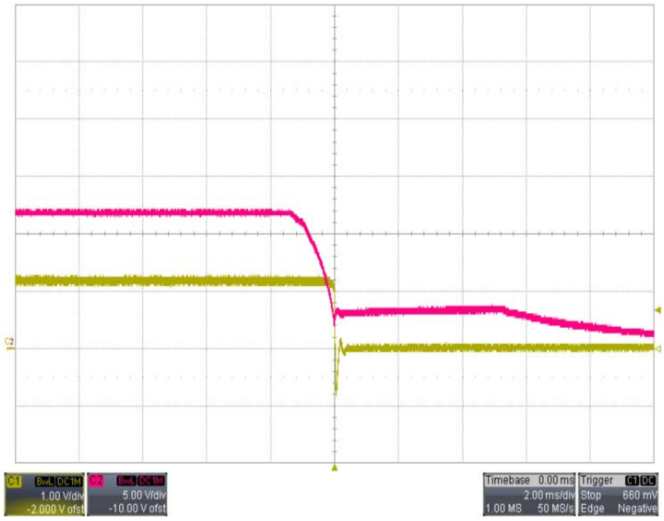
Noise V_{IN}=12V, I_O=100A, 20MHz Bandwidth



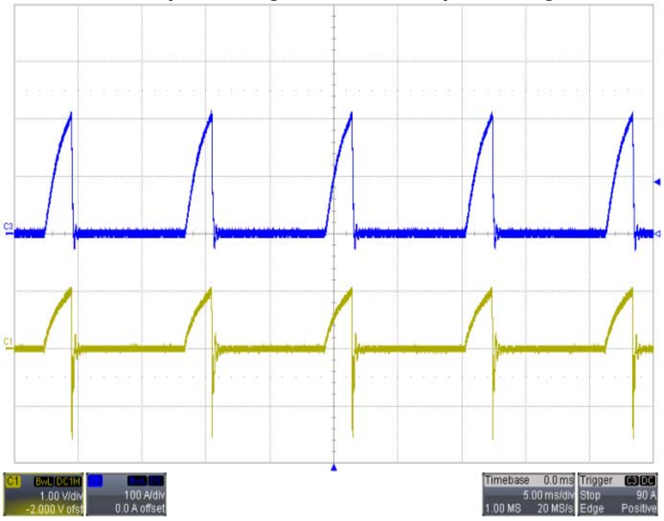
Transient Response V_{IN}=12V, Step from 50A~100A~50A
Blue: Output Current   Yellow: Output Ripple



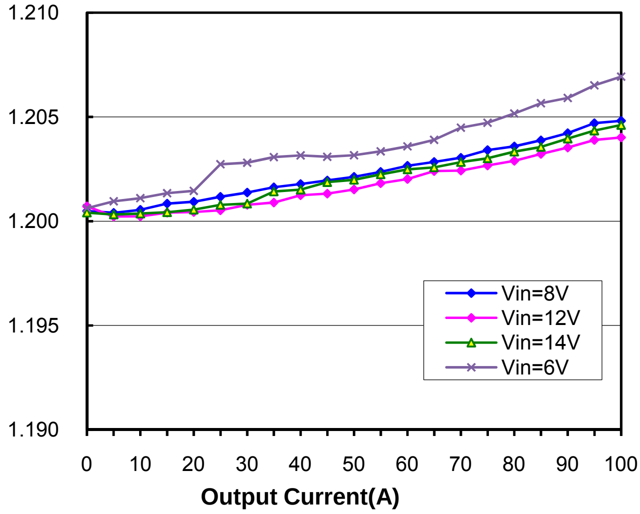
Start-up V_{IN}=12V, I_O=100A
Red: Input Voltage   Yellow: Output Voltage



Shut-down V_{IN}=12V, I_O=100A
Red: Input Voltage   Yellow: Output Voltage



Short-Circuit Output V_{IN}=12V



Regulation
Output voltage vs. Load Current

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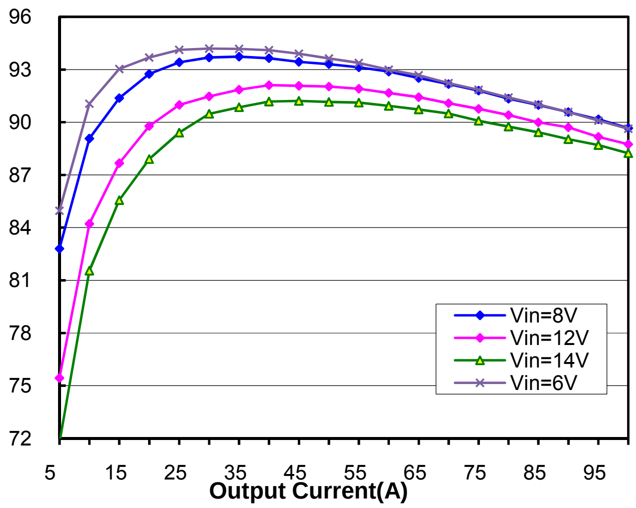
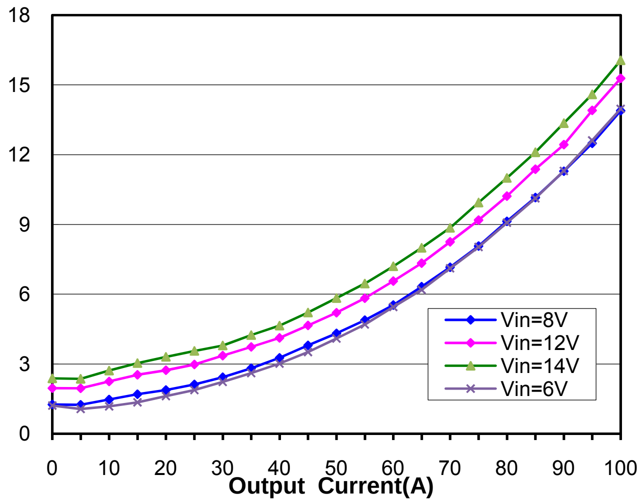
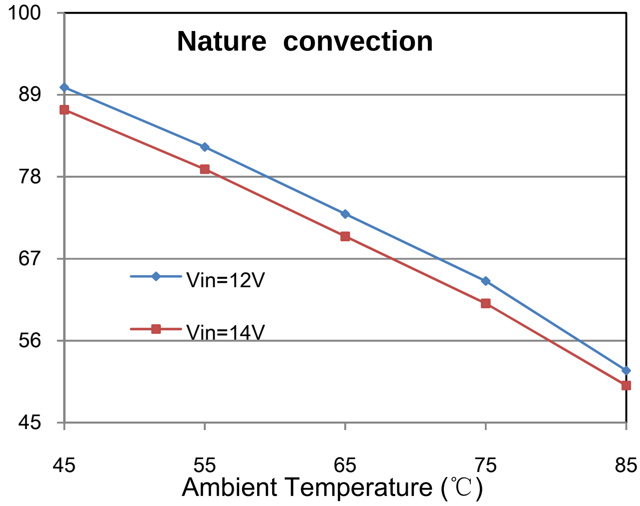


Efficiency vs. Load Current



Power Dissipation vs. Load Current



Ambient Temperature vs. Load Current

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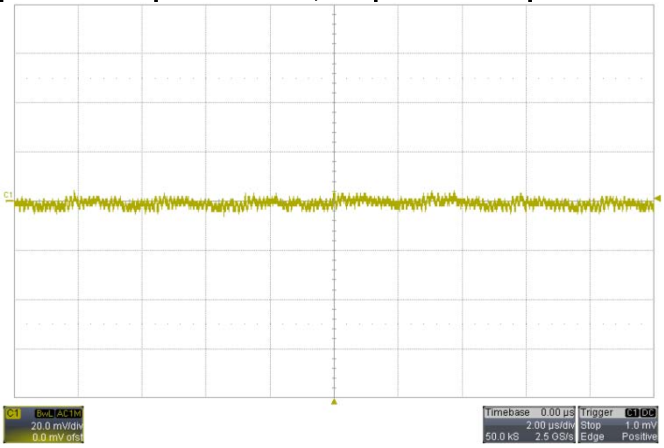
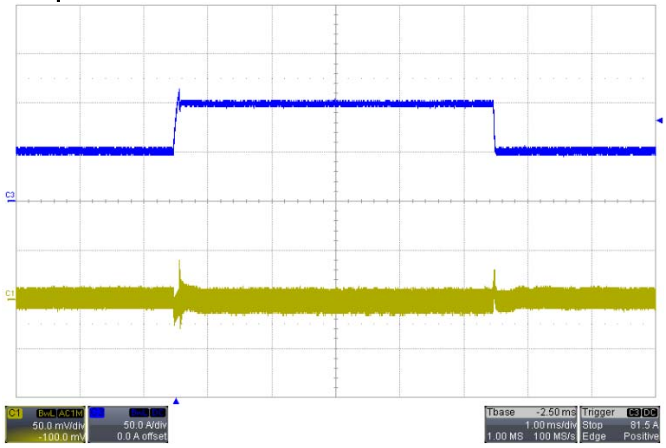
Typical Characteristics – output adjusted to 1.5V

General conditions:

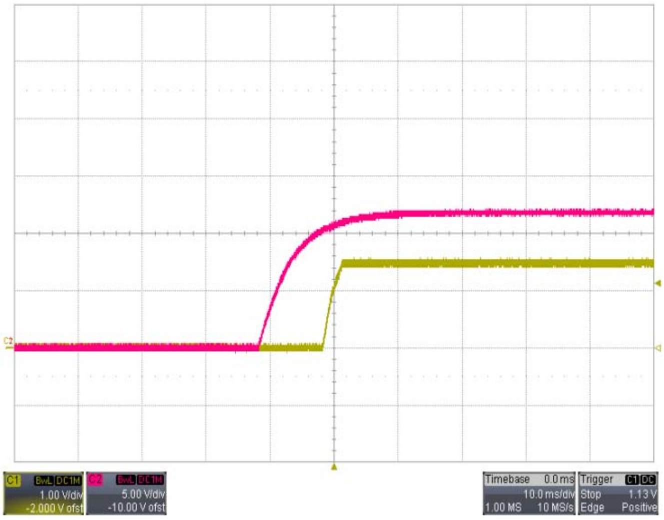
Input filter 270µF*4 AL-CAP, Output filter 470µF *4 POSCAP + 22µF*4 Ceramic



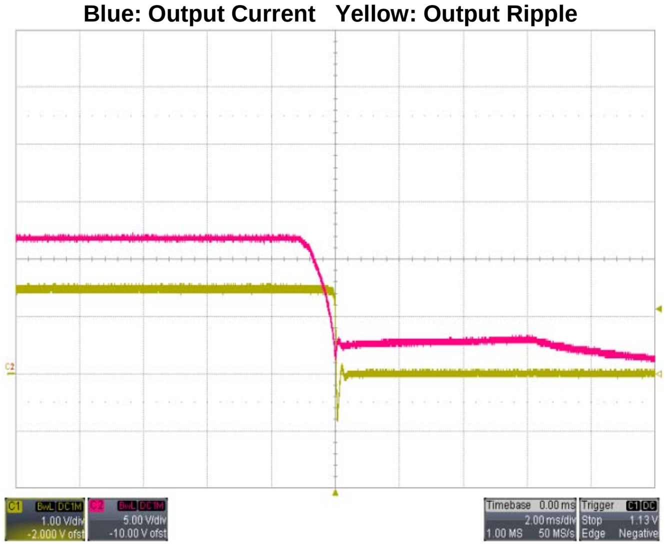
Noise V_{IN}=12V, I_O=100A, 20MHz Bandwidth



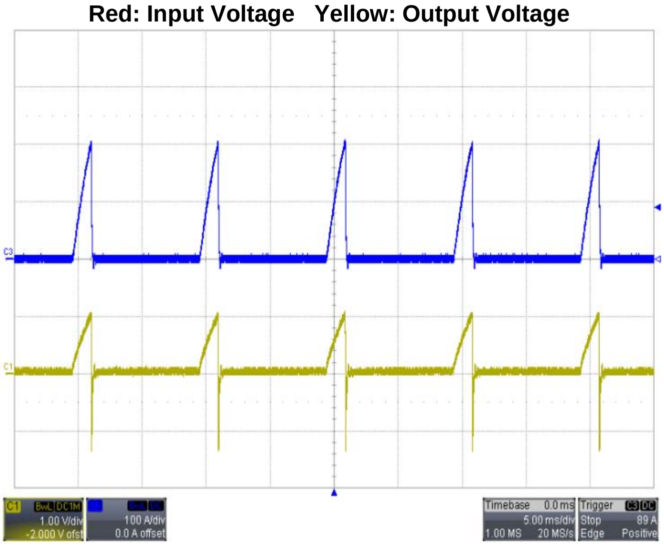
Transient Response V_{IN}=12V, Step from 50A~100A~50A
Blue: Output Current Yellow: Output Ripple



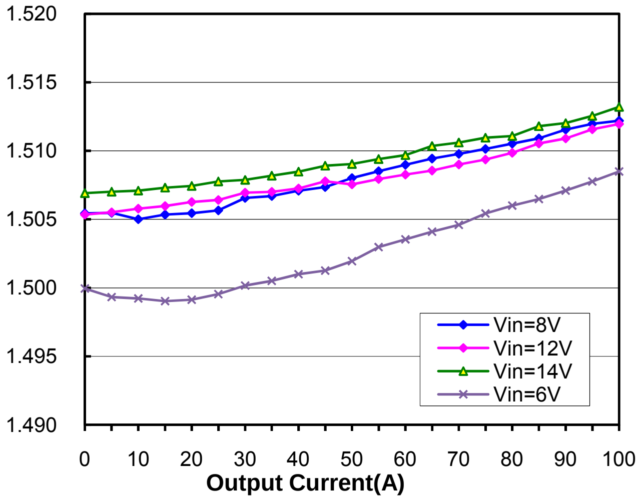
Start-up V_{IN}=12V, I_O=50A
Red: Input Voltage Yellow: Output Voltage



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



Short-Circuit Output V_{IN}=12V



Regulation
Output voltage vs. Load Current

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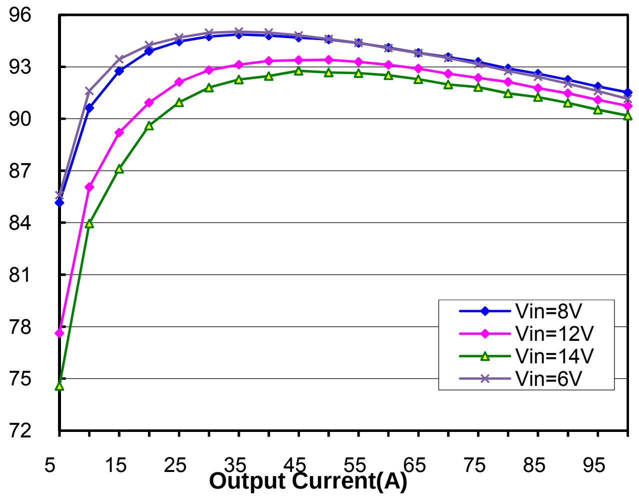
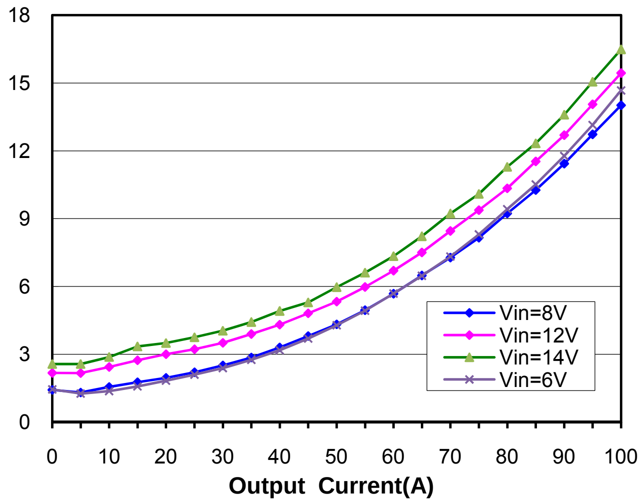
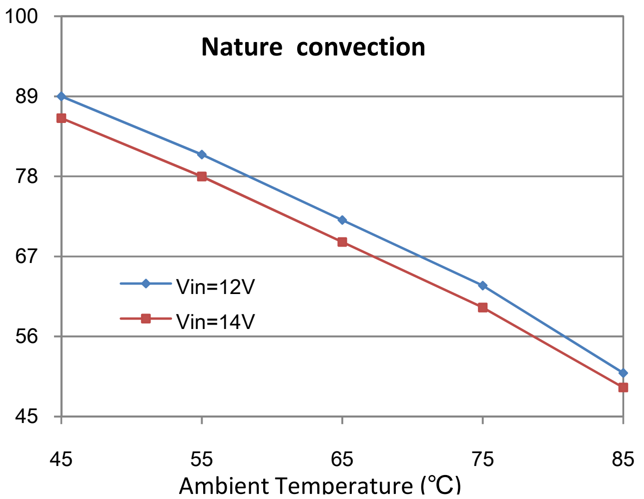


Efficiency vs. Load Current



Power Dissipation vs. Load Current



Ambient Temperature vs. Load Current

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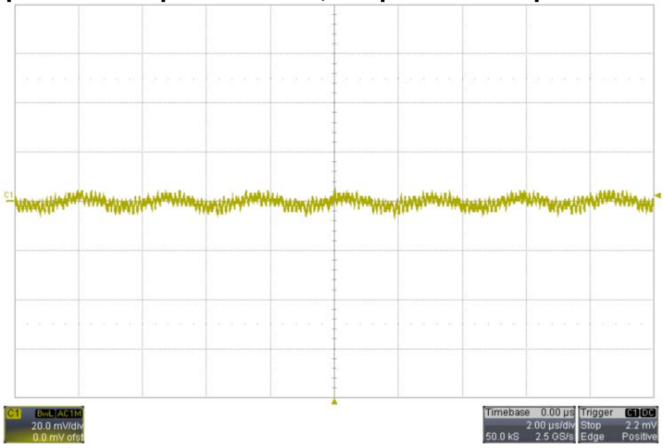
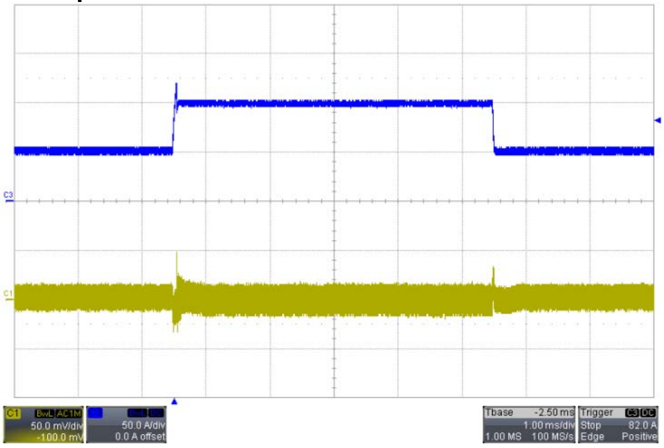
Typical Characteristics – output adjusted to 2.0V

General conditions:

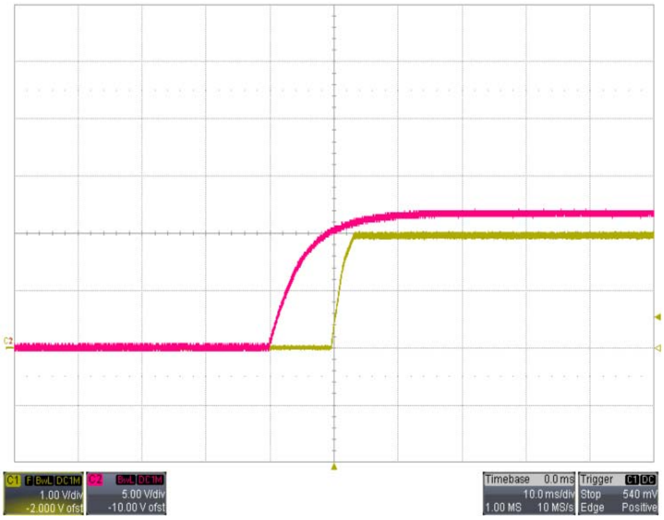
Input filter 270μF*4 AL-CAP, Output filter 470μF *4 POSCAP + 22μF*4 Ceramic



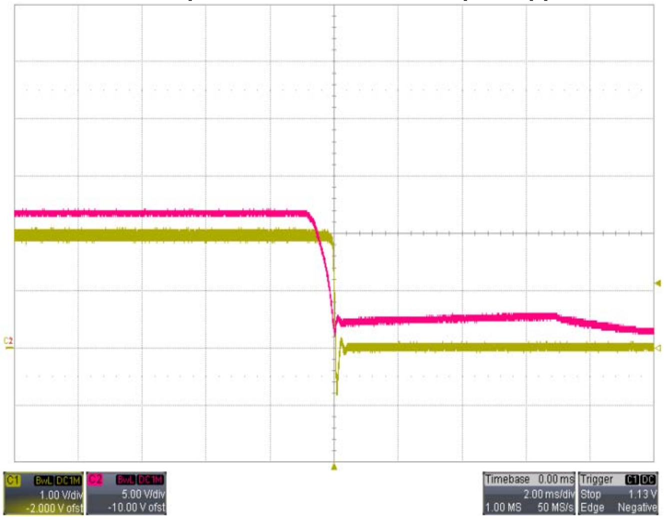
Noise V_{IN}=12V, I_O=100A, 20MHz Bandwidth



Transient Response V_{IN}=12V, Step from 50A~100A~50A
Blue: Output Current   Yellow: Output Ripple

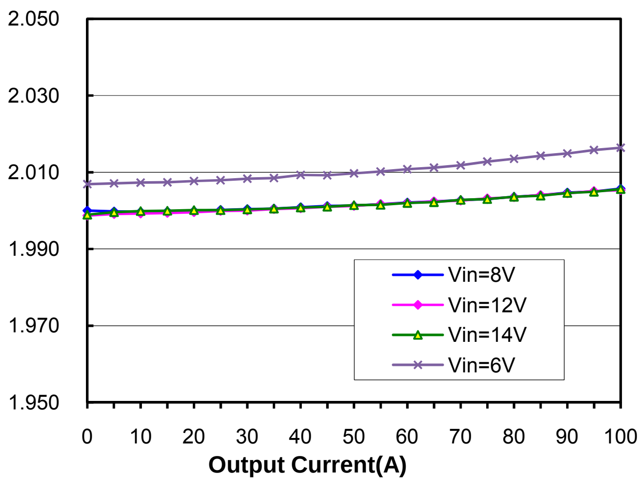


Start-up V_{IN}=12V, I_O=100A
Red: Input Voltage   Yellow: Output Voltage



Shut-down V_{IN}=12V, I_O=100A
Red: Input Voltage   Yellow: Output Voltage

Short-Circuit Output V_{IN}=12V



Regulation
Output voltage vs. Load Current

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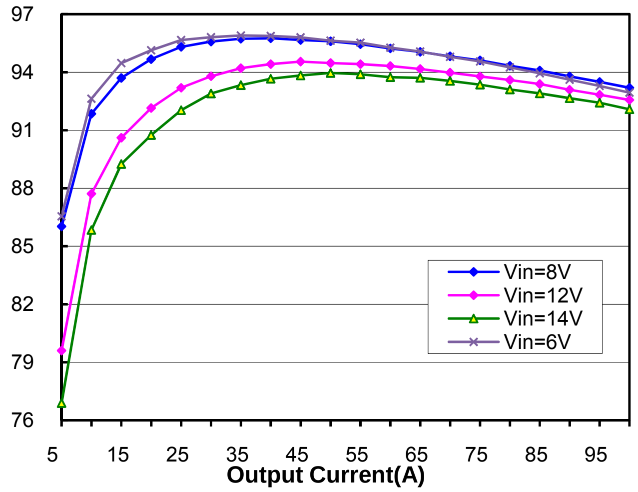
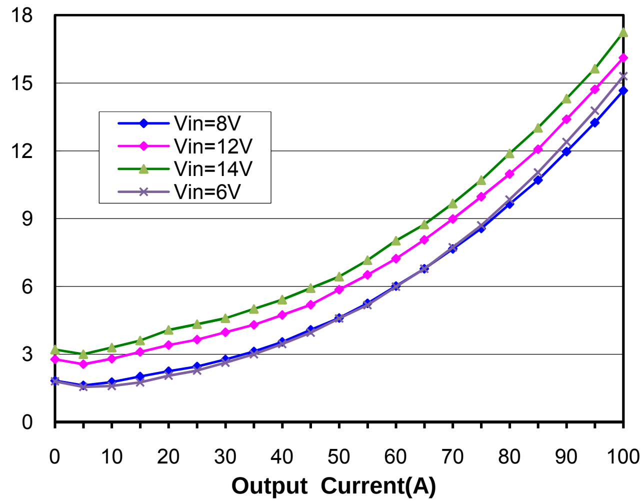
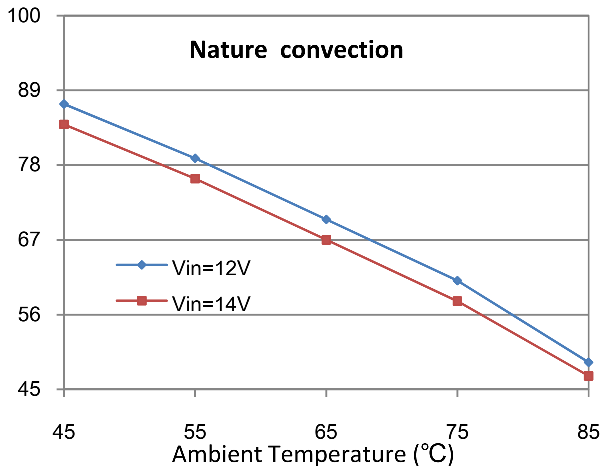


Efficiency vs. Load Current



Power Dissipation vs. Load Current



Ambient Temperature vs. Load Current

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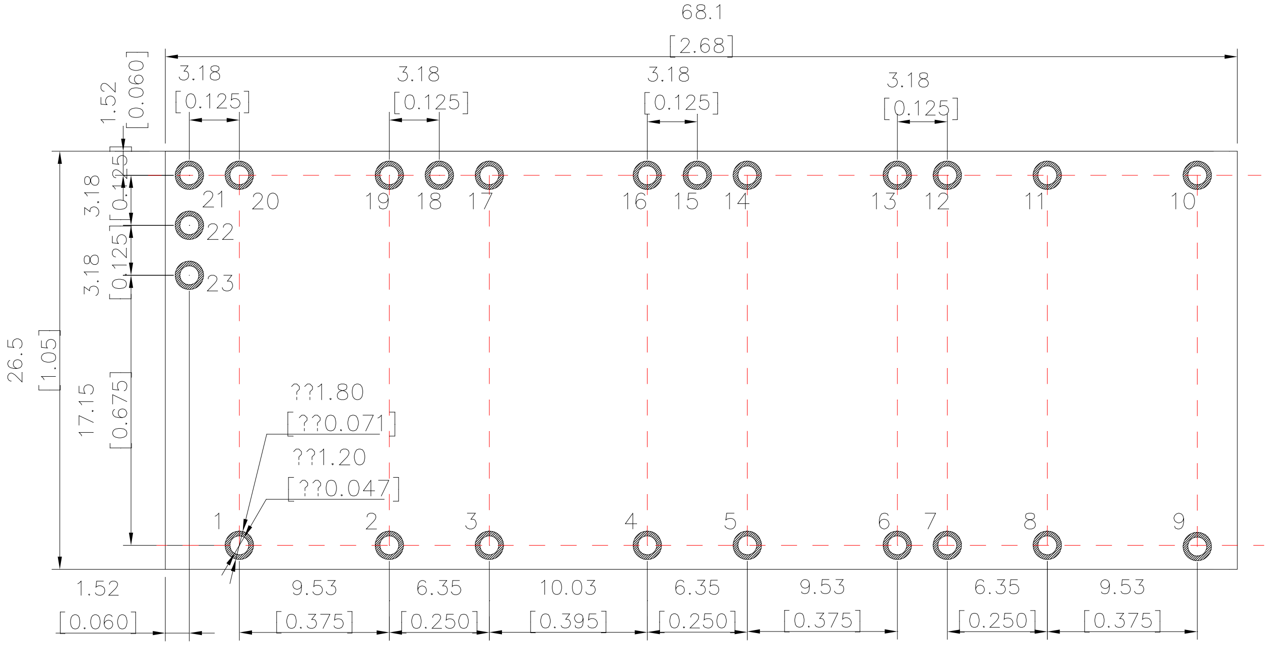
Recommended Hole Pattern for Through-Hole part

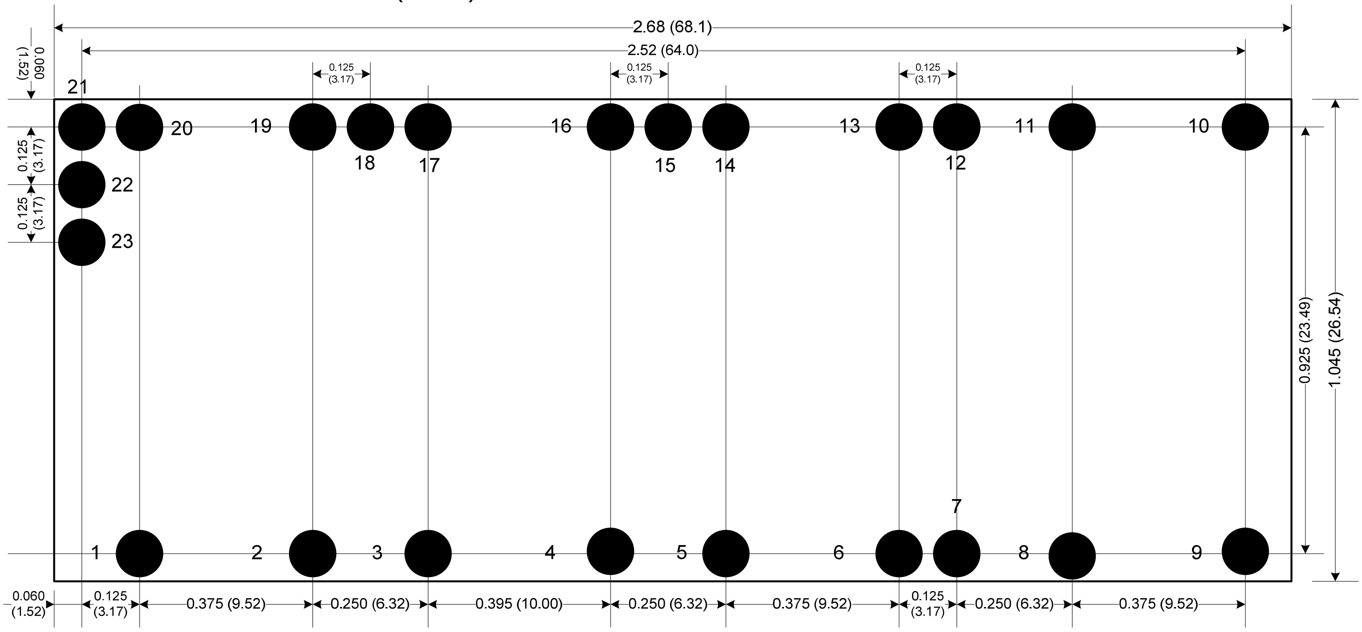
Dimensions are in millimeters (inches)



Component-side footprint

Recommended PAD Pattern for SMT part

Dimensions are in millimeters (inches)



0.100(2.54) Pad Size for Component Side

Component-side footprint

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Application Notes

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