NanoTarzan™MQ7230PL2

Non-Isolated, 4.5~14Vdc input, 0.59~ 6Vdc Output, 6A DC-DC Converters

APPLICATIONS

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

FEATURES

- Wide Operating Voltage: 4.5V ~14V
- Output Voltage: 0.59V ~ 6V
- Output Current Up to 6A
- Power Good:Open-Collector
- Over current/ short circuit protection
- Over Temperature Protection
- Minimal space on PCB:
  - 0.48 in x 0.48 in x 0.32in
  - 12.2mm x 12.2mm x 8.2mm
- Operating temperature range: -40°C to 85°C
- UL/IEC/EN60950 compliant
- RoHS Compliant

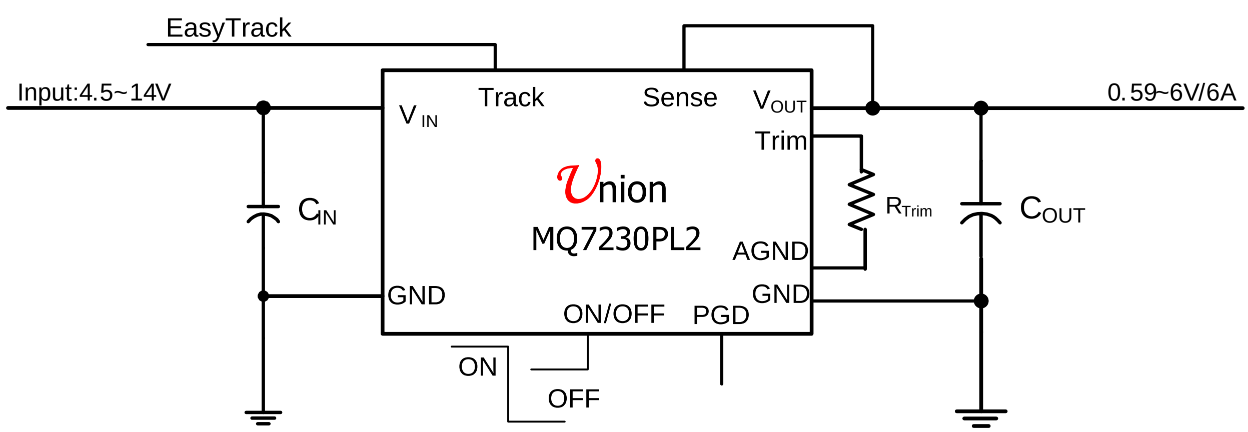
OPTIONS

- -E: Easy Track
- Positive(1) or Negative(0) logical control

Description

The ***NanoTarzan™***MQ7230PL2Series 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 voltage programmable from 0.59 Vdc to 6Vdc via external resistor. Such a module is suitable to application with 5V or 12V power supply bus. TheMQ7230PL2 have a maximum output current of 6A respectively, with a typical full-load efficiency of over 94% at 5Vdc output voltage. The modules are in industry standard through-hole pin-out. Standard features include remote on/off with positive logic and output voltage adjustment, over-current protection, over-temperature protection.

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



- GND and AGND is connected each other Inside module. For better performance, not to connect them outside module. If connected, the power module will operate normally.

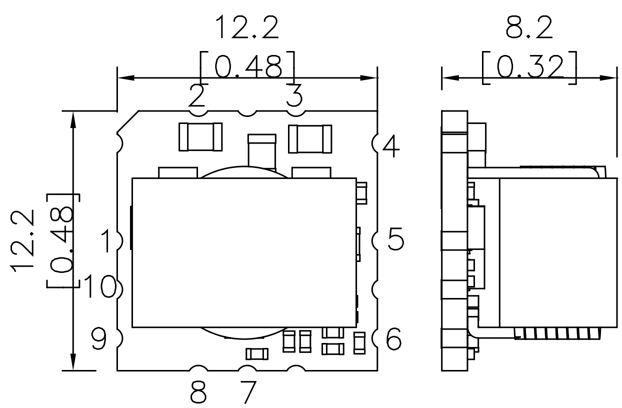
Performance Specifications (at T_A=+25℃)

Model	Pin Out	Number of Pins	Input V_{IN} Range(V)	Output				Efficiency (%)
				I_{OUT} (A)	Trim Range(V)	Regulation		
						Line (%)	Load (%)	
MQ7230PL2	Through Hole	12	4.5 ~14	6	0.59 ~ 6	1	1	95

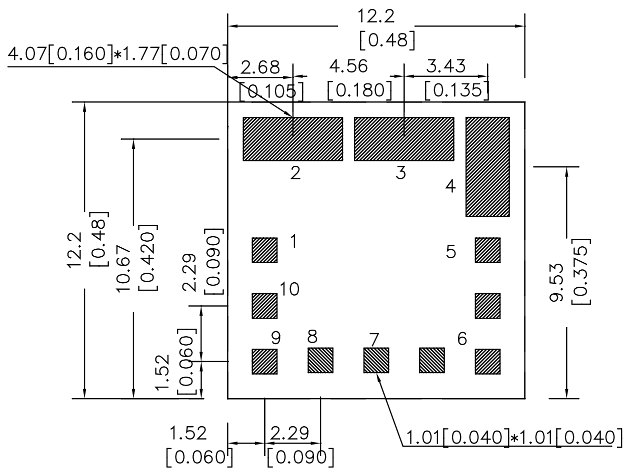
Mechanical Specifications

Dimensions are in mm (inches)

Tolerances: x.x mm±0.5mm (x.xx in ±0.02 in); x.xx mm±0.25mm (x.xxx in ±0.01 in)



COMPONENT-SIDE FOOTPRINT



PIN	Description
1	ON/OFF
2	VIN
3	GND
4	VOUT
5	SENSE
6	TRIM
7	AGND
8/11/12	NC
9	EasyTrack
10	PGD

Ordering Information

MQ7230PL20-E

Union Microsystems Power Module P/N

Options:
E: Easy Track

0: Negative Logic
1: Positive Logic

1 : Input voltage :3-5.5 V
2 : Input voltage :4.5-14 V

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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	℃

MQ7230PL2 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		6	A
Output Voltage Set point	100% load	ΔVo	-2		+2	%
Temperature Regulation	T_A= $T_{A.MIN}$ To $T_{A.MAX}$	-		0.4		$\%V_{O.SET}$
Line Regulation	See each output's corresponding character figure					
Load Regulation						
Output Ripple and Noise Voltage	Io=6A,0~20MHz					
Transient Response						

General Specifications

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Maximum Capacitive Load	<10mR ESR Ceramic			TBD		μF
	≧10mR ESR POSCAP			TBD		
Overcurrent Protection			12		20	A
Output short-circuit current (average)	All				3	A
Under Voltage Lockout Trip Level	Rising and falling V_{IN}, 3% hysteresis			4.3		V
Start-up Time	6A resistive load, with 100uF external capacitor			4		mS
Switching Frequency		F_O		600		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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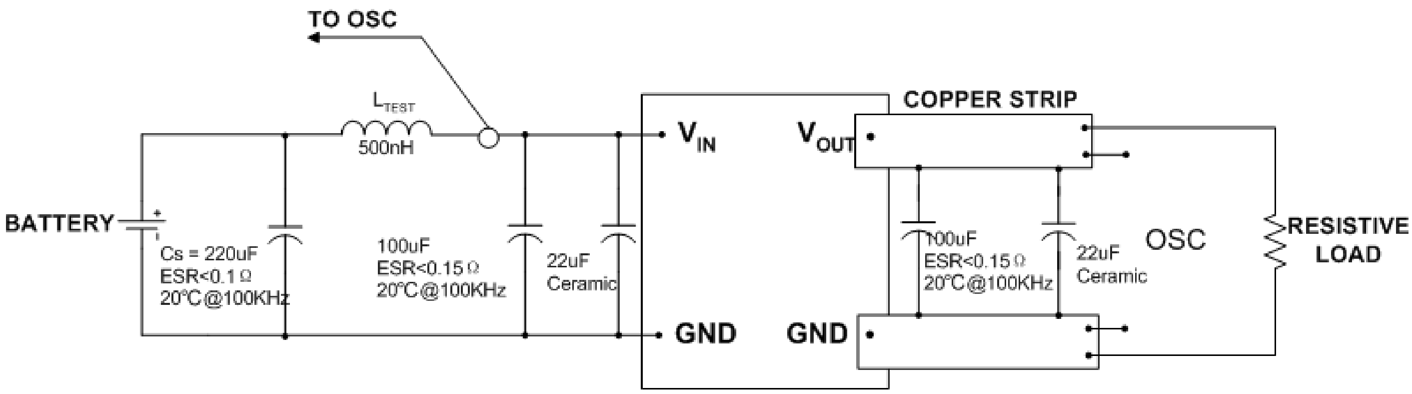
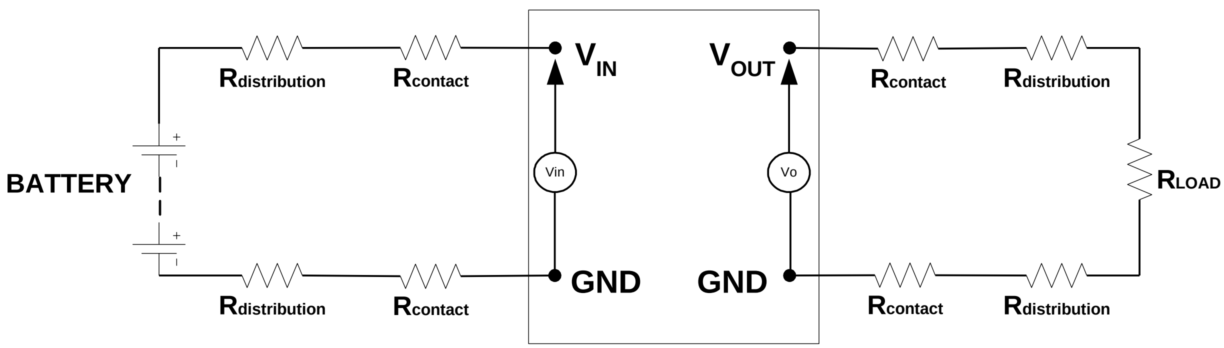
Test Configurations



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 shouldbe made using a BNC socket. Position the load between 50mm and 75mm（2in. and 3in）from the testedmodule.



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 terminalsto avoid measurement errors due to socket contactresistance.

Technical Notes

InputVoltageRange

The ***MQ7230PL2*** 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 ***MQ7230PL2*** Series is non-isolated DC/DC converters. To the extent possible with the intent of minimizing ground loops, input and output return current should be directed through pin GND as short as possible.

I/O Filtering

All the specifications of the ***MQ7230PL2*** 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 MQ7230PL2 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.

MQ7230PL2'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 MQ7230PL2'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 ***MQ7230PL2*** 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 8.5A fuses..
2. Both input traces must be capable of carrying a current of 1.5 times the value of the fuse without opening.

Safety Considerations

MQ7230PL2'sare 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), theinput must be ELV.

Remote Sense

MQ7230PL2 Power Modules with suffix "S" 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 MQ7230PL2's specified rating. Therefore:

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

ON/OFF Control

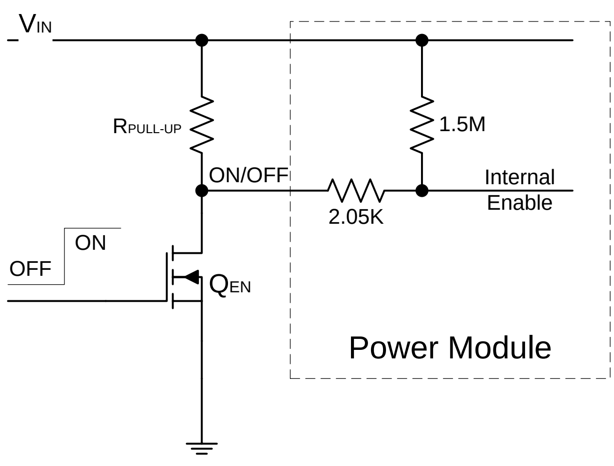

Fig1a. Circuit configuration for using positiveOn/Off logic.

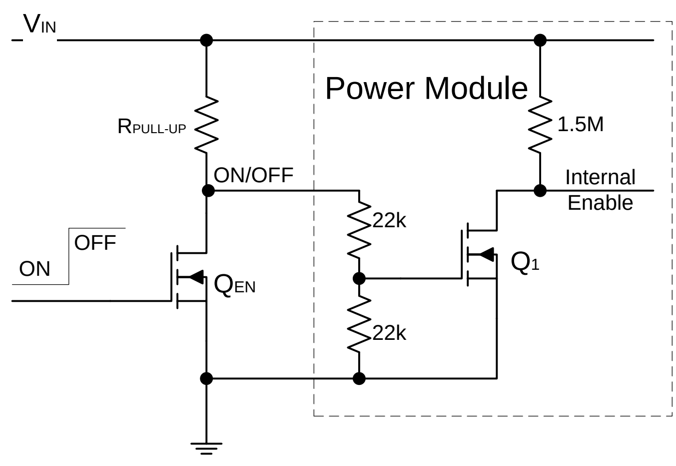

Fig1b. Circuit configuration for using negative On/Off logic.

The circuit configurations for using ON/OFF function are shown in Fig1. Two ON/OFF logic options are available. In the Positive LogicON/OFF option, the module turns ON during alogic 'High'on the ON/OFF pin and turns OFF during a logic 'Low'.With the Negative Logic ON/OFF option, the moduleturns OFF during logic 'High' and ON during logic 'Low'.The On/Off signal is always referenced to ground. Anyway, leaving the On/Off pin floated will turn the module ON when inputvoltage is present.

For positive logic modules, the circuit configurationfor using the On/Off pin is shown in Figure1a. Whenthe externaltransistor $Q_{EN}$is

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in the OFF state, theinternal Enable signal is pulled high through aninternal resistor and the external pullupresistor, the module is ON. When transistorQ_{EN} isturned ON, the On/Off pin is pulled low and themodule is OFF. A 20kΩ R_{PULLUP} resistorwill be ok formost applications.

For negative logic On/Off modules, the circuitconfiguration is shown in Fig1b. The ON/OFF pinshould be pulled high with an external pull-up resistor(20KΩ is ok for most applications). When Q_{EN} is in the OFF state,the On/Off pin is pulled high, Q1 is turnedON and the module is OFF. To turn the module ON,Q_{EN} is turned ON pulling the On/Off pin low, turningtransistor Q1 OFF resulting in the PWM Enable pingoing high.

Output Overvoltage Protection

MQ7230PL2 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)

MQ7230PL2 incorporates overcurrent and short circuit protection. If the load current exceeds the over-current protection trip level, the MQ7230PL2's internal overcurrent-protection circuitry immediately turns off the module, which then goes into Hiccup mode.The unit operates normallyonce the output current is brought back into itsspecified range. The typical average output currentduring hiccup is less than**2**A.

Caution：Be careful never to operate MQ7230PL2 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.

Power Good

MQ7230PL2 provides anopen-drain PowerGood (PwrGood) signal to indicate that the output voltage iswithin the regulation limits. ThePwrGood signal will be de-asserted to a low state if anycondition such as overtemperature, overcurrent or lossof regulation occurs that would result in the outputvoltage going ±10% outside the set-point value. ThePwrGood terminal should be connected through apullup resistor (100KΩ recommended) to a source of 3V~5.5VDC.

Output Voltage Trimming

MQ7230PL2'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：

$$R_{TRIM} = \frac{5.91}{V_O - 0.591} \text{k}\Omega$$

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

$$R_{TRIM} = \frac{5.91}{V_O - 0.591} \text{k}\Omega = 6.502\text{k}\Omega$$

So, R_{TRIM} = 6.502kΩ

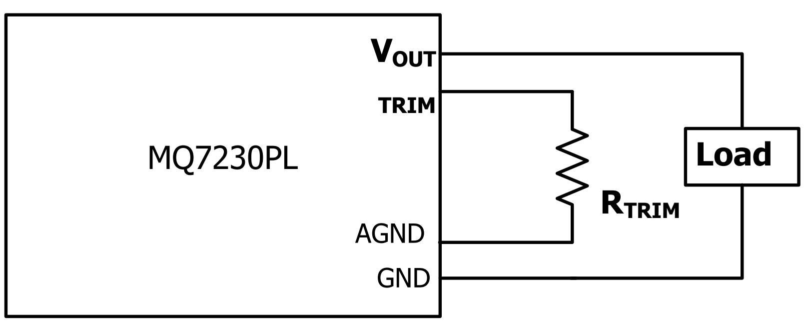

Fig3. Circuit configuration for programming output voltage using external resistor

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

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

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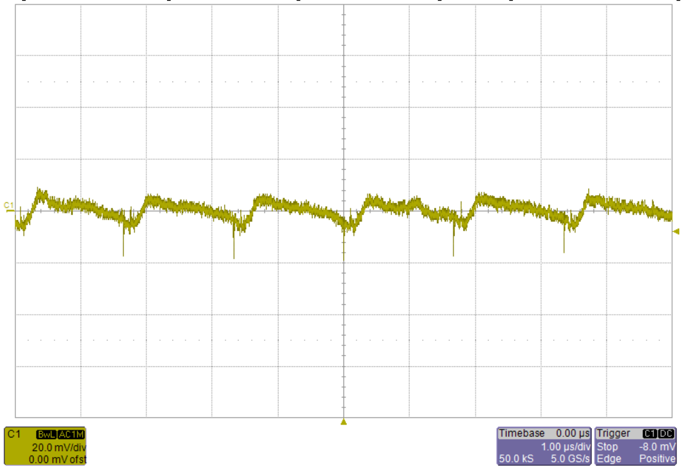
Desired Voltages (V)	R_{TRIM} **(kΩ)**
0.59	Open
1.0	14.45
1.2	9.704
1.5	6.502
1.8	4.888
2.5	3.096
3.3	2.182
5.0	1.340

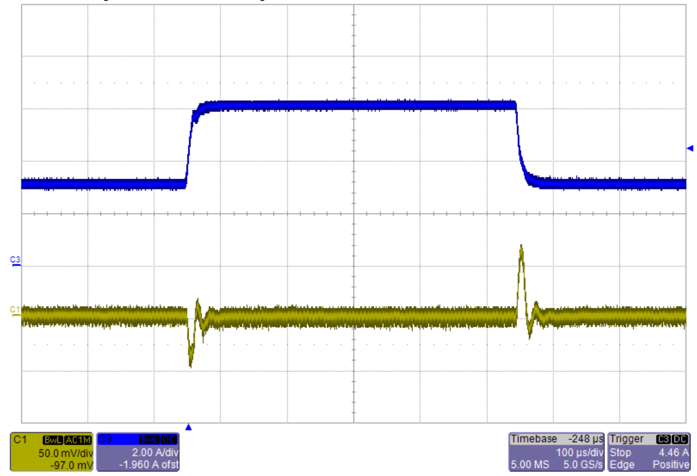
Typical Characteristics– output adjusted to 0.59V

General conditions:

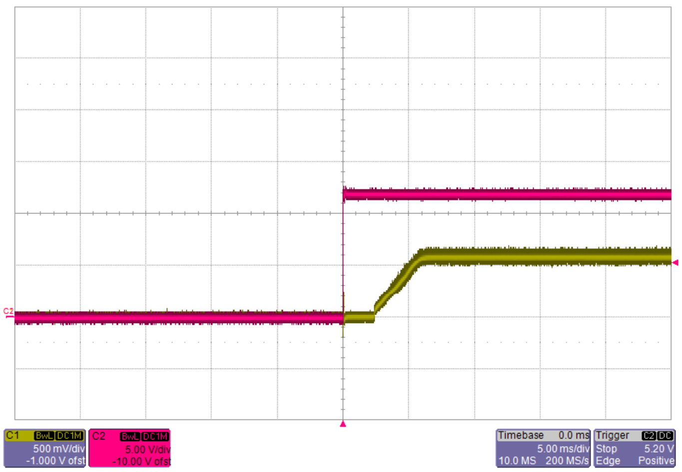
Input filter:68µF*3 TAN (50mΩ ESR), Output filter: 100µF*1 TAN (150mΩ ESR)



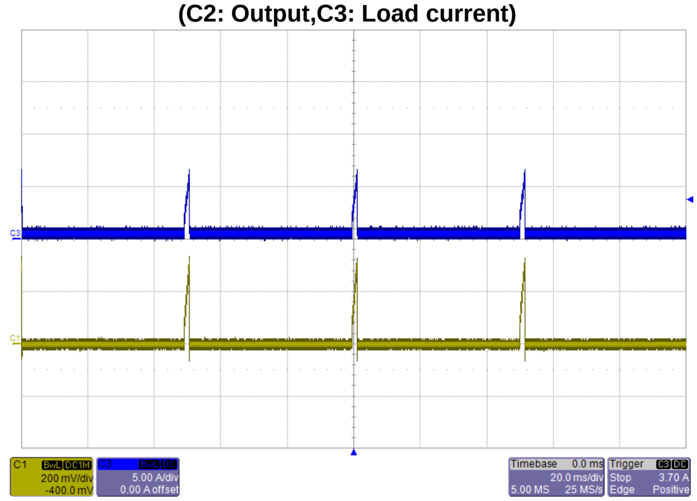
Noise V_{IN}=12V, I_O=6A, 5~20MHz Bandwidth



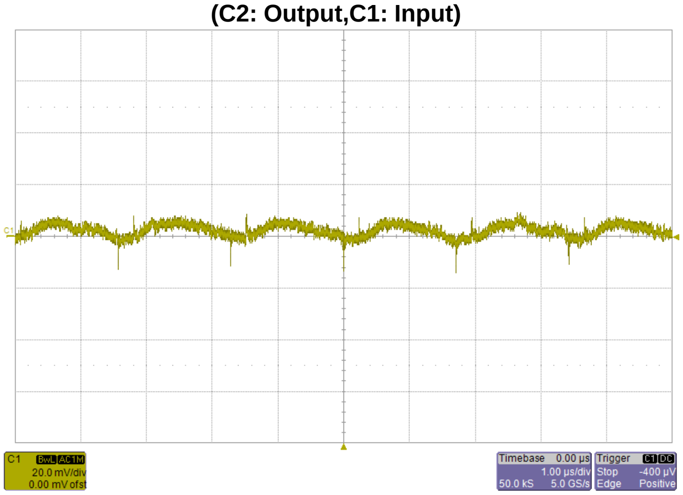
Transient Response V_{IN}=12V, Step from 3A~6A~3A (C2: Output,C3: Load current)



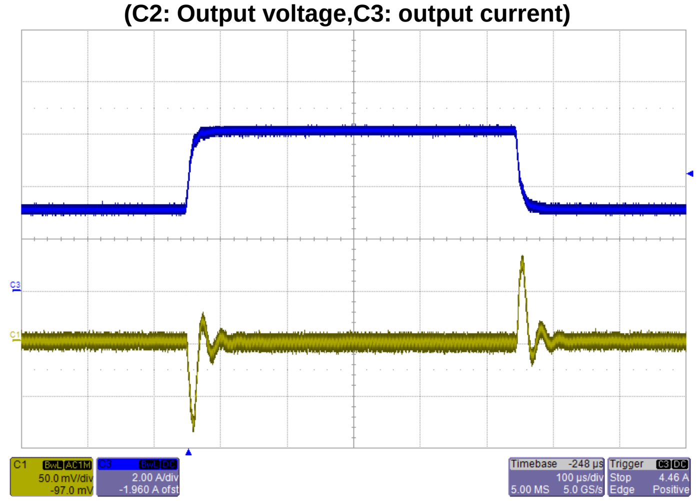
Start-up V_{IN}=12V, I_O=6A (C2: Output,C1: Input)



Short-Circuit Output V_{IN}=12V (C2: Output voltage,C3: output current)



Noise V_{IN}=5V, I_O=6A, 5~20MHz Bandwidth



Transient Response V_{IN}=5V, Step from 3A~6A~3A (C2: Output,C3: Load current)

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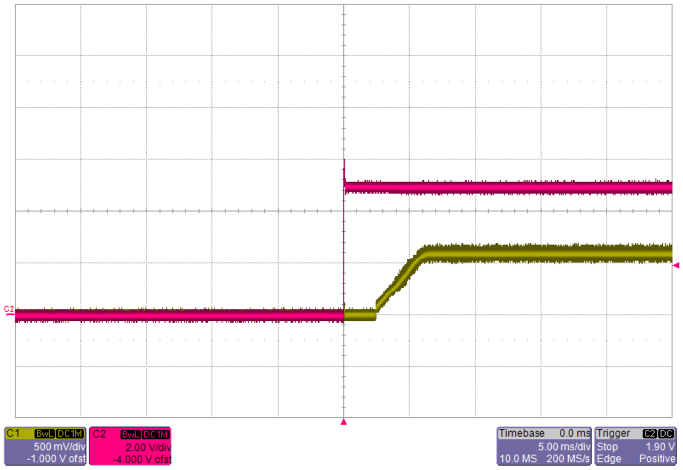
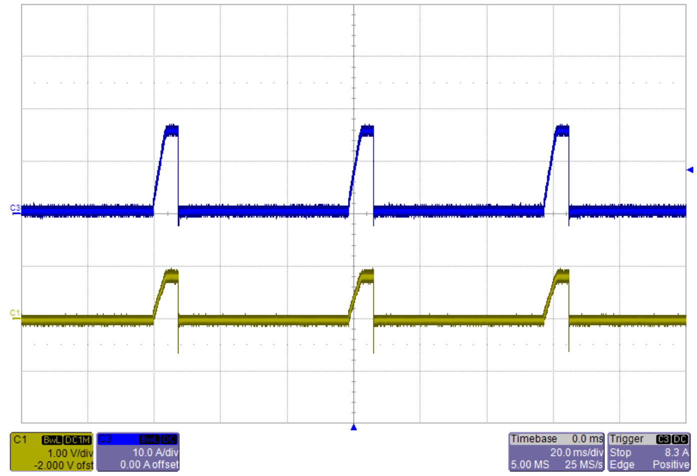
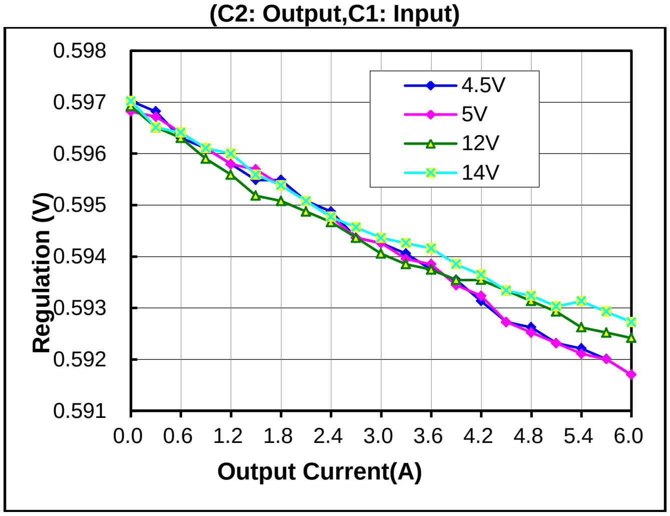


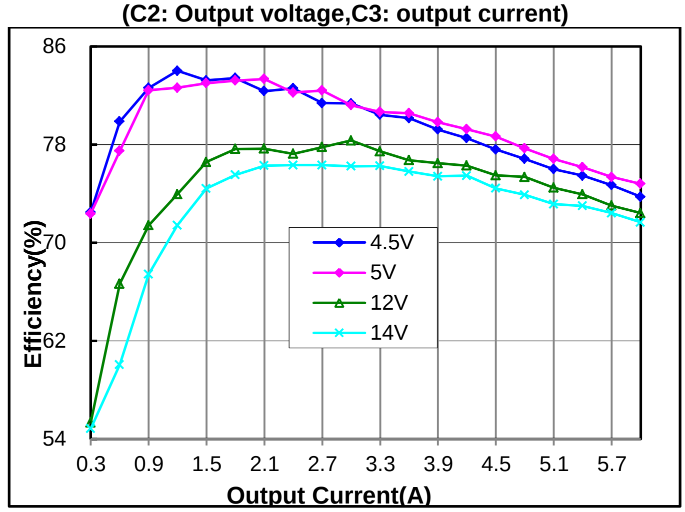
Start-up V_{IN}=5V, I_O=6A
(C2: Output,C1: Input)



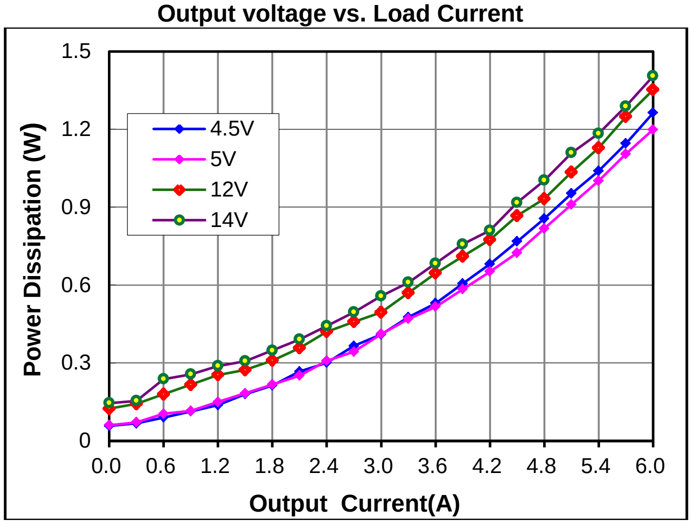
Short-Circuit Output V_{IN}=5V
(C2: Output voltage,C3: output current)



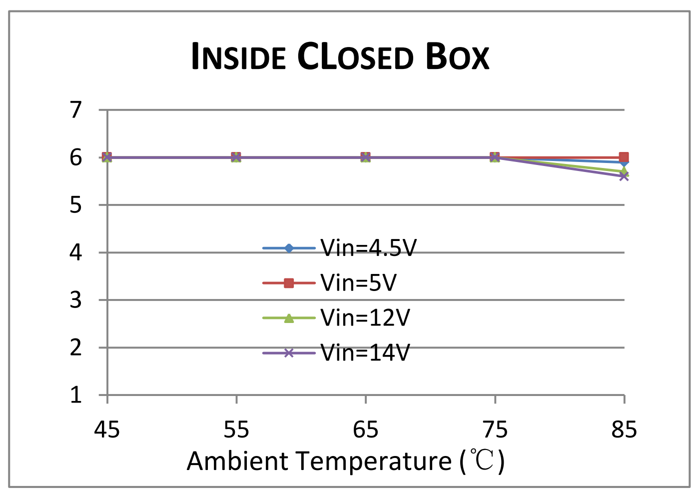
Regulation
Output voltage vs. Load Current



Efficiency



Power Dissipation



Output Current Derating

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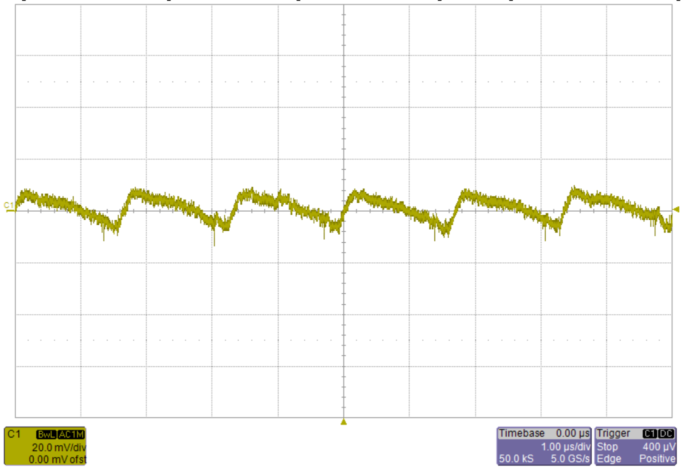
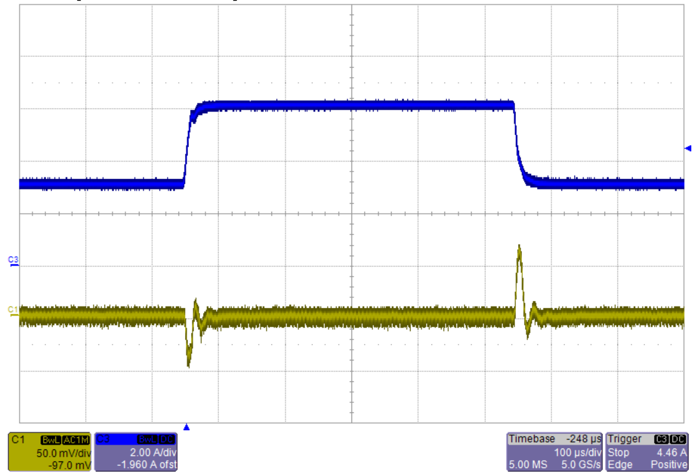
Typical Characteristics– output adjusted to 1V

General conditions:

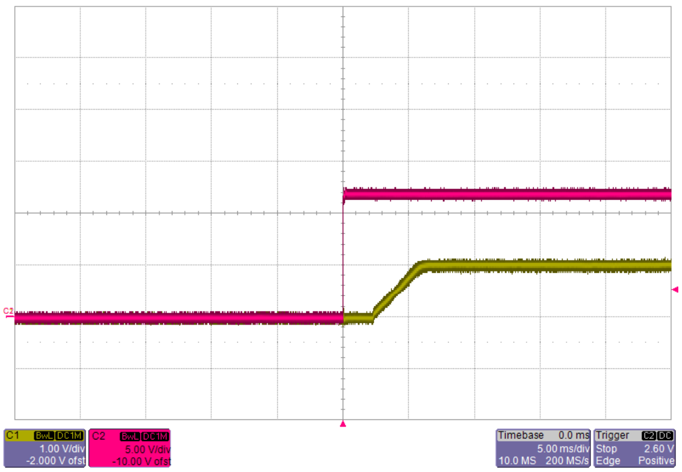
Input filter:68µF*3 TAN (50mΩ ESR), Output filter: 100µF TAN (150mΩ ESR)



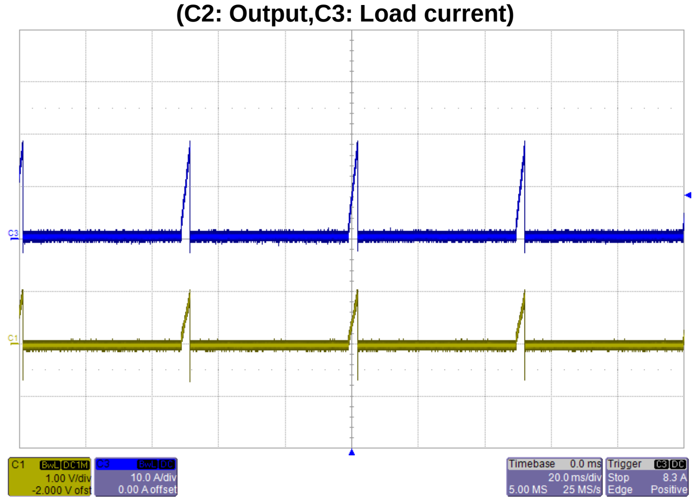
Noise V_{IN}=12V, I_O=6A, 5~20MHz Bandwidth



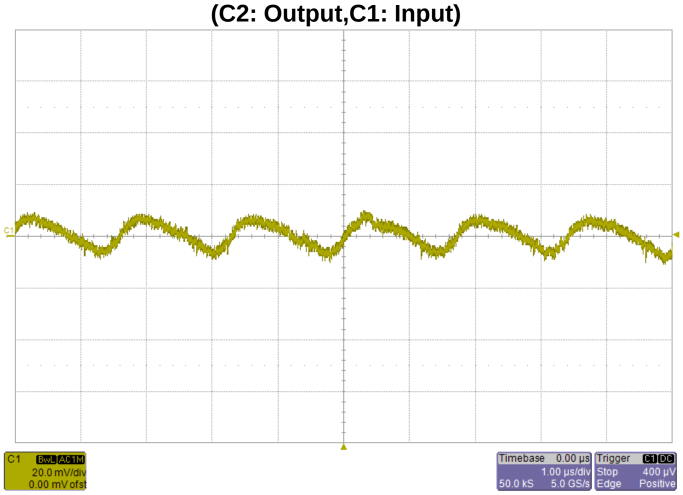
Transient Response V_{IN}=12V, Step from 3A~6A~3A (C2: Output,C3: Load current)



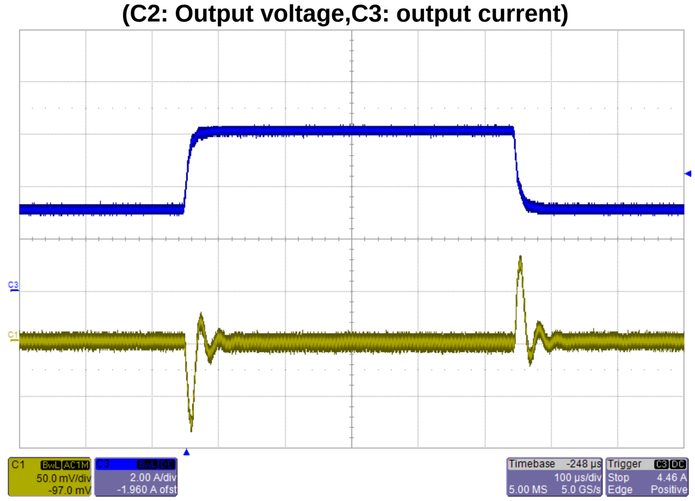
Start-up V_{IN}=12V, I_O=6A (C2: Output,C1: Input)



Short-Circuit Output V_{IN}=12V (C2: Output voltage,C3: output current)



Noise V_{IN}=5V, I_O=6A, 5~20MHz Bandwidth



Transient Response V_{IN}=5V, Step from 3A~6A~3A (C1: Output,C3: Load current)

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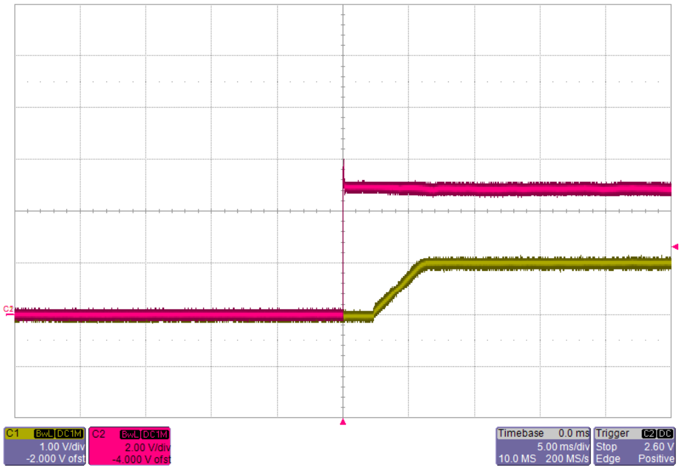
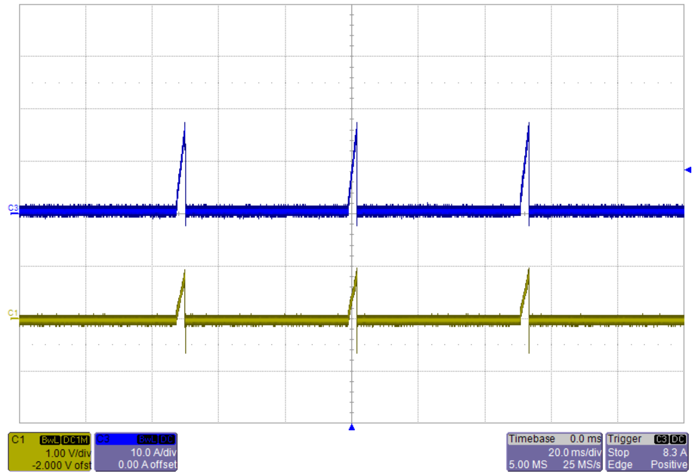
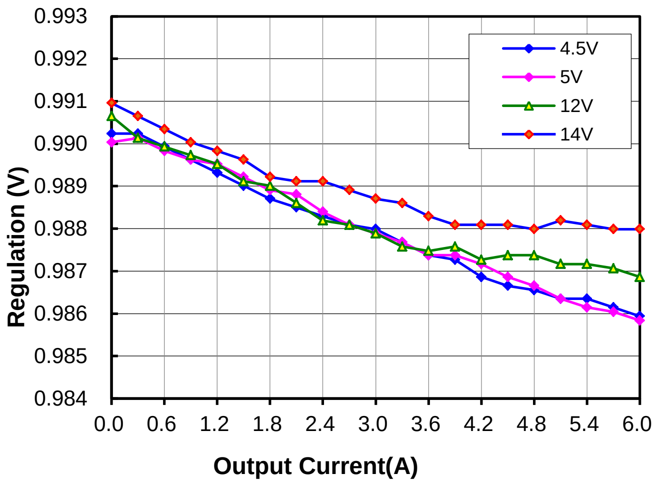


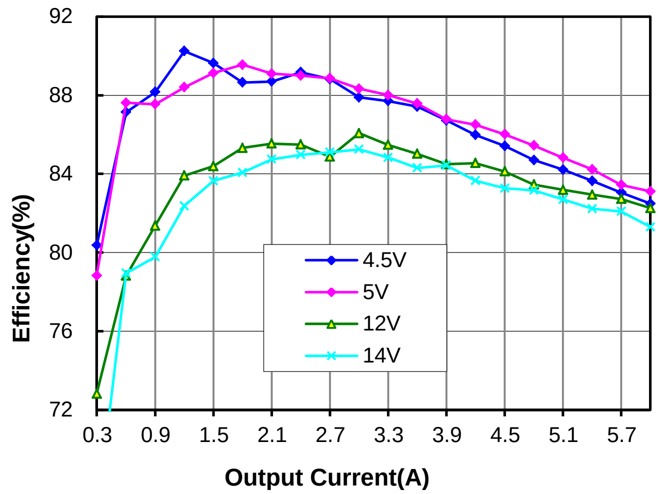
Start-up V_{IN}=5V, I_O=6A
(C2: Output,C1: Input)



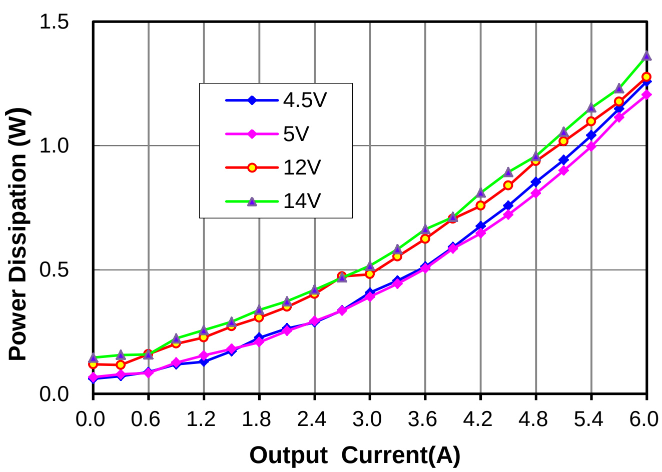
Short-Circuit Output V_{IN}=5V
(C2: Output voltage,C3: output current)



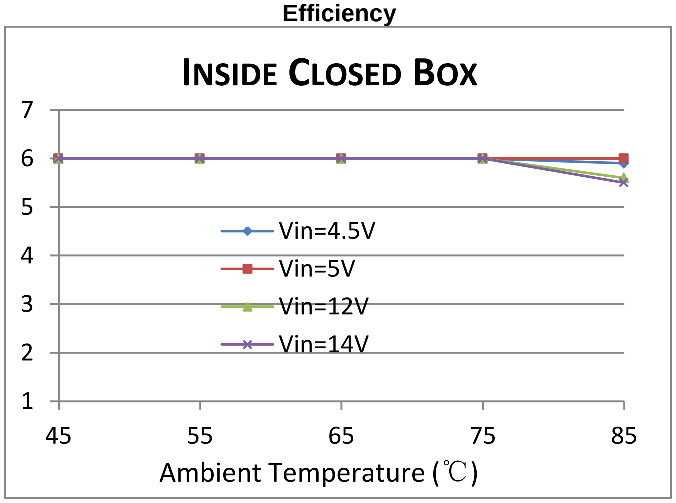
Regulation



Efficiency



Power Dissipation



Output Current Derating

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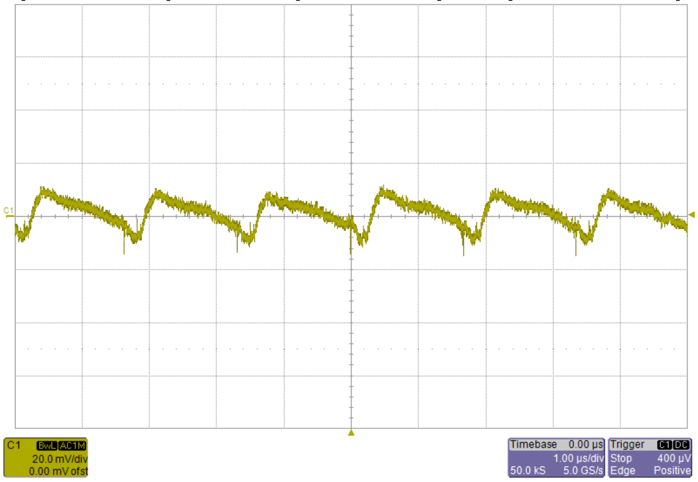
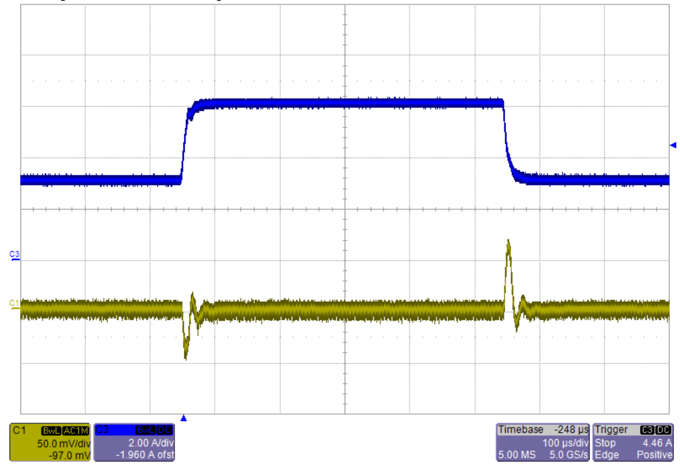
Typical Characteristics– output adjusted to 1.2V

General conditions:

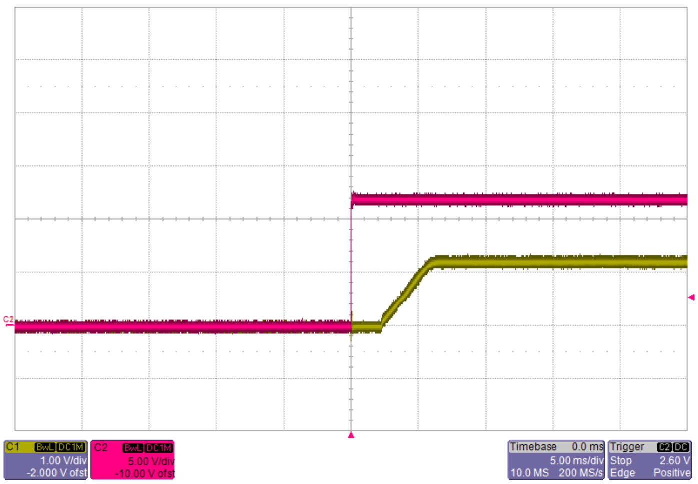
Input filter:68μF*3 TAN (50mΩ ESR), Output filter: 100μF TAN (150mΩ ESR)



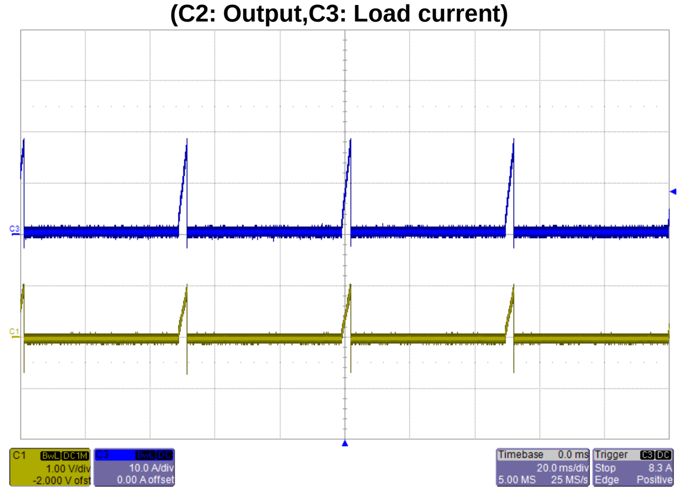
Noise V_{IN}=12V, I_O=6A, 5~20MHz Bandwidth



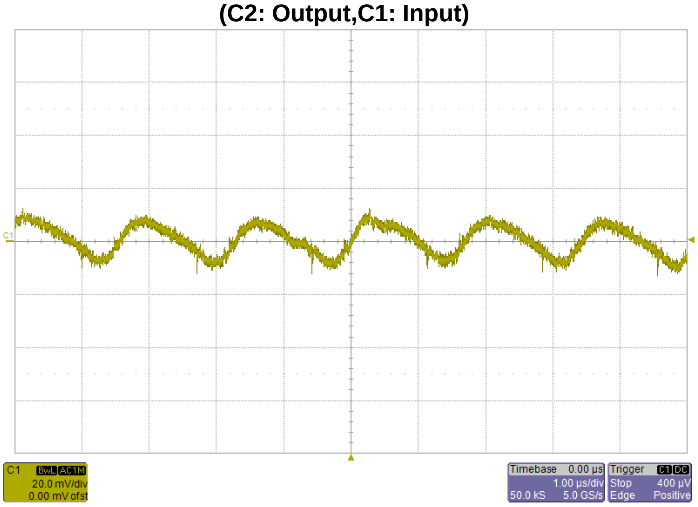
Transient Response V_{IN}=12V, Step from 3A~6A~3A (C2: Output,C3: Load current)



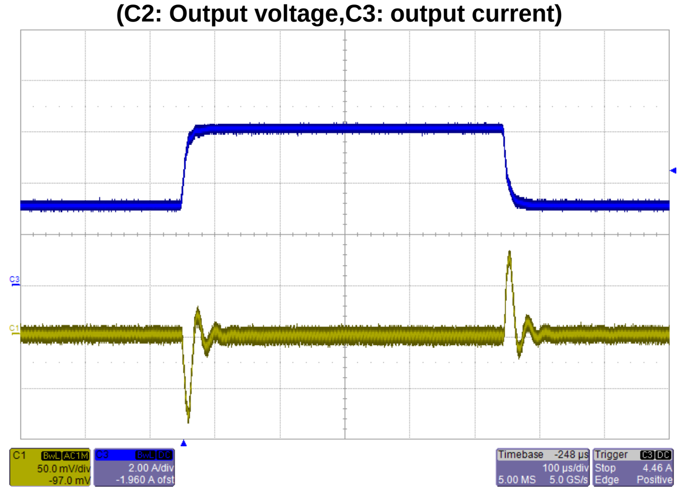
Start-up V_{IN}=12V, I_O=6A (C2: Output,C1: Input)



Short-Circuit Output V_{IN}=12V (C2: Output voltage,C3: output current)



Noise V_{IN}=5V, I_O=6A, 5~20MHz Bandwidth



Transient Response V_{IN}=5V, Step from 3A~6A~3A (C1: Output,C3: Load current)

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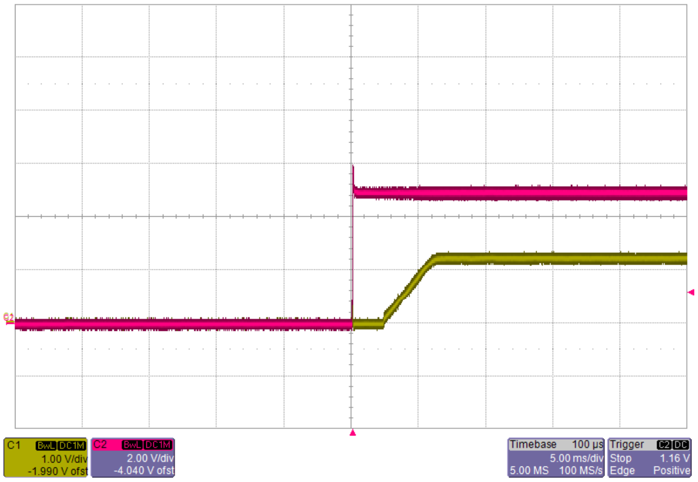
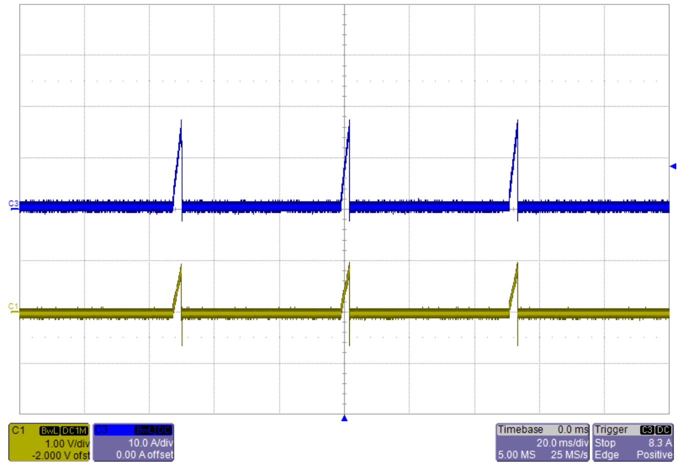
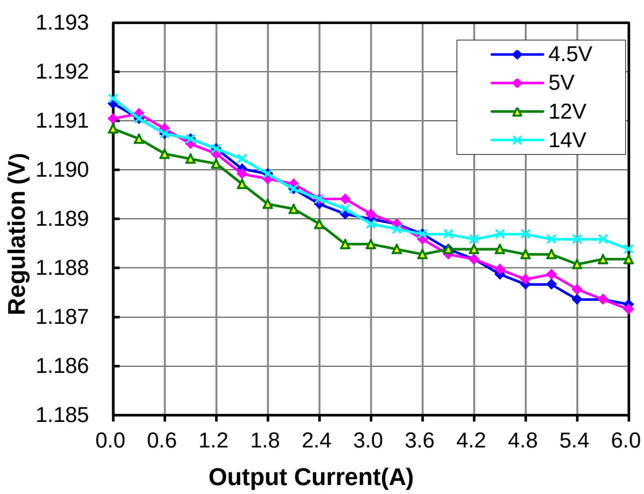


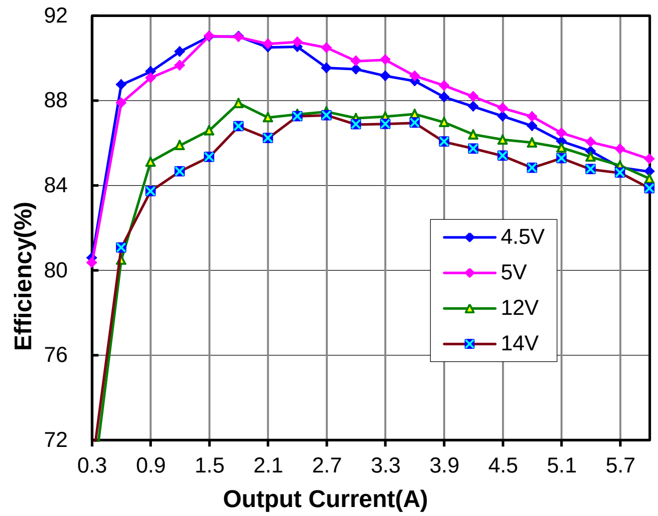
Start-up V_{IN}=5V, I_O=6A
(C2: Output,C1: Input)



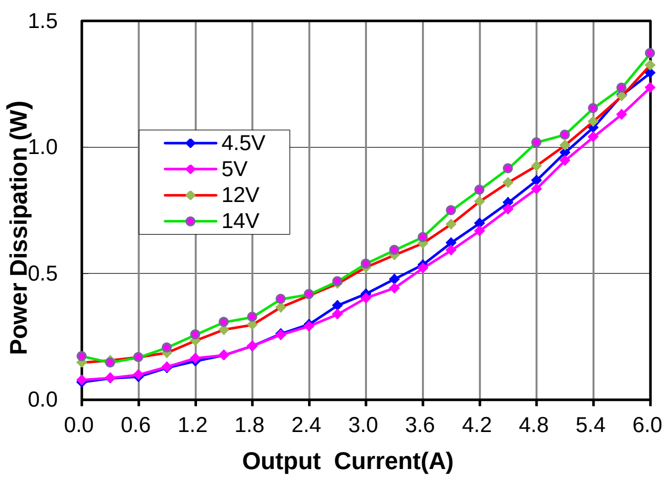
Short-Circuit Output V_{IN}=5V
(C2: Output voltage,C3: output current)



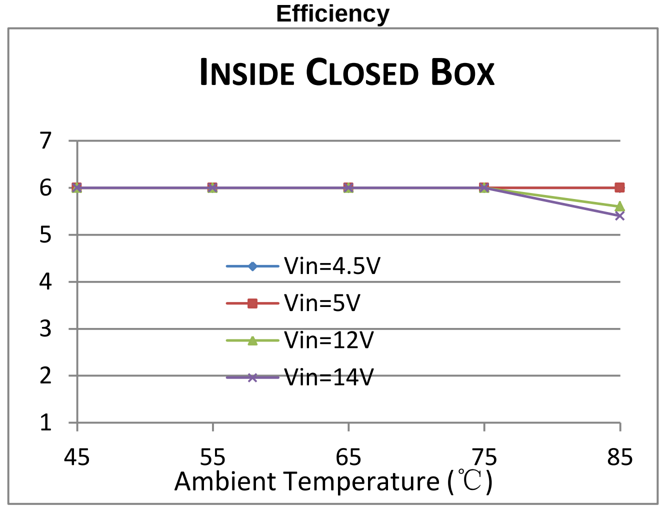
Regulation



Efficiency



Power Dissipation



Output Current Derating

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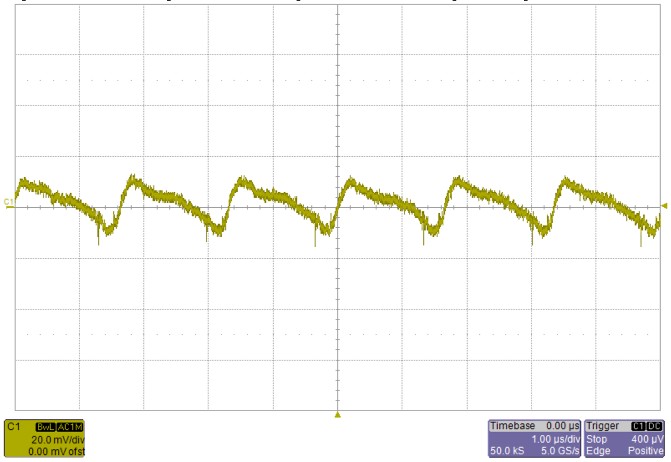
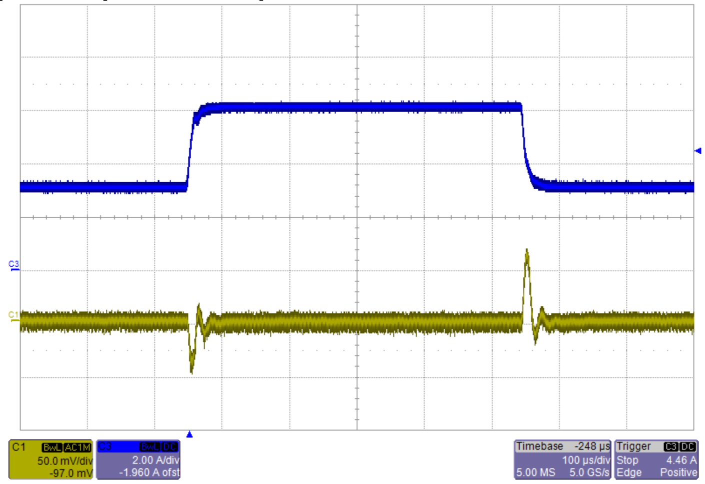
Typical Characteristics– output adjusted to 1.5V

General conditions:

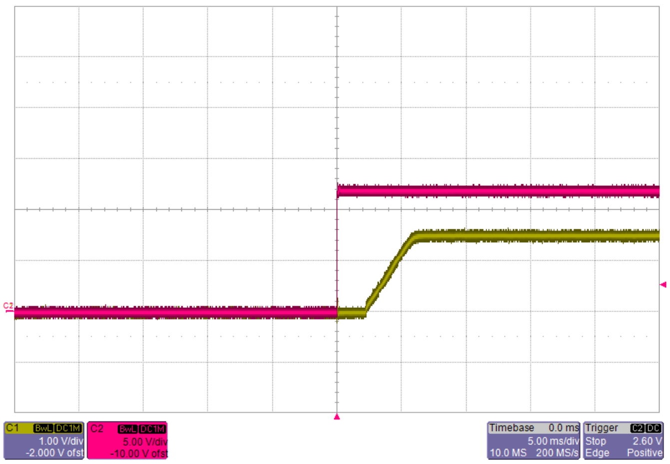
Input filter:68µF*3 TAN (100mΩ ESR), Output filter: 100µF TAN (150mΩ ESR)



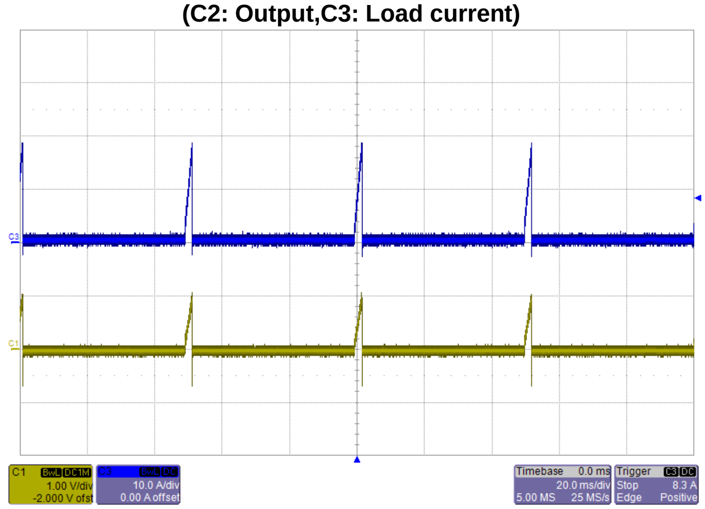
Noise V_{IN}=12V, I_O=6A, 5~20MHz Bandwidth



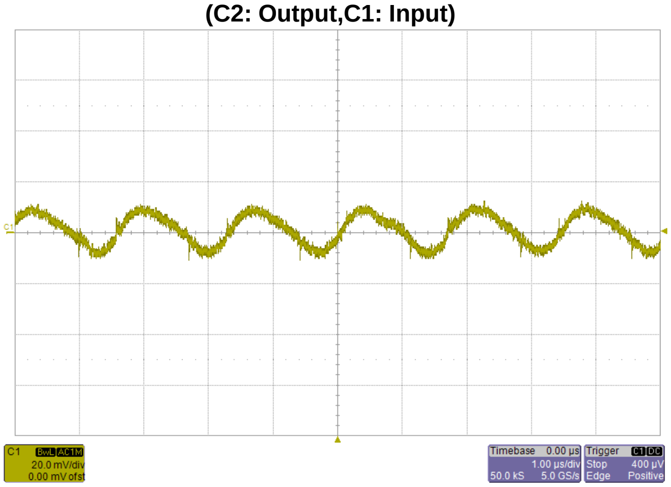
Transient Response V_{IN}=12V, Step from 3A~6A~3A (C2: Output,C3: Load current)



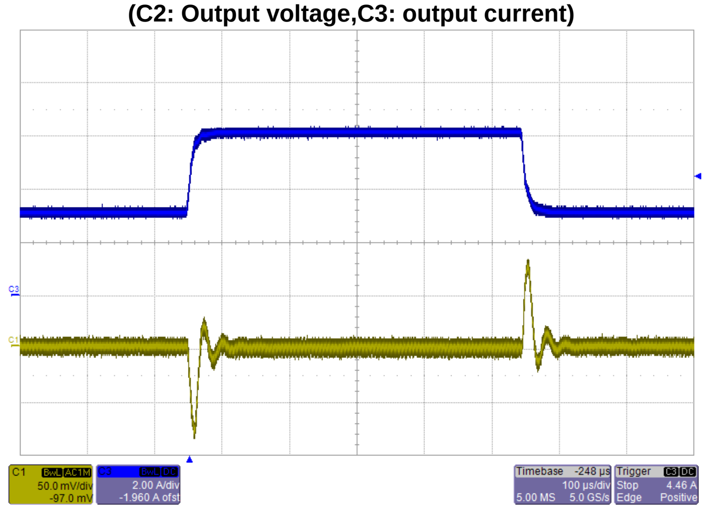
Start-up V_{IN}=12V, I_O=6A (C2: Output,C1: Input)



Short-Circuit Output V_{IN}=12V (C2: Output voltage,C3: output current)



Noise V_{IN}=5V, I_O=6A, 5~20MHz Bandwidth



Transient Response V_{IN}=5V, Step from 3A~6A~3A (C1: Output,C3: Load current)

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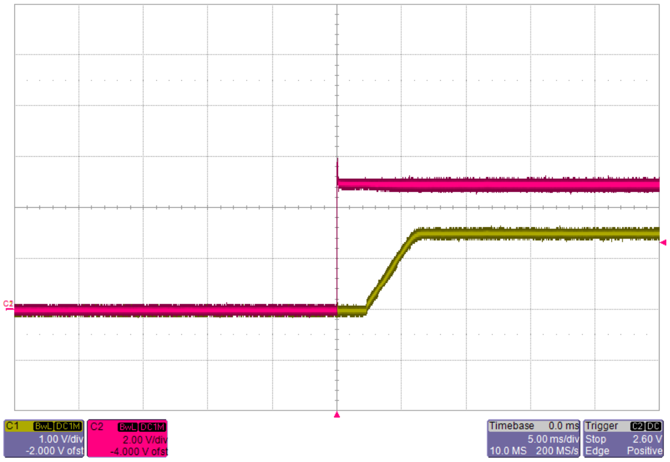
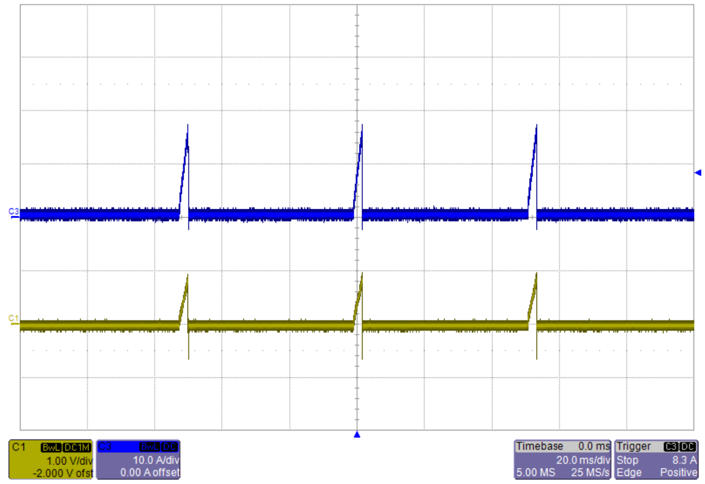
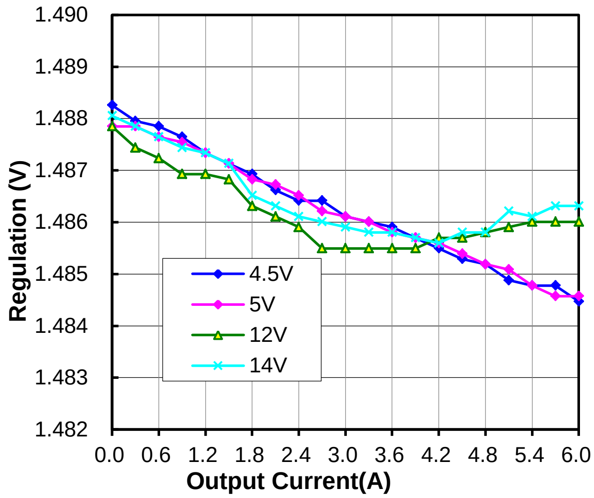


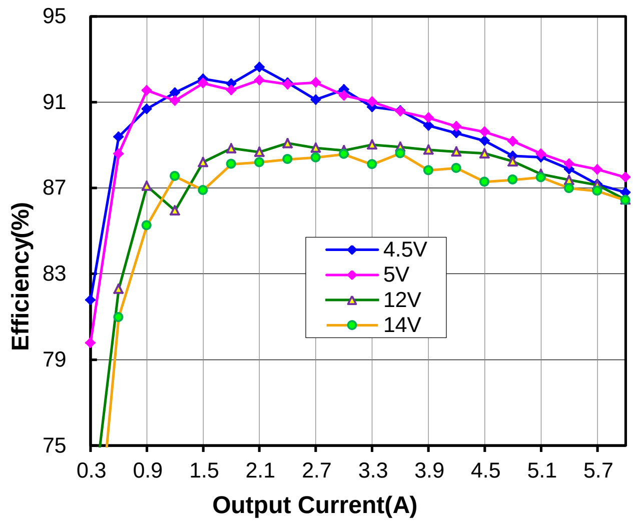


Start-up V_{IN}=5V, I_O=6A
(C2: Output,C1: Input)

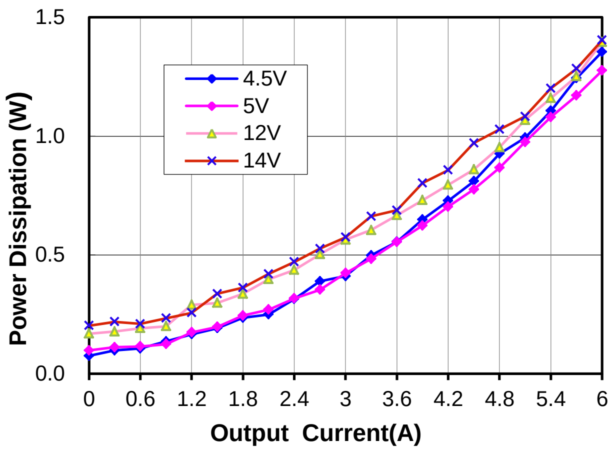
Short-Circuit Output V_{IN}=5V
(C2: Output voltage,C3: output current)



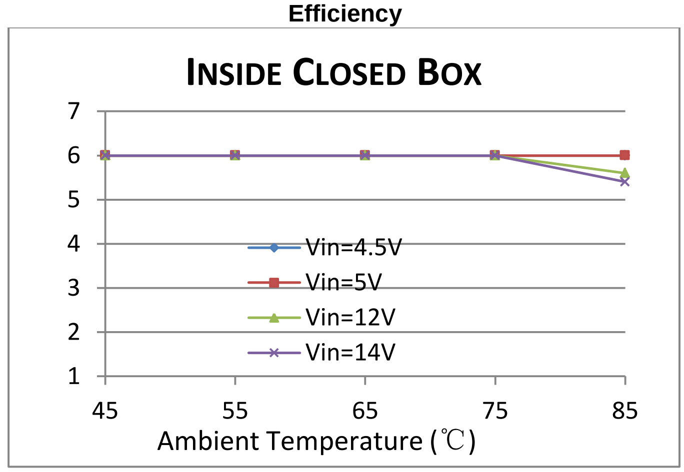
Regulation



Efficiency



Power Dissipation



Output Current Derating (Load Current vs. Ambient Temperature (TREF, See Page 6)), VIN=12V,

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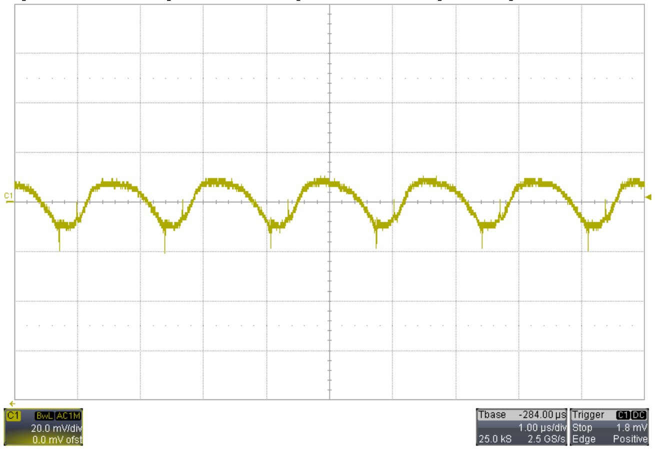
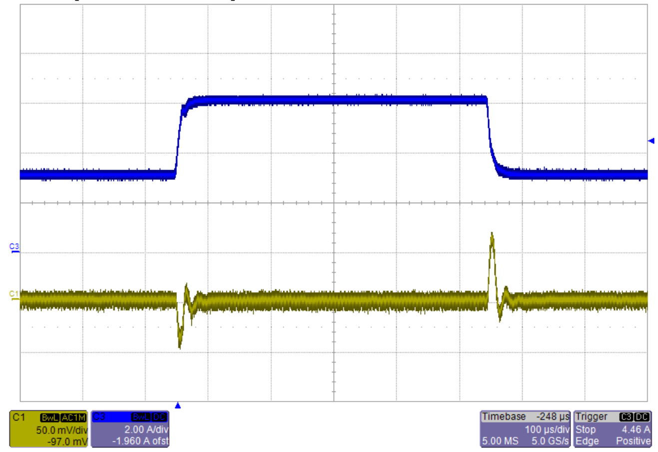
Typical Characteristics– output adjusted to 1.8V

General conditions:

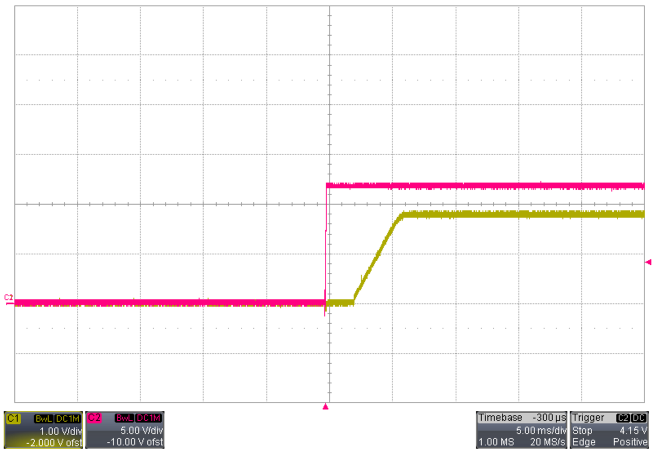
Input filter:68μF*3 TAN (50mΩ ESR), Output filter: 100μF TAN (150mΩ ESR)



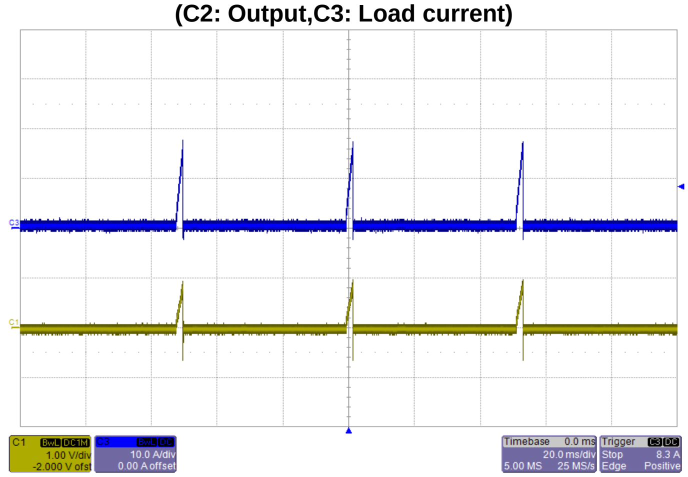
Noise V_{IN}=12V, I_O=6A, 5~20MHz Bandwidth



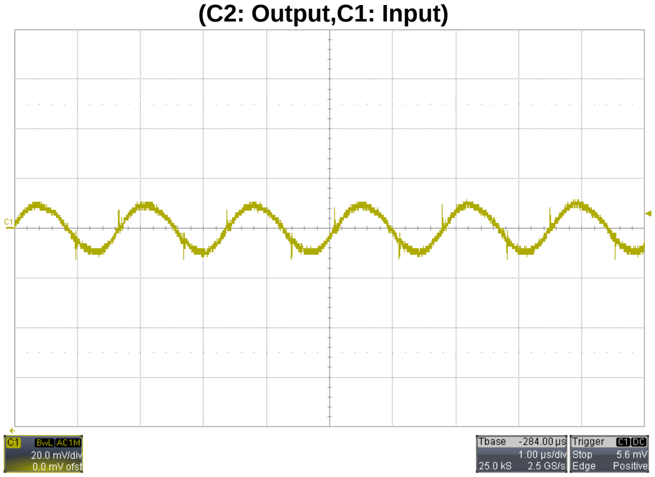
Transient Response V_{IN}=12V, Step from 3A~6A~3A (C2: Output,C3: Load current)



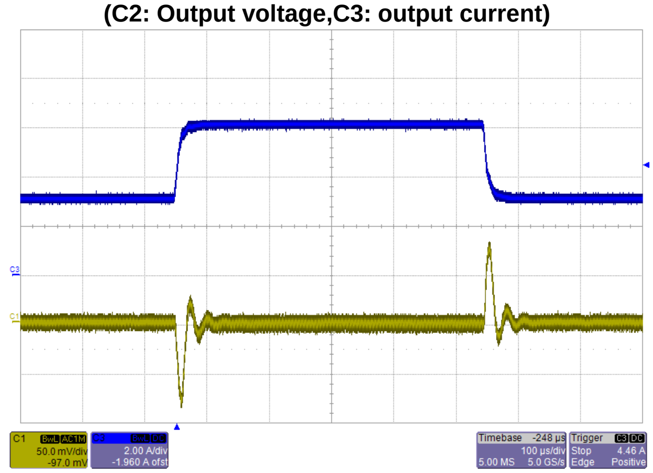
Start-up V_{IN}=12V, I_O=6A (C2: Output,C1: Input)



Short-Circuit Output V_{IN}=12V (C2: Output voltage,C3: output current)



Noise V_{IN}=5V, I_O=6A, 5~20MHz Bandwidth



Transient Response V_{IN}=5V, Step from 3A~6A~3A (C2: Output,C3: Load current)

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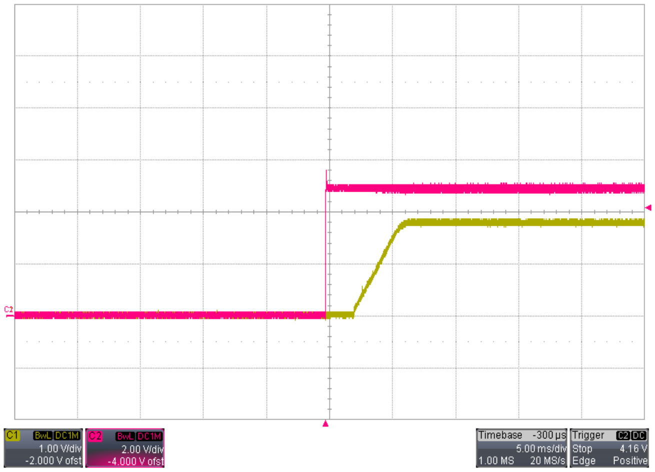
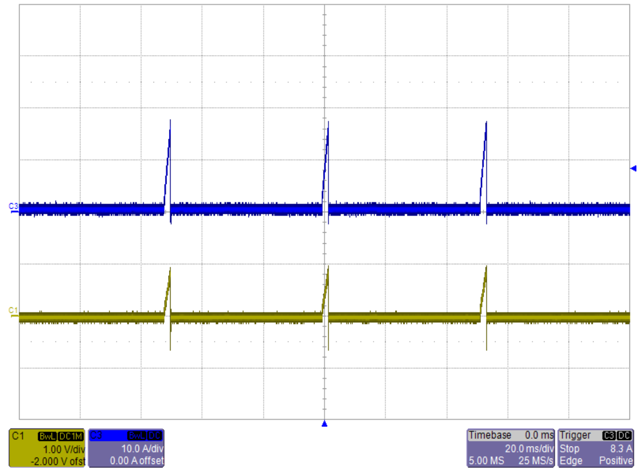
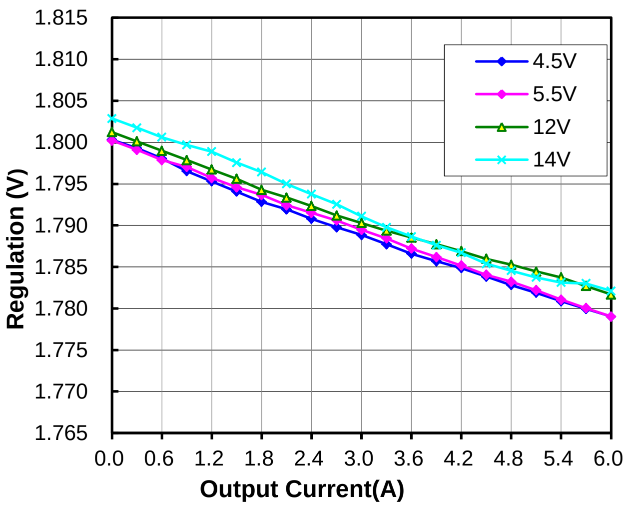


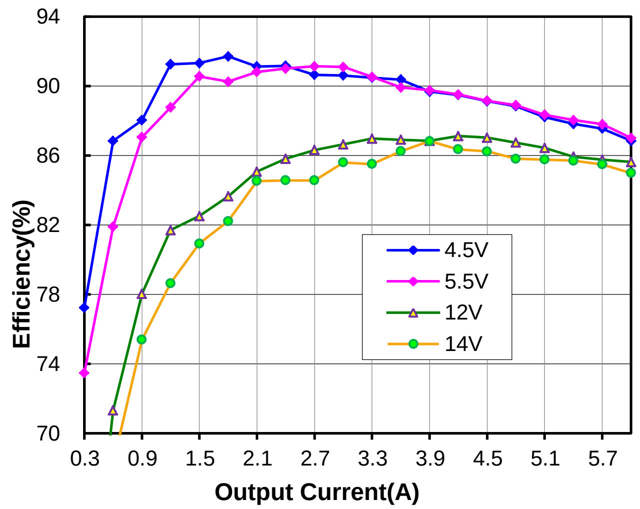
Start-up V_{IN}=5V, I_O=6A
(C2: Output,C1: Input)



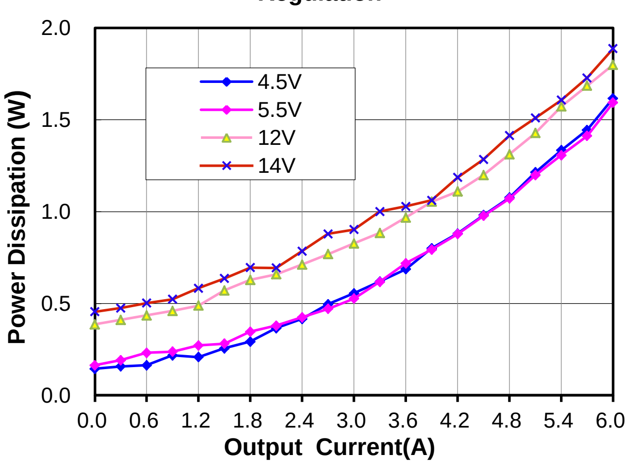
Short-Circuit Output V_{IN}=5V
(C2: Output voltage,C3: output current)



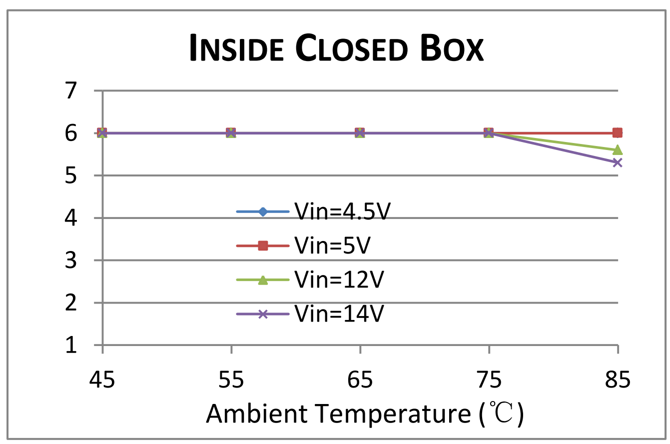
Regulation



Efficiency



Power Dissipation



Output Current Derating

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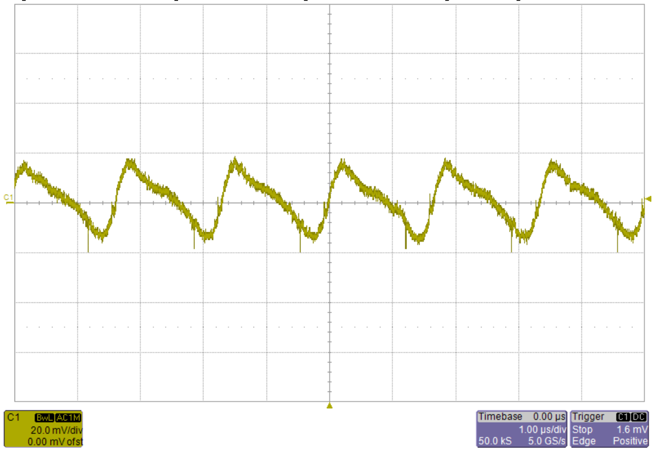
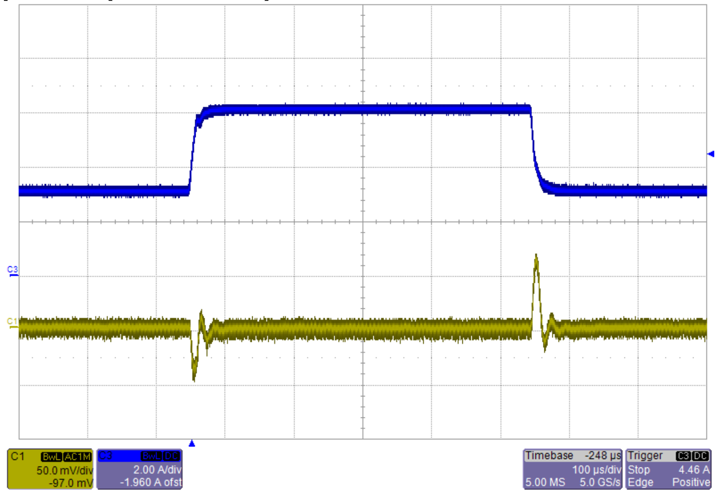
Typical Characteristics– output adjusted to 2.5V

General conditions:

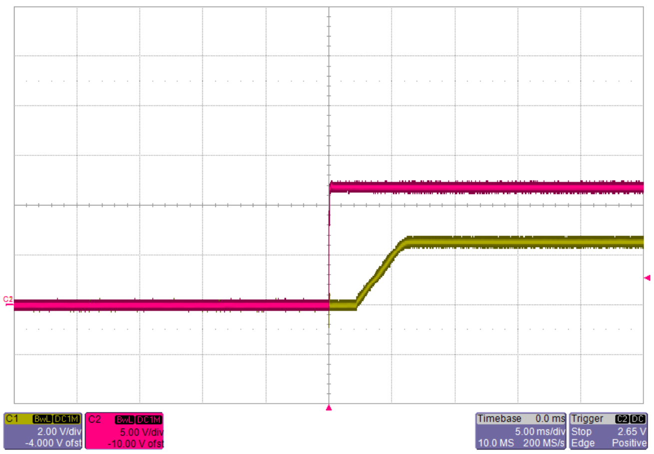
Input filter: 68µF*3 TAN (50mΩ ESR), Output filter: 100µF TAN (150mΩ ESR)



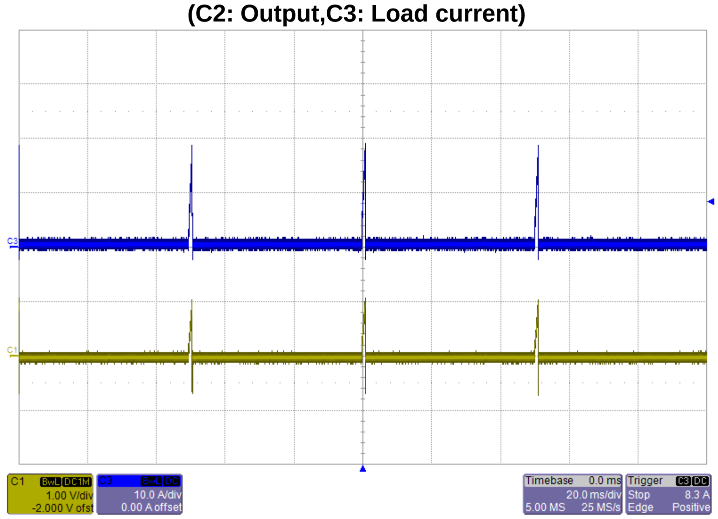
Noise V_{IN}=12V, I_O=6A, 5~20MHz Bandwidth



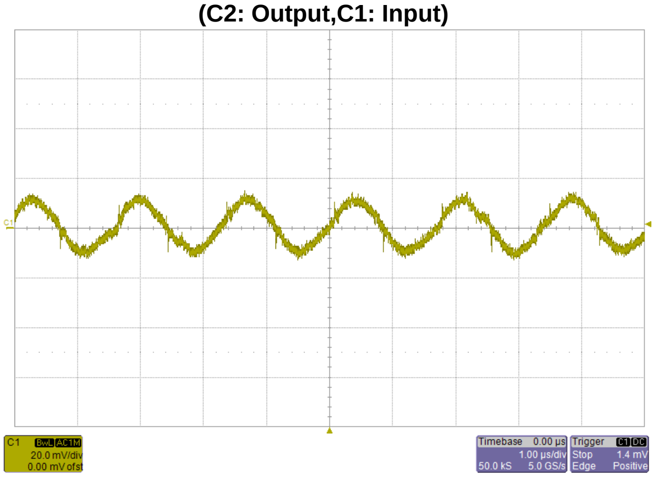
Transient Response V_{IN}=12V, Step from 3A~6A~3A (C2: Output,C3: Load current)



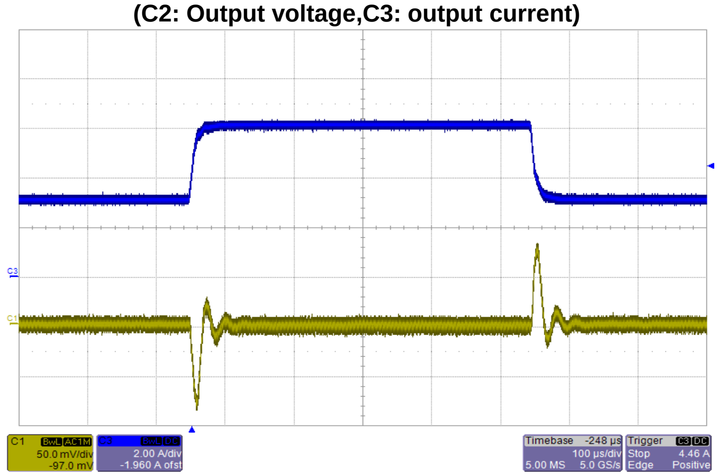
Start-up V_{IN}=12V, I_O=6A (C2: Output,C1: Input)



Short-Circuit Output V_{IN}=12V (C2: Output voltage,C3: output current)



Noise V_{IN}=5V, I_O=6A, 5~20MHz Bandwidth



Transient Response V_{IN}=5V, Step from 3A~6A~3A (C2: Output,C3: Load current)

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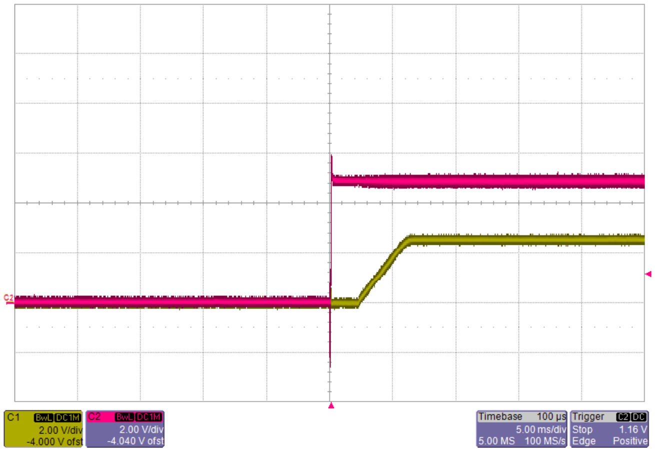
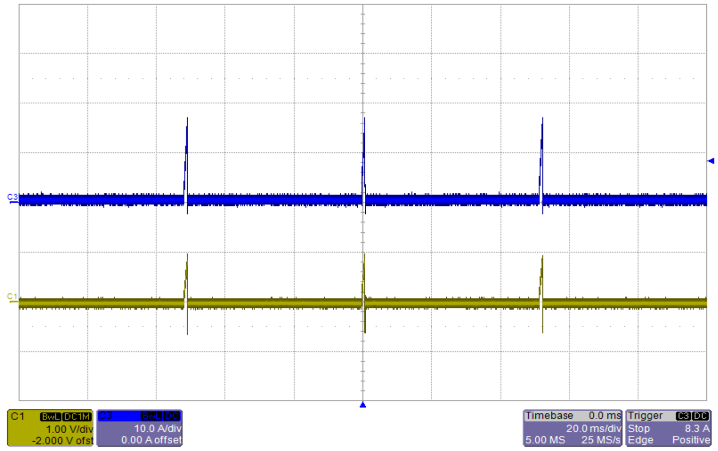
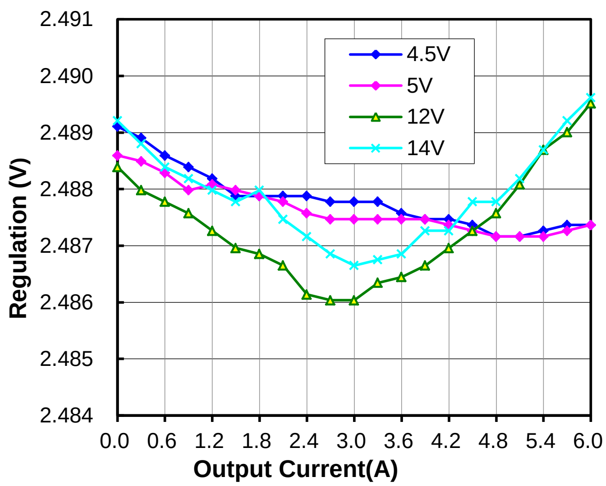


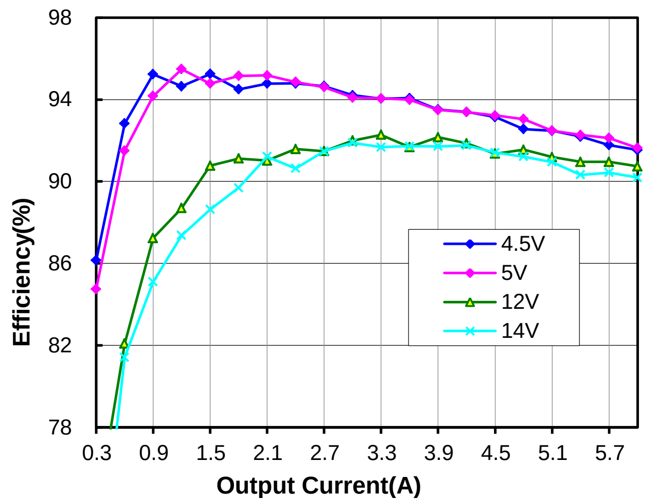
Start-up V_{IN}=5V, I_O=6A
(C2: Output,C1: Input)



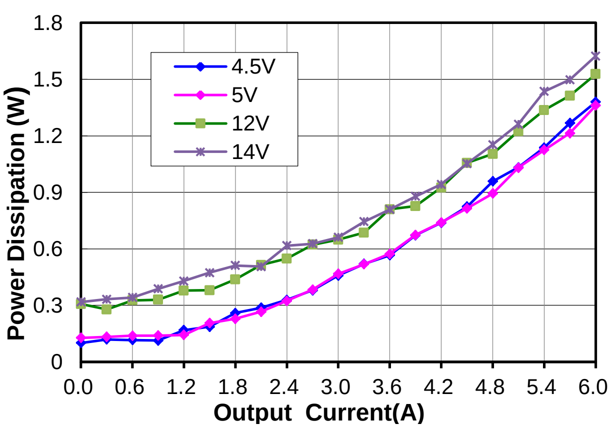
Short-Circuit Output V_{IN}=5V
(C2: Output voltage,C3: output current)



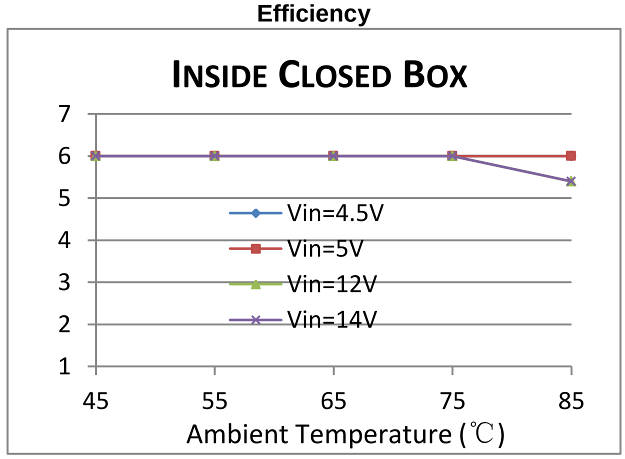
Regulation



Efficiency



Power Dissipation



Output Current Derating

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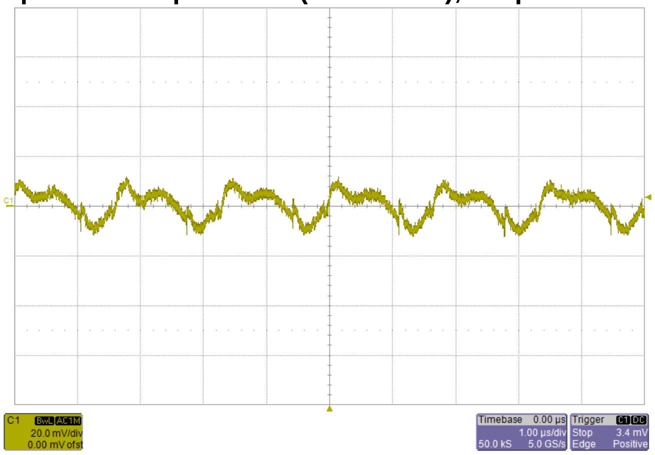
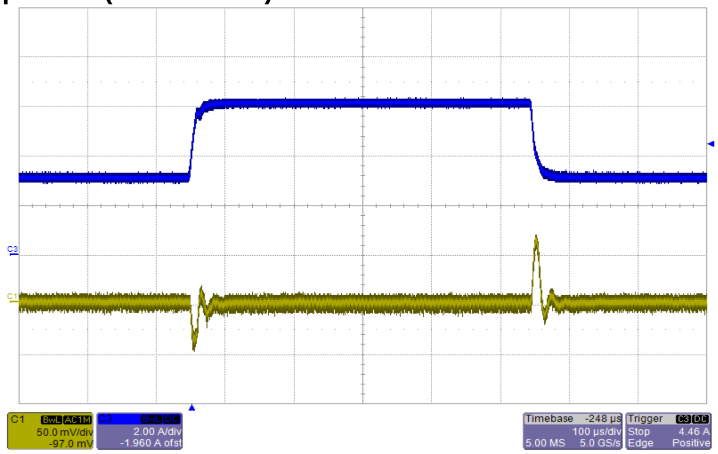
Typical Characteristics– output adjusted to 3.3V

General conditions:

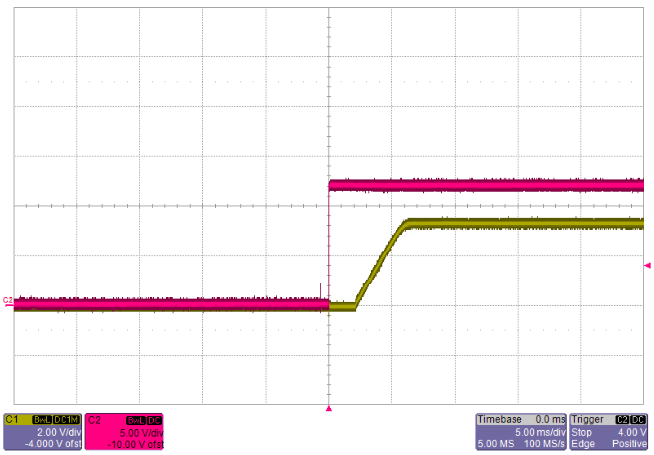
Input filter: 68μF*3 TAN (50mΩ ESR), Output filter: 100μF TAN (150mΩ ESR)



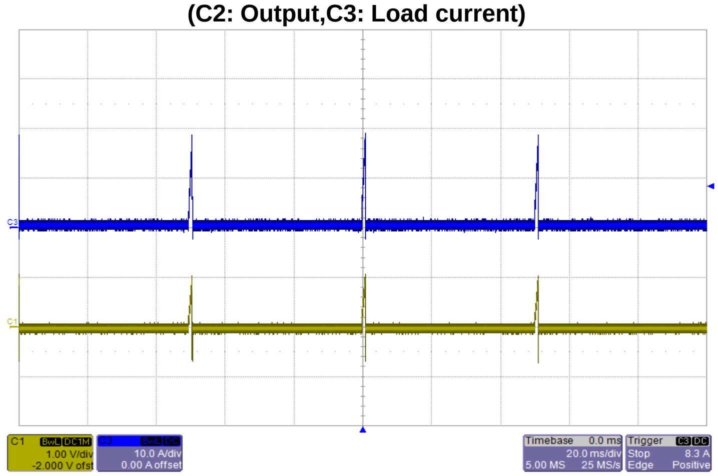
Noise V_{IN}=12V, I_O=6A, 5~20MHz Bandwidth



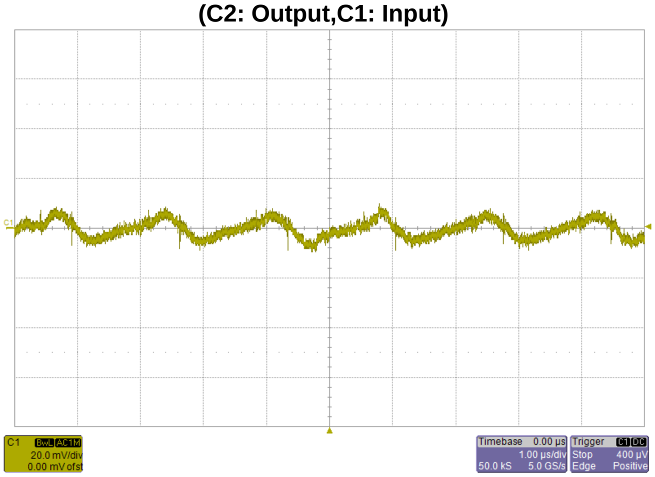
Transient Response V_{IN}=12V, Step from 3A~6A~3A (C2: Output,C3: Load current)



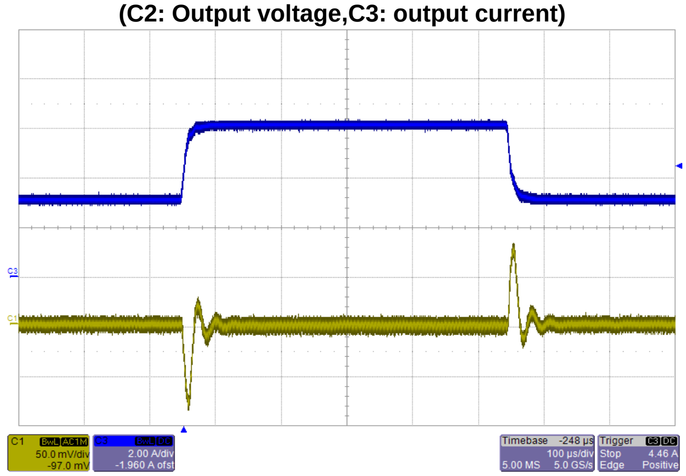
Start-up V_{IN}=12V, I_O=6A (C2: Output,C1: Input)



Short-Circuit Output V_{IN}=12V (C2: Output voltage,C3: output current)



Noise V_{IN}=5V, I_O=6A, 5~20MHz Bandwidth



Transient Response V_{IN}=5V, Step from 3A~6A~3A (C2: Output,C3: Load current)

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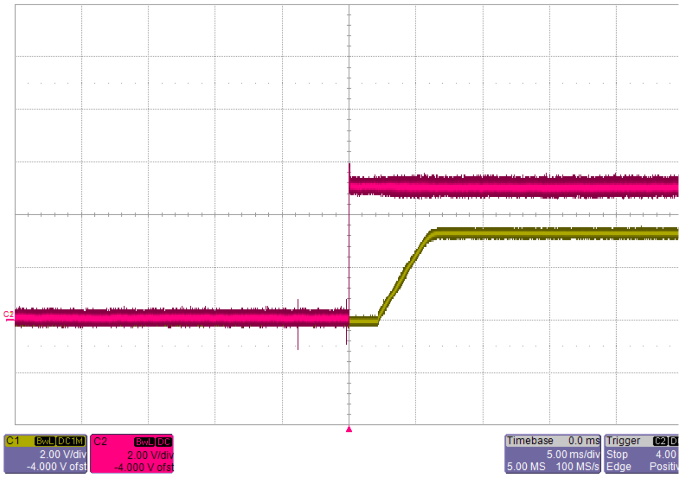
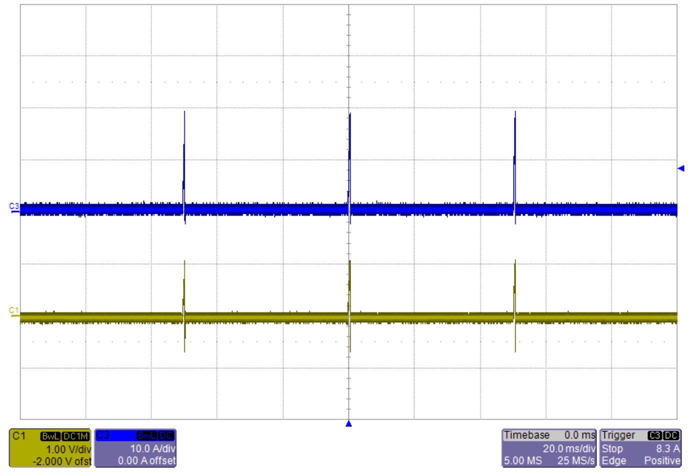
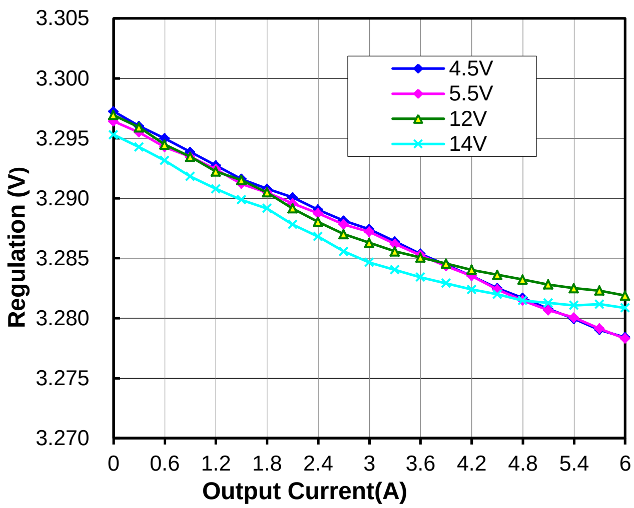


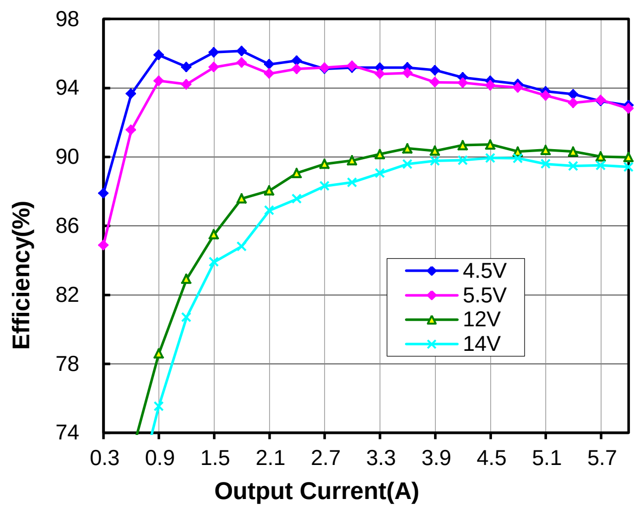
Start-up V_{IN}=5V, I_O=6A
(C2: Output,C1: Input)



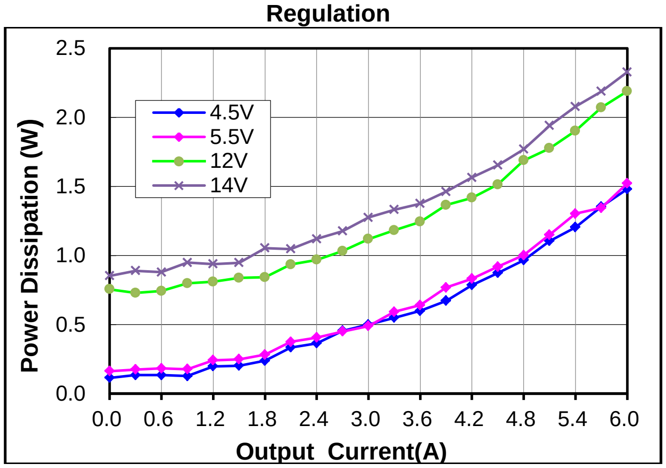
Short-Circuit Output V_{IN}=5V
(C2: Output voltage,C3: output current)



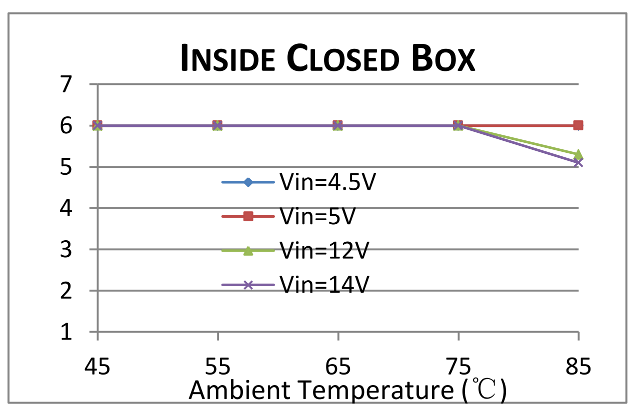
Regulation



Efficiency



Power Dissipation



Output Current Derating

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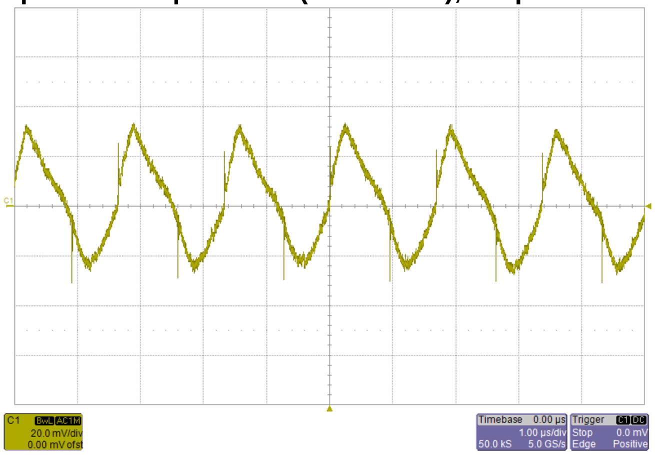
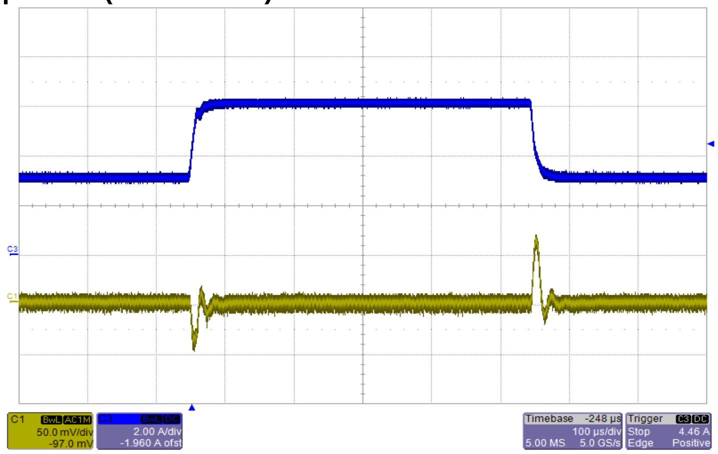
Typical Characteristics– output adjusted to 5.0V

General conditions:

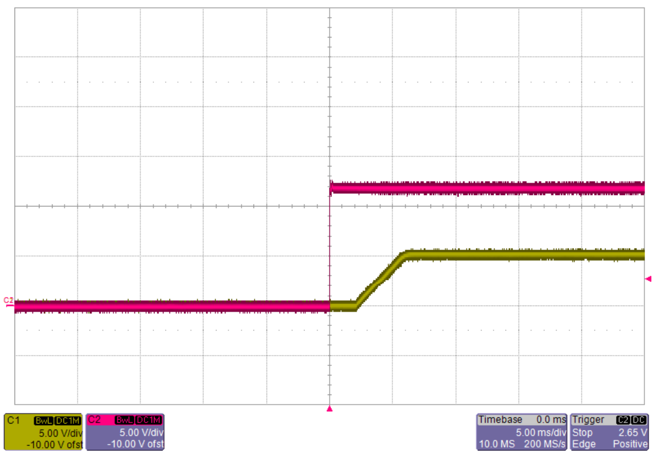
Input filter: 68µF*3 TAN (50mΩ ESR), Output filter: 100µF TAN (150mΩ ESR)



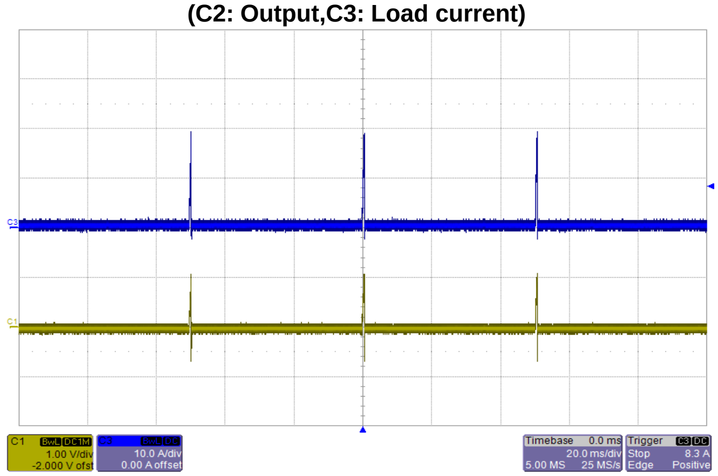
Noise V_{IN}=12V, I_O=6A, 5~20MHz Bandwidth



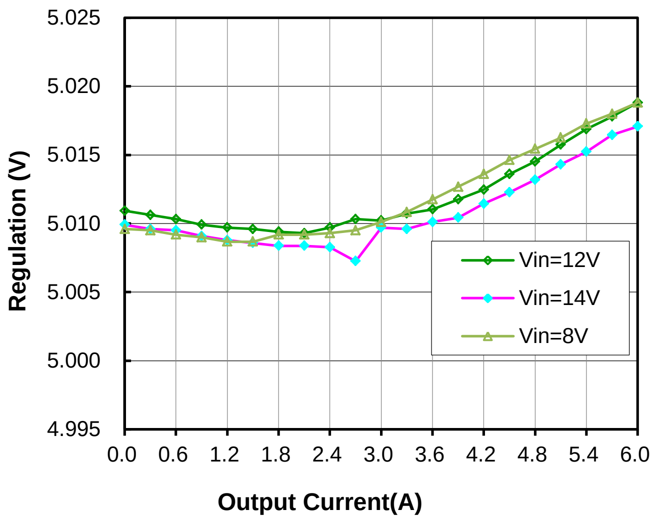
Transient Response V_{IN}=12V, Step from 3A~6A~3A (C2: Output,C3: Load current)

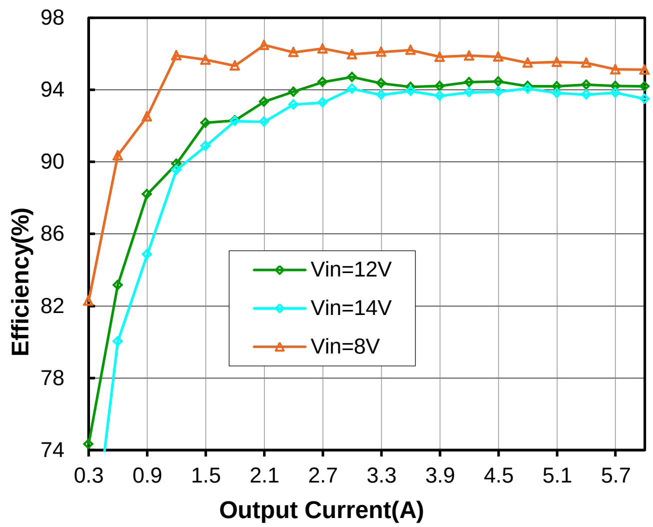


Start-up V_{IN}=12V, I_O=6A (C2: Output,C1: Input)



Short-Circuit Output V_{IN}=12V (C2: Output voltage,C3: output current)





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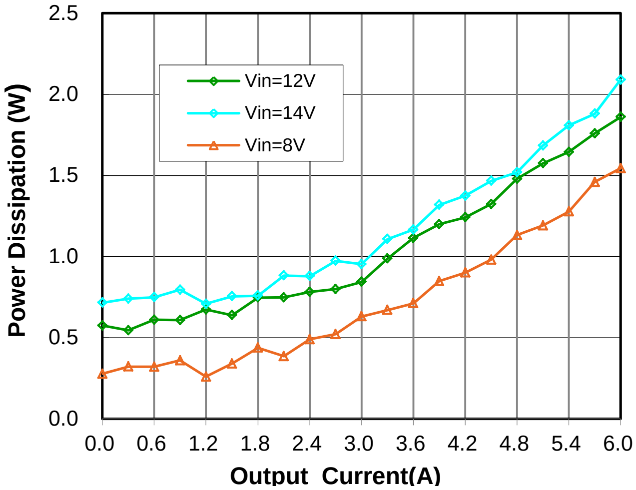

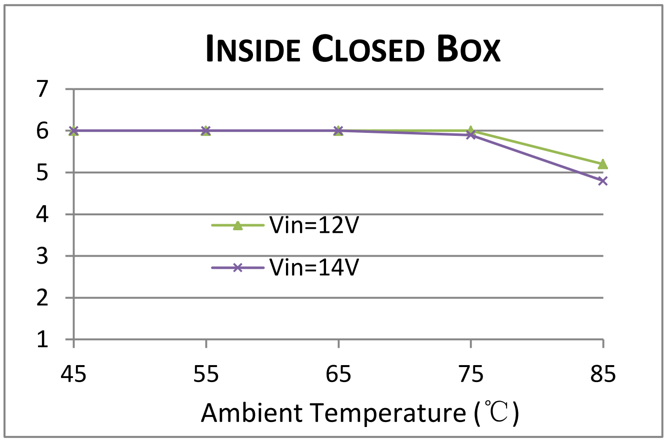

Output Current Derating

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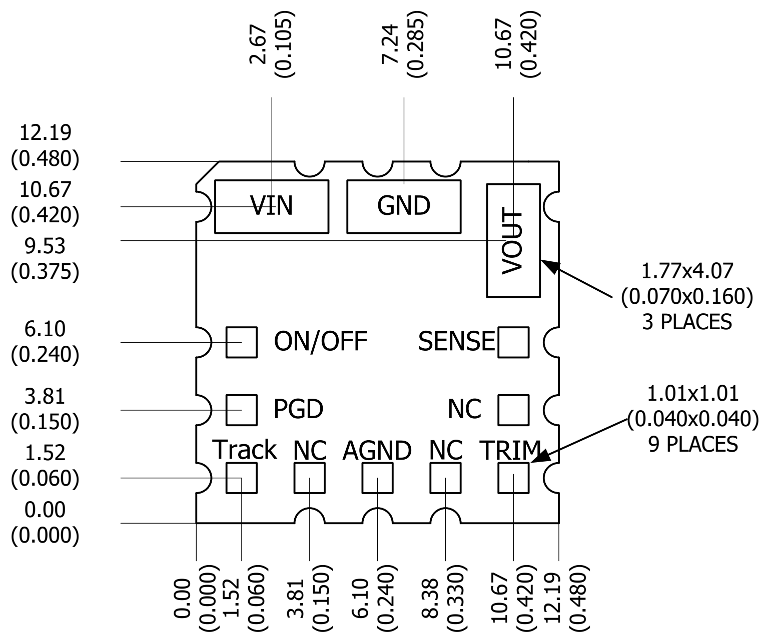
Recommended PAD Pattern

Dimensions are millimeters (inches)
Tolerances: x.x mm±0.5mm (x.xx in ±0.02 in);
x.xx mm±0.25mm (x.xxx in ±0.01 in)



COMPONENT-SIDE FOOTPRINT

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Application Notes

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