MQ7320
Non-isolated wide input, Buck-Boost 40W DC-DC Power Module

Features

- Wide input voltage: 6V ~ 36V
- Full load operating voltage: 9~30V
- Output power up to 40W
- Output voltage ripple: 60mV$_{PP}$(12V output)
- High Efficiency 94%(12Vin/12Vout with 40W load)
- Overcurrent /shortcircuit protection – continuous, Re-startup automatically after fault release
- Remote on/off control-negative logic
- Input under-/over-voltage protection -- shutdown
- High reliability: designed to meet 20 million hour MTBF
- Minimal space on PCB:
- Compact size:
  - 33.0 mm x 25.4 mm x 11.5 mm or
  - 1.3 in x 1.0 in x 0.45in
- No derating to +85℃, natural convection
- UL/IEC/EN60950 compliant
- RoHS Compliant available

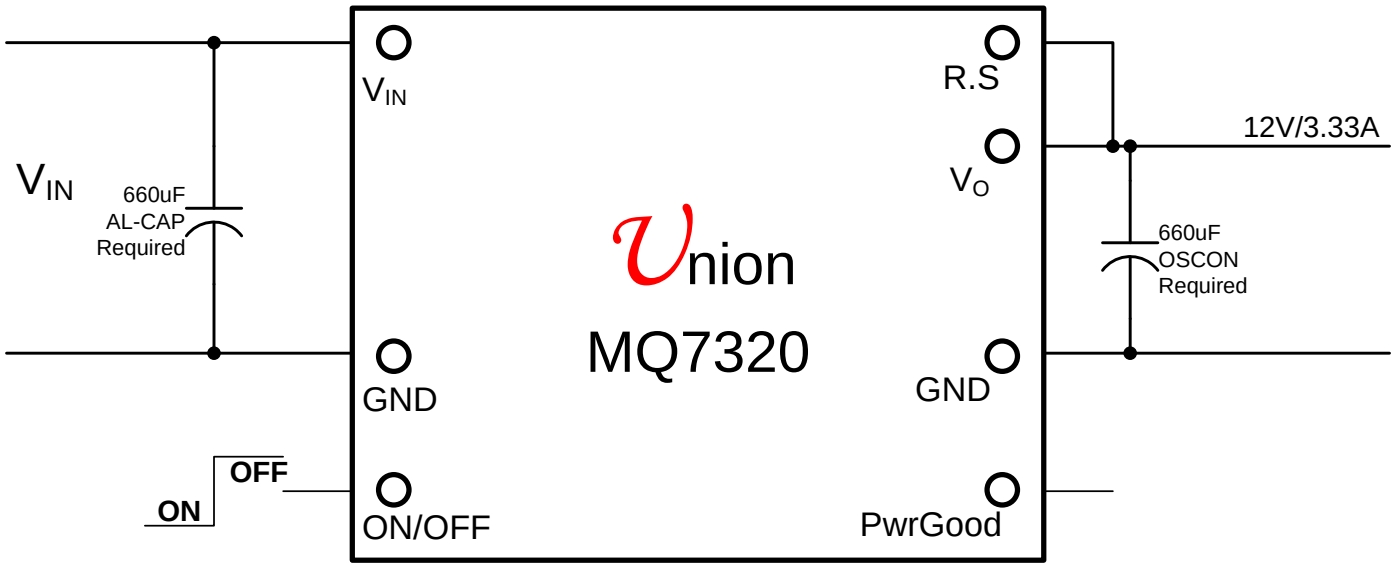
Applications

- Automotive Systems
- Distributed DC Power Systems
- High Power Battery-Operated Devices
- Industrial Control

Description

The ***MQ7320*** Series Power Modules are non-isolated dc-dc converters that operate over a wide input voltage range of 6Vdc to 36Vdc and provide a precisely (2%) regulated dc output. Such a module is suitable to applications with unstable 12V or 24V power supply. The modules have a maximum output power up to 40W at typical full-load efficiency over 94%.

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

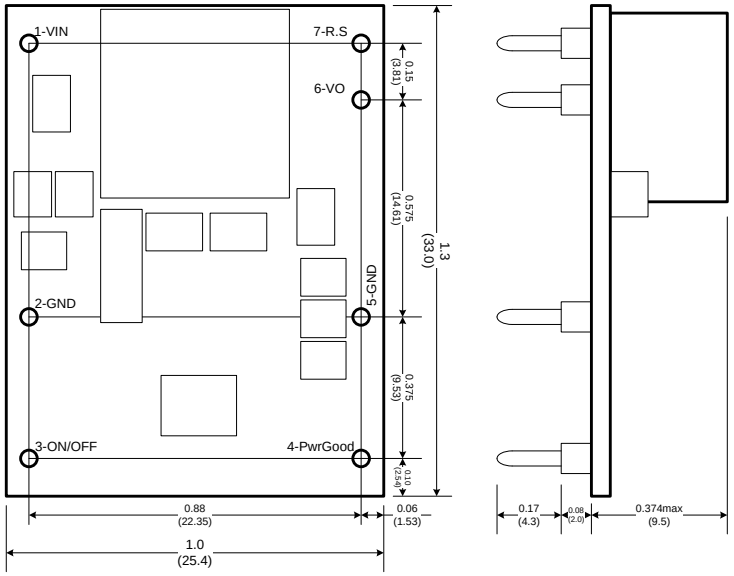


Performance Specifications (at TA=+25℃)

Model	Input V_{IN} Range (V)	Output				Efficiency (%)
		Vout (V)	$I_{OUT.MAX}$ (A)	Regulation		
				Line (%)	Load (%)	
MQ7320T050	6~36	5	8	0.5	0.5	93
MQ7320S050						
MQ7320T120		12	3.33	0.5	0.5	94
MQ7320S120						

Mechanical Specifications

Dimensions are in inches (mm)



PIN	Description
1	V_{IN}
2	GND
3	ON/OFF
4	PwrGood
5	GND
6	V_{OUT}
7	Remote Sense

Ordering Information

MQ7320T120

Union Microsystems P/N#

T: Through Hole
S: SMD

Output Voltage:
120: 12V
050: 5V

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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	40	V
Storage Temperature	T_{STG}	-40	125	℃

MQ7320T/S120 Electrical Specifications: *(T_A=+25°C)*

Parameter	Condition	Symbol	Min	Typ.	Max	Unit
Input Voltage Range		V_{IN}	6		36	V
Output Current	V_{IN}=9~30V	Io	0		3.33	A
Output Voltage Set point	100% load, $V_{IN}=V_{IN.MIN}$	ΔVo	-2		+2	%
Output Trim Range	***See Performance Specifications from page 7~8***					
Line Regulation						
Load Regulation						
Temperature Regulation	$T_A= T_{A.MIN}$ To $T_{A.MAX}$	-		0.4		$\%V_{O.SET}$
Output Ripple and Noise Voltage	Io=5A,0~20MHz（***Detail Please see Ripple Figures, Page 7~8***）					
Transient Response						

General Specifications

Parameter	Condition	Symbol	Min	Typ.	Max	Unit
Minimum Output Capacitive	3.33A resistive load, OSCON			660		uF
Overcurrent Protection					5	A
Output short-circuit current (average)	All				5	A
Under Voltage Lockout Trip Level	Rising			5.7		V
	Falling			5.2		
Over-voltage Lockout Trip Level				39		V
Logic High (Module OFF)		V_{IH}	2.5		10	V
Logic Low (Module ON)		V_{IL}	-0.3		1	V
Start-up blanking time		T_{BLK}			10	mS
Start-up Time	3A resistive load, no external output capacitors			25		mS
Switching Frequency		Fo		400		kHz
Operating Temperature	Natural convection, no forced air flow		-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

MQ7320T/S050 Electrical Specifications: *(T_A=+25°C)*

Parameter	Condition	Symbol	Min	Typ.	Max	Unit
Input Voltage Range		V_{IN}	6		36	V
Output Current	V_{IN}=9~30V	Io	0		8	A
Output Voltage Set point	100% load, V_{IN}=$V_{IN.MIN}$	ΔVo	-2		+2	%
Output Trim Range	***See Performance Specifications from page 7~8***					
Line Regulation						
Load Regulation						
Temperature Regulation	T_A= $T_{A.MIN}$ To $T_{A.MAX}$	-		0.4		$\%V_{O.SET}$
Output Ripple and Noise Voltage	Io=8A,0~20MHz（***Detail Please see Ripple Figures, Page 7~8***）					
Transient Response						

General Specifications

Parameter	Condition	Symbol	Min	Typ.	Max	Unit
Minimum Output Capacitive	8A resistive load, OSCON			660		uF
Overcurrent Protection					5	A
Output short-circuit current (average)	All				5	A
Under Voltage Lockout Trip Level	Rising			5.7		V
	Falling			5.2		
Over-voltage Lockout Trip Level				39		V
Logic High (Module OFF)		V_{IH}	2.5		10	V
Logic Low (Module ON)		V_{IL}	-0.3		1	V
Start-up blanking time		T_{BLK}			10	mS
Start-up Time	8A resistive load, no external output capacitors			25		mS
Switching Frequency		Fo		400		kHz
Operating Temperature	Natural convection, no forced air flow		-40		85	℃
Vibration	8 Axes, 5 Min Each	10~55Hz，0.35mm，5g				
	8 Axes, 6 Times Each	Peak Deviation 300g，Settling Time 6mS				
MTBF		5,000,000				Hour

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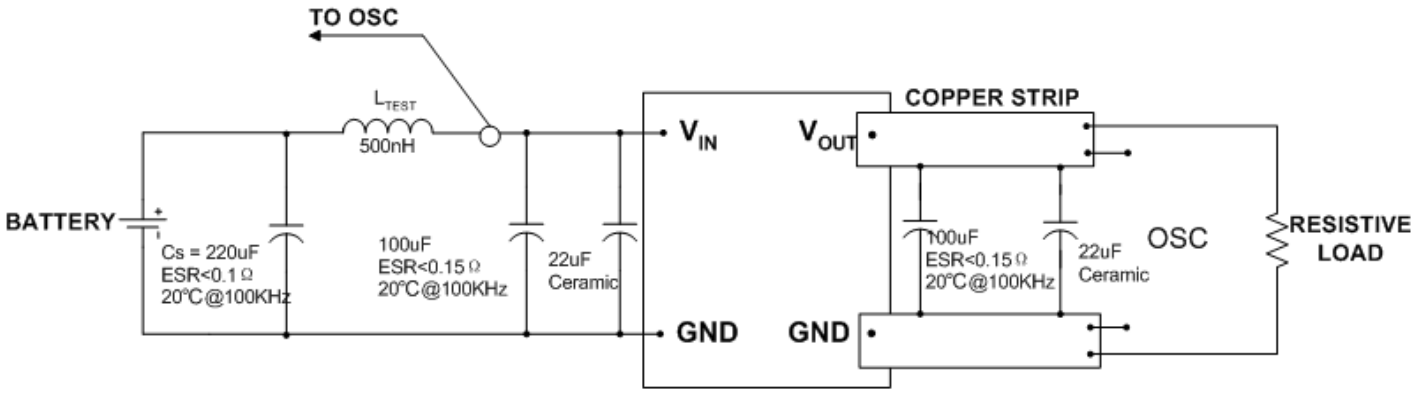
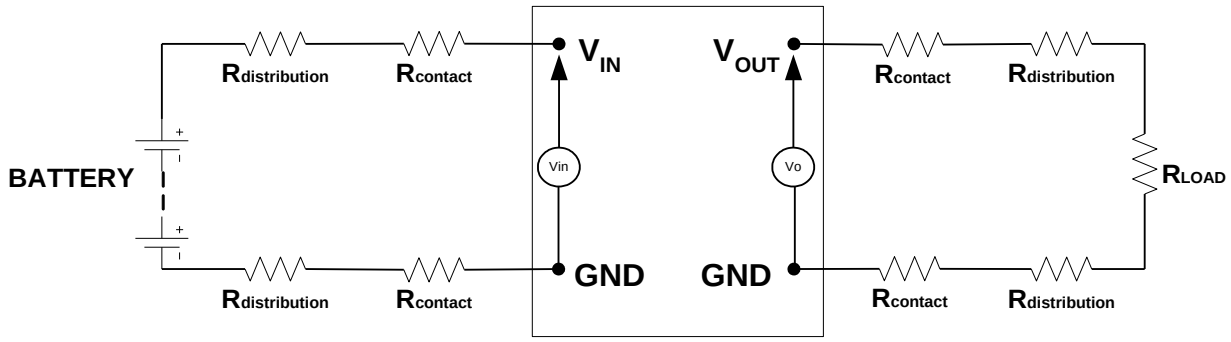
Test Configurations



Test setup for input noise, output noise and ripple

Note:

Output noise is measured with 0.1μ F 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 MQ7320 Series can be used in a wide variety of applications, esp. unregulated 12V or 24V power supply bus system. So, when system voltage transferred from unregulated input to regulated 12V, no redesign needed which simplifies design, speeds the time to market and adds flexibility to system.

Return Current Paths

The MQ7320 Series is non-isolated DC/DC converters. Their input and output shares same Common pins. To the extent possible with the intent of minimizing ground loops, input/output return current should be directed the Common pins as short as possible.

I/O Filtering

All the specifications of the MQ7320 Series are tested and specified without 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 MQ7320 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.

MQ7320'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 MQ7320's Maximum Capacitive Load to avoid the module's protection condition in the start-up.

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 MQ7320 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 module's maximum input current, 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

MQ7320'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.

ON/OFF Control

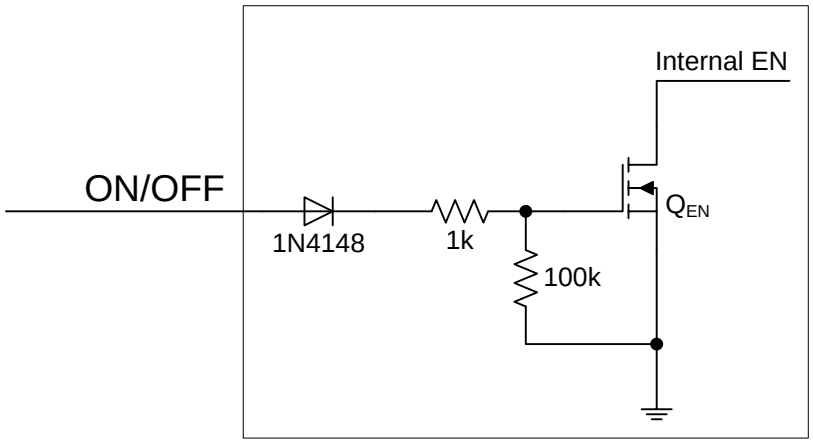


Fig1. Remote ON/OFF circuit inside power module

The MQ7320 power modules feature an On/Off pin for remote On/Off operation. If not using the remote On/Off pin, leave the pin open (module will be ON). Refer to Fig1, the On/Off pin signal is referenced to Ground. Applying a standard TTL logic level to this PIN can switch module on and off. During a logic-low when the transistor Q_{EN} inside power module is in the OFF state, the power module is ON and the maximum Von/off of the module is 1V. During a logic-high when Q_{EN} is in the active state, the power module is OFF.

Input Under-voltage Protection

MQ7320 Series products include input under-voltage protection. If the input voltage is lower than under-voltage trip level, the power module will be latched off without output. For avoiding any oscillating, the trip level is with 0.5V hysteresis.

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Input Overvoltage Protection

MQ7320 Series products include input over-voltage protection. If the input voltage is higher than over-voltage trip level, the power module will be latched off without output.

Output Overvoltage Protection

MQ7320 Series products do not incorporate output overvoltage 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)

MQ7320 incorporates overcurrent and short circuit protection. If the load current exceeds the overcurrent protection setpoint, the MQ7320'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 1~2A.

***Caution*: Be careful never to operate MQ7320 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.**

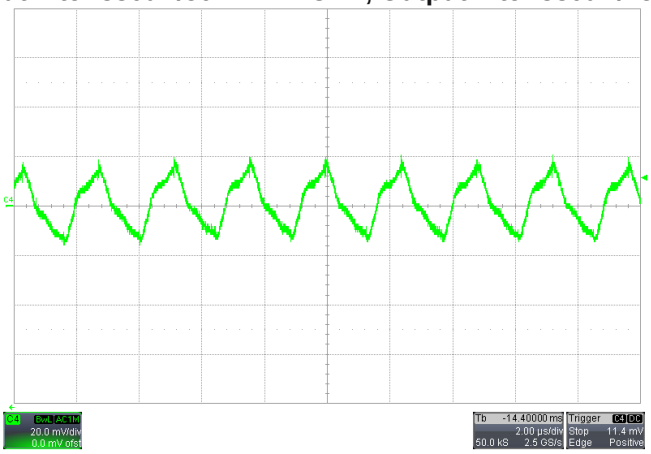
Power Good

MQ7320's modules provide a Power Good (PwrGood) signal to indicate that the output voltage is within the regulation limits of the power module. The PwrGood signal will be de-asserted to a low state if any condition such as overtemperature, overcurrent or loss of regulation occurs that would result in the output voltage going ±10% outside the set-point value. The PwrGood terminal is internally pulled-up and provides a voltage of 5.5V, when asserted, thus eliminating the need for an external source and pull-up resistor.

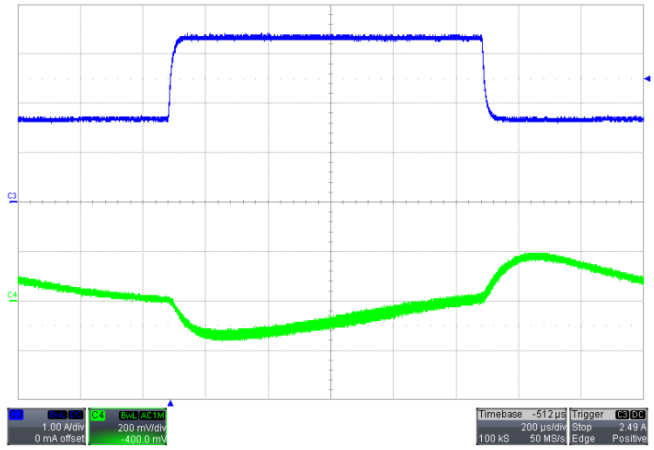
Typical Characteristics – output set to 12V

General conditions:

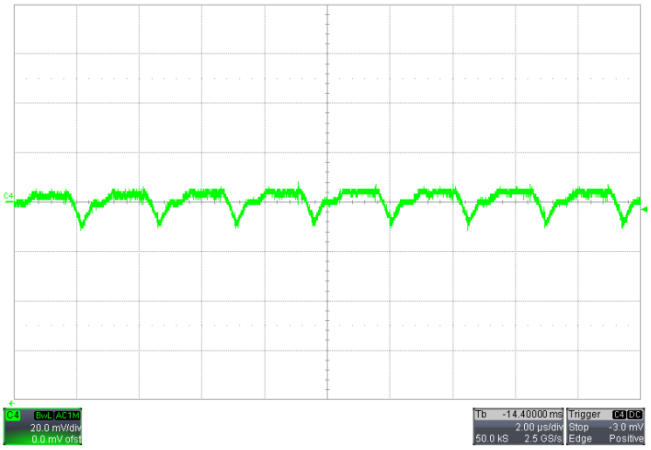
Input filter 330uF/50V*2 AL-CAP, Output filter 330uF/25V*2 POSCAP



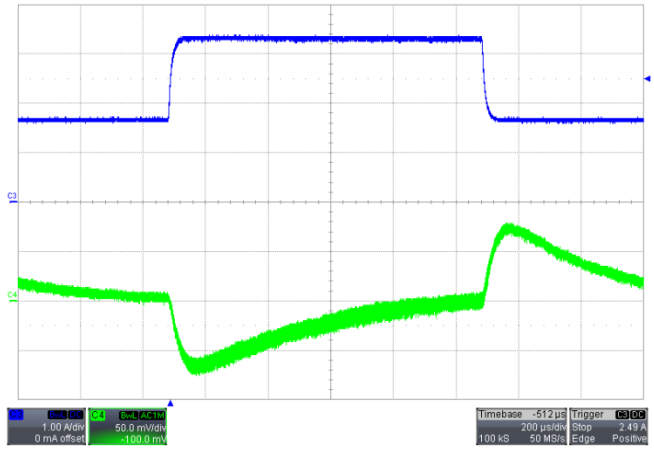
Noise V_{IN}=6V, I_O=2A, 5~20MHz Bandwidth



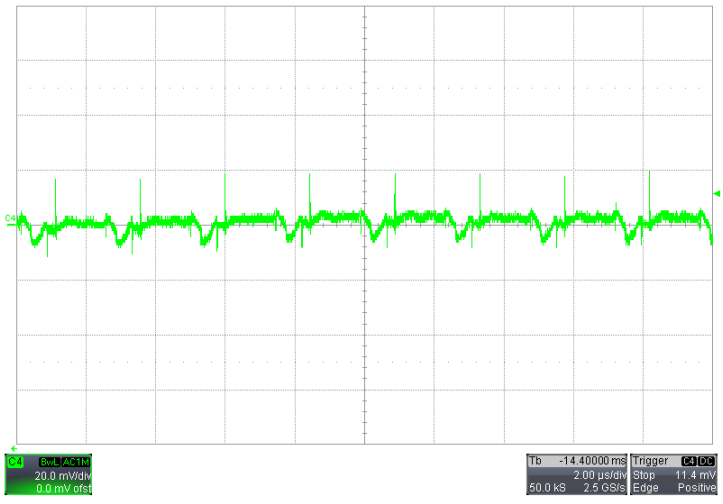
Transient Response V_{IN}=6V, Load step 1.65A~3.33A~1.65A



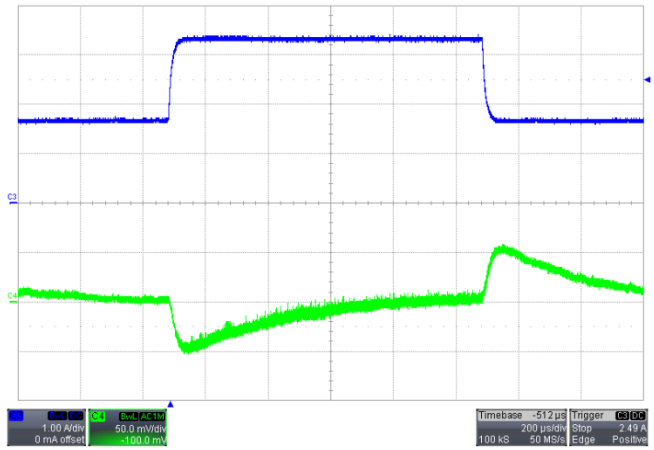
Noise V_{IN}=10V, I_O=3.33A, 5~20MHz Bandwidth



Transient Response V_{IN}=10V, Load step 1.65A~3.33A~1.65A



Noise V_{IN}=12V, I_O=3.33A, 5~20MHz Bandwidth



Transient Response V_{IN}=12V, Load step 1.65A~3.33A~1.65A

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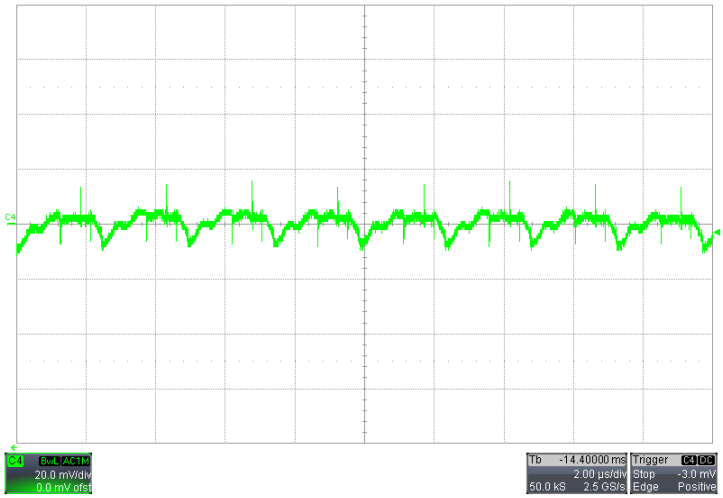
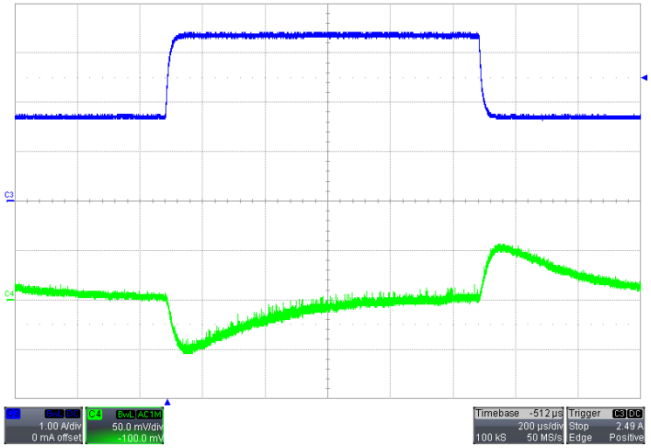
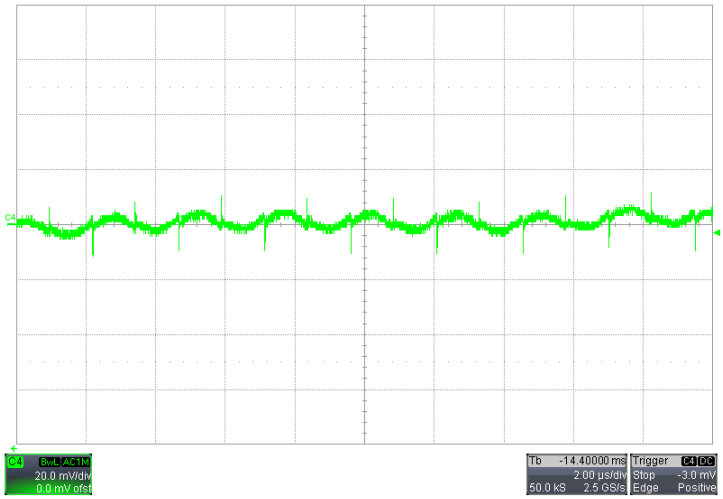


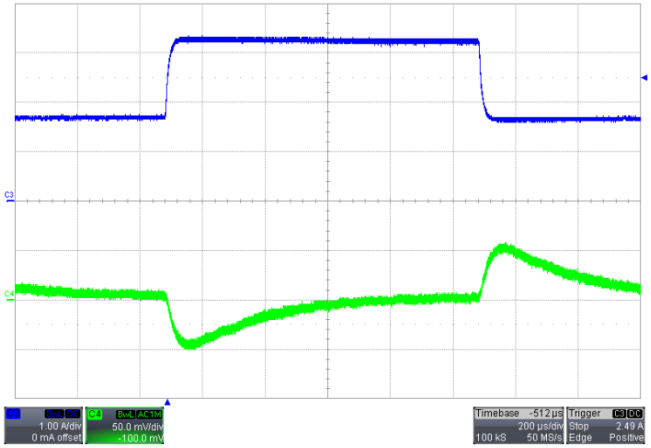
Noise V_{IN}=14V, I_O=2A, 5~20MHz Bandwidth



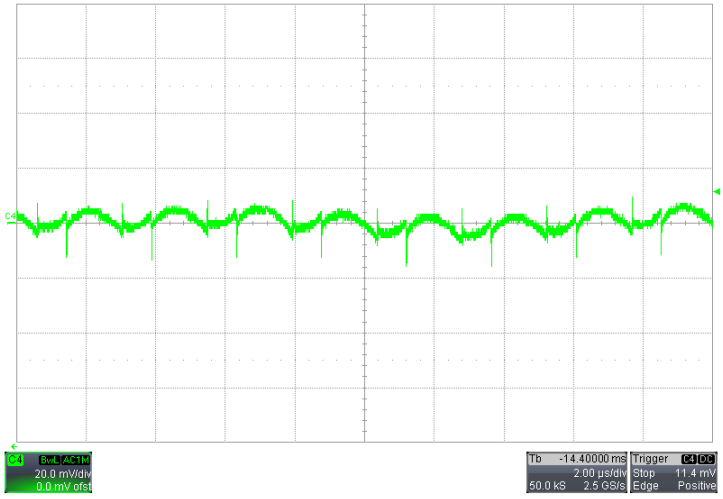
Transient Response V_{IN}=14V, Load step 1.65A~3.33A~1.65A



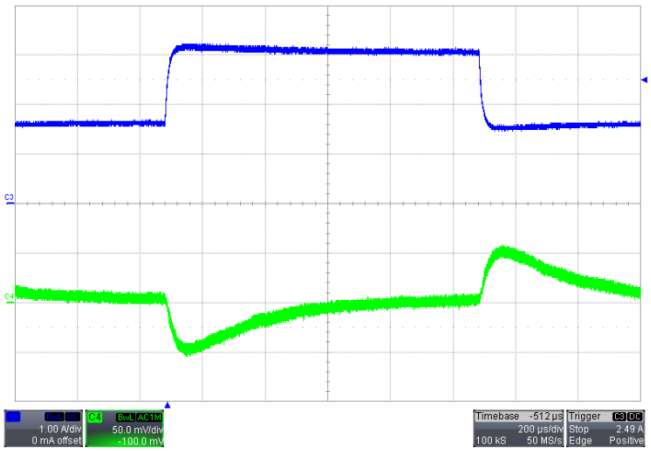
Noise V_{IN}=24V, I_O=3.33A, 5~20MHz Bandwidth



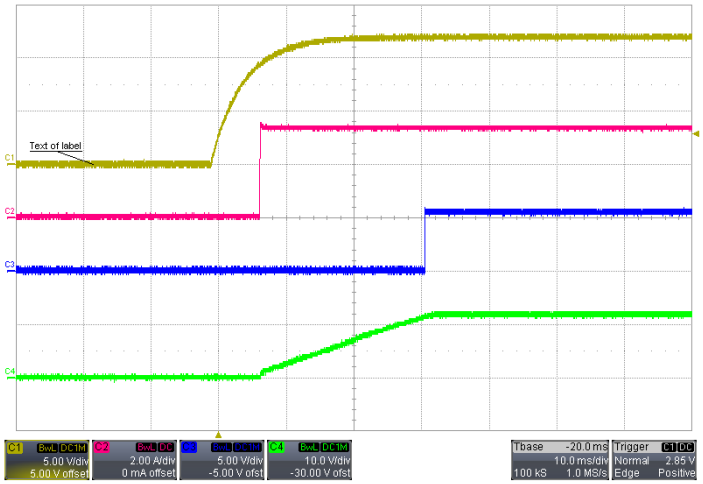
Transient Response V_{IN}=24V, Load step 1.65A~3.33A~1.65A



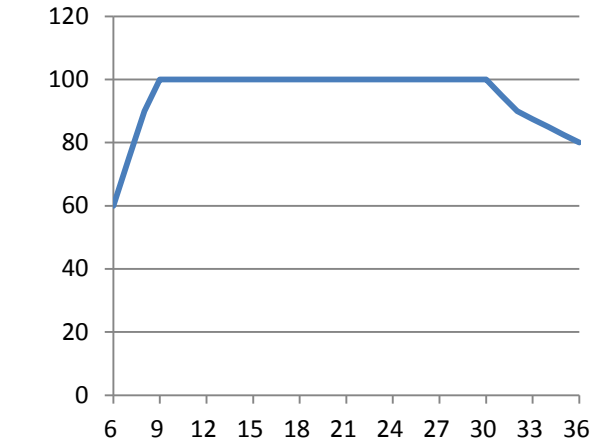
Noise V_{IN}=36V, I_O=3.33A, 5~20MHz Bandwidth



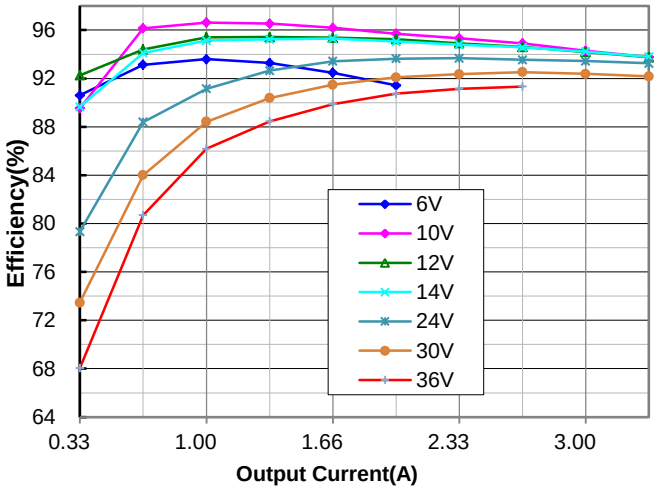
Transient Response V_{IN}=36V, Load step 1.65A~3.33A~1.65A

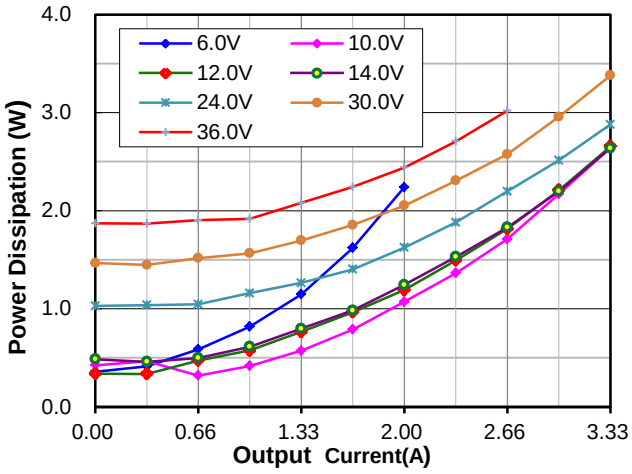


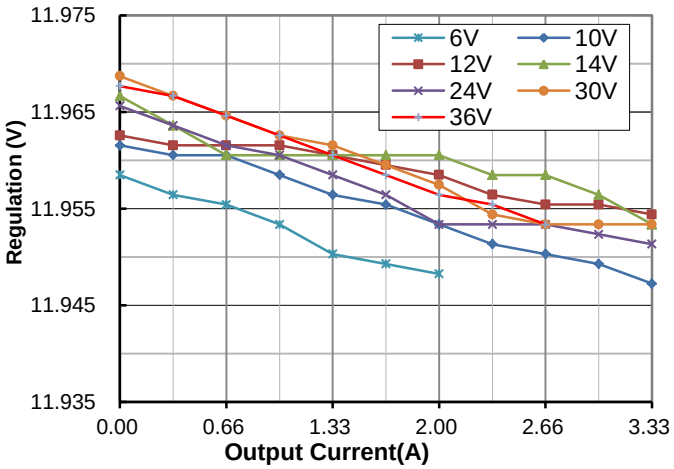
100% Load start up with 12V input
(C1: V_{IN}, C2: Load current, C3: PwrGood, C4: V_{OUT})

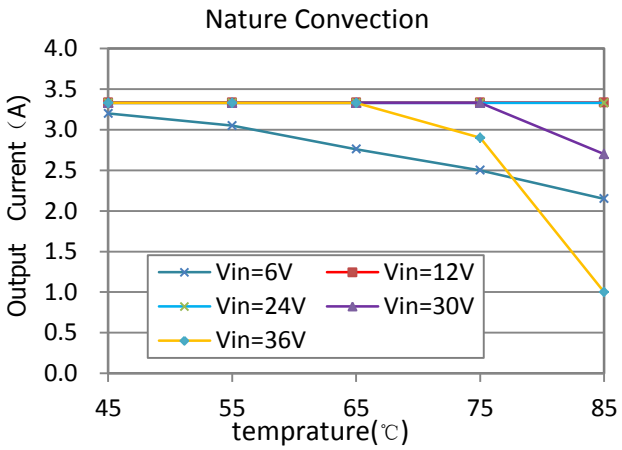


Continuous load capability(%$I_{O.MAX}$) vs. input voltage(V)









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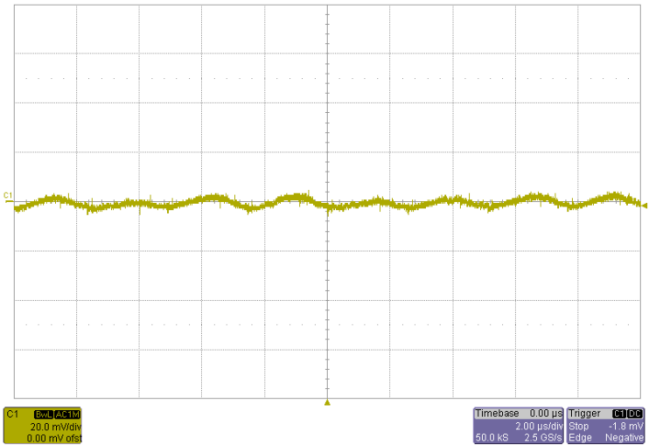
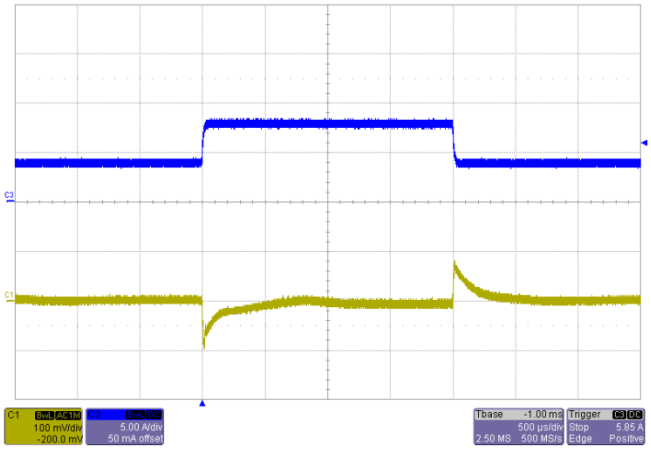
Typical Characteristics – output set to 5V

General conditions:

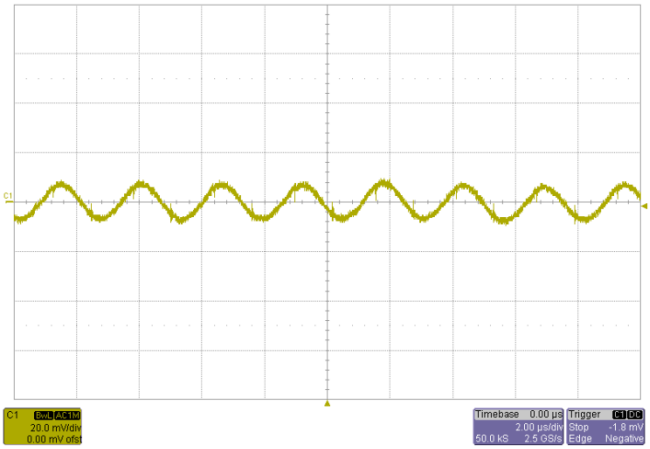
Input filter 330uF/50V*2 electrolytic capacitor, Output filter 330uF/50V*2electrolytic capacitor



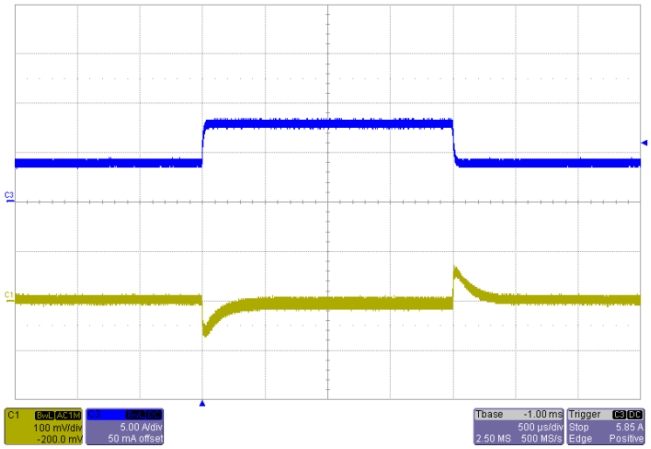
Noise V_{IN}=6V, I_O=8A, 5~20MHz Bandwidth



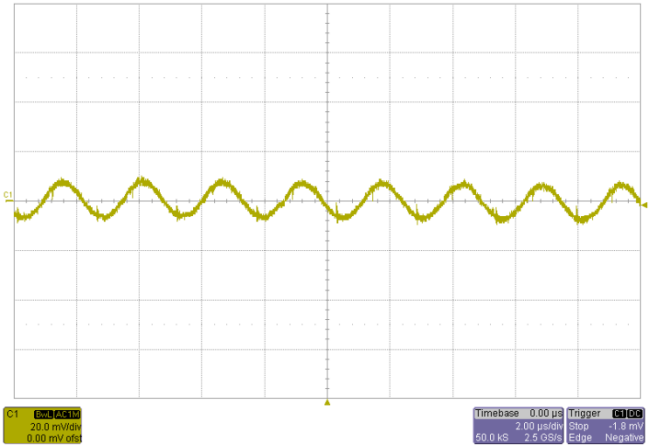
Transient Response V_{IN}=6V, Load step 100%~50%~100%A



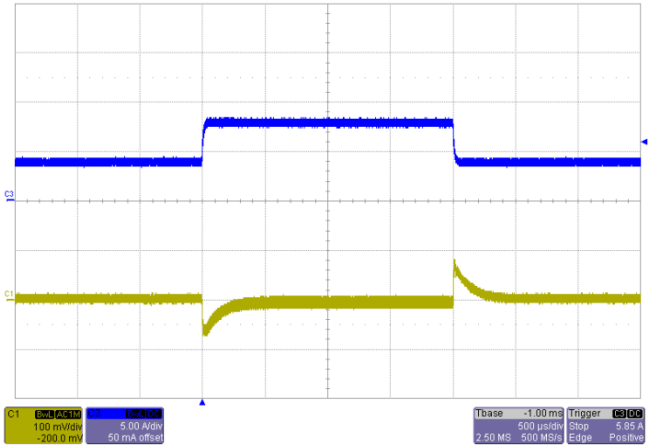
Noise V_{IN}=10V, I_O=8A, 5~20MHz Bandwidth



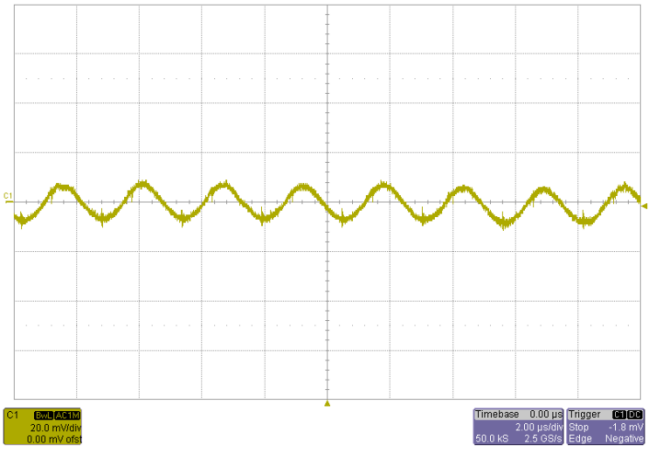
Transient Response V_{IN}=10V, Load step 100%~50%~100%A



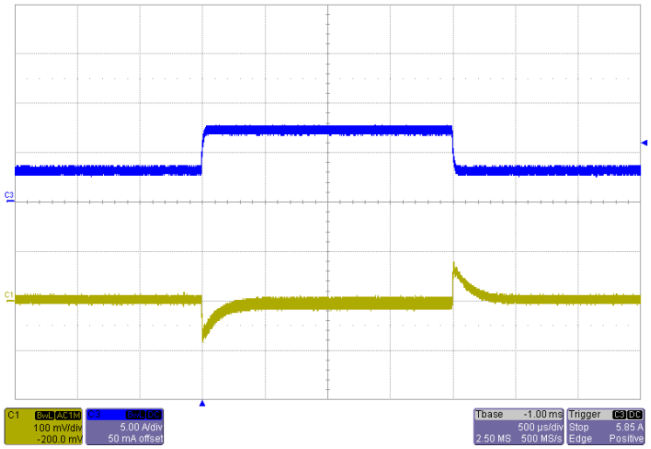
Noise V_{IN}=12V, I_O=8A, 5~20MHz Bandwidth



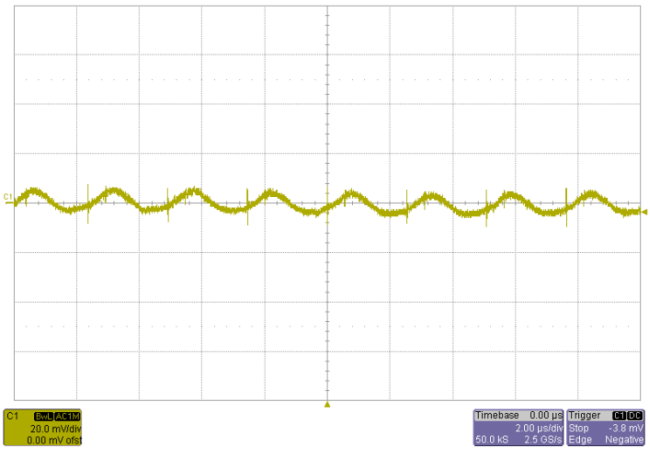
Transient Response V_{IN}=12V, Load step 100%~50%~100%A



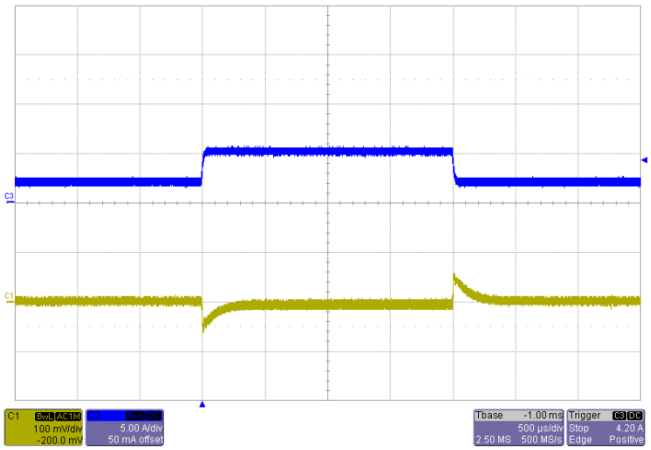
Noise V_{IN}=14V, I_O=8A, 5~20MHz Bandwidth



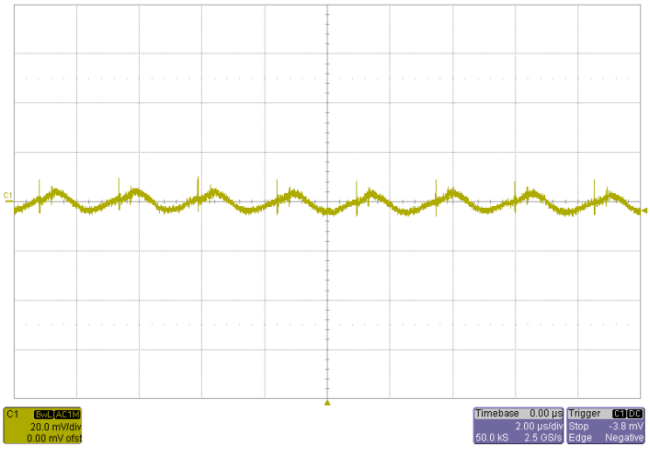
Transient Response V_{IN}=14V, Load step 100%~50%~100%A



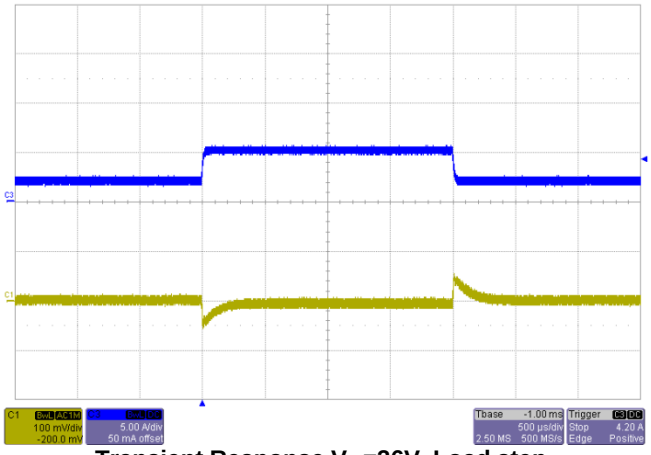
Noise V_{IN}=24V, I_O=6A, 5~20MHz Bandwidth



Transient Response V_{IN}=24V, Load step 100%~50%~100%A



Noise V_{IN}=36V, I_O=6A, 5~20MHz Bandwidth



Transient Response V_{IN}=36V, Load step 100%~50%~100%A

TBD

100% Load start up with 12V input
(C1: V_{IN}, C2: Load current, C3: PwrGood, C4: V_{OUT})

TBD

Continuous load capability(%$I_{O.MAX}$) vs. input voltage(V)

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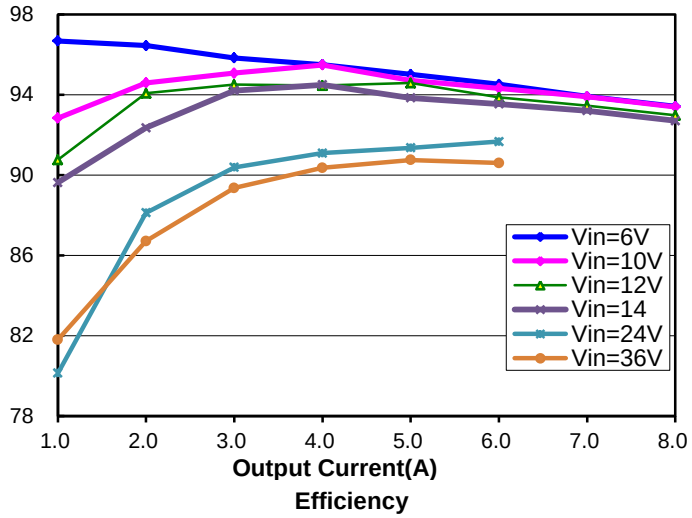
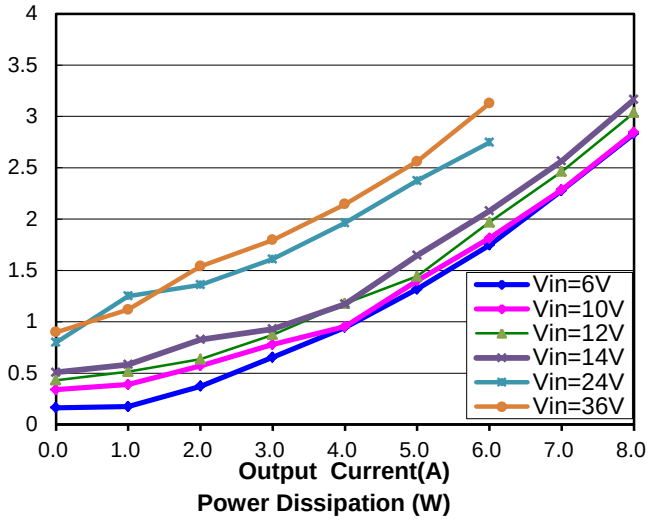
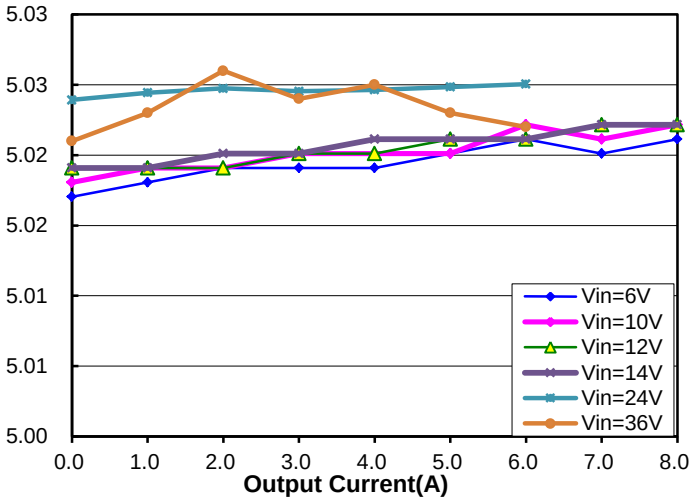


Efficiency



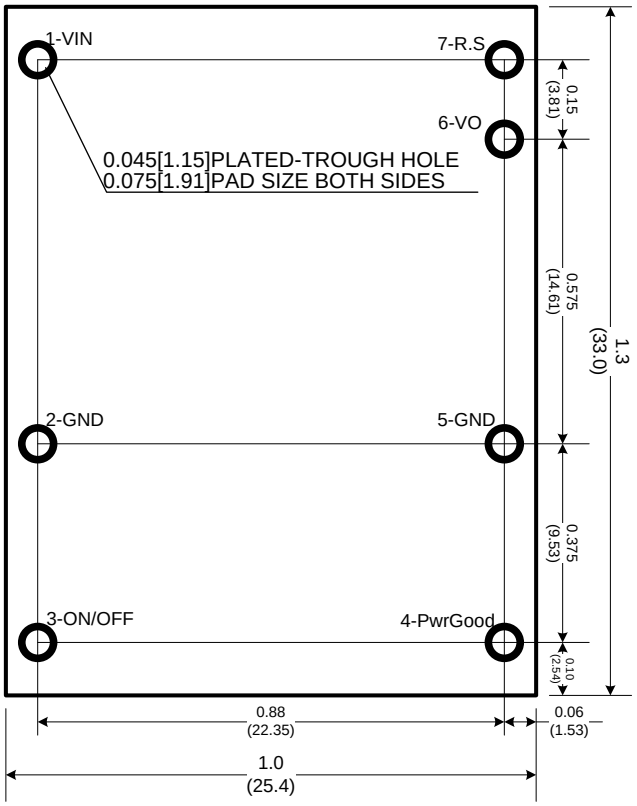
Power Dissipation (W)



Regulation (V)

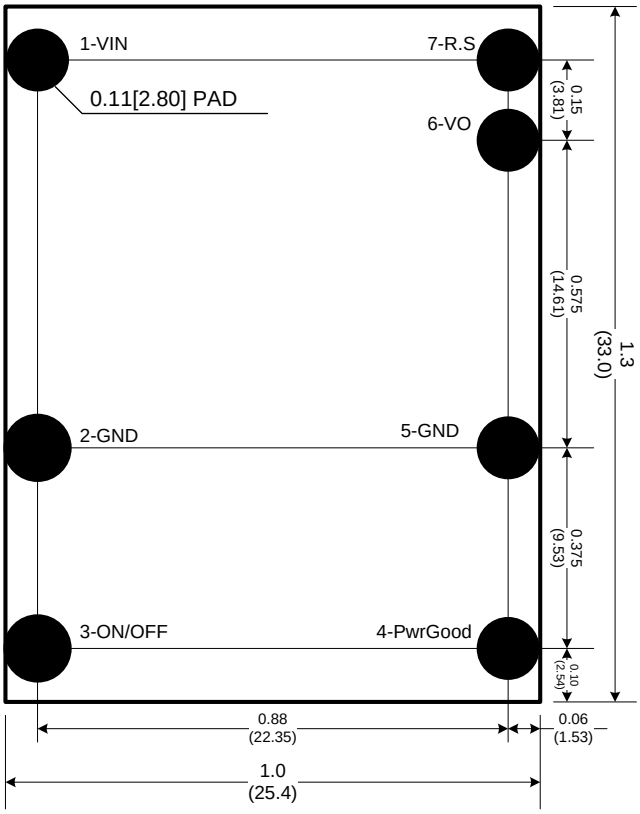
Recommended Hole Pattern

Dimensions are in inches (millimeters)



Component-side footprint for Through Hole

PIN	Description
1	V_{IN}
2	GND
3	ON/OFF
4	PwrGood
5	GND
6	V_{OUT}
7	Remote Sense



Component-side footprint for SMD

PIN	Description
1	V_{IN}
2	GND
3	ON/OFF
4	PwrGood
5	GND
6	V_{OUT}
7	Remote Sense

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Application Notes