MQ7804BS

Isolated 42~57VDC input, single output, 72W DC-DC Converter with active-bridge & bt PoE interface

FEATURES

- Wide operating voltage:
  - 42V ~ 57V
- Integrated active bridge & 802.3bt interface built-in
- Active bridge to reduce power loss
- Output Current:
  - 5V, 14A
  - 12V, 6A
  - 28V, 2.6A
- Output voltage ripple: 45 mVpp (input 48V, 5V@14A)
- High Efficiency 92% (input 48V, 5V@14A including bridge)
- Output Voltage adjust: 90% to 110% of $V_{O,SET}$
- Overcurrent/short-circuit protection
- High reliability: designed to meet 500k hour MTBF
- Minimal space on PCB:
  - 58.4 mm x 22.9 mm x 10.5 mm
  - 2.3 in x 0.9 in x 0.41 in
- No derating to +TBD℃, natural convection
- Design to meet UL/IEC/EN60950
- Operating Temperature: -40 ~ +85℃

APPLICATIONS

- IP Camera & Tilt
- Wireless Access Point
- Video surveillance
- 5G AAU

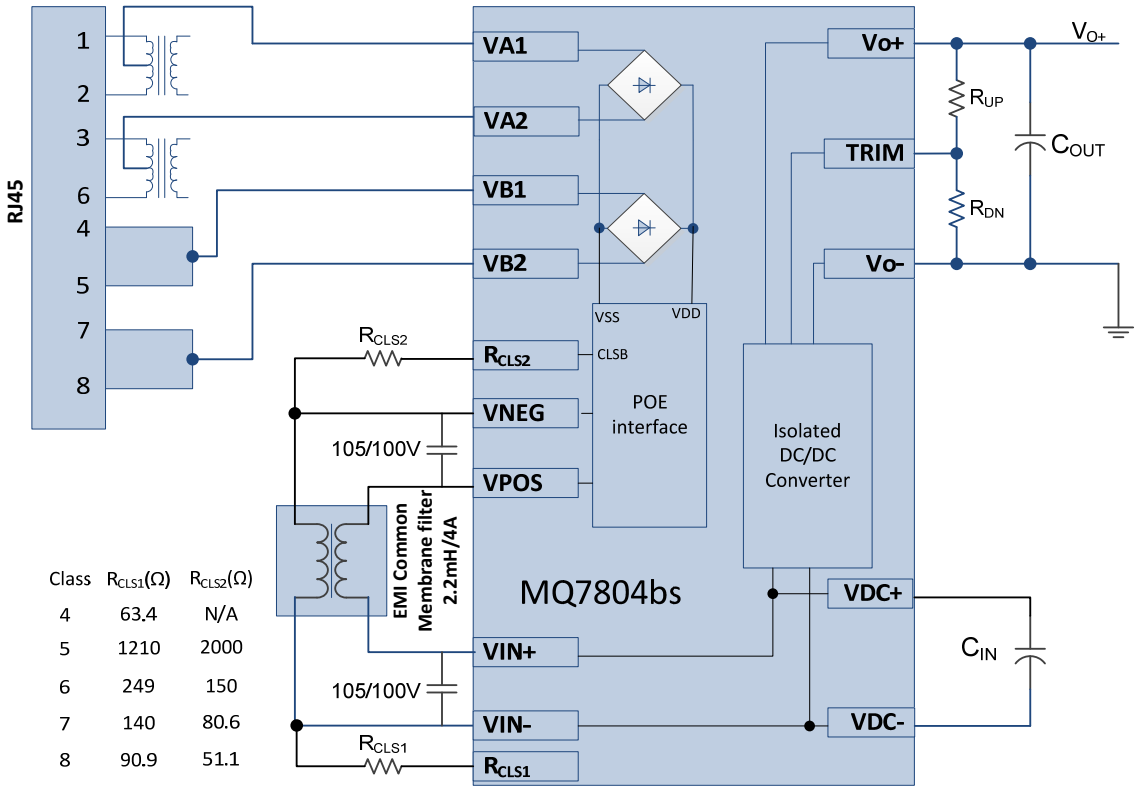
Description

The ***POE MQ7804BS*** series of modules are designed to extract power from a conventional twisted pair Category 5 Ethernet cable, conforming to the IEEE 802.3bt Power-over-Ethernet (PoE) standard but with 72W output power. The ***MQ7804BS*** series of modules embedded 2 active rectifier bridges which extremely reduce the power dispassion comparing with the traditional Schottky diodes bridges, have two pairs of power inputs pins: - VA1&2 and VB1&2 to accommodate high power PoE application with 4-pair wire power transfer.

The ***MQ7804BS*** signature and control circuit provides the PoE bt compatibility signature and power classification required by the Power Sourcing Equipment (PSE) before applying up to power to the port. The ***MQ7804BS*** can be set to class4 to class 8 by external one classification resistor to get different power class from PSE.

The high efficiency DC/DC converter operates over a wide input voltage range and provides a regulated low ripple and low noise output. The DC/DC converter also has built-in overload and short-circuit output protection.

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



Class	R_{CLS1}(Ω)	R_{CLS2}(Ω)
4	63.4	N/A
5	1210	2000
6	249	150
7	140	80.6
8	90.9	51.1

MQ7804BS application diagram

Note:
C_{IN} recommended from 47μF to 220μF AL-cap with 5~10μF ceramic cap;

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Tel: +86 21 5109 5021
Fax:+86 21 5106 2878
sales@union-pwr.com
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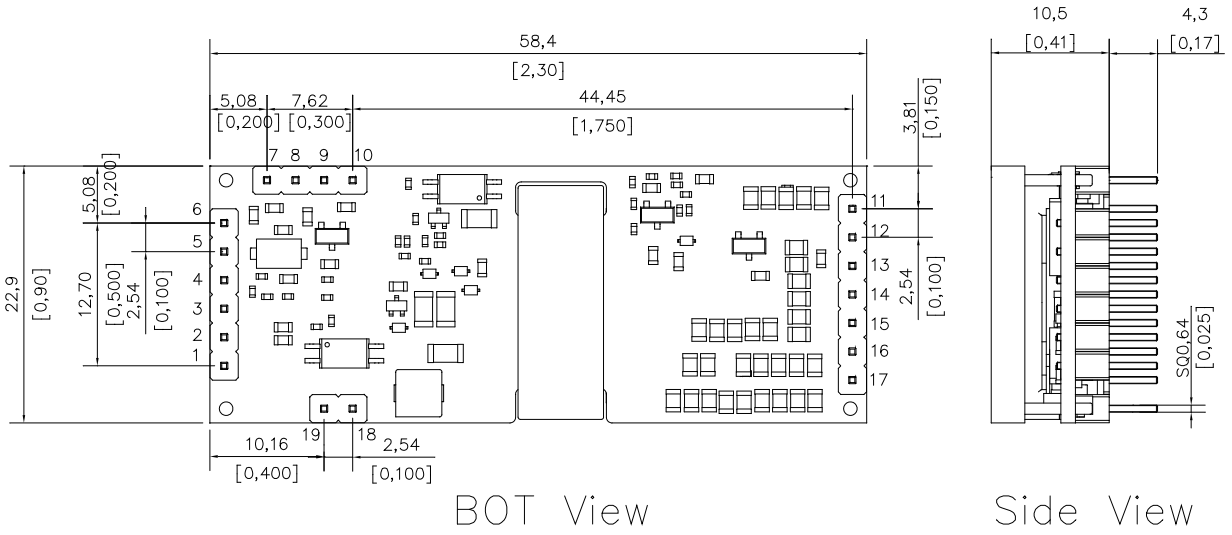
Performance Specifications (at Ta=+25℃)

Model	Input V_{IN} Range (V)	Output				Efficiency (%)
		$I_{OUT.MAX}$ (A)	V_{out} (V)	Regulation		
				Line (%)	Load (%)	
MQ7804BST050	42 ~57	14	5	0.5	0.5	92
MQ7804BST120		6.0	12	0.5	0.5	TBD
MQ7804BST280		2.6	28	0.5	0.5	TBD

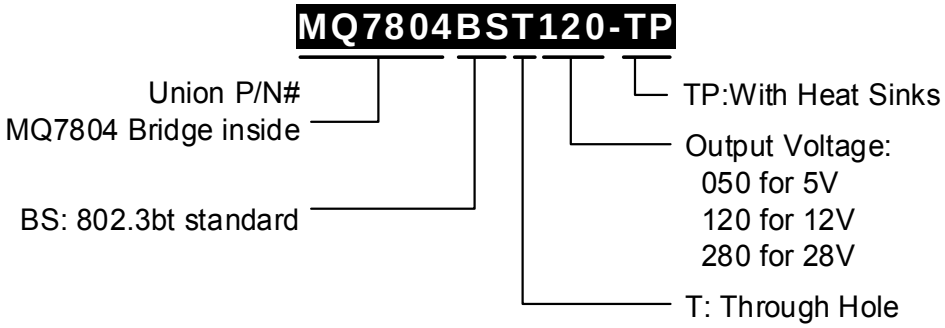
Mechanical Specifications

Dimensions are in millimeters (inches)



PIN	DESCRIPTION	
1	VIN+	PoE positive input
2	VIN-	PoE negative input
3	RCLS1	Classification resistor 1
4	RCLS2	Classification resistor 2
5	VNEG	Bridge negative output
6	VPOS	Bridge positive output
7	VA1	Pair from network transformer's central tap
8	VA2	
9	VB1	Pair from network transformer's central tap
10	VB2	
11、12、13	Vo-	Output negative end
14	Trim	Output Trim
15、16、17	Vo+	Output positive end
18	VDC+	DC/DC positive input end
19	VDC-	DC/DC negative input end

Ordering Information



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Fax:*+86 21 5106 2878*
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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
Operating Ambient Temperature	T_A	-40	85	℃
Storage Temperature	T_{STG}	-40	85	℃
Altitude			4000	m
I/O Isolation voltage (100% factory Hi-pot tested)			2250	V_{DC}

MQ7804BS General Specifications: *(TA=+25℃)*

Note: Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions.

Parameter	Condition	Symbol	Min	Typ.	Max	Unit
Operating Input Voltage Range	100% Load	V_{IN}	42		57	V_{DC}
V_{IN}- Inrush current limit	(VDC-) — (V_{IN}-)> 2 V, During C_{IN} charge period		275	335	395	mA
Input Current Limit	V_{IN}=$V_{IN.MIN}$ To $V_{IN.MAX}$		1.3	1.5	1.9	A
Input Turn-ON Threshold	10% Max Load, input rising	$V_{IN.ONTH}$	40.2		41.5	V_{DC}
Input Turn-OFF Threshold	10% Max Load, input falling	$V_{IN.OFFTH}$	38.3		39.3	V_{DC}
Output Power	V_{IN}=$V_{IN.MIN}$ To $V_{IN.MAX}$	Po	0		72	W
Output Continuous Short-circuit Protection	V_{IN}=$V_{IN.MIN}$ To $V_{IN.MAX}$		YES			
MTBF		500,000				Hours

MQ7804BST050 Electrical Specifications: *(TA=+25℃)*

Parameter	Condition	Symbol	Min	Typ.	Max	Unit
Input No Load Current	V_{IN}=48V, V_o=$V_{O,SET}$, I_o=0, module enabled	$I_{IN,NOLOAD}$			26	mA
Nominal Output Voltage Set-point	V_{IN} = $V_{IN.MIN}$ To $V_{IN.MAX}$			5		V
Maximum load	V_{IN} = $V_{IN.MIN}$ To $V_{IN.MAX}$				14.4	A
Output Current limit	Vin=48V	I_{ocp}			17.6	A
Output Voltage Set point	100% load	ΔVo	-1		+1	%$V_{O.SET}$
Adjustment Range		$V_{O, ADJ}$	-10		10	%$V_{O,SET}$
Output Ripple and Noise Voltage	V_{IN} =48V Io=10A,5~20MHz, Measured with 0.1μF ceramic	V_{pk-pk}		45		mVpp
Transient Response	Load step from 50%~100%~50% $I_{O.MAX}$, di/dt=0.1A/μS			1000		mV
	Response time			200		μS
Efficiency	V_{IN}=48, 100% Load, including bridge	η		92		%
Switching Frequency		Fo		400		KHz
External Capacitive Load		$C_{O,EXTERNAL}$	220		2500	μF
Inrush Current	V_{IN}=55V	I_{inrush}				mA

MQ7804BST120 Electrical Specifications: *(TA=+25℃)*

Parameter	Condition	Symbol	Min	Typ.	Max	Unit
Input No Load Current	V_{IN}=48V, V_o=$V_{O,SET}$, I_o=0, module enabled	$I_{IN,NOLOAD}$		70		mA
Nominal Output Voltage Set-point	V_{IN} = $V_{IN.MIN}$ To $V_{IN.MAX}$			12		V
Maximum load	V_{IN} = $V_{IN.MIN}$ To $V_{IN.MAX}$				6	A
Output Voltage Set point	100% load	ΔVo	-1		+1	%$V_{O.SET}$
Adjustment Range		$V_{O, ADJ}$	-10		10	%$V_{O,SET}$
Output Ripple and Noise Voltage	V_{IN} =48V Io=4.2A,5~20MHz, Measured with 0.1μF ceramic			120		mVpp
Transient Response	Load step from 50%~100%~50% $I_{O.MAX}$, di/dt=0.1A/μS					mV
	Response time			350		μS
Efficiency	V_{IN}=48, 100% Load, including bridge	η	89.5	90.5		%
	V_{IN}=48, 100% Load, no bridge	η	90.4	91.4		%
Switching Frequency		Fo		400		kHz
External Capacitive Load		$C_{O,EXTERNAL}$	0		2000	μF
Inrush Current	V_{IN}=55V	I_{inrush}		150		mA

MQ7804BST280 Electrical Specifications: *(TA=+25℃)*

Parameter	Condition	Symbol	Min	Typ.	Max	Unit
Input No Load Current	V_{IN}=48V, V_o=$V_{O,SET}$, I_o=0, module enabled	$I_{IN,NOLOAD}$				mA
Nominal Output Voltage Set-point	V_{IN} = $V_{IN.MIN}$ To $V_{IN.MAX}$			28		V
Maximum load	V_{IN} = $V_{IN.MIN}$ To $V_{IN.MAX}$				2.8	A
Output Voltage Set point	100% load	ΔVo	-1		+1	%$V_{O.SET}$
Adjustment Range		$V_{O, ADJ}$	-10		10	%$V_{O,SET}$
Output Ripple and Noise Voltage	V_{IN} =48V Io=2.1A,5~20MHz, Measured with 0.1μF ceramic					mVpp
Transient Response	Load step from 50%~100%~50% $I_{O.MAX}$, di/dt=0.1A/μS					mV
	Response time					μS
Efficiency	V_{IN}=48, 100% Load,including bridge	η				%
	V_{IN}=48, 100% Load,no bridge	η				%
Switching Frequency		Fo				KHz
External Capacitive Load		$C_{O,EXTERNAL}$				μF
Inrush Current	V_{IN}=55V	I_{inrush}				mA

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Fax:*+86 21 5106 2878*
sales@union-pwr.com
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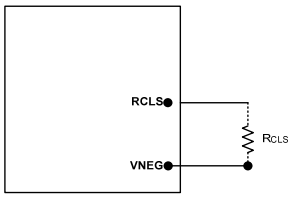
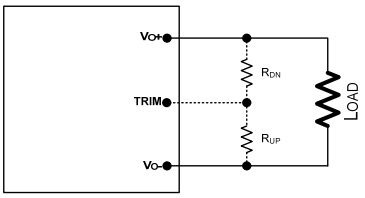
Test Configurations



NOTE: Class Resistor Selection

Fig 1. Classification Resistors



NOTE: Trimming function is allowed the output voltage set point to be adjusted from the default value in a allowed range.

Fig 2. Output Trim

Output Trim

MQ7804BS output can be trimmed up or down by connecting one resistor to output negative or positive end as **Fig 2.** Output Trim. Connecting an external resistor (R_{DN}) between the TRIM pin and the $V_{O(+)}$ (or Sense(+)) pin decreases the output voltage set point. To maintain set point accuracy, the trim resistor tolerance should be ±1.0%.The following equation determines the required external resistor value:

$$R_{DN} = \left[\frac{(V_{0,DN} - 2.5) * 12}{V_{0.SETP} - V_{0,DN}} - 2 \right] K\Omega$$

$V_{O,SET}$ is the output default set-point voltage of the module, $V_{O.DN}$ is the desired trim-down output voltage.
Connecting an external resistor (R_{UP}) between the TRIM pin and the $V_{O(-)}$ (or Sense (-)) pin increases the output voltage set point. The following equation determines the required external resistor value:

$$R_{UP} = \left(\frac{30}{V_{0,UP} - V_{0.SET}} - 2 \right) K\Omega$$

$V_{O,SET}$ is the output default set-point voltage of the module, $V_{O.UP}$ is the desired trim-up output voltage.

Over-temperature Protection

The unit isn't equipped with a thermal shutdown circuit. If the thermal reference points, Tref(Thermal Pad), exceed 115℃ respectively, the unit may not work properly or even be permanently damaged. So sufficient cooling should be provided to help ensure reliable operation.

Classification Resistors

Connect a resistor from RCLS to V_{IN}- to program the classification current according to the IEEE 802.3bt standard. Table 1 lists the external resistor values required for each of the PD power ranges defined by IEEE802.3bt.

PD class	Power at PD(W)	$R_{CLS1}(\Omega)$	$R_{CLS2}(\Omega)$
4	25.5	63.4	N/A
5	40	1210	2000
6	51	249	150
7	62	140	80.6
8	71	90.9	51.1

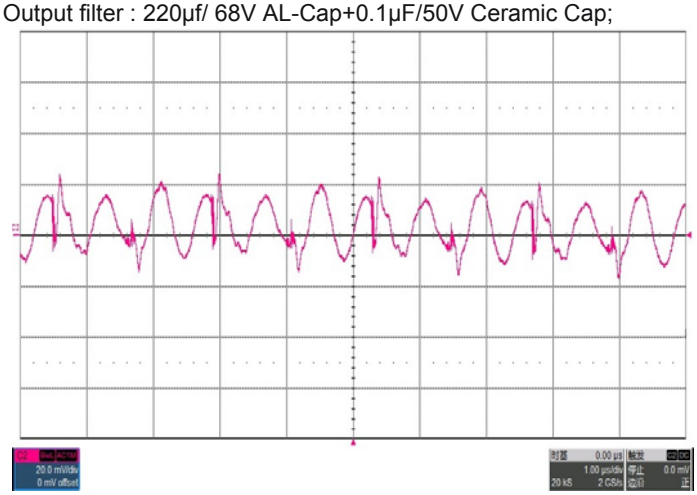
Table 1. Class Resistor Selection

Current limit during startup

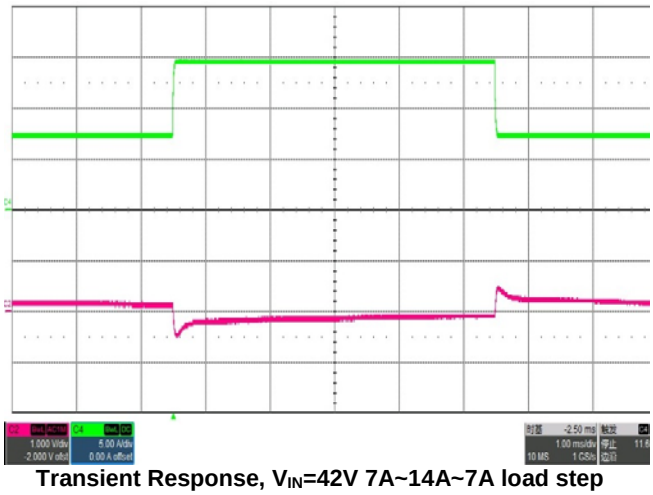
IEEE 802.3bt has a startup current limitation, providing compatibility between a PSE of any Type and a PD of any Type. When input voltage rises above input Turn-ON Threshold ($V_{IN.ONTH}$), the ***MQ7804BS*** starts charging the bulk capacitor C_{IN} under the 335mA V_{IN}- inrush current limit, which is compatible with all PSE type. Once the inrush current falls about 10% below the inrush current limit, the ***MQ7804BS*** internal current limit switches to the operational level, which is approximately 2.2 A, and internal DCDC converter will be started shortly.

Typical Characteristics – MQ7804BST050

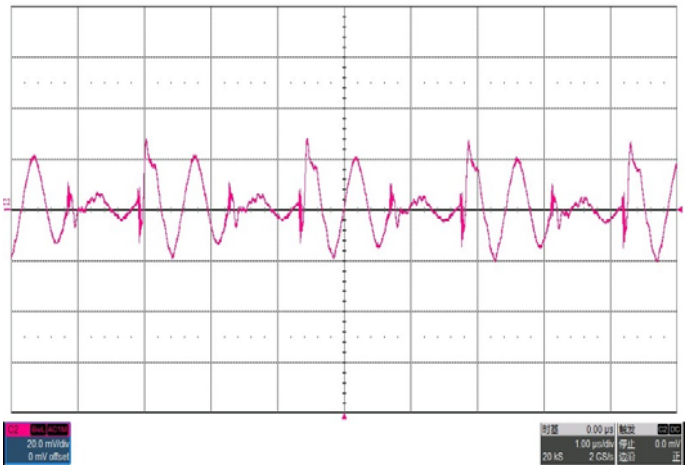
General conditions:
Input filter: 100μF/100V AL-Cap;
Output filter : 220μf/ 68V AL-Cap+0.1μF/50V Ceramic Cap;



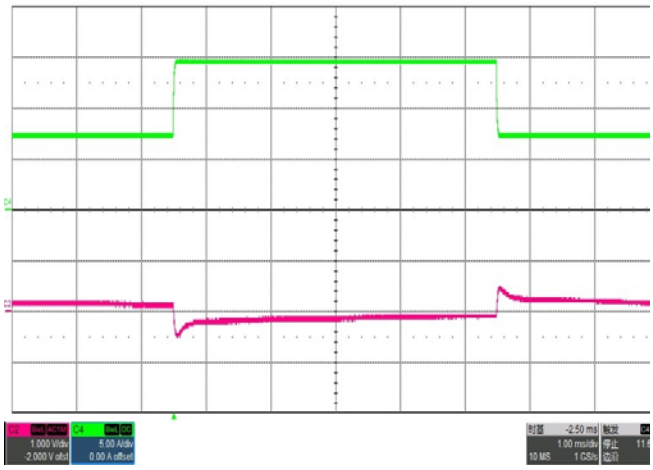
Noise & Ripple V_{IN}=42V, I_O=14A, 5~20MHz Bandwidth



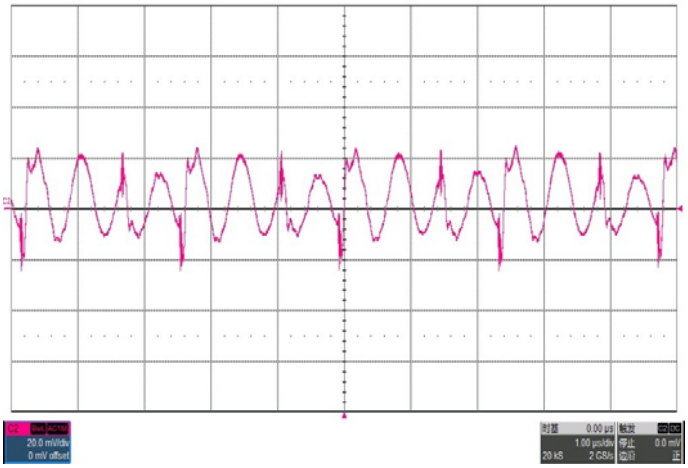
Transient Response, V_{IN}=42V 7A~14A~7A load step
CH4: Load Current CH1: Output Voltage

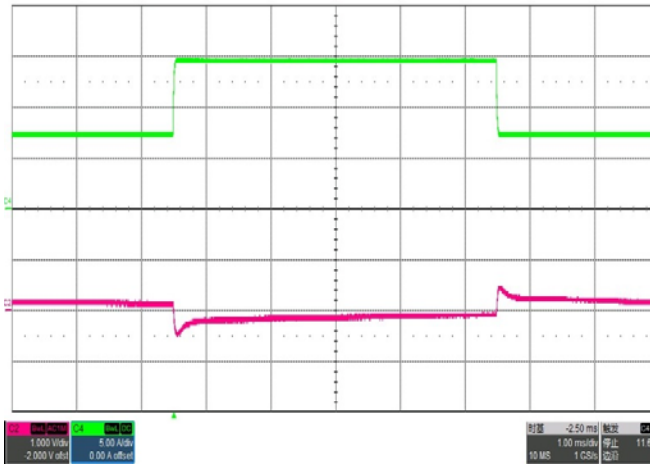


Noise & Ripple V_{IN}=48V, I_O=14A, 5~20MHz Bandwidth



Transient Response, V_{IN}=48V 7A~14A~7A load step
CH4: Load Current CH1: Output Voltage





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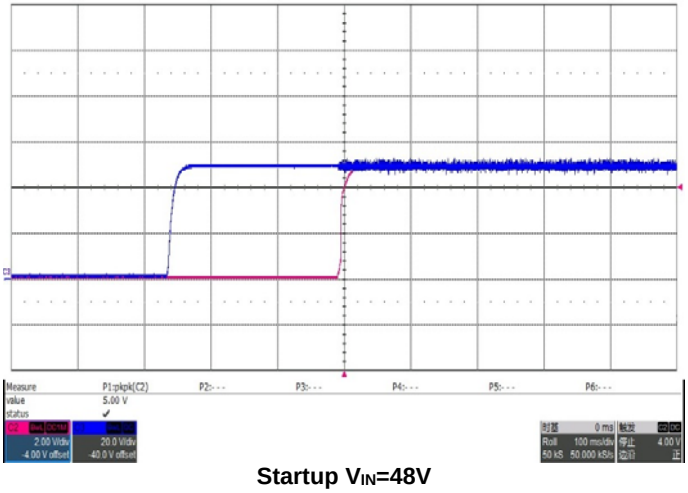
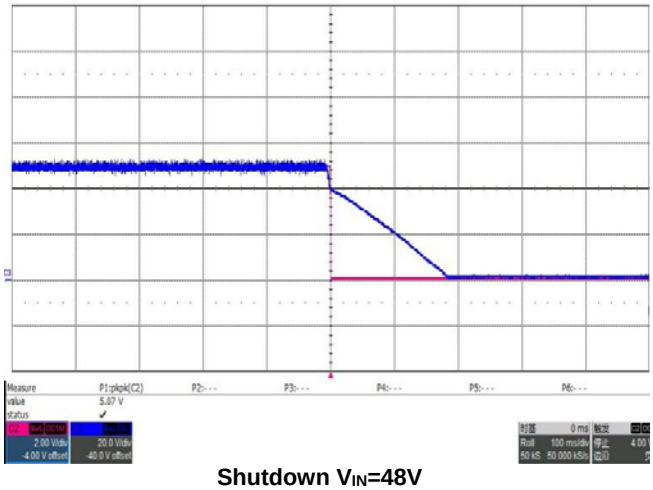
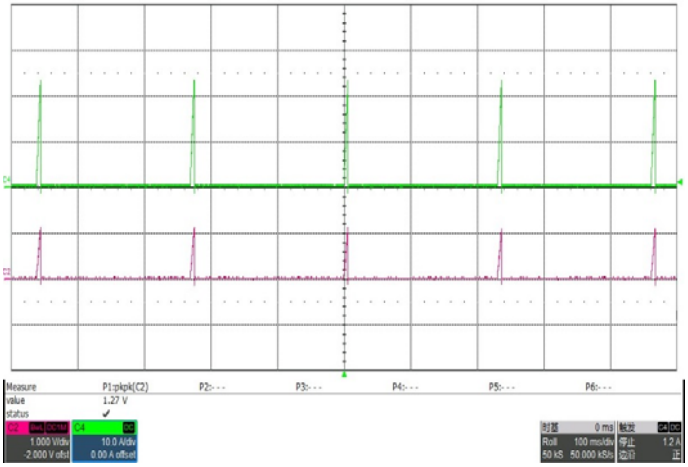
Noise & Ripple V_{IN}=57V, I_O=14A, 5~20MHz Bandwidth



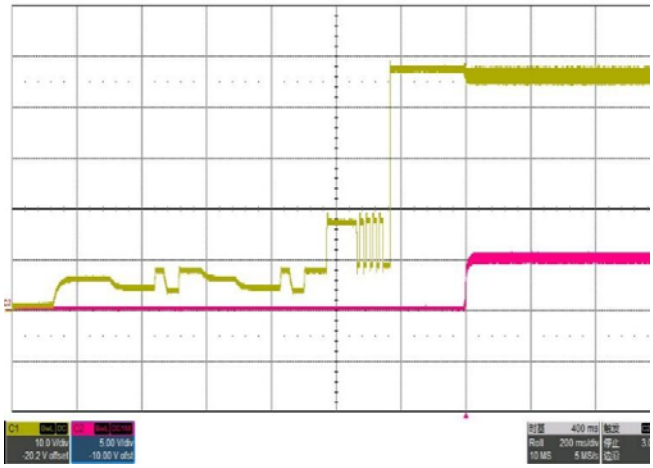
Transient Response, V_{IN}=57V 7A~14A~7A load step
CH4: Load Current CH1: Output Voltage



Startup V_{IN}=48V
CH3: Input Voltage CH2: Output Voltage



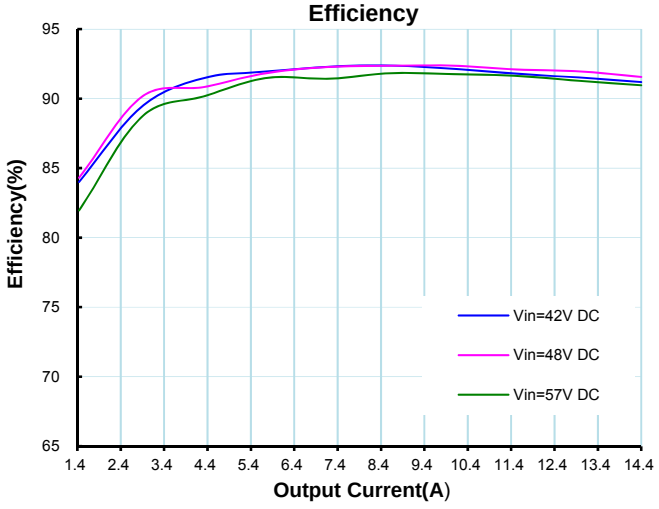
Shutdown V_{IN}=48V
CH3: Input Voltage CH2: Output Voltage



Load short protection V_{IN}=48V
CH3: Input Voltage CH2: Output Voltage

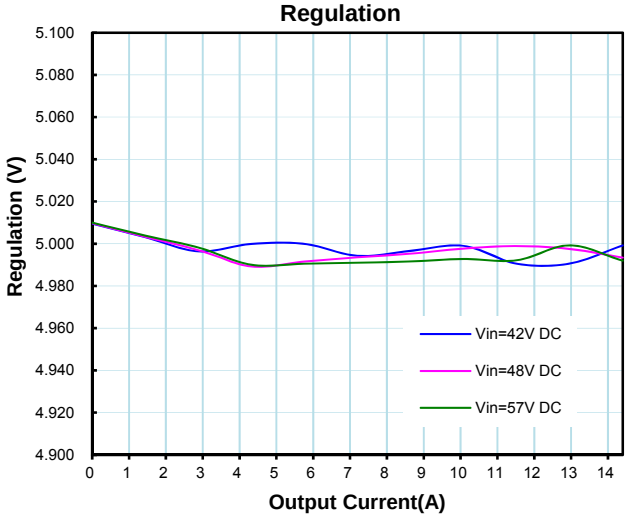
Startup from PSE
CH1: Input Voltage CH2: Output Voltage

Efficiency

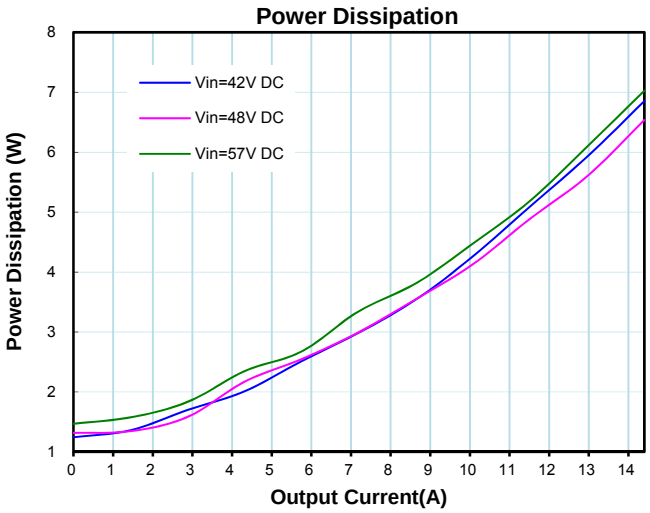


Efficiency

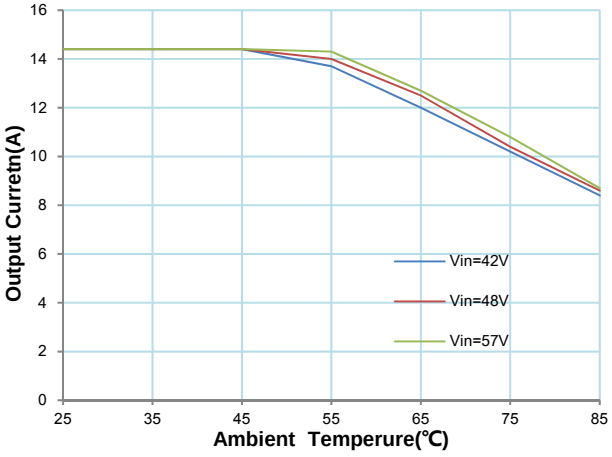
Regulation



Regulation

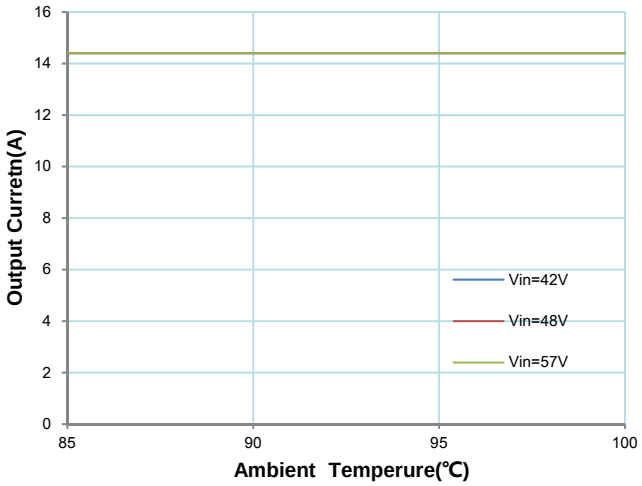


Power Dissipation



Power Derating

Note: "TP" Version; Test in a closed box with a size of 358mm*256mm*104mm.



Power Derating

Note: "TP" Version; An aluminum plate with a size of 260mm*170mm*15mm was used in the test.

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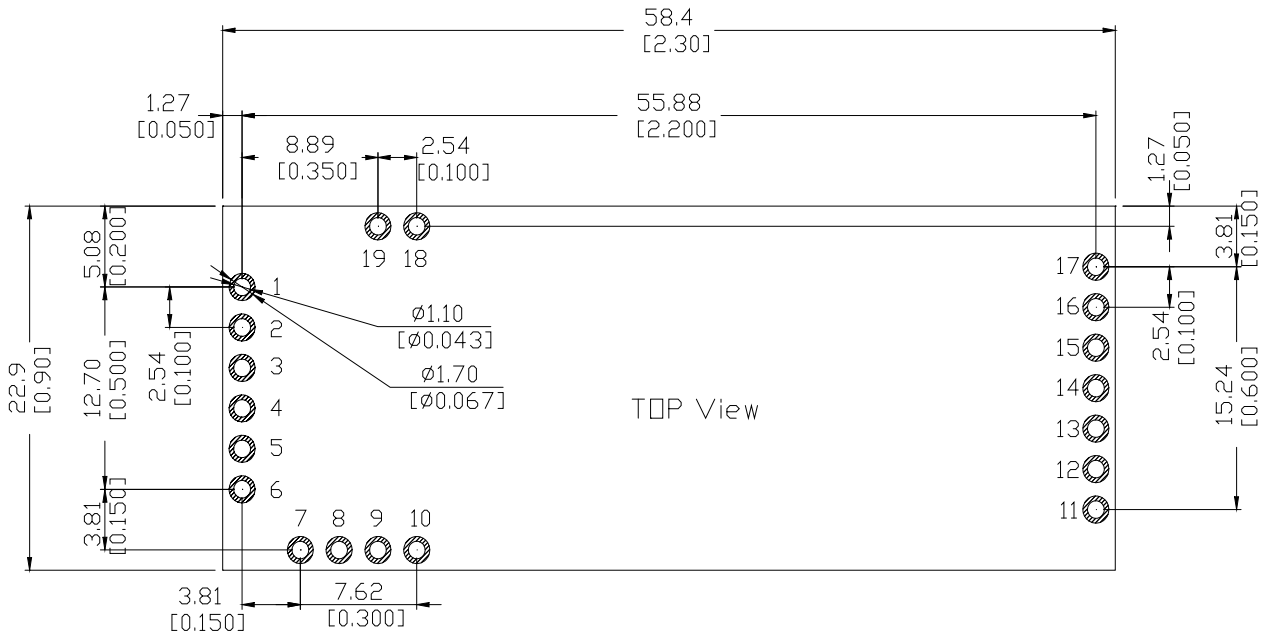
Recommended Hole Pattern

Dimensions are in millimeters (inches)



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