SUPLET® Technical Specification

DC-DC Converter Non-isolated

BAA10P5N5BSG

3.0Vdc to 13.8Vdc Input；0.59～5.1Vdc/10A Output

RoHS Compliant

Applications

- Distributed Power Architectures
- Wireless Networks
- Access and Optical Network Equipment
- Enterprise Networks
- Latest generation IC's (DSP, FPGA, ASIC) and Microprocessor powered applications

Features

- Compliant to RoHS EU Directive 2002/95/EC
- Compliant to Lead free or SnPb reflow environment
- Delivers up to 10A output current
- High efficiency: up to 93% at 5V full load (Vin= 12Vdc)
- Small size and profile: 0.67×0.41×0.126(inch)
- Low output ripple and noise
- Wide operating temperature range
- Constant switching frequency 620kHz
- Exceptional thermal performance
- High reliability: MTBF > 2,000,000h at 25 °C
- Remote On/Off positive logic
- Input under voltage protection
- Output over current protection
- Short circuit protection
- Meets the voltage and current requirements for ETSI 300-132-2 and complies with and licensed for Basic Insulation rating per IEC60950 3rd edition
- ISO 9001:2000 Certificate HK03/0436
- ISO 14001:2004 Certificate HK06/01652
- OHSAS 18001:2007 Certificate CN09131988

Description

BAA10P5N5BSG is a non-isolated DC/DC converter that provides a high efficiency single output. It can operate from 3.0Vdc to 13.8Vdc input and 0.59Vdc～5.1Vdc/10A output. The remote control logic is positive. The converter turns off when the REM pin is at logic low (0Vdc～0.2 Vdc/1μA) and turns on when it is left open or at logic high (that should be ensured above 0.5Vdc). The power good indicator/output adjustment function is alternative. The output adjustment (default option) is upward when a external resistor is connected between "TRIM" and "GND", and the minimum 0.59V output is attainable when the TRIM pin is left open. The POWER GOOD is available when the TRIM option is not used and the indicator output will be logic low when the output voltage is excess of ±10% of the set point.

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only, functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect the device reliability.

Parameter	Units	Specifications			Notes & conditions
		Min.	Typ.	Max.	
Input Voltage	Vdc	-	-	13.8	Continuous
Operating Ambient Temperature	℃	-40	-	70	Forced air cooling
Storage Temperature	℃	-40	-	125	
Solder Temperature	℃	-	-	260	<10S
Humidity	RH(%)	0	-	80	Non-condensing

Electrical Specifications

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

Input Characteristics

Parameter		Units	Specifications			Notes & conditions
			Min.	Typ.	Max.	
Operating Input Voltage	$V_O \leqslant 2.5V$	Vdc	3.0	-	13.8	Add a external 25V/22uF tantalum capacitor at input when Vin$\geqslant$9V
	V_O=3.3V		4.3	-	13.8	
	V_O=5.0V		6.0	-	13.8	
Maximum Input Current		A	-	8.27	-	Vin=3.3V/V_O=2.5V,I_O=I_O(max)
Input No load Current		mA	-	80	-	Vin=Vin(min) to Vin(max), I_O=0,module enabled
Input Reflected Ripple Current (Peak-to-Peak)		%	-	0.5	-	
Inrush Transient		A^2S	-	0.01	-	

Remote Control Characteristics

Parameter	Units	Specifications			Notes & conditions
		Min.	Typ.	Max.	
Turn on voltage	Vdc	Vin	-	5	Vin$\leqslant$5V,V_{REM}(max)=Vin; Vin$>$5V, V_{REM}(max)=5V.Converter guaranteed on when REM pin is left open
Turn off voltage	Vdc	0	-	0.2	

Output Characteristics

Parameter		Units	Specifications			Notes & conditions
			Min.	Typ.	Max.	
Output Voltage Set-Point		Vdc	0.59	0.6/0.9/1.2/ 1.5/1.8/2.5/ 3.3/5.0	5.1	Io=0 to Io(max)
Output Current		A	-	-	10	
Line Regulation		%Vo	-	0.2	-	Vin=Vin(min) to Vin(max) Io=Io(nom), Ambient temperature
Load Regulation		%Vo	-	0.5	-	Vin=Vin(nom) Io=0 to Io(max) Ambient temperature
Output Voltage Accuracy		%Vo	-	-	1	Vin=Vin(min) to Vin(max) Io=0 to Io(max)
Output Current Limit Point		A	-	16	-	
Temperature Coefficient		ppm	-	200	-	Ambient Temperature -40℃～70℃
External Capacitive Load	V_O=0.6V, 0.9V	μF	-	-	8400	Add aluminum electrolytic capacitor at output
	V_O=1.2V		-	-	6000	
	V_O=1.5V		-	-	4500	
	V_O=1.8V		-	-	3000	
	V_O=2.5V		-	-	2300	
	V_O=3.3V, 5.0V		-	-	1100	
Ripple and Noise	V_O=0.6V	mV	-	15	-	Measured with 1uF Ceramic external capacitor,20MHz
	V_O=0.9V		-	25	-	
	V_O=1.2V		-	25	-	
	V_O=1.8V		-	25	-	
	V_O=2.5V		-	30	-	
	V_O=5.0V		-	45	-	
Dynamic Response	V_O=0.6V	mV/μS	-	30/40	-	25%~50%Io(nom), di/dt=2.5A/μS. Add 25V/22uF tantalum capacitor at input and 1uF ceramic capacitor at output
	V_O=0.9V		-	27/45	-	
	V_O=1.2V		-	27/30	-	
	V_O=1.8V		-	30/20	-	
	V_O=2.5V		-	30/20	-	
	V_O=5.0V		-	55/20	-	
	V_O=0.6V	mV/μS	-	70/50	-	50%~75% Io(nom), di/dt=2.5A/μS Add 25V/22uF tantalum capacitor at input and 1uF ceramic capacitor at output
	V_O=0.9V		-	50/45	-	
	V_O=1.2V		-	55/45	-	
	V_O=1.8V		-	60/35	-	
	V_O=2.5V		-	65/35	-	

	V_O=5.0V		-	100/20	-	
Turn-on Delay Time	V_O=0.6V	ms	-	0.7	-	Delay from instant at which Vin=Vin(min) until Vo=10% of Vo(nom)
	V_O=0.9V		-	0.6	-	
	V_O=1.2V		-	0.5	-	
	V_O=1.8V		-	0.5	-	
	V_O=2.5V		-	0.4	-	
	V_O=5.0V		-	0.3	-	
Turn-on Rise Time	V_O=0.6V	ms	-	1.2	-	Time for Vo to rise from 10% of Vo(nom) to 90% of Vo(nom)
	V_O=0.9V		-	1.2	-	
	V_O=1.2V/1.8V/2.5V		-	1.3	-	
	V_O=5.0V		-	1.4	-	

Protection Characteristics

Parameter		Units	Specifications			Notes & conditions
			Min.	Typ.	Max.	
Input Undervoltage Lockout	Turn-on Threshold	Vdc	-	3.0	-	
	Turn-off Threshold	Vdc	-	2.7	-	
Output Overcurrent Protection		A	-	16	-	
Short Circuit Protection			-	Y	-	Hiccup mode Automatic recovery

General Specifications

Parameter			Units	Specifications			Notes & conditions
				Min.	Typ.	Max.	
Efficiency	Vin=5V	V_O=0.6V	%	-	72	-	Ambient Temperature 25℃, 100%load
		V_O=0.9V		-	80	-	
		V_O=1.2V		-	83	-	
		V_O=1.8V		-	87	-	
		V_O=2.5V		-	91	-	
	Vin=12V	V_O=5.0V		-	93	-	
	Vin=5V	V_O=0.6V		-	80	-	Ambient Temperature 25℃, 50%load
		V_O=0.9V		-	86	-	
		V_O=1.2V		-	88	--	
		V_O=1.8V		-	91	-	
		V_O=2.5V		-	94	-	
	Vin=12V	V_O=5.0V		-	94	-	
MTBF			Hours	-	2,000,000		Bellcore TR332, 25℃
Weight			g		2.7		

Moisture Sensitivity Level	Level 3
Safety Design	Compliant to IEC60950-1，UL60950-1,EN60950-1 and GB4943
Vibration	IEC68－2－6
Transportation	ETS300019－1－2

Characteristic Curves

The following figures provide typical characteristics for the BAA10P5N5BSG module at ambient temperature 25℃.

Characteristic Curves (Efficiency)

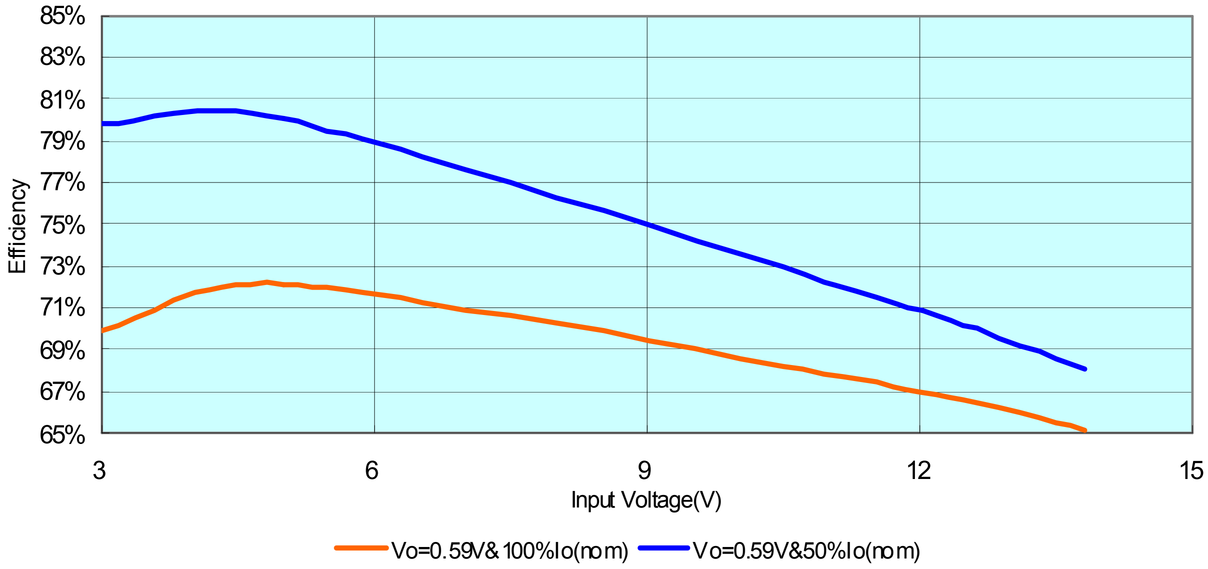


Figure1. Efficiency vs. Input voltage

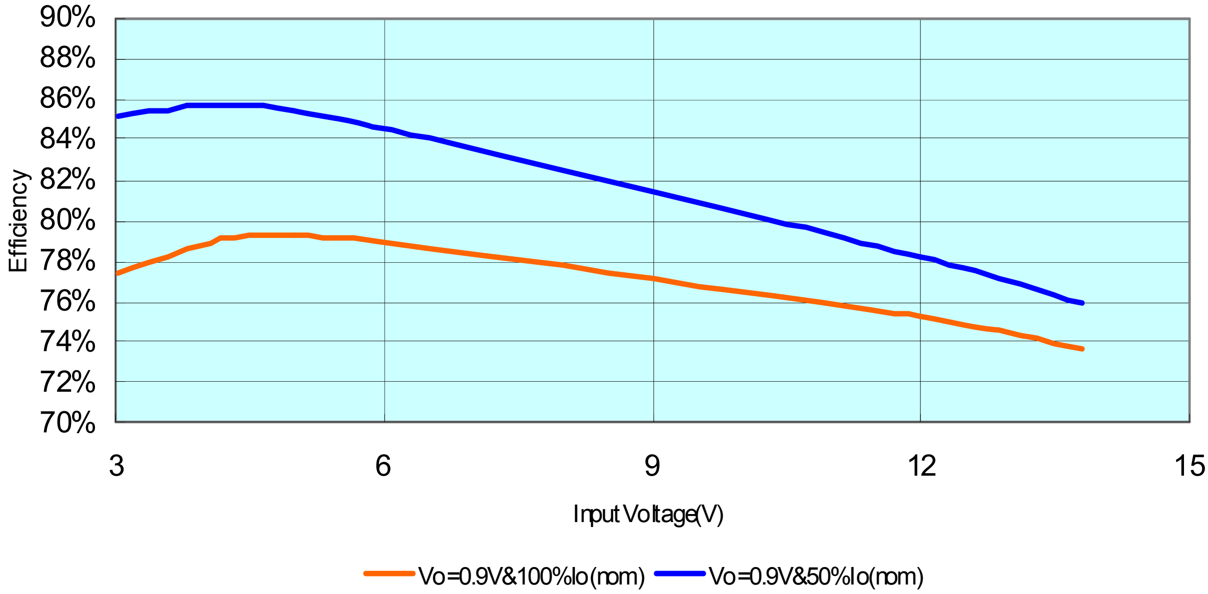


Figure2. Efficiency vs. Input voltage

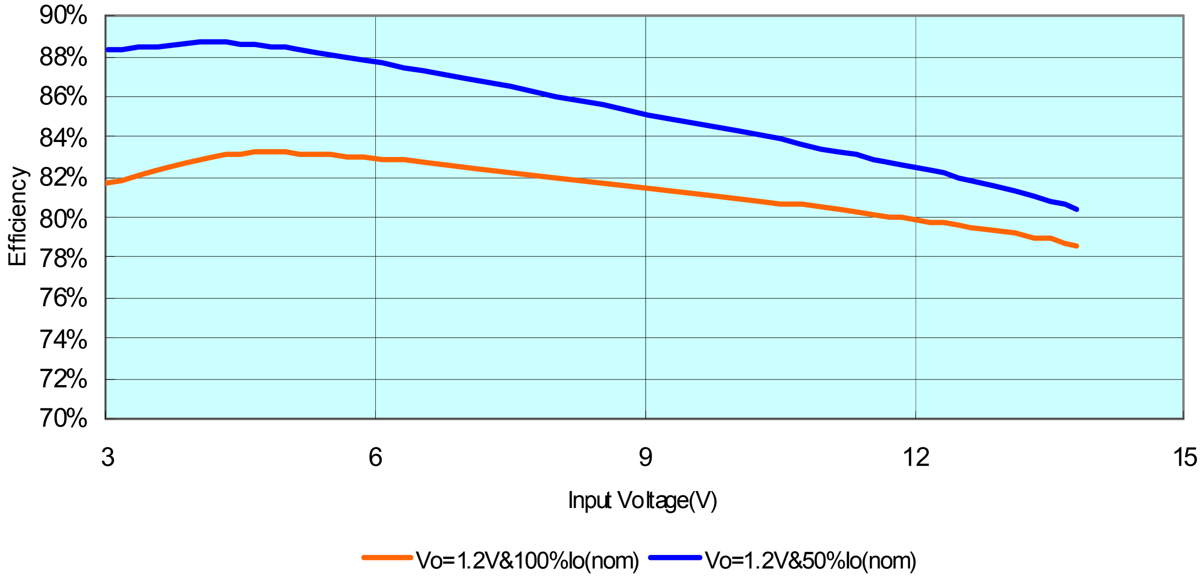


Figure3. Efficiency vs. Input voltage

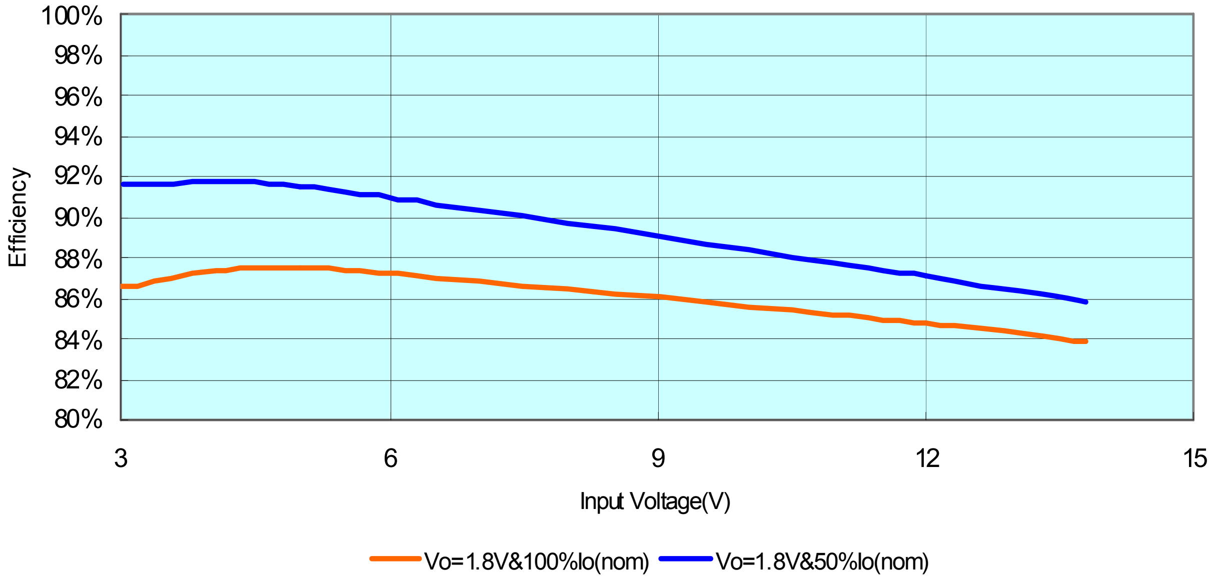


Figure4. Efficiency vs. Input voltage

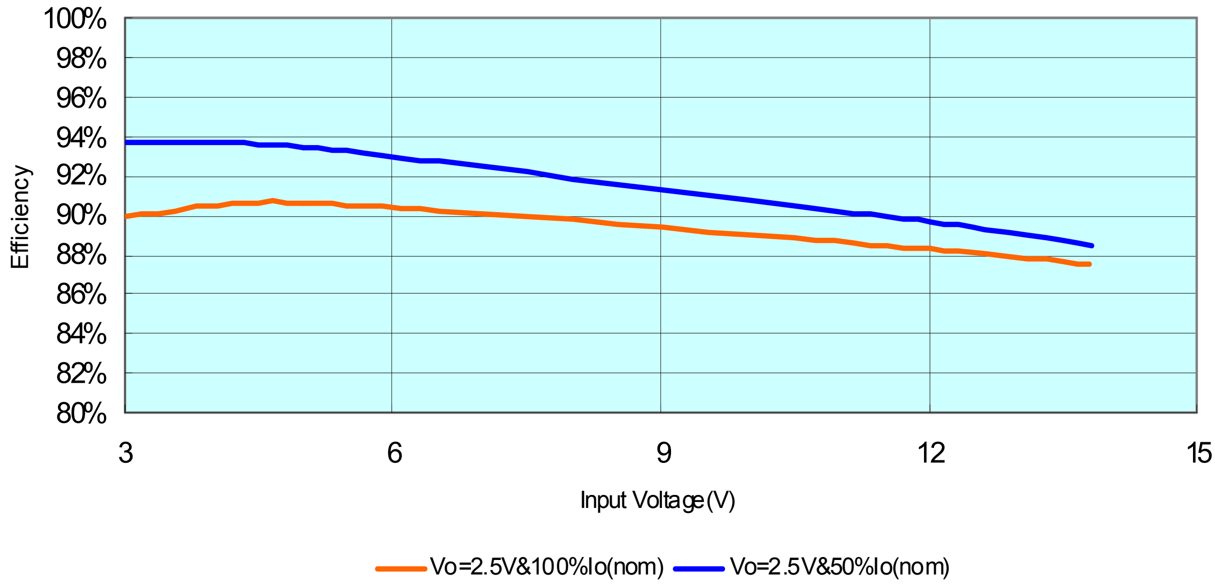


Figure5. Efficiency vs. Input voltage

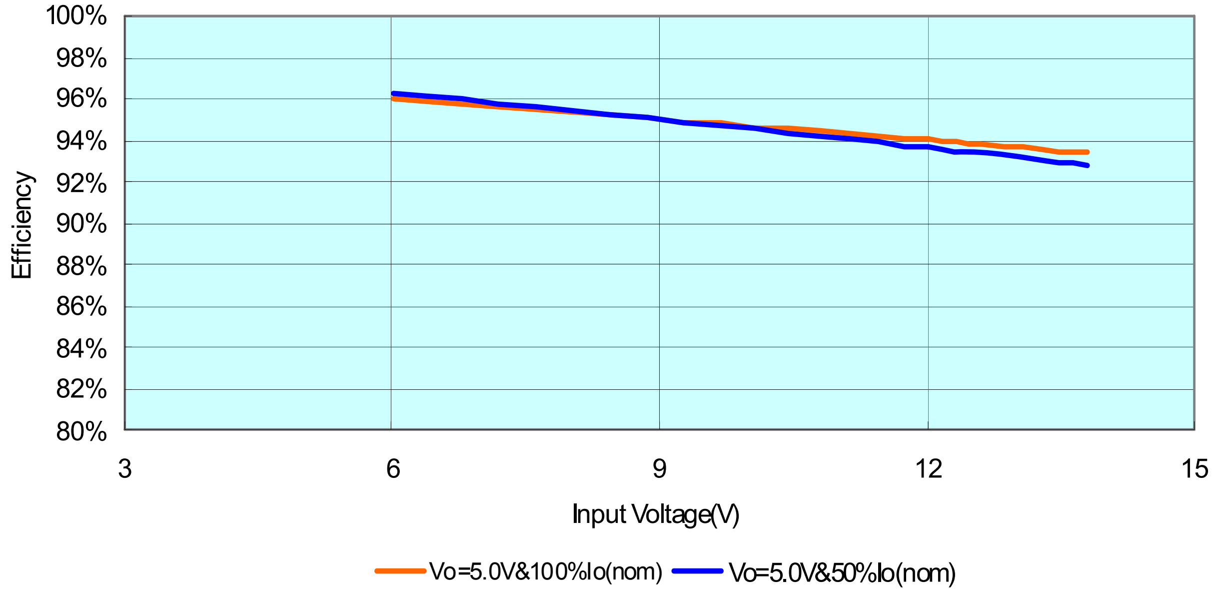


Figure6. Efficiency vs. Input voltage

Characteristic Curves (Derating)

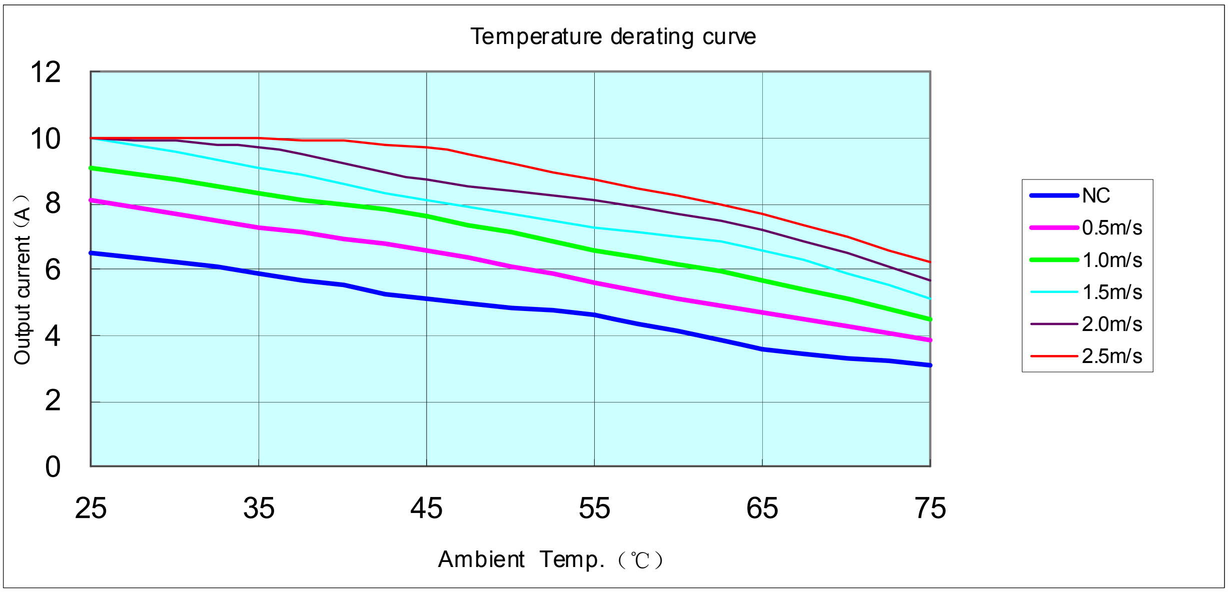


Figure 7. Vin=12.0V/Vo=5.0V Derating Curve

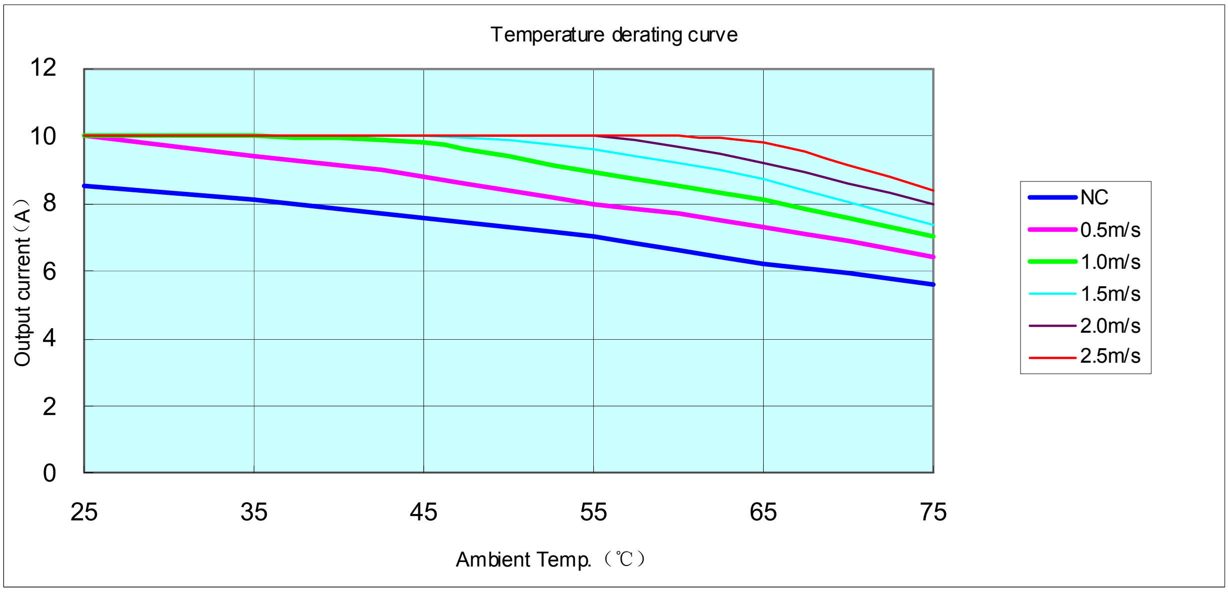


Figure 8. Vin=5.0V/Vo=2.5V Derating Curve

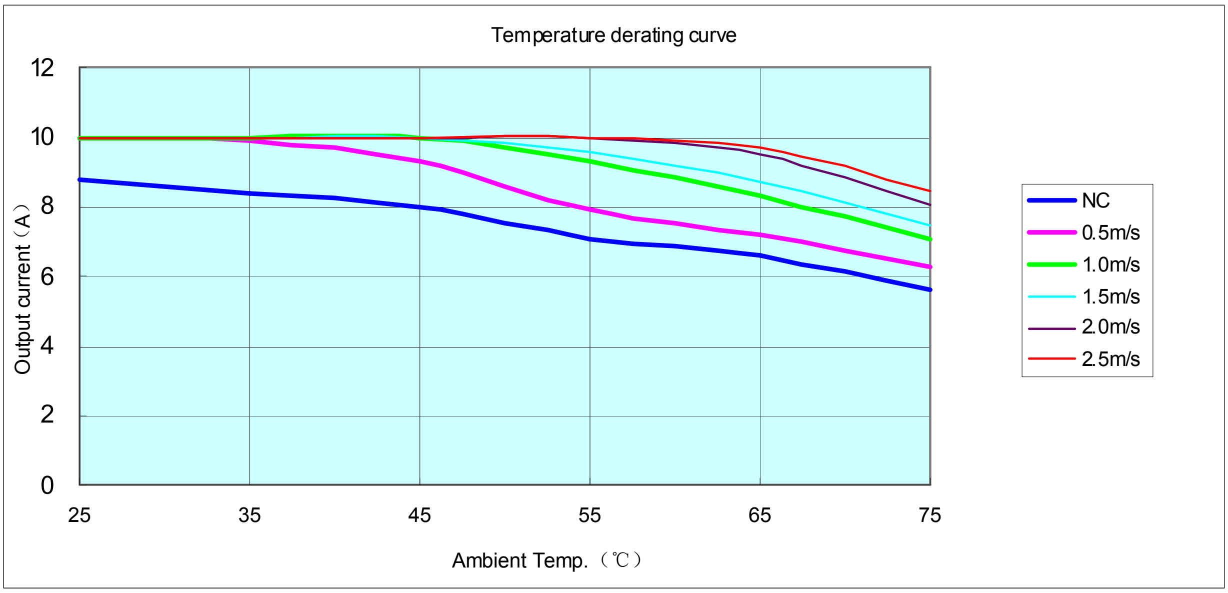


Figure 9. Vin=5.0V/Vo=0.9V Derating Curve

Characteristic Curves (Dynamic Response)

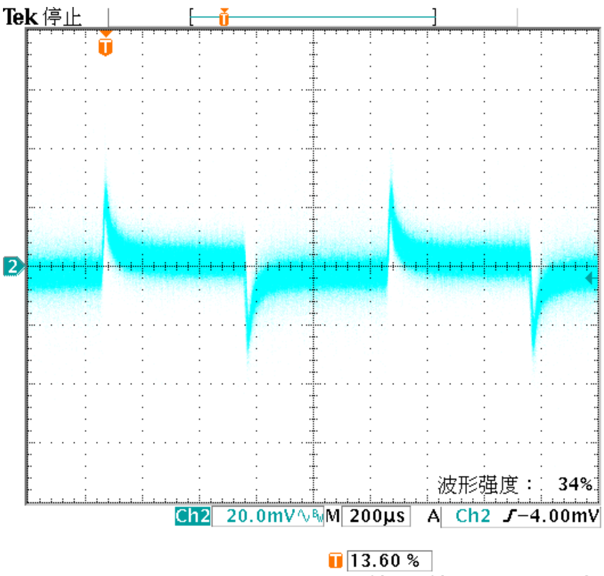


Figure 10. Vin=5V/Vo=0.59V, 25%~50%load, 2.5A/µS

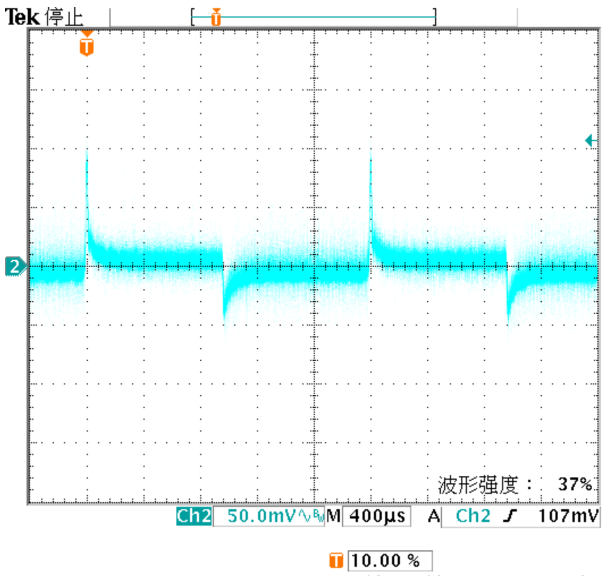


Figure 11. Vin=5V/Vo=0.59V, 50%~75%load, 2.5A/µS

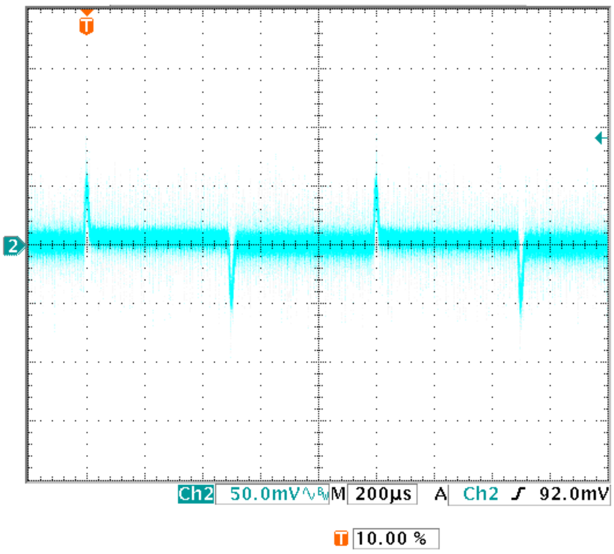


Figure 12. Vin=5V/Vo=0.9V, 25%~50%load, 2.5A/μS

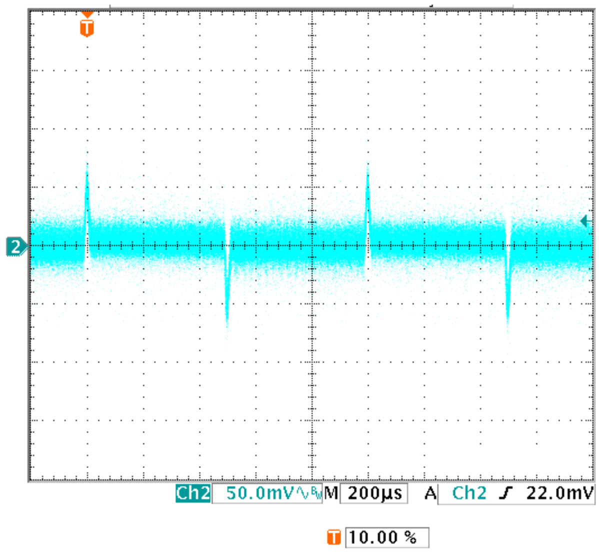


Figure 13. Vin=5V/Vo=0.9V, 50%~75%load, 2.5A/μS

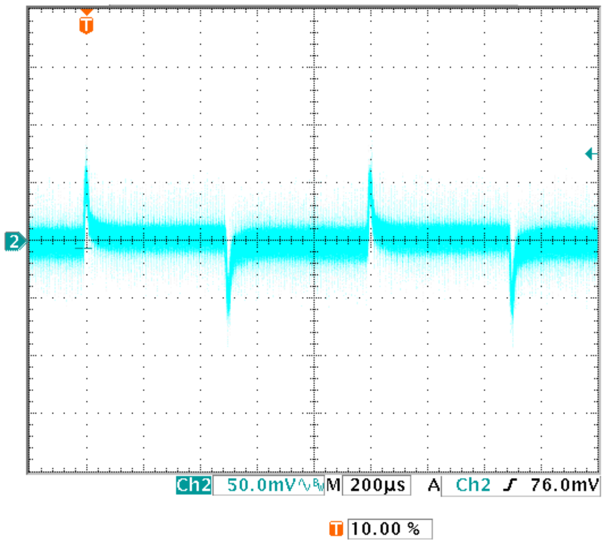


Figure 14. Vin=5V/Vo=1.8V, 25%~50%load, 2.5A/μS

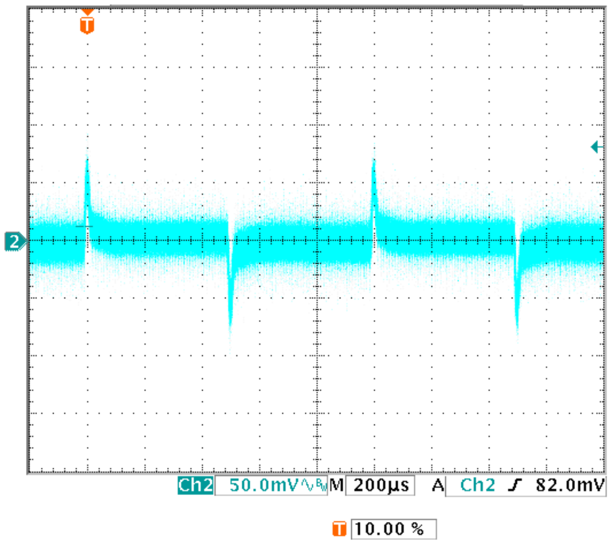


Figure 15. Vin=5V/Vo=1.8V, 50%~75%load, 2.5A/μS

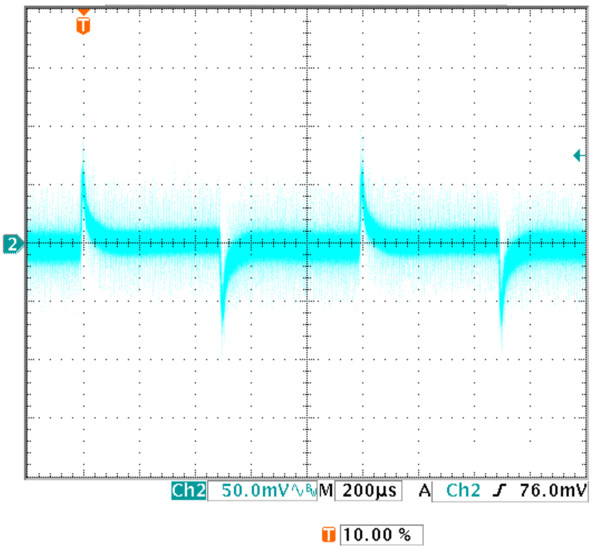


Figure 16. Vin=5V/Vo=2.5V, 25%~50%load, 2.5A/µS

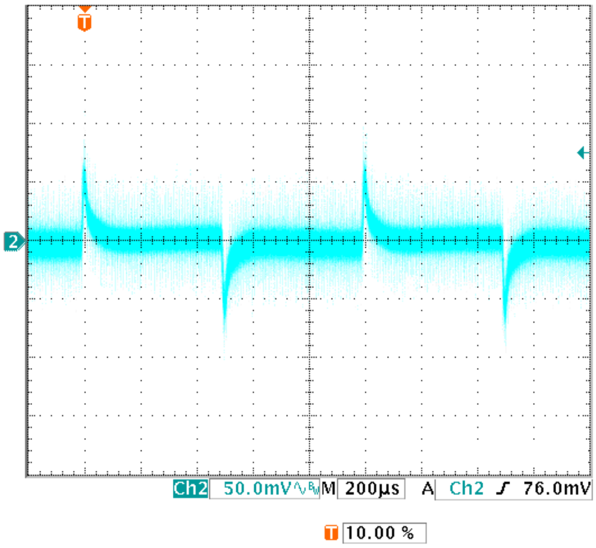


Figure 17. Vin=5V/Vo=2.5V, 50%~75%load, 2.5A/µS

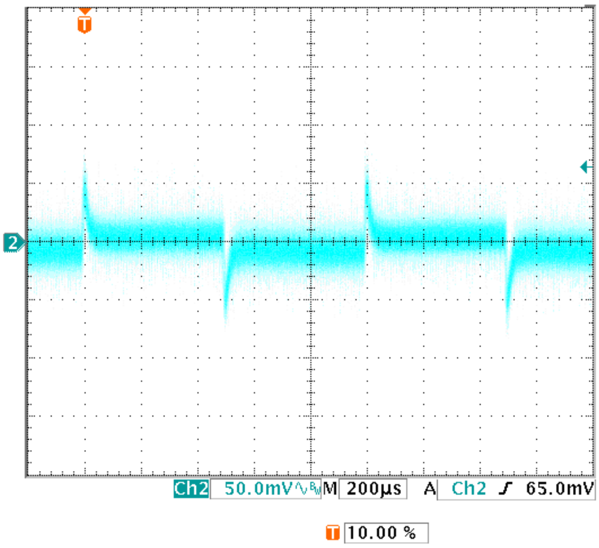


Figure 18. Vin=12V/Vo=5.0V, 25%~50%load, 2.5A/µS

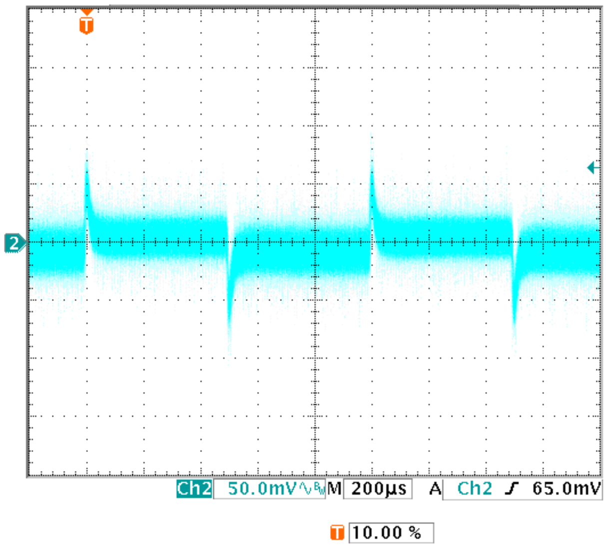


Figure 19. Vin=12V/Vo=5.0V, 50%~75%load, 2.5A/Ms

Characteristic Curves (Start-up)

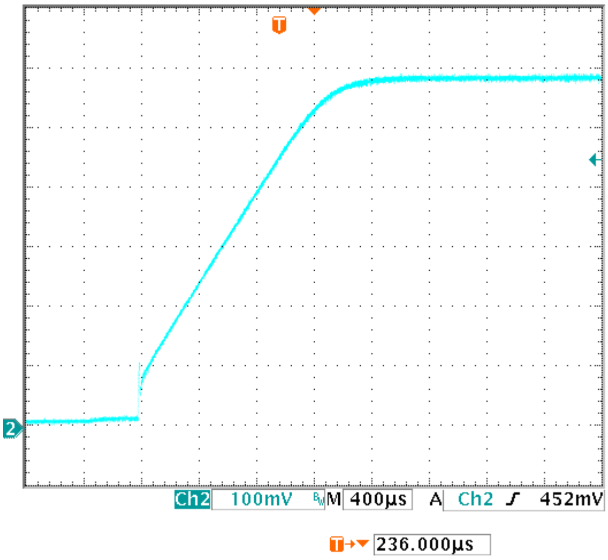


Figure 20. Vin=5V/Vo=0.59V, 100%load

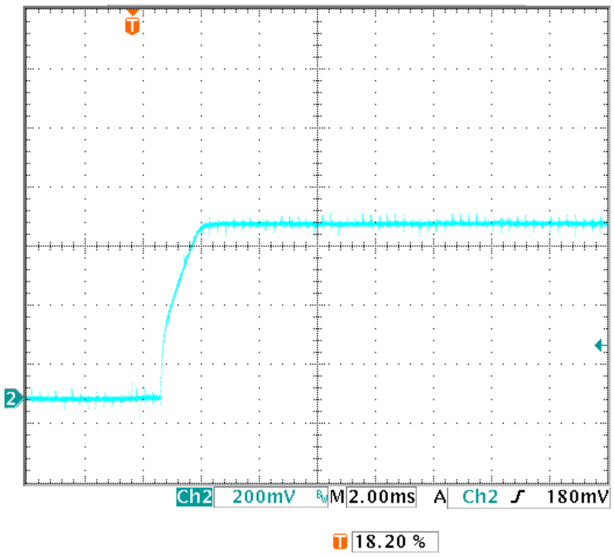


Figure 21. Vin=5V/Vo=0.59V, no-load

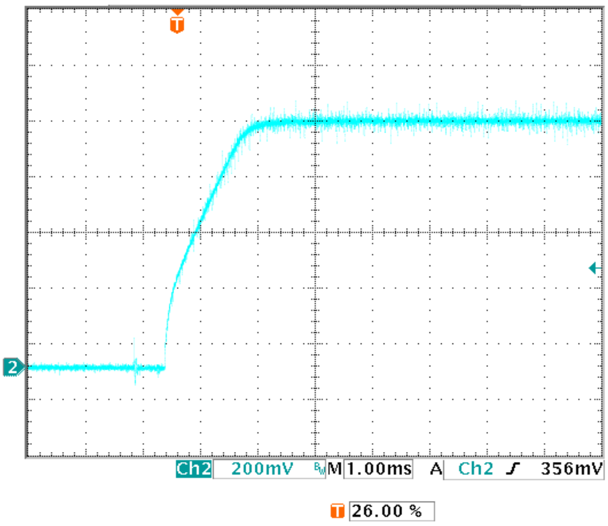


Figure22. Vin=5V/Vo=0.9V, 100%load

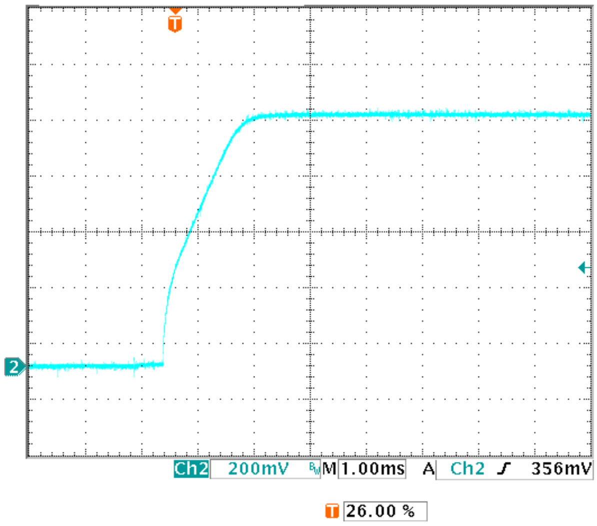


Figure 23. Vin=5V/Vo=0.9V, no-load

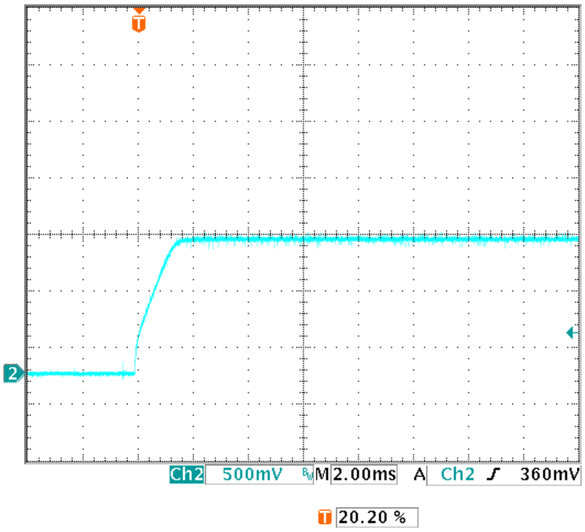


Figure 24. Vin=5V/Vo=1.2V, 100%load

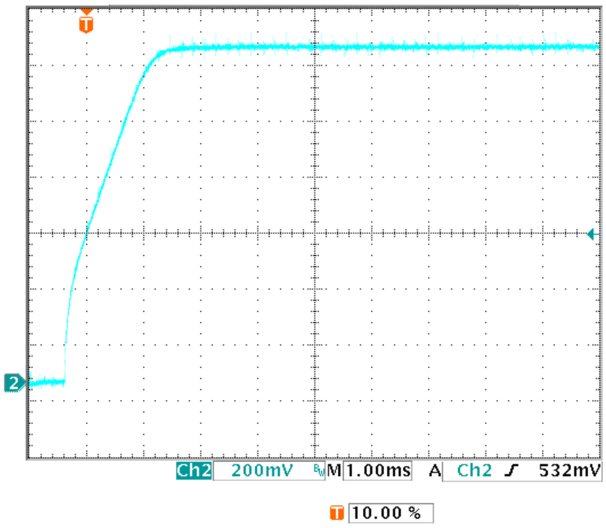


Figure 25. Vin=5V/Vo=1.2V, no-load

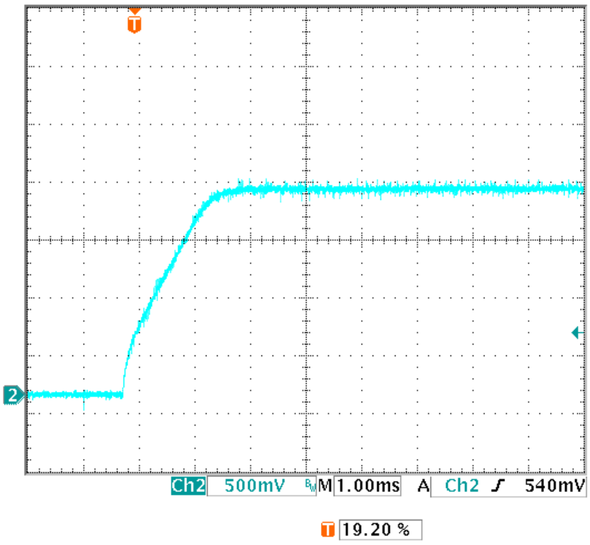


Figure 26. Vin=5V/Vo=1.8V, 100%load

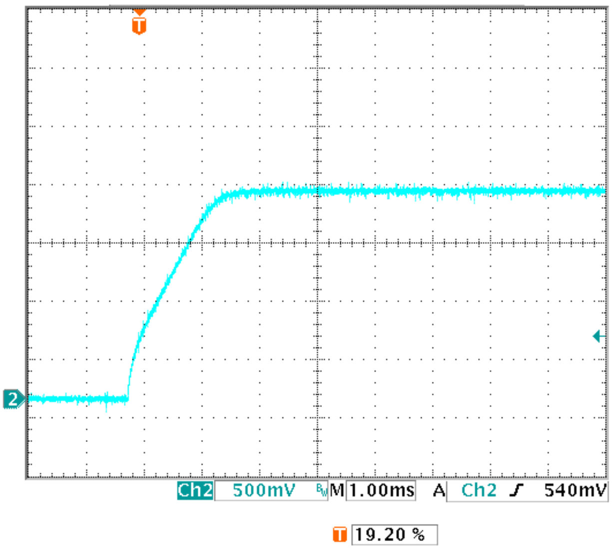


Figure 27. Vin=5V/Vo=1.8V, no-load

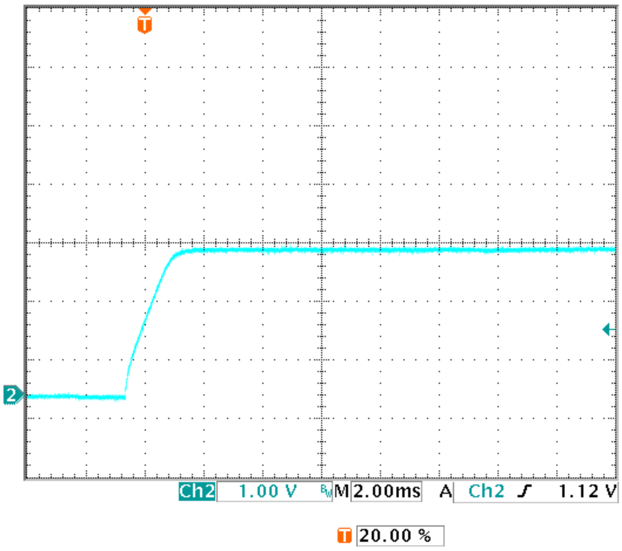


Figure 28. Vin=5V/Vo=2.5V, 100%load

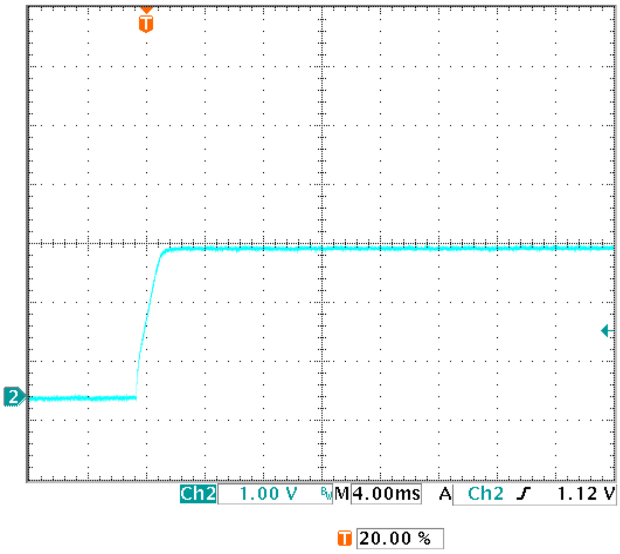


Figure 29. Vin=5V/Vo=2.5V, no-load

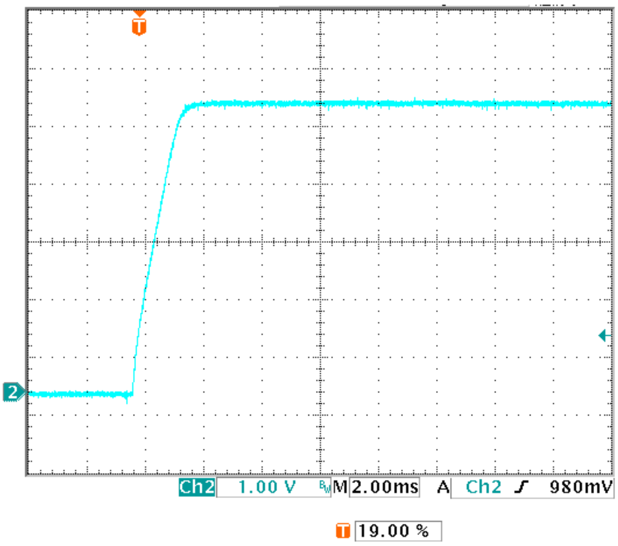


Figure 30. Vin=12V/Vo=5.0V, 100%load

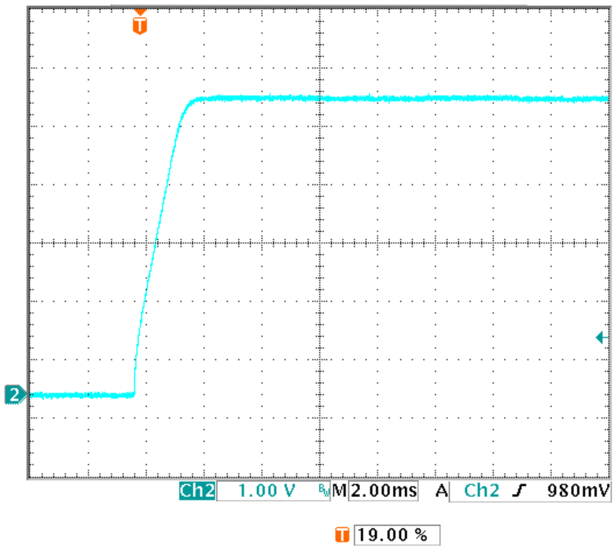


Figure 31. Vin=12V/Vo=5.0V, no-load

Characteristic Curves (Ripple, Peak to Peak)

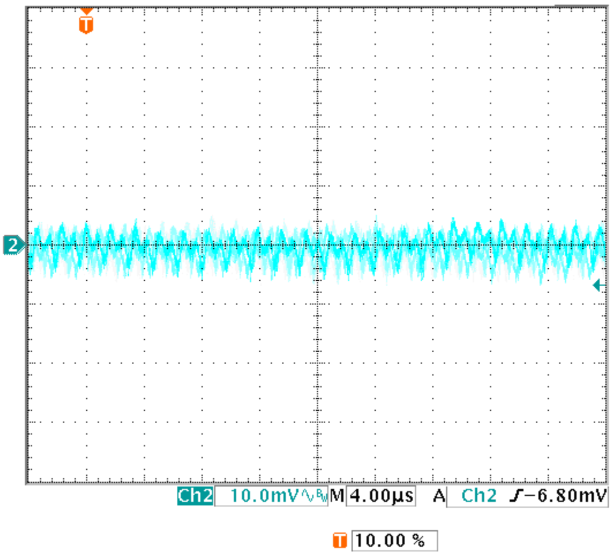


Figure 32. Vin=5V/Vo=0.59V, 100%load

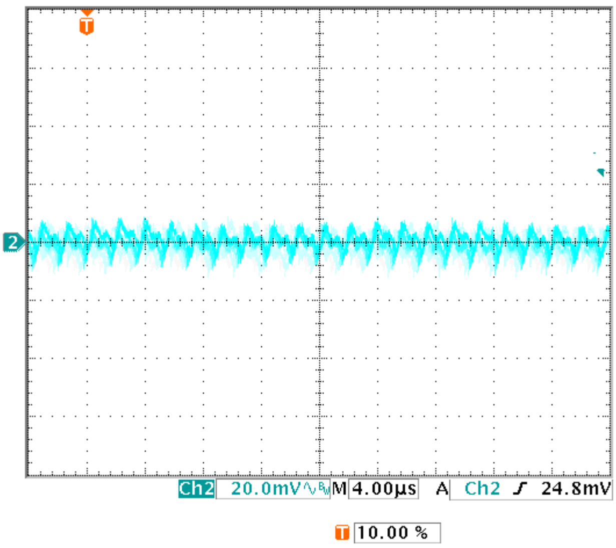


Figure 33. Vin=5V/Vo=0.9V, 100%load

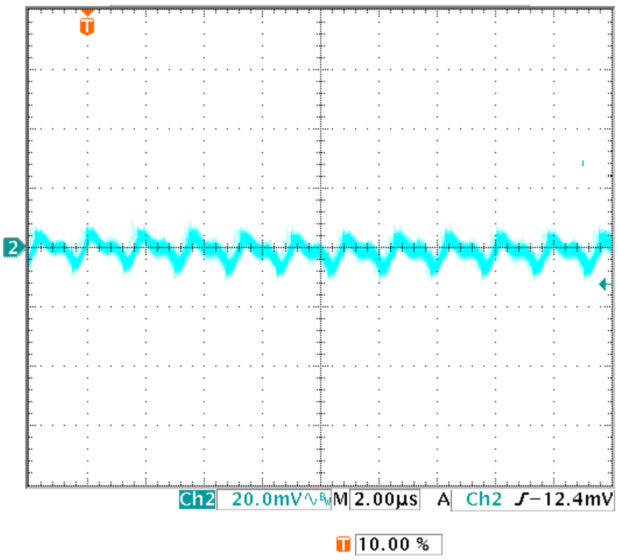


Figure 34. Vin=5V/Vo=1.2V, 100%load

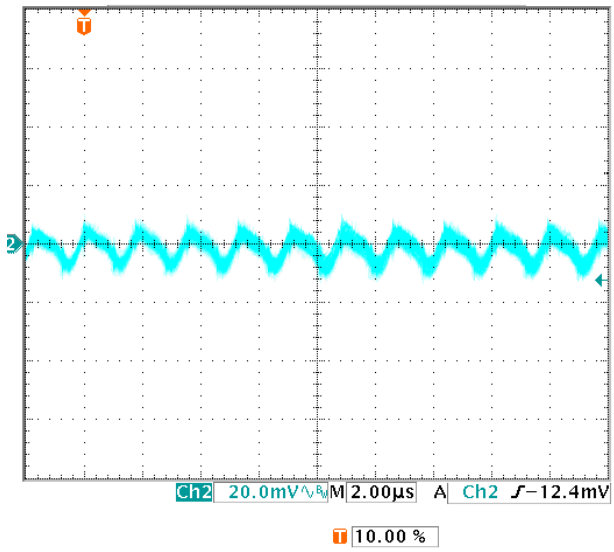


Figure 35. Vin=5V/Vo=1.8V, 100%load

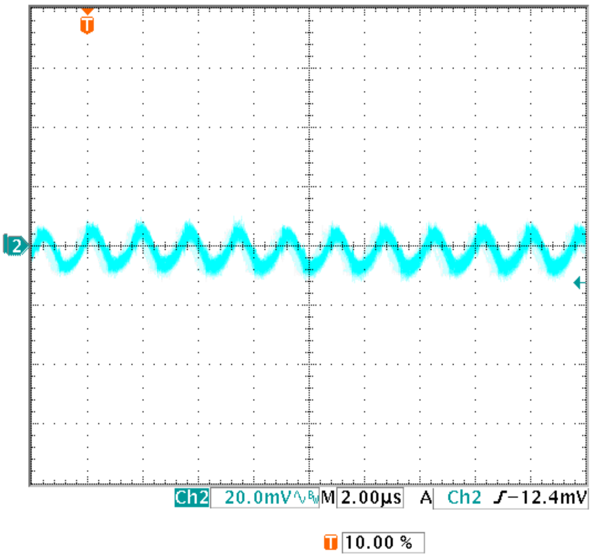


Figure 36. Vin=5V/Vo=2.5V, 100%load

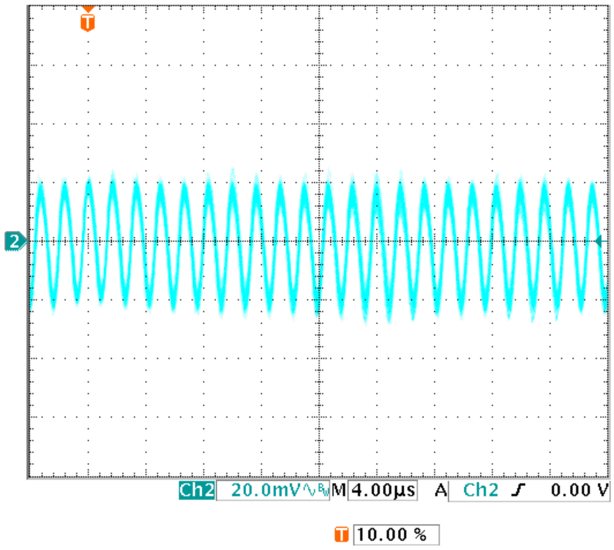
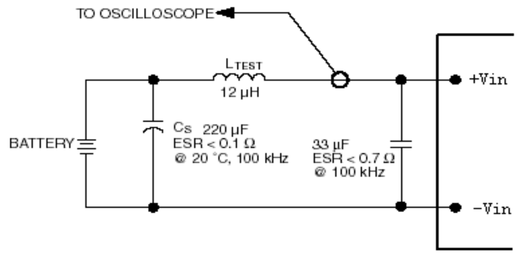


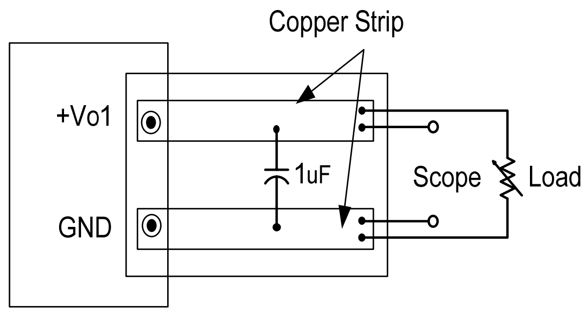
Figure 37. Vin=12V/Vo=5.0V, 100%load

Test Configurations



Note: Measure input reflected ripple current with a simulated source inductance (L_{TEST}) of 12μH. Capacitor C_S offsets possible battery impedance. Measure the current as shown above.

Figure 38. Input Reflected Ripple Current Test Setup



Note: Scope measurements should be made using a BNC socket with a 1μF ceramic capacitor. Position the load between 51mm and 76mm(2in and 3in) from the module

Figure39. Peak-to-Peak Output Ripple Test Setup

Safety Considerations

For safety agency approval the power module must be installed in compliance with the spacing and separation requirements of the end-use safety agency standards, i.e., UL 60950-1, CSA C22.2 No. 60950-1-03, and VDE 0850:2001-12 (EN60950-1) Licensed.

For the converter output to be considered meeting the requirements of safety extra-low voltage (SELV), the input must meet SELV requirements. The power module has extra-low voltage (ELV) outputs when all inputs are ELV. The input to these units is to be provided with a fast acting fuse with a maximum rating of 20A in the positive input lead.

Design Considerations

Input and Output Filter

The BAA SMT power module should be connected to a low ac-impedance input source. A highly inductive source can affect the stability of the power module. An input capacitor must be placed directly adjacent to the input pin of the module, to minimize input ripple voltage and ensure module stability.

To reduce the output ripple and improve the dynamic response to a step load change, additional capacitor at the output can be used. For stable operation of the module, limit the capacitor to less than the maximum output capacitance as specified in the electrical specification table. Figure 40 shows the typical application circuit with input and output filters.

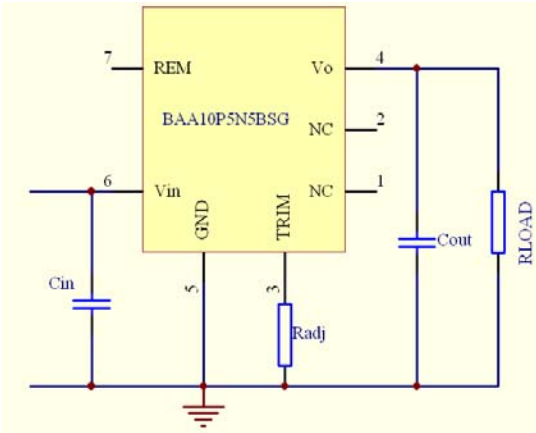


Figure 40. Typical application circuit

Feature Descriptions

Remote On/Off

The BAA SMT power modules feature an On/Off pin (REM) for remote On/Off control of the module. The remote On/Off operation is available by using a MOSFET with an external pull-up resistor (see Figure 41). The MOSFET keep the dissipation to a minimum, and the pull-up resistor is typically set at 5kΩ for proper operation of module over the entire temperature range.

To turn the module On, the REM pin should be left open, and to turn the module Off, the REM pin should be at 0~0.2Vdc

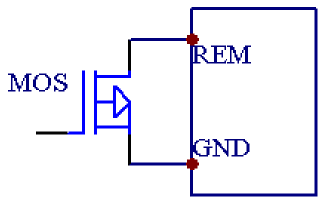


Figure 41. Remote On/Off Application Circuit

Output Voltage Programming

The output voltage of the module can be programmed to any voltage from 0.59Vdc to 5.1Vdc by connecting a single resistor R_{adj} between the TRIM and GND pins (shown in Figure 42). Without an external resistor between the TRIM and ground, that is to say, the TRIM pin is left open, the output voltage is 0.59Vdc. To calculate the value of the resistor R_{adj} for a particular output voltage Vo1, use the following equation:

$$R_{adj} = \frac{1.182}{Vo - 0.591} K\Omega$$

Where Vo = desired voltage.

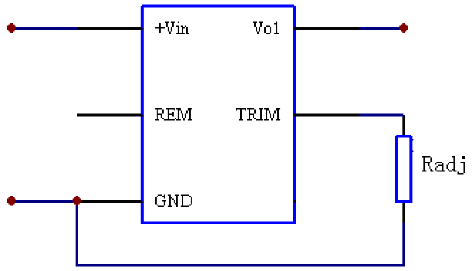


Figure 42. Output voltage programming application

The table below provides the R_{adj} values required for some common output voltages:

Vo (Vdc)	R_{adj} (KΩ)	Vo (Vdc)	R_{adj} (KΩ)
0.9	3.825	2.0	0.839
1.2	1.941	2.5	0.619
1.5	1.300	3.3	0.436
1.8	0.978	5.0	0.268

Power Good Indicator

The BAA SMT power modules have a power good indicator output. This output pin uses positive logic and is open-collector. The Power Good uses the same pin as the trim function and is not available if trim option is used (See figure 33). Also, the power good output is able to sink 10mA.

When the output of the module is within ±10% of the nominal set point, the power good pin can be pulled high. Note that Power Good should not be pulled higher than the following conditions:

If, Vin ≤ 5V, V_{pgood} (max) = Vin

If, Vin > 5V, V_{pgood} (max) = 5V.

Protection Features

Input Under Voltage Lockout

At input voltages below the input under-voltage lockout limit, the module operation is disabled. The module will begin to operate at an input voltage above the under-voltage lockout turn-on threshold.

Output Over current Protection

To provide protection in an output overload fault condition, the module is equipped with internal current-limiting circuitry and can endure current limiting for an unlimited duration. At the instance of current-limit inception, the module enters a "hiccup" mode of operation, whereby it shuts down and automatically attempts to restart. While the fault condition exists, the module will remain in this mode until the fault is cleared. The unit operates normally once the output current is reduced back into its specified range.

Over Temperature Protection

These modules feature an over-temperature protection circuit to safeguard against thermal damage. The circuit shuts down and latches off the module when the maximum device reference temperature is exceeded. The module can be restarted by cycling the dc input power for at least one second or by toggling the remote on/off signal for at least one second.

Thermal Considerations

Modules operate in a variety of thermal environments; however, sufficient cooling should always be provided to help ensure reliable operation. Considerations include ambient temperature, airflow, module power dissipation, and the need for increased reliability. A reduction in the operating temperature of the module will result in an increase in reliability. The thermal data presented here is based on physical measurements taken in a wind tunnel. Note that the airflow is parallel to the long axis of the module as shown in figure 43. The derating data applies to airflow in either direction of the module's long axis.

The thermal reference point, Tref1、Tref2，used to monitor the temperature limits of the product, are shown in Figure 43. For reliable operation the temperature should not exceed 120℃.

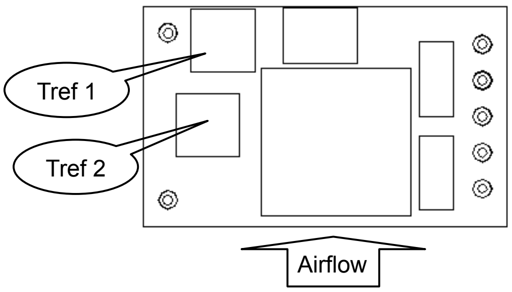


Figure43. Thermal test position and wind direction

Heat Transfer via Convection

Increased airflow over the module enhances the heat transfer via convection. Thermal derating curves showing the maximum output current that can be delivered at different local ambient temperature (TA) for airflow conditions ranging from natural convection and up to 2.5m/s are shown in the Characteristics Curves section.

Surface Mount Information

Pick and Place

The BAA SMT modules use an open frame construction and are designed for a fully automated assembly process. The modules are fitted with a label designed to provide a large surface area for pick and place operations. The label meets all the requirements for surface mount processing, as well as safety standards, and is able to withstand reflow temperatures of up to 280℃. The label also carries product information such as product family and serial number, as show in Figure44.

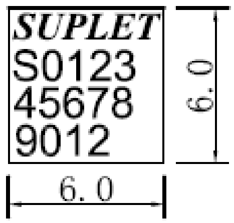


Figure44. Placement of the Label on the Product

Note:

Dimensions are in mm]. Tolerances: x.x mm ± 0.3mm

Figure44 and original figure in the proportion 3:1

Reflow Soldering Information

These power modules are large mass, low thermal resistance devices and typically heat up slower than other SMT components. It is recommended that the customer review data sheets in order to customize the solder reflow profile for each application board assembly.

The following instructions must be observed when SMT soldering these units. Failure to observe these instructions may result in the failure of or cause damage to the modules, and can adversely affect long-term reliability.

Typically, the eutectic solder melts at 217℃, wets the land, and subsequently wicks the device connection. Sufficient time must be allowed to fuse the plating on the connection to ensure a reliable solder joint. There are several types of SMT reflow technologies currently used in the industry. These surface mount power modules can be reliably soldered using natural forced convection, IR (radiant infrared), or a combination of convection/IR. For reliable soldering the solder reflow profile should be established by accurately measuring the modules pin connector temperatures.

Lead Free Soldering

The SMT modules are lead-free (Pb-free) and RoHS compliant and are compatible in a Pb-free soldering process. Failure to observe the instructions below may result in the failure of or cause damage to the modules and can adversely affect long-term reliability.

Pb-free Reflow Profile

Power Systems will comply with J-STD-020 Rev. B

(Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices) for both Pb-free solder profiles and MSL classification procedures. This standard provides a recommended forced-air-convection reflow profile based on the volume and thickness of the package (table 4-2). The suggested Pb-free solder paste is Sn/Ag/Cu (SAC).The recommended reflow profile using Sn/Ag/Cu solder is shown in Figure45.

Storage and Handling

The recommended storage environment and handling procedures for moisture-sensitive surface mount packages is detailed in J-STD-033 Rev. A (Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices). Moisture barrier bags (MBB) with desiccant are required for max. MSL 3 condition. These sealed packages should not be broken until time of use. Once the original package is broken, the floor life of the product at conditions of ≤ 30°C and 60% relative humidity varies according to the MSL rating (see J-STD-033A).The shelf life for dry packed SMT packages will be a minimum of 12 months from the bag seal date, when stored at the following conditions: < 40° C, < 90% relative humidity.

Post Solder Cleaning and Drying Considerations

Post solder cleaning is usually the final circuit-board assembly process prior to electrical board testing. The result of inadequate cleaning and drying can affect both the reliability of a power module and the test ability of the finished circuit-board assembly. For guidance on appropriate soldering, cleaning and drying procedures, refer to Suplet Soldering and Cleaning Application Note (SLG03.01008 Rev.C).

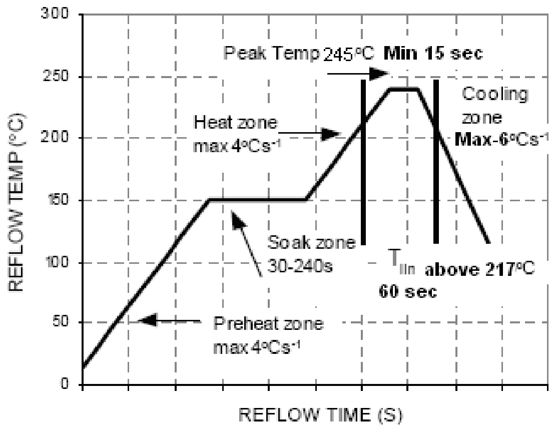


Figure45. Recommended Reflow Profile using Sn/Ag/Cu Solder.

Outline Diagram

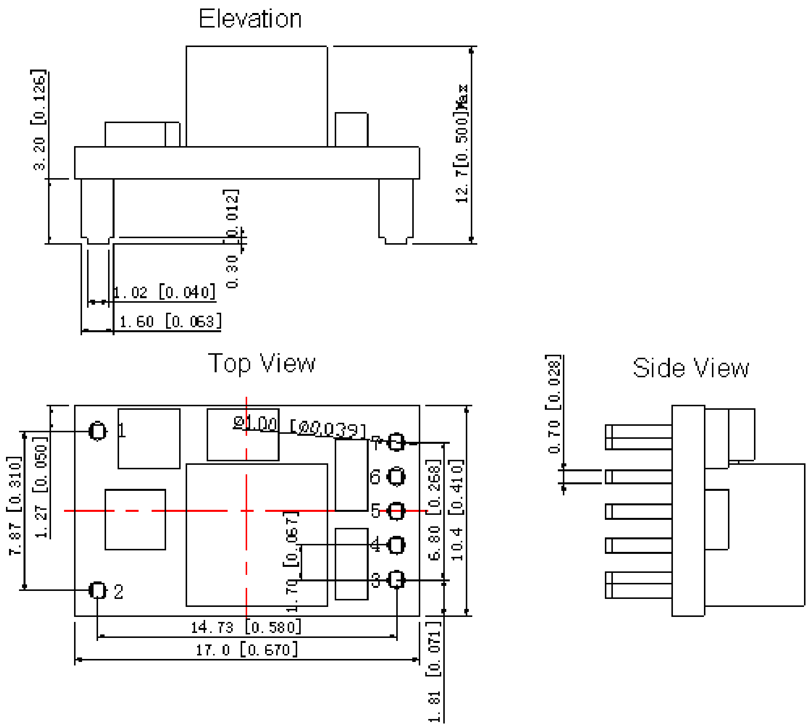


Figure46. Outline Diagram

Note: Dimensions are in mm [inch]. Tolerances: x.x mm ± 0.3mm [x.x in. ± 0.012 in.], x.xx mm ± 0.10 mm [x.xxx in. ± 0.004 in.] (Unless otherwise indicated).

Pin Designations

Pins No.	Symbols	Functions
1,2	NC	Location pin
3	TRIM / POWER GOOD	Output voltage adjustment / Power good indicator
4	Vo1	Positive output
5	GND	Negative input and output
6	Vin	Positive input
7	REM	Remote control

Recommended Pad Layout and Stencil Thickness

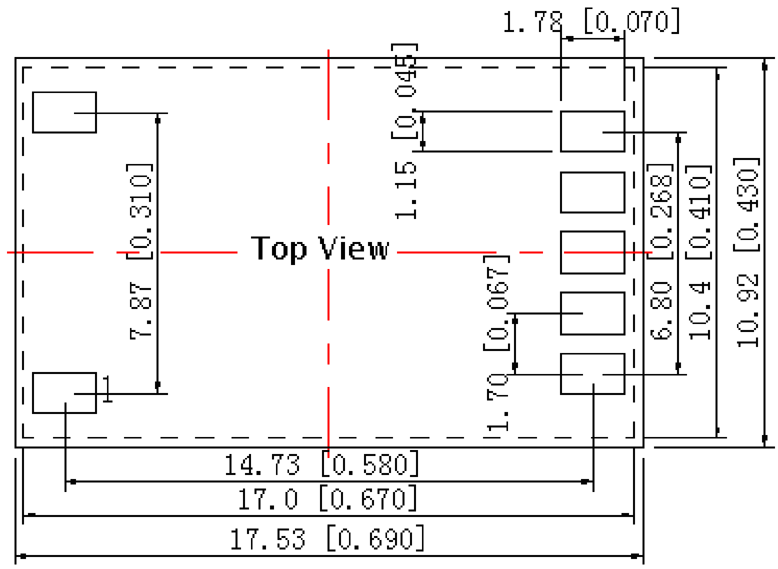


Figure47. Recommended Pad Layout

Note: Dimensions are in mm [inch]. Tolerances: x.x mm ± 0.3mm [x.x in. ± 0.012 in.], x.xx mm ± 0.10 mm [x.xxx in. ± 0.004 in.] (Unless otherwise indicated)
Pads Size: 0.120 in. * 0.095 in. (min); 135 in. * 0.110 in.(max)

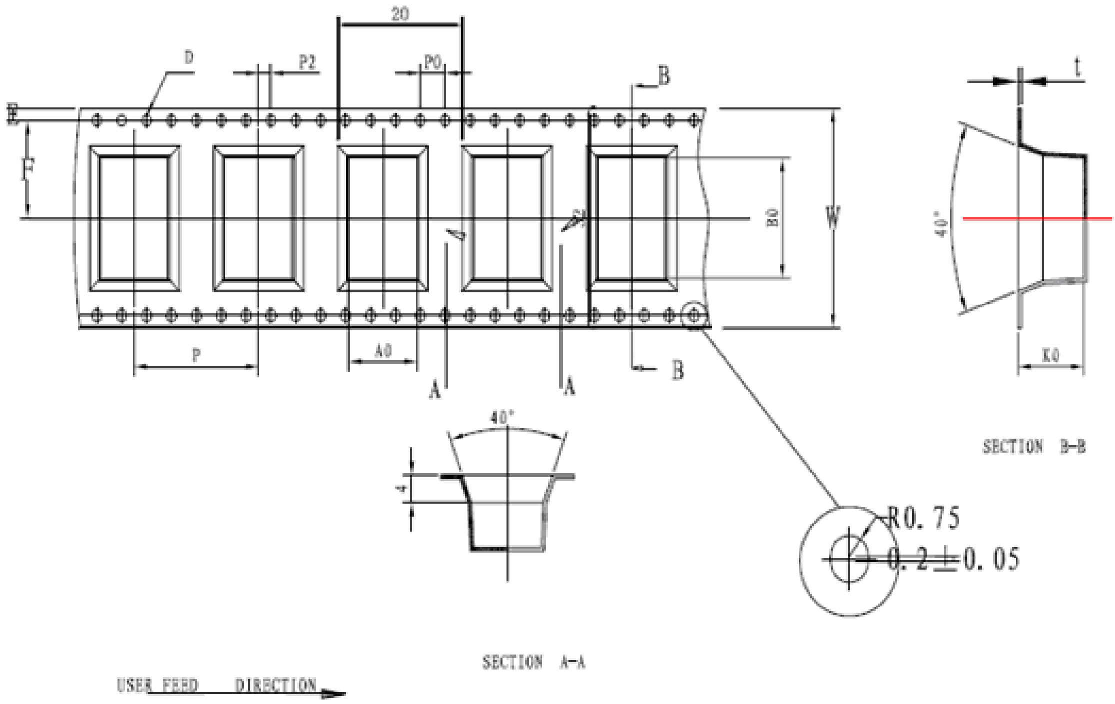
Recommended Stencil Thickness is more than 0.18mm

Packaging Details

The BAA SMT module is supplied in tape & reel as standard. Modules are shipped in quantities of 300 modules per reel.

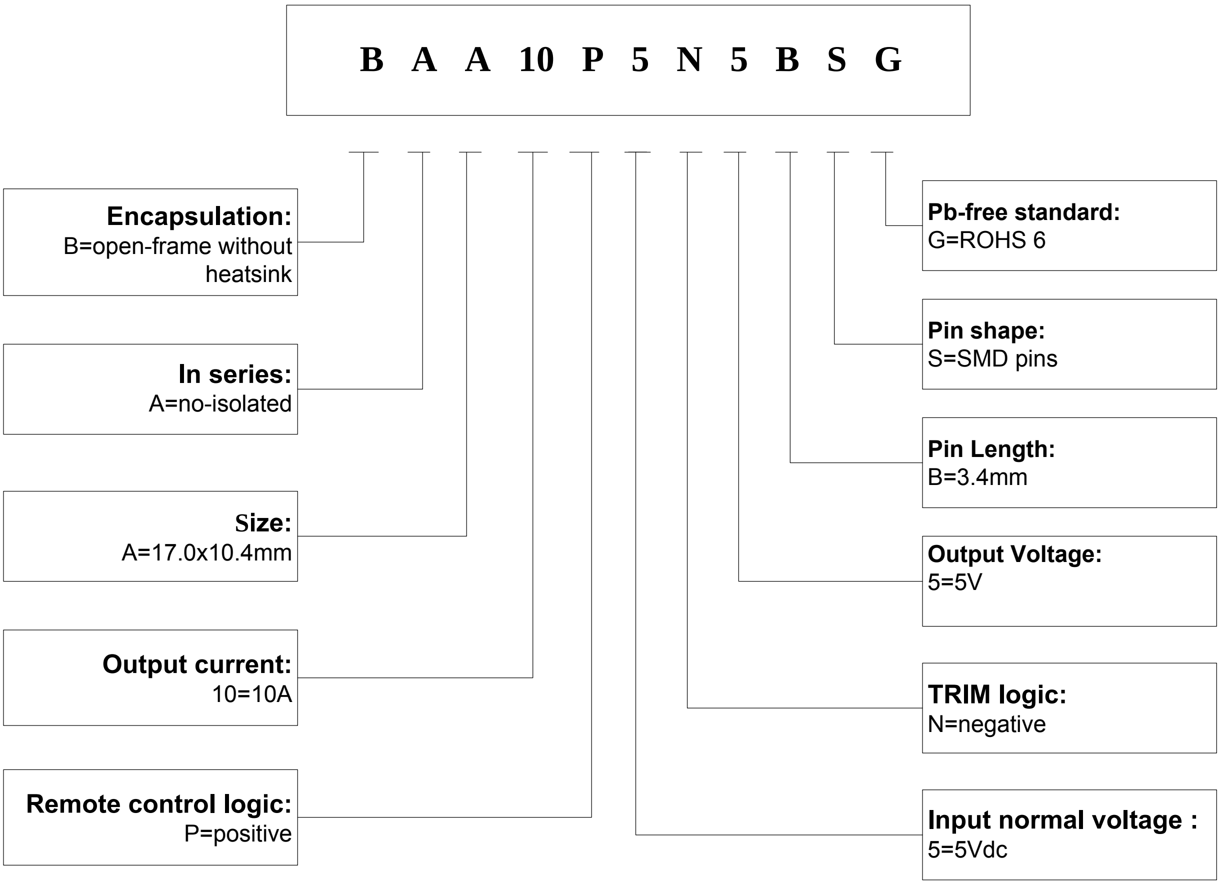
Tape Dimensions

ITEM	W	A0	B0	K0	P	F	E	D	P0	P2	t	13"	
DIM	32.0	10.9	17.5	10.5	20	14.2	1.75	1.50	4.00	2.00	0.5	Tape length	Tape capacity
TOLE	+0.30 -0.30	+0.10 -0.10	+0.10 -0.10	+0.10 -0.10	+0.10 -0.10	+0.10 -0.10	+0.10 -0.10	+0.10 -0.00	+0.10 -0.10	+0.10 -0.10	+0.05 -0.05	6.5M	300PCS



Reel Dimensions
Outside diameter: 320mm (12.60")
Inside diameter: 90mm (3.54")
Tape Width: 32mm (1.26")

Naming Rules On Models



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