uPOL MODULE

3A, High Efficiency uPOL Module

MUN3CAD03-SF

FEATURES:

- High Density uPOL Module
- 3A Output Current
- 94% Peak Efficiency at 5.0Vin to 3.3Vout
- Input Voltage Range from 2.75V to 5.5V
- Adjustable Output Voltage
- Enable / PGOOD Function
- Automatic Power Saving/PWM Mode
- Protections (UVLO,OCP: Non-latching, OTP)
- Internal Soft Start 0.8mS
- Compact Size: 3.0mm*3.0mm*1.3mm
- Pb-free for RoHS compliant
- 100% dropout voltage
- MSL 2, 260°C Reflow

APPLICATIONS:

- Single Li-Ion Battery-Powered Equipment
- Server power / telecom power
- Cell Phones / PDAs / Palmtops
- SSD

GENERAL DESCRIPTION:

The uPOL module is non-isolated dc-dc converters that can deliver up to 3A of output current. The PWM switching regulator, high frequency power inductor are integrated in one hybrid package. It only needs input/output capacitors and voltage dividing resistors.

The module has automatic operation with PWM mode and power saving mode according to loading, through constant on-time control, the module offers a simpler control loop and faster transient response. Other features include remote enable function, internal soft-start, non-latching over current protection, power good, and input under voltage locked-out capability.

The low profile and compact size package (3.0mm×3.0mmx 1.3mm) is suitable for automated assembly by standard surface mount equipment. The uPOL module is Pb-free and RoHS compliance.

TYPICAL APPLICATION CIRCUIT& PACKAGE:

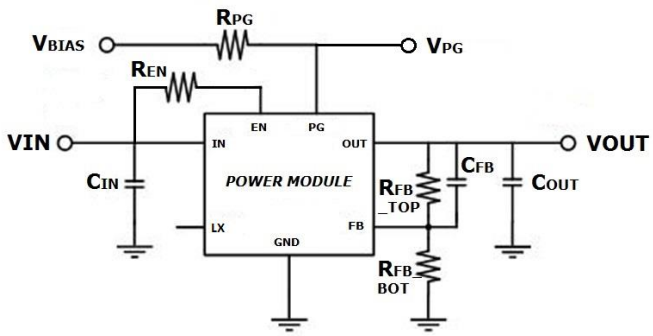


FIG.1 TYPICAL APPLICATION CIRCUIT

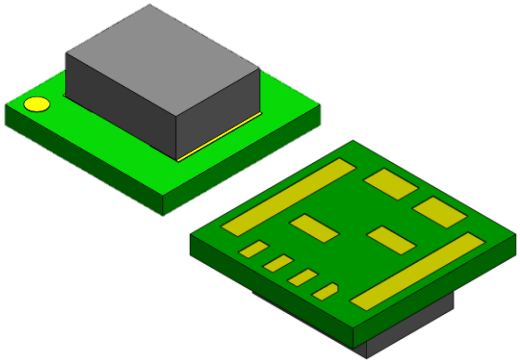


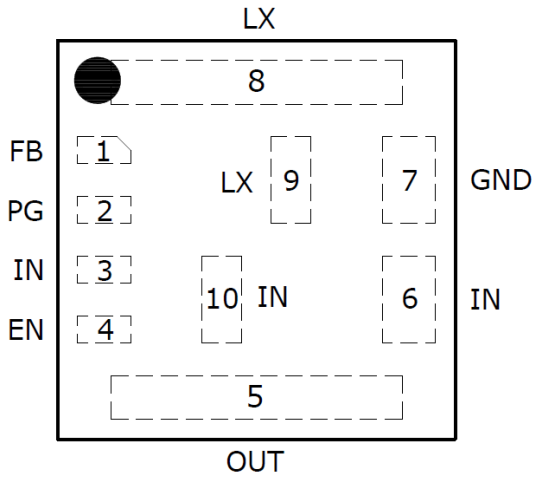
FIG.2 HIGH DENSITY LOW PROFILE uPOL MODULE

ORDER INFORMATION:

Part Number	Ambient Temp. Range (°C)	Package (Pb-Free)	MSL	Note
MUN3CAD03-SF	-40 ~ +85	QFN	Level 2	-

Order Code	Packing	Quantity
MUN3CAD03-SF	Tape and reel	2000

PIN CONFIGURATION:



TOP VIEW

PIN DESCRIPTION:

Symbol	Pin No.	Description
FB	1	Feedback input. Connect an external resistor divider from the output to FB and FB to GND.
PG	2	Power Good indicator. The pin output is an open drain.
IN	3, 6, 10	Power input pin.
EN	4	Enable control. Do not be float. EN = LOW, the module is off. EN = HIGH, the module is on.
OUT	5	Power output pin.
GND	7	Power ground pin for signal, input, and output return path. This pin needs to connect one or more ground plane directly.
LX	8, 9	Switch node, leave it no connection.

ELECTRICAL SPECIFICATIONS:

CAUTION: Do not operate at or near absolute maximum rating listed for extended periods of time. This stress may adversely impact product reliability and result in failures not covered by warranty.

Parameter	Description	Min.	Typ.	Max.	Unit
■ Absolute Maximum Ratings					
VIN to GND		-	-	+6.0	V
VOUT to GND		-	-	+6.0	V
SW to GND	Note 1			VIN+0.3	V
EN to GND	Note 1	-	-	+6.0	V
Tc	Case Temperature of Inductor	-	-	+110	°C
Tj	Junction Temperature	-40	-	+150	°C
Tstg	Storage Temperature	-40	-	+125	°C
ESD Rating	Human Body Model (HBM)	-	-	2k	V
	Machine Model (MM)	-	-	200	V
	Charge Device Model (CDM)	-	-	500	V
■ Recommendation Operating Ratings					
VIN	Input Supply Voltage	+2.75	-	+5.5	V
VOUT	Adjusted Output Voltage	+0.6	-	+3.3	V
Ta	Ambient Temperature	-40	-	+85	°C
■ Thermal Information					
Rth(j_{choke}-a)	Thermal resistance from junction to ambient, Ta = 25℃ (Note 1)	-	45	-	°C/W

NOTES:
1. Rth(jchoke-a) is measured with the component mounted on an effective thermal conductivity test board on 0 LFM condition. The test board size is 30mm×30mm×1.6mm with 4 layers, 2 oz per layer. The test condition is complied with JEDEC EIJ/JESD 51 Standards.

ELECTRICAL SPECIFICATIONS:(Cont.)

Conditions: T_A = 25 ºC, unless otherwise specified. Test Board Information: 30mm×30mm×1.6mm, 4 layers 1 oz.
The output ripple and transient response measurement is short loop probing and 20MegHz bandwidth limited. Vin = 3.3V, Vout = 1.8V, Cin =22uF/6.3V/0805/X5R, Cout = 47uF/6.3V/0805/X5R, Cfb = 22pF/50V/0402/C0G, external +5V connect pull-up resister to PG, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
■ Input Characteristics						
I_{SD}	Input shutdown current	Vin=3.3V,EN = GND	-	0.1	1.0	uA
I_{IN}	Input supply bias current	Vin=3.3V, Iout=0A Vout = 1.8V,EN = VIN	-	100	-	uA
I_S	Input supply current	Vin=3.3V, EN = VIN	-	-	-	-
		Iout = 10mA Vout = 1.8V	-	6.1	-	mA
		Iout = 3.0A Vout = 1.8V	-	1.83	-	A
■ Output Characteristics						
$I_{OUT(DC)}$	Output current	Vin=3.3V, Vout=1.8V	0	-	3	A
$V_{O(SET)}$	Ouput Voltage Set Point	With 0.1% tolerance for external resistor used to set output voltage at PWM mode	-2.0	-	+2.0	% $V_{O(SET)}$
$\Delta V_{OUT}/\Delta V_{IN}$	Line regulation accuracy	Vin = 3.3V to 5V Vout = 1.8V, Iout = 3A	-	0.5	-	% $V_{O(SET)}$
$\Delta V_{OUT}/\Delta I_{OUT}$	Load regulation accuracy	Iout = 0A to 3A Vin = 3.3V, Vout = 1.8V	-	3	-	% $V_{O(SET)}$
$V_{OUT(AC)}$	Output ripple voltage	Vin = 3.3V, Vout = 1.8V EN = VIN; Iout = 0A	-	15	-	mVp-p
		Vin = 3.3V, Vout = 1.8V EN = VIN; Iout = 3A	-	15	-	mVp-p
$C_{OUT(MAX)}$	Maximum capacitive load	Iout = 3A, ESR≧1mΩ	-	-	150	uF

ELECTRICAL SPECIFICATIONS:(Cont.)

Conditions: T_A = 25 ºC, unless otherwise specified. Test Board Information: 30mm×30mm×1.6mm, 4 layers 1 oz.
The output ripple and transient response measurement is short loop probing and 20MegHz bandwidth limited. Vin = 3.3V, Vout = 1.8V, Cin =22uF/6.3V/0805/X5R, Cout = 47uF/6.3V/0805/X5R, Cfb = 22pF/50V/0402/C0G, external +5V connect pull-up resister to PG, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
■ Control Characteristics						
V_{EN_TH}	Enable upper threshold voltage	V_{EN_TH} rising	1.2	-	-	V
	Enable lower threshold voltage	V_{EN_TH} falling	-	-	0.4	V
Fosc	Oscillator frequency	PWM Operation	0.96	1.2	1.44	MHz
V_{PGOOD_TH}	PGOOD high	Respect the V_{REF}	-	90	-	%
V_{PGOOD_LV}	PGOOD logic low voltage	I_{PGOOD} = 4mA	0.04	0.15	0.3	V
Discharge	LX node discharge resister		-	50	-	ohm
■ Fault Protection						
I_{LIMIT_TH}	Current limit threshold	Peak value of output current	5.0	-	7.0	A
T_{OTP}	Over temperature protection		-	150	-	°C
UVLO	Under voltage lockout			2.7		V

TYPICAL PERFORMANCE CHARACTERISTICS: (1.0 VOUT)

Conditions: T_A = 25 ºC, unless otherwise specified. Test Board Information: 30mm×30mm×1.6mm, 4 layers 2oz.
The output ripple and transient response measurement is short loop probing and 20MegHz bandwidth limited.
Cin =22uF/6.3V/0805/X5R, Cout = 47uF/6.3V/0805/X5R, Cfb = 22pF/50V/0402/C0G, external +5V connect pull-up resister to PG, unless otherwise specified.
The following figures provide the typical characteristic curves at 1.0Vout.

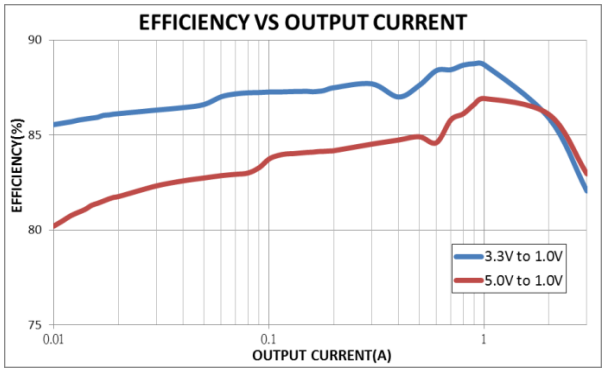


FIG.3 EFFICIENCY V.S. LOAD CURRENT

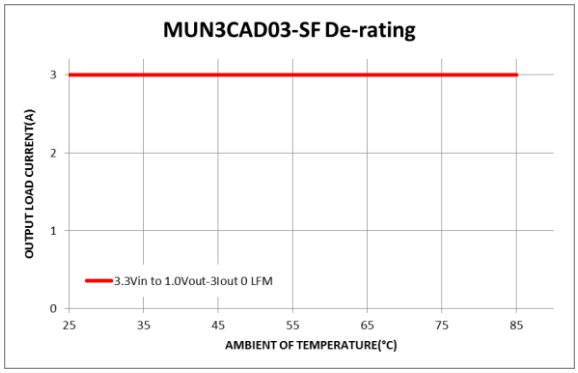


FIG.4 DE-RATING CURVE

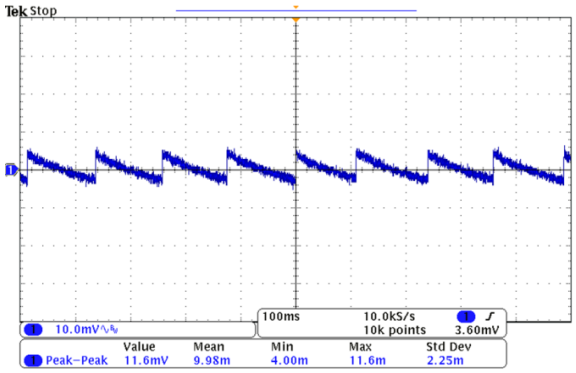


FIG.5 OUTPUT RIPPLE
(3.3VIN, IOUT=0A)

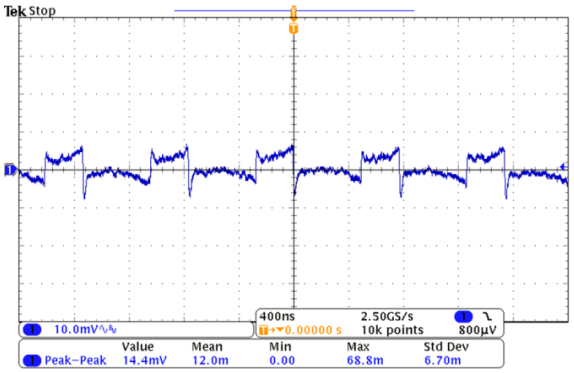


FIG.6OUTPUT RIPPLE
(3.3VIN, IOUT=3A)

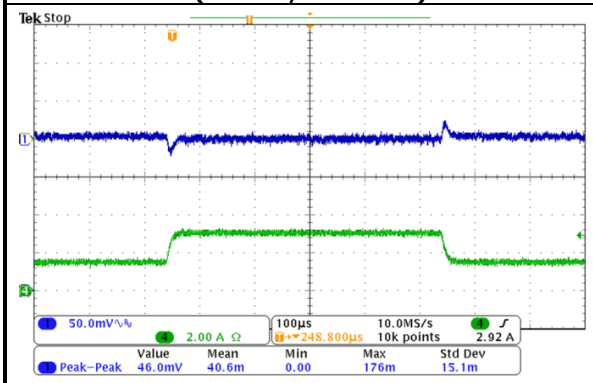


FIG.7 TRANSIENT RESPONSE
(3.3VIN, 50% to 100% LOAD STEP)

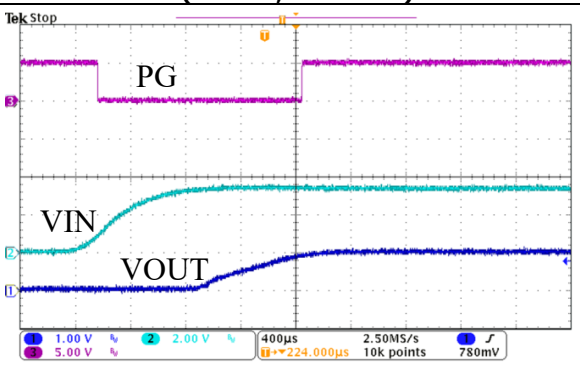


FIG.8 TURN-ON
(3.3VIN, IOUT=3A)

TYPICAL PERFORMANCE CHARACTERISTICS: (1.8VOUT)

Conditions: T_A = 25 ºC, unless otherwise specified. Test Board Information: 30mm×30mm×1.6mm, 4 layers 2oz.
The output ripple and transient response measurement is short loop probing and 20MegHz bandwidth limited.
Cin =22uF/6.3V/0805/X5R, Cout = 47uF/6.3V/0805/X5R, Cfb = 22pF/50V/0402/C0G, external +5V connect pull-up resister to PG, unless otherwise specified.
The following figures provide the typical characteristic curves at 1.8Vout.

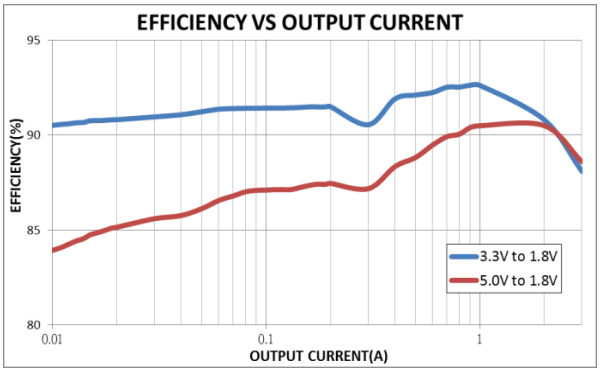


FIG.9 EFFICIENCY V.S. LOAD CURRENT

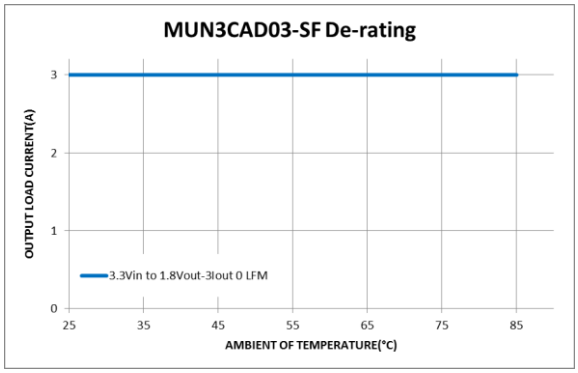


FIG.10 DE-RATING CURVE

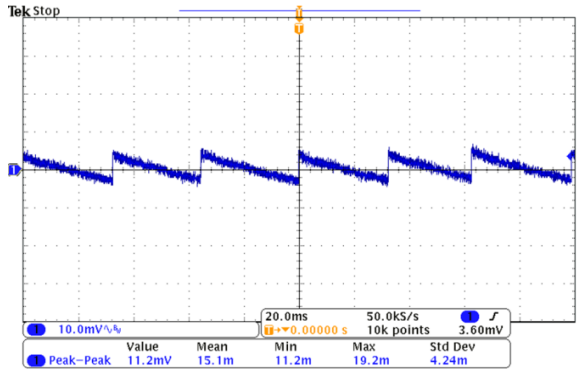


FIG.11 OUTPUT RIPPLE
(3.3VIN, IOUT=0A)

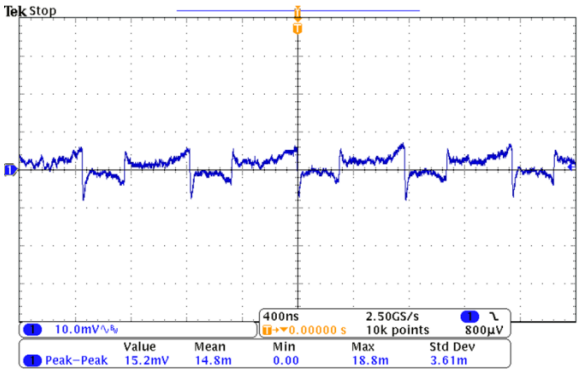


FIG.12 OUTPUT RIPPLE
(3.3VIN, IOUT=3A)

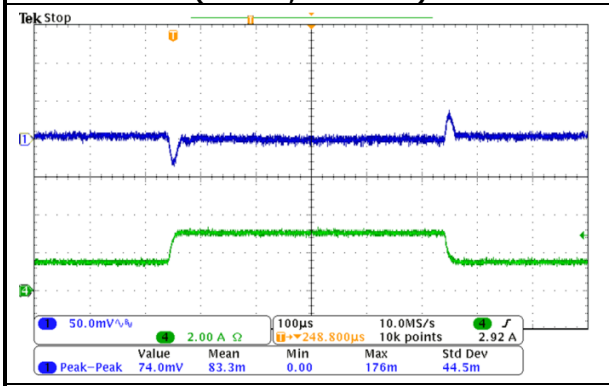


FIG.13 TRANSIENT RESPONSE
(3.3VIN, 50% to 100% LOAD STEP)

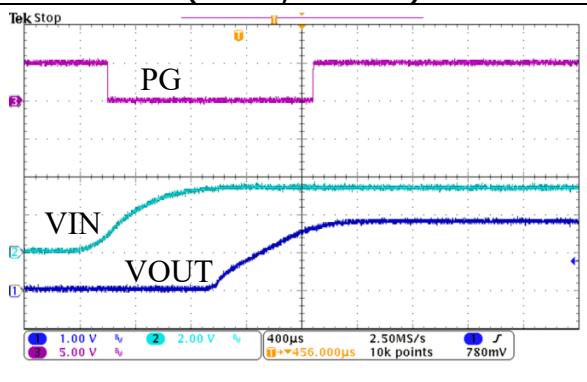


FIG.14 TURN-ON
(3.3VIN, IOUT=3A)

TYPICAL PERFORMANCE CHARACTERISTICS: (3.3VOUT)

Conditions: T_A = 25 ºC, unless otherwise specified. Test Board Information: 30mm×30mm×1.6mm, 4 layers 2oz.
The output ripple and transient response measurement is short loop probing and 20MegHz bandwidth limited.
Cin =22uF/6.3V/0805/X5R, Cout = 47uF/6.3V/0805/X5R, Cfb = 22pF/50V/0402/C0G, external +5V connect pull-up resister to PG, unless otherwise specified.
The following figures provide the typical characteristic curves at 3.3Vout.

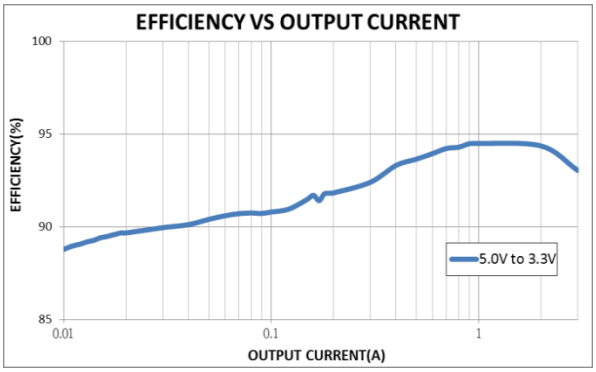


FIG.15 EFFICIENCY V.S. LOAD CURRENT

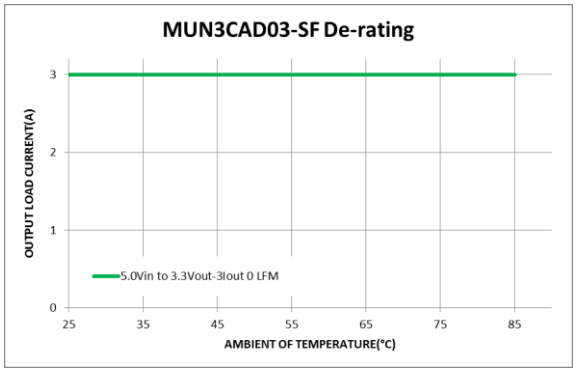


FIG.16 DE-RATING CURVE

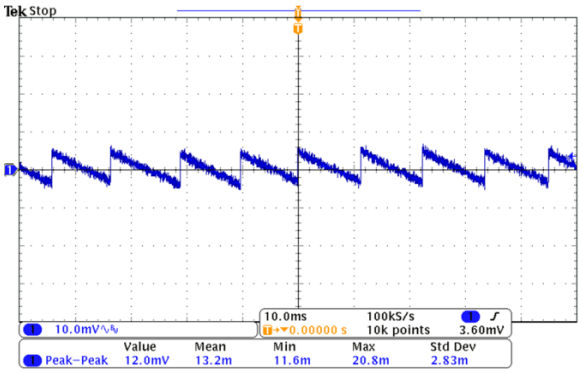


FIG.17 OUTPUT RIPPLE
(5.0VIN, IOUT=0A)

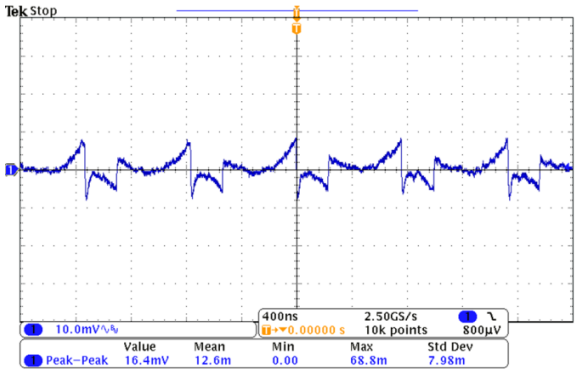


FIG.18 OUTPUT RIPPLE
(5.0VIN, IOUT=3A)

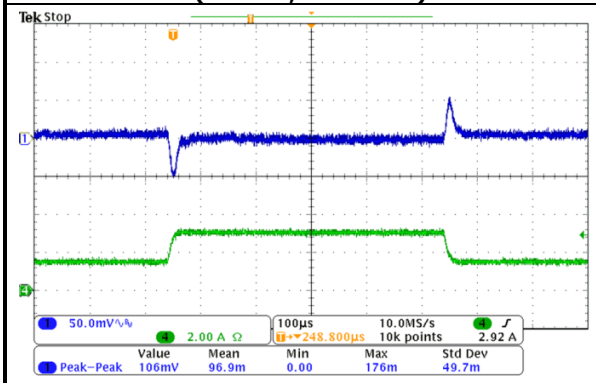


FIG.19 TRANSIENT RESPONSE
(5.0VIN, 50% to 100% LOAD STEP)

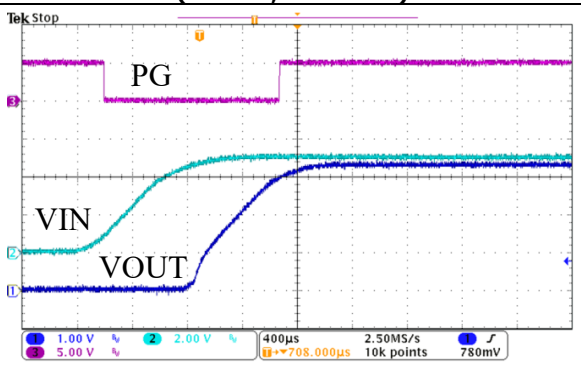


FIG.20 TURN-ON
(5VIN, IOUT=3A)

APPLICATIONS INFORMATION:

SAFETY CONSIDERATIONS:

Certain applications and/or safety agencies may require fuses at the inputs of power conversion components. Fuses should also be used when there is the possibility of sustained input voltage reversal which is not current limited. For greatest safety, we recommend a fast blow fuse installed in the ungrounded input supply line. The installer must observe all relevant safety standards and regulations. For safety agency approvals, install the converter in compliance with the end-user safety standard.

INPUT FILTERING:

The module should be connected to as low AC impedance source supply and a highly inductive source or line inductance can affect the stability of the module. Input capacitors must be placed directly to the input pin of the module, to minimize input ripple voltage and ensure module stability.

OUTPUT FILTERING:

To reduce output ripple and improve the dynamic response to as step load change, the additional capacitors at the output must be used. Low ESR ceramic capacitors are recommended to improve the output ripple and dynamic response of the module.

PROGRAMMING OUTPUT VOLTAGE:

The output voltage can be programmed by the dividing resistor RFB_top and RFB_bot, Assume RFB_top set 200 Kohm, the output voltage can be calculated as shown in Equation 1 and the resistance according to typical output voltage is shown in TABLE 1.

$$\text{VOUT (V)} = 0.6 \times \left(1 + \frac{\text{RFB\_top}}{\text{RFB\_bot}}\right) \quad \text{(EQ.1)}$$

Vout (V)	RFB_top (kΩ)	RFB_bot(kΩ)
1.0	200	300
1.2	200	200
1.8	200	100
2.5	200	63.158
3.3	200	44.444

TABLE.1 RESISTOR VALUES FOR COMMON OUTPUTVOLTAGES

APPLICATIONS INFORMATION: (Cont.)

LOAD TRANSIENT RESPONSE INCREASE:

In some applications, adding a ceramic cap (CFB) in parallel with RFB-top may further speedy up the load transient responses, recommend capacitance as below table 2.

Vout (V)	CFB (pF)
1.0	22~100
1.2	22~100
1.8	22~100
2.5	22~47
3.3	22

TABLE.2 RECOMMEND CFB FOR LOAD TRANSIENT

THERMAL CONSIDERATIONS:

All of thermal testing condition is complied with JEDEC EIJ/JESD 51 Standards. Therefore, the test board size is 30mm×30mm×1.6mm with 4 layers 2oz. The case temperature of module sensing point is shown as FIG.21 Then Rth(jchoke-a) is measured with the component mounted on an effective thermal conductivity test board on 0 LFM condition. The module is designed for using when the case temperature is below 110°C regardless the change of output current, input/output voltage or ambient temperature.

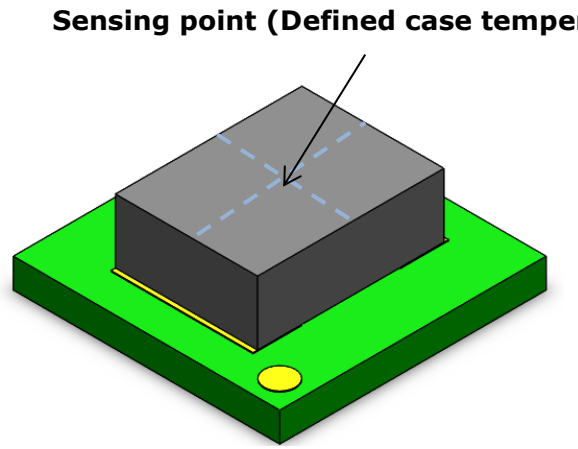


FIG.21 CASE TEMPERATURE SENSING POINT

APPLICATIONS INFORMATION: (Cont.)

LAYOUT RECOMMENDATIONS:

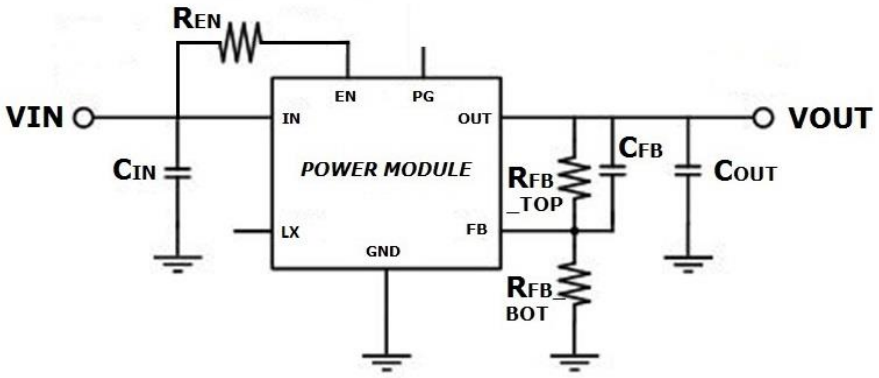


FIG.22 CIRCUIT OF LAYOUT

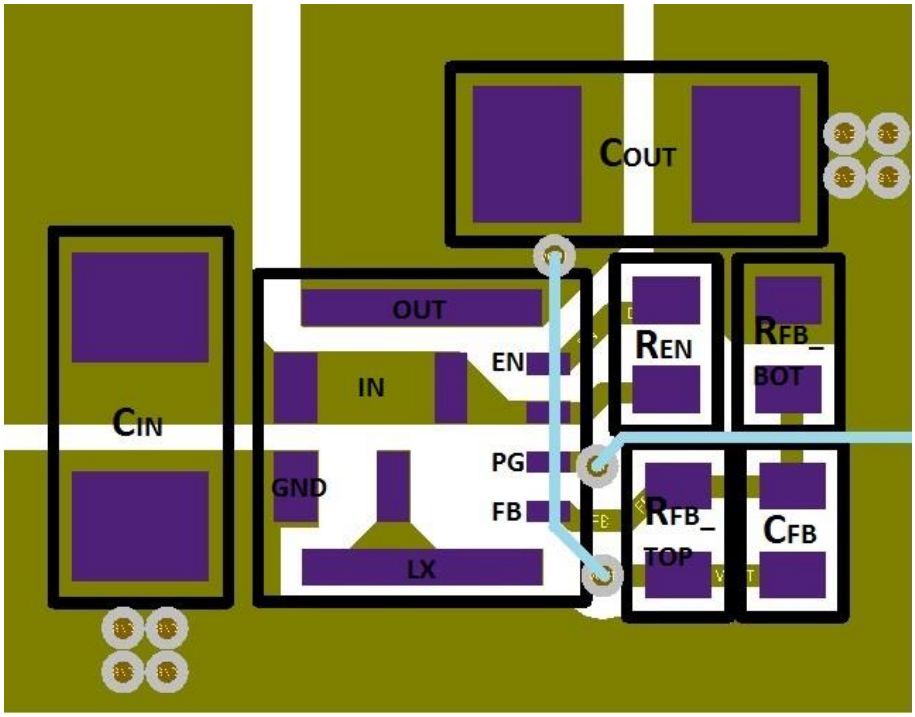


FIG.23 LAYOUT OF FIRST LAYER

APPLICATIONS INFORMATION: (Cont.)

REFLOW PARAMETERS:

Lead-free soldering process is a standard of electronic products production. Solder alloys like Sn/Ag, Sn/Ag/Cu and Sn/Ag/Bi are used extensively to replace the traditional Sn/Pb alloy. Sn/Ag/Cu alloy (SAC) is recommended for this power module process. In the SAC alloy series, SAC305 is a very popular solder alloy containing 3% Ag and 0.5% Cu and easy to obtain. Figure 24 shows an example of the reflow profile diagram. Typically, the profile has three stages. During the initial stage from room temperature to 150°C, the ramp rate of temperature should not be more than 3°C/sec. The soak zone then occurs from 150°C to 200°C and should last for 60 to 120 seconds. Finally, keep at over 217°C for 60~150 seconds limit to melt the solder and make the peak temperature at the range from 255°C to 260°C (Do not exceed 30 sec). It is noted that the time of peak temperature should depend on the mass of the PCB board. The reflow profile is usually supported by the solder vendor and one should adopt it for optimization according to various solder type and various manufacturers' formulae.

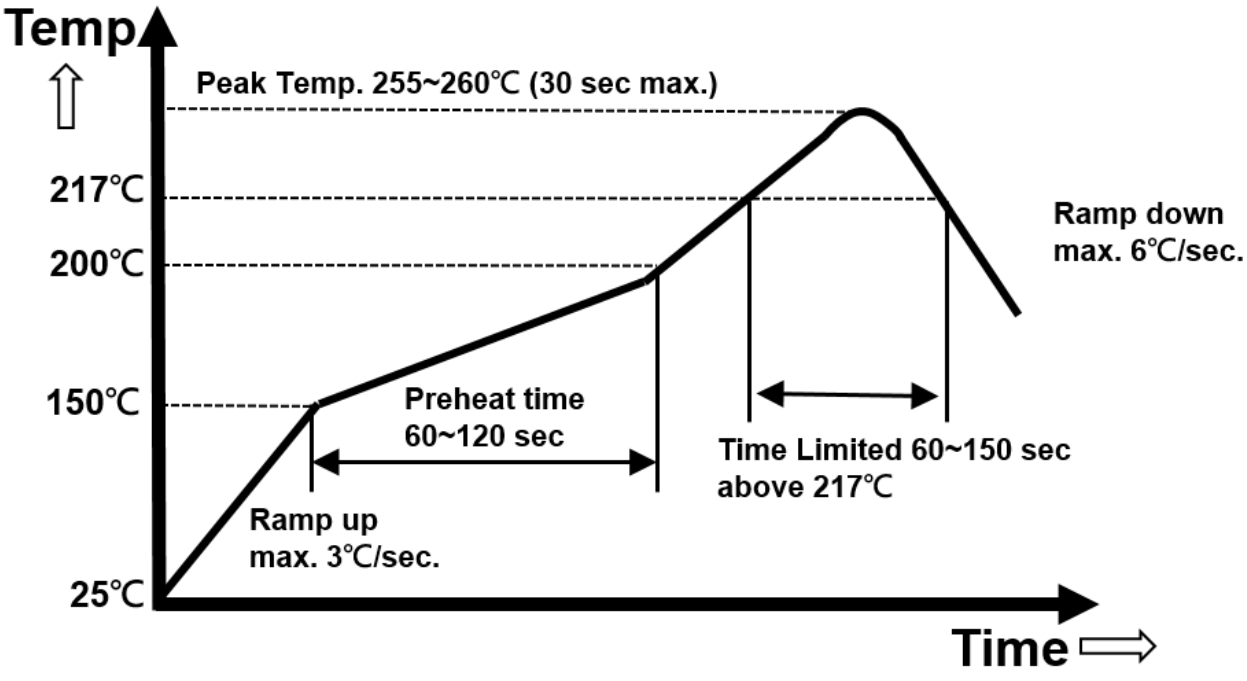


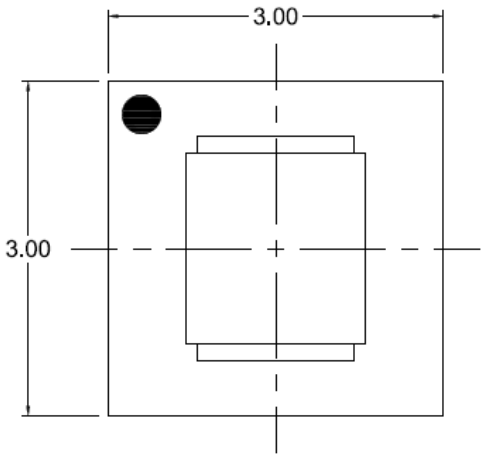
FIG.36 RECOMMENDATION REFLOW PROFILE*

(Not to scale)

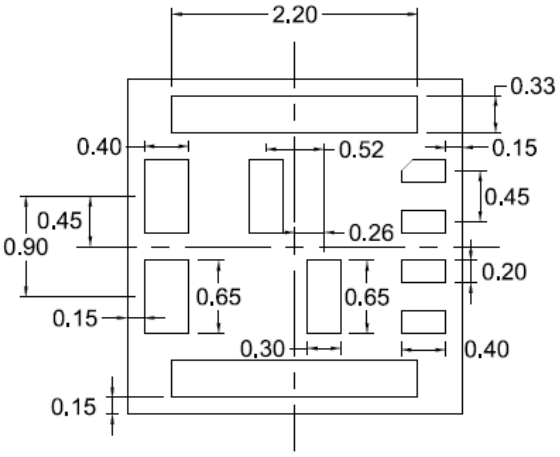
***Refer to the Classification Reflow Profile of J-STD-020.**

PACKAGE OUTLINE DRAWING:

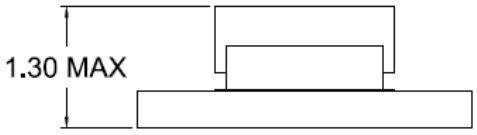
Unit: mm



Top View



Bottom View

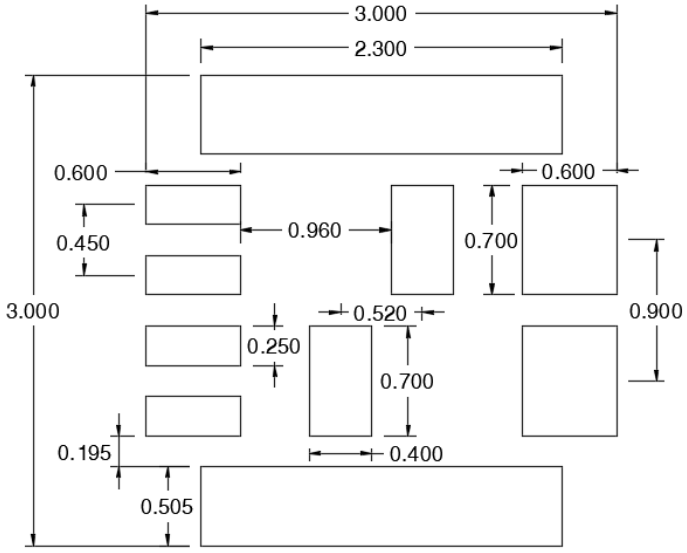


End View

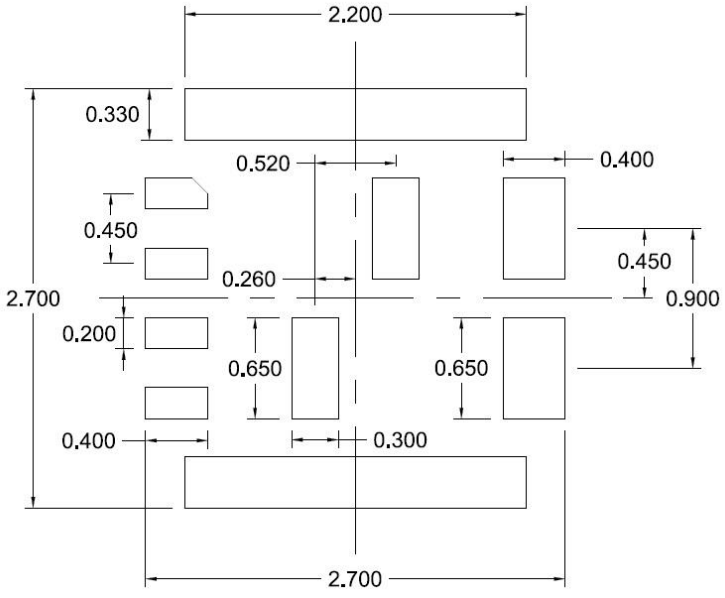
GENERAL TOLERANCE : ±0.1mm

LAND PATTERN REFERENCE:

Unit: mm



RECOMMENDED LAND PATTERN



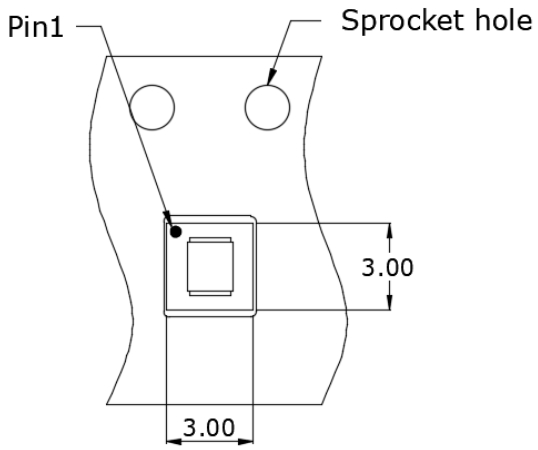
RECOMMENDED STENCIL PATTERN

BASED ON 0.1mm THICKNESS STENCIL (Reference only)

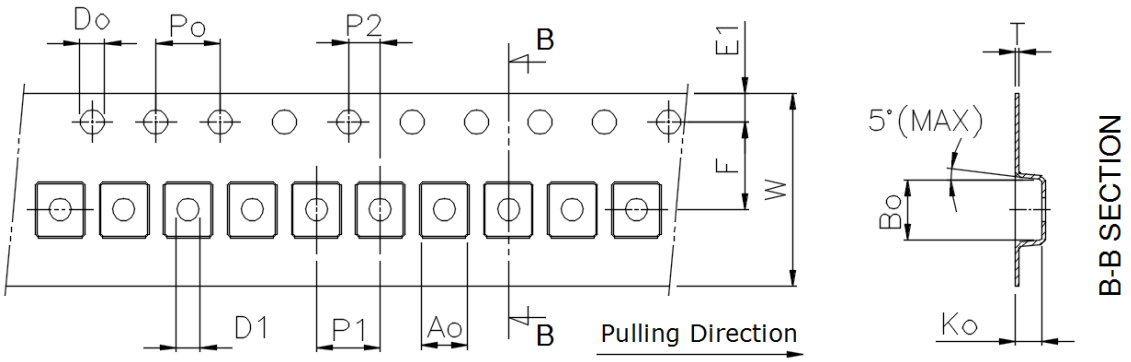
PACKING REFERENCE:

Unit: mm

Package In Tape Loading Orientation



Tape Dimension

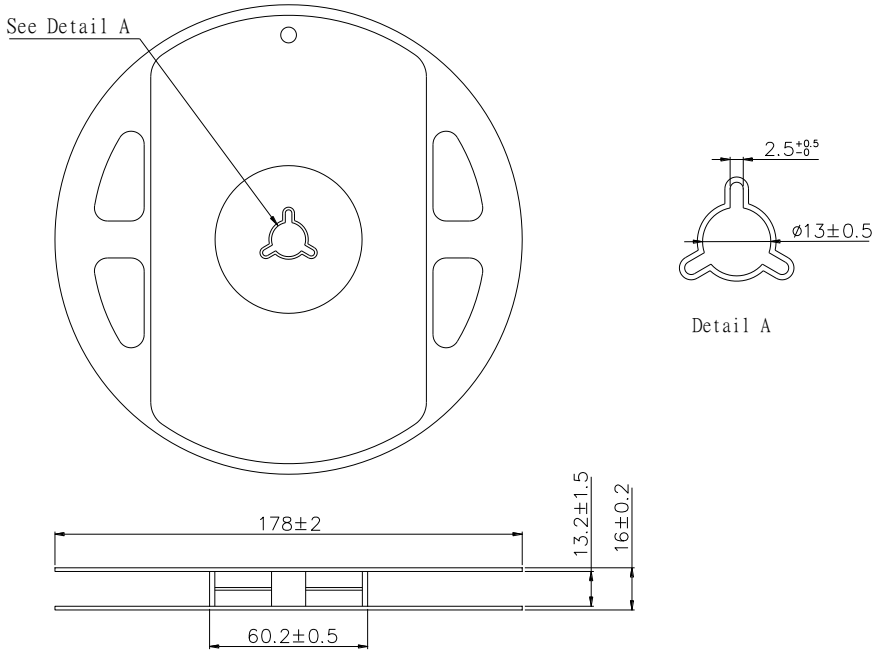


A0	3.20 ± 0.10	E1	1.75 ± 0.10
B0	3.30 ± 0.10	K0	1.65 ± 0.10
F	5.50 ± 0.05	P0	4.00 ± 0.10
W	12.00 ±0.30	P1	4.00 ± 0.10
D0	φ1.55 ±0.05	P2	2.00 ± 0.05
D1	φ1.5 +0.1/-0	T	0.25 ± 0.10

PACKING REFERENCE: (Cont.)

Unit: mm

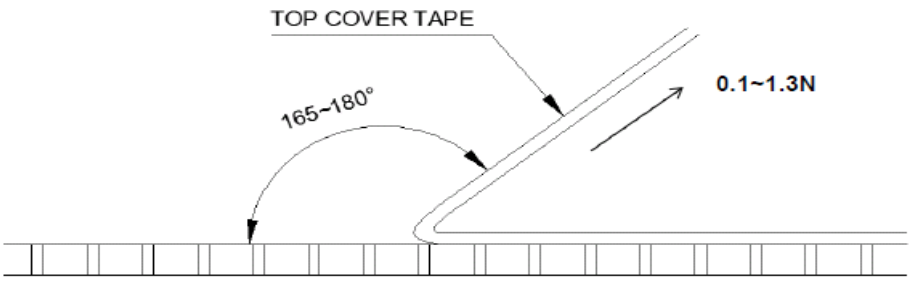
Reel Dimension



Peel Strength of Top Cover Tape

The peel speed shall be about 300mm/min.

The peel force of top cover tape is between 0.1N to 1.3N



REVISION HISTORY:

Date	Revision	Changes
2017.05.18	P00	Release the preliminary specification.
2017.08.03	P01	1、 Add page 3 Thermal Information 2、 Add page 4~5 electrical specifications 3、 Add page 6~8 1.0Vo、1.8Vo and 3.3Vo characteristics 4、 Add page 9~12 applications information 5、 Add page 14 land pattern reference
2019.06.24	P02	1、 Modified packing information for tape reel (page.16~17)
2019.07.23	A0	1、 Update page 2 packing quantity form 1000 to 2000 pcs
2022.02.04	A1	2、 Update page 14 land pattern reference
2023.10.25	A2	1. Update outline drawing 2. Update recommended reflow parameters.