uPOL MODULE

3A, High Efficiency uPOL Module

MUN3CAD03-SH

FEATURES:

- High Density uPOL Module
- 3A Output Current
- 91% Peak Efficiency at 5VIN
- 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
- Compact Size: 3.5mm*3.5mm*1.7mm
- Pb-free for RoHS compliant
- MSL 2, 260°C Reflow

APPLICATIONS:

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

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 (3.5mm × 3.5mm x 1.7mm) is suitable for automated assembly by standard surface mount equipment. The uPOL module is Pb-free and RoHS compliance.

TYPICAL APPLICATION CIRCUIT & PACKAGE:

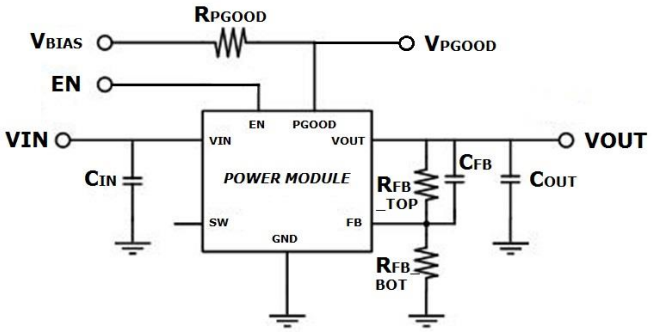


FIGURE.1 TYPICAL APPLICATION CIRCUIT

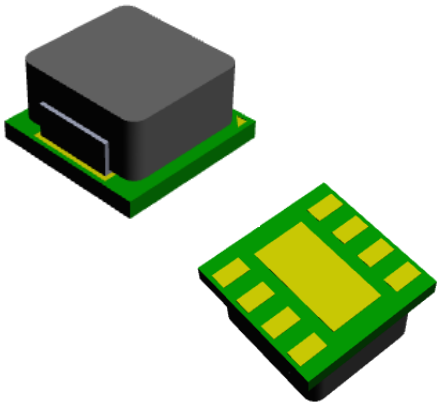


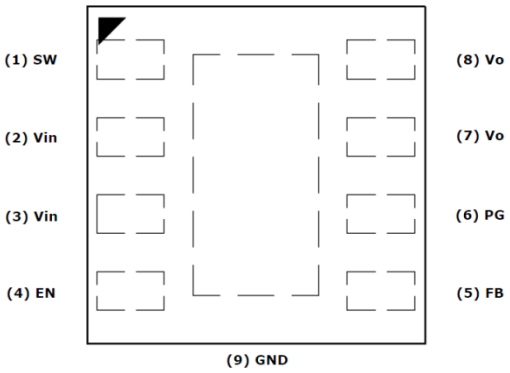
FIGURE.2 HIGH DENSITY LOW PROFILE uPOL MODULE

ORDER INFORMATION:

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

Order Code	Packing	Quantity
MUN3CAD03-SH	Tape and reel	1000

PIN CONFIGURATION:



TOP VIEW

PIN DESCRIPTION:

Symbol	Pin No.	Description
SW	1	Switch output
VIN	2, 3	Power input pin. It needs to connect input rail.
EN	4	Enable control. Do not float. EN = LOW, the module is off. EN = HIGH, the module is on.
FB	5	Feedback input. Connect an external resistor divider from the output to GND to set the output voltage.
PGOOD	6	Power Good indicator. The pin output is an open drain. PG is pulled up to VIN when the FB voltage is within 10% of the regulation level. If FB voltage is out of that regulation range, it is LOW.
VOUT	7, 8	Power output pin. Connect to output for the load.
GND	9	Power ground pin for signal, input, and output return path. This pin needs to connect one or more ground plane directly.

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 (Note 1)	-	40	-	°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, 1 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 = 5.0V, Vout = 3.3V, Cin =22uF/10V/1210/X7R, Cout = 47uF/10V/1210/X7R.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
■ Input Characteristics						
I_{SD}	Input shutdown current	Vin = 5V, EN = GND and no pull up resistance connect to VIN	-	0.5	-	uA
I_{IN}	input supply bias current	Vin = 5V, Iout = 0A Vout = 3.3V, EN = VIN	-	230	-	uA
I_S	Input supply current	Vin = 5V, EN = VIN	-	-	-	-
		Iout = 5mA Vout = 3.3V	-	4	-	mA
		Iout = 1.0A Vout = 3.3V	-	0.7	-	A
		Iout = 3.0A Vout = 3.3V	-	2.1	-	A
■ Output Characteristics						
$I_{OUT(DC)}$	Output continuous current range	Vin=5.0V, Vout=3.3V	0	-	3	A
$V_{O(SET)}$	Ouput Voltage Set Point	With 0.1% tolerance for external resistor used to set output voltage	-2.0	-	+2.0	% $V_{O(SET)}$
$V_{OUT(AC)}$	Output ripple voltage	Vin = 5.0V, Vout = 3.3V EN = VIN	-	-	-	-
		IOUT = 5mA	-	12	-	mVp-p
		IOUT = 3.0A	-	15	-	mVp-p
$C_{OUT(MAX)}$	Maximum capacitive load	Iout = 2.0A, ESR≧1 mΩ	-	-	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 = 5.0V, Vout = 3.3V, Cin =22uF/10V/1210/X7R, Cout = 47uF/10V/1210/X7R.

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
F_{OSC}	Oscillator frequency	PWM Operation	-	1.2	-	MHz
V_{REF}	Referance voltage	PWM mode	-1.5%	0.600	+1.5%	V/%
		Light load mode	-1.5%	0.600	+4.0%	
V_{PGOOD_TH}	PGOOD under-voltage threshold	Lower trip, V_{REF} respect to the regulation	-	-10	-	%
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 inductor current	4.5	-	7.5	A
T_{OTP}	Over temperature protection		-	150	-	°C

TYPICAL PERFORMANCE CHARACTERISTICS: (1.0VOUT)

Conditions: T_A = 25 ºC, unless otherwise specified. Test Board Information: 30mm×30mm×1.6mm, 4 layers 1oz.
The output ripple and transient response measurement is short loop probing and 20MegHz bandwidth limited.
Vin = 5.0V, Vout = 1.0V, Cin =22uF/10V/1210/X7R, Cout = 47uF/10V/1210/X7R.
The following figures provide the typical characteristic curves at 1.0Vout.

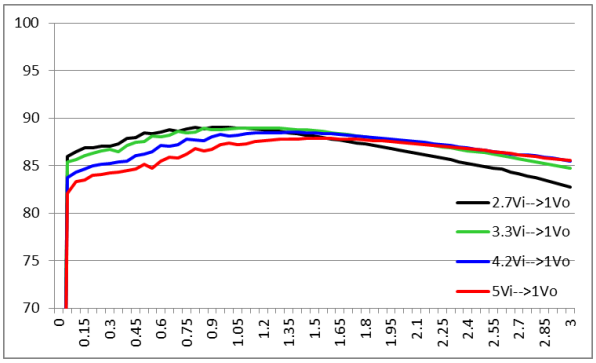


FIG.3 EFFICIENCY V.S. LOAD CURRENT

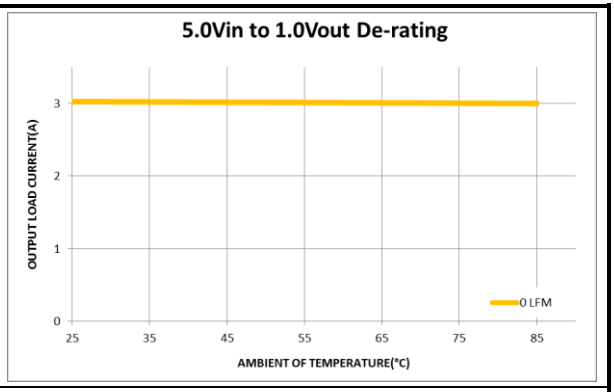


FIG.4 DE-RATING CURVE

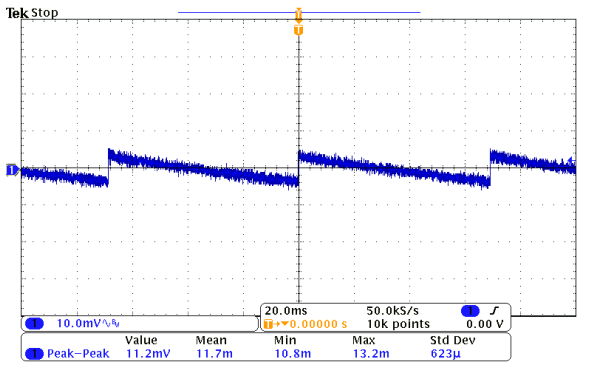


FIG.5 OUTPUT RIPPLE
(5VIN, IOUT=0A)

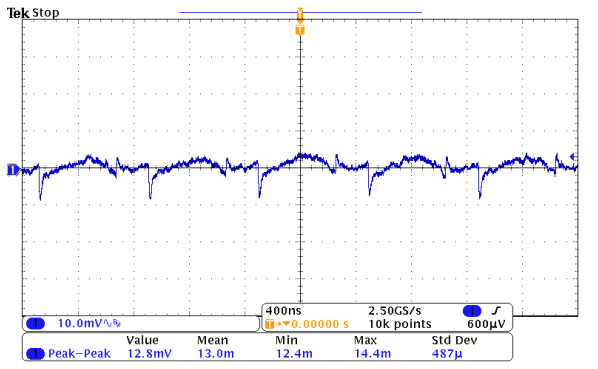


FIG.6 OUTPUT RIPPLE
(5VIN, IOUT=3A)

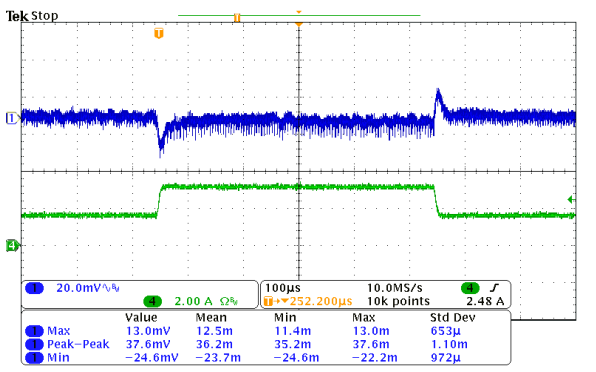


FIG.7 TRANSIENT RESPONSE
(5VIN, 50% to 100% LOAD STEP)

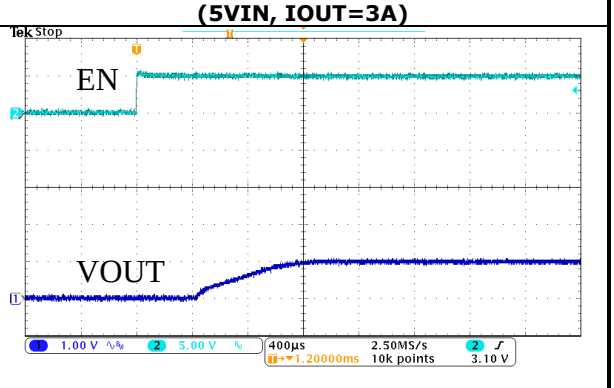


FIG.8 TURN-ON
(5VIN, IOUT=3A)

TYPICAL PERFORMANCE CHARACTERISTICS: (1.2VOUT)

Conditions: T_A = 25 ºC, unless otherwise specified. Test Board Information: 30mm×30mm×1.6mm, 4 layers 1oz.
The output ripple and transient response measurement is short loop probing and 20MegHz bandwidth limited.
Vin = 5.0V, Vout = 1.2V, Cin =22uF/10V/1210/X7R, Cout = 47uF/10V/1210/X7R.
The following figures provide the typical characteristic curves at 1.2Vout.

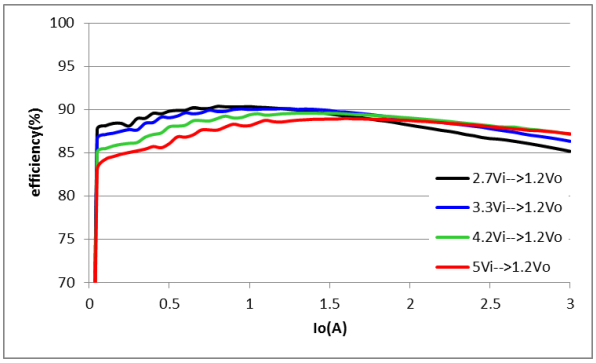


FIG.9 EFFICIENCY V.S. LOAD CURRENT

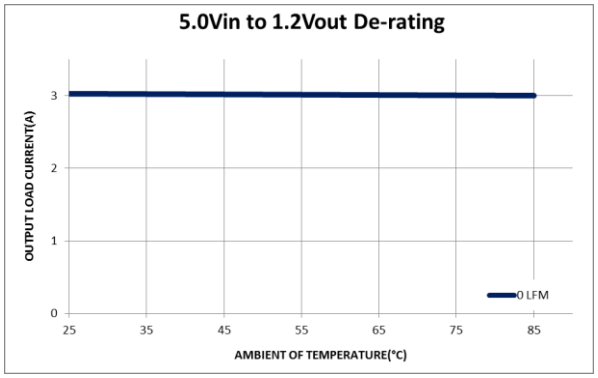


FIG.10 DE-RATING CURVE

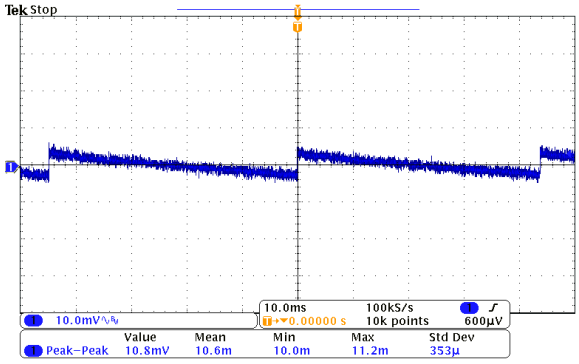


FIG.11 OUTPUT RIPPLE
(5VIN, IOUT=0A)

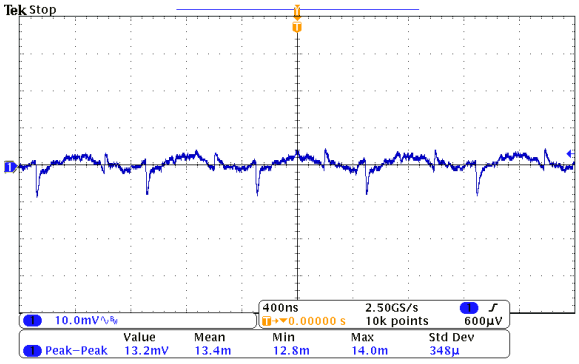


FIG.12 OUTPUT RIPPLE
(5VIN, IOUT=3A)

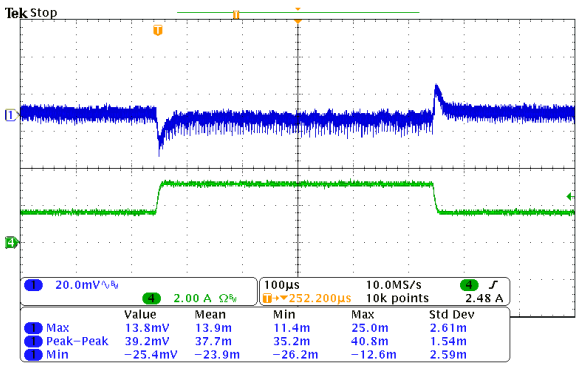


FIG.13 TRANSIENT RESPONSE
(5VIN, 50% to 100% LOAD STEP)

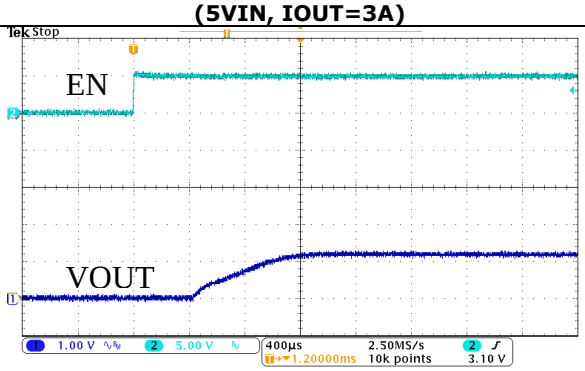


FIG.14 TURN-ON
(5VIN, IOUT=3A)

TYPICAL PERFORMANCE CHARACTERISTICS: (1.8VOUT)

Conditions: T_A = 25 ºC, unless otherwise specified. Test Board Information: 30mm×30mm×1.6mm, 4 layers 1oz.
The output ripple and transient response measurement is short loop probing and 20MegHz bandwidth limited.
Vin = 5.0V, Vout = 1.8V, Cin =22uF/10V/1210/X7R, Cout = 47uF/10V/1210/X7R.
The following figures provide the typical characteristic curves at 1.8Vout.

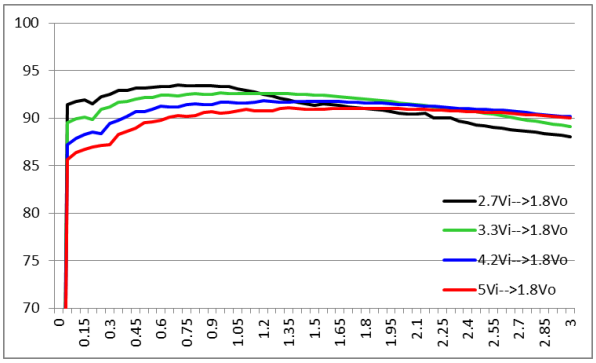


FIG.15 EFFICIENCY V.S. LOAD CURRENT

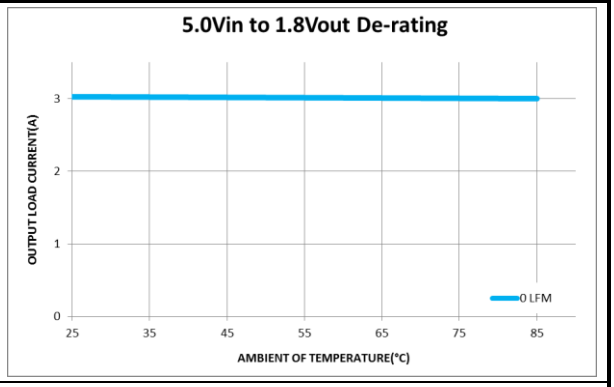


FIG.16 DE-RATING CURVE

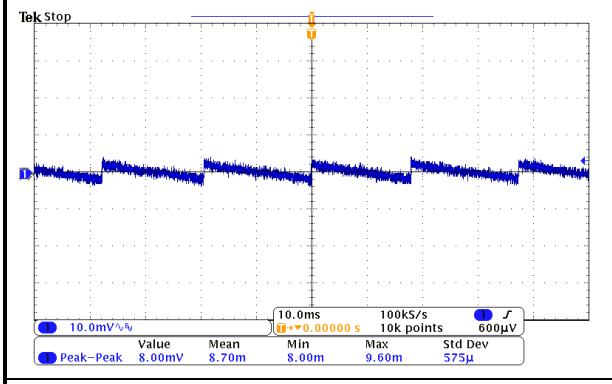


FIG.17 OUTPUT RIPPLE
(5VIN, IOUT=0A)

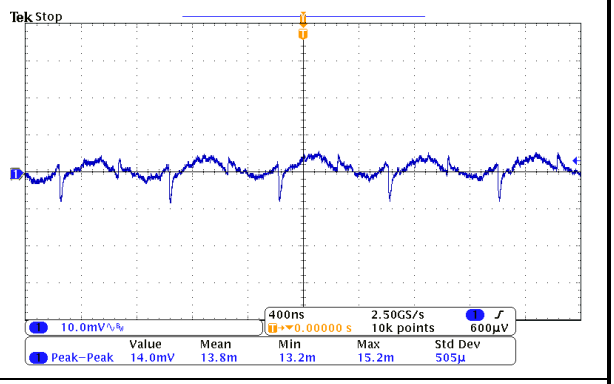


FIG.18 OUTPUT RIPPLE
(5VIN, IOUT=3A)

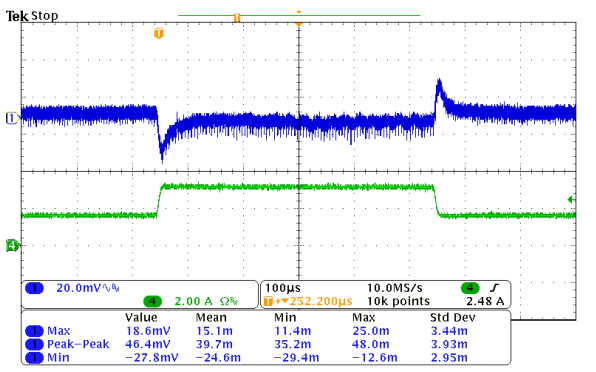


FIG.19 TRANSIENT RESPONSE
(5VIN, 50% to 100% LOAD STEP)

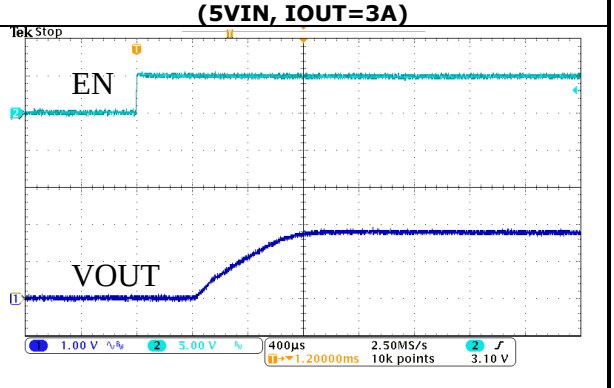


FIG.20 TURN-ON
(5VIN, IOUT=3A)

TYPICAL PERFORMANCE CHARACTERISTICS: (3.3VOUT)

Conditions: T_A = 25 ºC, unless otherwise specified. Test Board Information: 30mm×30mm×1.6mm, 4 layers 1oz.
The output ripple and transient response measurement is short loop probing and 20MegHz bandwidth limited.
Vin = 5.0V, Vout = 3.3V, Cin =22uF/10V/1210/X7R, Cout = 47uF/10V/1210/X7R.
The following figures provide the typical characteristic curves at 3.3Vout.

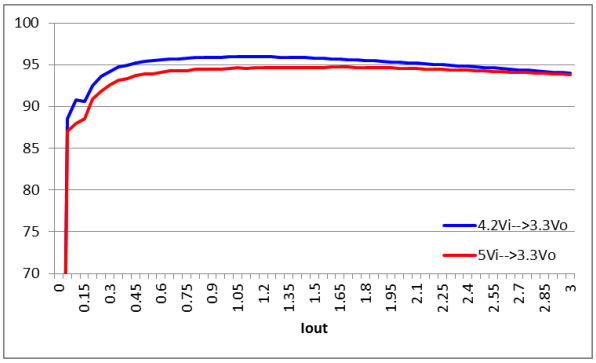


FIG.21 EFFICIENCY V.S. LOAD CURRENT

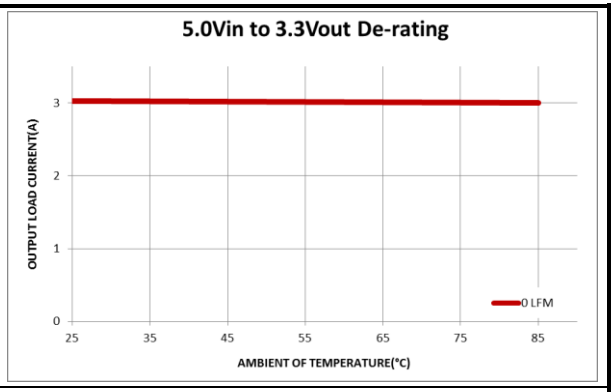


FIG.22 DE-RATING CURVE

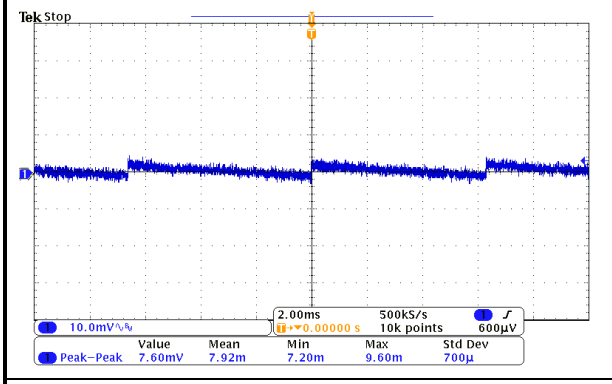


FIG.23 OUTPUT RIPPLE
(5VIN, IOUT=0A)

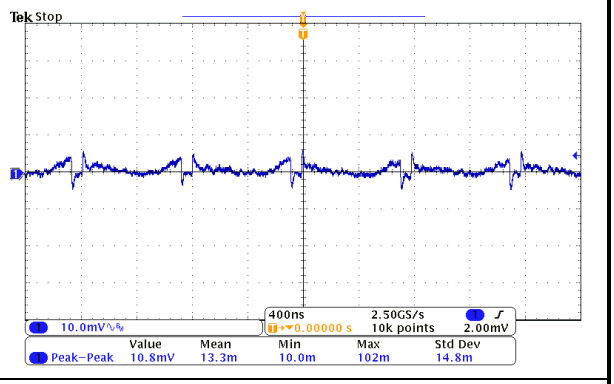


FIG.24 OUTPUT RIPPLE
(5VIN, IOUT=3A)

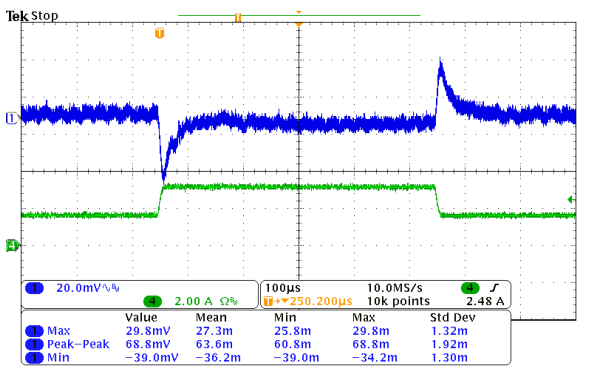


FIG.25 TRANSIENT RESPONSE
(5VIN, 50% to 100% LOAD STEP)

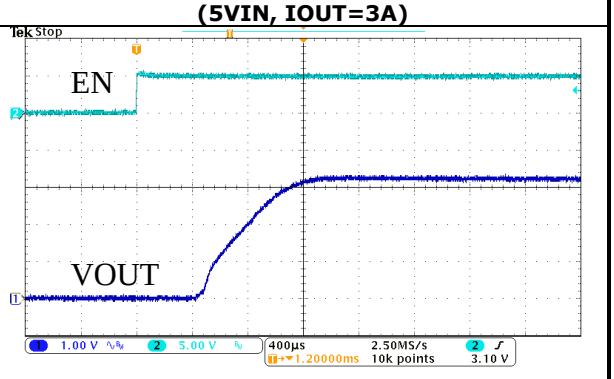


FIG.26 TURN-ON
(5VIN, IOUT=3A)

APPLICATIONS INFORMATION:

REFERENCE CIRCUIT FOR GENERAL APPLICATION:

The Figure27 shows the module application schematics for input voltage from 2.75V to 5.5V and turn on by input voltage directly through enable resistor (REN).

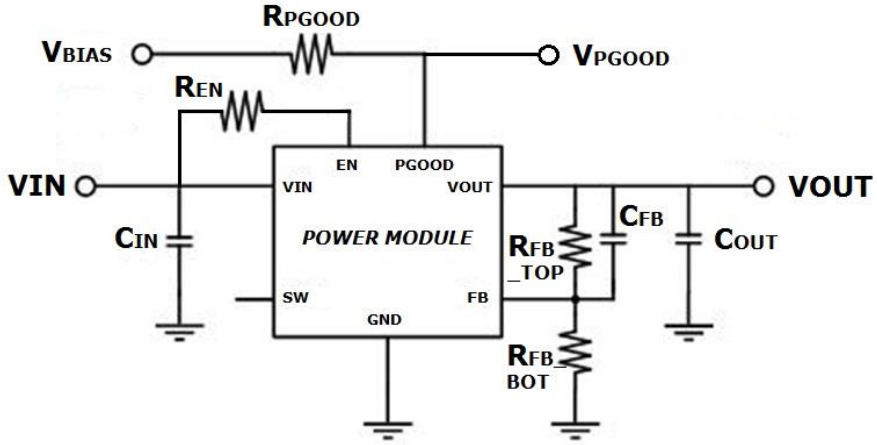


FIG.27 REFERENCE CIRCUIT FOR GENERAL APPLICATION

APPLICATIONS INFORMATION: (Cont.)

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 a low AC impedance source supply and a highly inductive source or line inductance can affect the stability of the module. An input capacitor 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 capacitor at the output must be used. Low ESR polymer and ceramic capacitors are recommended to improve the output ripple and dynamic response of the module.

PROGRAMMING OUTPUT VOLTAGE:

The module has an internal 0.6V±2% reference voltage. The output voltage can be programed by the dividing resistor RFB which respects to FB pin and GND pin. The output voltage can be calculated as shown in Equation 1 and the resistance according to typical output voltage is shown in TABLE 1.

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

Vout (V)	RFB_top (kΩ)	RFB_bot (kΩ)
1.0	200(1%)	300(1%)
1.2	200(1%)	200(1%)
1.8	200(1%)	100(1%)
2.5	200(1%)	63.158(1%)
3.3	200(1%)	44.444(1%)

TABLE.1 RESISTOR VALUES FOR COMMON OUTPUT VOLTAGES

APPLICATIONS INFORMATION: (Cont.)

Thermal Considerations:

All thermal testing condition is complied with JEDEC EIJ/JESD 51 Standards. Therefore, the test board size is 30mm×30mm×1.6mm with 4 layers, 1 oz per layer. The case temperature of module sensing point is shown as Figure 28. Then Rth(j_{choke}-a) is measured with the component mounted on an effective thermal conductivity test board on 0 LFM condition. The MUN3CAD03-SH power 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.

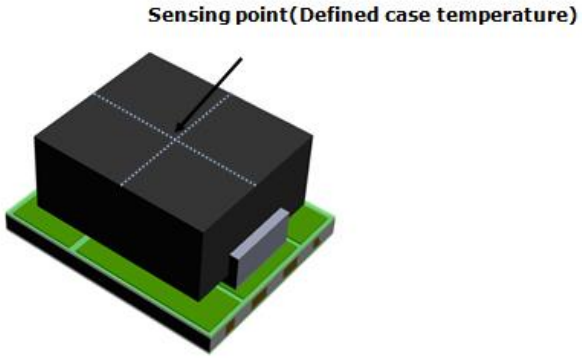


Figure.28 CASE TEMPERATURE SENSING POINT

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 29 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 seconds limit to melt the solder and make the peak temperature at the range from 240°C to 250°C. 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.

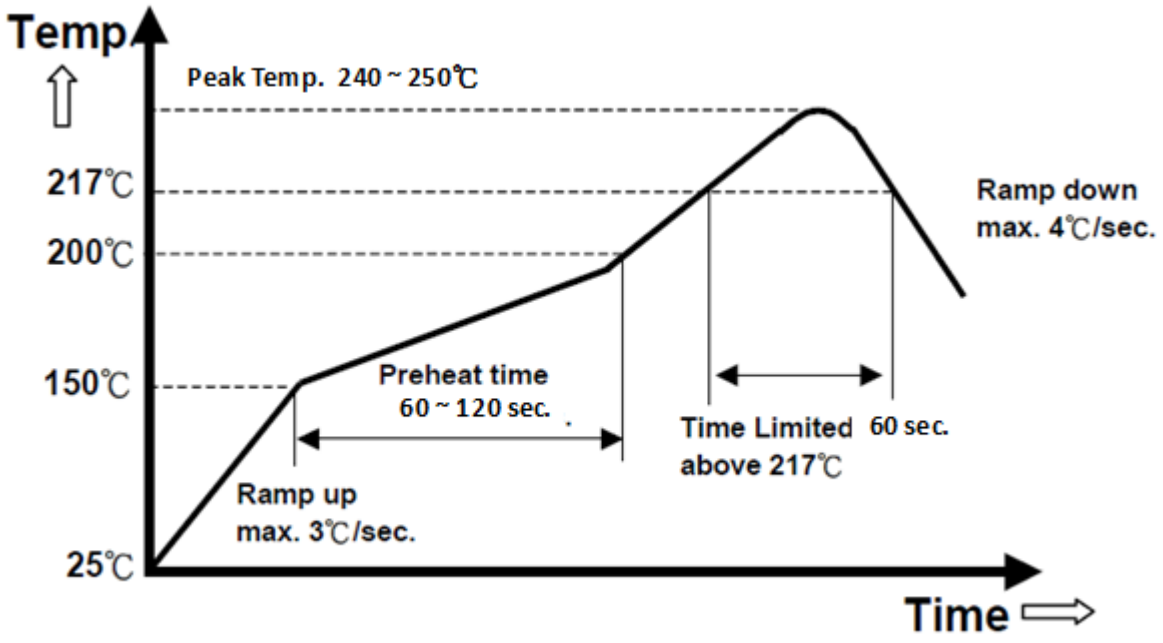
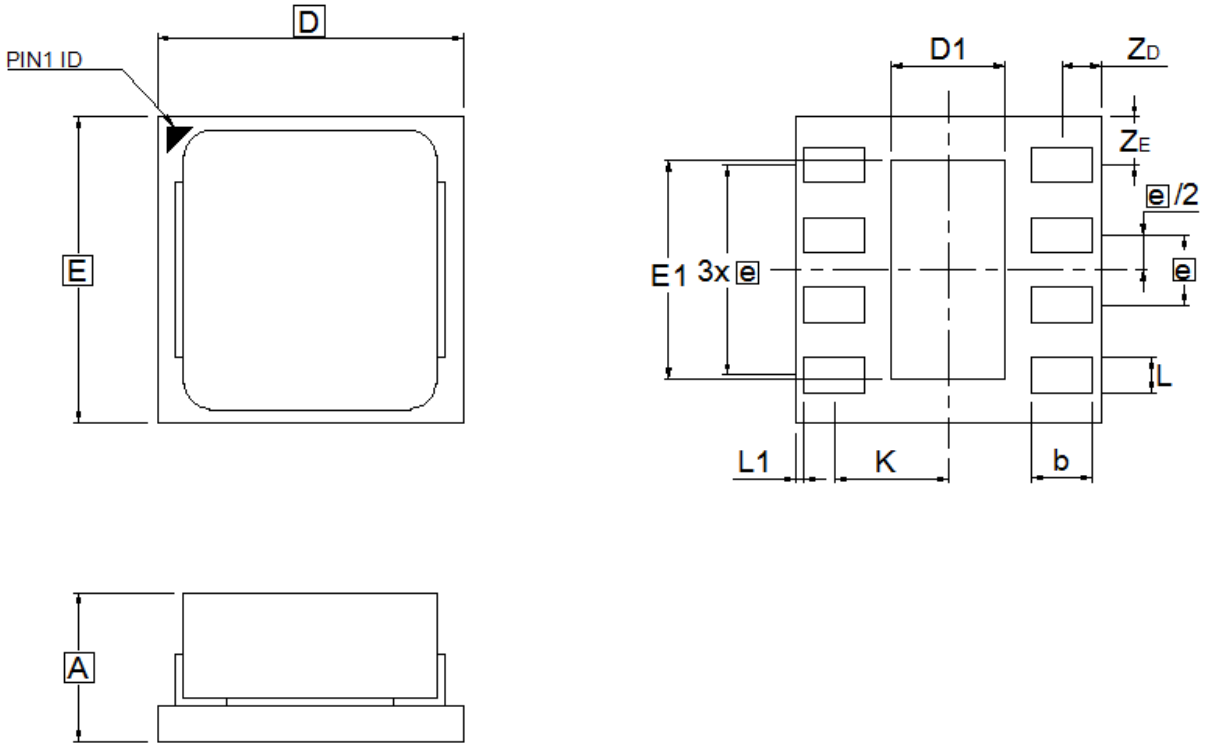


FIG.29 RECOMMENDATION REFLOW PROFILE

PACKAGE OUTLINE DRAWING:

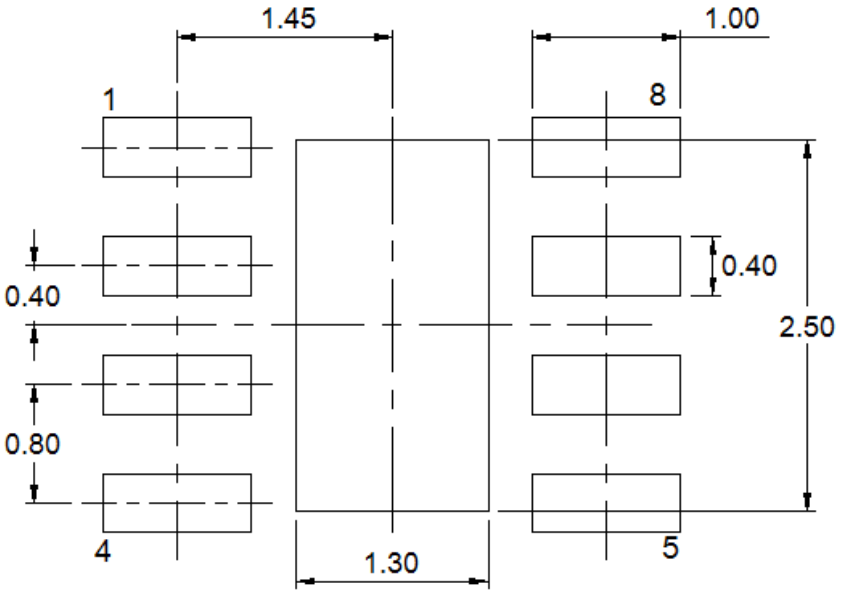
Unit: mm



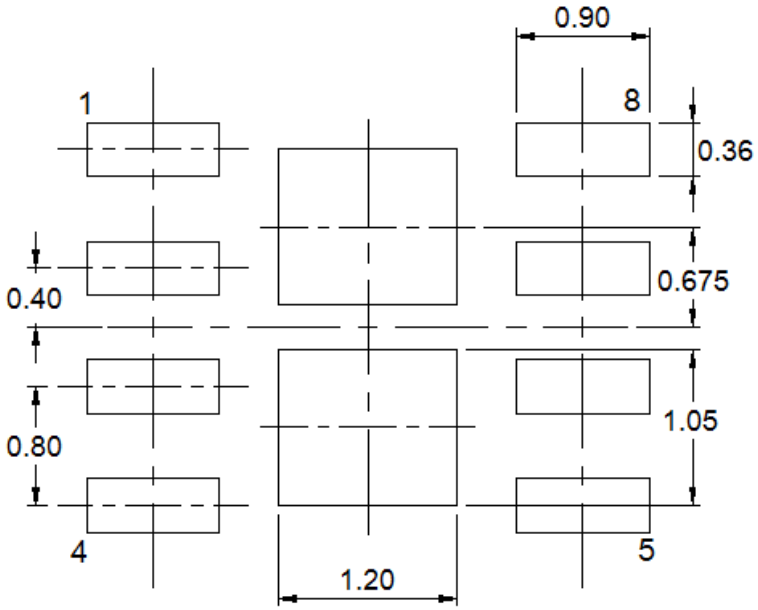
DIM	MILLIMETERS		
	MIN	NOM	MAX
A	1.40	1.55	1.70
D	3.40	3.50	3.60
D1	1.20	1.30	1.40
E	3.40	3.50	3.60
E1	2.40	2.50	2.60
K	1.20	1.30	1.40
e	0.70	0.80	0.90
b	0.60	0.70	0.80
L	0.30	0.40	0.50
L1	0.00	0.10	0.20
ZD	0.30	0.45	0.60
ZE	0.40	0.55	0.70

LAND PATTERN REFERENCE:

Unit: mm



RECOMMENDED LAND PATTERN

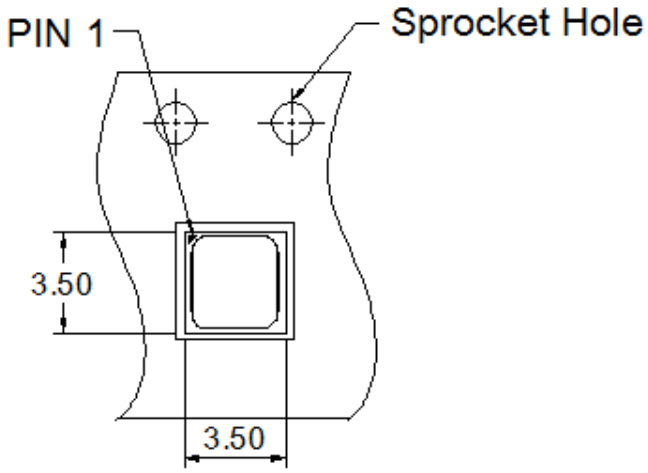


RECOMMENDED STENCIL PATTERN
BASED ON 0.1mm THICKNESS STENCIL

PACKING REFERENCE:

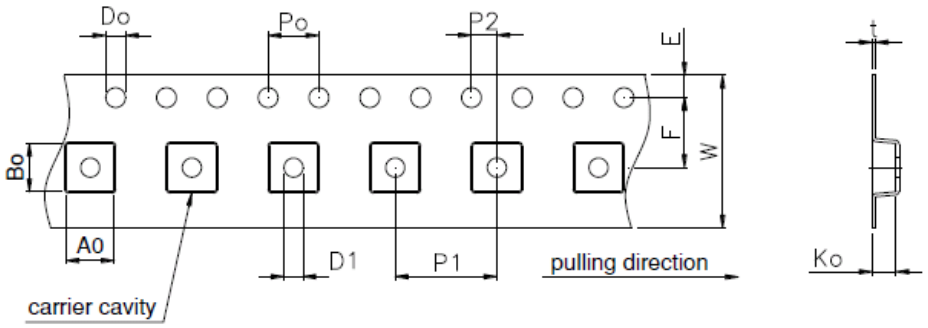
Unit: mm

Package In Tape Loading Orientation



Tape Dimension

Unit:mm

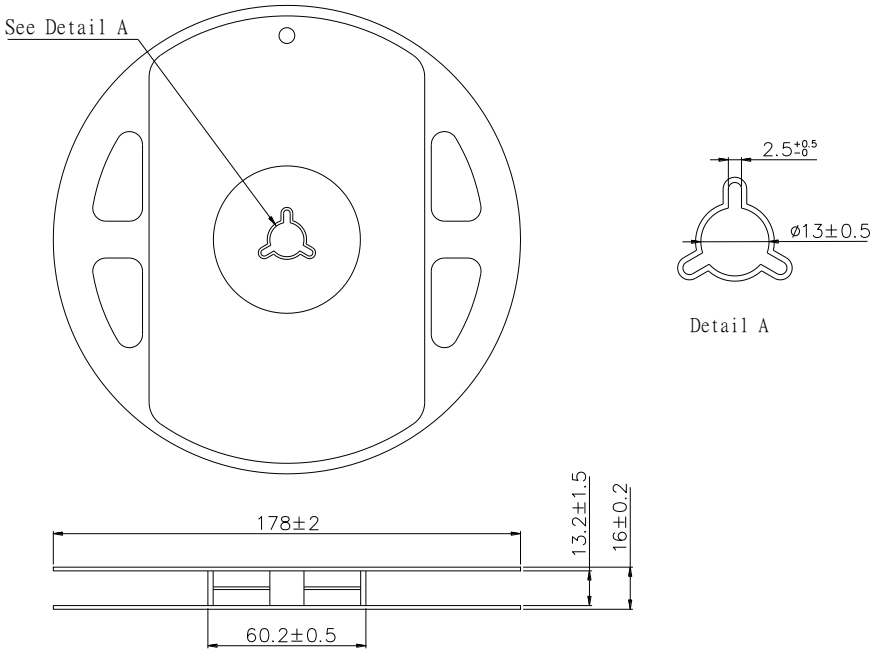


A0	3.80 ± 0.10	E	1.75 ± 0.10
B0	3.80 ± 0.10	K0	1.88 ± 0.10
F	5.50 ± 0.05	P0	4.00 ± 0.10
W	12.0 ± 0.30	P1	8.00 ± 0.10
D0	φ1.55 ±0.05	P2	2.00 ± 0.05
D1	φ1.50± 0.10	t	0.25 ± 0.1

PACKING REFERENCE: (Cont.)

Unit: mm

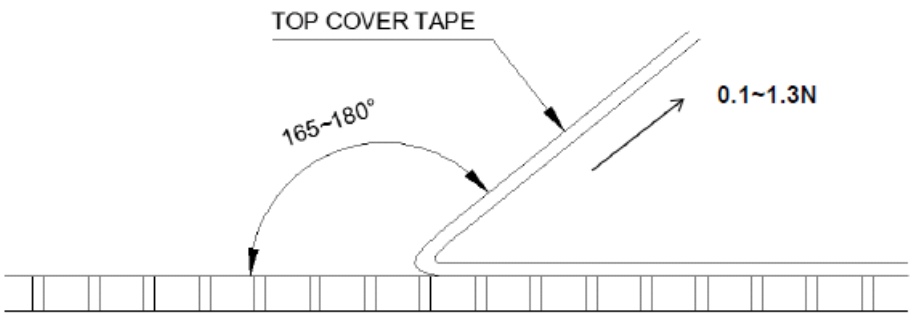
Reel Dimension



Peel Strength of Top Cover Tape

The peel speed shall be about 300mm/min.

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



REVISION HISTORY:

Date	Revision	Changes
2015.7.2	00	Release the preliminary specification.
2016.04.07	01	Change height value of module from typical 1.7mm to maximum 2.0mm
2016.09.29	02	1. Update page 12 division resistance value 2. Update page 14 reflow parameters information 3. Update page 16 land pattern reference
2016.12.29	03	1. Correcting Page 2 package name from QFN to DFN 2. Update page 4 I_{SD}、I_{IN}、I_S electrical specifications 3. Add page 6~9 thermal de-rating test condition 4. Change page 12 size of test board for thermal considerations
2017.03.30	04	1. Add page 5 V_{PGOOD_LV} electrical specifications