1000mA, High Efficiency uPOL Module

MUN123C01-SGB

FEATURES:

- High Density Fully Integration Module
- 1000mA Output Current
- Input Voltage Range from 4.5 V to 16 V
- Fixed Output Voltage :3.3V
- 88% Peak Efficiency at 12 VIN to 3.3 VOUT
- Force PWM mode
- Enable Function
- Protections (UVLO, OCP: Non-latching)
- Internal Soft Start
- Compact Size: 3.9mm*2.6mm*1.7mm
- Pb-free for RoHS compliant
- MSL 2, 260C Reflow

APPLICATIONS:

- DSL Modem / LCD TV
- Portable TV / Access Point Router

GENERAL DESCRIPTION:

The MUN123C01-SGB is non-isolated dc-dc converters. The PWM switching regulator, high frequency power inductor, and most of components are integrated in one hybrid package.

Other features include remote enable function, internal soft-start, non-latching over current protection, and input under voltage locked-out capability.

The low profile and compact size package (3.9mm × 2.6mm x 1.7mm) is suitable for automated assembly by standard surface mount equipment. The MUN123C01-SGB is Pb-free and RoHS compliance.
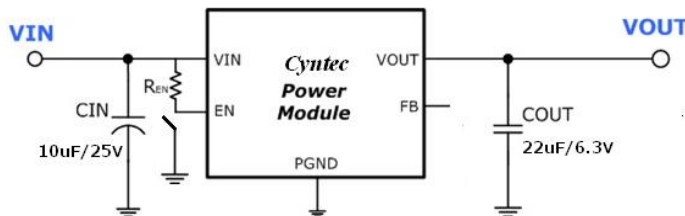
TYPICAL APPLICATION CIRCUIT & PACKAGE SIZE:
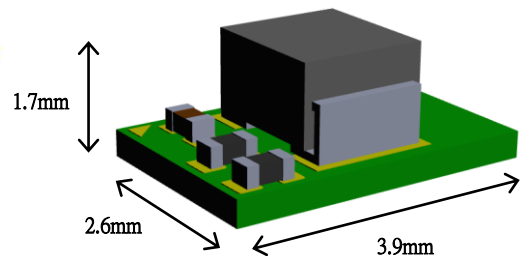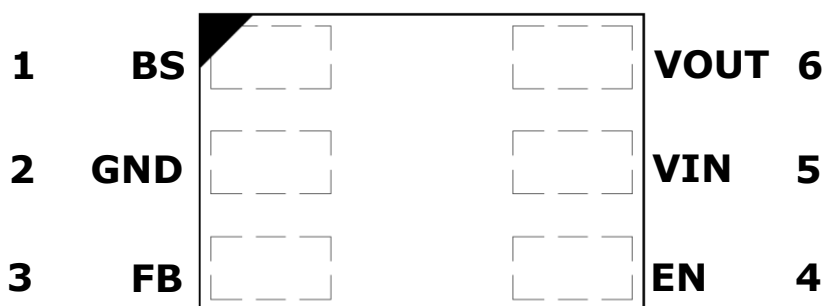

FIGURE.1 TYPICAL APPLICATION CIRCUIT

FIGURE.2 HIGH DENSITY uPOL MODULE

ORDER INFORMATION:

Part Number	Ambient Temp. Range (°C)	Package (Pb-Free)	MSL	Note
MUN123C01-SGB	-40 ~ +85	DFN	Level 2	-

Order Code	Packing	Quantity
MUN123C01-SGB	Tape and reel	1000

PIN CONFIGURATION:

TOP VIEW

Symbol	Pin No.	Description
BS	1	Boot-strap pin. No need connection.
GND	2	Power ground pin for signal, input, and output return path. This pin needs to connect to one or more ground planes directly.
FB	3	Feedback input.
EN	4	On/Off control pin for module.
VIN	5	Input pin. Decouple this pin to GND pin with 10uF ceramic cap
VOUT	6	Power output pin. Connect to output for the load.

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		-	-	18	V
EN to GND	(Note 1)	-	-	VIN+0.3	V
Tc	Case Temperature of Inductor (Note 3)	-40	-	+125	°C
Tj	Junction Temperature, Main IC(Note 3)	-40	-	+150	°C
Tstg	Storage Temperature	-40	-	+125	°C
Ta	Ambient Tamperture (Note 2)	-40	-	+105	°C
■ Recommendation Operating Ratings					
VIN	Input Supply Voltage	+4.5	-	+16	V
VOUT	Adjuested Output Voltage	-	3.3	-	V
Ta	Ambient Tamperture	-40	-	+85	°C
Tc	Case Temperature of Inductor	-40	-	+110	°C
Tj	Junction Temperature, Main IC	-40	-	+125	°C
■ Thermal Information					
Rth(j$_{choke}$-a)	Thermal resistance from junction to ambient. (Note 1)	-	50	-	°C/W

NOTES:
1. Rth(j$_{choke}$-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 2oz. The test condition is complied with JEDEC EIJ/JESD 51 Standards.

2. Need to consider the thermal de-rating

3. Only for over stress test, the normal operation condition bases on recommedation operating ratings.

ELECTRICAL SPECIFICATIONS: (Cont.)

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. VIN = 12V, VOUT = 3.3V, Cin =10uF/25V/1210/X7R, Cout = 22uF/10V/1210/X7R.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Switching Frequency				1.2		MHz
■ Input Characteristics						
$I_{Q(IN)}$	Input supply bias current	VIN = 12V, IOUT = 0A EN = With pull-up 100kΩ to VIN VOUT = 3.3V	-	10	-	mA
$I_{S(IN)}$	Input supply current	IOUT = 5mA VOUT = 3.3V	-	11	-	mA
		IOUT = 100mA VOUT = 3.3V	-	37	-	mA
		IOUT = 1000mA VOUT = 3.3V	-	320	-	mA
■ Output Characteristics						
$I_{OUT(DC)}$	Output continuous current range	VIN=12V, VOUT=3.3V	0	-	1000	mA
V_O	Fixed Ouput voltage 3.3V	VIN=12V, Ta=25℃, IOUT=10mA	-1.0	-	+1.0	% $V_{O(SET)}$
$\Delta V_{OUT} / \Delta V_{IN}$	Line regulation accuracy	VIN = 12V to 5V VOUT = 3.3V, IOUT = 1000mA		0.2		% $V_{O(SET)}$
$\Delta V_{OUT} / \Delta I_{OUT}$	Load regulation accuracy	IOUT = 0A to 1000mA VIN = 12 V, VOUT = 3.3V		0.5		% $V_{O(SET)}$
$V_{OUT(AC)}$	Output ripple voltage	VIN = 5V, VOUT = 3.3V IOUT = 1000mA		9		mVp-p
		VIN = 12V, VOUT = 3.3V IOUT = 1000mA		13		mVp-p

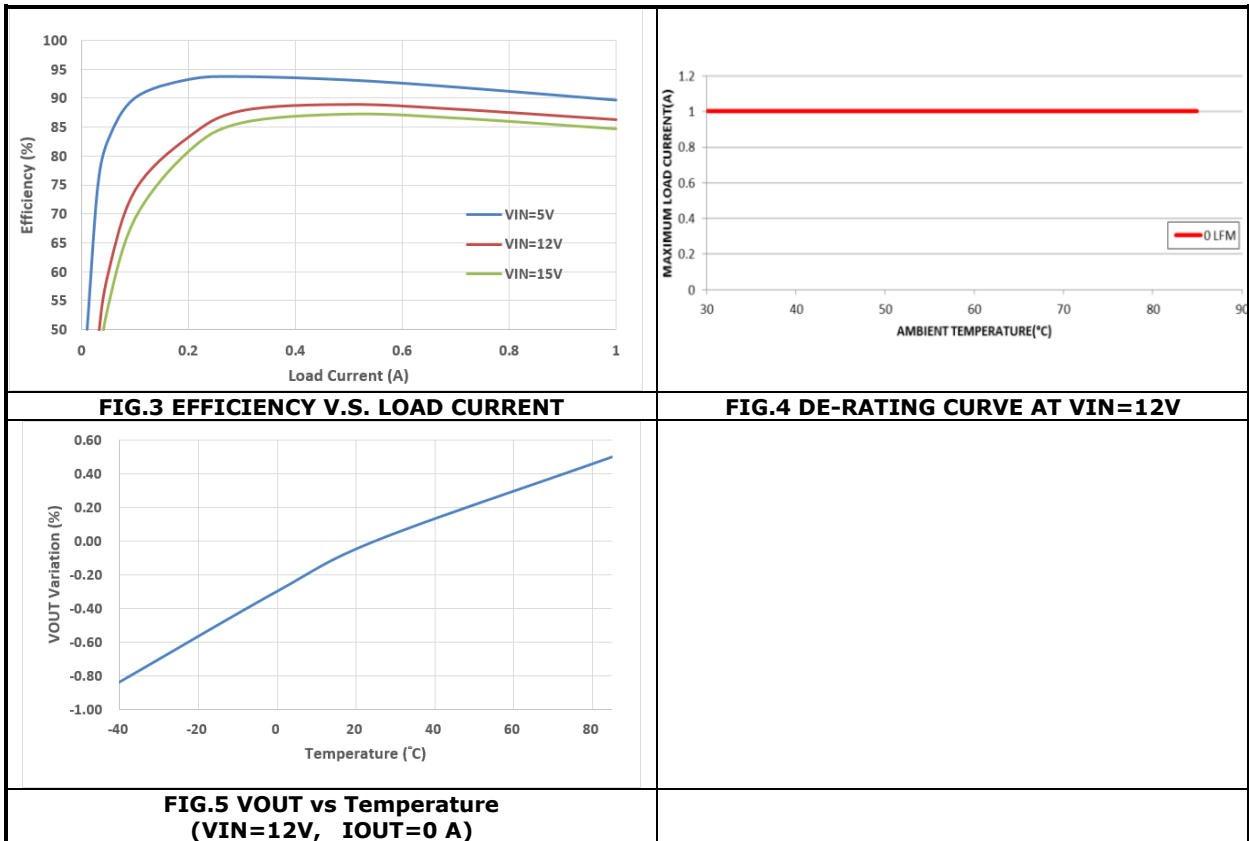## ELECTRICAL SPECIFICATIONS: (Cont.)

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. VIN = 12V, VOUT = 3.3V, Cin =10uF/25V/1210/X7R, Cout = 22uF/10V/1210/X7R.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
■ Control Characteristics						
V_{EN_TH}	Rising threshold voltage		1.5			V
	Falling threshold voltage				0.4	V
■ Fault Protection						
V_{UVLO_TH}	Input under voltage lockout threshold	Falling	-		4.5	V
T_{OTP}	Over temp protection		-	150		℃
I_{LIMIT_TH}	Current limit threshold	Peak value of inductor current	1.8	-	3.0	A
I_{SCP}	Short circuit protection	Auto-recovery	-	-	-	-

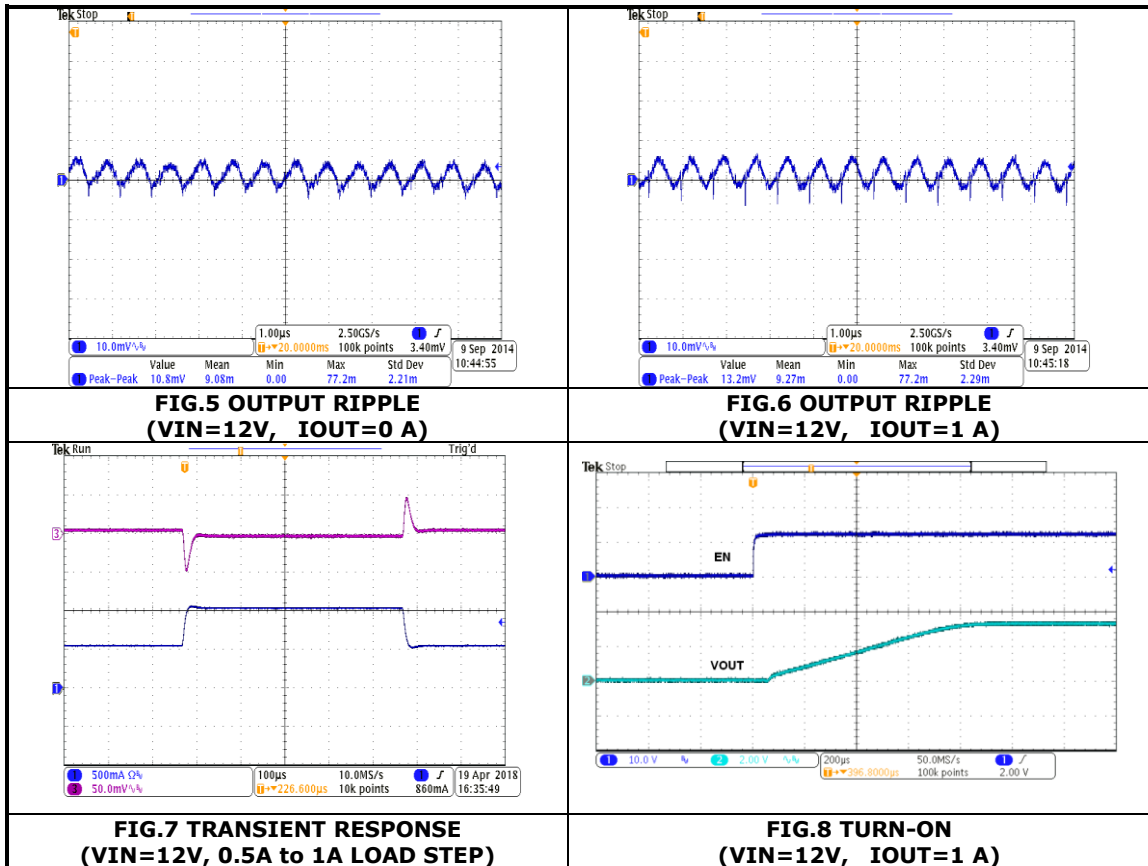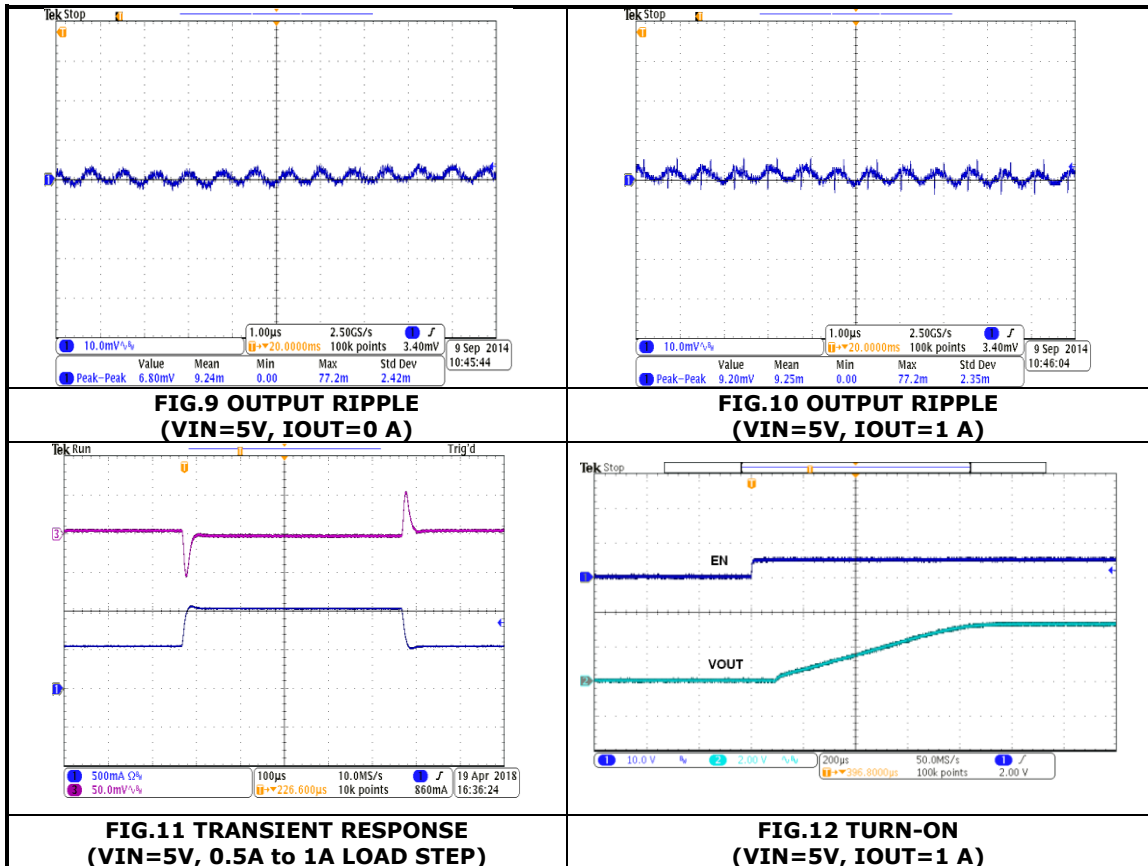## TYPICAL PERFORMANCE CHARACTERISTICS:

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 =10uF/25V/1210/X7R, Cout = 22uF/10V/1210/X7R.
The following figures provide the typical characteristic curves at VOUT=3.3V.

FIG.3 EFFICIENCY V.S. LOAD CURRENT	**FIG.4 DE-RATING CURVE AT VIN=12V**
FIG.5 VOUT vs Temperature (VIN=12V, IOUT=0 A)	

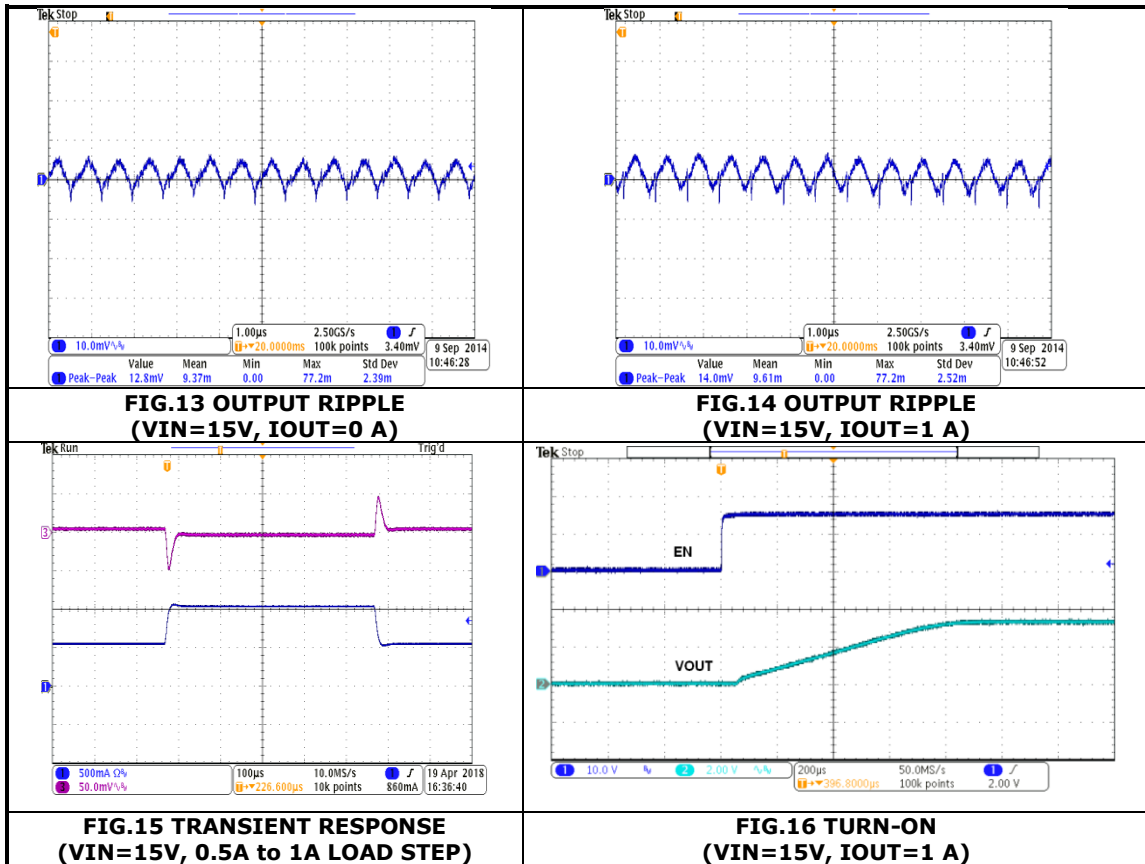## TYPICAL PERFORMANCE CHARACTERISTICS:

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 =10uF/25V/1210/X7R, Cout = 22uF/10V/1210/X7R.
The following figures provide the typical characteristic curves at VOUT=3.3V.

FIG.5 OUTPUT RIPPLE (VIN=12V, IOUT=0 A)	**FIG.6 OUTPUT RIPPLE (VIN=12V, IOUT=1 A)**
FIG.7 TRANSIENT RESPONSE (VIN=12V, 0.5A to 1A LOAD STEP)	**FIG.8 TURN-ON (VIN=12V, IOUT=1 A)**

TYPICAL PERFORMANCE CHARACTERISTICS:

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 =10uF/25V/1210/X7R, Cout = 22uF/10V/1210/X7R.
The following figures provide the typical characteristic curves at VOUT=3.3V.

FIG.9 OUTPUT RIPPLE (VIN=5V, IOUT=0 A)

FIG.10 OUTPUT RIPPLE (VIN=5V, IOUT=1 A)

FIG.11 TRANSIENT RESPONSE (VIN=5V, 0.5A to 1A LOAD STEP)

FIG.12 TURN-ON (VIN=5V, IOUT=1 A)

TYPICAL PERFORMANCE CHARACTERISTICS:

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 =10uF/25V/1210/X7R, Cout = 22uF/10V/1210/X7R.
The following figures provide the typical characteristic curves at VOUT=3.3V.

FIG.13 OUTPUT RIPPLE (VIN=15V, IOUT=0 A)	**FIG.14 OUTPUT RIPPLE (VIN=15V, IOUT=1 A)**
FIG.15 TRANSIENT RESPONSE (VIN=15V, 0.5A to 1A LOAD STEP)	**FIG.16 TURN-ON (VIN=15V, IOUT=1 A)**

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 source with low AC impedance source supply and a highly inductive in which line inductance can affect the stability of the module. It need to place an input capacitance 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 as step load changes. It is need the additional capacitor. Low ESR polymer and ceramic capacitors are recommended to improve the output ripple and dynamic response of the module.

APPLICATIONS INFORMATION: (Cont.)

LOAD TRANSIENT CONSIDERATIONS:

The MUN123C01-SGB integrates the compensation components to achieve good stability and fast transient responses. In some applications, adding a 100pF ceramic cap between VOUT and FB may further speed up the load transient responses and is thus recommended for applications with large load transient step requirements.
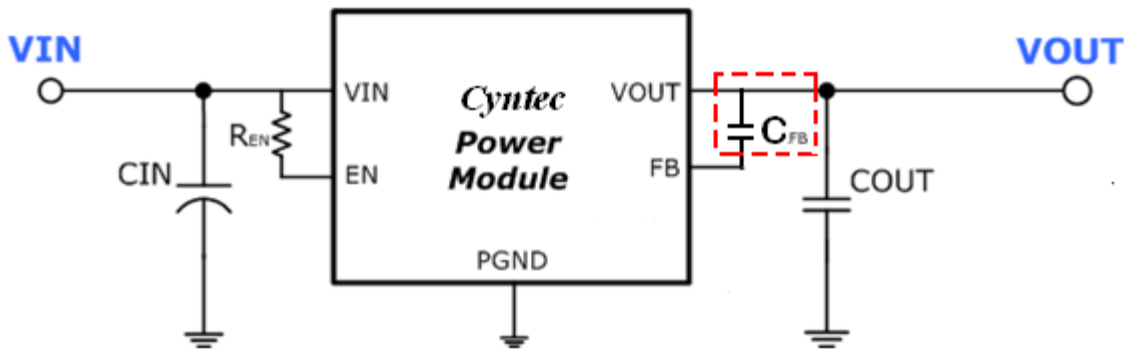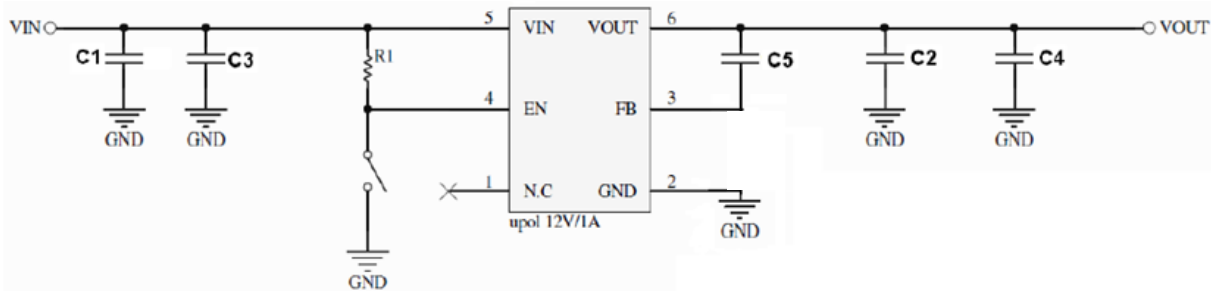

FIG.17 TRANSIENT RESPONSES APPLICATION

REFERENCE CIRCUIT FOR GENERAL APPLICATION:

Figure 18 shows the module application schematics for input voltage +12V and turn on by input voltage directly through enable resistor (R1).

FIG.18 REFERENCE CIRCUIT FOR GENERAL APPLICATION

APPLICATIONS INFORMATION: (Cont.)

RECOMMEND PCB LAYOUT:

Figure 19 shows recommendation PCB layout for using uPOL module,

➢ C3/C4 are bypass filter for high frequency noise.

➢ Design paths of main current wide and short as Make the traces of the main current paths as short and wide as possible.

➢ Place the input/out capacitor as close as possible to the uPOL module pins.

➢ Ensure all feedback network connections are short and direct.

➢ The GND pin and should be connected to a strong ground plane for heat dissipating.
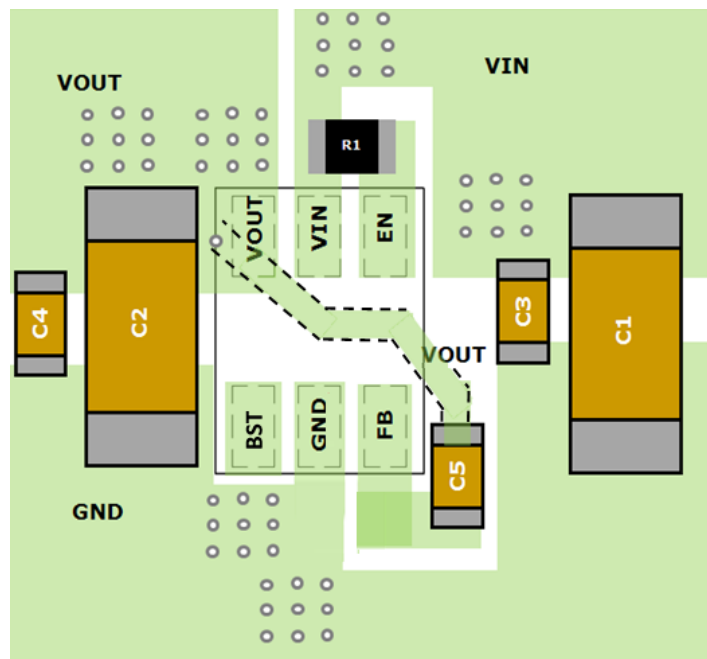
FIG.19 PCB LAYOUT

APPLICATIONS INFORMATION: (Cont.)

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 Figure 20. Then $Rth(j_{choke}-a)$ is measured with the component mounted on an effective thermal conductivity test board on 0 LFM condition. The MUN123C01-SGB module is designed for using when the case temperature is below 125°C regardless the change of output current, input/output voltage or ambient temperature.

Sensing point (Defined case temperature)
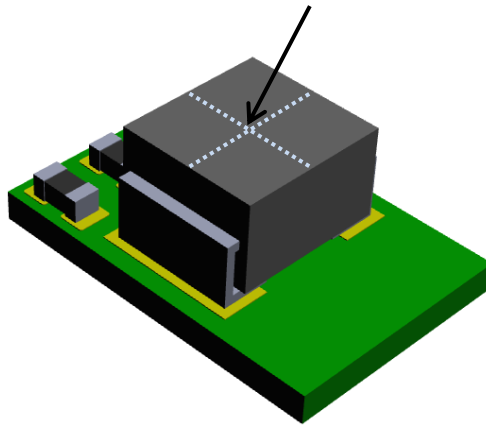
FIG 20. Case Temperature Sensing Point

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 21 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 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.
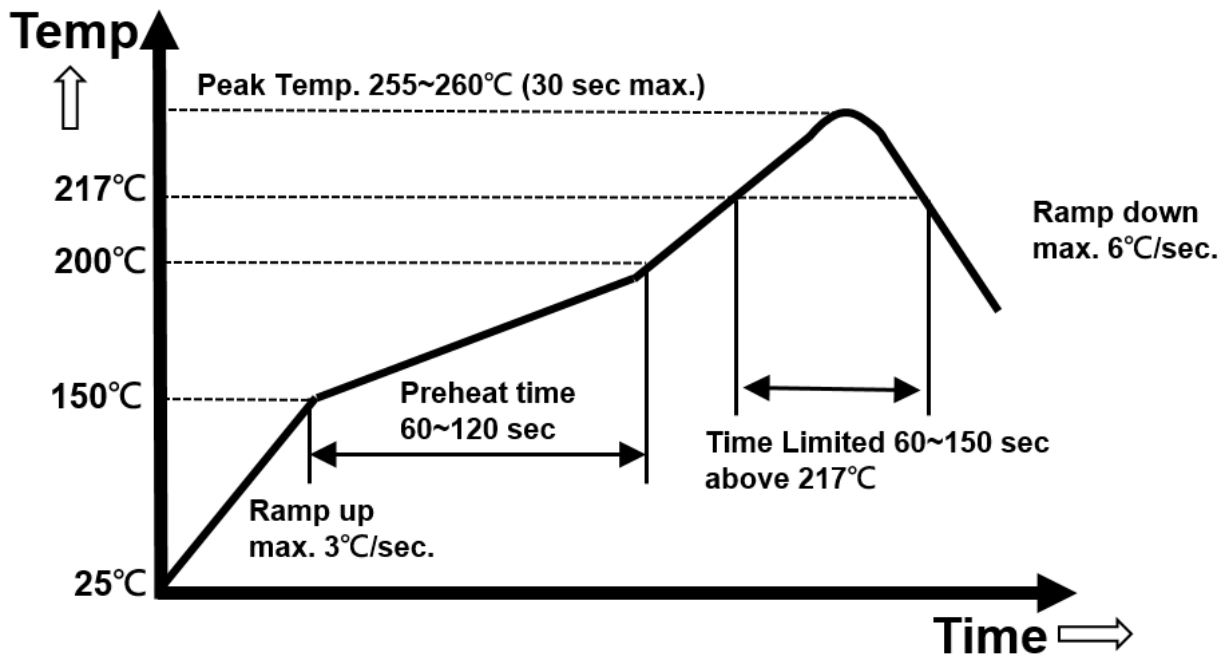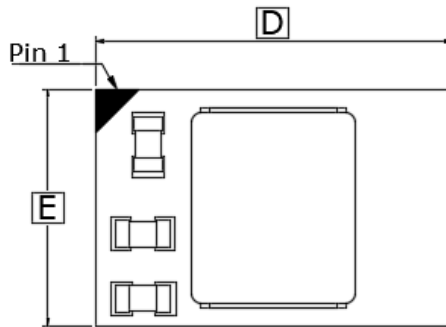

FIG.21 Recommendation Reflow Profile
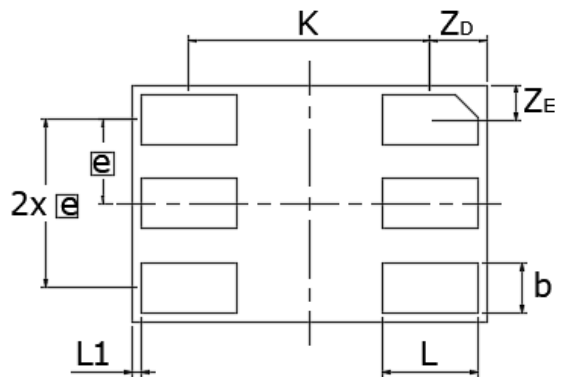
(Not to scale)

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

PACKAGE OUTLINE DRAW:
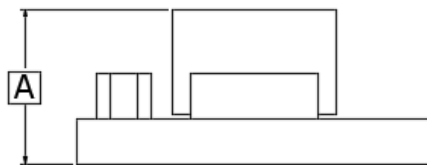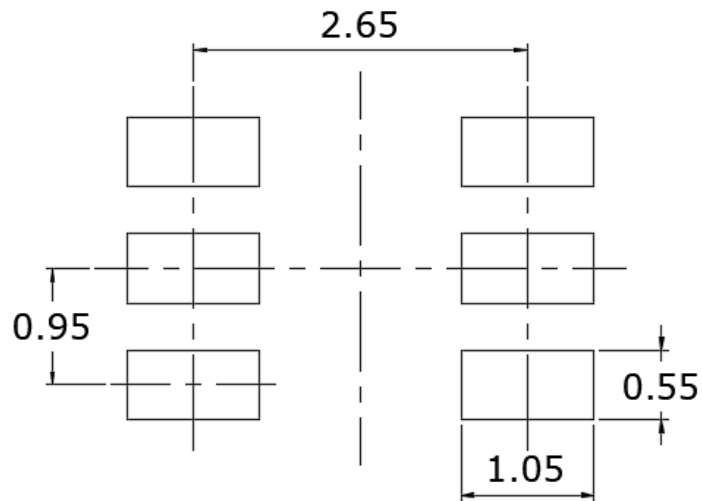
Unit:mm

TOP VIEW

BOTTOM VIEW

SIDE VIEW

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	-	1.50	1.70
D	3.8	3.9	4.0
E	2.5	2.6	2.7
K	2.55	2.65	2.75
e	0.85	0.95	1.05
b	0.45	0.55	0.65
L	0.95	1.05	1.15
L1	0.00	0.10	0.20
Z_D	0.50	0.65	0.80
Z_E	0.25	0.40	0.55

LAND PATTERN REFERENCE:

RECOMMENDED LAND PATTERN

2.65

0.95

0.55

1.05
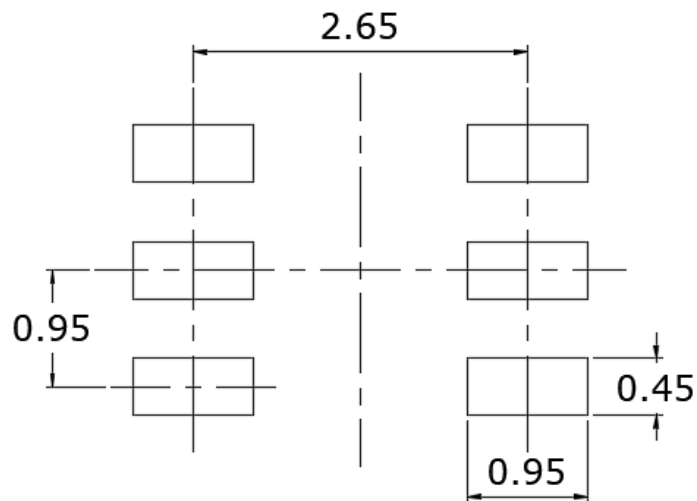
RECOMMENDED STENCIL PATTERN

2.65

0.95

0.45

0.95

*Based on 0.1~0.15mm thickness stencil (Reference only)

*Recommended solder paste coverage 55~100%

PACKING REFERENCE:

Package In Tape Loading Orientation

Sprocket Hole   Pin1

3.90

2.60

Tape Dimension

carrier cavity
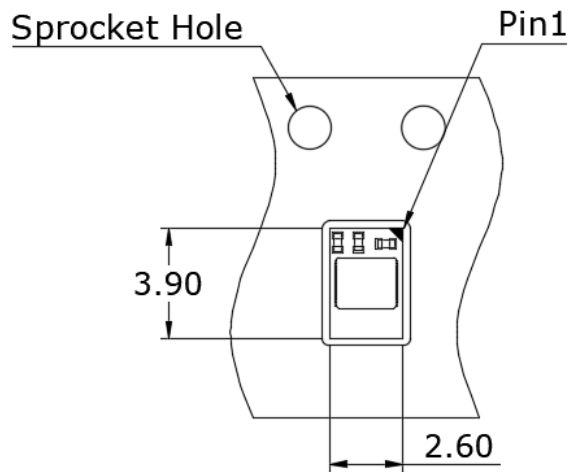
pulling direction
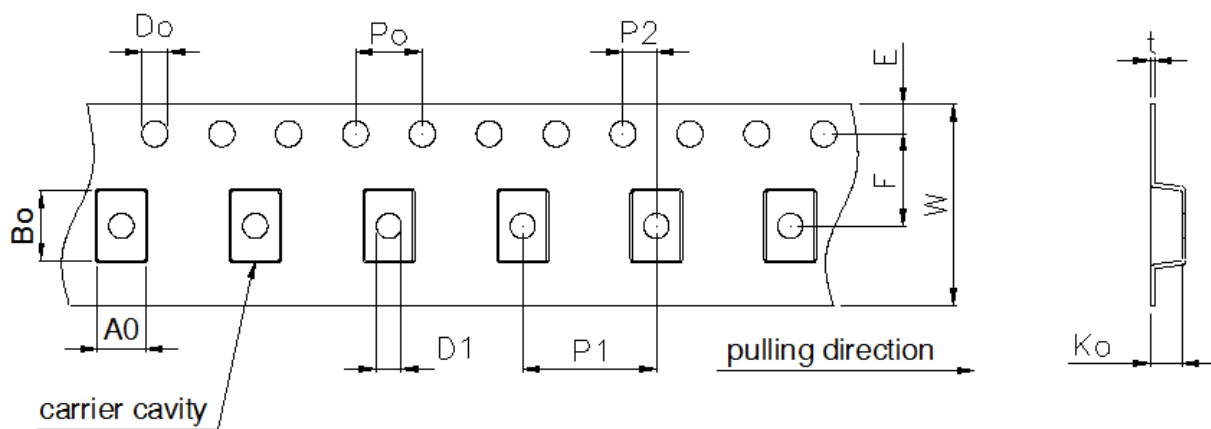
A0	2.9± 0.10	E	1.75 ± 0.10
B0	4.2 ± 0.10	K0	1.88 ± 0.10
F	5.50 ± 0.05	P0	4.00 ± 0.10
W	12.00 ±0.30	P1	8.00 ± 0.10
D0	φ1.55 ±0.05	P2	2.00 ± 0.05
D1	φ1.50± 0.10	t	0.25 ± 0.10

PACKING REFERENCE: (Cont.)

Unit: mm

Reel Dimension

See Detail A

$2.5^{+0.5}_{0}$

$\phi13\pm0.5$

Detail A

TOP COVER TAPE

165~180°

0.1~1.3N

TOP COVER TAPE

165~180°

0.1~1.3N

Rev. P05
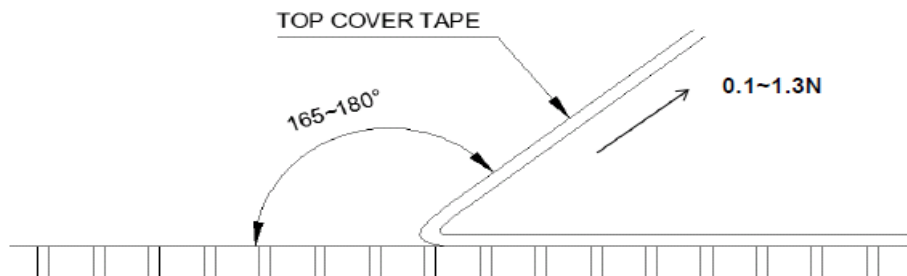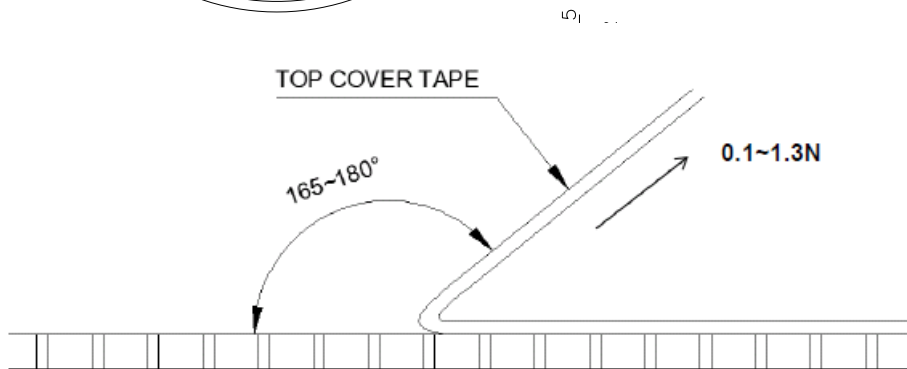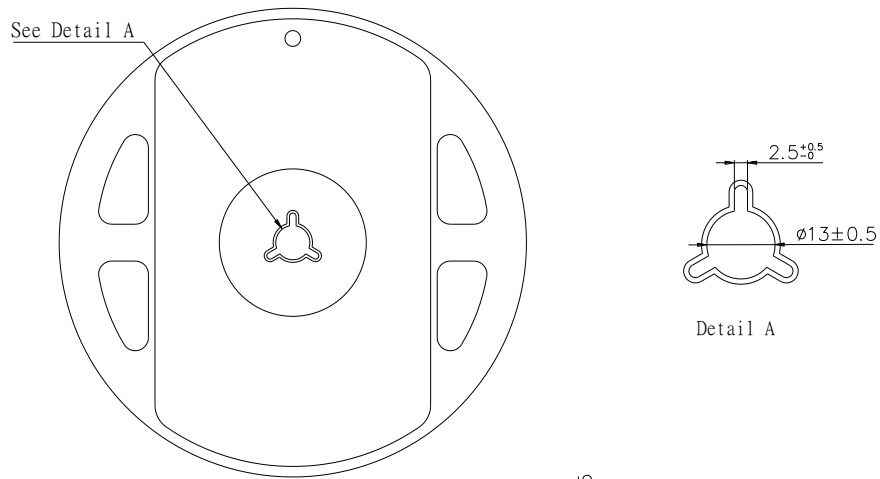
REVISION HISTORY:

Date	Revision	Changes
2018.08.03	P00	Release the preliminary spec
2018.10.24	P01	Modify the AMR ambient temperature
2019.1.09	P02	Modify the AMR data
2019.03.08	P03	Modify the Package Outline
2019.05.28	P04	Add SCP description
2022.12.23	P05	1. Page 13, add information"2oz". Correct the case temperature to 125°C. 2. Page 14, update reflow parameters and FIG.21. 3. Page 16, change the thickness description of stencil. Add note.