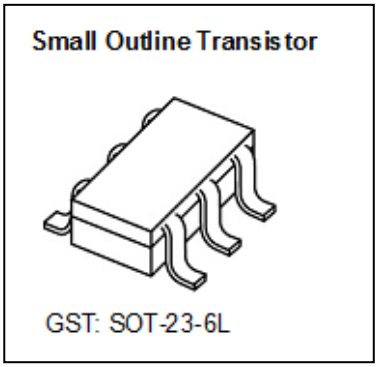
High Power Factor AC/DC LED Driver

Features

- Constant current LED driver
- Voltage step down design
- Built-in active power factor correction
- Quasi-resonant switching
- Universal input voltage range
- Full protection: Thermal shutdown
  V_{DD} over voltage (OVP)
  Under voltage lock-out (UVLO)
  LED open-/short- circuit
  Current sensing resistor open/short-circuit
  Compensating capacitor open/short-circuit
- Available in SOT-236 package
- Package MSL Level : 3



Product Description

MBI6912 is a universal input AC-DC converter designed to deliver constant current with step down control. The built-in active power factor correction circuit maintains high power factor over a wide input voltage range. MBI6912 is optimized for applications of output power up to 50 Watt, and the efficiency is enhanced with quasi-resonant switching technique. MBI6912 is also featured with under voltage lock-out (UVLO), over temperature protection (OTP), LED open-circuit protection and LED short-circuit protection to protect the converter from being damaged accidentally. MBI6912 is specifically designed with current sensing resistor short protection to prevent MOSFET over-current caused by manufacturing defect such as solder splash or abnormal operation such as accidental short-circuit by earthquake.

Applications

- T8 light tube LED alternative solutions
- E26/E27 light bulb LED alternative solutions
- PAR light LED alternative solutions
- Interior LED power module

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Typical Application Circuit

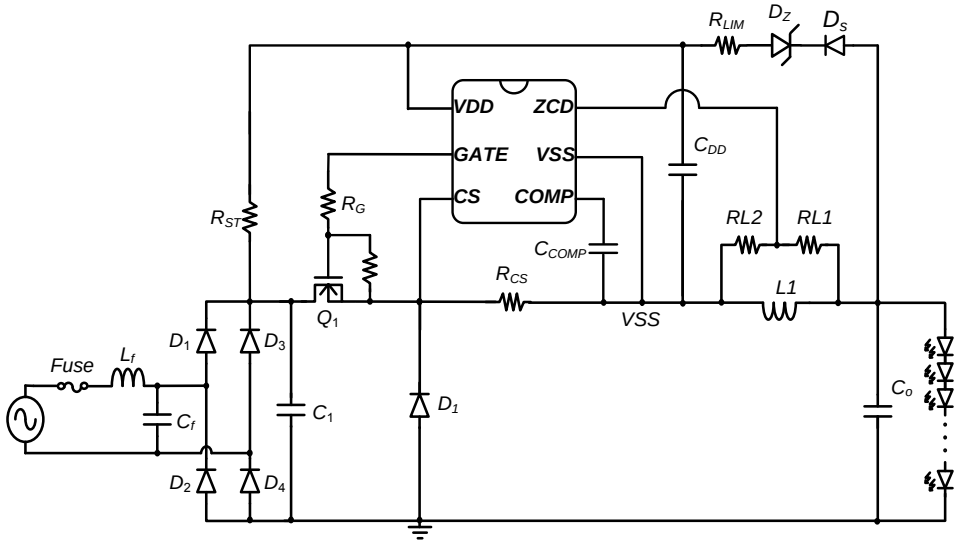


Fig.1 Typical application circuit of MBI6912 with standard inductor

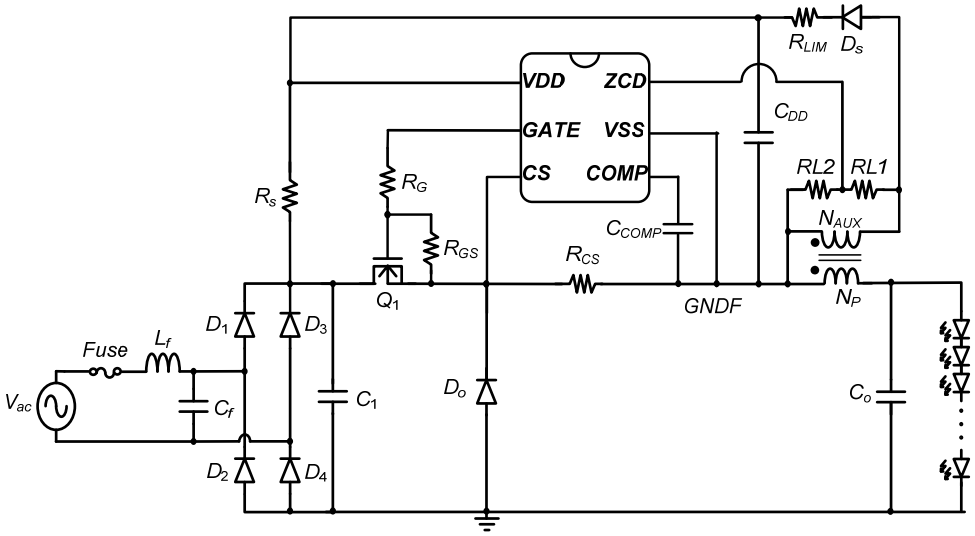


Fig.2 Typical application circuit of MBI6912 with auxiliary winding inductor

Functional Diagram

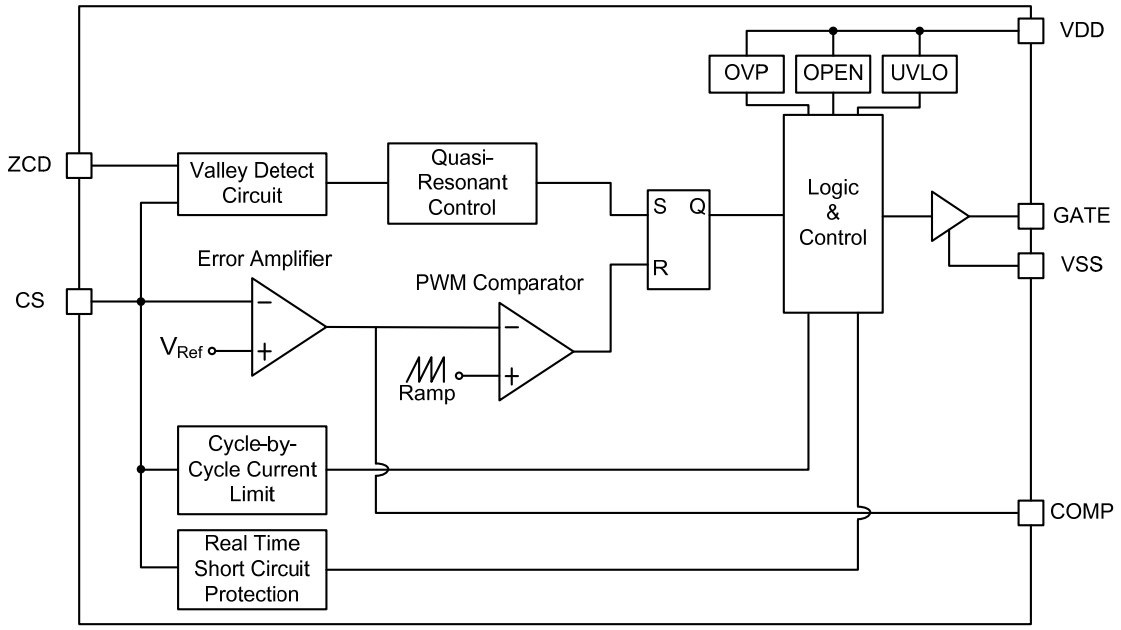


Fig.3 Functional diagram of MBI6912

Pin Configuration

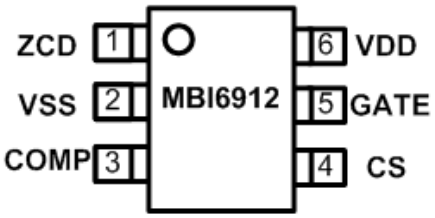


Fig. 4 Pin configuration of MBI6912

Pin Description

No.	Name	Description
1	ZCD	Input from auxiliary winding for output over-voltage sense
2	VSS	Floating ground (IC reference)
3	COMP	Terminal to connect a compensator (EA's output)
4	CS	Sense inductor current and output current.
5	GATE	Drive the gate of the external MOSFET
6	VDD	Supply voltage (With OVP=40V)

Absolute Maximum Ratings

NOTE: Operations above the maximum ratings may cause device failure or reduce device reliability.

Characteristics	Symbol	Min	Max	Unit
Supply voltage	V_{DD}	-0.3	44	V
Output Voltage at the COMP pin	V_{COMP}	-0.3	7	V
Output voltage range	V_{GATE}	-0.3	16	V
Input voltage for CS pin	V_{CS}	-0.3	7	V
Input voltage for ZCD pin.	V_{ZCD}	-0.3	7	V
Maximum source current in ZCD pin	$I_{ZCD-SOURCE}$	-	150	uA
Maximum sink current in ZCD pin	$I_{ZCD-SINK}$	-	50	uA
Storage temperature	T_{STG}	-55	150	°C
Operating ambient temperature	T_{OPA}	-40	85	°C
Junction temperature	T_{JC}	-40	**150	°C
Power Dissipation	P_{DISSIP}	-	0.51	W
Thermal resistance	$R_{th(j-a)}$	-	244	°C /W

**Operation at the maximum rating for excessive period may reduce the device reliability; therefore, the suggested typical operation temperature of the device should be under 125°C.

Electrical Characteristics

Test condition: V_{DD}=20V, C_{IN}=10μF, and T_A=25°C unless otherwise specified.

Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Supply voltage						
Input Voltage	V_{DD}		18		39	V
Mean output current accuracy		Rcs Variation±1%	-	±1	-	%
Line regulation		Vin=85~265Vac, fs=70kHz		-	±1	%
Load regulation		ΔVo=±15% Vo		-	±1	%
Supply voltage						
Start-up Voltage	$V_{START\ UP}$	Start-up	14.4	16	17.6	V
Under Voltage Lockout	V_{UVLO}	UVLO	6.3	7	7.7	V
V_{DD} over voltage protection	V_{DD-OVP}		37	39	42	V
UVLO Hysteresis	V_{DD-HYS}		8.1	9	9.9	
Operating current	I_{DD-OP}	V_{DD}=24V, C_L=1nF, fsw=30KHz	-	-	1.5	mA
Standby current	I_{DD-ST}	I_{DD} before start-up	-	20	40	uA
Error amplifier						
COMP Clamping voltage	V_{COMPH}		-	3	-	V
Current sense reference voltage	V_{REF}		-	0.2	-	V
Gate driver						
Output high voltage	V_{OH}	V_{DD}=30V	10.8	12	13.2	V
Output low voltage	V_{OL}	V_{DD}=30V	-	-	0.5	V
Rising time	T_R	V_{DD}=30V, C_L=1nF 20%~80%	-	-	100	ns
Falling time	T_F	V_{DD}=30V, C_L=1nF 80%~20%	-	-	100	ns
Maximum frequency	f_{MAX}		180	200	220	kHz
Maximum on time	t_{ON-MAX}		21.6	24	26.4	us
Minimum on time	t_{ON-MIN}		180	200	220	ns
Maximum off time	$t_{OFF-MAX}$		24	33.7	41.8	us
Minimum off time	$t_{OFF-MIN}$		1.8	2	2.2	uS
Over voltage protection						
Open protection threshold ZCD	$V_{VS-open}$		1.8	2	2.2	V
Over-current protection(OCP)						
Current Limit threshold CS	V_{OC}		1.18	1.2	1.32	V
Short protection threshold CS	V_{SCP}		1.35	1.5	1.65	V
Startup						
Pre-charge comp Level	V_{PRE}		0.9	1	1.1	V
Over-temperature protection(OTP)						
Thermal shutdown temperature	T_{SD}		140	155	170	°C

Application Information

MBI6912 is a universal ac input AC/DC constant current LED driver designed for high power LED applications. The built-in power factor correction (PFC) circuit maintains high power factor over a wide input voltage range while suppresses the harmonic current to conform to EN61000-3-2 regulations. The embedded quasi-resonant switching technique enables each cycle to start at the relative valley of the drain-source voltage (V_{DS}) of the MOSFET, which greatly enhances the conversion efficiency and alleviates radiation EMI. MBI6912 is also equipped with full protections, inclusive of over-temperature protection, LED open-circuit protection, and LED short-circuit protection. The built-in soft-start circuit eliminates the in-rush current, while the current sensing resistor short protection prevents the damage caused by manufacturing defect or abnormal operation which leads to short-circuit of the current sensing resistor.

In the application circuit, there are distinct grounds, namely VSS and GND. VSS is the reference ground for internal circuit while GND is the earth ground. Users should be aware that VSS and GND **CAN NOT** be directly connected together to avoid IC damage and system malfunction.

Protection

V_{DD} Over Voltage Protection (OVP)

MBI6912 realizes input over voltage protection by sensing the input voltage at pin *VDD*. Once any abnormal spike occurs and exceeds the V_{DD} OVP threshold V_{DD_OVP}, numerically 40V, *GATE* signal ceases switching and V_{DD} drops accordingly. The converter is fully turned off when V_{DD} drop below V_{UVLO}.

Under Voltage Lock-Out (UVLO)

When V_{IN} drops below 7.0V, the GATE output will be forced low to turn off the external power MOSFET. When V_{IN} rises above 16.0V, the GATE output resumes normal operation and the external power MOSFET starts switching.

Over Temperature Protection (OTP)

When the junction temperature exceeds 155°C, the built-in over-temperature protection (OTP) is activated to force off the MOSFET. Once the junction temperature drops below 140°C, OTP is deactivated and MBI6912 resumes normal operation.

LED Open-Circuit Protection

When any LED connected to MBI6912 is open-circuited, it will trigger AUX-OVP to turn off the external power MOSFET and therefore no current is supplied to LEDs.

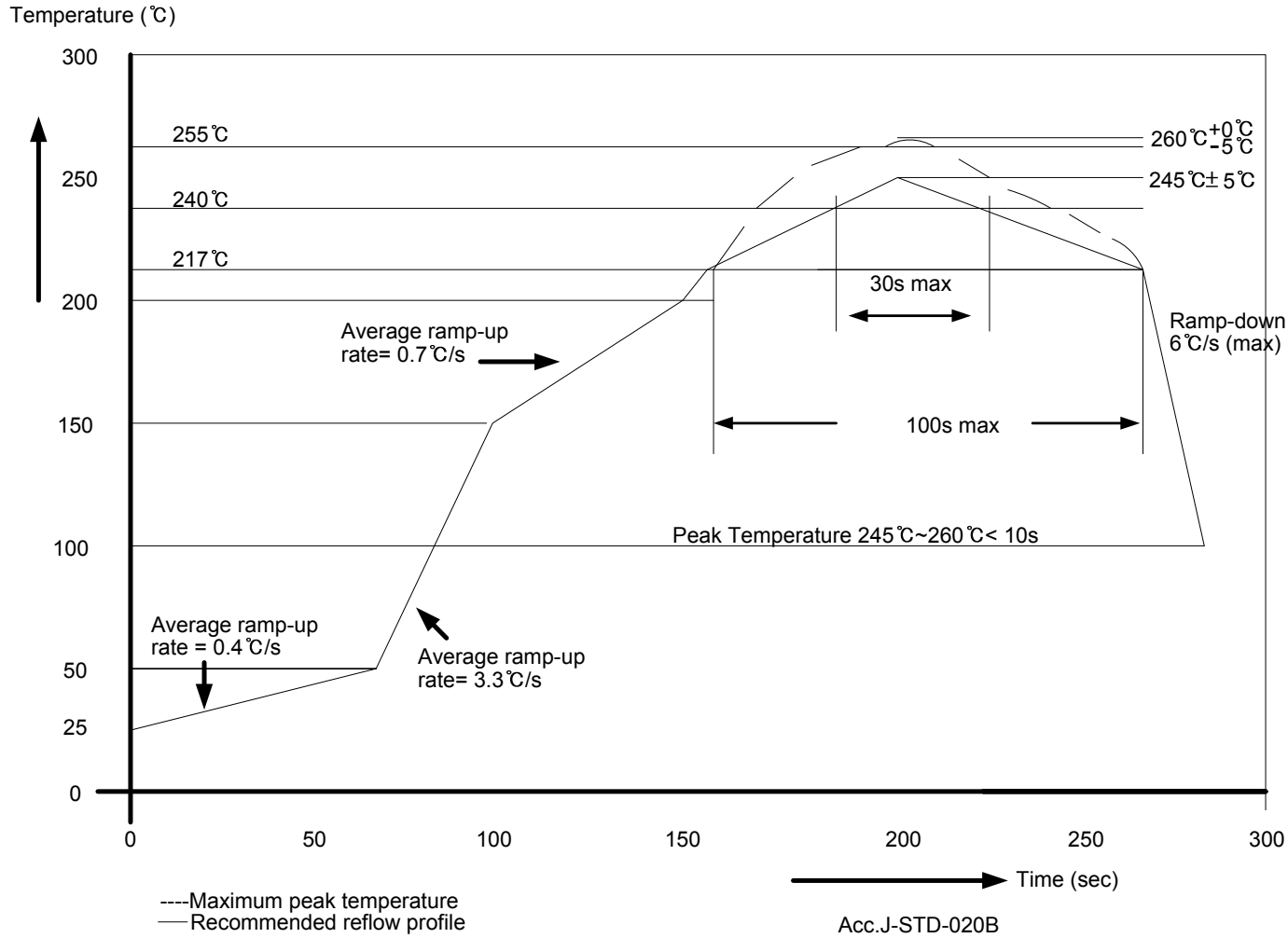
LED Short-Circuit Protection

When any LED connected to MBI6912 is short-circuited, MBI6912 adaptively regulates the output current according to the new loading.

Soldering Process of "Pb-free & Green" Package Plating*

Macroblock has defined "Pb-Free & Green" to mean semiconductor products that are compatible with the current RoHS requirements and selected 100% pure tin (Sn) to provide forward and backward compatibility with both the current industry-standard SnPb-based soldering processes and higher-temperature Pb-free processes. Pure tin is widely accepted by customers and suppliers of electronic devices in Europe, Asia and the US as the lead-free surface finish of choice to replace tin-lead. Also, it adopts tin/lead (SnPb) solder paste, and please refer to the JEDEC J-STD-020C for the temperature of solder bath. However, in the whole Pb-free soldering processes and materials, 100% pure tin (Sn) will all require from 245 °C to 260°C for proper soldering on boards, referring to JEDEC J-STD-020C as shown below.

For managing MSL3 Package, it should refer to JEDEC J-STD-020C about floor life management & refer to JEDEC J-STD-033C about re-bake condition while IC's floor life exceeds MSL3 limitation.

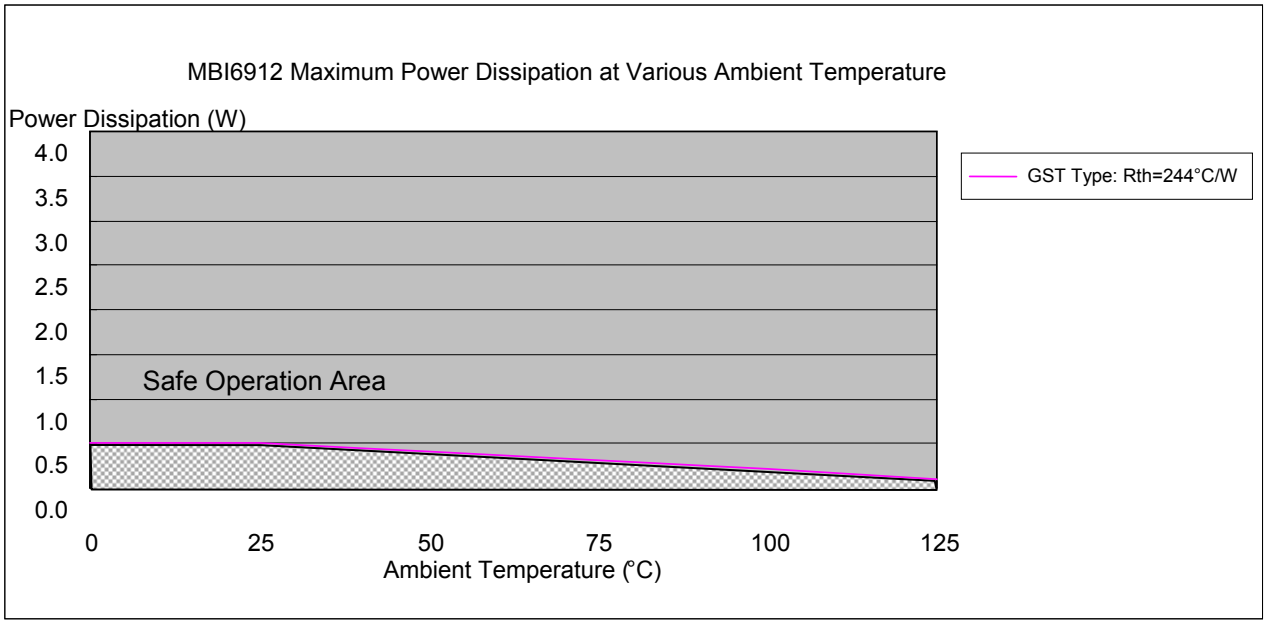


Package Thickness	Volume mm^3 <350	Volume mm^3 350-2000	Volume mm^3 ≧2000
<1.6mm	260 +0 °C	260 +0 °C	260 +0 °C
1.6mm – 2.5mm	260 +0 °C	250 +0 °C	245 +0 °C
≧2.5mm	250 +0 °C	245 +0 °C	245 +0 °C

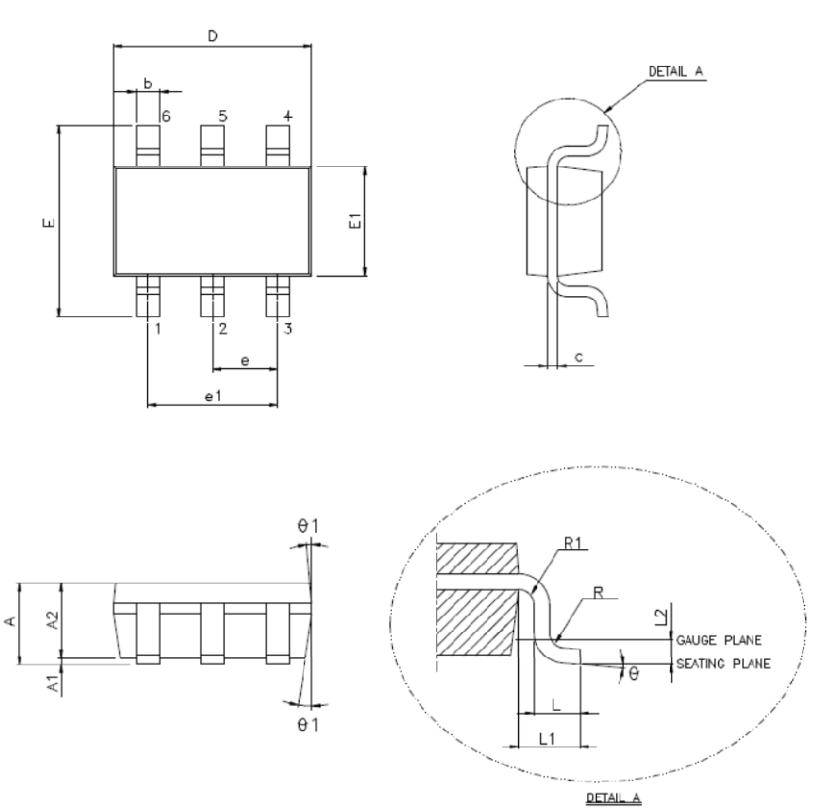
*Note: For details, please refer to Macroblock's "Policy on Pb-free & Green Package".

Package Power Dissipation (PD)

The maximum power dissipation, $P_D(max)=(Tj–Ta)/R_{th(j-a)}$, decreases as the ambient temperature increases.



Outline Drawings



VARIATION(ALL DIMENSIONS SHOWN IN MM)

SYMBOL	MIN.	NOM.	MAX.
A	–	–	1.45
A1	0.00	–	0.15
A2	0.90	1.15	1.30
b	0.30	–	0.50
c	0.08	–	0.22
D		2.90 BSC.	
E		2.80 BSC.	
E1		1.60 BSC.	
e		0.95 BSC.	
e1		1.90 BSC.	
L	0.30	0.45	0.60
L1		0.60 REF.	
L2		0.25 BSC.	
R	0.10	–	–
R1	0.10	–	0.25
θ	0°	4°	8°
θ1	5°	10°	15°

NOTE :
1. JEDEC OUTLINE : MO-178 AB.

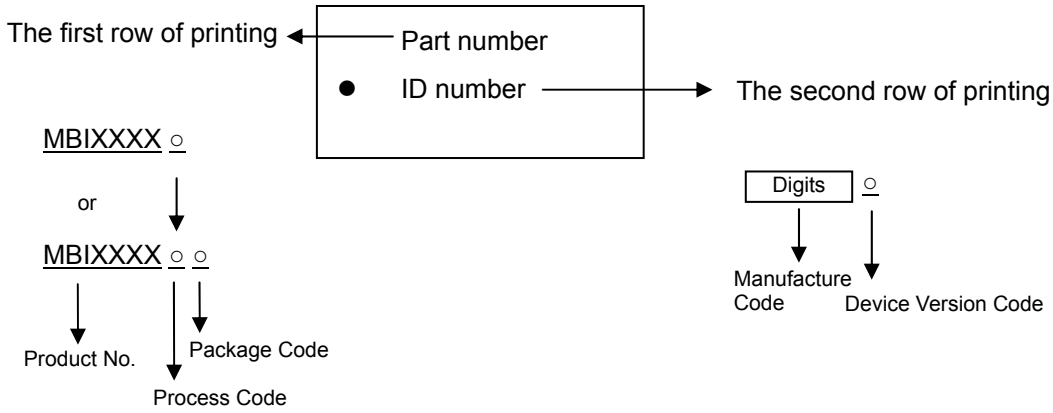
MBI6912 GST outline drawing

Note1: The unit for the outline drawing is mm.

Note2: Please use the maximum dimensions for the thermal pad layout. To avoid the short circuit risk, the vias or circuit traces shall not pass through the maximum area of thermal pad.

Product Top Mark Information

GD(SOP-8)



Product Revision History

Datasheet version	Device Version Code
V1.00	A

Product Ordering Information

Part Number	"RoHS Compliant" Package Type	Weight (g)
MBI6912GST-A	SOP8L-150-1.27	0.079g

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