WM3100

High Performance Stereo 2Vrms Line Driver

DESCRIPTION

The WM3100 is a high performance stereo $2V_{RMS}$ line driver with ground referenced outputs.

The device is ideal for cost-sensitive applications requiring line level outputs, minimal external components and small PCB area. The WM3100 offers excellent audio performance.

The two high performance amplifiers are capable of driving a wide variety of loads. The device supports single-ended or differential input configurations. The input and feedback resisitors around both amplifiers are integrated within the WM3100, giving a high impedance input and a fixed signal gain of +6.4dB.

An on-board charge pump is provided to generate the negative supply for the ground-referenced drivers; the charge pump requires only two external capacitors for normal operation.

The line outputs can be muted using a hardware control input. A high impedance mute state is also supported, where the outputs are undriven - this is useful in applications where a common external connector is used as an input and an output.

The device uses a single 3.3V supply, and is available in a 14-pin SOIC.

FEATURES

- 108dB SNR ('A' weighted)
- -95dB THD+N
- 108dB dynamic range
- Single-ended or differential input
- Fixed gain +6.4dB

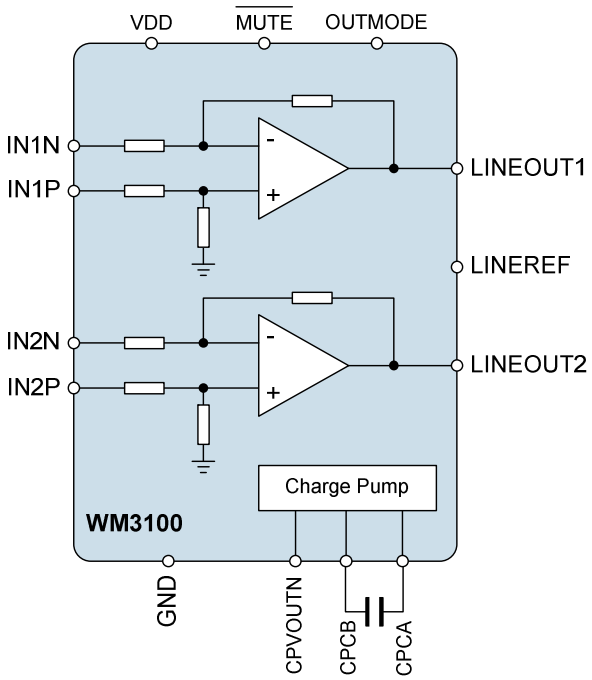
- Digital control inputs
  - Mute pin
  - High impedance output mode
- Pop and click suppression
- Fast start-up
  - 200µs start-up from OFF
  - 100µs start-up from MUTE

- 3.3V supply
- 14-pin SOIC

APPLICATIONS

- Digital televisions
- DVD players & recorders
- Blu-ray disc players
- Gaming consoles
- Set-top boxes

BLOCK DIAGRAM



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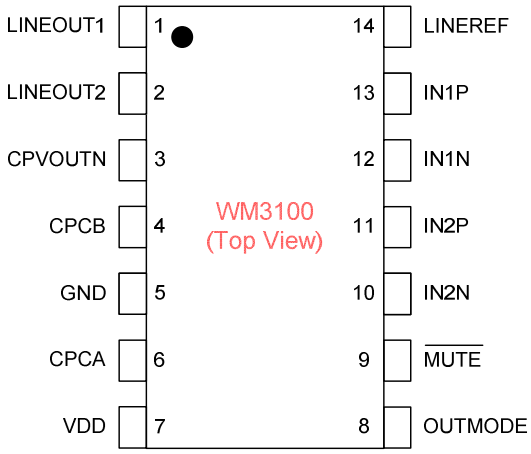
PIN CONFIGURATION



ORDERING INFORMATION

ORDER CODE	TEMPERATURE RANGE	PACKAGE	MOISTURE SENSITIVITY LEVEL	PEAK SOLDERING TEMPERATURE
WM3100GED	-40°C to +85°C	14-pin SOIC	MSL1	260°C
WM3100GED/R	-40°C to +85°C	14-pin SOIC (Pb-free, Tape and reel)	MSL1	260°C

Note:
Tube quantity = 56
Reel quantity = 3000

PIN DESCRIPTION

PIN NO	NAME	TYPE	DESCRIPTION
1	LINEOUT1	Analogue Output	Line output 1
2	LINEOUT2	Analogue Output	Line output 2
3	CPVOUTN	Analogue Output	Charge pump output decoupling pin
4	CPCB	Analogue Output	Charge pump fly-back capacitor pin
5	GND	Supply	Ground
6	CPCA	Analogue Output	Charge pump fly-back capacitor pin
7	VDD	Supply	Positive supply pin
8	OUTMODE	Digital Input	Output mode control pin 0 = Normal operation 1 = High impedance mute state
9	MUTE	Digital Input	Mute control (only valid when OUTMODE = 0) 0 = Output muted 1 = Normal operation
10	IN2N	Analogue Input	Inverting input 2
11	IN2P	Analogue Input	Non-inverting input 2
12	IN1N	Analogue Input	Inverting input 1
13	IN1P	Analogue Input	Non-inverting input 1
14	LINEREF	Analogue Input	Line output reference (connect to GND)

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings are stress ratings only. Permanent damage to the device may be caused by continuously operating at or beyond these limits. Device functional operating limits and guaranteed performance specifications are given under Electrical Characteristics at the test conditions specified.

ESD Sensitive Device. This device is manufactured on a CMOS process. It is therefore generically susceptible to damage from excessive static voltages. Proper ESD precautions must be taken during handling and storage of this device.

Wolfson tests its package types according to IPC/JEDEC J-STD-020B for Moisture Sensitivity to determine acceptable storage conditions prior to surface mount assembly. These levels are:

MSL1 = unlimited floor life at <30°C / 85% Relative Humidity. Not normally stored in moisture barrier bag.
MSL2 = out of bag storage for 1 year at <30°C / 60% Relative Humidity. Supplied in moisture barrier bag.
MSL3 = out of bag storage for 168 hours at <30°C / 60% Relative Humidity. Supplied in moisture barrier bag.

The Moisture Sensitivity Level for each package type is specified in Ordering Information.

CONDITION	MIN	MAX
Supply voltage (VDD)	-0.3V	+4.5V
Voltage range digital inputs	GND -0.3V	VDD +0.3V
Voltage range analogue inputs	GND -0.3V	VDD +0.3V
Operating temperature range, T_A	-40ºC	+85ºC
Junction temperature, T_{JMAX}	-40ºC	+150ºC
Storage temperature after soldering	-65ºC	+150ºC

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Supply voltage	VDD	2.97	3.3	3.6	V
Ground	GND		0		V

ELECTRICAL CHARACTERISTICS

Test Conditions

VDD=3.3V, GND=0V, T_A = +25°C, 1V_{RMS} 1kHz sinusoidal input signal unless otherwise stated

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Analogue Inputs						
Maximum full-scale input signal level. (This changes in proportion to VDD.)				1		V_{RMS}
Input resistance	R_{IN}			24		kΩ
Analogue Outputs						
Full-scale output signal level. (This changes in proportion to VDD.)		Full scale input signal, R_L = 10kΩ		2.1		V_{RMS}
DC offset				0	±3	mV
Minimum load resistance	R_L		2.5			kΩ
Maximum load capacitance		Without external RC filter			220	pF
		With recommended external RC filter			1	µF
Audio Performance						
Signal to Noise ratio	SNR	A-weighted, 20Hz to 20kHz		108		dB
		unweighted, 20Hz to 20kHz		104		
Total Harmonic Distortion + Noise (2.1V_{RMS} output, 10kΩ load)	THD+N	Single-ended inverting input		-91		dB
		Single-ended non-inverting input		-95		
		Differential input		-92		
Dynamic range	DNR	A-weighted, -60dBV input		108		dB
Channel separation (L/R)		1kHz		90		dB
		20Hz to 20kHz		80		
Channel level matching		1kHz			0.1	dB
Channel phase deviation		1kHz			0.1	degree
Gain			6.2	6.4	6.6	dB
Power Supply Rejection Ratio (VDD)	PSRR	100mV pk-pk, 1kHz		69		dB
		100mV pk-pk, 20Hz to 20kHz		50		
Mute attenuation		MUTE = 0	70			dB
Output impedance (high impedance mute state)		OUTMODE = 1		50		kΩ
Internal low-pass filter 3dB cut-off				300		kHz
Start-up time (from OFF)				200		µs
Start-up time (from MUTE)				100		µs

TERMINOLOGY

1. Signal-to-Noise Ratio (dB) – SNR is a measure of the difference in level between the maximum full scale output signal and the output with no input signal applied. (Note that this is measured without any mute function enabled.)
2. Total Harmonic Distortion (dB) – THD is the level of the rms value of the sum of harmonic distortion products relative to the amplitude of the measured output signal.
3. Total Harmonic Distortion plus Noise (dB) – THD+N is the level of the rms value of the sum of harmonic distortion products plus noise in the specified bandwidth relative to the amplitude of the measured output signal.
4. Dynamic range (dB) - DNR is a measure of the difference between the maximum full scale output signal level and the sum of all harmonic distortion products plus noise with a low level input signal applied. Typically, an input signal level 60dB below full scale is used.
5. Channel separation (L/R) (dB) – left-to-right and right-to-left channel separation is the measured signal level in the idle channel at the test signal frequency relative to the signal level at the output of the active channel. The active channel is configured and supplied with an appropriate input signal to drive a full scale output, with signal measured at the output of the associated idle channel.
6. Mute Attenuation – This is a measure of the difference in level between the full scale output signal and the output with mute applied.
7. All performance measurements carried out with 20kHz low pass filter and, where noted, an A-weighted filter. Failure to use such a filter will result in higher THD and lower SNR readings than are found in the Electrical Characteristics. The low pass filter removes out of band noise; although it is not audible it may affect dynamic specification values.

DEVICE DESCRIPTION

INTRODUCTION

The WM3100 is a high-performance stereo line driver designed for Digital televisions, DVD, Blu-ray, set-top box and gaming applications. It is packaged in a 14-pin SOIC.

The device comprises two fixed gain analogue channels. Input signals up to $1V_{RMS}$ are supported, in single-ended or differential configurations. The output driver drives up to $2.1V_{RMS}$, assuming a 3.3V supply.

The inputs and outputs to the WM3100 are ground-referenced; an integrated charge pump circuit generates the required negative supply rail from the single VDD supply.

The analogue outputs can be muted under control of a digital logic input. The outputs can also be set to a high impedance state, supporting applications where a common external connector is used as an input and an output.

INPUT SIGNAL PATH

The WM3100 supports two line input channels, which can each be used in single-ended or differential circuit configurations, as illustrated in Figure 1, Figure 2 and Figure 3. The signal gain is 6.4dB in each case.

The input capacitor must be correctly selected as it affects the low cut-off frequency of the input circuit. A low cut-off frequency is desirable as it means that there is no significant filtering of the 20Hz to 20kHz audio frequency bandwidth.

Typically, the 3dB cut-off frequency for the line input should be around 10Hz. The WM3100 input impedance is 24kΩ (see “Electrical Characteristics”). Using the equations below, it follows that the AC coupling capacitors should be approximately 1µF (which gives a 3dB cut-off frequency around 7Hz).

$$\text{3dB filter roll-off frequency} = \frac{1}{2\pi RC} \qquad R = \text{WM3100 input impedance}$$

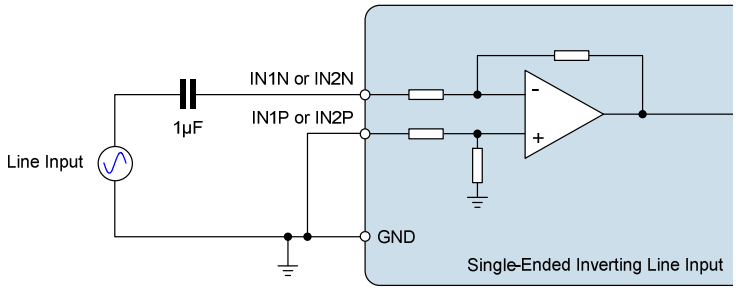


Figure 1 Single-Ended Line Input (Inverting)

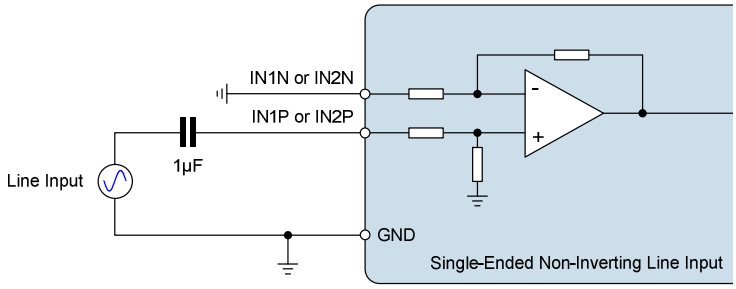


Figure 2 Single-Ended Line Input (Non-Inverting)

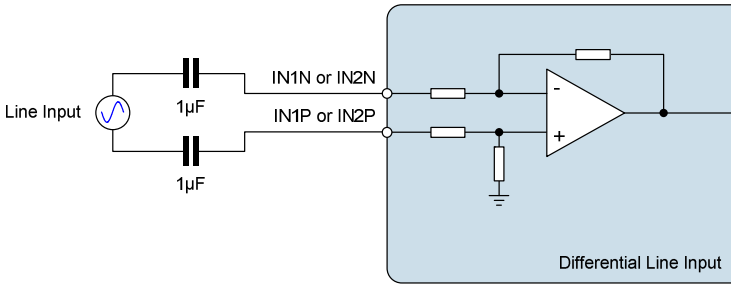


Figure 3 Differential Line Input

OUTPUT SIGNAL PATH

The WM3100 provides two line output channels, which each support a peak output voltage of ±2.97V (6.4dBV or 2.1V_{RMS} sine wave) when operating with a 3.3V supply.

The line outputs are ground-referenced, removing the requirement for DC-blocking capacitors.

The WM3100 provides an internal low-pass filter (LPF) on the output paths. It is also recommended to connect an external analogue low pass filter to the output pins. This ensures that all out-of-band noise is filtered, and improves the maximum load capacitance rating, as noted in the "Electrical Characteristics".

There are many suitable LPF architectures, but a simple RC filter is recommended, as illustrated in Figure 4. The filter shown here has a -3dB cut-off frequency of approximately 105kHz, and a droop of -0.15dB at 20kHz.

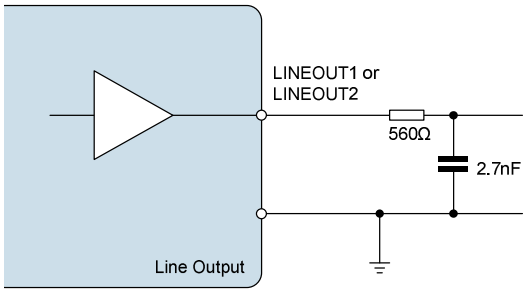


Figure 4 Line Output Low Pass Filter

CHARGE PUMP

The WM3100 incorporates a charge pump circuit, which generates the negative supply rail for the line output drivers. The charge pump is powered from VDD, and generates the negative supply CPVOUTN. The switching clock for the charge pump is generated internally.

The external connections for the charge pump are illustrated in Figure 5. A fly-back capacitor is connected between the CPCA and CPCB pins. A de-coupling capacitor is required on CPVOUTN. Note that an input decoupling capacitor is also recommended on the VDD pin.

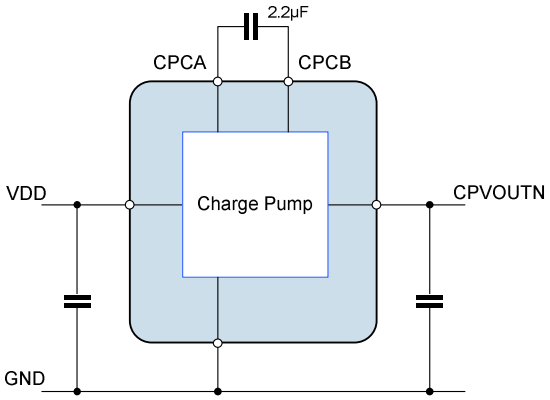


Figure 5 External Connections for Charge Pump

DIGITAL CONTROL INPUTS

The WM3100 supports two digital control inputs, as described below.

The OUTMODE pin selects between normal operation and high-impedance mute state. A logic '1' input selects the high-impedance state, in which the outputs are muted and un-driven. This mode enables the external connectors to support other functions without interference from the WM3100 drivers. A logic '0' input selects normal operation.

The $\overline{\text{MUTE}}$ pin selects between normal operation and muted output mode. This is an "active low" input pin. A logic '0' input enables the mute function. A logic '1' input selects normal operation.

Note that the $\overline{\text{MUTE}}$ pin has no function when the OUTMODE pin is asserted.

The digital control inputs are summarised in Table 1.

INPUT	DESCRIPTION
OUTMODE	Output mode control pin 0 = Normal operation 1 = High impedance mute state
$\overline{\text{MUTE}}$	Mute control (only valid when OUTMODE = 0) 0 = Output muted 1 = Normal operation

Table 1 Digital Control Inputs

RECOMMENDED EXTERNAL COMPONENTS

AUDIO INPUT PATHS

A DC-blocking input capacitor is required on each input pin that is used. A single capacitor is required for a single-ended connection; for differential connection, a capacitor is required on both input pins. Unused input pins must be connected to ground.

For typical applications, a 1µF capacitor is recommended. Tantalum electrolytic capacitors are particularly suitable as they offer high stability in a small package size.

AUDIO OUTPUT PATHS

An analogue low-pass filter is recommended on each line output. A simple RC filter comprising a 560Ω resistor and a 2.7nF capacitor is suitable. Ceramic capacitors with C0G / NP0 dielectric are recommended.

POWER SUPPLY DECOUPLING

Power supply decoupling is required on VDD. A 4.7µF capacitor is recommended.

Decoupling capacitors should be placed as close as possible to the WM3100 device. The connection between GND, the VDD decoupling capacitor and the main system ground should be made at a single point as close as possible to the GND pin of the WM3100.

Due to the wide tolerance of many types of ceramic capacitors, care must be taken to ensure that the selected components provide the required capacitance across the required temperature and voltage ranges in the intended application. For most application the use of ceramic capacitors with capacitor dielectric X5R is recommended.

CHARGE PUMP COMPONENTS

A fly-back capacitor is required between the CPCA and CPCB pins. The required capacitance is 2.2µF. A decoupling capacitor is required on CPVOUTN; the recommended value is 1µF.

The positioning of the charge pump capacitors is important, particularly the fly-back capacitor. The use of short and wide PCB tracks for the fly-back capacitor connections will give best results due to its low resistance. Both capacitors should be placed as close as possible to the WM3100.

Due to the wide tolerance of many types of ceramic capacitors, care must be taken to ensure that the selected components provide the required capacitance across the required temperature and voltage ranges in the intended application. For most application the use of ceramic capacitors with capacitor dielectric X5R is recommended.

RECOMMENDED EXTERNAL CONNECTIONS

The recommended external connections to the WM3100 are illustrated in Figure 6.

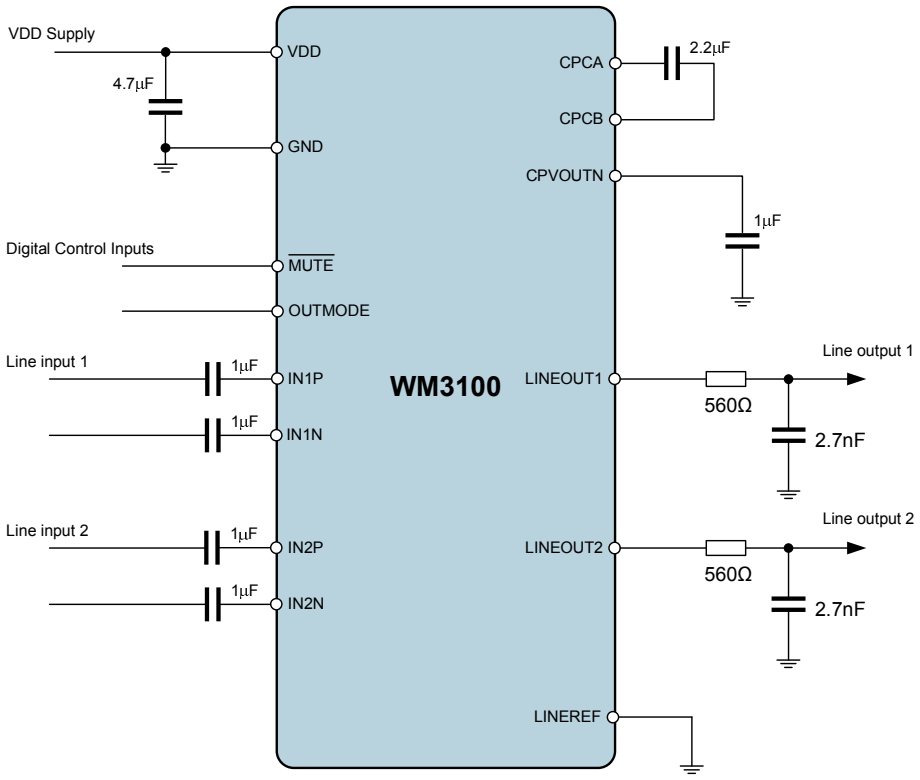
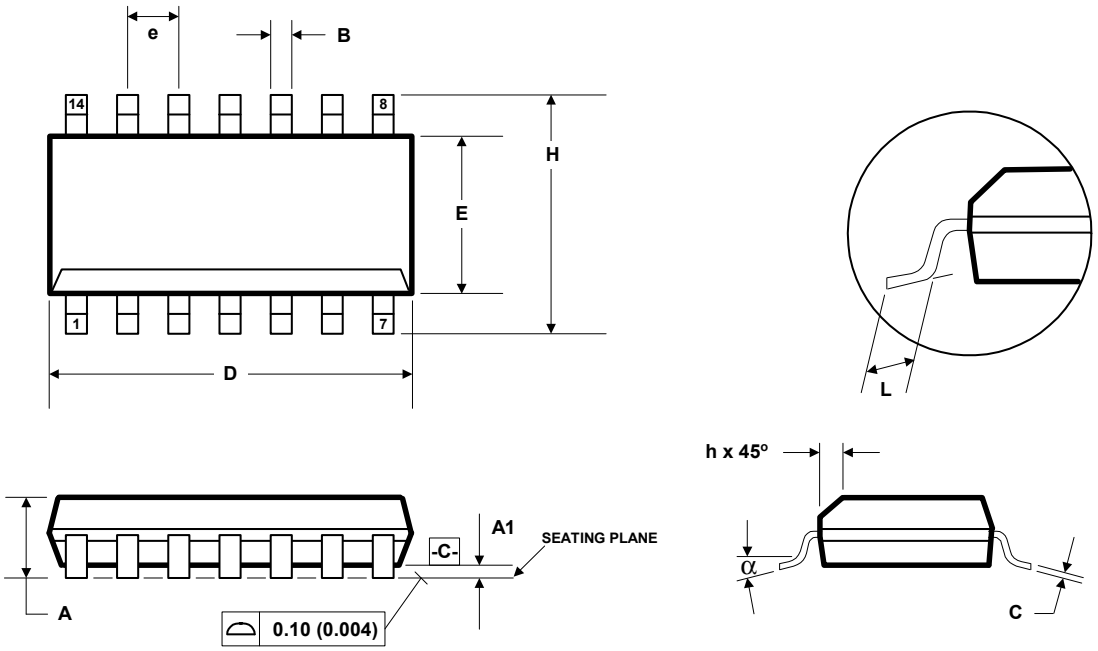


Figure 6 Recommended External Connections

PACKAGE DIMENSIONS

D: 14 PIN SOIC 3.9mm Wide Body **DM001.C**



Symbols	Dimensions (mm)		Dimensions (Inches)	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.0532	0.0688
A1	0.10	0.25	0.0040	0.0098
B	0.33	0.51	0.0130	0.0200
C	0.19	0.25	0.0075	0.0098
D	8.55	8.75	0.3367	0.3444
E	3.80	4.00	0.1497	0.1574
e	1.27 BSC		0.05 BSC	
H	5.80	6.20	0.2284	0.2440
h	0.25	0.50	0.0099	0.0196
L	0.40	1.27	0.0160	0.0500
α	0^o	8^o	0^o	8^o
REF:	JEDEC.95, MS-012			

NOTES:
A. ALL LINEAR DIMENSIONS ARE IN MILLIMETERS (INCHES).
B. THIS DRAWING IS SUBJECT TO CHANGE WITHOUT NOTICE.
C. BODY DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSION, NOT TO EXCEED 0.25MM (0.010IN).
D. MEETS JEDEC.95 MS-012, VARIATION = AB. REFER TO THIS SPECIFICATION FOR FURTHER DETAILS.

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