3.3V Low Power Full-Duplex RS-485 Transceivers with 10Mbps Data Rate

Description

The TK3491 devices are 3.3V low power full-duplex transceivers that meet the specifications of the RS-485 and RS-422 serial protocols. These devices are pin-to-pin compatible with the standard devices as well as popular industry standards. TheTK3491allowing low power operation without sacrificing performance. The TK3491 meet the electrical specifications of the RS-485 and RS-422 serial protocols up to 10Mbps under load. The TK3491 is identical to the TK3491 with the addition of driver and reciveiver tri-state enable lines.

Drivers are short-circuit current-limited and are protected against excessive power dissipation by thermal shutdown circuitry that places the driver outputs into a high-imped-ance state. The receiver input has a fail-safe feature that guarantees a logic-high output if both inputs are open circuit.

Features

Full-duplex RS-485 and RS-422 transceivers
Operates from a single 3.3V supply
Interoperable with 5.0V logic Driver/receiver tri-state enable lines
 -7V to 12V common-mode input voltage range
±200mV receiver input sensitivity
Driver/receiver tri-state enable lines
 Allows up to 32 transceivers on the serial bus
Enhanced ESD Specifications:（"EC" and "EE" only)

   ±15kV IEC61000-4-2 Air Discharge
   ±8kV IEC61000-4-2 Contact Discharge

Applications

Low-Power RS-485/RS-422 Transceivers
Industrial-Control Local Area Networks
Telecommunications
Transceivers for EMI-Sensitive Applications

Ordering Information

Part Number	Package	Packing	Temperature(TA)	Package Qty	ESD
TK3491CSD	SOIC-14	Reel	0°C ~ 70°C	2500	
TK3491ESD	SOIC-14	Reel	-40°C ~ 85°C	2500	
TK3491ECSD	SOIC-14	Reel	0°C ~ 70°C	2500	±15KV
TK3491EESD	SOIC-14	Reel	-40°C ~ 85°C	2500	±15KV

Note: Please contact us to customize DIP packaging device.

Absolute Maximum Ratings

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

V_{CC}..6.0V

Input Voltages

Logic.......... .... -0.3V to 6.0V

Drivers .... -0.3V to 6.0V

Receivers.............................±14V

Output Voltages

Drivers ....±14V

Receivers........ .... -0.3V to 6.0V

Storage Temperature ....-65°C to +150°C

Maximum Junction Temperature, T_J ....125°C

Power Dissipation

14-pin NSOIC 700mW

(derate 8.33mW/°C above +70°C)

Operating Conditions

Package Power Dissipation

14-pin NSOIC Θ_{JA} .... 88.2°C/W

ESD Rating

Human Body Model (HBM)...........................±15kV

Electrical Characteristics

$T_{AMB} = T_{MIN}$ to T_{MAX} and $V_{CC} = 3.3V \pm 5\%$ unless otherwise noted.

| PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
TK3491 Driver DC Characteristics					
Differential output voltage			Vcc	V	Unloaded; R = ∞Ω ; Figure 1
Differential output voltage	2		Vcc	V	With load; R = 50Ω (RS-422); Figure 1
Differential output voltage	1.5		Vcc	V	With load; R = 27Ω (RS-485); Figure 1
Change in magnitude of driver differential output voltage for complimentary states			0.2	V	R = 27Ω or R = 50Ω; Figure 1
Driver common-mode output voltage			3	V	R = 27Ω or R = 50Ω; Figure 1
Input high voltage	2.0			V	Applies to DE, D, $\overline{REB}$
Input low voltage			0.8	V	Applies to DE, D, $\overline{REB}$
Input current			±10	µA	Applies to DE, D, $\overline{REB}$
Driver short circuit current V_{OUT} = HIGH			±250	mA	-7V ≤ V_O ≤ 12V; Figure 8
Driver short circuit current V_{OUT} = LOW			±250	mA	-7V ≤ V_O ≤ 12V; Figure 8
TK3491 Driver AC Characteristics					
Maximum data rate	10			Mbps	
Driver input to output, t_{PLH}	20	40	60	ns	Figures 2 & 9
Driver input to output, t_{PHL}	20	40	60	ns	Figures 2 & 9
Differential driver skew		2		ns	$|t_{PHL}(Y)- t_{PLH}(Y)|$, $|t_{PHL}(Z)- t_{PLH}(Z)|$, Figures 2 and 9

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Electrical Characteristics (Continued)

$T_{AMB} = T_{MIN}$ to T_{MAX} and $V_{CC} = 3.3V \pm 5\%$ unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Driver rise or fall time		5	20	ns	From 10%-90%; Figures 3 and 10
Driver enable to output HIGH		52	120	ns	Figures 4 and 11
Driver enable to output LOW		60	120	ns	Figures 5 and 11
Driver disable from LOW		40	120	ns	Figures 5 and 11
Driver disable from HIGH		60	120	ns	Figures 4 and 11
TK3491 Receiver DC Characteristics					
Differential input threshold	-0.2		0.2	Volts	$-7V \leq V_{CM} \leq 12V$
Input hysteresis		25		mV	$V_{CM} = 0V$
Output voltage HIGH	Vcc-0.4			Volts	$V_{ID} = 200mV, I_O = -1.5mA$
Output voltage LOW			0.4	Volts	$V_{ID} = -200mV, I_O = 2.5mA$
Three-State (High Impedance) Output Current			±1	µA	$0V \leq V_O \leq Vcc$; $\overline{REB} = Vcc$
Input resistance	12	15		kΩ	$-7V \leq V_{CM} \leq 12V$
Input current (A, B); $V_{IN} = 12V$			1.0	mA	DE = 0V, V_{CC} = 0V or 3.6V, $V_{IN} = 12V$
Input current (A, B); $V_{IN} = -7V$			-0.8	mA	DE = 0V, V_{CC} = 0V or 3.6V, $V_{IN} = -7V$
Short circuit current			60	mA	$0V \leq V_O \leq V_{CC}$
TK3491 Receiver AC Characteristics					
Maximum data rate	10			Mbps	$\overline{REB}$ = 0V, DE = 0V
Receiver input to output, t_{PLH}	40	70	120	ns	Figures 6 and 12
Receiver input to output, t_{PLH}			85	ns	$T_{AMB} = 25°C$, Vcc = 3.3V, Figures 6 and 12
Receiver input to output, t_{PHL}	40	70	120	ns	Figures 6 and 12
Receiver input to output, t_{PHL}			85	ns	$T_{AMB} = 25°C$, Vcc = 3.3V, Figures 6 and 12
Differential receiver skew		4		ns	$|t_{PHL}(A)- t_{PLH}(A)|, |t_{PHL}(B)- t_{PLH}(B)|$, Figures 6 and 12
Receiver enable to output LOW		65	150	ns	Figures 7 and 13; S_1 Closed, S_2 open
Receiver enable to output HIGH		65	150	ns	Figures 7 and 13; S_2 Closed, S_1 open
Receiver disable from LOW		65	200	ns	Figures 7 and 13; S_1 Closed, S_2 open
Receiver disable from HIGH		65	200	ns	Figures 7 and 13; S_2 Closed, S_1 open

Electrical Characteristics (Continued)

$T_{AMB} = T_{MIN}$ to T_{MAX} and $V_{CC} = 3.3V \pm 5\%$ unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Power Requirements					
Supply voltage	3.0		3.6	V	
Supply current		1000	2000	µA	$\overline{REB}$, D = 0V or V_{CC}; DE = V_{CC}
Supply current		800	1500	µA	DE = 0V
ESD protection for R, D, DE, $\overline{REB}$, A, B, Y and Z pins		±15		kV	Human Body Model

Pin Functions

TK3491
Pinout (Top View)
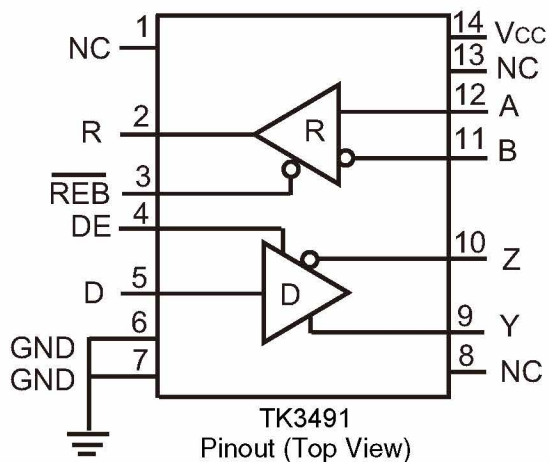
Pin Number	Pin Name	Description
1	NC	No connect[1]
2	R	Receiver output
3	$\overline{REB}$	Receiver output enable active LOW
4	DE	Driver output enable active HIGH
5	D	Driver input
6	GND	Ground connection
7	GND	Ground connection
8	NC	No connect[1]
9	Y	Non-inverting driver output
10	Z	Inverting driver output
11	B	Inverting receiver input
12	A	Non-Inverting receiver input
13	NC	No connect[1]
14	V_{CC}	Positive supply 3.00V < Vcc < 3.60V

Test Circuits
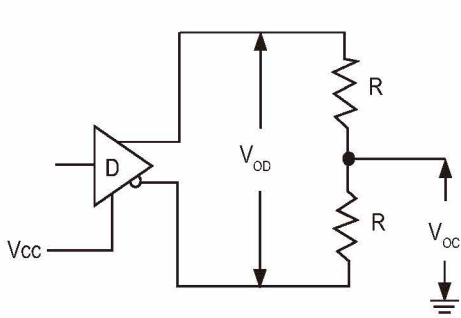
Figure 1: Driver DC Test Load Circuit

$$V_{OM} = \frac{V_{OH} + V_{OL}}{2} \approx 1.5V$$
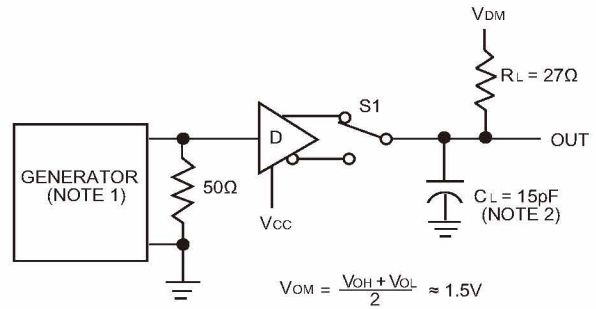
Figure 2: Driver Propagation Delay Test Circuit
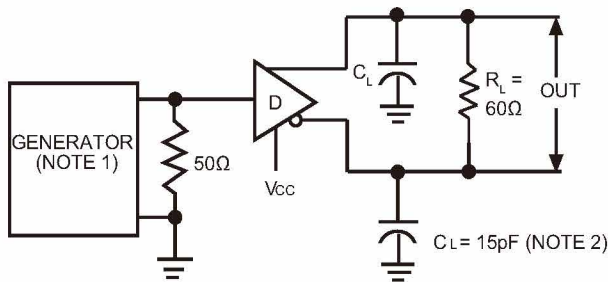
Figure 3: Driver Differential Output Delay and Transition Time Circuit.
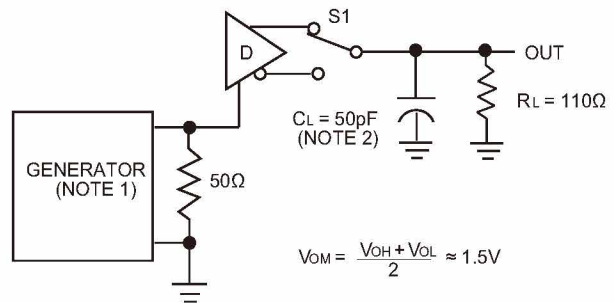

$$V_{OM} = \frac{V_{OH} + V_{OL}}{2} \approx 1.5V$$

Figure 4: Driver Enable and Disable Timing Circuit, Output High
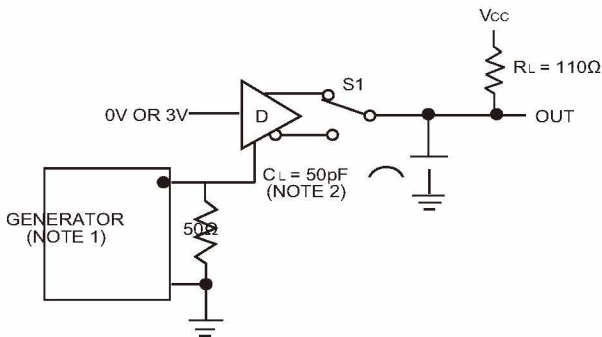
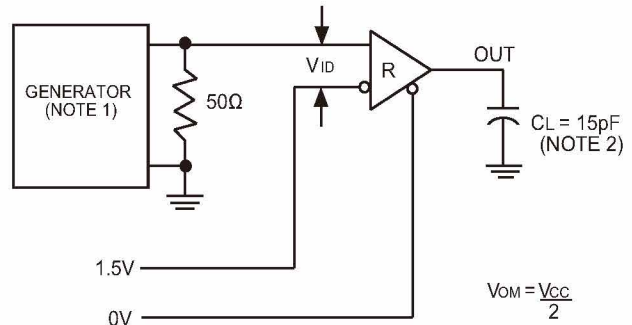Figure 5: Driver Enable and Disable Timing Circuit, Output Low

$$V_{OM} = \frac{V_{CC}}{2}$$

Figure 6: Receiver Propagation Delay Test Circuit
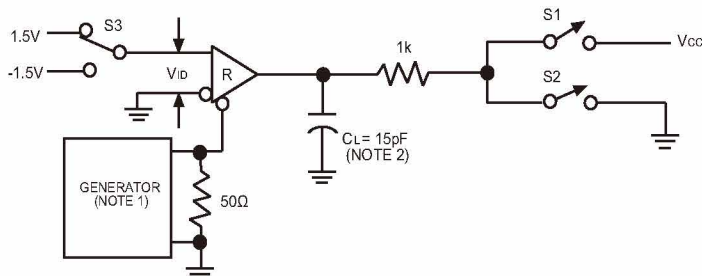
Figure 7: Receiver Enable and Disable Timing Circuit
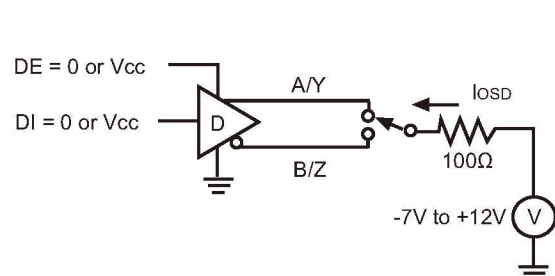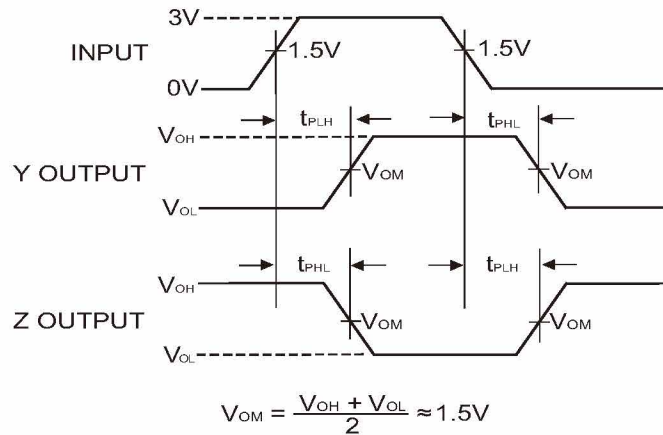

Figure 8: Driver Short Circuit Current Limit Test

Switching Waveforms

$$V_{OM} = \frac{V_{OH} + V_{OL}}{2} \approx 1.5V$$

Figure 9: Driver Propagation Delay Waveforms
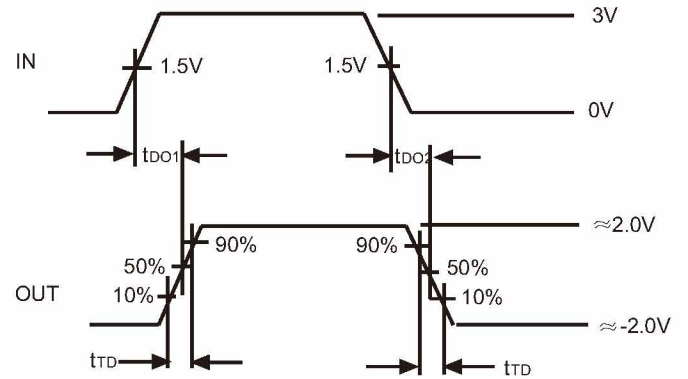
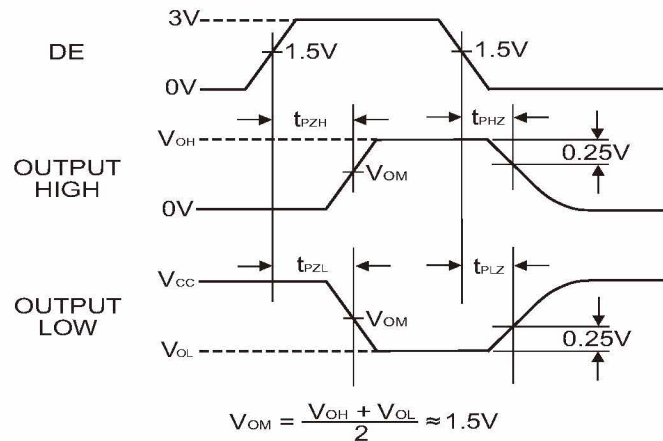Figure 10: Driver Differential Output Delay and Transition Time Waveforms

$$V_{OM} = \frac{V_{OH} + V_{OL}}{2} \approx 1.5V$$

Figure 11: Driver Enable and Disable Timing Waveforms

$$V_{OM} = \frac{V_{CC}}{2}$$
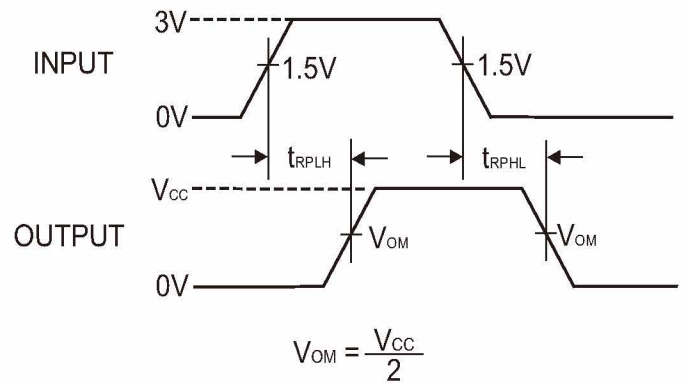
Figure 12: Receiver Propagation Delay Waveforms

S1 is open
S2 is closed
S3 = 1.5V

S1 is closed
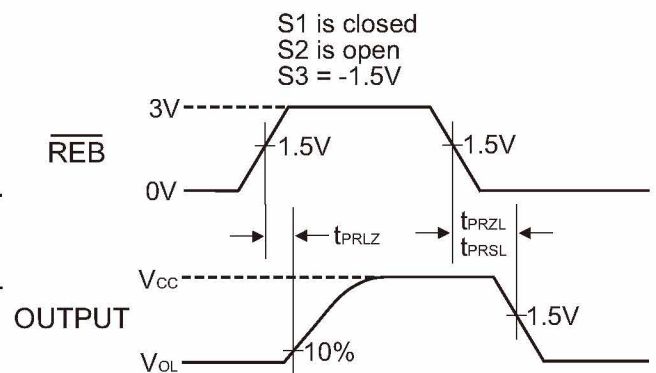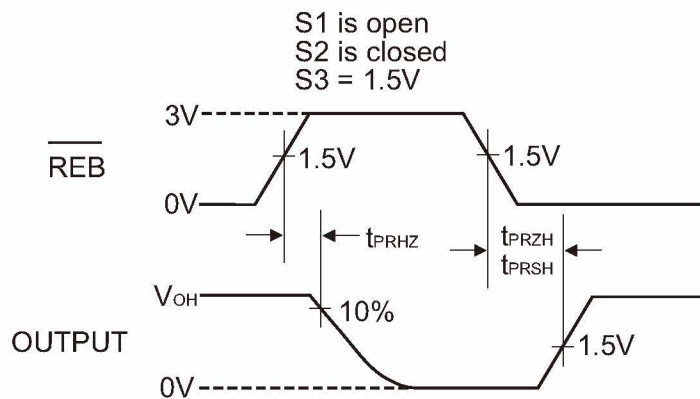S2 is open
S3 = -1.5V

Figure 13: Receiver Enable and Disable Waveforms

NOTES
1. The input pulse is supplied by a generator with the following characteristics:
   PRR = 250kHz, 50% duty cycle, t_R < 6.0ns, Z_O = 50Ω.
2. C_L includes probe and stray capacitance.

Detailed Description

The TK3491is in the family of 3.3V low power full-duplex transceivers that meet the electrical specifications of the RS-485 and RS-422 serial protocols. These devices are pin-to-pin compatible with the standard devices as well as popular industry standards. The TK3491 feature allowing low power operation without sacrificing performance.

The RS-485 standard is ideal for multi-drop applications and for long-distance interfaces. RS-485 allows up to 32 drivers and 32 receivers to be connected to a data bus, making it an ideal choice for multi-drop applications. Since the cabling can be as long as 4,000 feet, RS-485 transceivers are equipped with a wide (-7V to 12V) common mode range to accommodate ground potential differences. Because RS-485 is a differential interface, data is virtually immune to noise in the transmission line.

Drivers

The drivers for both the TK3490 and TK3491 have differential outputs. The typical voltage output swing with no load will be 0 volts to Vcc. With worst case loading of 54Ω across the differential outputs, the drivers can maintain greater than 1.5V voltage levels.

The driver of the TK3491 has a driver enable control line which is active HIGH. A logic HIGH on DE (pin 4) of the TK3491 will enable the differential driver outputs. A logic LOW on the DE (pin 4) will tri-state the driver outputs.

Receivers

The receivers of the TK3491 has differential inputs with an input sensitivity of ±200mV. Input impedance of the receivers is typically 15kΩ (12kΩ minimum). A wide common mode range of -7V to 12V allows for large ground potential differences between systems.

The receivers TK3491 is equipped with a fail-safe feature that guarantees the receiver output will be in a HIGH state when the input is left unconnected.
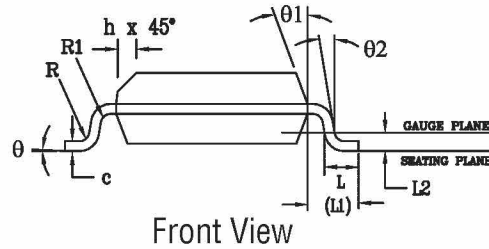The receiver of the TK3491 has a enable control line which is active LOW. A logic LOW on $\overline{REB}$ (pin 3) of the TK3491 will enable the differential receiver. A logic HIGH on $\overline{REB}$ (pin 3) of the TK3491 will tri-state the receiver.

PACKAGE OUTLINE SOIC - 14

Top View

INDEX AREA
(D/2 X E1/2)

1 2 3
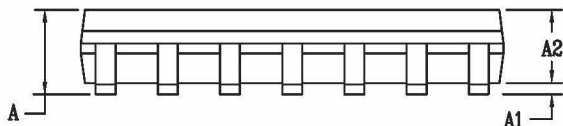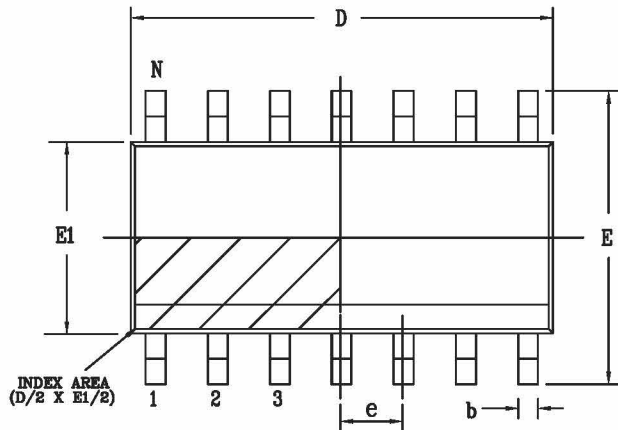
Side View

Front View

SYMBOLS	PACKAGE OUTLINE NSOIC .150" BODY JEDEC MS-012 VARIATION AB					
	COMMON DIMENSIONS IN MM (Control Unit)			COMMON DIMENSIONS IN INCH (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	—	1.75	0.053	—	0.069
A1	0.10	—	0.25	0.004	—	0.010
A2	1.25	—	1.65	0.049	—	0.065
b	0.31	—	0.51	0.012	—	0.020
c	0.17	—	0.25	0.007	—	0.010
E	6.00 BSC			0.236 BSC		
E1	3.90 BSC			0.154 BSC		
e	1.27 BSC			0.050 BSC		
h	0.25	—	0.50	0.010	—	0.020
L	0.40	—	1.27	0.016	—	0.050
L1	1.04 REF			0.041 REF		
L2	0.25 BSC			0.010 BSC		
R	0.07	—	—	0.003	—	—
R1	0.07	—	—	0.003	—	—
q	0°	—	8°	0°	—	8°
q1	5°	—	15°	5°	—	15°
q2	0°	—	—	0°	—	—
D	8.65 BSC			0.341 BSC		
N	14					