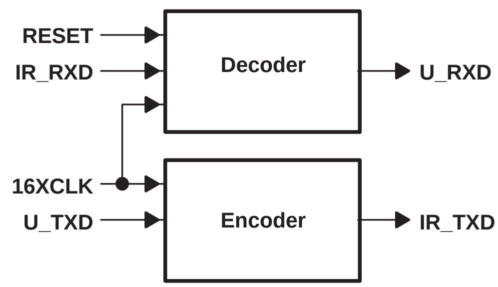
- Adds Infrared (IR) Port to Universal Asynchronous Receiver Transmitter (UART)
- Compatible with Infrared Data Association (IrDA™) & Hewlett Packard Serial Infrared (HPSIR)
- Provides 1200 bps to 115 kbps Data Rate
- Operates from 2.7 V to 5.5 V
- Provides Simple Interface With UART
- Decodes Negative or Positive Pulses
- Available in two 8-Pin Plastic Small Outline Packages (PSOP), PS Package Has Slightly Larger Dimensions Than PW Package

PS OR PW PACKAGE
(TOP VIEW)

functional block diagram



description

The TIR1000 serial infrared (SIR) encoder/decoder is a CMOS device which encodes and decodes bit data in conformance with the IrDA specification.

A transceiver device is needed to interface to the photo-sensitive diode (PIN) and the light emitting diode (LED). A UART is needed to interface to the serial data lines.

Terminal Functions

TERMINAL NAME	NO.	I/O	DESCRIPTION
16XCLK	1	I	Clock signal. 16XCLK should be set to 16 times the baud rate. The highest baud rate for IrDA is 115.2 kbps for which the clock frequency equals 1.843 MHz (this terminal is tied to the BAUDOUT of a UART).
GND	4		Ground
IR_RXD	6	I	Infrared receiver data. IR_RXD is an IrDA-SIR-modulated input from an optoelectronics transceiver whose input pulses should be 3/16 of the baud rate period.
IR_TXD	7	O	Infrared transmitter data. IR_TXD is an IrDA-SIR-modulated output to an optoelectronics transceiver.
RESET	5	I	Active high reset. RESET initializes an IrDA-SIR-decode/encode state machine (this terminal is tied to a UART reset line).
U_RXD	3	O	Receiver data. U_RXD is decoded (demodulated) data from IR_RXD according to the IrDA specification (this terminal is tied to SIN of a UART).
U_TXD	2	I	Transmitter data. U_TXD is encoded (modulated) data and output data as IR_TXD (this terminal is tied to SOUT from a UART).
V_{CC}	8		Supply voltage

IrDA is a registered trademark of the Infrared Data Association.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC} (see Note 1) . . . –0.5 V to 6 V
Input voltage range at any input, V_I . . . –0.5 V to V_{CC} + 0.5 V
Output voltage range, V_O . . . –0.5 V to V_{CC} + 0.5 V
Operating free-air temperature range, T_A . . . 0°C to 70°C
T_A . . . –40°C to 85°C
Storage temperature range, T_{stg} . . . –65°C to 150°C
Case temperature for 10 seconds: SOP package . . . 260°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: All voltage levels are with respect to GND.

recommended operating conditions over recommended operating free-air temperature range

low voltage (3 V nominal)

	MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}	2.7	3	3.3	V
High-level input voltage, V_{IH}	0.7 V_{CC}			V
Low-level input voltage, V_{IL}			0.2 V_{CC}	V
Operating free-air temperature, T_A	0		70	°C

standard voltage (5 V nominal)

	MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}	4.5	5	5.5	V
High-level input voltage, V_{IH}	0.7 V_{CC}			V
Low-level input voltage, V_{IL}			0.2 V_{CC}	V
Operating free-air temperature, T_A	0		70	°C

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{OH}	High-level output voltage	I_{OH} = –4 mA	V_{CC} = 5 V	V_{CC} – 0.8			V
		I_{OH} = –1.8 mA	V_{CC} = 3 V	V_{CC} – 0.55			
V_{OL}	Low-level output voltage	I_{OL} = +4 mA	V_{CC} = 5 V			0.5	V
		I_{OL} = +1.8 mA	V_{CC} = 3 V			0.5	
I_I	Input current	V_I = 0 to V_{CC},	All other pins floating			±3	µA
I_{CC}	Supply current	V_{CC} = 5.25 V, All inputs at 0.2 V, No load on outputs	T_A = 25°C, 16XCLK at 2 MHz,			1	mA
$C_{i(16XCLK)}$	Clock input capacitance				5		pF
$f_{(16XCLK)}$	Clock frequency					2	MHz

switching characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
t_r	Output rise time	$C_{(LOAD)}$ = 15 pF (10% to 90%)		1.3		ns
t_f	Output fall time	$C_{(LOAD)}$ = 15 pF (90% to 10%)		1.8		ns

† Typical values are at T_A = 25°C.

APPLICATION INFORMATION

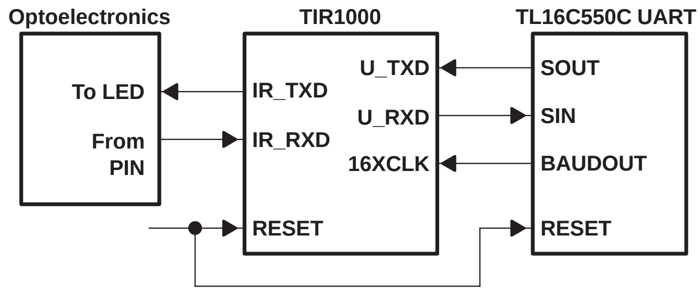


Figure 1. Typical application of the TIR1000

PRINCIPLES OF OPERATION

IrDA overview

The Infrared Data Association (IrDA) defines several protocols for sending and receiving serial infrared data, including rates of 115.2 kbps, 0.576 Mbps, 1.152 Mbps, and 4 Mbps. The low rate of 115.2 kbps was specified first and the others must maintain downward compatibility with it. At the 115.2 kbps rate, the protocol implemented in the hardware is fairly simple. It primarily defines a serial infrared data “word” to be surrounded by a start bit equal to 0 and a stop bit equal to 1. Individual bits are encoded or decoded the same whether they are start, data, or stop bits. The TIR1000 evaluates only single bits and only follows the 115.2 kbps protocol. The 115.2 kbps rate is a maximum rate. When both ends of the transfer are set up to a lower but matching speed, the protocol (with the TIR1000) still works. The clock used to code or sample the data is 16 times the baud rate, or 1.843 Mhz maximum. To code a 1, no pulse is sent or received for 1-bit time period, or 16 clock cycles. To code a 0, one pulse is sent or received within a 1-bit time period, or 16 clock cycles. The pulse must be at least 1.6 µs wide and 3 clock cycles long at 1.843 Mhz. At lower baud rates the pulse can be 1.6 µs wide or as long as 3 clock cycles. The transmitter output, IR_TXD, is intended to drive a LED circuit to generate an infrared pulse. The LED circuits work on positive pulses. A PIN circuit is expected to create the receiver input, IR_RXD. Most, but not all, PIN circuits have inversion and generate negative pulses from the detected infrared light. Their output is normally high. The TIR1000 can decode either negative or positive pulses on IR_RXD.

PRINCIPLES OF OPERATION

IrDA encoder function

Serial data from a UART is encoded to transmit data to the optoelectronics. While the serial data input to this block (U_TXD) is high, the output (IR_TXD) is always low, and the counter used to form a pulse on IR_TXD is continuously cleared. After U_TXD resets to 0, IR_TXD rises on the falling edge of the seventh 16XCLK. On the falling edge of the tenth 16XCLK pulse, IR_TXD falls, creating a 3-clock-wide pulse. While U_TXD stays low, a pulse is transmitted during the seventh to tenth clocks of each 16-clock bit cycle.

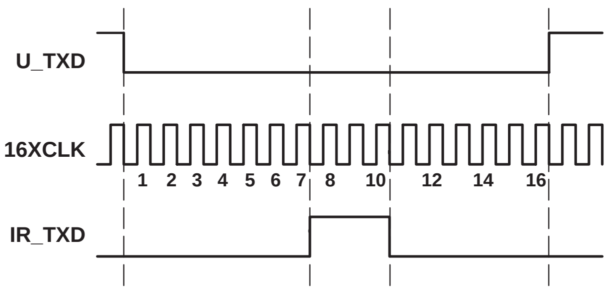


Figure 2. IrDA-SIR Encoding Scheme – Detailed Timing Diagram

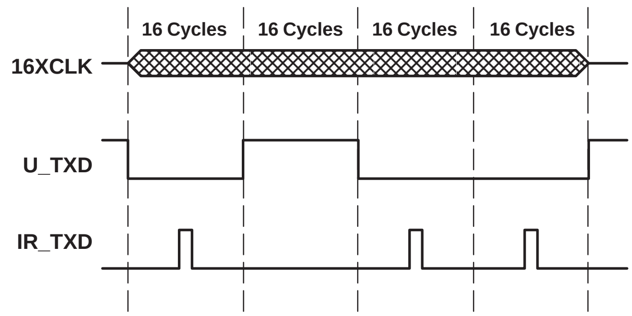


Figure 3. Encoding Scheme – Macro View

IrDA decoder function

After reset, U_RXD is high and the 4-bit counter is cleared. When a falling edge is detected on IR_RXD, U_RXD falls on the next rising edge of 16XCLK with sufficient setup time. U_RXD stays low for 16 cycles (16XCLK) and then returns to high as required by the IrDA specification. As long as no pulses (falling edges) are detected on IR_RXD, U_RXD remains high.

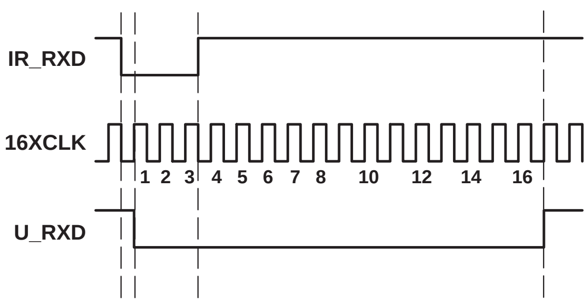


Figure 4. IrDA-SIR Decoding Scheme – Detailed Timing Diagram

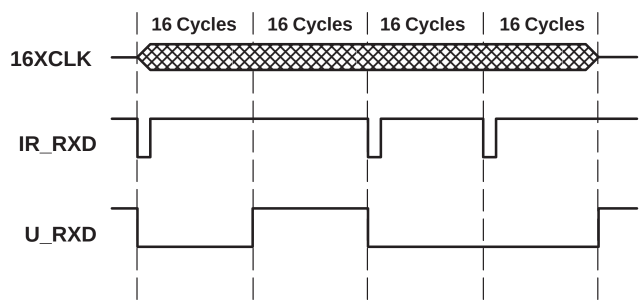


Figure 5. Decoding Scheme – Macro View

PRINCIPLES OF OPERATION

IrDA encoder function (continued)

It is possible for jitter or slight frequency differences to cause the next falling edge on IR_RXD to be missed for one 16XCLK cycle. In that case, a 1-clock-wide pulse appears on U_RXD between consecutive zeroes. It is important for the UART to strobe U_RXD in the middle of the bit time to avoid latching this 1-clock-wide pulse. The TL16C550C UART already strobes incoming serial data at the proper time. Otherwise, note that data is required to be framed by a leading zero and a trailing one. The falling edge of that first zero on U_RXD synchronizes the read strobe. The strobe occurs on the eighth 16XCLK pulse after the U_RXD falling edge and once every 16 cycles thereafter until the stop bit occurs.

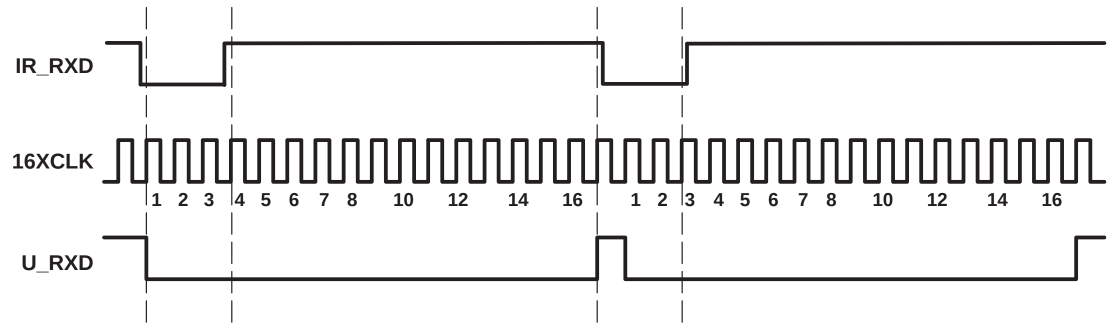


Figure 6. Timing Causing 1-clock-wide Pulse Between Consecutive Ones

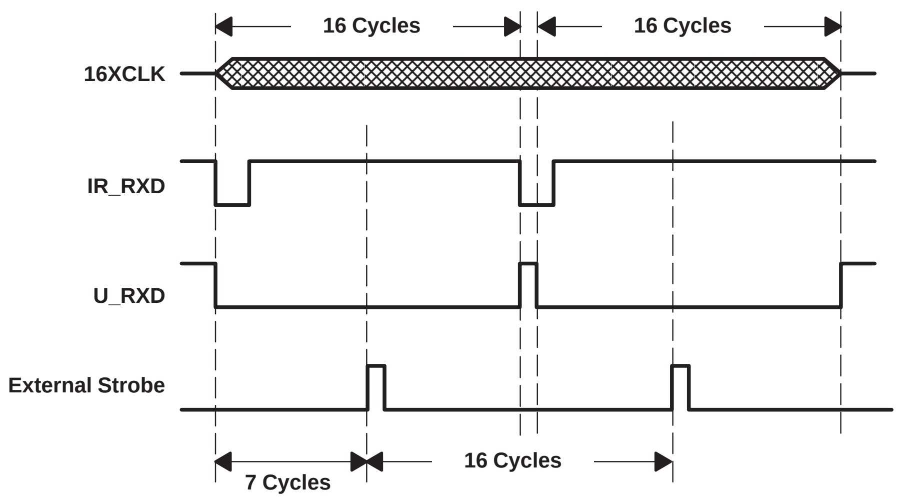


Figure 7. Recommended Strobing For Decoded Data

PRINCIPLES OF OPERATION

IrDA encoder function (continued)

The TIR1000 can also decode positive pulses on IR_RXD. The timing is different, but the variation is invisible to the UART. The decoder, which works from the falling edge, now recognizes a zero on the trailing edge of the pulse rather than on the leading edge. As long as the pulse width is fairly constant, as defined by the specification, the trailing edges should also be 16 clock cycles apart and data can readily be decoded. The zero appears on U_RXD after the pulse rather than at the start of it.

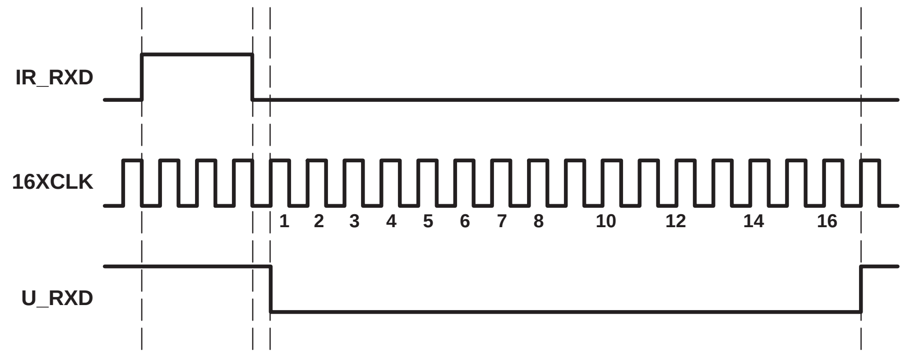


Figure 8. Positive IR_RXD Pulse Decode – Detailed View

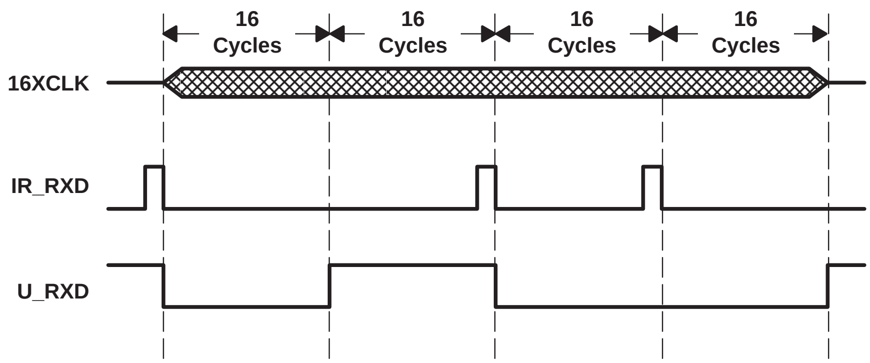
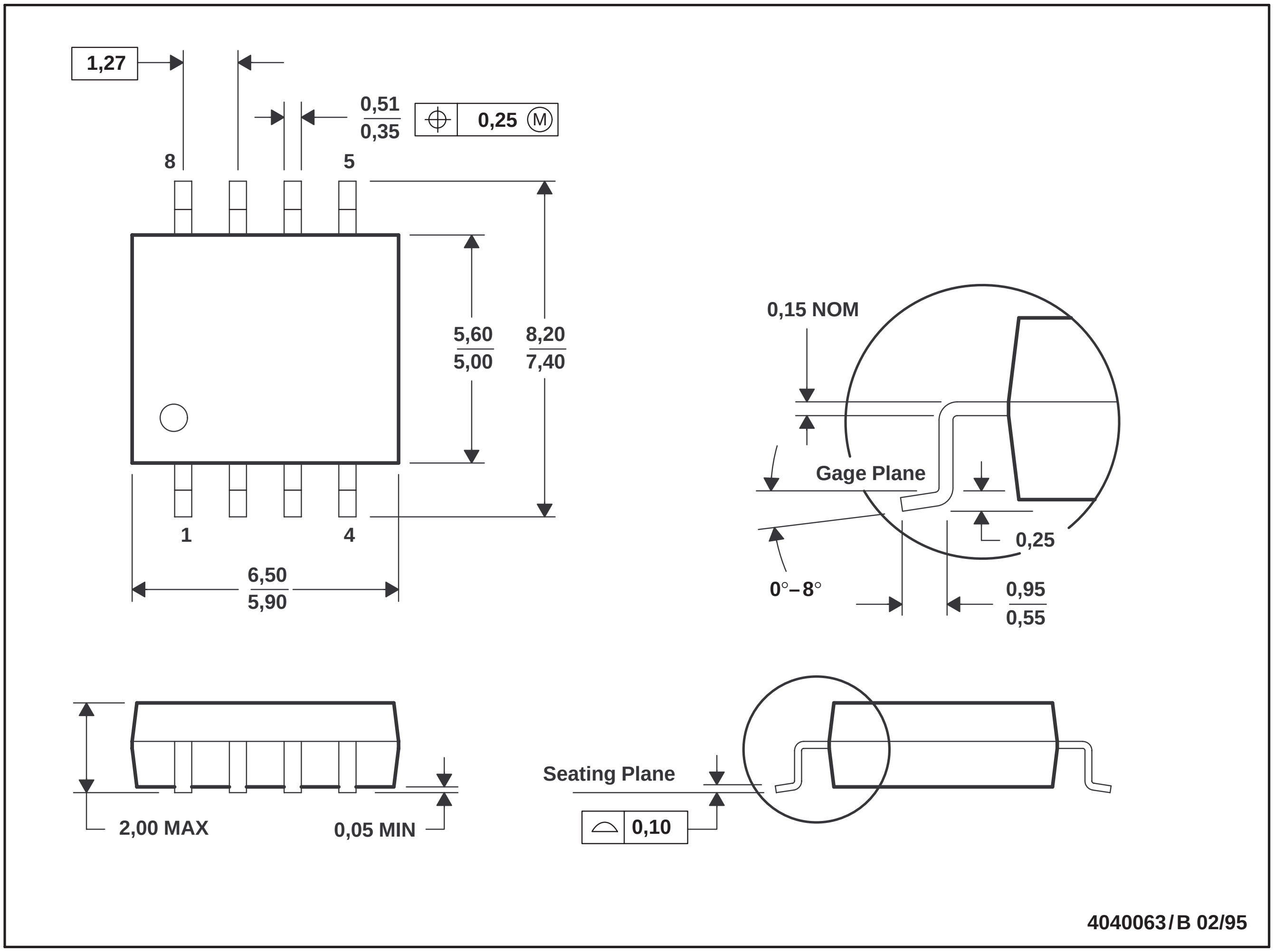


Figure 9. Positive IR_RXD Pulse Decode – Macro View

MECHANICAL DATA

PS (R-PDSO-G8) **PLASTIC SMALL-OUTLINE PACKAGE**

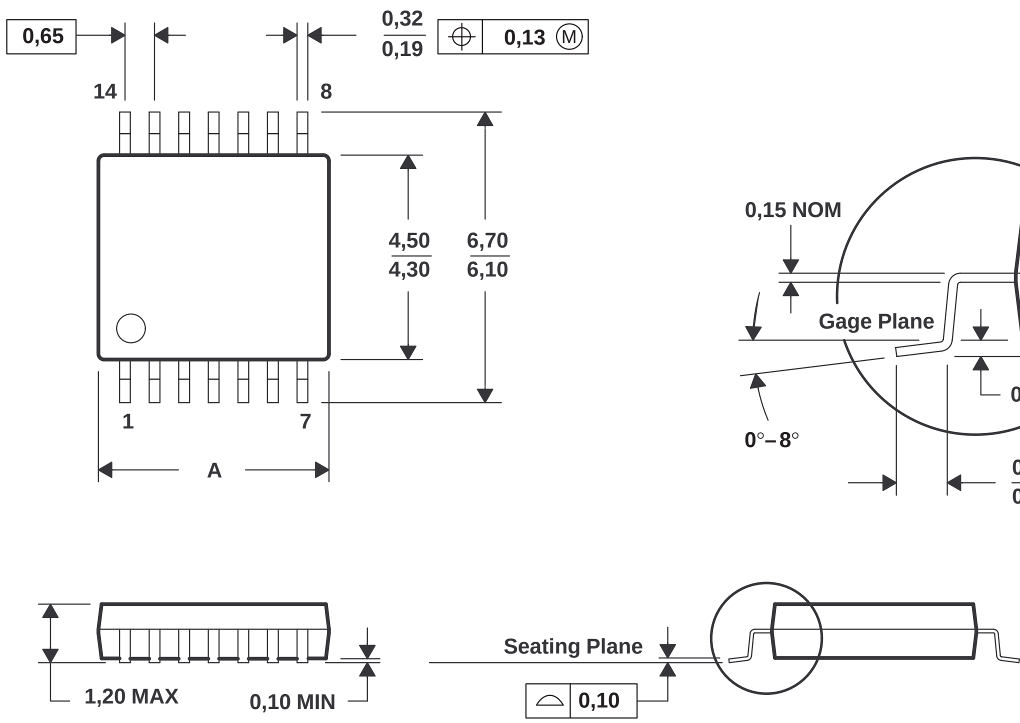


NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

MECHANICAL DATA

PW (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PIN SHOWN



PINS ** / DIM	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

4040064 / D 10/95

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

IMPORTANT NOTICE