Military Standard Products

UT63M14x MIL-STD-1553A/B Bus Transceiver

Preliminary Data Sheet

UNITED TECHNOLOGIES MICROELECTRONICS CENTER

May 1993

FEATURES

- ☐ 5-volt only operation
- ☐ Completely monolithic bipolar technology
- ☐ Fit and functionally compatible to industry standard transceiver
- ☐ Idle low and idle high encoding versions
- ☐ Dual-channel .050-center small outline package
- ☐ Full military operating temperature range, -55°C to +125°C, screened to the specific test methods listed in Table I MIL-STD-883, Method 5004, Class B

INTRODUCTION

The monolithic UT63M14x Transceivers are complete transmitter and receiver pairs for MIL-STD-1553A and 1553B applications. Encoder and decoder interfaces are either idle low or idle high.

The receiver section of the UT63M1x series accepts biphase-modulated Manchester II bipolar data from a MIL-STD-1553 data bus and produces TTL-level signal data at its RXOUT and $\overline{\text{RXOUT}}$ outputs. An external RXEN input enables or disables the receiver outputs.

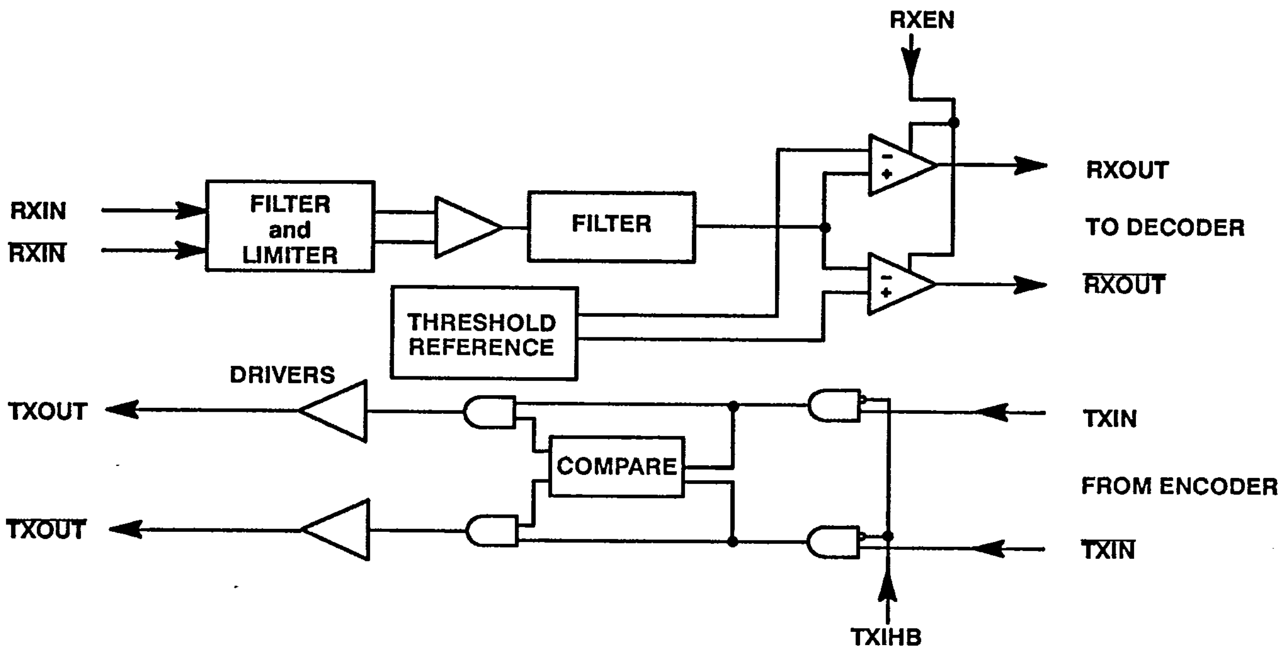


Figure 1. Functional Block Diagram

The transmitter section accepts biphase TTL-level signal data at its TXIN and $\overline{\text{TXIN}}$ and produces MIL-STD-1553 data signals. The transmitter's output voltage is typically 12 $V_{PP, L-L}$. Activating the TXIHB input or setting both data inputs to the same logic level disables the transmitter.

The UT63M14x series offers complete transmitter and receiver pairs packaged in a dual-channel 36-pin DIP or 24-lead flatpack configurations designed for use in any MIL-STD-1553 application.

Legend for TYPE field:

TI = TTL input
TO = TTL output
DO = Differential output
DI = Differential input
DIO = Differential input/output
( ) = Channel designator
[ ] = 24-lead flatpack

TRANSMITTER

NAME	PIN NUMBER	TYPE	DESCRIPTION
TXOUT [1] (A)	1 [1]	DO [DIO]	Transmitter outputs: TXOUT and $\overline{\text{TXOUT}}$ are differential data signals.
TXOUT (B)	10 [7]	DO [DIO]	
$\overline{\text{TXOUT}}$ [1] (A)	2 [2]	DO [DIO]	$\overline{\text{TXOUT}}$ is the half-cycle complement of TXOUT.
$\overline{\text{TXOUT}}$ (B)	11 [8]	DO [DIO]	
TXIHB (A)	34 [22]	TI	Transmitter inhibit: This is an active high input signal.
TXIHB (B)	25 [16]	TI	
TXIN (A)	35 [23]	TI	Transmitter input: TXIN and $\overline{\text{TXIN}}$ are complementary TTL-level Manchester II encoder inputs.
TXIN (B)	26 [17]	TI	
$\overline{\text{TXIN}}$ (A)	36 [24]	TI	$\overline{\text{TXIN}}$ is the complement of TXIN input.
$\overline{\text{TXIN}}$ (B)	27 [18]	TI	

Note:
1. The 24-lead flatpack internally connects TXOUT to RXIN (CHA, CHB) and $\overline{\text{TXOUT}}$ to $\overline{\text{RXIN}}$ ($\overline{\text{CHA}}$, $\overline{\text{CHB}}$) for each channel.

RECEIVER

NAME	PIN NUMBER	TYPE	DESCRIPTION
RXOUT (A)	5 [4]	TO	Receiver outputs: RXOUT and $\overline{\text{RXOUT}}$ are complementary Manchester II decoder outputs.
RXOUT (B)	14 [10]	TO	
$\overline{\text{RXOUT}}$ (A)	8 [6]	TO	$\overline{\text{RXOUT}}$ is the complement of RXOUT output.
$\overline{\text{RXOUT}}$ (B)	17 [12]	TO	
RXEN (A)	6 [5]	TI	Receiver enable/disable: This is an active high input signal.
RXEN (B)	15 [11]	TI	
RXIN [1] (A)	29 [1]	DI [DIO]	Receiver input: RXIN and $\overline{\text{RXIN}}$ are biphase-modulated Manchester II bipolar inputs from MIL-STD-1553 data bus.
RXIN (B)	20 [7]	DI [DIO]	
$\overline{\text{RXIN}}$ [1] (A)	30 [2]	DI [DIO]	$\overline{\text{RXIN}}$ is the half-cycle complement of RXIN input.
$\overline{\text{RXIN}}$ (B)	21 [8]	DI [DIO]	

Note:
1. The 24-lead flatpack internally connects TXOUT to RXIN (CHA, CHB) and $\overline{\text{TXOUT}}$ to $\overline{\text{RXIN}}$ ($\overline{\text{CHA}}$, $\overline{\text{CHB}}$) for each channel.

POWER AND GROUND

NAME	PIN NUMBER	TYPE	DESCRIPTION
V_{CC} (A)	33 [20]	PWR	+5 V_{DC} power (±5%)
V_{CC} (B)	24 [14]	PWR	
GND (A)	3, 7, 31 [3,9,21]	GND	Ground reference
GND (B)	12, 16, 22 [9,13,15]	GND	

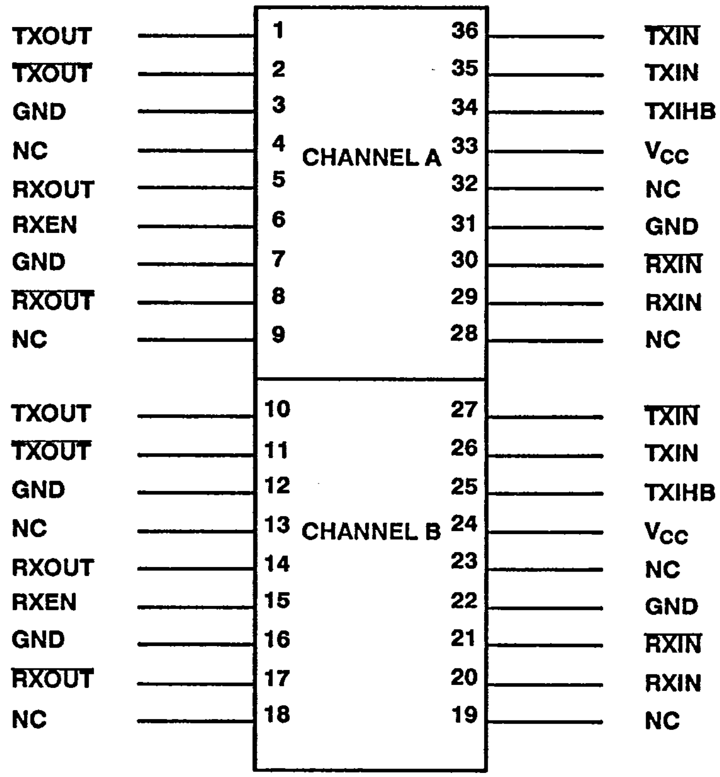


Figure 2a. Functional Pin Diagram -- Dual Channel (36)

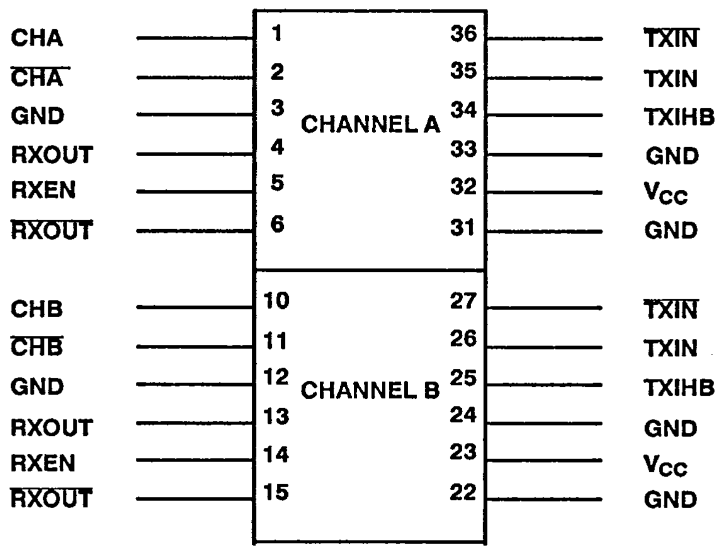


Figure 2b. Functional Pin Diagram -- Dual Channel (24) [1]

Note:
1. The 24-lead flatpack internally connects TXOUT to RXIN (CHA, CHB) and TXOUT to RXIN (CHA, CHB) for each channel.

TRANSMITTER

The transmitter section accepts Manchester II biphase TTL data and converts this data into differential phase-modulated current drive. Transmitter current drivers are coupled to a MIL-STD-1553 data bus via a transformer driven from the TXOUT and $\overline{\text{TXOUT}}$ terminals. Transmitter output terminals' non-transmitting state is enabled by asserting TXIHB (logic "1"), or by placing both TXIN and $\overline{\text{TXIN}}$ at the same logic level. Table 1, Transmit Operating Mode, lists the functions for the output data in reference to the state of TXIHB. Figure 3 shows typical transmitter waveforms.

RECEIVER

The receiver section accepts biphase differential data from a MIL-STD-1553 data bus at its RXIN and $\overline{\text{RXIN}}$ inputs. The receiver converts input data to biphase Manchester II TTL format and is available for decoding at the RXOUT and $\overline{\text{RXOUT}}$ terminals. The outputs RXOUT and $\overline{\text{RXOUT}}$ represent positive and negative excursions (respectively) of the inputs RXIN and $\overline{\text{RXIN}}$. Figure 4 shows typical receiver output waveforms.

Depending on the transceiver version selected, the outputs RXOUT and $\overline{\text{RXOUT}}$ will idle in either the logic "0"or "1" state. The following flexibility in idle states allows compatibility to either the "Harris" or "Smith"-type encoder/decoder. Model UT63M147 idles in the "0" state when disabled or receiving no signal. Model UT63M149 idles in the "1" state when they are disabled or receiving no signal.

Table 1. Transmit Operating Mode

TXIN	$\overline{\text{TXIN}}$	TXIHB	TXOUT
x[1]	x	1	Off[2]
0	0	x	Off[3]
0	1	0	On
1	0	0	On
1	1	x	Off[3]

Notes:
1. x = Don't care.
2. Transmitter output terminals are in the non-transmitting mode during Off-time.
3. Transmitter output terminals are in the non-transmitting mode during Off-time, independent of TXIHB status.

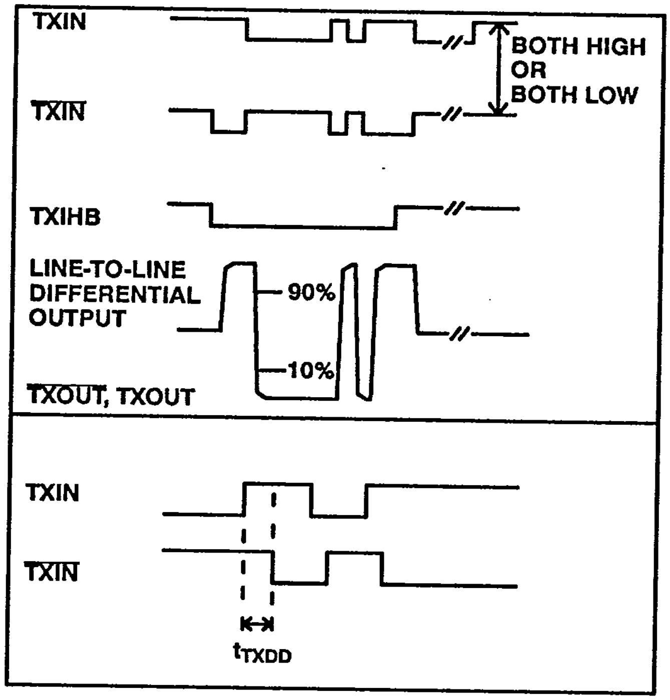


Figure 3. Typical Transmitter Waveforms

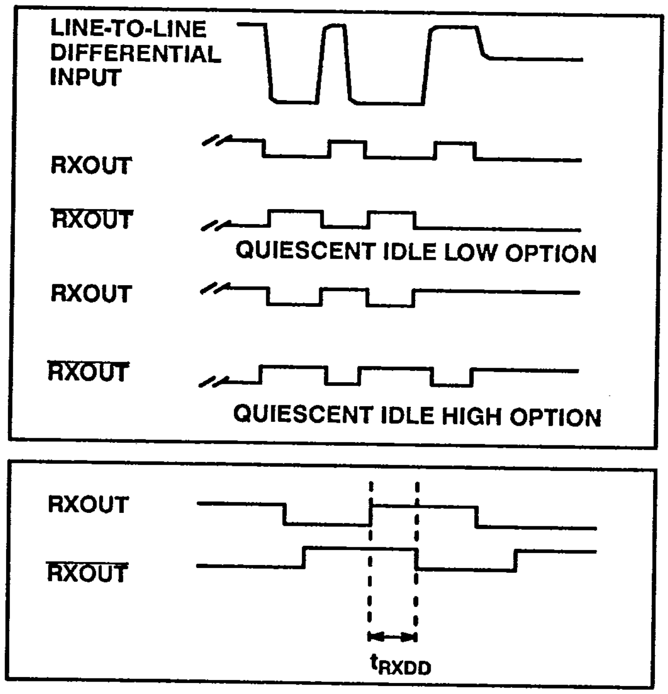


Figure 4. Typical Receiver Waveforms

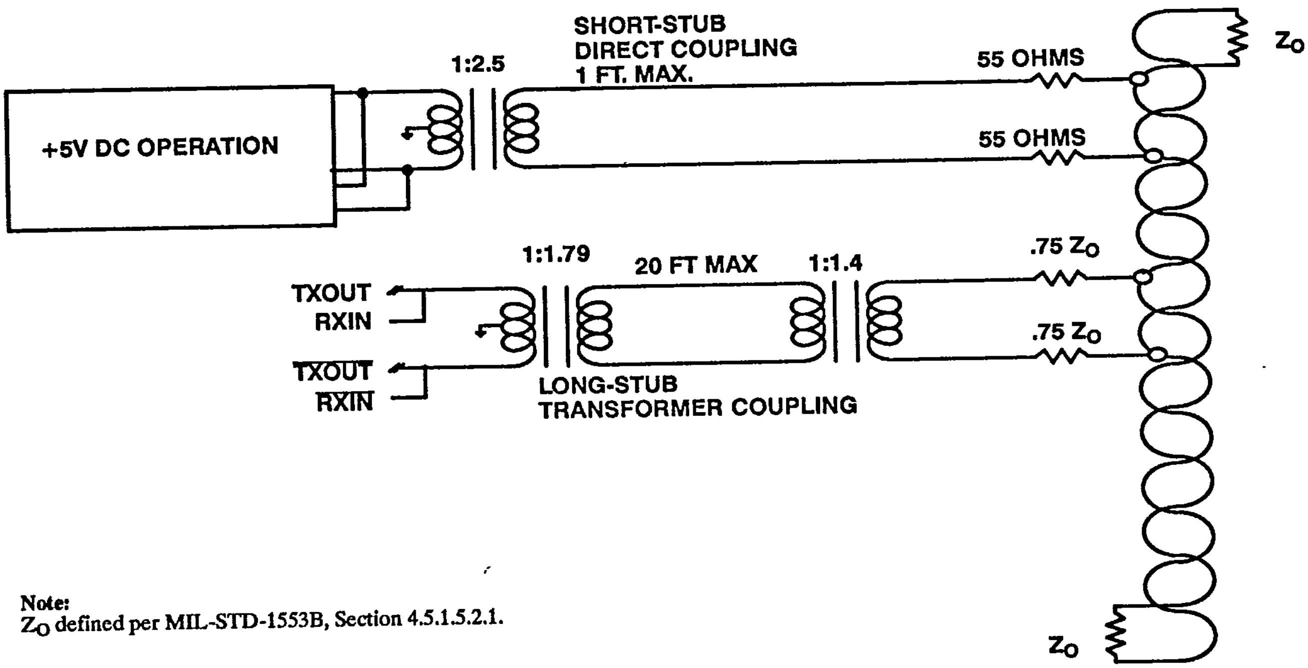
DATA BUS INTERFACE [1]

The designer can connect the UT63M14x to the data bus via a short-stub (direct-coupling) connection or a long-stub (transformer-coupling) connection. Use a short-stub connection when the distance from the isolation transformer to the data bus does not exceed a one-foot maximum. Use a long-stub connection when the distance from the isolation transformer exceeds the one-foot maximum and is less than twenty-five feet. Figure 5 shows various examples of bus coupling configurations. The UT63M14x series transceivers are designed to function with MIL-STD-1553A and 1553B compatible transformers.

Note:
1. The 24-lead flatpack internally connects TXOUT to RXIN and $\overline{\text{TXOUT}}$ to $\overline{\text{RXIN}}$ for each channel.

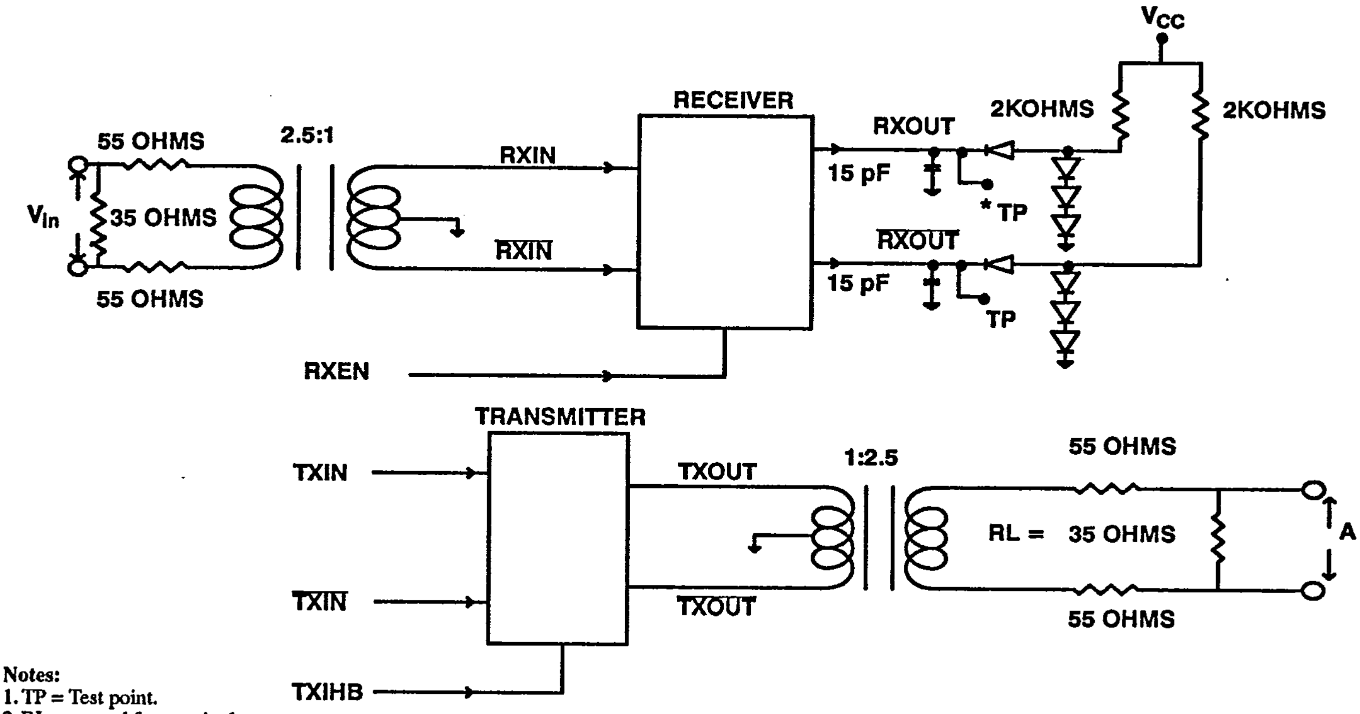
RECOMMENDED THERMAL PROTECTION

All packages should mount to or contact a heat removal rail located in the printed circuit board. To insure proper heat transfer between the package and the heat removal rail, use a thermally-conductive material between the package and the heat removal rail. Use a material such as Mereco XLN-589 or equivalent to insure heat transfer between the package and heat removal rail.



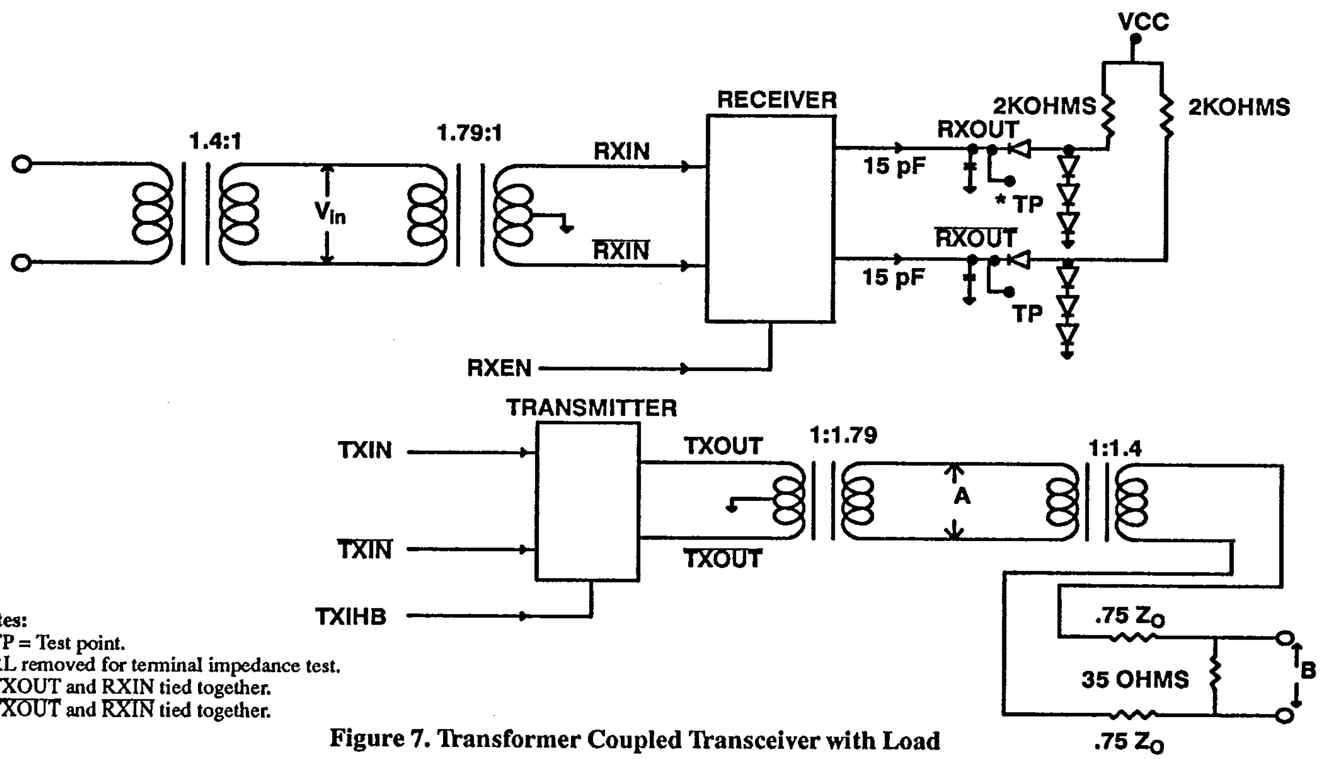
Note:
Z_O defined per MIL-STD-1553B, Section 4.5.1.5.2.1.

Figure 5. Bus Coupling Configuration



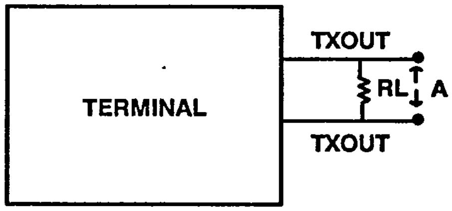
Notes:
1. TP = Test point.
2. RL removed for terminal input impedance test.
3. TXOUT and RXIN tied together. $\overline{\text{TXOUT}}$ and $\overline{\text{RXIN}}$ tied together.

Figure 6. Direct Coupled Transceiver with Load



Notes:
1. TP = Test point.
2. RL removed for terminal impedance test.
3. TXOUT and RXIN tied together. $\overline{\text{TXOUT}}$ and $\overline{\text{RXIN}}$ tied together.

Figure 7. Transformer Coupled Transceiver with Load



Notes:
1. Transformer Coupled Stub:
   Terminal is defined as transceiver plus isolation transformer. Point A is defined in figure 7.
2. Direct Coupled Stub:
   Terminal is defined as transceiver plus isolation transformer and fault resistors. Point A is defined in figure 6.

Figure 8. Transceiver Test Circuit MIL-STD-1553B

ABSOLUTE MAXIMUM RATINGS [1]

PARAMETER	LIMITS	UNIT
V_{CC}	-0.3 to +7.0	V
Input voltage range (receiver)	10	$V_{PP, L-L}$
Logic input voltage range	-0.3 to +5.5	V
Output current (transmitter)	1.0	A
Power dissipation (per channel) [3]	.250	W
Power dissipation 100% duty cycle (per channel)	2.21	W
Thermal impedance junction to case	4.0[2]	°C/W
Operating temperature junction	-55 to +135	°C
Operating temperature case	-55 to +125	°C
Storage temperature	-65 to +150	°C
Receiver common mode input voltage range	-5 to +5	V

Notes:
1. Stress outside the listed absolute maximum rating may cause permanent damage to the devices. This is a stress rating only, and functional operation of the device at these or any other conditions beyond limits indicated in the operational sections of this specification is not recommended. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
2. Mounting per MIL-STD-883, Method 1012.
3. $V_{CC} = 5.0V$, $T_C = 25°C$.

RECOMMENDED OPERATING CONDITIONS

PARAMETER	LIMITS	UNIT
Supply voltage range	4.75 to +5.25	V
Logic input voltage range	0 to +5.0	V
Receiver differential voltage	8.0	V_{P-P}
Receiver common mode voltage range	±4.0	V
Driver peak output current	700	mA
Serial data rate	0 to 1	MHz
Case operating termperature range (T_C)	-55 to +125	°C

DC ELECTRICAL CHARACTERISTICS [1]

$V_{CC} = 5.0V \pm 5\%$
$-55°C < T_C < +125°C$

SYMBOL	PARAMETER	MINIMUM	MAXIMUM	UNIT	CONDITION
V_{IL}	Input low voltage		0.7	V	RXEN, TXIHB, TXIN, $\overline{TXIN}$
V_{IH}	Input high voltage	2.0		V	RXEN, TXIHB, TXIN, $\overline{TXIN}$
I_{IL}	Input low current	-1.1		mA	$V_{IL} = 0.4V$; RXEN, TXIHB, TXIN, $\overline{TXIN}$
I_{IH}	Input high current		40	µA	$V_{IH} = 2.7V$; RXEN, TXIHB, TXIN, $\overline{TXIN}$
V_{OL}	Output low voltage		.65	V	$I_{OL} = 10mA$; RXOUT, $\overline{RXOUT}$
V_{OH}	Output high voltage	2.5		V	$I_{OH} = 0.4mA$; RXOUT, $\overline{RXOUT}$
I_{IIH}	Transmitter inhibit input high current		100	µA	$V_{IH} = 2.7V$; TXIHB
I_{CC}	V_{CC} supply current		55 300 500 800 800	mA mA mA mA mA	0% duty cycle (non-transmitting) 25% duty cycle (f = 1MHz) 50% duty cycle (f = 1MHz) 80% duty cycle (f = 1MHz) 100% duty cycle (f = 500KHz)

Note:
1. All tests guaranteed per test figure 6.

RECEIVER ELECTRICAL CHARACTERISTICS [1]

V_{CC} = 5.0V ±5%
-55°C < T_C < +125°C

SYMBOL	PARAMETER	MINIMUM	MAXIMUM	UNIT	CONDITION
C_{IN} [2]	Input capacitance		10	pF	RXEN; input f = 1MHz @ 0V
C_{OUT} [2]	Output capacitance		15	pF	RXOUT, $\overline{RXOUT}$; f = 1MHz @ 0V
V_{IC} [2]	Common mode input voltage	-5	5	V	Direct-coupled stub; input 1.2 V_{PP} 200ns rise/fall time ±25ns, f = 1MHz
V_{TH} [2]	Input threshold voltage (no response)		0.20	$V_{PP,L-L}$	Transformer-coupled stub; input at f = 1MHz, rise/fall time 200ns at (Receiver output 0 → 1 transition)
	Input threshold voltage (no response)		0.28	$V_{PP,L-L}$	Direct-coupled stub; input at f = 1MHz, rise/fall time 200ns at (Receiver output 0 → 1 transition)
	Input threshold voltage (response)	0.86	14.0	$V_{PP,L-L}$	Transformer-coupled stub; input at f = 1MHz, rise/fall time 200ns at (Receiver output 0 → 1 transition)
	Input threshold voltage (response)	1.20	20.0	$V_{PP,L-L}$	Direct-coupled stub; input at f = 1MHz, rise/fall time 200ns at (Receiver output 0 → 1 transition)
CMRR [2]	Common mode rejection ratio	Pass/Fail [3]		N/A	
V_{IDR}	Differential input voltage level	--	8.0	V_{P-P}	

Notes:
1. All tests guaranteed per test figure 6.
2. Guaranteed by device characterization.
3. Pass/fail criteria per the test method described in MIL-HDBK-1553 Appendix A, RT Validation Test Plan, Section 5.1.2.2, Common Mode Rejection.

TRANSMITTER ELECTRICAL CHARACTERISTICS [1]

V_{CC} = 5.0V ±5%
-55°C < T_C < +125°C

SYMBOL	PARAMETER	MINIMUM	MAXIMUM	UNIT	CONDITION
V_O	Output voltage swing per MIL-STD-1553B [2] (see figure 9)	18	27	$V_{PP,L-L}$	Transformer-coupled stub, Figure 8, Point A; input *f* = 1MHz, RL = 70 ohms
	per MIL-STD-1553B (see figure 9)	5.8	9	$V_{PP,L-L}$	Direct-coupled stub, Figure 8, Point A; input *f* = 1MHz, RL = 35 ohms
	per MIL-STD-1553A [2] (see figure 9)	5.8	20	$V_{PP,L-L}$	Figure 7, Point A; input *f* = 1MHz, RL = 35 ohms
V_{NS} [2]	Output noise voltage differential (see figure 9)		14	mV-RMS L-L	Transformer-coupled stub, Figure 8, Point A; input *f* = DC to 10MHz, RL = 70 ohms
			10	mV-RMS L-L	Direct-coupled stub, Figure 8, Point A; input *f* = DC to 10MHz, RL = 35 ohms
V_{OS} [2]	Output symmetry (see figure 9)	-360	+360	$mV_{PP,L-L}$	Transformer-coupled stub, Figure 8, Point A; RL = 140 ohms, measurement taken 2.5μs after end of transmission
		-90	+90	$mV_{PP,L-L}$	Direct-coupled stub, Figure 8, Point A; RL = 35 ohms, measurement taken 2.5μs after end of transmission
V_{DIS}	Output voltage distortion (overshoot or ring) (see figure 9)	-2.0	+2.0 [2]	$V_{peak,L-L}$	Transformer-coupled stub, Figure 8, Point A; RL = 70 ohms
		-1.0	+1.0	$V_{peak,L-L}$	Direct-coupled stub, Figure 8, Point A; RL = 35 ohms
C_{IN} [2]	Input capacitance		10	pF	TXIHB, TXIN, $\overline{TXIN}$; input *f* = 1MHz @ 0V
T_{IZ} [2]	Terminal input impedance	1		Kohm	Transformer-coupled stub, Figure 7, Point A; input *f* = 75KHz to 1MHZ (power on or power off; non-transmitting, RL removed from circuit).
		2		Kohm	Direct-coupled stub, Figure 6, Point A; input *f* = 75KHz to 1MHZ (power on or power off; non-transmitting, RL removed from circuit).
T_{OZ}	Differential output impedance	10		Kohm	Input *f* = 1 MHz (no transformer in circuit)

Notes:
1. All tests guaranteed per test figure 6.
2. Guaranteed by device characterization.

AC ELECTRICAL CHARACTERISTICS [1]

V_{CC} = 5.0V ±5%
-55°C < T_C < +125°C

SYMBOL	PARAMETER	MINIMUM	MAXIMUM	UNIT	CONDITION
t_R, t_F	Transmitter output rise/ fall time (see figure 10)	100	300	ns	Input f = 1MHz 50% duty cycle: direct-coupled RL = 35 ohms output at 10% through 90% points TXOUT, $\overline{TXOUT}$. Figure 10.
t_{RXDD}	RXOUT delay	-200	200	ns	RXOUT to $\overline{RXOUT}$, Figure 4.
t_{TXDD} [3]	TXIN skew	-25	25	ns	TXIN to $\overline{TXIN}$, Figure 3.
t_{RZCD}	Zero crossing distortion (see figure 11)	-150	150	ns	Direct-coupled stub; input f = 1MHz, 3 V_{PP} (skew INPUT ±150ns), rise/fall time 200ns.
t_{TZCS}	Zero crossing stability (see figure 11)	-25	25	ns	Input TXIN and $\overline{TXIN}$ should create Transmitter output zero crossings at 500ns, 1000ns, 1500ns, and 2000ns. These zero crossings should not deviate more than ±25ns.
t_{RDXOFF} [3,4]	Transmitter off; delay from inhibit active		450	ns	TXIN and $\overline{TXIN}$ toggling @ 1MHz; TXIHB transitions from logic zero to one.
t_{DXON} [3,5]	Transmitter on; delay from inhibit inactive		250	ns	TXIN and $\overline{TXIN}$ toggling @ 1MHz; TXIHB transitions from logic one to zero.
t_{RCVOFF}	Receiver off		200	ns	Receiver turn off time.
t_{RCVON}	Receiver on		200	ns	Receiver turn on time.
t_{RCVPD}	Receiver propagation		600	ns	Receiver propagation delay.
t_{XMITPD}	Transmitter propagation		450	ns	Transmitter propagation delay.

Notes:
1. All tests guaranteed per test figure 6.
2. Guaranteed by device characterization.
3. Supplied as a design limit but not guaranteed or tested.
4. Delay time from transmit inhibit (1.5V) to transmit off (280mV).
5. Delay time from not transmit inhibit (1.5V) to transmit off (1.2V).

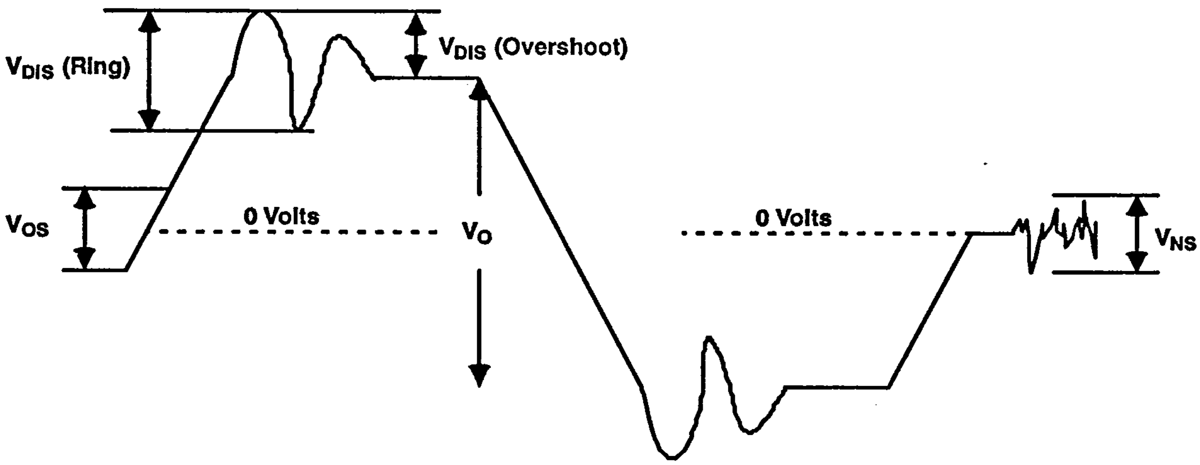


Figure 9. Transmitter Output Characteristics (V_{DIS}, V_{OS}, V_{NS}, V_O)

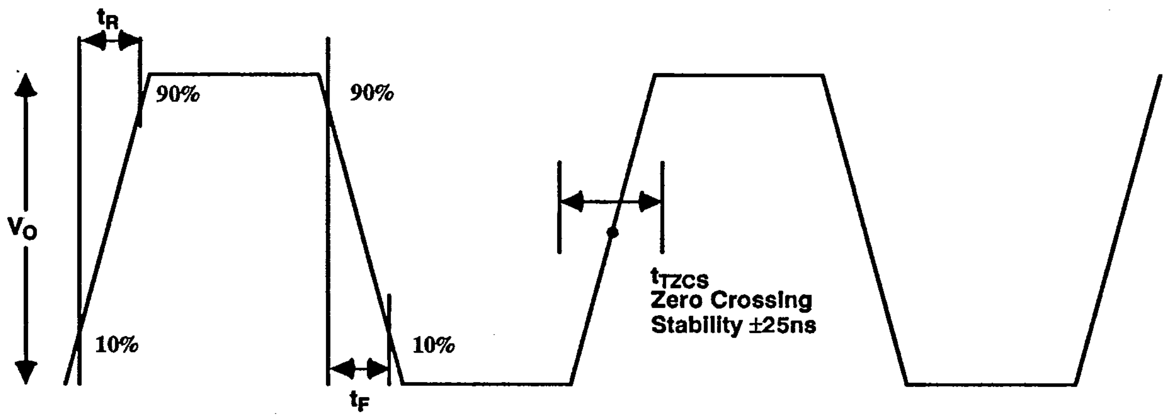


Figure 10. Transmitter Output Zero Crossing Stability (t_{TZCS}, t_R, t_F)

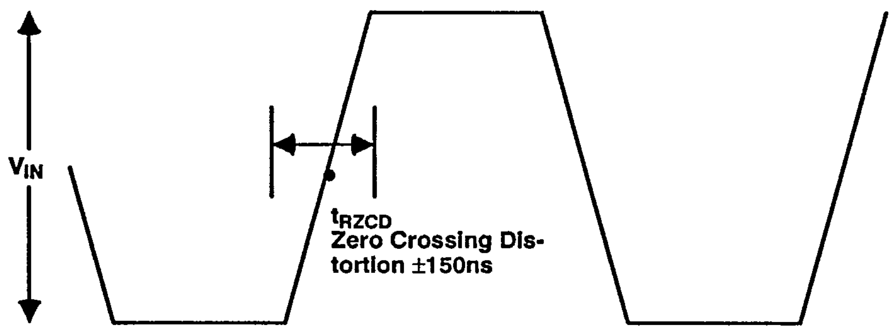
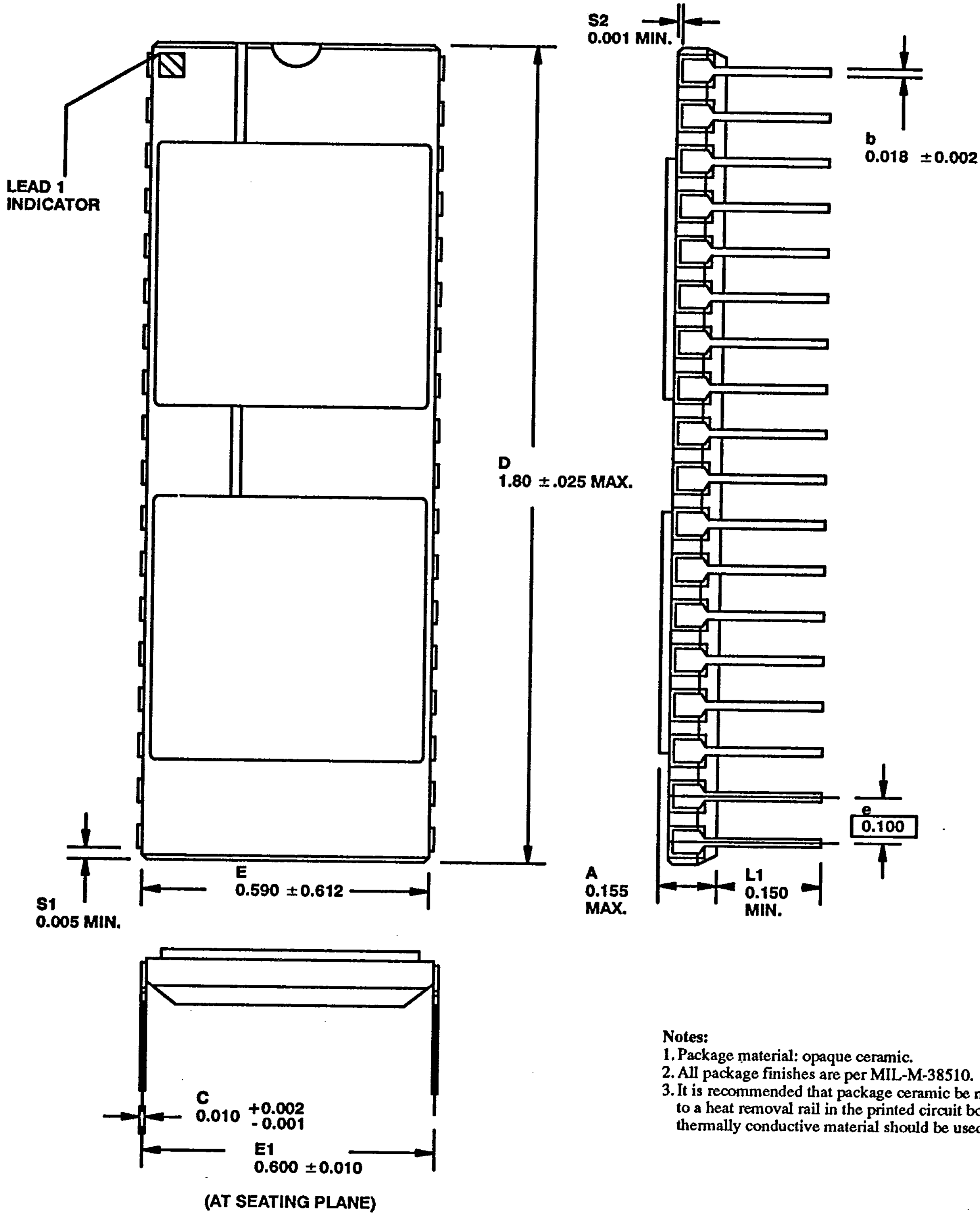
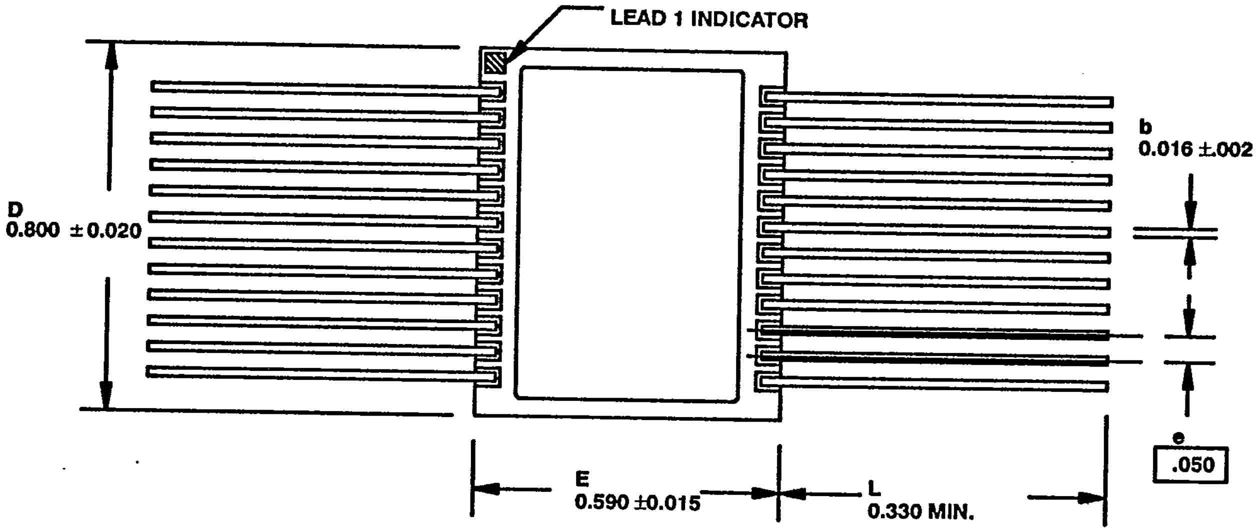


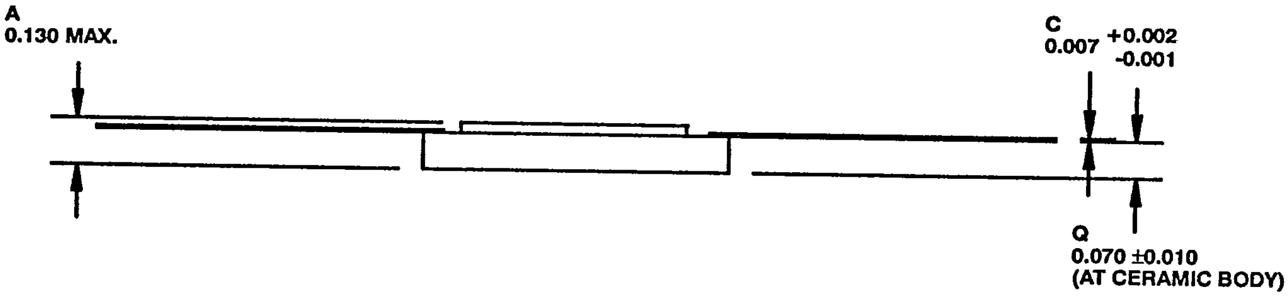
Figure 11. Receiver Input Zero Crossing Distortion (t_{RZCD})



Notes:
1. Package material: opaque ceramic.
2. All package finishes are per MIL-M-38510.
3. It is recommended that package ceramic be mounted to a heat removal rail in the printed circuit board. A thermally conductive material should be used.

Figure 12. 36-Lead Side-Brazed DIP, Dual Cavity





Notes:
1. Package material: opaque ceramic.
2. All package plating finishes are per MIL-M-38510.
3. It is recommended that package ceramic be mounted to a heat removal rail located in the printed circuit board. A thermally conductive material should be used.

Figure 13. 24-Lead Flatpack, Dual Cavity (50-mil lead spacing)

ORDERING INFORMATION

5V Transceiver: Prototypes, Reduced High-Reliability, Class B, & Class S

UT 63M ***-* * *

Lead Finish [1]:
(A) = Hot solder dipped
(C) = Gold
(X) = Factory Option (gold or solder) [2]

Screening:
(S) = Class S per MIL-STD-883, Method 5004 only (QCI per Method 5005 may be purchased separately)
(B) = SMD device available 3Q93. Contact factory for correct part number.
(C) = Reduced High-Reliability flow [3]
(P) = Prototype flow [4]

Package:
(B) = 36-pin ceramic dual-cavityy side-braxed DIP
(C) = 24-lead ceramic dual-cavity top-brazed dual-in-line flatpack (.050" lead centers)

Device Type:
(147) = Idle low
(149) = Idle high

Notes:
1. Lead finish (A, C, or X) must be specified.
2. If "X" is specified, part marking will match lead finish and will be either "A" (solder) or "C" (gold).
3. Reduced High-Reliability flow per UTMC's document MANFLOW-2-5-93-TD. Devices have 48 hours of burn-in and are tested at -55°C, room temperature, and 125°C. Radiation characteristics are neither tested nor guaranteed and may not be specified.
4. Prototype flow per UTMC's document MANFLOW-2-5-93-TD. Devices have prototype assembly and are tested at 25°C only. Radiation characteristics are neither tested nor guaranteed and may not be specified. Lead finish is at UTMC's option and an "X" must be specified when ordering.

UTMC Main Office
1575 Garden of the Gods Road
Colorado Springs, CO 80907-3486
1-800-722-1575

Western Sales Office
101 Columbia Street, Suite 130
Aliso Viejo, CA 92636
1-714-362-2260

Eastern Sales Office
1901 S. Harbor City Blvd., Suite 802
Melbourne, FL 32901
1-407-951-4164

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