DATASHEET

RELEASED 3/4/11

MIL-STD-1553A/B Bus Transceiver

UT63M1X5C

Features

- Compatible with MIL-STD-1553A and 1553B
- Meets RT validation noise rejection at 135 mV RMS noise power level (transformed coupled)
- Completely monolithic CMOS technology
- Low power consumption
- Fit and functionally compatible to industry standard 631XX series
- Idle low encoding version
- Power supply voltages: V_{CC} =+5V, V_{EE} -15V, and V_{CCA}=+5V to +15V
- Full operating temperature range, -55°C to +125°C

Introduction

The monolithic UT63M1X5C Transceivers are complete transmitter and receiver pairs compatible with MIL-STD-1553A and 1553B. Encoder and decoder interfaces are idle low.

The receiver section of the UT63M1X5C 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.

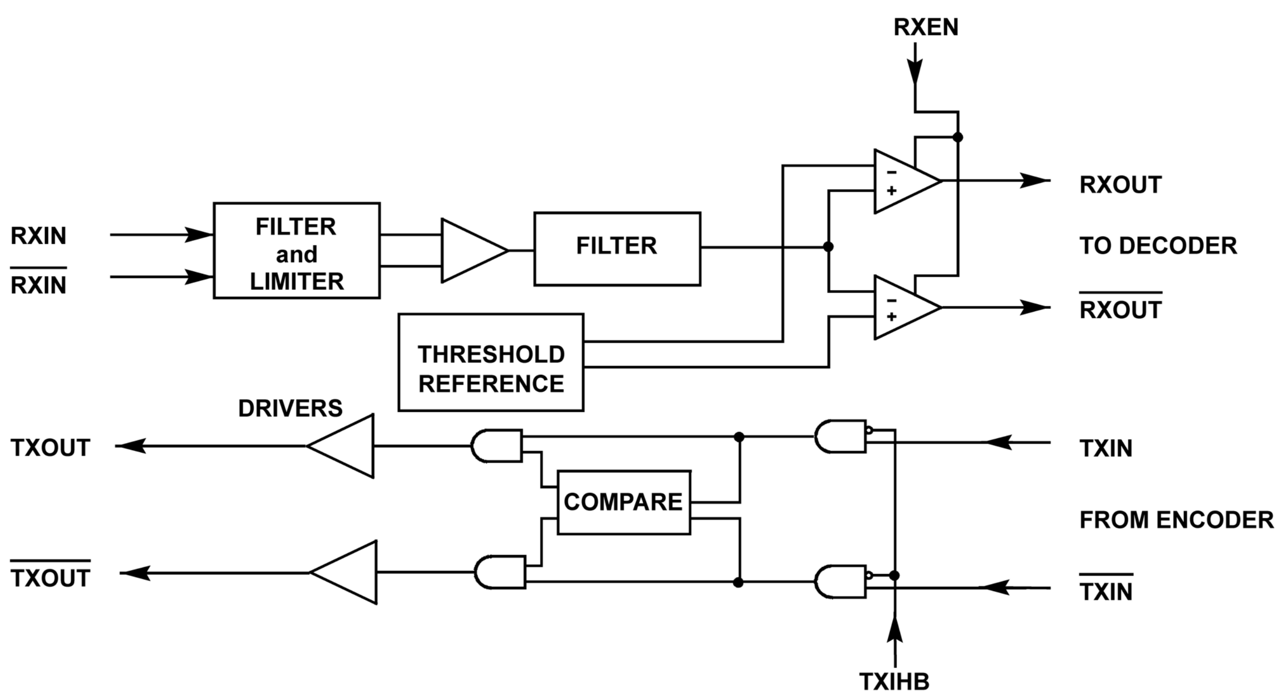

Figure 1. Functional Block Diagram

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 $42V_{PP}$, L-L. Activating the TXIHB input or setting both data inputs to the same logic level disables the transmitter.

The UT63M1X5C series offers a monolithic transmitter and receiver packaged in either single channel (24-pin) or dual-channel (36-pin) 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
() = Channel designator

Transmitter

Name	Package Pin		Type	Description
	Single	Dual		
TXOUT (A)	1	1	DO	Transmitter outputs: TXOUT and $\overline{\text{TXOUT}}$ are differential data signals.
TXOUT (B)	N/A	10	DO	
$\overline{\text{TXOUT}}$ (A)	2	2	DO	$\overline{\text{TXOUT}}$ is the complement of TXOUT.
$\overline{\text{TXOUT}}$ (B)	N/A	11	DO	
TXIHB (A)	21	34	TI	Transmitter inhibit: this is an active high input signal.
TXINB (B)	N/A	25	TI	
TXIN (A)	22	35	TI	Transmitter inputs: TXIN and $\overline{\text{TXIN}}$ are complementary TTL-level Manchester II encoder inputs.
TXIN (B)	N/A	26	TI	
$\overline{\text{TXIN}}$ (A)	23	36	TI	$\overline{\text{TXIN}}$ is the complement of TXIN input.
$\overline{\text{TXIN}}$ (B)	N/A	27	TI	

Receiver

Name	Package Pin		Type	Description
	Single	Dual		
RXOUT (A)	7	5	TO	Receiver outputs: RXOUT and $\overline{RXOUT}$ are complementary Manchester II decoder outputs.
RXOUT (B)	N/A	14	TO	
$\overline{RXOUT}$ (A)	10	8	TO	$\overline{RXOUT}$ is the complement of RXOUT output
$\overline{RXOUT}$ (B)	N/A	17	TO	
RXEN (A)	8	6	TI	Receiver enable/disable: This is an active high input signal.
RXEN (B)	N/A	15	TI	
RXIN (A)	15	29	DI	Receiver inputs: RXIN and $\overline{RXIN}$ are biphase-modulated Manchester II bipolar inputs from MIL-STD-1553 data bus.
RXIN (B)	N/A	20	DI	
$\overline{RXIN}$ (A)	16	30	DI	$\overline{RXIN}$ is the complement of RXIN input.
$\overline{RXIN}$ (B)	N/A	21	DI	

Power and Ground

Name	Package Pin		Type	Description
	Single	Dual		
V_{CC} (A) V_{CC} (B)	20 N/A	33 24	PWR PWR	+5V_{DC} power (±10%)
V_{CCA} (A) V_{CCA} (B)	13 N/A	28 19	PWR PWR	+5 to +15V_{DC} power (± 5%)
V_{EE} (A) V_{EE} (B)	19 N/A	32 23	PWR PWR	-15V_{DC} power (± 5%) Recommended de-coupling capacitors 4.7µF and.1µF
GND (A) GND (B)	3, 9, 18 N/A	3, 7, 31 12, 16, 22	GND GND	Ground reference

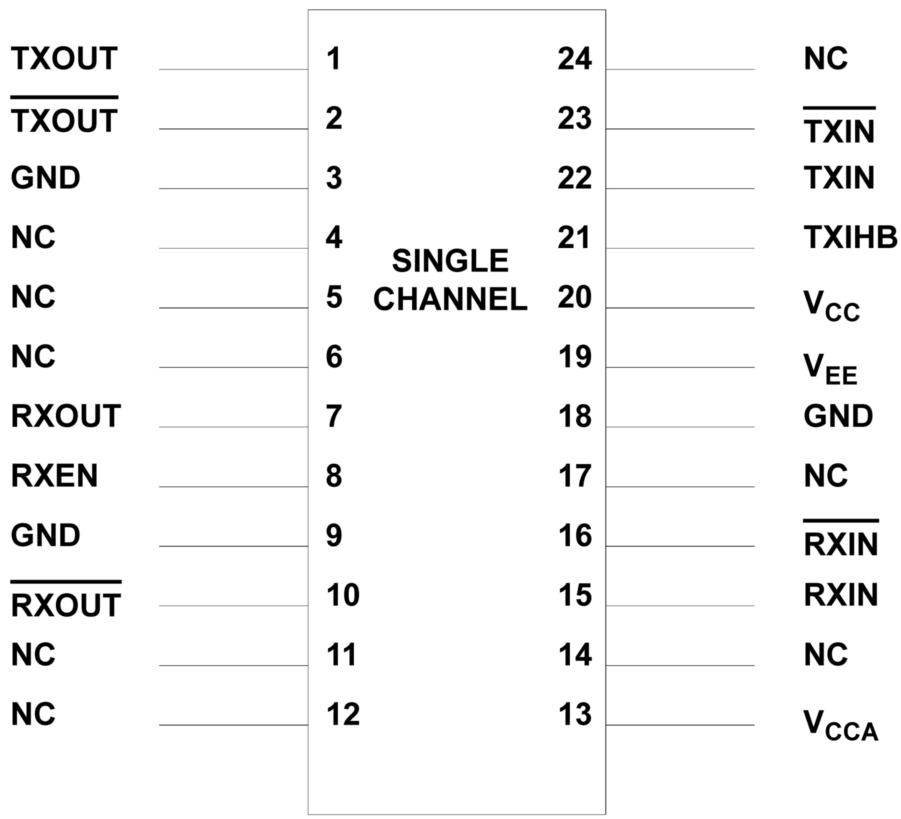

Figure 2a. Functional Pin Diagram--Single Channel

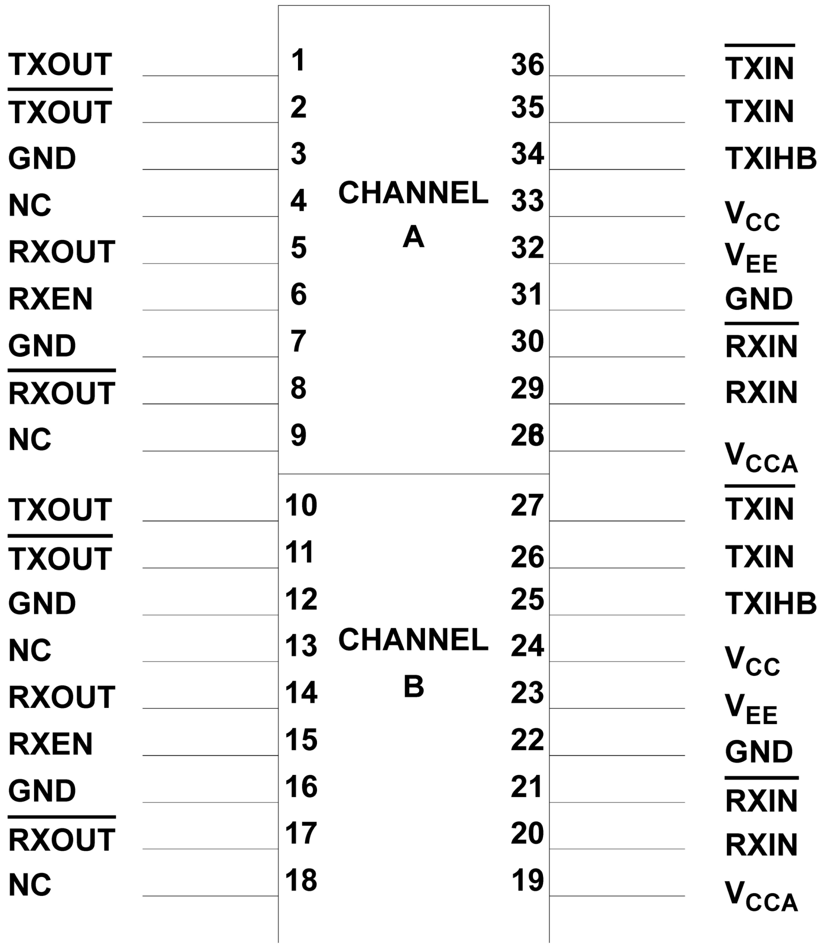

Figure 2b. Functional Pin Diagram--Dual Channel

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 $\overline{TXOUT}$ terminals. Transmitter output terminals' non-transmitting state is enabled by asserting TXIHB (logic 1), or by placing both TXIN and $\overline{TXIN}$ 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 $\overline{RXIN}$ inputs. The receiver converts input data to biphase Manchester II TTL format and is available for decoding at the RXOUT and $\overline{RXOUT}$ terminals. The outputs RXOUT and $\overline{RXOUT}$ represent positive and negative excursions (respectively) of the inputs RXIN and $\overline{RXIN}$. Figure 4 shows typical receiver output waveforms.

Models UT63M105C and UT63M125C idle in the "0" state when disabled or receiving no signal.

UT63M1X5C

Power Supply Voltages

The UT63M1X5C series meets device requirements over a wide range of power supply voltages. Table 2 shows the overall capabilities of all available devices. Each channel of the dual transceiver is electrically and physically separate from the other and fully independent, including all power and signal lines. Thus there will be no interaction between the channels.

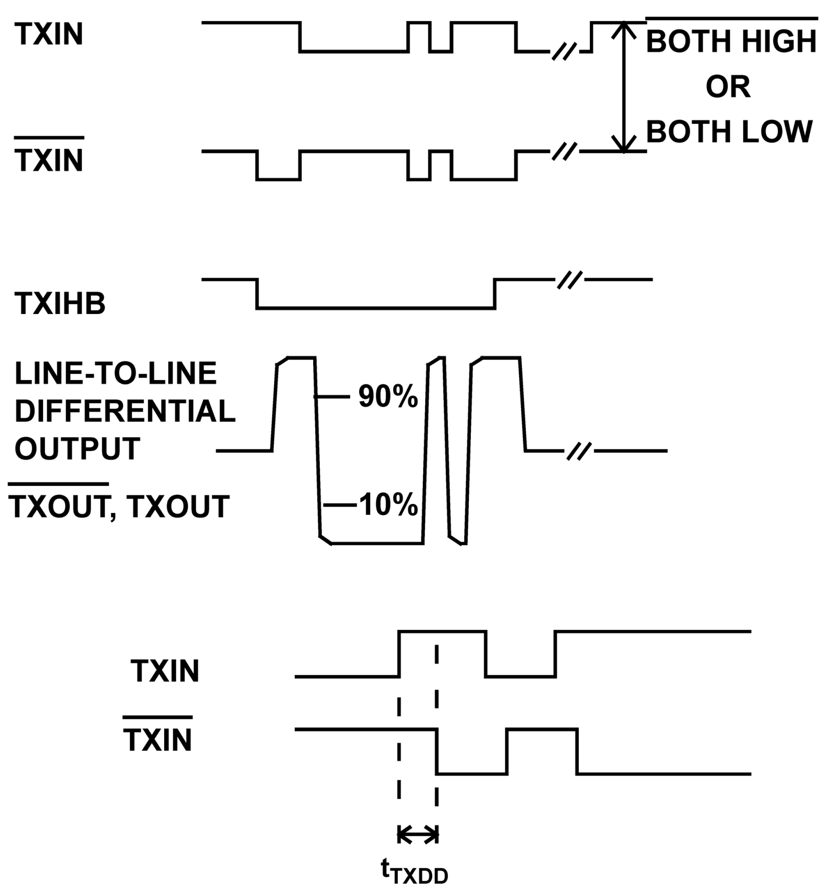

Figure 3. Typical Transmitter Waveforms

Table 1. Transmit Operating Mode

TXIN	$\overline{TXIN}$	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.

Data Bus Interface

The designer can connect the UT63M1X5C 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 UT63M1X5C series transceivers are designed to function with MIL-STD-1553A and 1553B compatible transformers.

Recommended Thermal Protection

All packages, single and dual, 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.

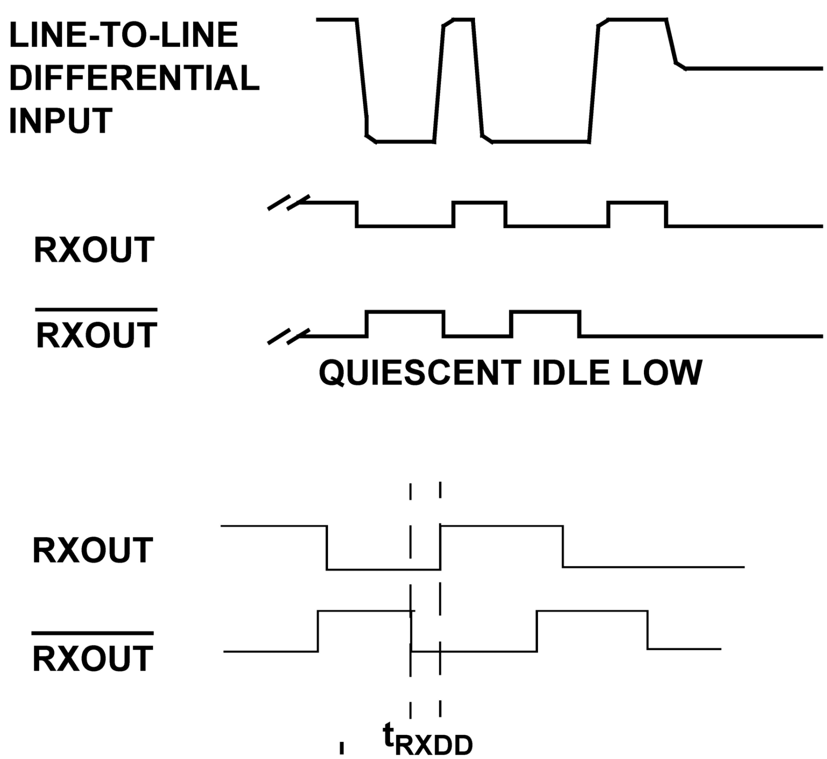

Figure 4. Typical Receiver Waveforms

Table 2. Transceiver Model Capabilities

Model	V_{CC}	V_{EE}	V_{CCA}	IDLE
UT63M105C	+5V	-15V	+5 to +15V	Low
UT63M125C	+5V	-15V	+5 to +15V	Low

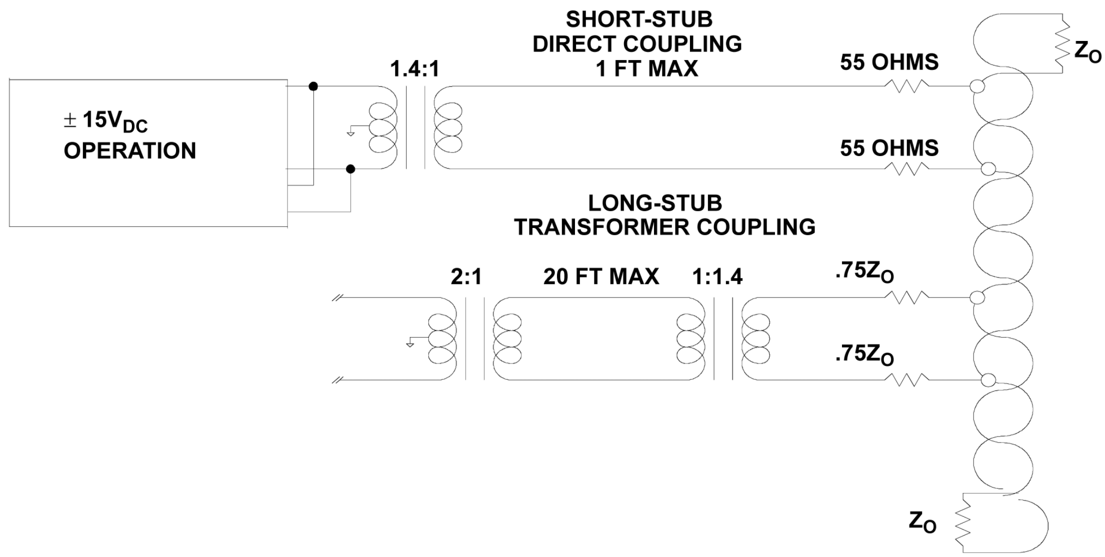

Figure 5. Bus Coupling Configuration

Note:

1) Z_O defined per MIL-STD-1553B in section 4.5.1.5.2.1.

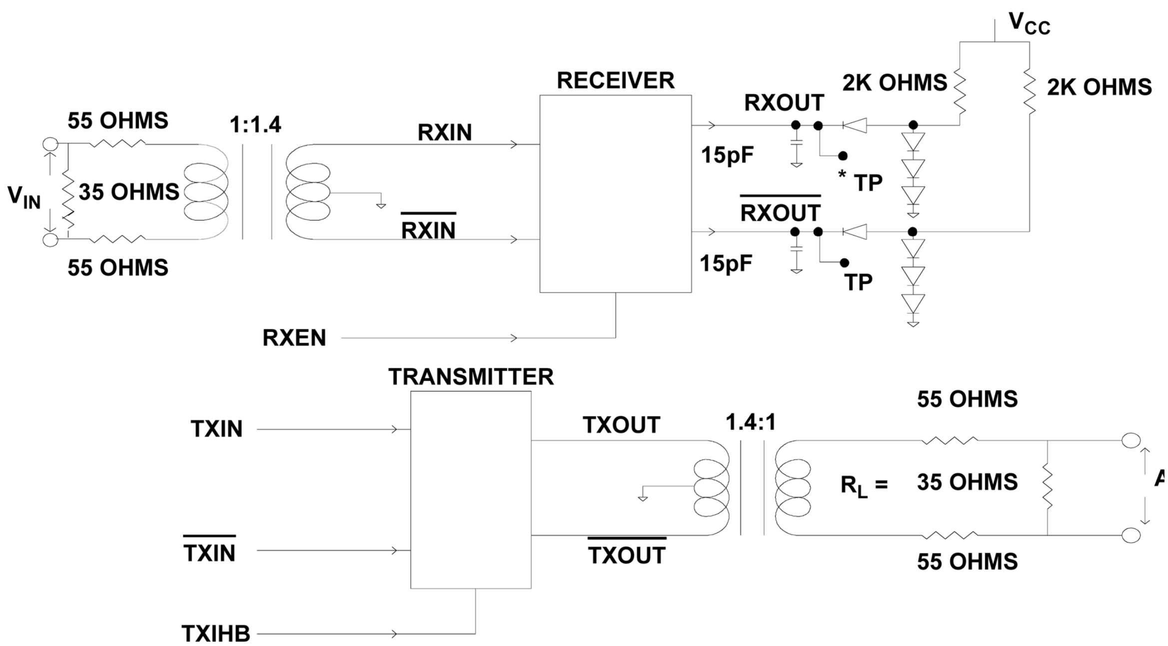

Figure 6. Direct-Coupled Transceiver with Test Load

Notes:

1) TP = Test point.
2) R_L removed for terminal input impedance test.
3) TXOUT and RXIN tied together.

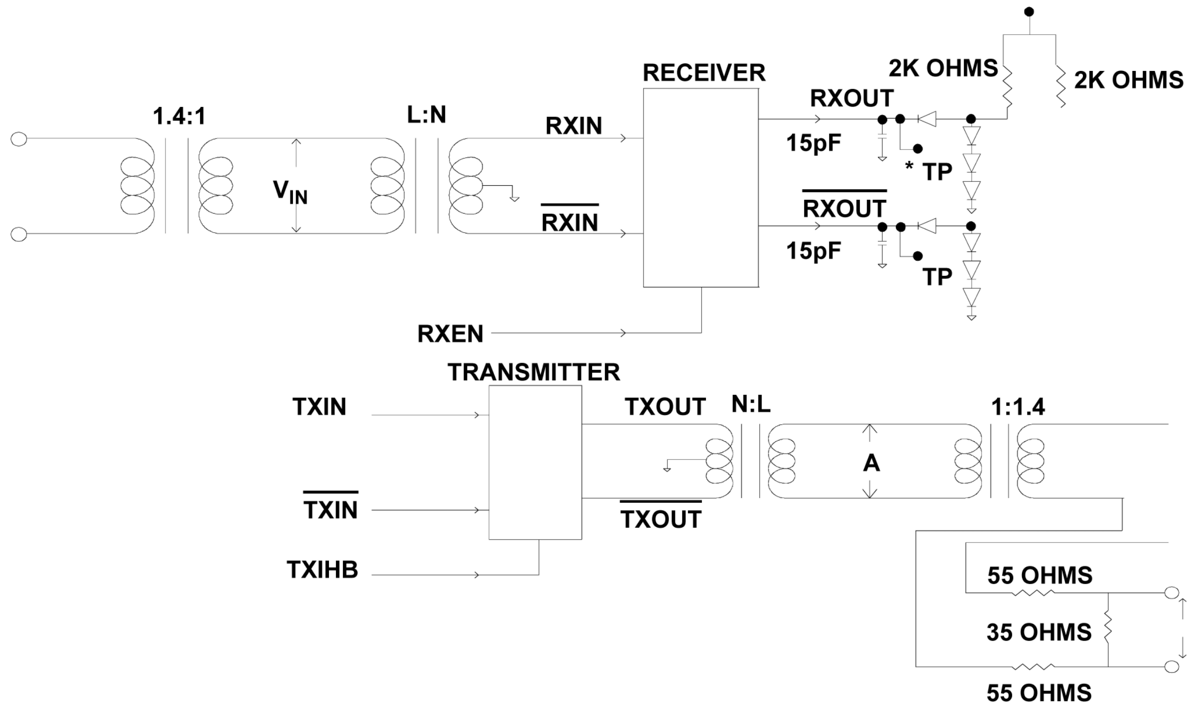

Figure 7. Transformer-Coupled Transceiver with Test Load

Notes:

1) TP = Test point.
2) N:L Ratio is dependent on power supply voltage.
3) R_L removed for terminal input impedance test.
4) TXOUT and RXIN tied together.

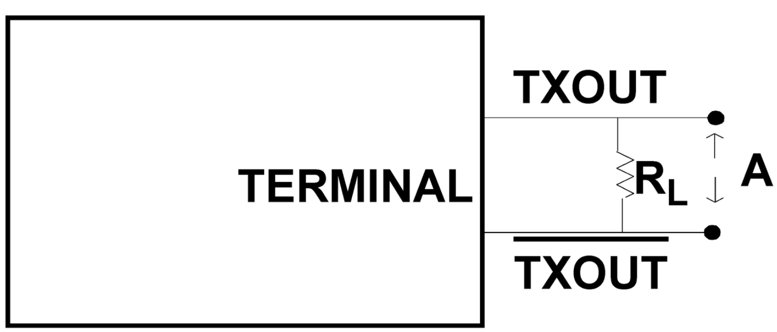

Figure 8. Transceiver Test Circuit MIL-STD-1553B

Notes:

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

Absolute Maximum Ratings [1]

(Referenced to V_{SS})

Symbol	Parameter	Limits	Unit
V_{CC}	Supply Voltage	7.0	V
V_{EE}	Supply Voltage	-22	V
V_{CCA}	Supply Voltage	+22	V
V_{IN}	Input Voltage Range (Receiver)	42	$V_{P\text{-}P,\ L\text{-}L}$
V_{IN}	Logic Input Voltage	-0.3 to +5.5	V
I_O	Output Current (Transmitter)	190	mA
P_D	Power Dissipation (per Channel)	4	W
Θ_{JC}	Thermal Impedance, Junction-to-Case	6[2]	°C/W
T_J	Operating Temperature, Junction	-55 to +150	°C
T_C	Operating Temperature, Case	-55 to +125	°C
T_{STG}	Storage Temperature	-65 to +150	°C

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.

Recommended Operating Conditions

Parameter	Limits	Unit
Logic input voltage range	0 to +5.0	V
Receiver differential voltage	9.0	$V_{P\text{-}P,\ L\text{-}L}$
Driver peak output current	180	mA
Serial data rate	0.1 to 1	MHz
Case operating temperature range (T_C)	-55 to +125	°C

DC Electrical Characteristics

V_{CC} = +5V (± 10%)
V_{CCA} = +5V to +15V (± 5%)
V_{EE} = -15V (± 5%)
-55°C < T_C < +125°C

Symbol	Parameter	Minimum	Maximum	Unit	Condition
V_{IL}	Input Low Voltage		0.8	V	RXEN, TXIHB, TXIN, $\overline{TXIN}$
V_{IH}	Input High Voltage	2.0		V	RXEN, TXIHB, TXIN, $\overline{TXIN}$
I_{IL}	Input Low Current	-1.6		mA	V_{IL} = 0.4V; RXEN, TXIHB, TXIN, $\overline{TXIN}$
I_{IH}	Input High Current		40	μA	V_{IL} = 2.4V; RXEN, TXIHB, TXIN, $\overline{TXIN}$
V_{OL}	Output Low Voltage		0.55	V	I_{OL} = 4.0 mA; RXOUT, $\overline{RXOUT}$
V_{OH}	Output High Voltage	2.4		V	I_{OH} = 0.4 mA; RXOUT, $\overline{RXOUT}$
I_{CC}	V_{CC} Supply Current		60 60 60	mA mA mA	0% duty cycle (non-transmitting) 50% duty cycle (f = 1MHz) 100% duty cycle (f = 1MHz) V_{EE} = -15V V_{CC} = 5V V_{CCA} = +5V to +15V
I_{CCA}	V_{CCA} Supply Current		10 10 10	mA mA mA	0% duty cycle (non-transmitting) 50% duty cycle (f = 1MHz) 100% duty cycle (f = 1MHz) V_{EE} = -15V V_{CC} = 5V V_{CCA} = +5V to +15V
I_{EE}	V_{EE} Supply Current		40 140 230	mA mA mA	0% duty cycle (non-transmitting) 50% duty cycle (f = 1MHz) 100% duty cycle (f = 1MHz) V_{EE} = -15V V_{CC} = 5V V_{CCA} = +5V to +15V
P_{CD}	Power Dissipation		1.0 2.5 3.8	W W W	0% duty cycle (non-transmitting) 50% duty cycle (f = 1MHz) 100% duty cycle (f = 1MHz) V_{EE} = -15V V_{CC} = 5V V_{CCA} = +5V to +15V

Notes:
1) All tests guaranteed per test figure 6.
2) As specified in test conditions.

Receiver Electrical Characteristics [1]

V_{CC} = +5V (± 10%)
V_{CCA} = +5V to +15V (± 5%)
V_{EE} = -15V (± 5%)
-55°C < T_C < +125°C

Symbol	Parameter	Minimum	Maximum	Unit	Condition
R_{IZ} [4]	Differential (Receiver) Input Impedance	15		K Ohms	Input f = 1MHz (no transformer in circuit)
C_{IN} [2]	Input Capacitance		10	pF	RXEN; input f = 1MHz @ 0V
V_{IC} [5]	Common Mode Input Voltage	-10	+10	V	Direct-coupled stub: input 1.2V_{PP}, 200ns rise/fall time ± 25ns, f = 1MHz.
V_{TH}	Input Threshold Voltage (No Response)		0.20 [5]	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 [5]	14.0 [5]	V_{PP}, L-L	Transformer-coupled stub: input at f = 1MHz, rise/fall time 200ns output at (Receiver output 0 ⟶ 1 transition).
	Input Threshold Voltage (Response)	1.20	20.0 [4]	V_{PP}, L-L	Direct-coupled stub: input at f = 1MHz, rise/fall time 200ns output at (Receiver output 0 ⟶ 1 transition).
CMMR [3, 5]	Common Mode Rejection Ratio	Pass/Fail		N/A	

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.
4) Guaranteed by design to the limits specified. Not tested.
5) Verified by RT validation testing at nominal voltage and room temperature per MIL-HDBK-1553 Appendix A, RT Validation Test Plan.

Transmitter Electrical Characteristics [1]

V_{CC} = +5V (± 10%)
V_{CCA} = +5V to +15V (± 5%)
V_{EE} = -15V (± 5%)
-55°C < T_C < +125°C

Symbol	Parameter	Minimum	Maximum	Unit	Condition
V_O	Output Voltage Swing per MIL-STD-1553B [4] (See figure 9)	18	27	V_{PP}, L-L	Transformer-coupled stub, Figure 8, Point A: input f = 1MHz, R_L = 70 ohms.
	per MIL-STD-1553B (See figure 9)	6	9	V_{PP}, L-L	Direct-coupled stub, Figure 8, Point A: input f = 1MHz, R_L = 35 ohms.
	per MIL-STD-1553A [3] (See figure 9)	6	20	V_{PP}, L-L	Figure 7, Point A: input f = 1MHz, R_L = 35 ohms.
V_{NS}	Output Noise Voltage Differential (See figure 9)		14 [4]	mV-RMS, L-L	Transformer-coupled stub, Figure 8, Point A: input f = DC to 10MHz, R_L = 70 ohms.
			5 [3]	mV-RMS, L-L	Direct-coupled stub, Figure 8, Point A: input f = DC to 10MHz, R_L = 35 ohms.
V_{OS}	Output Symmetry (See figure 9)	-250	+250 [3]	mV_{PP}, L-L	Transformer-coupled stub, Figure 8, Point A: R_L = 70 ohms, measurement taken 2.5μs after end of transmission
		-90 [2]	+90 [2]	mV_{PP}, L-L	Direct-coupled stub, Figure 8, Point A: R_L = 35 ohms, measurement taken 2.5μs after end of transmission
V_{DIS}	Output voltage distortion (overshoot or ring) (See figure 9)	-900 [3]	+900 [3]	mV peak, L-L	Transformer-coupled stub, Figure 8, Point A: R_L = 70 ohms.
		-300 [2]	+300 [2]	mV peak, L-L	Direct-coupled stub, Figure 8, Point A: R_L = 35 ohms.
C_{IN} [2]	Input Capacitance		10	pF	TXIHB, TXIN, TXIN; input f = 1MHz @ 0 V
T_{IZ}	Terminal Input Impedance	1 [4]		Kohm	Transformer-coupled stub, Figure 7, Point A: input f = 75KHz to 1MHz (power on or power off: non-transmitting, R_L removed from circuit).
		2 [3]		Kohm	Direct-coupled stub, Figure 6, Point A: input f = 75KHz to 1MHz (power on or power off: non-transmitting, R_L removed from circuit).

Notes:

1) All tests guaranteed per test figure 6.
2) Guaranteed by device characterization.
3) Guaranteed by design to the limits specified. Not tested.
4) Verified by RT validation testing at nominal voltage and room temperature per MIL-HDBK-1553 Appendix A, RT Validation Test Plan.

AC Electrical Characteristics [1]

V_{CC} = +5V (± 10%)

V_{CCA} = +5V to +15V (± 5%)

V_{EE} = -15V (± 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 R_L = 35 ohms output at 10% through 90% points $\overline{TXOUT}$, TXOUT. Figure 3.
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 4.
t_{RZCD}	Zero Crossing	-150	+150	ns	Direct-coupled stub; input f = 1MHz, 3V_{PP} (skew INPUT ± 150ns), rise/fall time 200ns
t_{TZCS} [2]	Zero Crossing Stability (See figure 10)	-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_{DXOFF} [3, 4]	Transmitter Off; Delay from Inhibit Active		400	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.

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 on (1.2V).

Table 3. Transformer Requirements Versus Power Supplies

Coupling Technique	± $15V_{DC}$
DIRECT-COUPLED: Isolation Transformer Ratio	1.4:1
TRANSFORMER-COUPLED: Isolation Transformer Ratio	2:1
Coupling Transformer Ratio	1:1.4

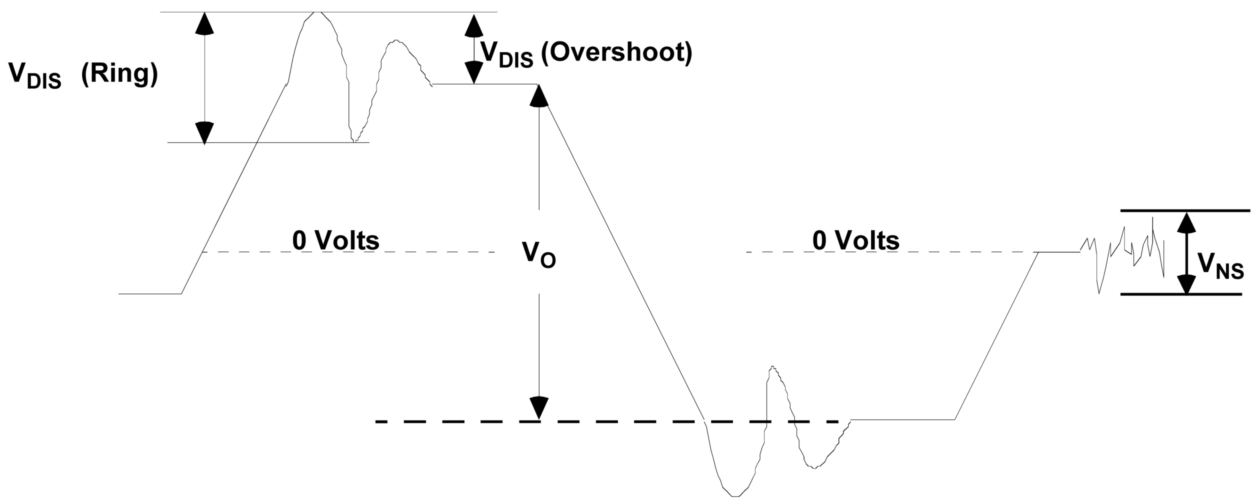

Figure 9. Transmitter Output Characteristics (V_{DIS}, V_{NS}, V_O)

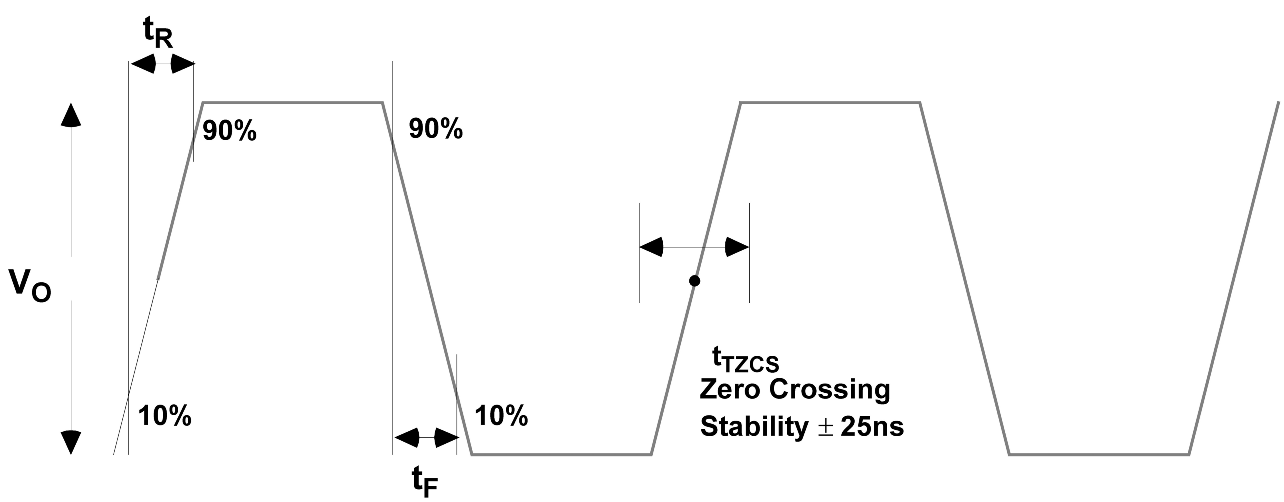

Figure 10. Transmitter Output Zero Crossing Stability (t_{TZCS}, t_R, t_F)

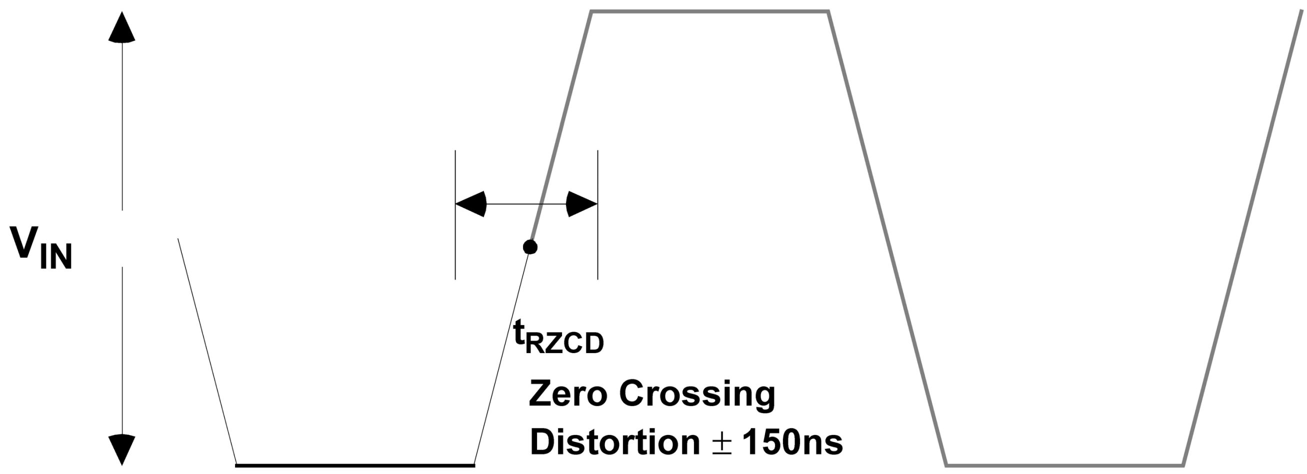

Figure 11. Receiver Input Zero Crossing Distortion (t_{RZCD})

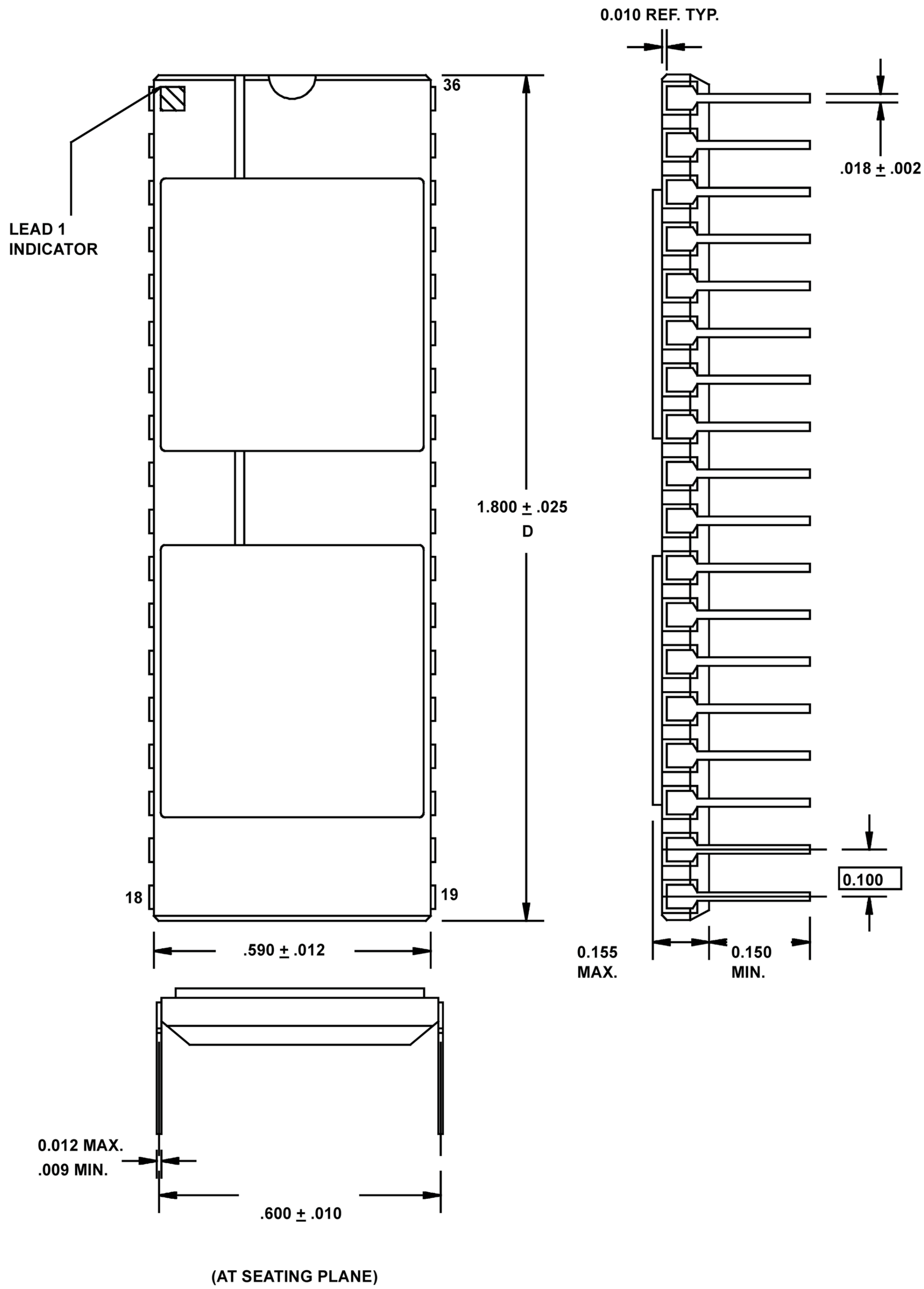

Figure 12. 36-Pin Side-Brazed DIP, Dual Cavity

Notes:

1) Package material: opaque ceramic.
2) All package finishes are per MIL-PRF-38535.
3) It is recommended that package ceramic be mounted on a heat removal rail in the printed circuit board. A thermally conductive material should be used.

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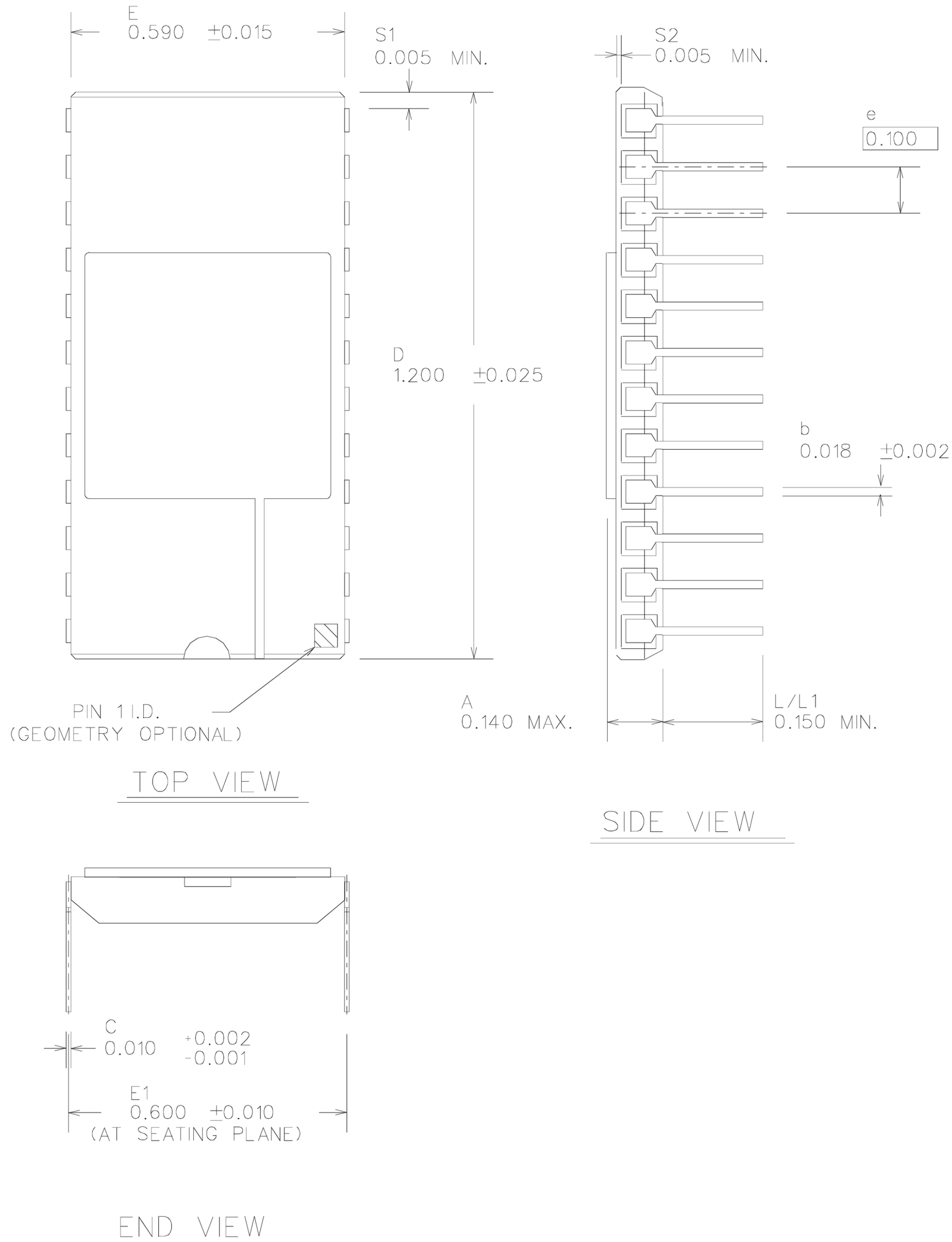

Figure 13. 24-Pin Side-Brazed DIP, Single Cavity

Notes:

1) All package finishes are per MIL-M-38510.
2) It is recommended that package ceramic be mounted on a heat removal rail in the printed circuit board. A thermally conductive material such as MERECO XLN-589 or equivalent should be used.
3) Letter designations are for cross-reference to MIL-M-38510.

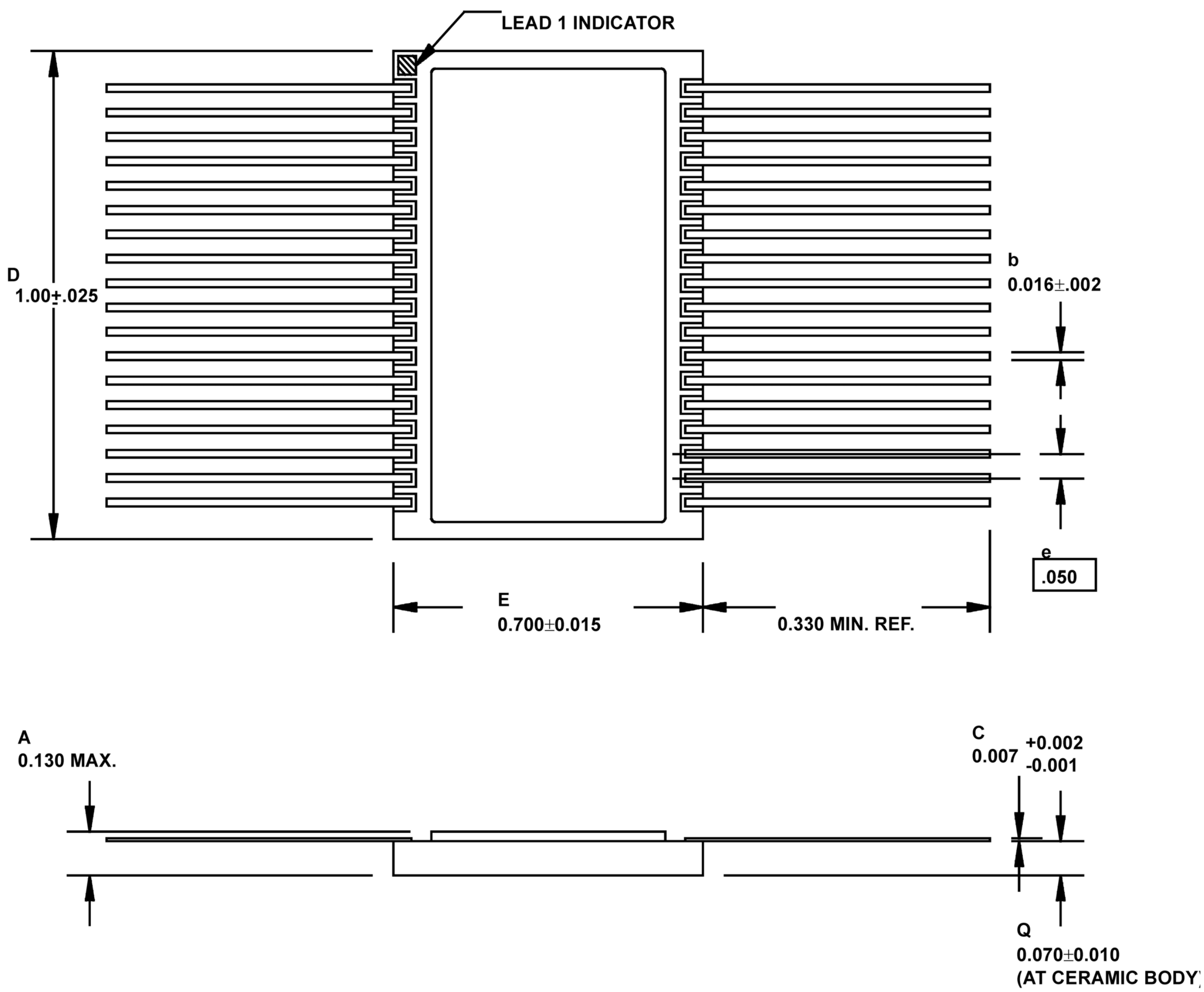

Figure 14. 36-Lead Flatpack, Dual Cavity
(50-Mil Lead Spacing)

Notes:

1) Package material: opaque ceramic.
2) All package plating finishes are per MIL-M-38510.
3) Lid is not connected to any electrical potential.
4) It is recommended that package ceramic be mounted to a heat removal rail located in the printed circuit board. A thermally conductive material such as Mereco XLN-589 or equivalent should be used.

UT63M1X5C

Ordering Information

UT63M Single Channel MIL-STD-1553 Monolithic Transceiver

UT63M * - * * *

Lead Finish: (Notes 1,2)
(A) = Solder
(C) = Gold
(X) = Optional

Screening: (Notes 3,4)
(C) = Aeroflex's QML-Q Process Flow
(P) = Prototype

Package Type:
(P) = 24-pin DIP

Device Type Modifier:
105C = +\-15V, Idle low

Notes:

1) Lead finish (A, C, or X) must be specified.
2) If an "X" is specified when ordering, part marking will match the lead finish and will be either "A" (solder) or "C" (gold).
3) Devices that are manufactured using CAES QML-Q process flow are burned-in and are tested at -55°C, room temperature, and 125°C.
4) Prototype devices are tested at 25°C only. Lead finish is Gold only.
5) Radiation characteristics not guaranteed.
6) The UT63M105C complies with all the requirements of MIL-STD-1553 with the exception of the RT Validation Noise Rejection at 140mV RMS noise power. CAES guarantees full compliance to the RT Validation Noise Rejection requirements at 135mV RMS noise power level in the Transformer Coupled configuration. In the Direct Coupled configuration, the UT63M105C complies with the requirements of the RT Validation Noise Rejection at 190mV RMS.

UT63M Dual Multichip Monolithic Transceiver

UT63M * - * * *

Lead Finish: (Notes 1,2)
(A) = Solder
(C) = Gold
(X) = Optional

Screening: (Notes 3,4)
(C) = Aeroflex's QML-Q Process Flow
(P) = Prototype

Package Type:
(B) = 36-pin DIP
(C) = 36-pin FP (.50)
(D) = 36-pin FP (0.100)

Device Type Modifier:
125C = +\-15V, Idle low

Notes:

1) Lead finish (A, C, or X) must be specified.
2) If an "X" is specified when ordering, part marking will match the lead finish and will be either "A" (solder) or "C" (gold).
3) Devices that are manufactured using CAES QML-Q process flow are burned-in and are tested at -55°C, room temperature, and 125°C.
4) Prototype devices are tested at 25°C only. Lead finish is Gold only.
5) Radiation characteristics not guaranteed.
6) The UT63M125C complies with all the requirements of MIL-STD-1553 with the exception of the RT Validation Noise Rejection at 140mV RMS noise power. CAES guarantees full compliance to the RT Validation Noise Rejection requirements at 135mV RMS noise power level in the Transformer Coupled configuration. In the Direct Coupled configuration, the UT63M125C complies with the requirements of the RT Validation Noise Rejection at 190mV RMS.

DATASHEET

MIL-STD-1553A/B Bus Transceiver

UT63M1X5C

Datasheet Definitions

	DEFINITION
Advanced Datasheet	CAES reserves the right to make changes to any products and services described herein at any time without notice. The product is still in the development stage and the datasheet **is subject to change**. Specifications can be **TBD** and the part package and pinout are **not final**.
Preliminary Datasheet	CAES reserves the right to make changes to any products and services described herein at any time without notice. The product is in the characterization stage and prototypes are available.
Datasheet	Product is in production and any changes to the product and services described herein will follow a formal customer notification process for form, fit or function changes.

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