UT63M1XX 1553A/B Bus Transceiver

Features

- ☐ Full conformance to MIL-STD-1553A and 1553B
- ☐ Completely monolithic bipolar technology
- ☐ Low power consumption
- ☐ Fit and functionally compatible to industry standard 631XX series
- ☐ Idle low and idle high encoding versions
- ☐ Dual-channel .050-center small outline package
- ☐ Flexible power supply voltages: VCC = +5 V, VEE = -12 V or -15 V, and VCCA = +5 V to +12 V or +5 V to +15 V
- ☐ Full military operating temperature range, -55°C to +125°C, screened to the specific test methods listed in Table I of MIL-STD-883, Method 5004, Class B
- ☐ Standard Military Drawing available

Introduction

The monolithic UT63M1XX Transceivers are complete transmitter and receiver pairs conforming fully to MIL-STD-1553A and 1553B. Encoder and decoder interfaces are either idle low or idle high. UTMC's advanced bipolar technology allows the positive analog power to range from +5 V to +12 V or +5 V to +15 V, providing more flexibility in system power supply design.

The receiver section of the UT63M1XX 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.

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 42 VPP, L-L. Activating the TXIHB input or setting both data inputs to the same logic level disables the transmitter.

The UT63M1XX series offers complete transmitter and receiver pairs packaged in either single channel (24-pin) or dual-channel (36-pin) configurations designed for use in any MIL-STD-1553 application.

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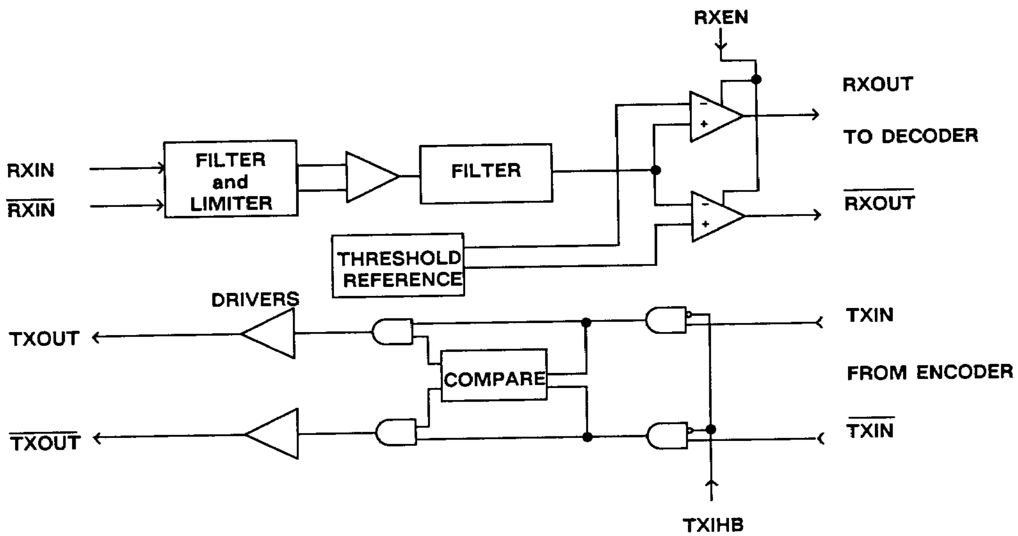

Figure 1. Functional Block Diagram

2.0 Pin Identification

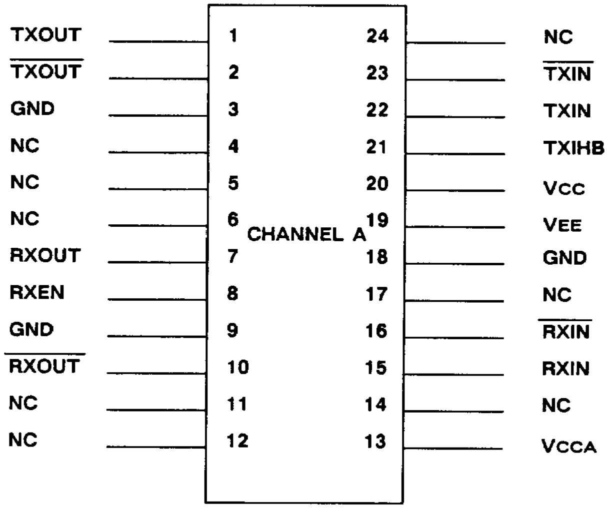

Figure 2a. Functional Pin Diagram--Single Channel

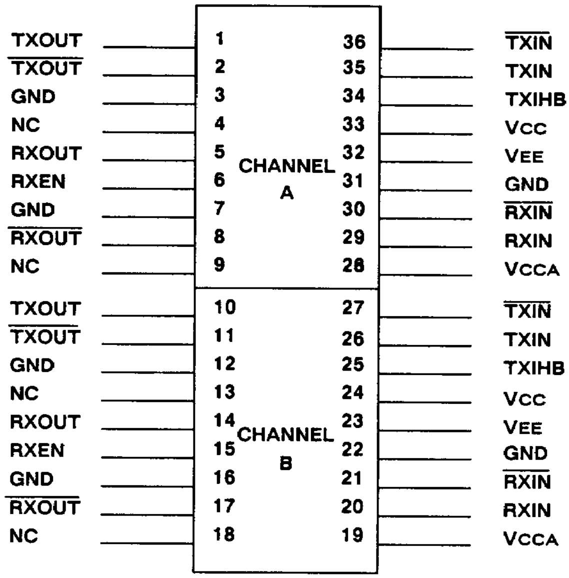

Figure 2b. Functional Pin Diagram--Dual Channel

Legend for TYPE field:

- TI = TTL input
- TO = TTL output
- DO = Differential output
- DI = Differential input
- ( ) = Channel designator

TRANSMITTER

NAME	PACKAGE SINGLE	PACKAGE DUAL	TYPE	DESCRIPTION
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.
TXIHB (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		TYPE	DESCRIPTION
	SINGLE	DUAL		
RXOUT (A)	7	5	TO	Receiver outputs: RXOUT and $\overline{\text{RXOUT}}$ are complementary Manchester II decoder outputs.
RXOUT (B)	N/A	14	TO	
$\overline{\text{RXOUT}}$ (A)	10	8	TO	$\overline{\text{RXOUT}}$ is the complement of RXOUT output.
$\overline{\text{RXOUT}}$ (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 $\overline{\text{RXIN}}$ are biphase-modulated Manchester II bipolar inputs from MIL-STD-1553 data bus.
RXIN (B)	N/A	20	DI	
$\overline{\text{RXIN}}$ (A)	16	30	DI	$\overline{\text{RXIN}}$ is the complement of RXIN input.
$\overline{\text{RXIN}}$ (B)	N/A	21	DI	

POWER AND GROUND

NAME	PACKAGE		TYPE	DESCRIPTION
	SINGLE	DUAL		
VCC (A)	20	33	PWR	+5 VDC power (+/−10%)
VCC (B)	N/A	24	PWR	
VCCA (A)	13	28	PWR	+5 to +12 VDC power or +5 to +15 VDC power (+/−5%)
VCCA (B)	N/A	19	PWR	
VEE (A)	19	32	PWR	−12 or −15 VDC power (+/−5%) Recommended de-coupling capacitors -4.7 µF and .1 µF
VEE (B)	N/A	23	PWR	
GND (A)	3, 9, 18	3, 7, 31	GND	Ground reference
GND (B)	N/A	12, 16, 22	GND	

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. Models UT63M105, UT63M107, UT63M125, and UT63M127 idle in the "0" state when disabled or receiving no signal. Models UT63M115, UT63M117, UT63M135, and UT63M137 idle in the "1" state when they are disabled or receiving no signal.

Power Supply Voltages

The UT63M1XX 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.

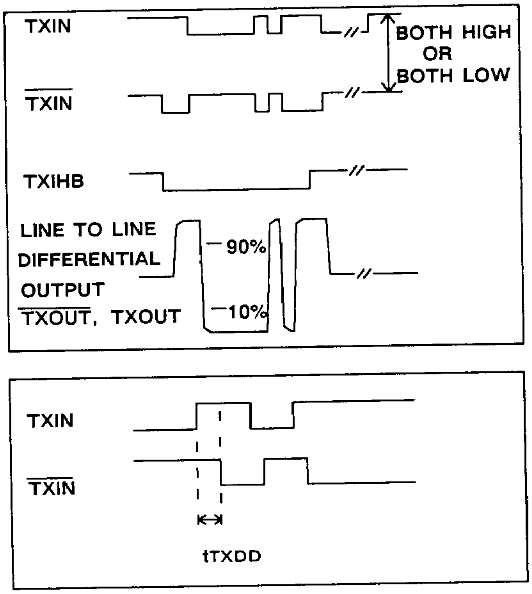

Figure 3. Typical Transmitter Waveforms

Table 1. Transmit Operating Mode

TXIN	$\overline{\text{TXIN}}$	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.

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DATA BUS INTERFACE

The designer can connect the UT63M1XX 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 UT63M1XX 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.

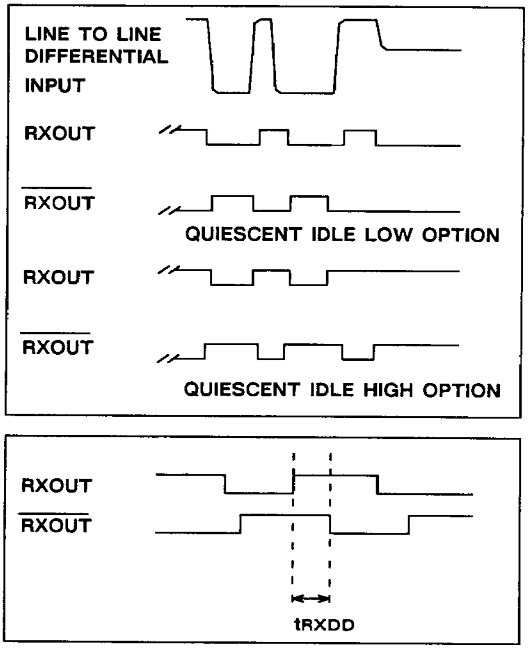
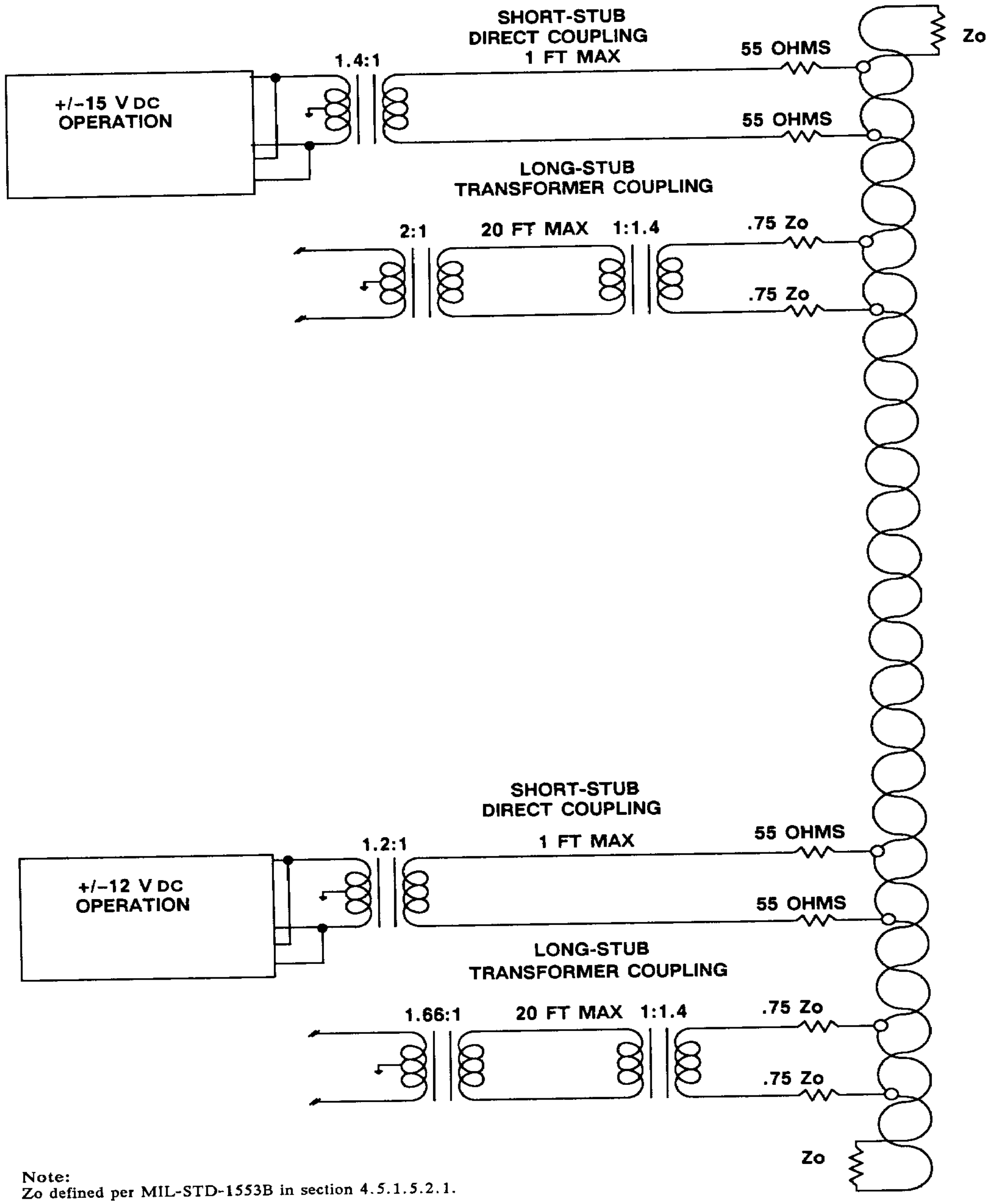


Figure 4. Typical Receiver Waveforms

Table 2. Transceiver Model Capabilities

MODEL	VCC	VEE	VCCA	IDLE
UT63M105	+5 V	−15 V	+5 to +15 V	Low
UT63M107	+5 V	−12 V	+5 to +12 V	Low
UT63M115	+5 V	−15 V	+5 to +15 V	High
UT63M117	+5 V	−12 V	+5 to +12 V	High
UT63M125	+5 V	−15 V	+5 to +15 V	Low
UT63M127	+5 V	−12 V	+5 to +12 V	Low
UT63M135	+5 V	−15 V	+5 to +15 V	High
UT63M137	+5 V	−12 V	+5 to +12 V	High



Note:
Zo defined per MIL-STD-1553B in section 4.5.1.5.2.1.

Figure 5. Bus Coupling Configuration

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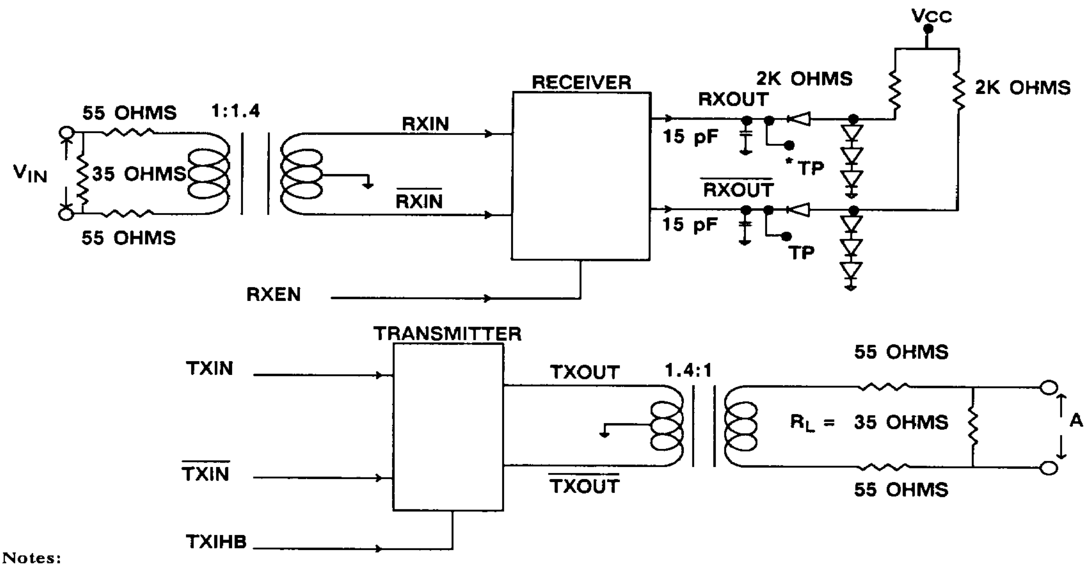
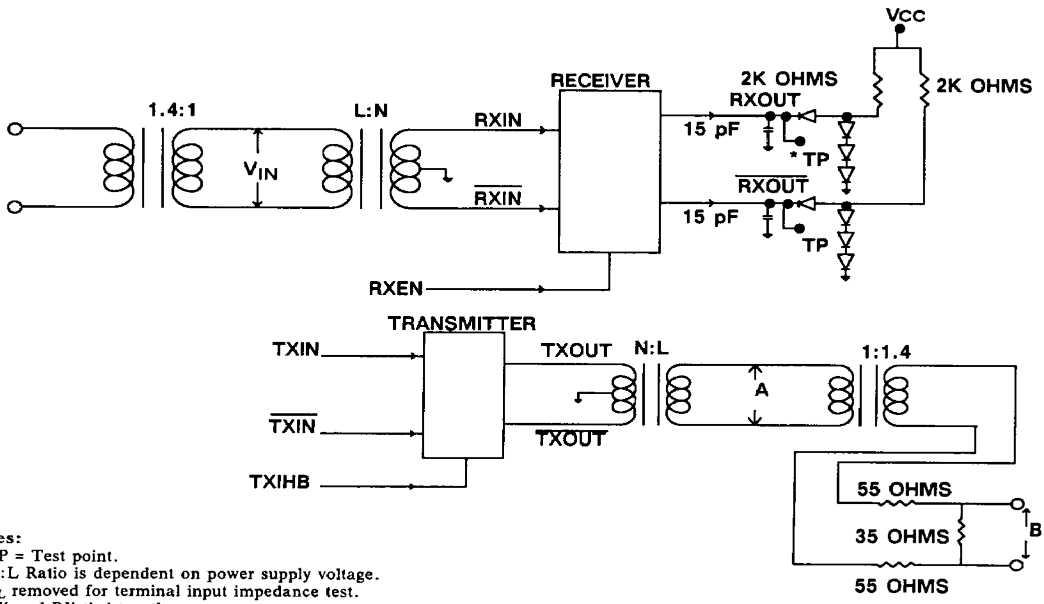


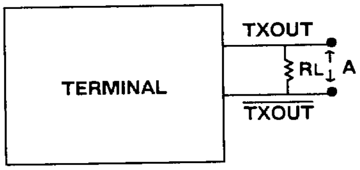
Notes:
1) TP = Test point.
2) R_L removed for terminal input impedance test.
3) TX and RX tied together.

Figure 6. Direct-Coupled Transceiver with 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) TX and RX tied together.

Figure 7. Transformer-Coupled Transceiver with Load



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

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

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ABSOLUTE MAXIMUM RATINGS (1)
(Reference 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	$V_{PP,\ L\text{-}L}$
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
Q_{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.

DC ELECTRICAL CHARACTERISTICS
V_{CC} = +5 V (+/-10%)
V_{CCA} = +5 V to +12 V (+/-5%) or +5 V to +15 V (+/-5%)
V_{EE} = -12 V or -15 V (+/-5%)
-55°C < T_C < +125°C

SYMBOL	PARAMETER	MINIMUM	MAXIMUM	UNIT	CONDITION
V_{IL}	Input low voltage		0.8	V	RXEN, TXIHB, TXIN, $\overline{\text{TXIN}}$
V_{IH}	Input high voltage	2.0		V	RXEN, TXIHB, TXIN, $\overline{\text{TXIN}}$
I_{IL}	Input low current	−1.6		mA	V_{IL} = 0.4 V; RXEN, TXIHB, TXIN, $\overline{\text{TXIN}}$
I_{IH}	Input high current		40	uA	V_{IH} = 2.4 V; RXEN, TXIHB TXIN, $\overline{\text{TXIN}}$
V_{OL}	Output low voltage		0.55	V	I_{OL} = 4.0 mA; RXOUT, $\overline{\text{RXOUT}}$
V_{OH}	Output high voltage	2.4		V	I_{OH} = 0.4 mA; RXOUT, $\overline{\text{RXOUT}}$

DC ELECTRICAL CHARACTERISTICS (1)

V_{CC} = +5 V
V_{CCA} = (2)
V_{EE} = (2)
-55°C < T_C < +125°C

SYMBOL	PARAMETER	MINIMUM	MAXIMUM	UNIT	CONDITION
I_{CC}	V_{CC} supply current				V_{EE} = −12 V V_{CC} = 5 V V_{CCA} = +5 V to +12 V
			60	mA	0% duty cycle (non-transmitting)
			60	mA	50% duty cycle (f = 1 MHz)
			60	mA	100% duty cycle (f = 1 MHz)
					V_{EE} = −15 V V_{CC} = 5 V V_{CCA} = +5 V to +15 V
			60	mA	0% duty cycle (non-transmitting)
			60	mA	50% duty cycle (f = 1 MHz)
			60	mA	100% duty cycle (f = 1 MHz)
I_{CCA}	V_{CCA} supply current				V_{EE} = −12 V V_{CC} = 5 V V_{CCA} = +5 V to +12 V
			10	mA	0% duty cycle (non-transmitting)
			10	mA	50% duty cycle (f = 1 MHz)
			10	mA	100% duty cycle (f = 1 MHz)
					V_{EE} = −15 V V_{CC} = 5 V V_{CCA} = +5 V to +15 V
			10	mA	0% duty cycle (non-transmitting)
			10	mA	50% duty cycle (f = 1 MHz)
			10	mA	100% duty cycle (f = 1 MHz)
I_{EE}	V_{EE} supply current				V_{EE} = −12 V V_{CC} = 5 V V_{CCA} = +5 V to +12 V
			40	mA	0% duty cycle (non-transmitting)
			140	mA	50% duty cycle (f = 1 MHz)
			230	mA	100% duty cycle (f = 1 MHz)
					V_{EE} = −15 V V_{CC} = 5 V V_{CCA} = +5 V to +15 V
			40	mA	0% duty cycle (non-transmitting)
			140	mA	50% duty cycle (f = 1 MHz)
			230	mA	100% duty cycle (f = 1 MHz)
P_{CD}	Power dissipation				V_{EE} = −12 V V_{CC} = 5 V V_{CCA} = +5 V to +12 V
			0.9	W	0% duty cycle (non-transmitting)
			2.1	W	50% duty cycle (f = 1 MHz)
			3.3	W	100% duty cycle (f = 1 MHz)
					V_{EE} = −15 V V_{CC} = 5 V V_{CCA} = +5 V to +15 V
			1.0	W	0% duty cycle (non-transmitting)
			2.5	W	50% duty cycle (f = 1 MHz)
			3.8	W	100% duty cycle (f = 1 MHz)

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

RECEIVER ELECTRICAL CHARACTERISTICS (1)
V_{CC} = +5 V (+/-10%)
V_{CCA} = +5 V to +12 V (+/-5%) or +5 V to +15 V (+/-5%)
V_{EE} = -12 V or -15 V (+/-5%)
-55°C < T_C < +125°C

SYMBOL	PARAMETER	MINIMUM	MAXIMUM	UNIT	CONDITION
R_{IZ} (2)	Differential (receiver) input impedance	15		K ohms	Input f = 1 MHz (no transformer in circuit)
C_{IN} (2)	Input capacitance		10	pF	RXEN; input f = 1 MHz @ 0 V
V_{IC} (2)	Common mode input voltage	−10	+10	V	Direct-coupled stub: input 1.2 V_{PP}, 200 ns rise/fall time +/−25 ns, f = 1 MHz.
V_{TH} (2)	Input threshold voltage (no response)		0.20	V_{PP}, L-L	Transformer-coupled stub: input at f = 1 MHz, rise/fall time 200 ns at (Receiver output 0-->1 transition).
	Input threshold voltage (no response)		0.28	V_{PP}, L-L	Direct-coupled stub: input at f = 1 MHz, rise/fall time 200 ns at (Receiver output 0-->1 transition).
(2)	Input threshold voltage (response)	.86	14.0	V_{PP}, L-L	Transformer-coupled stub: input at f = 1 MHz, rise/fall time 200 ns output at (Receiver output 0-->1 transition).
	Input threshold voltage (response)	1.20	20.0 (2)	V_{PP}, L-L	Direct-coupled stub: input at f = 1 MHz, rise/fall time 200 ns output at (Receiver output 0-->1 transition).
CMRR (2)	Common mode rejection ratio	Pass/Fail (3)		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.

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TRANSMITTER ELECTRICAL CHARACTERISTICS (1)

V_{CC} = +5 V (+/-10%)

V_{CCA} = +5 V to +12 V (+/-5%) or +5 V to +15 V (+/-5%)

V_{EE} = -12 V or -15 V (+/-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	VPP, L-L	Transformer-coupled stub, Figure 8, Point A: input f = 1 MHz, R_L = 70 ohms.
	per MIL-STD-1553B (see figure 9)	6	9	VPP, L-L	Direct-coupled stub, Figure 8, Point A: input f = 1 MHz, R_L = 35 ohms.
	per MIL-STD-1553A (2) (see figure 9)	6	20	VPP, L-L	Figure 7, Point A: input f = 1 MHz, R_L = 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 10 MHz, R_L = 70 ohms.
			5	mV-RMS L-L	Direct-coupled stub, Figure 8, Point A: input f = DC to 10 MHz, R_L = 35 ohms.
V_{OS} (2)	Output symmetry (see figure 9)	–250	+250	mVPP, L-L	Transformer-coupled stub, Figure 8, Point A: R_L = 70 ohms, measurement taken 2.5 µs after end of transmission.
		–90	+90	mVPP, L-L	Direct-coupled stub, Figure 8, Point A: R_L = 35 ohms, measurement taken 2.5 µs after end of transmission.
V_{DIS} (2)	Output voltage distortion (overshoot or ring) (see figure 9)	–900	+900	mVpeak L-L	Transformer-coupled stub, Figure 8, Point A: R_L = 70 ohms.
		–300	+300	mVpeak L-L	Direct-coupled stub, Figure 8, Point A: R_L = 35 ohms.
C_{IN} (2)	Input capacitance		10	pF	TXIHB, TXIN, $\overline{TXIN}$; input f = 1 MHz @ 0 V
T_{IZ} (2)	Terminal input impedance	1		K ohm	Transformer-coupled stub, Figure 7, Point A: input f = 75 KHz to 1 MHz (power on or power off: non-transmitting, R_L removed from circuit).
		2		K ohm	Direct-coupled stub, Figure 6, Point A: input f = 75 KHz to 1 MHz (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.

AC ELECTRICAL CHARACTERISTICS (1)

V_{CC} = +5 V (+/-10%)
V_{CCA} = +5 V to +12 V (+/-5%) or +5 V to +15 V (+/-5%)
V_{EE} = -12 V or -15 V (+/-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 = 1 MHz 50% duty cycle: direct-coupled R_L = 35 ohms output at 10% through 90% points TXOUT, $\overline{TXOUT}$. 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 3.
t_{RZCD}	Zero crossing distortion (see figure 11)	−150	150	ns	Direct-coupled stub; input f = 1 MHz, 3 V_{PP} (skew INPUT +/−150 ns), rise/fall time 200 ns.
t_{TZCS}	Zero crossing stability (see figure 10)	−25	25	ns	Input TXIN and $\overline{TXIN}$ should create transmitter output zero crossings at 500 ns, 1000 ns, 1500 ns, and 2000 ns. These zero crossings should not deviate more than +/−25 ns.
t_{DXOFF} (3) (4)	Transmitter off; delay from inhibit active		400	ns	TXIN and $\overline{TXIN}$ toggling @ 1 MHz; TXIHB transitions from logic zero to one.
t_{DXON} (3) (5)	Transmitter on; delay from inhibit inactive		250	ns	TXIN and $\overline{TXIN}$ toggling @ 1 MHz; 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 (1.5 V) to transmit off (280 mV).
5. Delay time from not transmit inhibit (1.5 V) to transmit on (1.2 V).

Table 3. Transformer Requirements Versus Power Supplies

COUPLING TECHNIQUE	+/−12 V_{DC}	+/−15 V_{DC}
DIRECT-COUPLED: Isolation Transformer Ratio	1.2:1	1.4:1
TRANSFORMER-COUPLED: Isolation Transformer Ratio	1.66:1	2:1
Coupling Transformer Ratio	1:1.4	1:1.4

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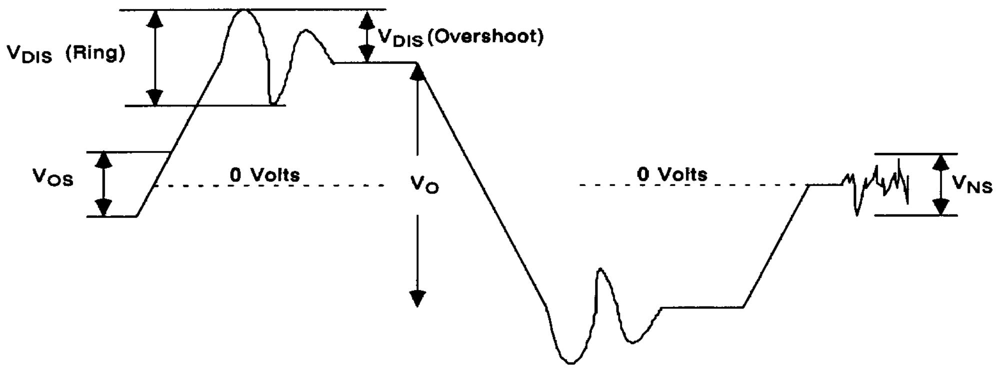

Figure 9. Transmitter Output Characteristics (VDIS, VOS, VNS, VO)

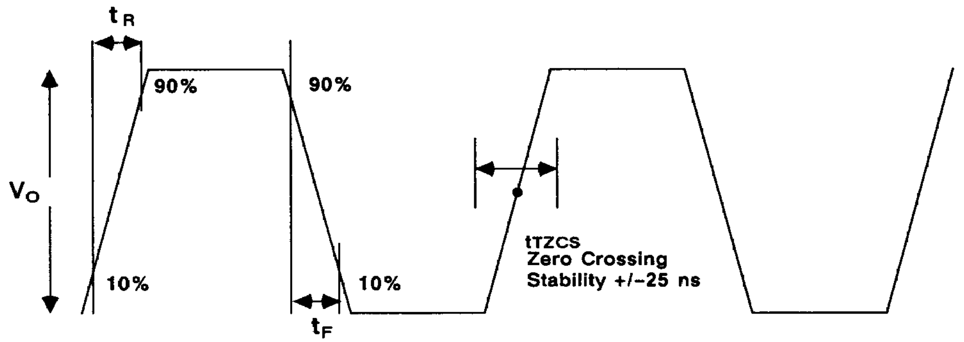

Figure 10. Transmitter Output Zero Crossing Stability (tTZCS, tR, tF)

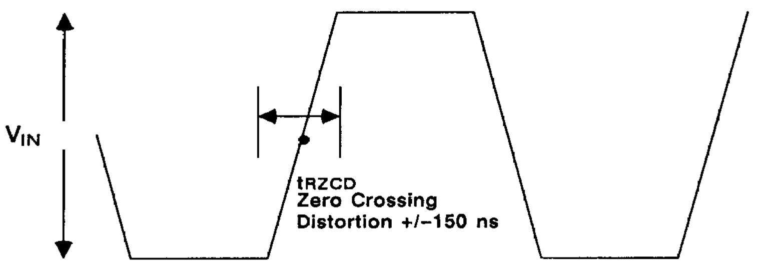

Figure 11. Receiver Input Zero Crossing Distortion (tRZCD)