HOLT INTEGRATED CIRCUITS INC.

May 2003

HI-1567, HI-1568

MIL-STD-1553 / 1760
5V Monolithic Dual Transceivers

DESCRIPTION

The HI-1567 and HI-1568 are low power CMOS dual transceivers designed to meet the requirements of MIL-STD-1553 /1760 specifications.

The transmitter section of each channel takes complementary CMOS / TTL digital input data and converts it to bi-phase Manchester encoded 1553 signals suitable for driving the bus isolation transformer. Separate transmitter inhibit control signals are provided for each transmitter.

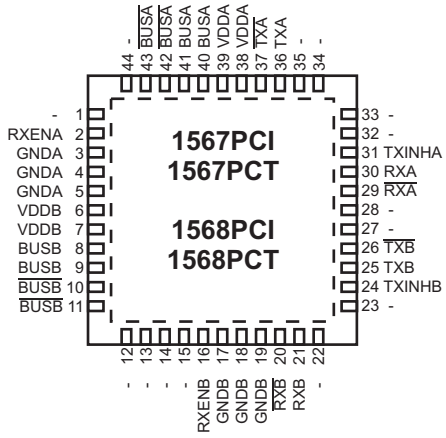
The receiver section of the each channel converts the 1553 bus bi-phase data to complementary CMOS / TTL data suitable for inputting to a Manchester decoder. Each receiver has a separate enable input which can be used to force the output of the receiver to a logic 0 (HI-1567) or logic 1 (HI-1568).

To minimize the package size for this function, the transmitter outputs are internally connected to the receiver inputs, so that only two pins are required for connection to each coupling transformer. For designs requiring independent access to transmitter and receiver 1553 signals, please refer to the HI-1569 data sheet.

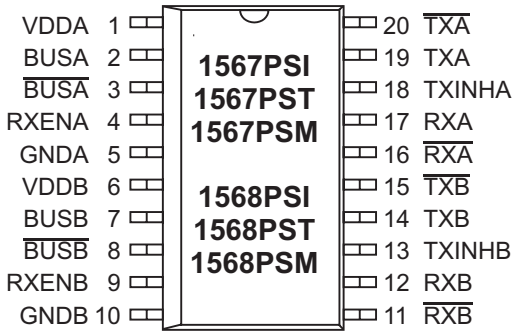
FEATURES

- Compliant to MIL-STD-1553A & B, MIL-STD-1760, ARINC 708A
- CMOS technology for low standby power
- Smallest footprint available in 44-pin plastic chip-scale package with integral heatsink
- Less than 1.0W maximum power dissipation
- Radiation tolerant
- Also available in DIP and small outline (ESOIC) package options
- Military processing options
- Industry standard pin configurations

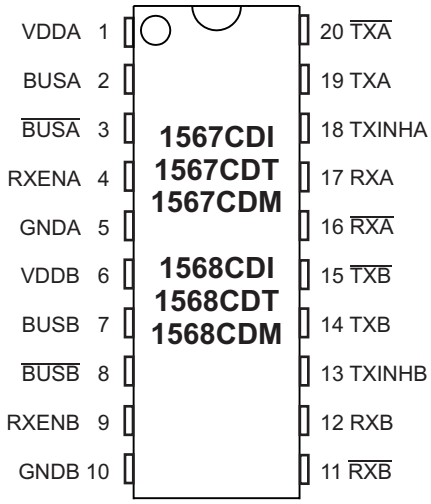
PIN CONFIGURATIONS



44 Pin Plastic 7mm x 7mm Chip-scale package



20 Pin Plastic ESOIC - WB package



20 Pin Ceramic DIP package

PIN DESCRIPTIONS

PIN (DIP/ESOIC)	SYMBOL	FUNCTION	DESCRIPTION
1	VDDA	power supply	+5 volt power for channel A
2	BUSA	analog output	MIL-STD-1533 bus driver A, positive signal
3	$\overline{\text{BUSA}}$	analog output	MIL-STD-1553 bus driver A, negative signal
4	RXENA	digital input	Receiver A enable. If low, forces RXA and $\overline{\text{RXA}}$ low (HI-1567) or High (HI-1568)
5	GNDA	power supply	Ground for channel A
6	VDDB	power supply	+5 volt power for channel B
7	BUSB	analog output	MIL-STD-1533 bus driver B, positive signal
8	$\overline{\text{BUSB}}$	analog output	MIL-STD-1553 bus driver B, negative signal
9	RXENB	digital input	Receiver B enable. If low, forces RXB and $\overline{\text{RXB}}$ low (HI-1567) or High (HI-1568)
10	GNDB	power supply	Ground for channel B
11	$\overline{\text{RXB}}$	digital output	Receiver B output, inverted
12	RXB	digital output	Receiver B output, non-inverted
13	TXINHB	digital input	Transmit inhibit, channel B. If high BUSB, $\overline{\text{BUSB}}$ disabled
14	TXB	digital input	Transmitter B digital data input, non-inverted
15	$\overline{\text{TXB}}$	digital input	Transmitter B digital data input, inverted
16	$\overline{\text{RXA}}$	digital output	Receiver A output, inverted
17	RXA	digital output	Receiver A output, non-inverted
18	TXINHA	digital input	Transmit inhibit, channel A. If high BUSA, $\overline{\text{BUSA}}$ disabled
19	TXA	digital input	Transmitter A digital data input, non-inverted
20	$\overline{\text{TXA}}$	digital input	Transmitter A digital data input, inverted

FUNCTIONAL DESCRIPTION

The HI-1567 family of data bus transceivers contain differential voltage source drivers and differential receivers. They are intended for applications using a MIL-STD-1553 A/B data bus. The device produces a trapezoidal output waveform during transmission.

TRANSMITTER

Data input to the device's transmitter section is from the complementary CMOS /TTL inputs TXA/B and $\overline{\text{TXA}}$/$\overline{\text{B}}$. The transmitter accepts Manchester II bi-phase data and converts it to differential voltages on BUSA/B and $\overline{\text{BUSA}}$/$\overline{\text{B}}$. The transceiver outputs are either direct or transformer coupled to the MIL-STD-1553 data bus. Both coupling methods produce a nominal voltage on the bus of 7.5 volts peak to peak.

The transmitter is automatically inhibited and placed in the high impedance state when both TXA/B and $\overline{\text{TXA}}$/$\overline{\text{B}}$ are either at a logic "1" or logic "0" simultaneously. A logic "1" applied to the TXINHA/B input will force the transmitter to the high impedance state, regardless of the state of TXA/B and $\overline{\text{TXA}}$/$\overline{\text{B}}$.

RECEIVER

The receiver accepts bi-phase differential data from the MIL-STD-1553 bus through the same direct or transformer coupled interface as the transmitter. The receiver's differential input stage drives a filter and threshold comparator that produces CMOS/TTL data at the RXA/B and $\overline{\text{RXA}}$/$\overline{\text{B}}$ output pins.

Each set of receiver outputs can be independently forced to a logic "0" (HI-1567) or logic "1" (HI-1568) by setting RXENA or RXENB low.

MIL-STD-1553 BUS INTERFACE

A direct coupled interface (see Figure 2) uses a 1:2.5 ratio isolation transformer and two 55 ohm isolation resistors between the transformer and the bus.

In a transformer coupled interface (see Figure 3), the transceiver is connected to a 1:1.79 isolation transformer which in turn is connected to a 1:1.4 coupling transformer. The transformer coupled method also requires two coupling resistors equal to 75% of the bus characteristic impedence (Zo) between the coupling transformer and the bus.

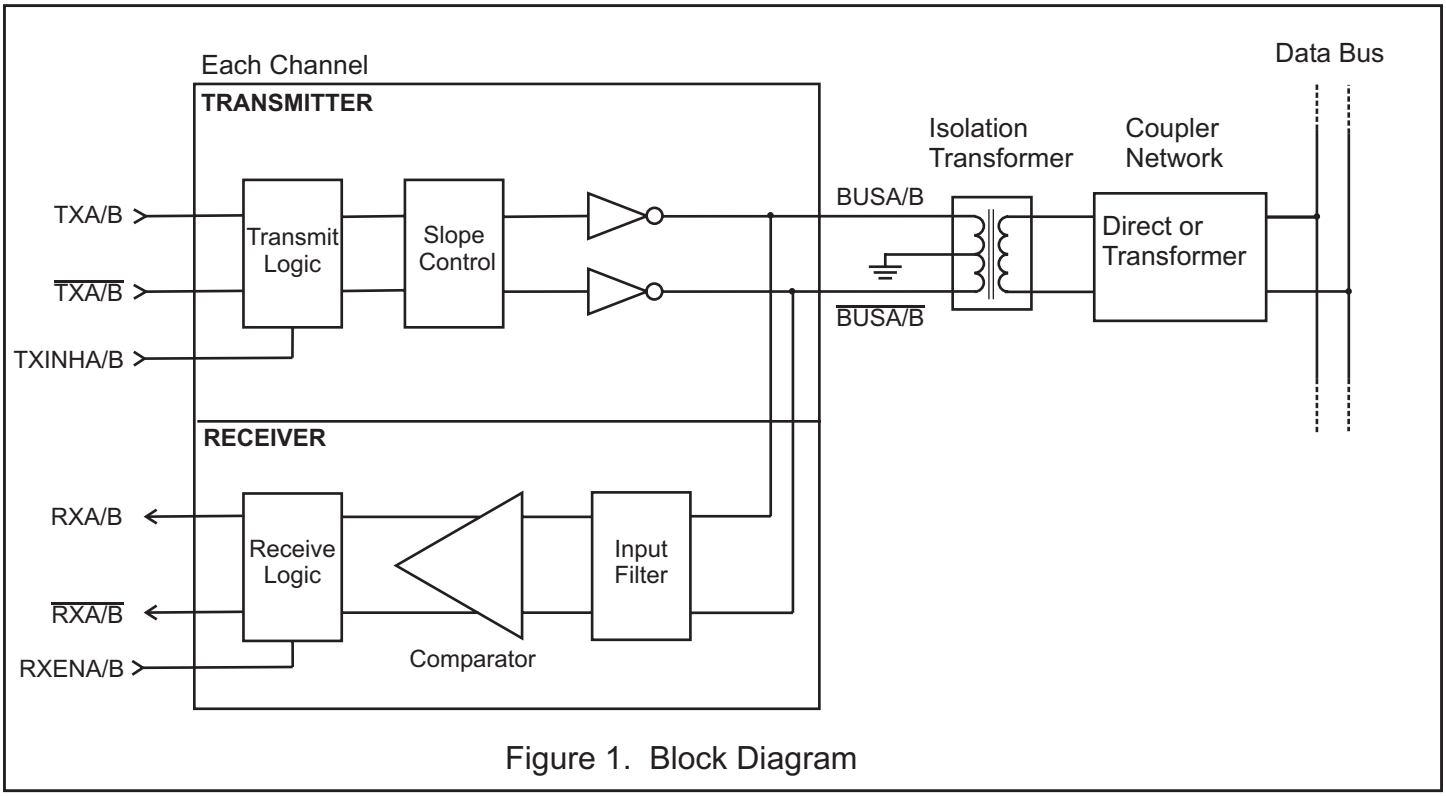
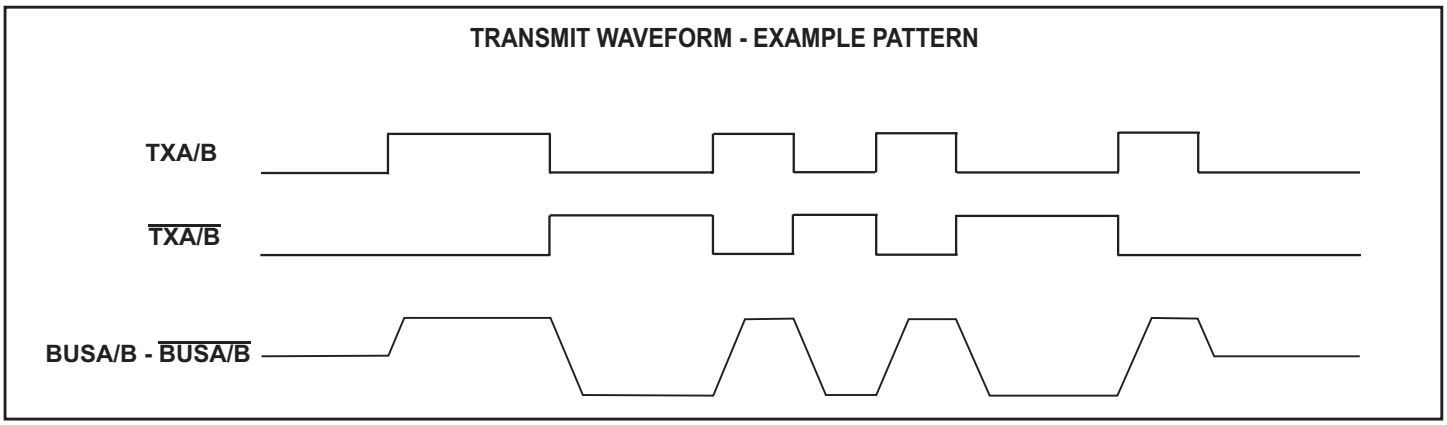
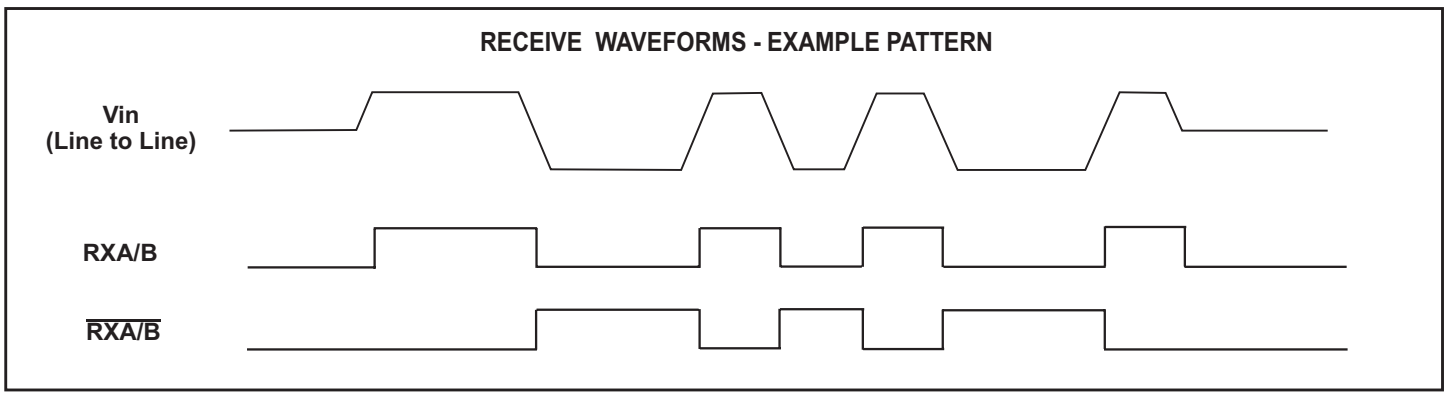


Figure 1. Block Diagram





ABSOLUTE MAXIMUM RATINGS

Supply voltage (VDD)	-0.3 V to +7 V
Logic input voltage range	-0.3 V dc to +5.5 V
Receiver differential voltage	10 Vp-p
Driver peak output current	+1.0 A
Power dissipation at 25°C ceramic DIL, derate	1.0 W 7mW/°C
Solder Temperature	275°C for 10 sec.
Junction Temperature	175°C
Storage Temperature	-65°C to +150°C

RECOMMENDED OPERATING CONDITIONS

Supply Voltage

VDD..... 5V... ±5%

Temperature Range

Industrial Screening.....-40°C to +85°C
Hi-Temp Screening.....-55°C to +125°C
Military Screening.....-55°C to +125°C

NOTE: Stresses above absolute maximum ratings or outside recommended operating conditions may cause permanent damage to the device. These are stress ratings only. Operation at the limits is not recommended.

DC ELECTRICAL CHARACTERISTICS

VDD = 5.0V, GND = 0V, T_A = Operating Temperature Range (unless otherwise specified).

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS
Operating Voltage	VDD		4.75	5	5.25	V
Total Supply Current	ICC1	Not Transmitting		14	22	mA
	ICC2	Transmit one channel @ 50% duty cycle		200	340	mA
	ICC3	Transmit one channel @ 100% duty cycle		400	550	mA
Power Dissipation	PD1	Not Transmitting			0.11	W
	PD2	Transmit one channel @ 100% duty cycle		0.70	0.95	W
Min. Input Voltage (HI)	V_{IH}	Digital inputs	2.0	1.4		V
Max. Input Voltage (LO)	V_{IL}	Digital inputs		1.4	0.8	V
Min. Input Current (HI)	I_{IH}	V_{IH} = 4.9V, Digital inputs			20	µA
Max. Input Current (LO)	I_{IL}	V_{IL} = 0.1V, Digital inputs	-20			µA
Min. Output Voltage (HI)	V_{OH}	I_{OUT} = -0.4mA, Digital outputs	2.7			V
Max. Output Voltage (LO)	V_{IH}	I_{OUT} = 4.0mA, Digital outputs			0.4	V
RECEIVER (Measured at Point "A_D" in Figure 2 unless otherwise specified)						
Input resistance	R_{IN}	Differential	20			Kohm
Input capacitance	C_{IN}	Differential			5	pF
Common mode rejection ratio	CMRR		40			dB
Input Level	V_{IN}	Differential			9	Vp-p
Input common mode voltage	V_{ICM}		-5.0		5.0	V-pk
Threshold Voltage - Direct-coupled Detect	V_{THD}	1 Mhz Sine Wave (Measured at Point "A_D" in Figure 2)	1.15		20.0	Vp-p
No Detect	V_{THND}				0.28	Vp-p
Threshold Voltage - Transformer-coupled Detect	V_{THD}	1 MHz Sine Wave (Measured at Point "A_T" in Figure 3)	0.86		14.0	Vp-p
No Detect	V_{THND}				0.20	Vp-p

DC ELECTRICAL CHARACTERISTICS (cont.)

VDD = 5.0V, GND = 0V, T_A = Operating Temperature Range (unless otherwise specified).

PARAMETER		SYMBOL	CONDITION	MIN	TYP	MAX	UNITS
TRANSMITTER (Measured at Point "A_D" in Figure 2 unless otherwise specified)							
Output Voltage	Direct coupled	V_{OUT}	35 ohm load (Measured at Point "A_D" in Figure 2)	7.0		9.0	Vp-p
	Transformer coupled	V_{OUT}	70 ohm load (Measured at Point "A_T" in Figure 3)	20.0		27.0	Vp-p
Output Noise		V_{ON}	Differential, inhibited			10.0	mVp-p
Output Dynamic Offset Voltage	Direct coupled	V_{DYN}	35 ohm load (Measured at Point "A_D" in Figure 2)	-90		90	mV
	Transformer coupled	V_{DYN}	70 ohm load (Measured at Point "A_T" in Figure 3)	-250		250	mV
Output resistance		R_{OUT}	Differential, not transmitting	10			Kohm
Output Capacitance		C_{OUT}	1 MHz sine wave			15	pF

AC ELECTRICAL CHARACTERISTICS

VDD = 5.0V, GND = 0V, T_A =Operating Temperature Range (unless otherwise specified).

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
RECEIVER (Measured at Point "A_D" in Figure 2)						
Receiver Delay	tDR	From input zero crossing to RXA/B or $\overline{RXA/B}$			450	ns
Receiver Enable Delay	tREN	From RXENA/B rising or falling edge to RXA/B or $\overline{RXA/B}$			40	ns
TRANSMITTER (Measured at Point "A_D" in Figure 2)						
Driver Delay	tDT	TXA/B, TXA/B to BUSA/B, BUSA/B			150	ns
Rise time	tr	35 ohm load	100		300	ns
Fall Time	tf	35 ohm load	100		300	ns
Inhibit Delay	tDI-H	Inhibited output			100	ns
	tDI-L	Active output			150	ns

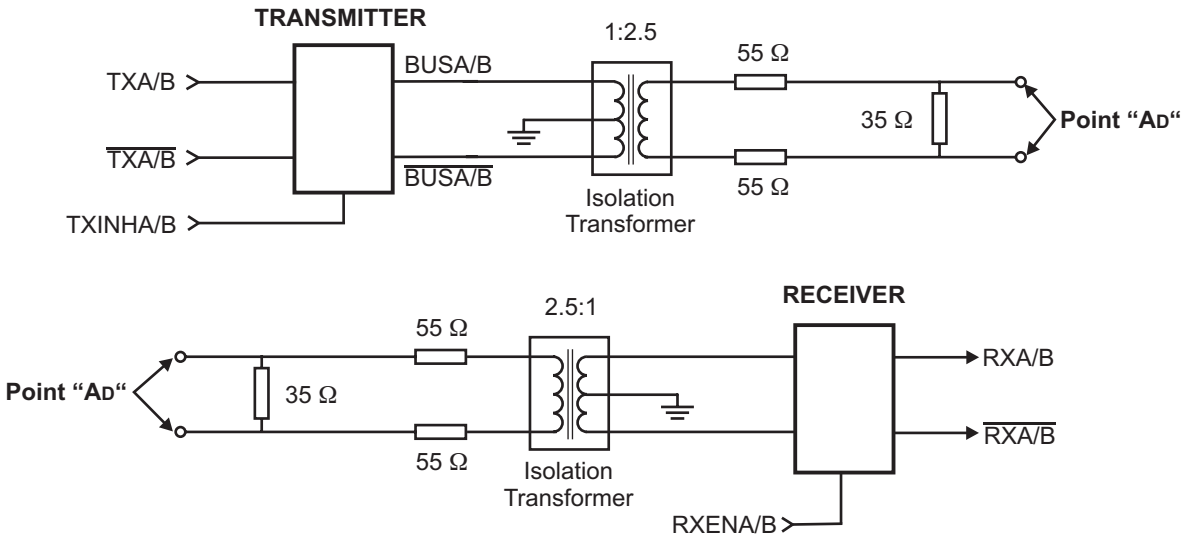


Figure 2. Direct Coupled Test Circuits

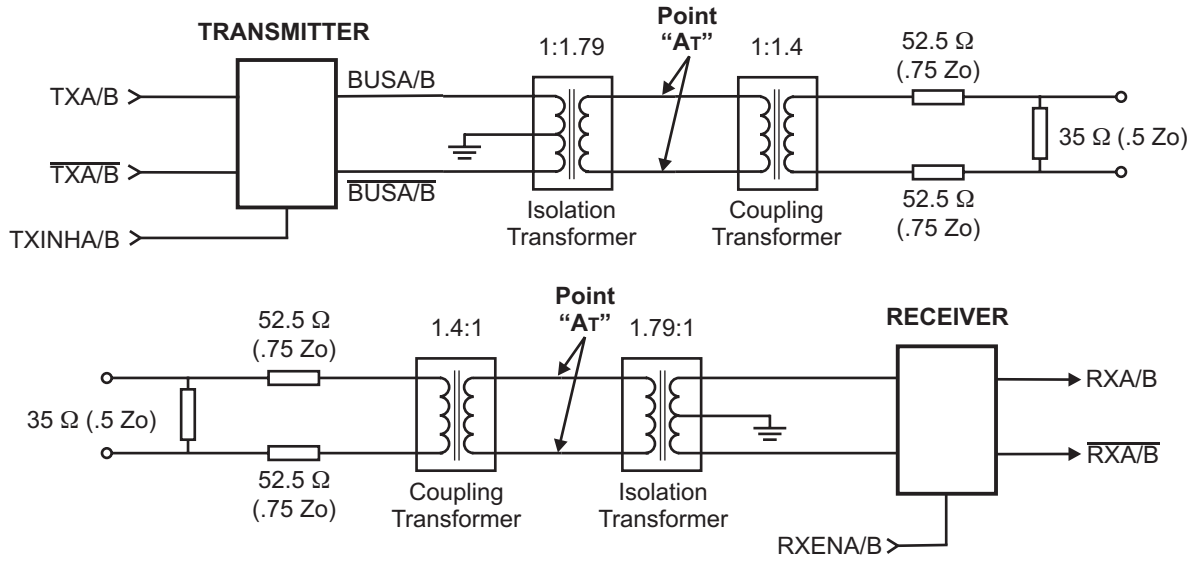


Figure 3. Transformer Coupled Test Circuits

HEAT SINK - ESOIC PACKAGE

Both the HI-1567PSI/T and HI-1568PSI/T use a 20-pin thermally enhanced SOIC package. The package includes a metal heat sink located on the bottom surface of the device. This heat sink should be soldered down to the printed circuit board for optimum thermal dissipation. The heat sink is electrically connected to the VDD supply of the chip and therefore must be isolated from all other signals.

THERMAL CHARACTERISTICS

PART NUMBER	PACKAGE STYLE	CONDITION	$Ø_{JA}$	JUNCTION TEMPERATURE		
				T_A=25°C	T_A=85°C	T_A=125°C
HI-1567PSI / T / M	20-pin Thermally enhanced plastic SOIC (ESOIC)	Heat sink unsoldered	54°C/W	62°C	122°C	162°C
HI-1568PSI / T / M		Heat sink soldered	47°C/W	57°C	117°C	157°C
HI-1567CDI / T / M HI-1568CDI / T / M	20-pin Ceramic side-brazed DIP	Socketed	62°C/W	69°C	129°C	169°C
HI-1567PCI / T HI-1568PCI / T	44-pin Plastic chip-scale package	Heat sink unsoldered	49°C/W	59°C	119°C	159°C

Data taken at VDD=5.0V, continuous transmission at 1Mbit/s, single transmitter enabled.

RADIATION TOLERANCE

The HI-1567 has been characterized for total dose radiation performance in accordance with MIL-STD-883 method 1019. The part meets all data sheet parameters after exposure to 25 KRad(Si).

APPLICATIONS NOTE

Holt Applications Note AN-500 provides circuit design notes regarding the use of Holt's family of MIL-STD-1553 transceivers. Layout considerations, as well as recommended interface and protection components are included.

ORDERING INFORMATION

PART NUMBER	IDLE STATE	PACKAGE DESCRIPTION	TEMPERATURE RANGE	PROCESS FLOW	BURN IN	LEAD FINISH
HI-1567PSI	0	20 PIN PLASTIC ESOIC - WB	-40°C TO +85°C	I	NO	SOLDER
HI-1567PST	0	20 PIN PLASTIC ESOIC - WB	-55°C TO +125°C	T	NO	SOLDER
HI-1567PSM	0	20 PIN PLASTIC ESOIC - WB	-55°C TO +125°C	M	YES	SOLDER
HI-1567CDI	0	20 PIN CERAMIC SIDE BRAZED DIP	-40°C TO +85°C	I	NO	GOLD
HI-1567CDT	0	20 PIN CERAMIC SIDE BRAZED DIP	-55°C TO +125°C	T	NO	GOLD
HI-1567CDM	0	20 PIN CERAMIC SIDE BRAZED DIP	-55°C TO +125°C	M	YES	SOLDER
HI-1567PCI	0	44 PIN CHIP SCALE PACKAGE	-40°C TO +85°C	I	NO	SOLDER
HI-1567PCT	0	44 PIN CHIP SCALE PACKAGE	-55°C TO +125°C	T	NO	SOLDER
HI-1568PSI	1	20 PIN PLASTIC ESOIC - WB	-40°C TO +85°C	I	NO	SOLDER
HI-1568PST	1	20 PIN PLASTIC ESOIC - WB	-55°C TO +125°C	T	NO	SOLDER
HI-1568PSM	1	20 PIN PLASTIC ESOIC - WB	-55°C TO +125°C	M	YES	SOLDER
HI-1568CDI	1	20 PIN CERAMIC SIDE BRAZED DIP	-40°C TO +85°C	I	NO	GOLD
HI-1568CDT	1	20 PIN CERAMIC SIDE BRAZED DIP	-55°C TO +125°C	T	NO	GOLD
HI-1568CDM	1	20 PIN CERAMIC SIDE BRAZED DIP	-55°C TO +125°C	M	YES	SOLDER
HI-1568PCI	1	44 PIN CHIP SCALE PACKAGE	-40°C TO +85°C	I	NO	SOLDER
HI-1568PCT	1	44 PIN CHIP SCALE PACKAGE	-55°C TO +125°C	T	NO	SOLDER

Legend: ESOIC - Thermally Enhanced Small Outline Package (SOIC w/built-in heat sink)
WB - Wide Body

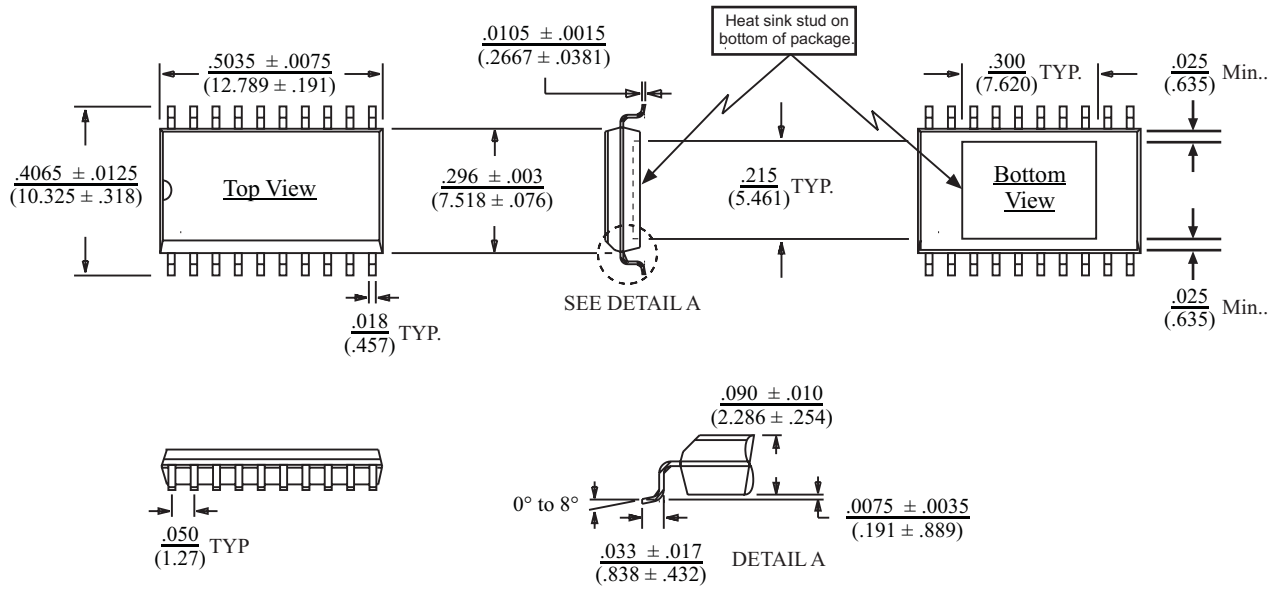
RECOMMENDED TRANSFORMERS

The HI-1567 and HI-1568 transceivers have been characterized for compliance with the electrical requirements of MIL-STD-1553 when used with the following transformers. Holt recommends the Premier Magnetics parts as offering the best combination of electrical performance, low cost and small footprint.

MANUFACTURER	PART NUMBER	APPLICATION	TURNS RATIO(S)	DIMENSIONS
Technotrol	TL1553-45	Isolation	Dual tapped 1:1.79, 1:2.5	.630 x 630 x .155 inches
Premier Magnetics	PM-DB2725EX	Isolation	Dual tapped 1:1.79, 1:2.5	.500 x .500 x .375 inches
Technotrol	TQ1553-2	Stub coupling	1:1.4	.625 x .625 x .250 inches
Premier Magnetics	PM-DB2702	Stub coupling	1:1.4	.625 x .500 x .250 inches

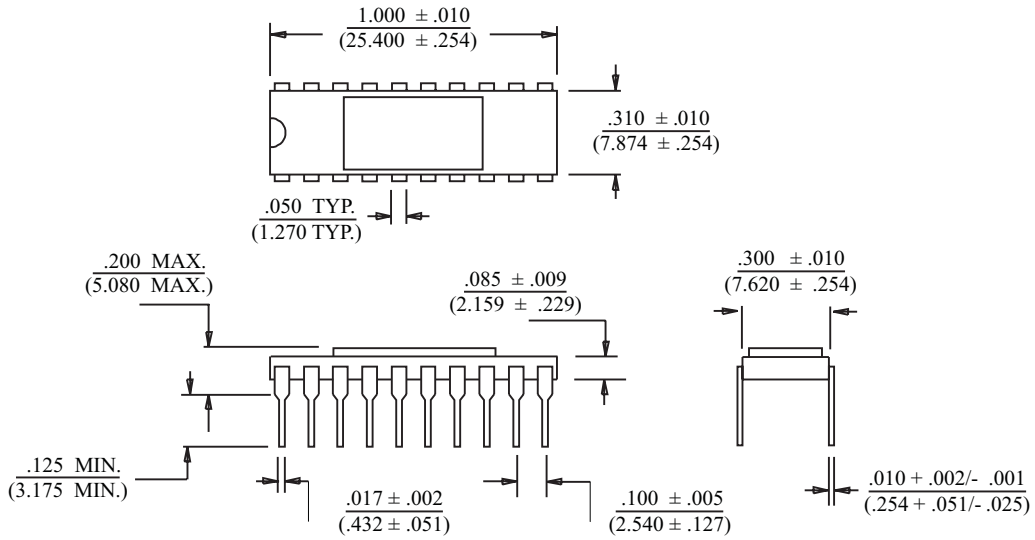
20-PIN PLASTIC SMALL OUTLINE (ESOIC) - WB
(Wide Body, Thermally Enhanced)

Package Type: 24HEW



20-PIN CERAMIC SIDE-BRAZED DIP

PACKAGE TYPE: 20C



44-PIN PLASTIC CHIP-SCALE PACKAGE