HOLT INC.
INTEGRATED CIRCUITS

HI-1584

April 2019

MIL-STD-1553 / 1760
3.3V Monolithic Dual Transceiver

DESCRIPTION

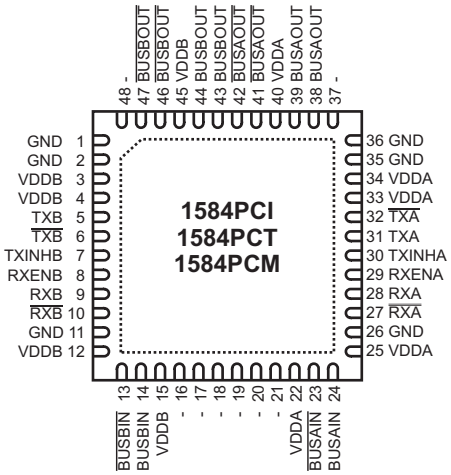
The HI-1584 is an ultra-low power CMOS dual transceiver designed to meet the requirements of the MIL-STD-1553 and MIL-STD-1760 specifications.

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

The receiver section of the each bus converts the 1553 bus bi-phase analog signals to complementary CMOS / TTL data suitable for input to a Manchester decoder. Each receiver has a separate enable input, which forces the receiver outputs to logic "0".

The HI-1584 is housed in a small-footprint, 7 x 7 mm 48-pin plastic chip-scale package (QFN) and is a drop-in replacement for the Data Device Corporation BU-67401L0C0x-102 transceiver.

PIN CONFIGURATION



48 Pin Plastic 7mm x 7mm Chip-Scale Package (QFN)

FEATURES

- Compliant to MIL-STD-1553A and B, MIL-STD-1760 and ARINC 708A
- 3.3V single supply operation
- Smallest footprint available in 7mm x 7mm 48 pin plastic chip-scale package (QFN)
- Industrial and extended temperature ranges
- Drop-in alternative to BU-67401L0C0x-102

APPLICATIONS

- MIL-STD-1553 Terminals
- Flight Control and Monitoring
- Radar Systems
- ECCM Interfaces
- Stores Management
- Test Equipment
- Sensor Interfaces
- Instrumentation

PIN DESCRIPTIONS

PIN	SYMBOL	FUNCTION	DESCRIPTION
1	GND	power supply	Ground
2	GND	power supply	Ground
3	VDDB	power supply	+3.3 volt power for transceiver B
4	VDDB	power supply	+3.3 volt power for transceiver B
5	TXB	digital input	Transmitter B digital data input, non-inverted
6	$\overline{\text{TXB}}$	digital input	Transmitter B digital data input, inverted
7	TXINHB	digital input	Transmit inhibit, bus B. If high BUSBOUT, $\overline{\text{BUSBOUT}}$ disabled
8	RXENB	digital input	Receiver B enable. If low, forces RXB and $\overline{\text{RXB}}$ low
9	RXB	digital output	Receiver B output, non-inverted
10	$\overline{\text{RXB}}$	digital output	Receiver B output, inverted
11	GND	power supply	Ground
12	VDDB	power supply	+3.3 volt power for transceiver B
13	$\overline{\text{BUSBIN}}$	analog input	MIL-STD-1553 bus input B, negative signal
14	BUSBIN	analog input	MIL-STD-1553 bus input B, positive signal
15	VDDB	power supply	+3.3 volt power for transceiver B
16	-	-	Not connected
17	-	-	Not connected
18	-	-	Not connected
19	-	-	Not connected
20	-	-	Not connected
21	-	-	Not connected
22	VDDA	power supply	+3.3 volt power for transceiver A
23	$\overline{\text{BUSAIN}}$	analog input	MIL-STD-1553 bus input A, negative signal
24	BUSAIN	analog input	MIL-STD-1553 bus input A, positive signal
25	VDDA	power supply	+3.3 volt power for transceiver A
26	GND	power supply	Ground
27	$\overline{\text{RXA}}$	digital output	Receiver A output, inverted
28	RXA	digital output	Receiver A output, non-inverted
29	RXENA	digital input	Receiver A enable. If low, forces RXA and $\overline{\text{RXA}}$ low
30	TXINHA	digital input	Transmit inhibit, bus A. If high BUSAOUT, $\overline{\text{BUSAOUT}}$ disabled
31	TXA	digital input	Transmitter A digital data input, non-inverted
32	$\overline{\text{TXA}}$	digital input	Transmitter A digital data input, inverted
33	VDDA	power supply	+3.3 volt power for transceiver A
34	VDDA	power supply	+3.3 volt power for transceiver A
35	GND	power supply	Ground
36	GND	power supply	Ground
37	-	-	Not connected
38	BUSAOUT	analog output	MIL-STD-1553 bus driver A, positive signal
39	BUSAOUT	analog output	MIL-STD-1553 bus driver A, positive signal
40	VDDA	power supply	+3.3 volt power for transceiver A
41	$\overline{\text{BUSAOUT}}$	analog output	MIL-STD-1553 bus driver A, negative signal
42	$\overline{\text{BUSAOUT}}$	analog output	MIL-STD-1553 bus driver A, negative signal
43	BUSBOUT	analog output	MIL-STD-1553 bus driver B, positive signal
44	BUSBOUT	analog output	MIL-STD-1553 bus driver B, positive signal
45	VDDB	power supply	+3.3 volt power for transceiver B
46	$\overline{\text{BUSBOUT}}$	analog output	MIL-STD-1553 bus driver B, negative signal
47	$\overline{\text{BUSBOUT}}$	analog output	MIL-STD-1553 bus driver B, negative signal
48	-	-	Not connected

FUNCTIONAL DESCRIPTION

The HI-1584 dual data bus transceiver contains differential voltage source drivers and differential receivers. It is 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 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 BUSAOUT/$\overline{\text{BUSAOUT}}$ and BUSBOUT/$\overline{\text{BUSBOUT}}$. 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 driven with the same logic state. A logic "1" applied to the TXINHA/B input forces 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 at the BUSAIN/$\overline{\text{BUSAIN}}$ or BUSBIN/$\overline{\text{BUSBIN}}$ pads. The receiver's differential input stage drives a filter and threshold comparator to produce CMOS data at the RXA/B and $\overline{\text{RXA}}/\overline{\text{B}}$ output pins. When the MIL-STD-1553 bus is idle and RXENA or RXENB are high, RXA/B will be logic "0".

The receiver outputs are forced to the bus idle state (logic "0") when RXENA or RXENB is low.

MIL-STD-1553 BUS INTERFACE

A direct-coupled interface (see Figure 2) uses a 1:2.65 turns-ratio isolation transformer and two 55 ohm isolation resistors between the transformer and the bus. The primary center-tap of the isolation transformer must be connected to GND.

In a transformer-coupled interface (see Figure 2), the transceiver is connected to a 1:2.07 turns-ratio isolation transformer which is connected to the main bus using a 1:1.4 coupling transformer. The transformer coupled method also requires two coupling resistors equal to 75% of the bus characteristic impedance (Zo) between the coupling transformer and the bus.

Figure 3 and Figure 4 show test circuits for measuring electrical characteristics of both direct- and transformer-coupled interfaces respectively. (See electrical characteristics on the following pages).

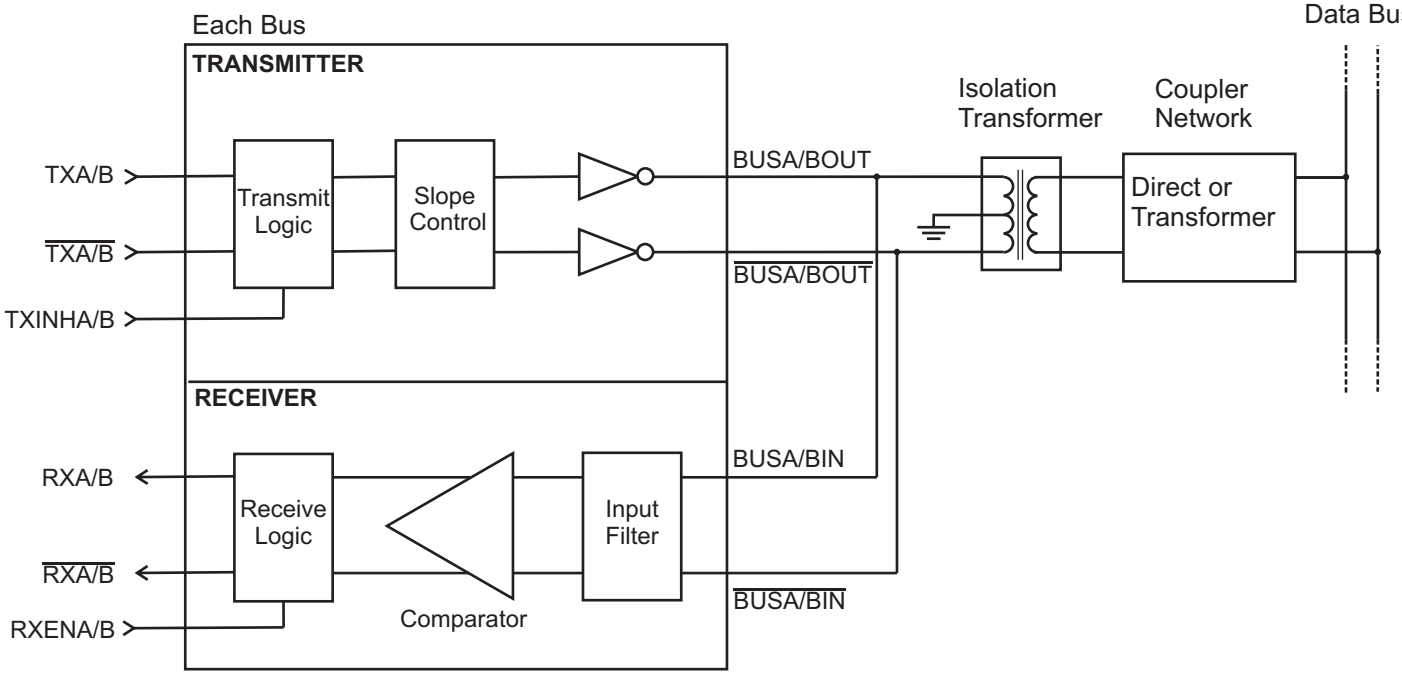
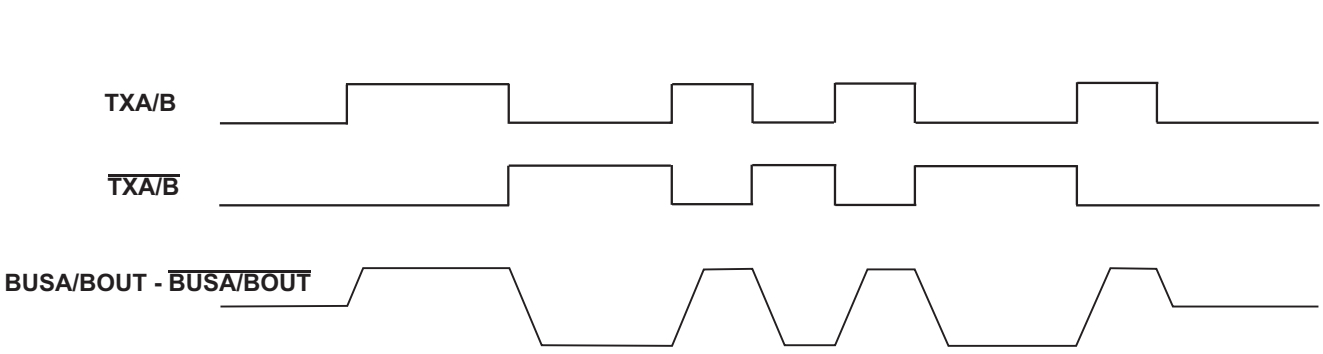
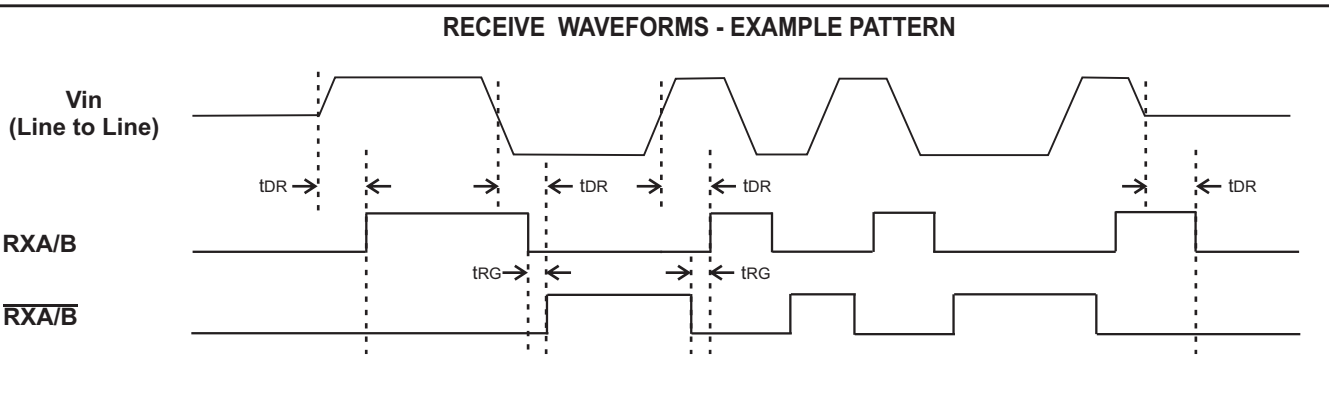


Figure 1. Block Diagram





ABSOLUTE MAXIMUM RATINGS

Supply voltage (V_{DD})	-0.3 V to +4.5 V
Logic input voltage range	-0.3 Vdc to V_{DD} + 0.3 V
Receiver differential voltage	50 Vp-p
Driver peak output current	+1.0 A
Power dissipation at 25°C	1.0 W
Reflow Solder Temperature	260°C
Junction Temperature	175°C
Storage Temperature	-65°C to +150°C

RECOMMENDED OPERATING CONDITIONS

Supply Voltage

V_{DD}..... 3.3V... ±5%

Temperature Range

Industrial ..... -40°C to +85°C
Hi-Temp ..... -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

V_{DD} = 3.14 V to 3.46V, GND = 0V, T_A = Operating Temperature Range (unless otherwise specified).

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS
Operating Voltage	V_{DD}		3.14	3.30	3.46	V
Total Supply Current	I_{CC1}	Not Transmitting		30	40	mA
	I_{CC2}	Transmit one bus @ 50% duty cycle		300	320	mA
	I_{CC3}	Transmit one bus @ 100% duty cycle		625	675	mA
Power Dissipation	PD_1	Not Transmitting		0.1	0.14	W
	PD_2	Transmit one bus @ 100% duty cycle		0.85	0.98	W
Min. Input Voltage (High)	V_{IH}	Digital inputs	70%			V_{DD}
Max. Input Voltage (Low)	V_{IL}	Digital inputs			30%	V_{DD}
Min. Input Current (High)	I_{IH}	Digital inputs			20	µA
Max. Input Current (Low)	I_{IL}	Digital inputs	-20			µA
Min. Output Voltage (High)	V_{OH}	I_{OUT} = -1.0mA, Digital outputs	90%			V_{DD}
Max. Output Voltage (Low)	V_{OL}	I_{OUT} = 1.0mA, Digital outputs			10%	V_{DD}
RECEIVER (Measured at Point "A_D" in Figure 3 unless otherwise specified)						
Input resistance	R_{IN}	Differential (at chip pins)	5			Kohm
Input capacitance	C_{IN}	Differential			5	pF
Common mode rejection ratio	CMRR		40			dB
Input common mode voltage	V_{ICM}		-10.0		10.0	V-pk
Threshold Voltage - Direct-coupled Detect	V_{THD}	1 MHz Sine Wave Measured at Point "A_D" in Figure 3 RXA/B, $\overline{RXA/B}$ pulse width >70 ns	1.15			Vp-p
No Detect	V_{THND}	No pulse at RXA/B, $\overline{RXA/B}$			0.28	Vp-p
Theshold Voltage - Transformer-coupled Detect	V_{THD}	1 MHz Sine Wave Measured at Point "A_T" in Figure 4 RXA/B, $\overline{RXA/B}$ pulse width >70 ns	0.86			Vp-p
No Detect	V_{THND}	No pulse at RXA/B, $\overline{RXA/B}$			0.20	Vp-p

DC ELECTRICAL CHARACTERISTICS (cont.)

V_{DD} = 3.14 V to 3.46 V, 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 3 unless otherwise specified)							
Output Voltage	Direct coupled	V_{OUT}	35 ohm load (Measured at Point "A_D" in Figure 3)	6.0		9.0	Vp-p
	Transformer coupled	V_{OUT}	70 ohm load (Measured at Point "A_T" in Figure 4)	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 3)	-90		90	mV
	Transformer coupled	V_{DYN}	70 ohm load (Measured at Point "A_T" in Figure 4)	-250		250	mV
Output Capacitance		C_{OUT}	1 MHz sine wave			15	pF

AC ELECTRICAL CHARACTERISTICS

V_{DD} = 3.14 V to 3.46 V, GND = 0V, T_A =Operating Temperature Range (unless otherwise specified).

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
RECEIVER (Measured at Point "A_T" in Figure 4 unless otherwise specified)						
Receiver Delay	t_{DR}	From input zero crossing to RXA/B or $\overline{RXA/B}$			450	ns
Receiver gap time	t_{RG}	Spacing between RXA/B and $\overline{RXA/B}$ pulses. 1 MHz sine wave applied at point "AT" Figure 4, amplitude range 0.86 Vp-p to 27.0Vp-p	90		365	ns
Receiver Enable Delay	t_{REN}	From RXENA/B rising or falling edge to RXA/B or $\overline{RXA/B}$			40	ns
TRANSMITTER (Measured at Point "AT" in Figure 4)						
Driver Delay	t_{DT}	TXA/B, TXA/B to BUSA/BOUT, BUSA/BOUT			150	ns
Rise time	tr	70 ohm load	100		300	ns
Fall Time	tf	70 ohm load	100		300	ns
Inhibit Delay	t_{DI-H}	Inhibited output			100	ns
	t_{DI-L}	Active output			150	ns

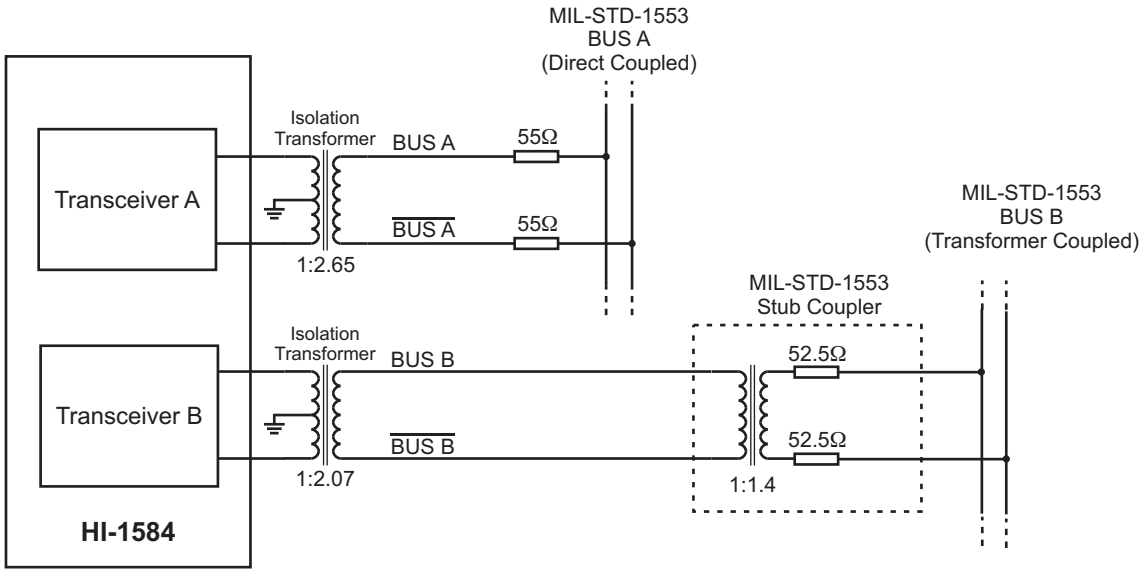


Figure 2. Bus Connection Example

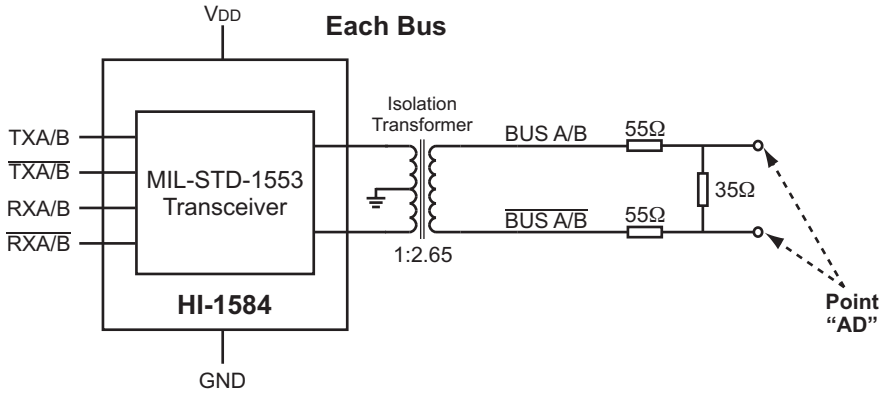


Figure 3. Direct Coupled Test Circuit

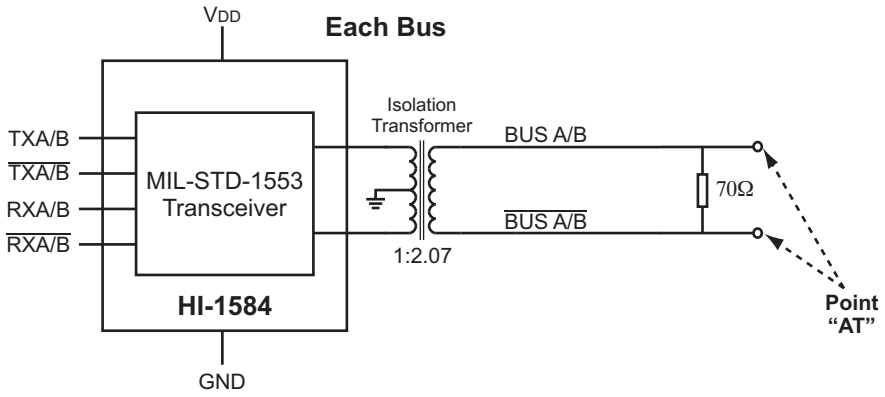


Figure 4. Transformer Coupled Test Circuit

HEAT SINK

The HI-1584PCI/T/M uses a plastic chip-scale package (QFN). These packages include a metal heat sink located on the bottom surface of the device. This heat sink may be soldered down to the printed circuit board for optimum thermal dissipation. The heat sink is electrically isolated and may be soldered to any convenient power or ground plane.

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

HI - 1584 PC x F

PART NUMBER	LEAD FINISH
F	NiPdAu (Pb-free RoHS compliant)

PART NUMBER	TEMPERATURE RANGE	FLOW	BURN IN
I	-40°C TO +85°C	I	No
T	-55°C TO +125°C	T	No
M	-55°C TO +125°C	M	Yes

PART NUMBER	PACKAGE DESCRIPTION
PC	48 PIN PLASTIC CHIP-SCALE PACKAGE QFN (48PCS7)

RECOMMENDED TRANSFORMERS

The HI-1584 transceiver has been characterized for compliance with the electrical requirements of MIL-STD-1553 when used with the following transformers. Holt recommends Premier Magnetics parts as offering the best combination of electrical performance, low cost and small footprint.

MANUFACTURER	PART NUMBER	APPLICATION	TURNS RATIO	DIMENSIONS
Premier Magnetics	PM-DB2779	Isolation	Dual 1:2.65 / 1:2.07	.675 x .400 x .185 inches
Premier Magnetics	PM-DB2702	Stub coupling	1:1.4	.625 x .625 x .250 inches

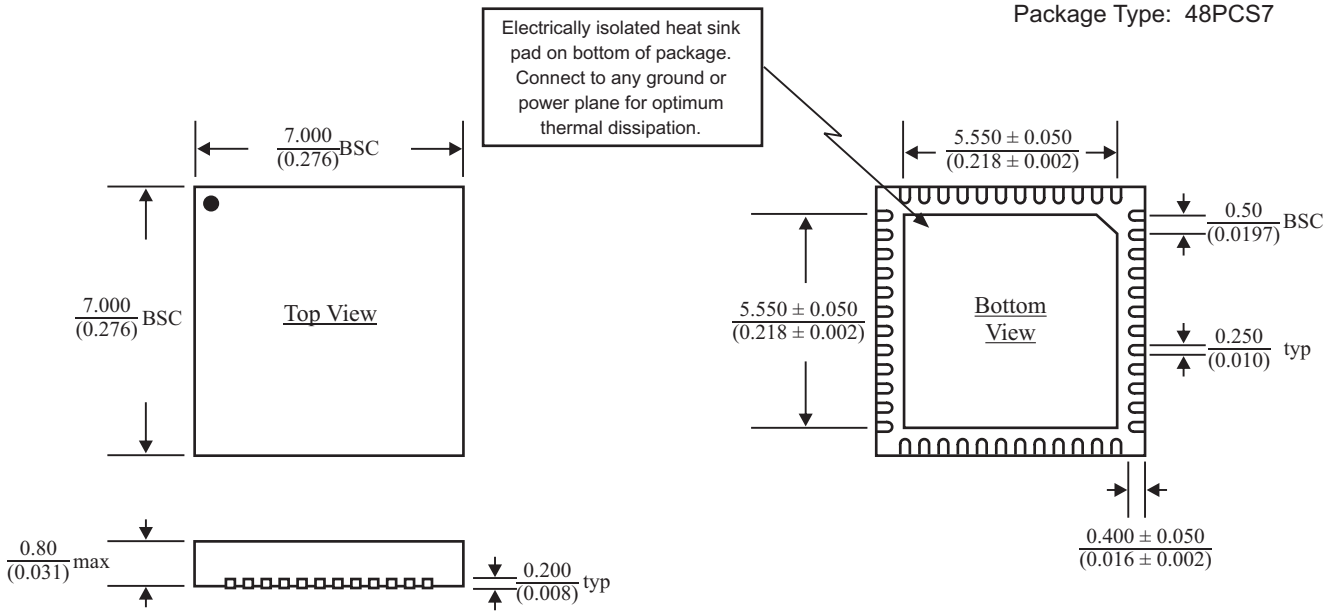
REVISION HISTORY

Document	Rev.	Date	Description of Change
DS1584	New	12/08/15	Initial Release.
	A	02/06/17	Remove Thermal Characteristics Table (refer to web). Update Total Supply Current (Not transmitting) parameter in DC Characteristics Table. Correct other minor typos.
	B	06/05/17	Update Power Dissipation and Power Supply Current parameters.
	C	08/24/17	Remove Power Dissipation bullet from Features.
	D	04/16/19	Update Supply Voltage and Logic Input Voltage Range in Absolute Maximum Ratings Table.

48-PIN PLASTIC CHIP-SCALE PACKAGE (QFN)

millimeters (inches)

Package Type: 48PCS7



BSC = "Basic Spacing between Centers" is theoretical true position dimension and has no tolerance. (JEDEC Standard 95)