HI-15691

MIL-STD-1553 / 1760
5.0V Monolithic Dual Transceivers

November 2021

DESCRIPTION

The HI-15691 is a 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 each bus converts the 1553 bus bi-phase data to complementary CMOS / TTL data suitable for input to a Manchester decoder. Each receiver has a separate enable input, which may be used to force the receiver outputs to logic "0".

The HI-15691 is housed in a 64-pin plastic quad flat pack (PQFP) and is a drop-in replacement for the Holt HI-1569 and the Data Device Corporation BU-63152G3 transceivers.

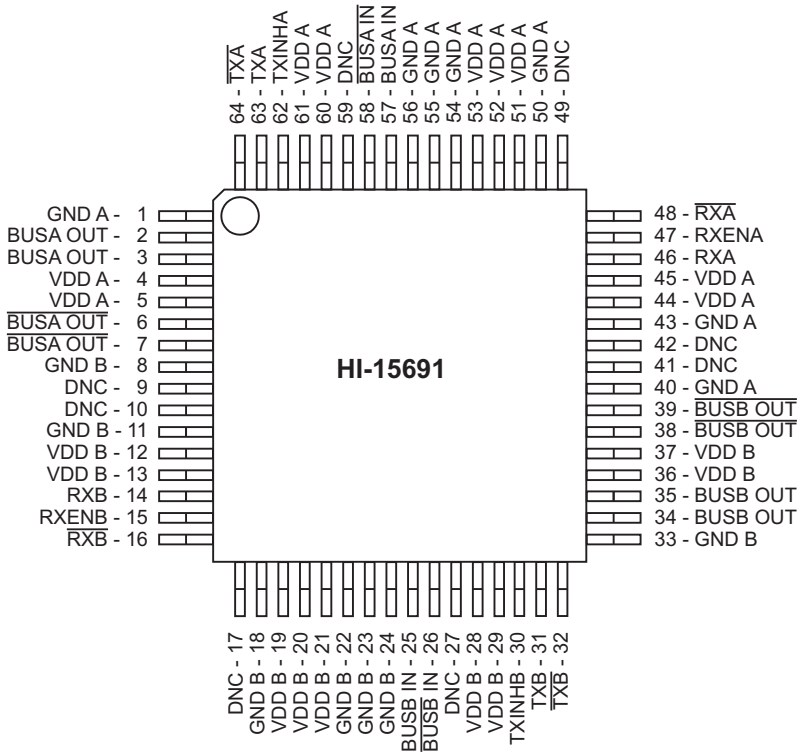
FEATURES

- Compliant to MIL-STD-1553A and B, MIL-STD-1760 and ARINC 708A
- 5.0V single supply operation
- Industrial and extended temperature ranges
- Drop-in alternative for Holt HI-1569 and DDC BU-63152G3 transceivers

APPLICATIONS

- MIL-STD-1553 Terminals
- Flight Control and Monitoring
- Stores Management
- Test Equipment

PIN CONFIGURATIONS



64 - Pin Plastic Quad Flat Pack (PQFP)

PIN DESCRIPTIONS

PIN	SYMBOL	FUNCTION	DESCRIPTION	PULL-UP / PULL-DOWN
1, 40, 43, 50, 54 – 56	GNDA	power supply	Ground for channel A (Connect ALL pins)	
2, 3	BUSA OUT	analog output	MIL-STD-1533 bus driver A, positive signal	
4, 5, 44, 45, 51 – 53, 60, 61	VDDA	power supply	+5 volt power for channel A (Connect ALL pins)	
6, 7	$\overline{\text{BUSA OUT}}$	analog output	MIL-STD-1533 bus driver A, negative signal	
8, 11, 18, 22 – 24, 33	GNDB	power supply	Ground for channel B (Connect ALL pins)	
12, 13, 19 – 21, 28, 29, 36, 37	VDDB	power supply	+5 volt power for channel B (Connect ALL pins)	
14	RXB	digital output	Receiver B output, non-inverted	
15	RXENB	digital input	Receiver B enable. If low, forces RXB and $\overline{\text{RXB}}$ low	Pull-Up
16	$\overline{\text{RXB}}$	digital output	Receiver B output, inverted	
25	BUSB IN	analog input	MIL-STD-1553 bus receiver B, positive signal	
26	$\overline{\text{BUSB IN}}$	analog input	MIL-STD-1553 bus receiver B, negative signal	
30	TXINHB	digital input	Transmit inhibit, channel B. If high BUSB OUT, $\overline{\text{BUSB OUT}}$ disabled	Pull-Down
31	TXB	digital input	Transmitter B digital data input, non-inverted	Pull-Down
32	$\overline{\text{TXB}}$	digital input	Transmitter B digital data input, inverted	Pull-Down
34, 35	BUSB OUT	analog output	MIL-STD-1533 bus driver B, positive signal	
38, 39	$\overline{\text{BUSB OUT}}$	analog output	MIL-STD-1533 bus driver B, negative signal	
46	RXA	digital output	Receiver A output, non-inverted	
47	RXENA	digital input	Receiver B enable. If low, forces RXB and $\overline{\text{RXB}}$ low	Pull-Up
48	$\overline{\text{RXA}}$	digital output	Receiver B output, inverted	
57	BUSA IN	analog input	MIL-STD-1553 bus receiver A, positive signal	
58	$\overline{\text{BUSA IN}}$	analog input	MIL-STD-1553 bus receiver A, negative signal	
62	TXINHA	digital input	Transmit inhibit, channel A. If high BUSA OUT, $\overline{\text{BUSA OUT}}$ disabled	Pull-Down
63	TXA	digital input	Transmitter A digital data input, non-inverted	Pull-Down
64	$\overline{\text{TXA}}$	digital input	Transmitter A digital data input, inverted	Pull-Down
9, 10, 17, 27 41, 42, 49, 59	NC	-	Not connected internally	

FUNCTIONAL DESCRIPTION

The HI-15691 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 /TTL inputs TXA/B and $\overline{\text{TXA/B}}$. The transmitter accepts Manchester II bi-phase data and converts it to differential voltages on BUSA/B OUT and $\overline{\text{BUSA/B OUT}}$. 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 $\overline{\text{TXA/B}}$ 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 $\overline{\text{TXA/B}}$.

RECEIVER

The receiver accepts bi-phase differential data from the MIL-STD-1553 bus through a direct or transformer coupled interface. The receiver's differential input stage drives a filter and threshold comparator that produces CMOS/TTL data at the RXA/B and $\overline{\text{RXA/B}}$ 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 can be independently forced to the bus idle state (logic "0") when RXENA or RXENB are 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 2), 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 impedance (Zo) between the coupling transformer and the bus.

In both direct coupled and transformer coupled cases, the primary center-tap of the isolation transformer must be connected to GND.

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).

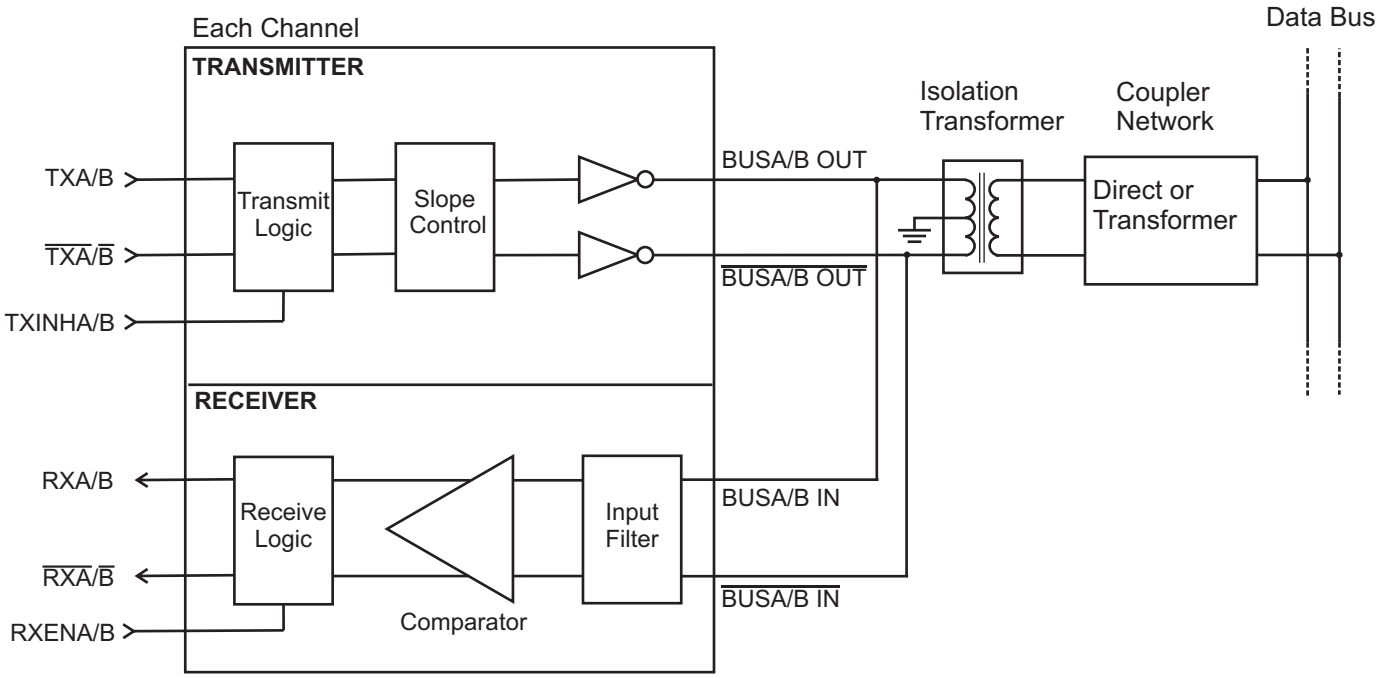
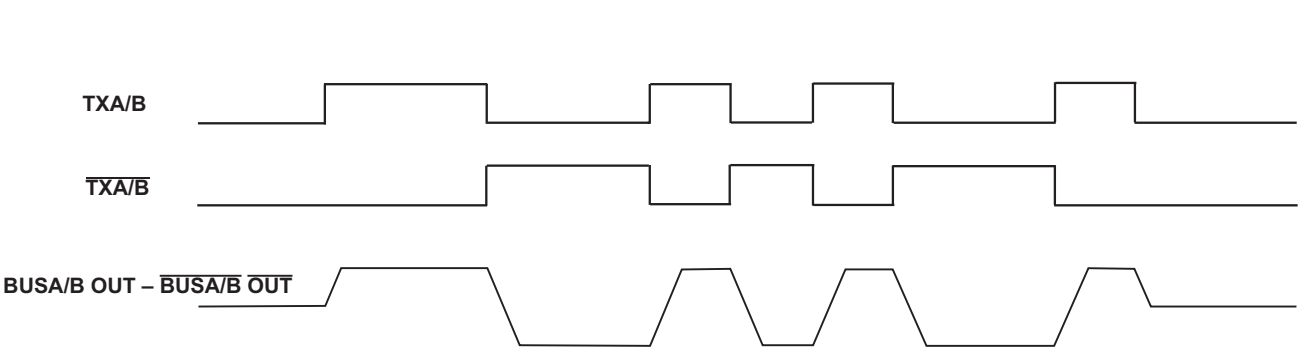
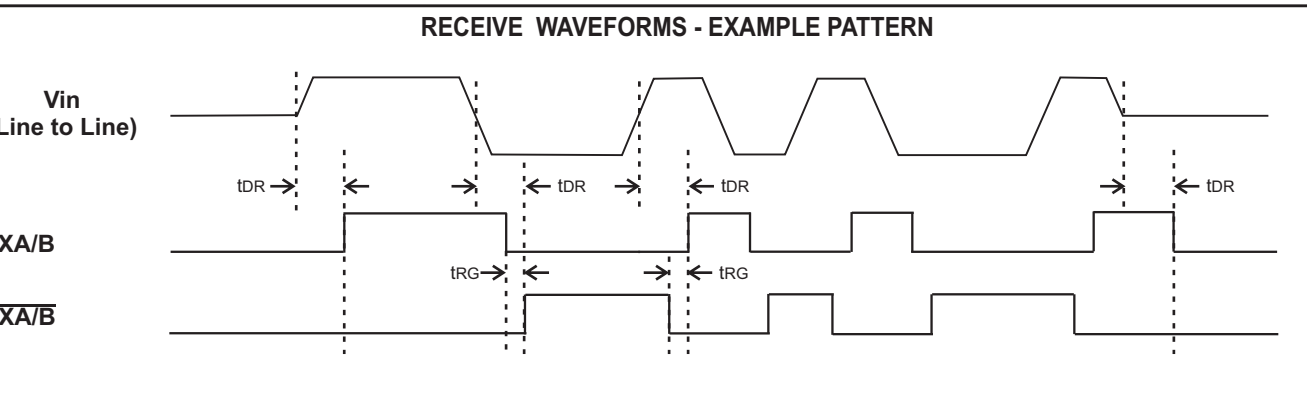


Figure 1. Block Diagram





ABSOLUTE MAXIMUM RATINGS

Supply voltage (V_{DD})	-0.3 V to +7 V
Logic input voltage range	-0.3 Vdc to V_{DD}+0.3 V
Receiver differential voltage	50 Vp-p
Reflow Solder Temperature	260°C
Junction Temperature	175°C
Storage Temperature	-65°C to +150°C

RECOMMENDED OPERATING CONDITIONS

Supply Voltage

V_{DD}..... 5.0V... ±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} = 5.0 V, GND = 0V, T_A = Operating Temperature Range (unless otherwise specified).

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS
Operating Voltage	V_{DD}		4.75	5.00	5.25	V
Total Supply Current	I_{CC1}	Not Transmitting		25	40	mA
	I_{CC2}	Transmit one bus @ 50% duty cycle		303	360	mA
	I_{CC3}	Transmit one bus @ 100% duty cycle		580	680	mA
Power Dissipation	PD_1	Not Transmitting		0.13	0.21	W
	PD_2	Transmit one bus @ 100% duty cycle			1.35	W
Input Voltage (HI)	V_{IH}	Digital inputs	2.0		V_{DD}	V
Input Voltage (LO)	V_{IL}	Digital inputs	0		0.8	V
Input Current (HI)	I_{IH}	Digital inputs (pull-downs), V_{IH} = 5V	5	30	110	µA
Input Current (LO)	I_{IL}	Digital inputs (pull-ups), V_{IL} = 0V	-110	-30	-5	µA
Output Voltage (HI)	V_{OH}	V_{DD} = 4.75V, I_{OH} = max	4.0			V
Output Voltage (LO)	V_{OL}	V_{DD} = 4.75V, I_{OL} = min			0.4	V
Output Current (HI)	I_{OH}				-2.4	mA
Output Current (LO)	I_{OL}		4.0			mA
RECEIVER(Measured at Point "A_D" in Figure 3 unless otherwise specified)						
Input resistance	R_{IN}	Differential (at chip pins)	2.5			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}		-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} = 5.0 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

VDD = 5.0 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)						
Receiver Delay	t_{DR}	From input zero crossing to RXA/B or $\overline{RXA/B}$			450 Note 3	ns
Receiver gap time	t_{RG}	Spacing between RXA/B and $\overline{RXA/B}$ pulses	90 Note 1		365 Note 2	ns
Receiver Enable Delay	t_{REN}	From RXENA/B rising or falling edge to RXA/B or $\overline{RXA/B}$			100	ns
TRANSMITTER (Measured at Point "A_D" in Figure 3)						
Driver Delay	t_{DT}	TXA/B, $\overline{TXA/B}$ to BUSA/B OUT, $\overline{BUSA/B\ OUT}$			150	ns
Rise time	tr	35 ohm load	100		300	ns
Fall Time	tf	35 ohm load	100		300	ns
Inhibit Delay	t_{DI-H}	Inhibited output			400	ns
	t_{DI-L}	Active output			250	ns

Note 1. Measured using a 1 MHz sinusoid, 20 V peak to peak, line to line at point "AT" (Guaranteed but not tested).

Note 2. Measured using a 1 MHz sinusoid, 860 mV peak to peak, line to line at point "AT" (100% tested).

Note 3. Measured using a 1 MHz sinusoid, 860 mV peak to peak, line to line at point "AT". Measured from input zero crossing point.

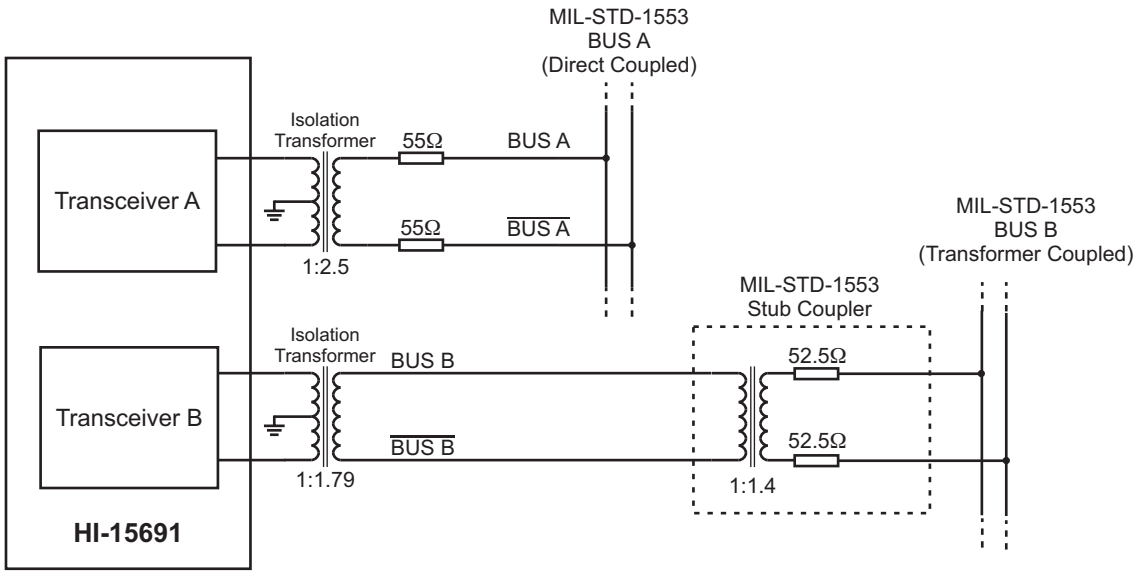


Figure 2. Bus Connection Example using HI-15691

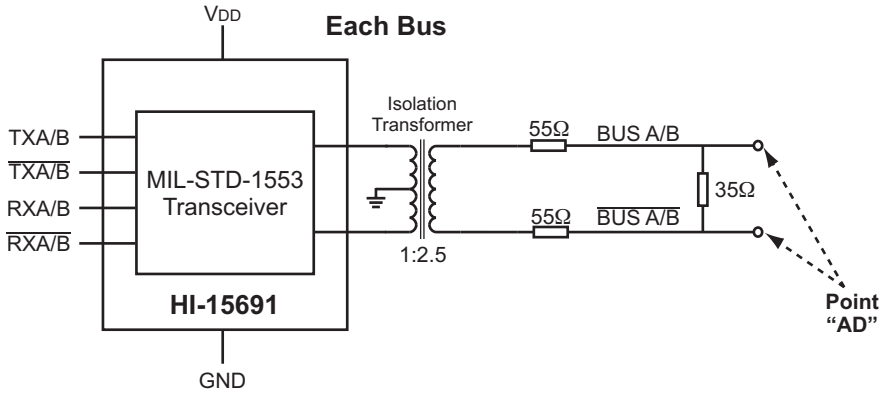


Figure 3. Direct Coupled Test Circuit

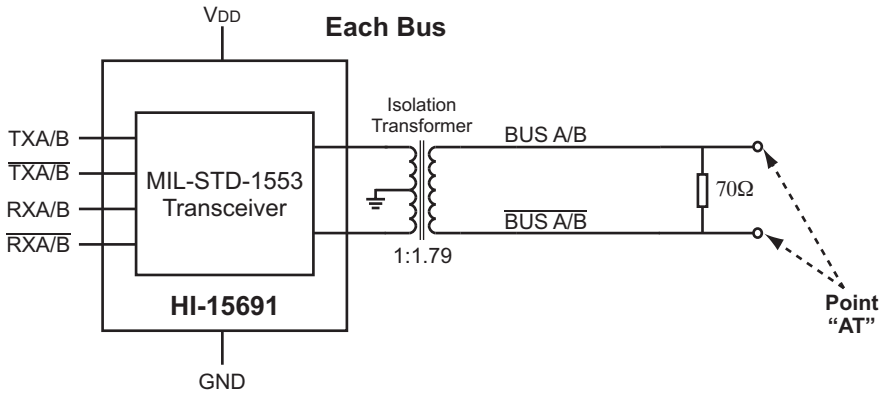


Figure 4. Transformer Coupled Test Circuit

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 - 15691PQ x x (Plastic)

PART NUMBER	LEAD FINISH
Blank	Tin / Lead (Sn / Pb) Solder
F	100% Matte Tin (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	RXENA = 0		RXENB = 0		PACKAGE DESCRIPTION
	RXA	$\overline{\text{RXA}}$	RXB	$\overline{\text{RXB}}$	
15691PQ	0	0	0	0	64 PIN PLASTIC PQFP (64LPQS)

RECOMMENDED TRANSFORMERS

The HI-15691 transceiver have 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(S)	DIMENSIONS
Premier Magnetics	PM-DB2725EX	Isolation	Dual ratio 1:1.79, 1:2.5	0.4 x 0.4 x 0.242 inches
Premier Magnetics	PM-DB2702	Stub coupling	1:1.4	.625 x .625 x .250 inches
Premier Magnetics	PM-DB-2791S	Isolation	1:2.5	0.4 x 0.4 x 0.185 inches
Premier Magnetics	PM-DB-2795S	Isolation	1:1.79	0.4 x 0.4 x 0.185 inches
Premier Magnetics	PM-DB-2798S	Isolation	Dual ratio 1:1.79, 1:2.5	0.4 x 0.4 x 0.185 inches
Premier Magnetics	PM-DB-2762	Isolation	Dual core 1:2.5	0.4 x 0.4 x 0.320 inches
Premier Magnetics	PM-DB-2766	Isolation	Dual core 1:1.79	0.4 x 0.4 x 0.320 inches

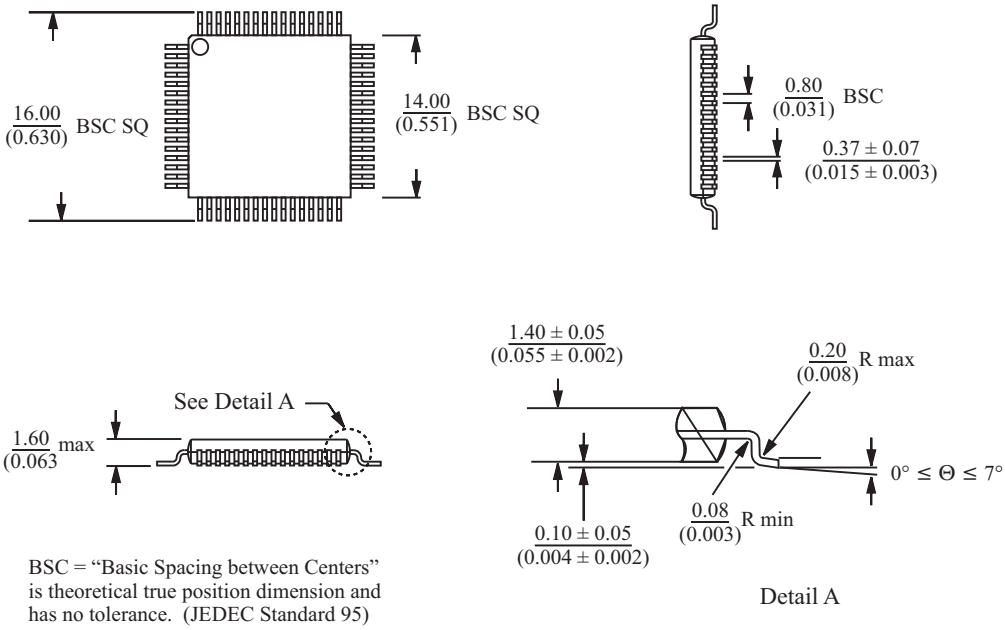
REVISION HISTORY

Document	Rev.	Date	Description of Change
DS15691	New	11/16/2021	Initial Release.

64 PIN PLASTIC QUAD FLAT PACK (PQFP)

millimeters (inches)

Package Type: 64LPQS



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