HOLT INTEGRATED CIRCUITS INC.

HI-15690

MIL-STD-1553 / 1760
5.0V Monolithic Transceiver

December 2021

DESCRIPTION

The HI-15690 is a low power CMOS transceiver designed to meet the requirements of the MIL-STD-1553 and MIL-STD-1760 specifications.

The transmitter section takes complementary CMOS / TTL Manchester II bi-phase data and converts it to differential voltages suitable for driving the bus isolation transformer. A transmitter inhibit control signal is also provided for the transmitter.

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

The HI-15690 is housed in a 32-pin plastic leadless chip-carrier package (QFN) with an integral exposed heatsink on the package bottom. The heatsink may be optionally soldered to the PCB ground plane for optimal thermal dissipation. The device is also available in a 24-pin ceramic side-brazed DIP.

The QFN package version is a drop-in replacement for the Data Device Corporation BU-63155L3 transceiver and the ceramic DIP version is a drop-in replacement for the DDC BUS-63105 and BUS-63107 transceivers.

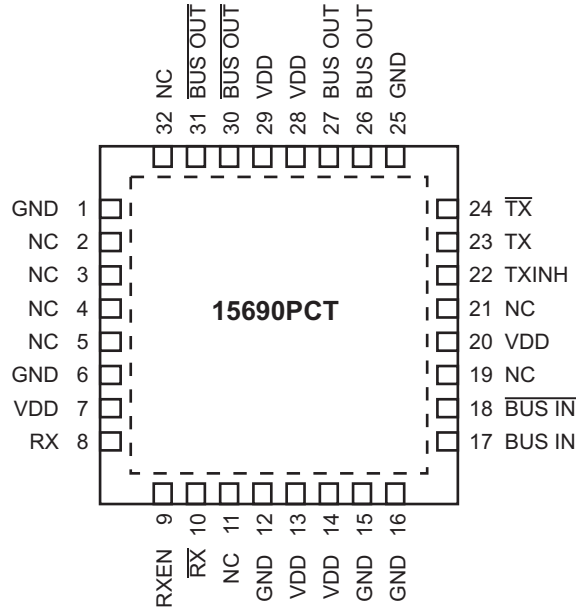
APPLICATIONS

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

FEATURES

- Compliant to MIL-STD-1553A and B, MIL-STD-1760 and ARINC 708A
- 5.0V single supply operation
- Small 7mm x 7mm 32-pin plastic chip-scale package (QFN)
- Industrial and extended temperature ranges
- Drop-in alternative for DDC BU-63155L3 (QFN) and BUS-63105 / BUS-63107 (ceramic DIP) transceivers

PIN CONFIGURATIONS



32 Pin Plastic 7mm x 7mm QFN

PIN DESCRIPTIONS (HI-15690PCx)

PIN	SYMBOL	FUNCTION	DESCRIPTION	PULL-UP / PULL-DOWN
1	GND	power supply	Ground (Connect ALL pins)	
2	NC	-	Not connected internally	
3	NC	-	Not connected internally	
4	NC	-	Not connected internally	
5	NC	-	Not connected internally	
6	GND	power supply	Ground (Connect ALL pins)	
7	VDD	power supply	+5 volt power (Connect ALL pins)	
8	RX	digital output	Receiver output, non-inverted	
9	RXEN	digital input	Receiver enable. If low, forces RX and $\overline{RX}$ low	Pull-Up
10	$\overline{RX}$	digital output	Receiver output, inverted	
11	NC	-	Not connected internally	
12	GND	power supply	Ground (Connect ALL pins)	
13	VDD	power supply	+5 volt power (Connect ALL pins)	
14	VDD	power supply	+5 volt power (Connect ALL pins)	
15	GND	power supply	Ground (Connect ALL pins)	
16	GND	power supply	Ground (Connect ALL pins)	
17	BUS IN	analog input	MIL-STD-1553 bus receiver, positive signal	
18	$\overline{BUS\ IN}$	analog input	MIL-STD-1553 bus receiver, negative signal	
19	NC	-	Not connected internally	
20	VDD	power supply	+5 volt power (Connect ALL pins)	
21	NC	-	Not connected internally	
22	TXINH	digital input	Transmit inhibit. If high BUS OUT, $\overline{BUS\ OUT}$ disabled	Pull-Down
23	TX	digital input	Transmitter digital data input, non-inverted	Pull-Down
24	$\overline{TX}$	digital input	Transmitter digital data input, inverted	Pull-Down
25	GND	power supply	Ground (Connect ALL pins)	
26	BUS OUT	analog output	MIL-STD-1533 bus driver, positive signal	
27	BUS OUT	analog output	MIL-STD-1533 bus driver, positive signal	
28	VDD	power supply	+5 volt power (Connect ALL pins)	
29	VDD	power supply	+5 volt power (Connect ALL pins)	
30	$\overline{BUS\ OUT}$	analog output	MIL-STD-1533 bus driver, negative signal	
31	$\overline{BUS\ OUT}$	analog output	MIL-STD-1533 bus driver, negative signal	
32	NC	-	Not connected internally	

PIN DESCRIPTIONS (HI-15690CDx)

PIN	SYMBOL	FUNCTION	DESCRIPTION	PULL-UP / PULL-DOWN
1	BUS OUT	analog output	MIL-STD-1533 bus driver, positive signal	
2	$\overline{\text{BUS OUT}}$	analog output	MIL-STD-1533 bus driver, negative signal	
3	GND	power supply	Ground (Connect ALL pins)	
4	NC[1]	-	Not connected internally	
5	NC	-	Not connected internally	
6	NC	-	Not connected internally	
7	RX	digital output	Receiver output, non-inverted	
8	RXEN	digital input	Receiver enable. If low, forces RX and $\overline{\text{RX}}$ low	Pull-Up
9	GND	power supply	Ground (Connect ALL pins)	
10	$\overline{\text{RX}}$	digital output	Receiver output, inverted	
11	NC	-	Not connected internally	
12	NC	-	Not connected internally	
13	NC	-	Not connected internally	
14	NC	-	Not connected internally	
15	BUS IN	analog input	MIL-STD-1553 bus receiver, positive signal	
16	$\overline{\text{BUS IN}}$	analog input	MIL-STD-1553 bus receiver, negative signal	
17	NC	-	Not connected internally	
18	GND	power supply	Ground (Connect ALL pins)	
19	NC	-	Not connected internally	
20	VDD	power supply	+5 volt power	
21	TXINH	digital input	Transmit inhibit. If high BUS OUT, $\overline{\text{BUS OUT}}$ disabled	Pull-Down
22	TX	digital input	Transmitter digital data input, non-inverted	Pull-Down
23	$\overline{\text{TX}}$	digital input	Transmitter digital data input, inverted	Pull-Down
24	NC	-	Not connected internally	

Note 1: All pins labeled “NC” are not connected internally and may be safely connected to any source or left floating.

FUNCTIONAL DESCRIPTION

The HI-15690 data bus transceiver contains a differential voltage source driver and differential receiver. It is intended for applications using a MIL-STD-1553 A or 1553B 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 TX and $\overline{TX}$. The transmitter accepts Manchester II bi-phase data and converts it to differential voltages on BUS OUT and $\overline{BUS\ OUT}$. The transceiver output is 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 TX and $\overline{TX}$ are driven with the same logic state. A logic "1" applied to the TXINH input forces the transmitter to the high impedance state, regardless of the state of TX and $\overline{TX}$.

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 RX and $\overline{RX}$ output pins. When the MIL-STD-1553 bus is idle and RXEN is high, RX will be logic "0".

The receiver output can be independently forced to the bus idle state (logic "0") when RXEN is 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).

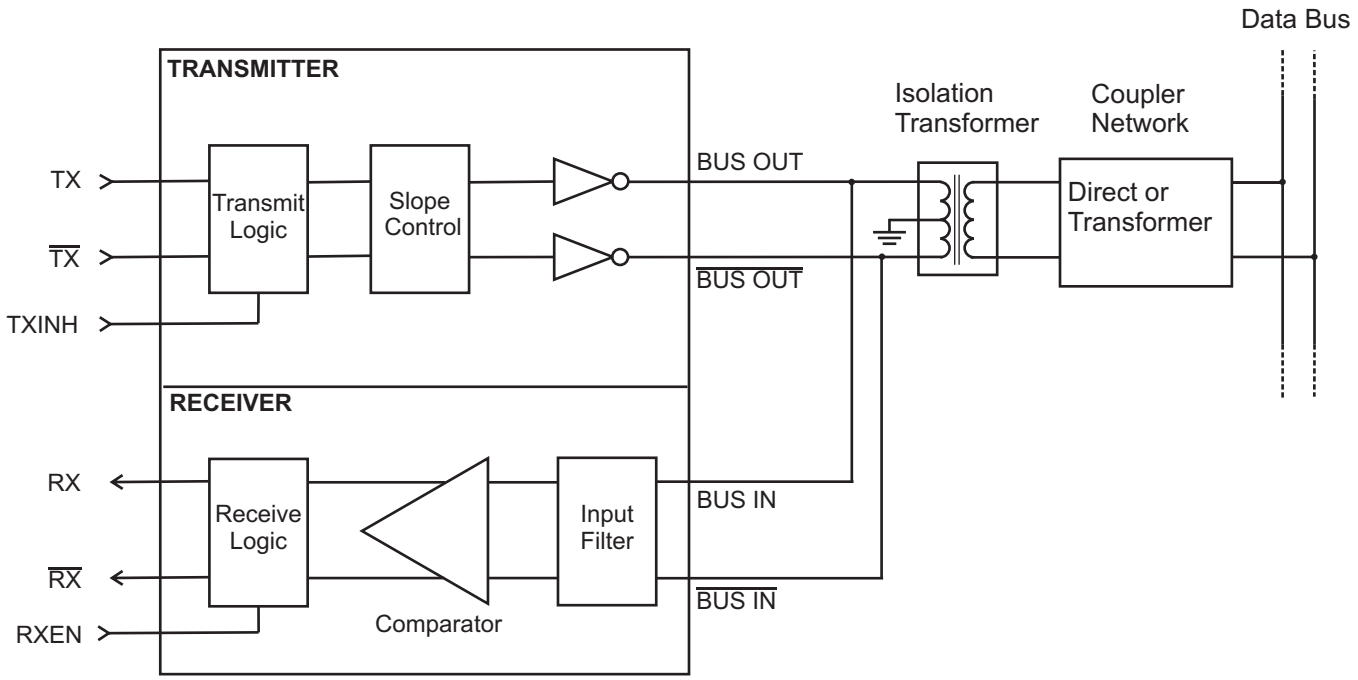
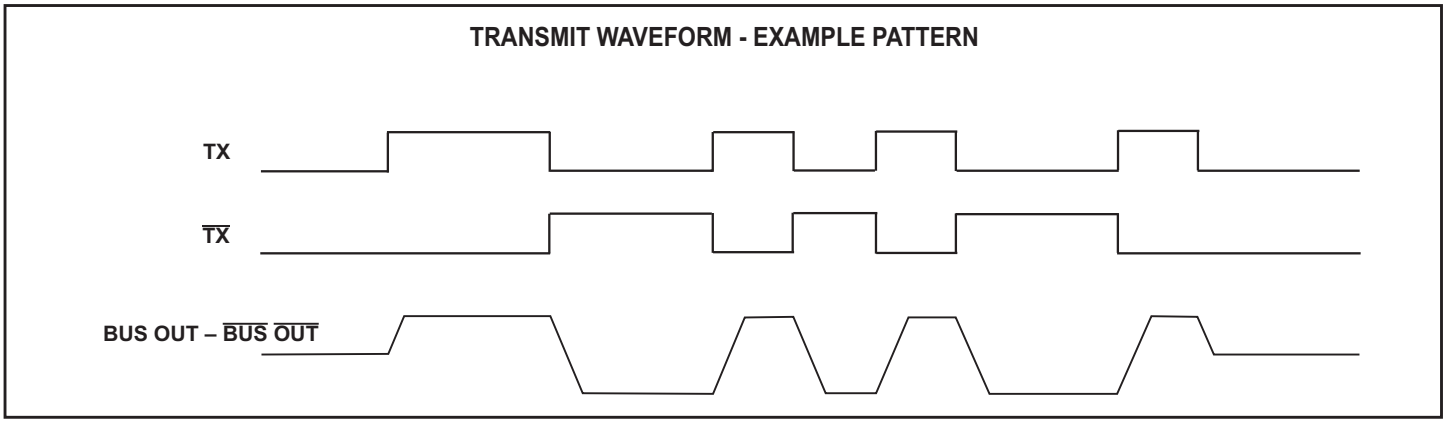
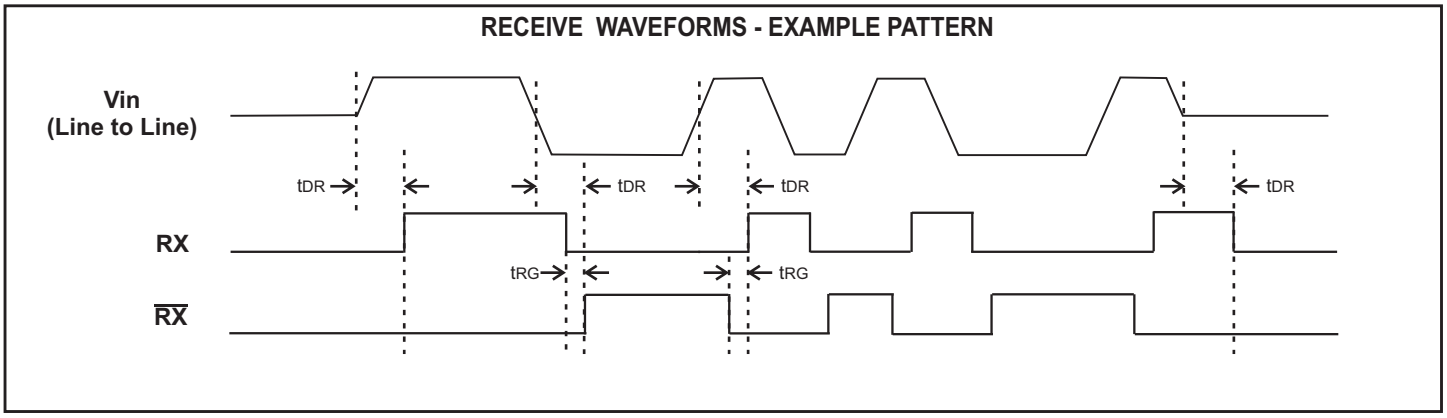


Figure 1. Block Diagram





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		12	20	mA
	I_{CC2}	Transmit one bus @ 50% duty cycle		285	335	mA
	I_{CC3}	Transmit one bus @ 100% duty cycle		560	650	mA
Power Dissipation	PD_1	Not Transmitting		0.20	0.25	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 RX, $\overline{RX}$ pulse width >70 ns	1.15			Vp-p
No Detect	V_{THND}	No pulse at RX, $\overline{RX}$			0.28	Vp-p
Theshold Voltage - Transformer-coupled Detect	V_{THD}	1 MHz Sine Wave Measured at Point "A_T" in Figure 4 RX, $\overline{RX}$ pulse width >70 ns	0.86			Vp-p
No Detect	V_{THND}	No pulse at RX, $\overline{RX}$			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 RX or $\overline{RX}$			450 Note 3	ns
Receiver gap time	t_{RG}	Spacing between RX and $\overline{RX}$ pulses	90 Note 1		365 Note 2	ns
Receiver Enable Delay	t_{REN}	From RXEN rising or falling edge to RX or $\overline{RX}$			100	ns
TRANSMITTER (Measured at Point "A_D" in Figure 3)						
Driver Delay	t_{DT}	TX, $\overline{TX}$ to BUS OUT, $\overline{BUS\ OUT}$			250	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.

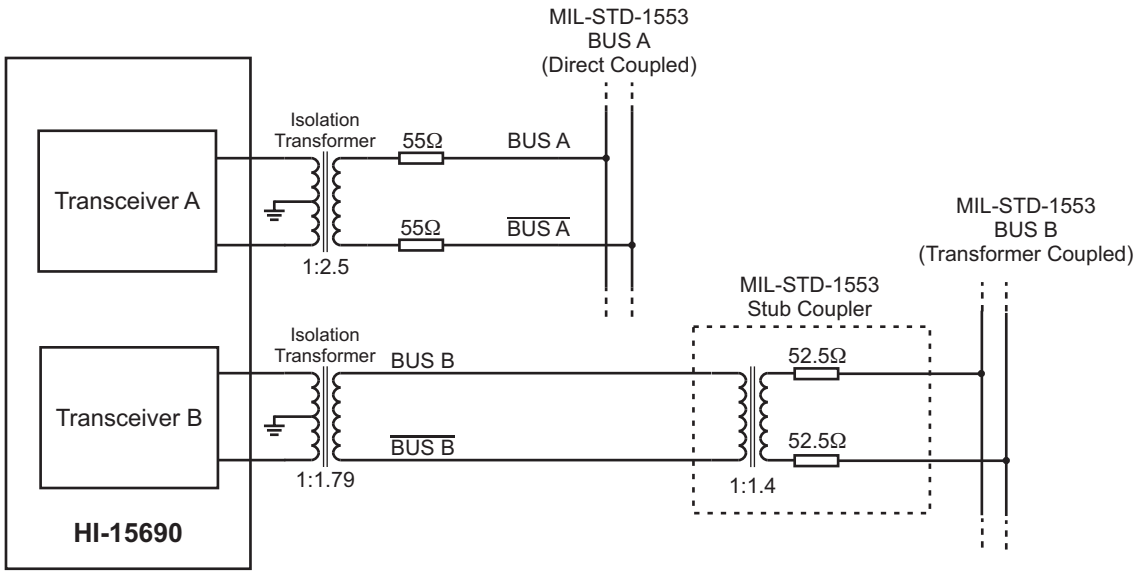


Figure 2. Bus Connection Example using HI-15690

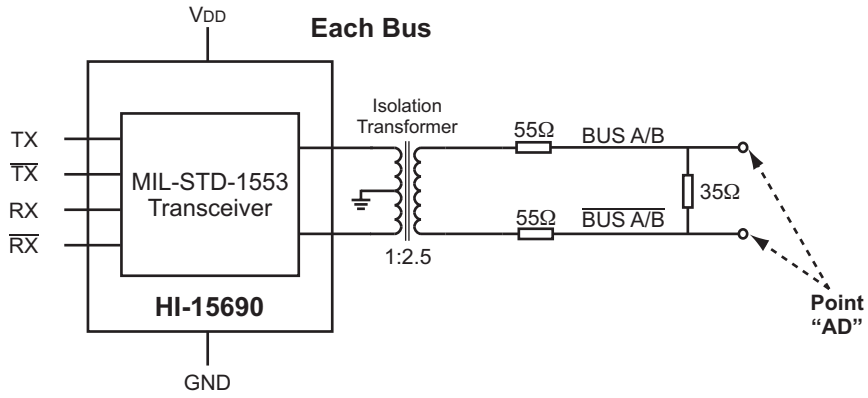


Figure 3. Direct Coupled Test Circuit

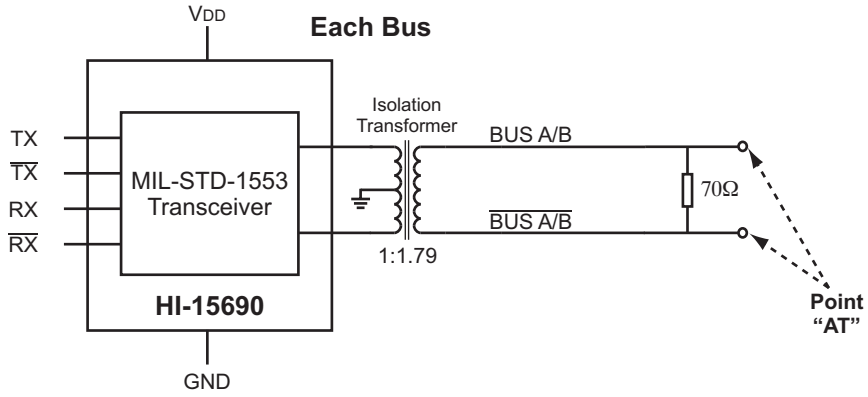


Figure 4. Transformer Coupled Test Circuit

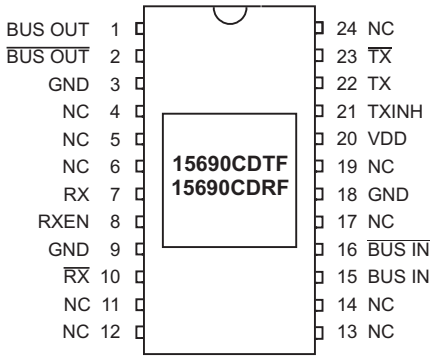
HEAT SINK - CHIP-SCALE PACKAGE

The HI-15690PCx uses a 32-pin thermally enhanced QFN package. The package includes 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.

ADDITIONAL PIN CONFIGURATIONS



24 Pin Ceramic Side-Brazed DIP

ORDERING INFORMATION

HI - 15690PC x x (Plastic)

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

* Compatible with both leaded and lead-free assemblies.

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	$\overline{\text{RXB}}$	
15690PC	0	0	0	0	32 PIN PLASTIC CHIP-SCALE PACKAGE (QFN) (32PCS7)

HI - 15690CD x (Ceramic)

PART NUMBER	TEMPERATURE RANGE	FLOW	BURN IN	MIL-PRF-38535 COMPLIANT	LEAD FINISH
T	-55°C TO +125°C	T	NO	NO	Gold (Pb-free, RoHS compliant)
R	-55°C TO +125°C	R	YES	YES	Tin / Lead (Sn / Pb) Solder

PART NUMBER	RXENA = 0		RXENB = 0		PACKAGE DESCRIPTION
	RXA	$\overline{\text{RXA}}$	RXB	$\overline{\text{RXB}}$	
15690CD	0	0	0	0	24 PIN CERAMIC SIDE BRAZED DIP (24C)

RECOMMENDED TRANSFORMERS

The HI-15690 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-DB2725	Isolation	Dual ratio 1:1.79, 1:2.5	.625 x .625 x .250 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

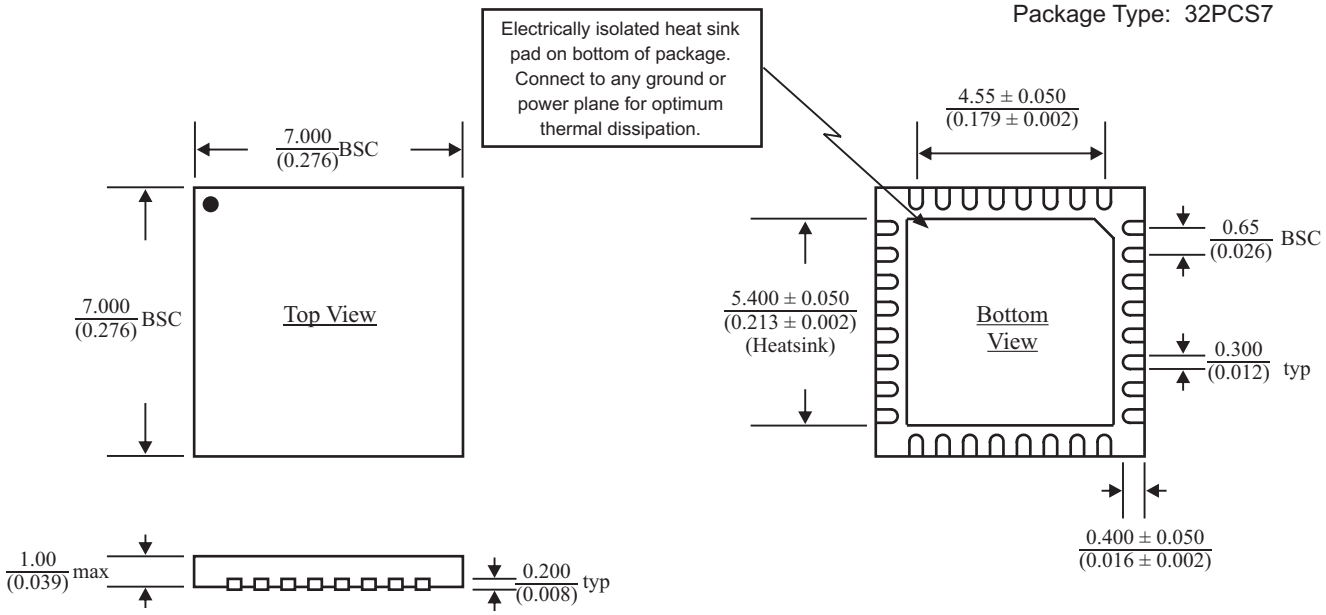
REVISION HISTORY

Document	Rev.	Date	Description of Change
DS15690	New	11/16/2021	Initial Release.
	A	12/092021	Correct lead finish on “CDR” parts. Drop “F” designator from ceramic parts.

32-PIN PLASTIC CHIP-SCALE PACKAGE (QFN)

millimeters (inches)

Package Type: 32PCS7

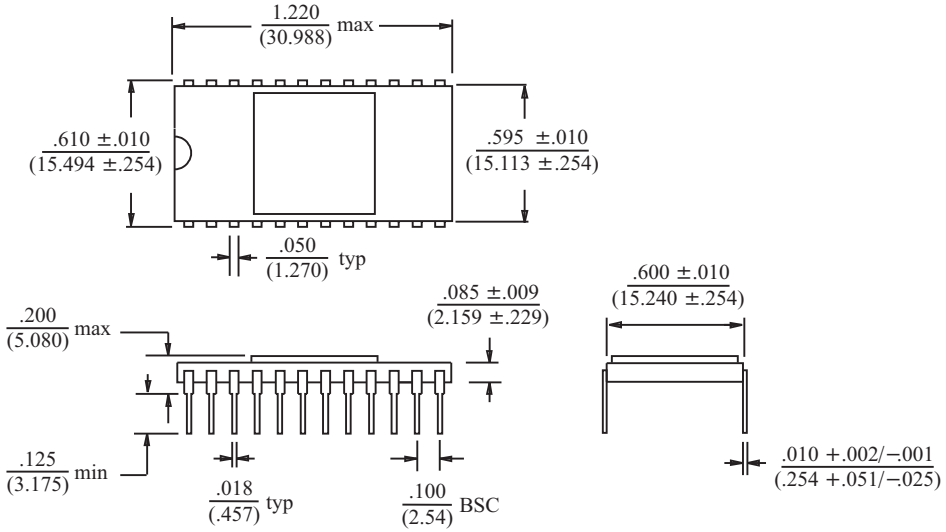


BSC = "Basic Spacing between Centers" is theoretical true position dimension and has no tolerance. (JEDEC Standard 95)

24-PIN CERAMIC SIDE-BRAZED DIP

inches (millimeters)

Package Type: 24C



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