HI-1590 1553B Dual Transceiver with SPI Amplitude Control Evaluation Board

April 2018

REVISION HISTORY

Revision	Date	Description of Change
AN-1590 Rev. New	10-10-14	Initial Release
Rev. A	03-14-17	Reformat document to newer template. Update schematic to correct error in wiring of J1, Bus B connector. Remove obsolete section on Freescale Development Tools. New Instructions included separately with Kit.
Rev. B	04-09-18	Update schematic and BOM to include TVS hot switching protection diodes.

INTRODUCTION

The Holt HI-1590 Evaluation Board demonstrates features of the HI-1590 MIL-STD-1553B dual transceiver IC. This device transmits and receives Manchester encoded 20 bit MIL-STD-1553B serial data suitable bus transformers. Transceiver drive amplitude can be digitally adjusted from 0 to 26 Vp-p through the SPI interface. Adjustment can also be made with a 0 to 3.3VDC analog control signal; a potentiometer is provided for this. Amplitude controls for both buses are ganged together. In SPI mode, a low range option allows for more accurate amplitude adjustment from 0 to 4.9 Vp-p. The board runs from a single 3.3V ±5% supply voltage. A MIL-STD-1553B protocol message generator and receiver are included on the board to demonstrate the HI-1590 features. The EVM (Evaluation Module) includes a microcontroller that generates the SPI messages, the interface is through a terminal emulator connected to a PC through the USB interface. The EVM is shown in the picture below:

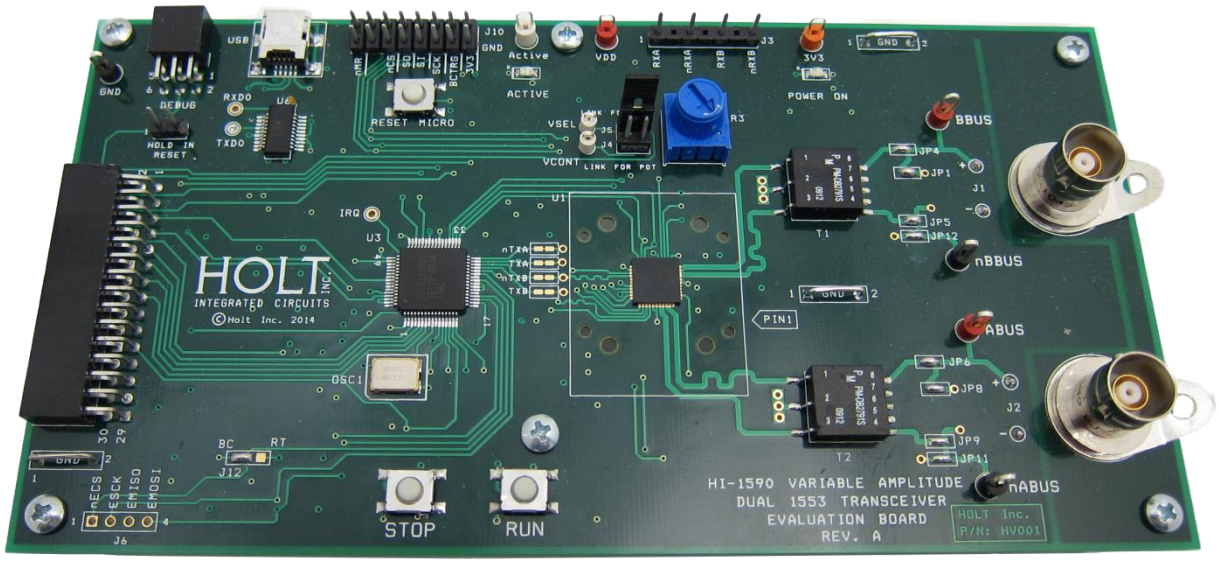


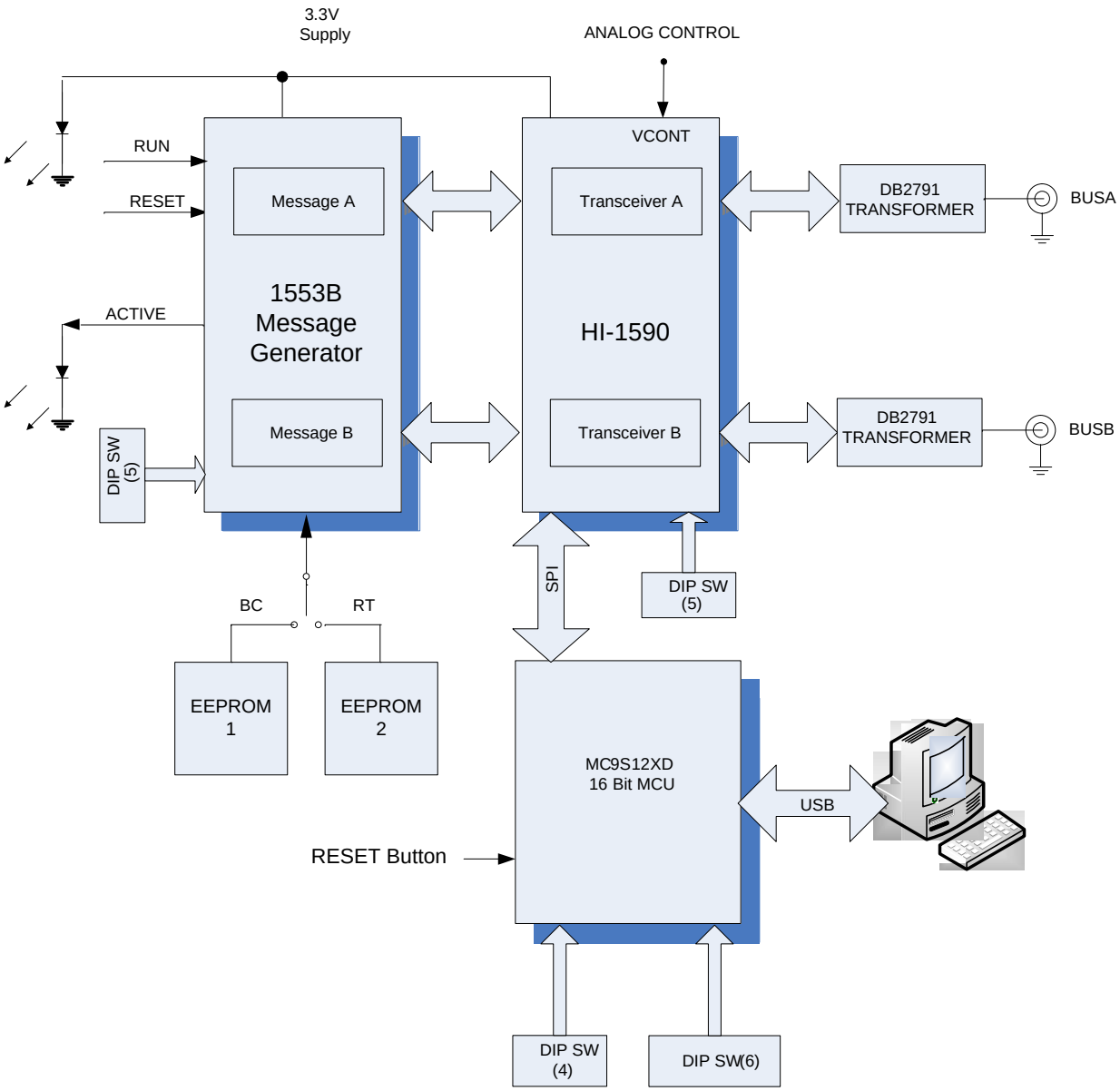
Fig 1 – HI-1590 Evaluation Board

This guide summarizes how to set up and running quickly.

KIT CONTENTS

- This User Guide
- HI-1590 Evaluation Board
- Mini USB Serial Cable.

Board Block Diagram



LED Functions

REF	NAME	DEFAULT	DESCRIPTION
LED1	POWER	ON	Indicated when 3.3V power is present
LED2	ACTIVE	OFF	Flashes at the start of a 1553 message transmit sequence

Link Jumper Functions

REF	NAME	DEFAULT	DESCRIPTION
J4	LINK FOR POT	OFF	Link to use potentiometer R3 to adjust output amplitude
J5	LINK FOR SPI	ON	Link to use SPI to adjust output amplitude
J8	HOLD IN RESET	OFF	Holds the microcontroller in reset, for instance while using an external SPI interface.
J12	BC/RT	BC	Connects memory for BC or RT messages

Wired Jumper Functions (JP)

REF	NAME	DEFAULT	DESCRIPTION
JP1		ON	Link to use on-board 70 Ω load on Bus B output
JP8		ON	Link to use on-board 70 Ω load on Bus A output
JP2, 3, 4, 5		JP4, 5 ON	Option links for transformer variants, Bus B
JP6, 7, 9, 10		JP6, 9 ON	Option links for transformer variants, Bus A
JP11		ON	Connects Bus A negative output to ground
JP12		ON	Connects Bus B negative output to ground
JP13-16		ON	Cut if using an external 1553 message generator

Switch Functions

REF	NAME	DEFAULT	DESCRIPTION
SW1/1	VSEL	ON	Selects output control of amplitude range, using SPI. ON = SPI control 0-24V, Low = SPI, 0-2.4V
SW1/2	TXAINH	OFF	Inhibits the transmitter output of transceiver A
SW1/3	TXBINH	OFF	Inhibits the transmitter output of transceiver B
SW1/4	RXAEN	ON	Enables the receiver of transceiver A
SW1/5	RXBEN	ON	Enables the receiver of transceiver B
SW3	RUN		Press = Starts 1553 messages
SW4	STOP		Press = Stops 1553 messages
SW5/1-5	AUTOEN etc	01101	Message loading control (leave in default)
SW6/1-6	RT1A4:0, RT1AP	000000	RT Address (only used if RT mode available)
SW7	RESET		Press to reset the microcontroller and control software

Connector Functions

REF	NAME	DESCRIPTION
J1	BUSB	1553 Bus A connection (secondary of transformer)
J2	BUSA	1553 Bus B connection (secondary of transformer)
J3/ 1,2	RXA/nRXA	Differential Logic signal from HI-1590 Bus A receive data pins
J3/ 3,4	RXB/nRXB	Differential Logic signal from HI-1590 Bus B receive data pins
J6	Not fitted	SPI interface for the EEPROMs
J7		Data connector to load 1553 messages
J9	USB	Connect to PC to send SPI commands from terminal emulator
J10	External SPI	Use to connect an external SPI for HI-1590 control
J11	Debug Header	Used for downloading microcontroller firmware

Test Point Functions

REF	NAME	DESCRIPTION
TP1/TP2	BUSB	1553 Bus B connection (secondary of transformer)
TP4/TP6	BUSA	1553 Bus A connection (secondary of transformer)
TP3, 8,9,10	GND	Board Ground
TP5	VCONT	Connection to measure of input analog amplitude control, note that J5 should be open. J4 should be open when inputting a voltage.
TP6	UPDATE	Test point for Update signal indicates when MIL-STD-1553B word has been received
TP7	VSEL	This pin monitors voltage on the VSEL pin control on the output amplitude. High = SPI control 0-24V Float = Analog Control Low = SPI Control, 0-5.1V
TP3, 8, 9, 10	GND	Board Ground
TP11	3V3	VLOGIC Supply, connect power supply here
TP21	VDD	VLOGIC after supply filter
TP13	IRQ	INTERRUPT
TP14	ACTIVE	Produces pulse just before 1553 message starts, can be used to trigger scope.
TP17/18	TXDO/RXDO	USB data.
	TXA, nTXA	Connect external 1553 data here if not using the on board message generator for BUSA. Need to cut links TXA and nTXA.
	TXB, nTXB	Connect external 1553 data here if not using the on board message generator for BUSB. Need to cut links TXB and nTXB.

Using the Board

1. Check all the link and switch positions comply with the tables above. Connect a 3.3V, 1A supply to the 3V3 test point. A 1A supply current is required at maximum amplitude. Verify the 'Power On' LED is lit; the board should take about 160mA, when not sending 1553 messages. Connect the mini USB lead to your PC and then to the HI-1590 board. Your PC should automatically install the driver, if not the driver FT231 can be installed from the Holt CD. If you have problems installing the driver please refer to the FTDI website below:

   http://www.ftdichip.com/Documents/InstallGuides.htm

2. All control of the HI-1590 is done through the 'Control Console'. This requires use of a terminal emulator for communication, such as HyperTerminal or Tera Term. Tera Term is used with Windows versions of Vista or later and is supplied on the Holt CD.

   To install Tera Term:

   Use the Tera Term installer program teraterm.exe from the Holt CD. Accept the license agreement stating redistribution is permitted provided that copyright notice is retained. The notice can be displayed from the Tera Term window by clicking **Help** then clicking **About Tera Term**. Continuing to install…

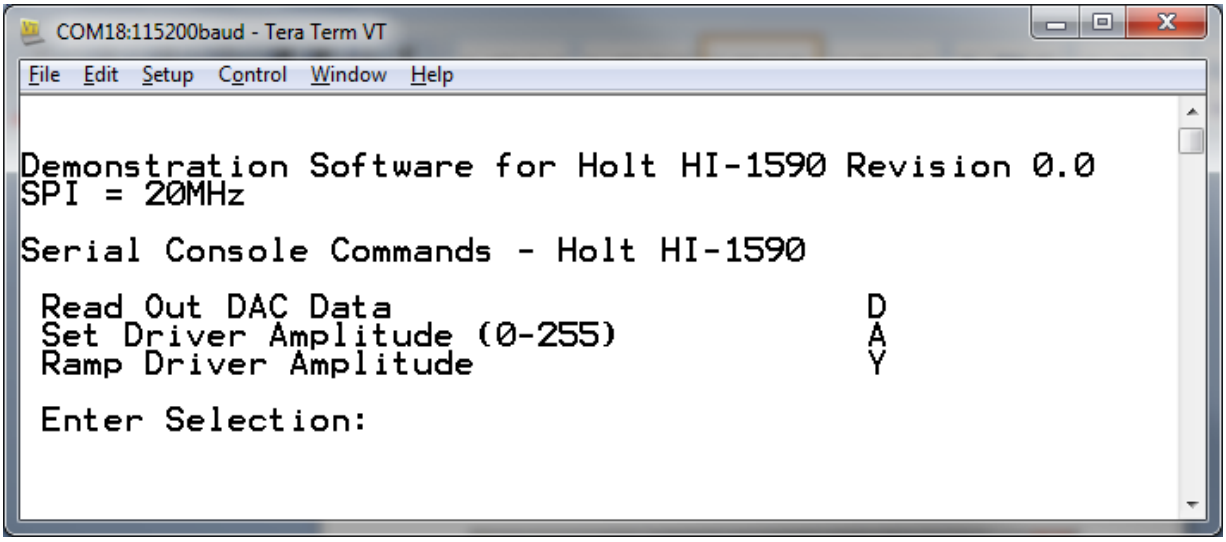
   - Accept the default install destination and click **Next**.
   - At the Select Components screen, unselect all options except Additional Plugin = TTXResizeMenu and click **Next**.
   - Select the installed language, then click **Next**.
   - Accept the default Start Menu folder, then click **Next**.
   - Select any desired shortcuts, then click **Next**.
   - At the Ready to Install screen, click **Install**.

   Run the Tera Term program. At the **New Connection** screen, select **Serial** and choose the selected USB serial COM port, you can find the correct COM port using **Device Manager**.

3. Click **Setup** then **Serial Port** to open the serial port setup window.

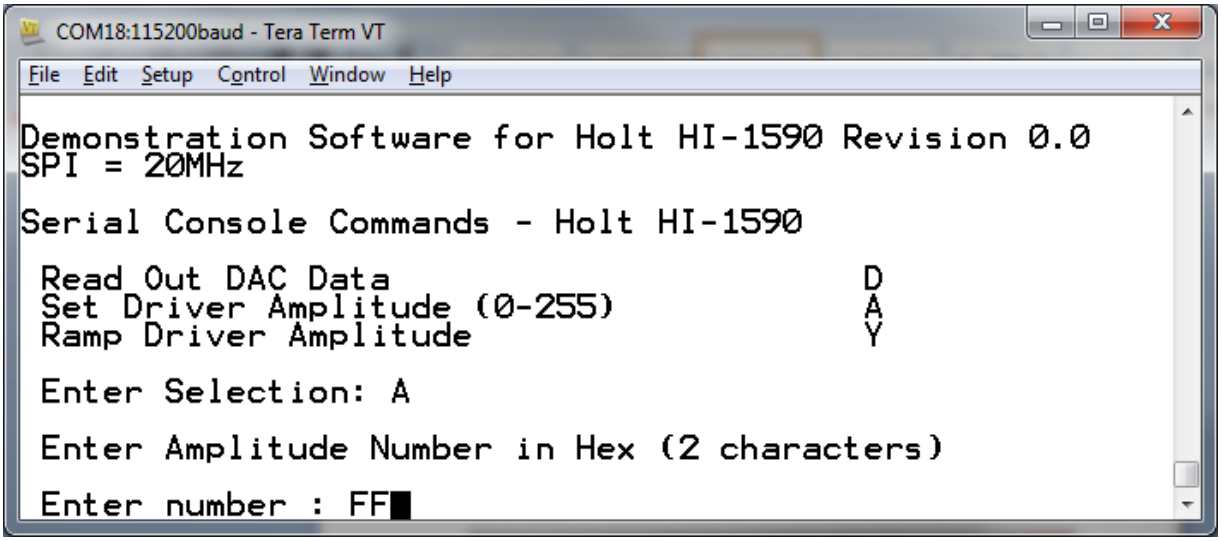
   Choose the COM port for the mini-USB connection and then select the following settings: Baud Rate: 115200, Data: 8 bits, Parity: none, Stop: 1 bit, Flow Control: none

4. The evaluation software is preprogrammed into the microcontroller and was loaded at the Holt Applications Support Center. On pressing the 'RESET MICRO' button on the board, the software displays a message on the monitor, as shown below.



Note: If under any circumstances the software locks up, use the 'RESET' key to restart.

5. Press the 'A' key to set the output amplitude. Enter the maximum amplitude of 'FF' as shown below.



6. Connect an oscilloscope to the ABUS and BBUS terminal, with the grounds going to nABUS and nBBUS respectively. Grounding the negative bus terminals provides differential voltage measurements using just one scope probe per bus. Trigger the scope from the ACTIVE test point. Press the STOP button, this loads the 1553 messages. Press the RUN button to start message transmission. The messages will be transmitted alternately on the A and B buses. Check that a 1553 signal of about 24V p-p amplitude is seen on one of the buses, as shown in Fig 2 below. Every 5 seconds it will switch to the other bus and during transmission you should see the 3.3V supply current go up to about 1A.

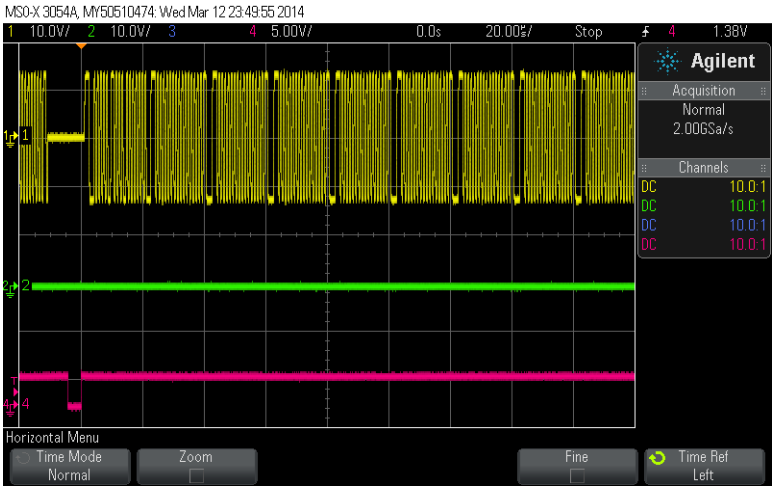
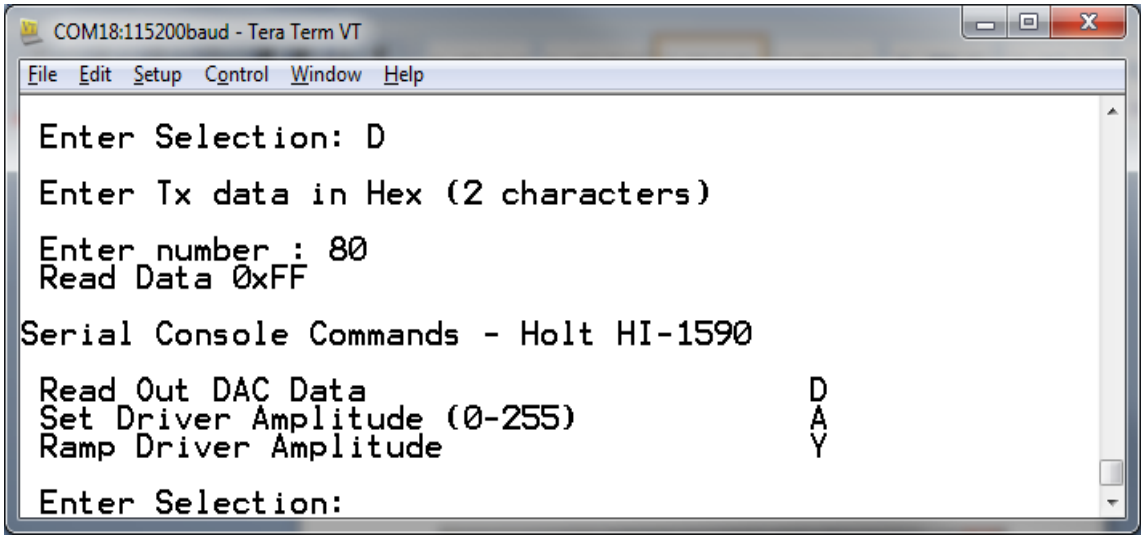


Fig 2: Yellow is BUSA output, green is BUSB, Red is the ACTIVE trigger signal

7. The HI-1590 can also read back data from the DAC register but only after a value has been written into the register. Press the 'D' key, type in '80', the previous setting of 'FF' should be read out as shown below. Observe the amplitude on the scope; this should be reduced by half, or approximately 12V p-p.



8. The SPI software has a ramp function, this ramps the amplitude on both outputs up to maximum and back down to zero in a 'sawtooth' function. Press the 'Y' button and observe the amplitude rising and falling. Whilst in this mode switch the VSEL switch to 'Low', this selects the low amplitude, you should see the oscilloscope trace go down to one fifth maximum amplitude or about 5V.

9. As well as SPI control of amplitude through a DAC, the HI-1590 has the option of using an analog voltage of 0 to 3.3VDC to control the amplitude. To use this feature move the jumper

link from J5 to J4. Now amplitude is controlled by potentiometer R3, turn fully clockwise for maximum amplitude. An external voltage can be used by removing the J4 jumper and applying the voltage to pin 2 of J4. The range is 0 to VLOGIC (3.3V nominal)

10. To test HI-1590 BusA and BusB receivers, RXENA and/or RXENB switches should be in the high position. Any 1553B compliant data is now output on the relevant RXA/nRXA and RXB/nRXB pins of J3. An example is shown in Fig 3 below:

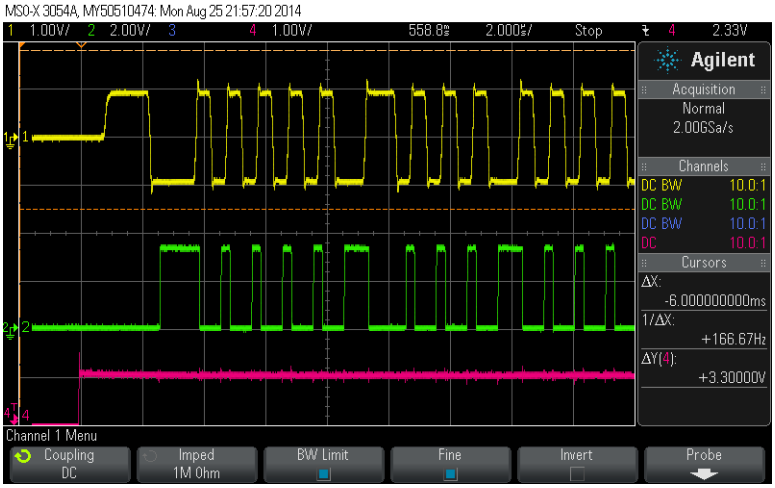
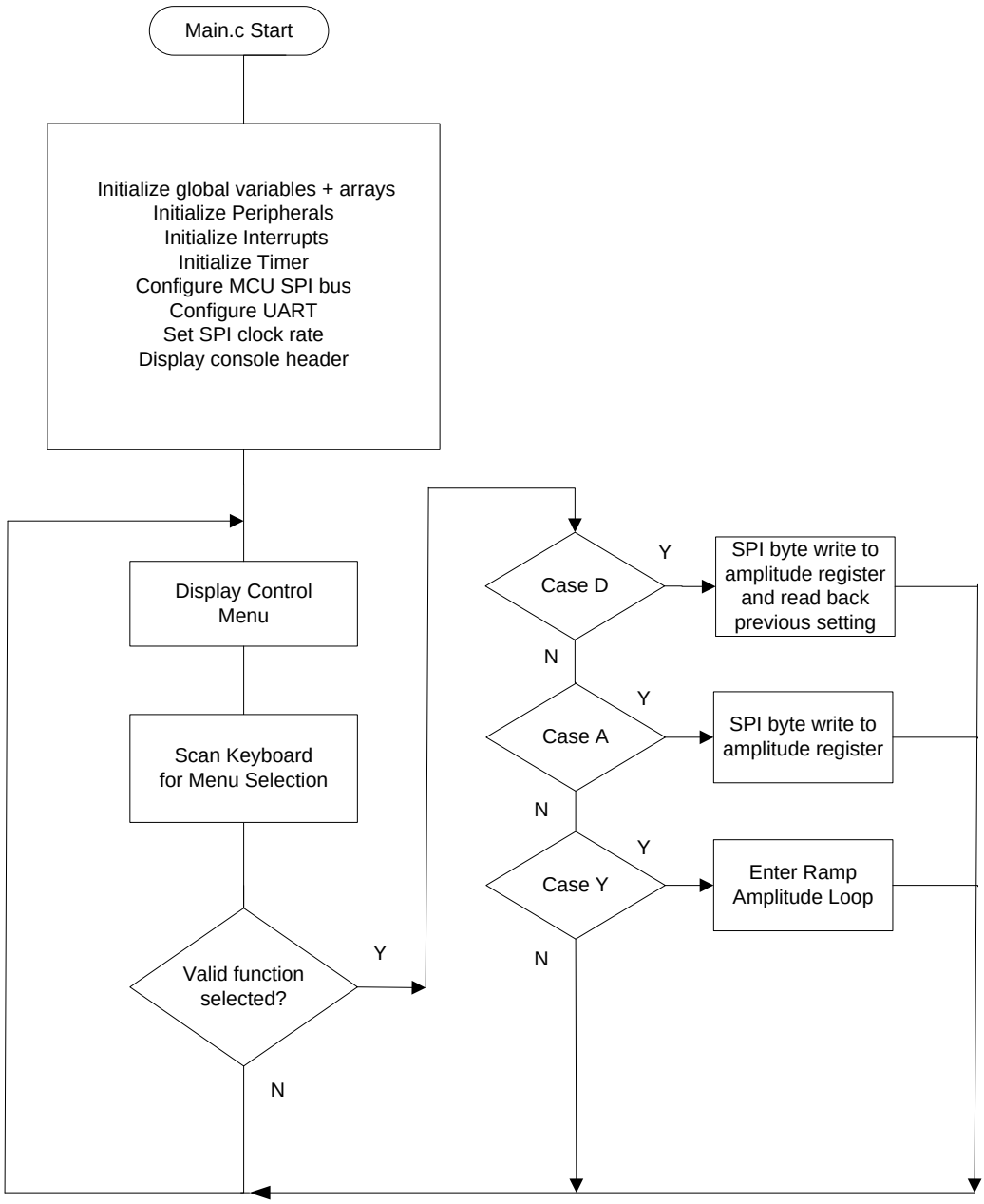


Fig 3: Yellow is BUSA output, green is RXA output, Red is the ACTIVE trigger signal

11. If isolation of the 1553B outputs is required from the board ground the soldered jumpers JP11 and JP12 should be opened.

Appendix 1 Demo software overview

This overview flow chart shows the demo program at a glance.



At reset the program initializes the variables and configures the peripherals including the SPI block, Timers, Interrupts and serial communication UART. The program then enters Serial Command mode, this is an endless loop that continuously samples the keyboard. Once a key is pressed the

The program enters a case function that selects which function to call.

There is one write function that just writes a byte to the amplitude control register, a read function that writes data to the amplitude register whilst simultaneously reading back the previous byte. The third function is a loop that ramps up the amplitude to maximum and then ramps down, taking about 4 secs to complete this cycle. This last function is an endless loop that is interrupted by pressing any key.

MCU Clock and SPI Frequencies

The Freescale MC9S12XDT512 (MCU) on the main board uses a 4MHz crystal for operation and the built-in PLL multiplies this by 20 to achieve an 80MHz system clock. This system clock is divided by two for a 40MHz Bus Clock, used internally for the MCU peripherals.

The PLL is programmed to multiply by 20 by this line of code in the Peripherals.c module:

```
SYNR = 9;                   // 80MHz PLL system clock
```

The SPI frequency is set at the beginning of the main.c module, by this code :

```
    SPI0BR = 0x00;          // 20MHz SPI
//  SPI0BR = 0x01;          // 10MHz SPI
//  SPI0BR = 0x02;          // 5MHz SPI
```

The speeds that are not used are commented out. In this case the 10MHz and 5MHz are commented out, so the 20MHz option is set. The maximum SPI frequency for the HI-1590 is 20MHz, the code can be altered to set a lower rate of 10MHz or 5MHz, if desired.

Timing and Delay Functions

These functions provide the basic timing for the program. The Delay100us() can be used anywhere an accurate delay is needed in the program .

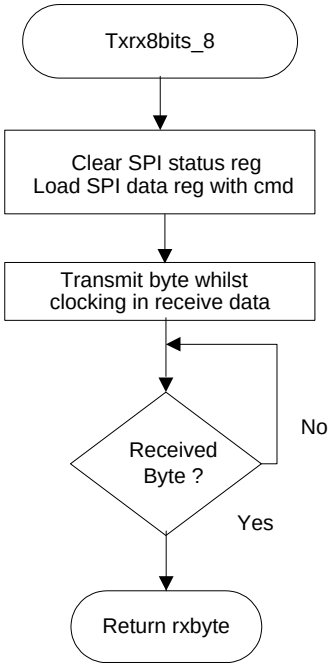
The global g_count100us variable is decremented at the 100us timer rate. This variable is used by a general delay function which can be called with a specified number of delay intervals. The g_count100us variable is a 16-bit integer so the delay ranges from 100us to 6.5536 seconds.

```
// -------------------------------------
// General timer tick 100us for delays
// -------------------------------------
void Delay100us(unsigned int delay){
    g_count100us=delay;
    while(g_count100us);

}
```

SPI Driver Functions

Only one SPI function is used, trx8bits_8, shown the figure below:



SPI Read/Write Function

Only single-byte transfers are used on the HI-1590, this HI-1590 SPI driver function is included in the Driver.c module and its Driver.h header file. The MCU slave select pin SSO (not nCS) is connected to the HI-1590 nCS pin.

Uart.c Serial Port

The drivers supporting the USB serial port (console) are contained in this module. Some function drivers allow messages to be sent and received on the UART. This is useful to log status or data messages on HyperTerminal or any other terminal program. It currently uses polling to determine when the data receive or transmit registers can be read or written.

HI-1590 demo Codewarrior Software Project

The software project is built with Freescale's CodeWarrior version 5.9.0 using the free limited 32K version. The current code size of the demo is approximately 10K. The main functions are in main.c and the low level drivers are in the driver.c file. The software project "HI-1590 Demo x_x" will normally be distributed in a zip file on a CD-ROM with the same name. **To develop, debug and download this software into the board, a PE Micro "USB Multilink Interface" debug cable is necessary. It is not provided in this kit.** To purchase this cable, go to the PE Micro website or purchase it from DigiKey. See the links at the end of this document.

Project Files

Source Files

main.c	Main code
Driver.C	SPI low-level driver for the HI-1590
peripherals.c	Micro GPIO, PLL frequency and SPI configuration
Uart.c	Low-level UART drivers
datapage.c	Freescale IDE support file

Include Files

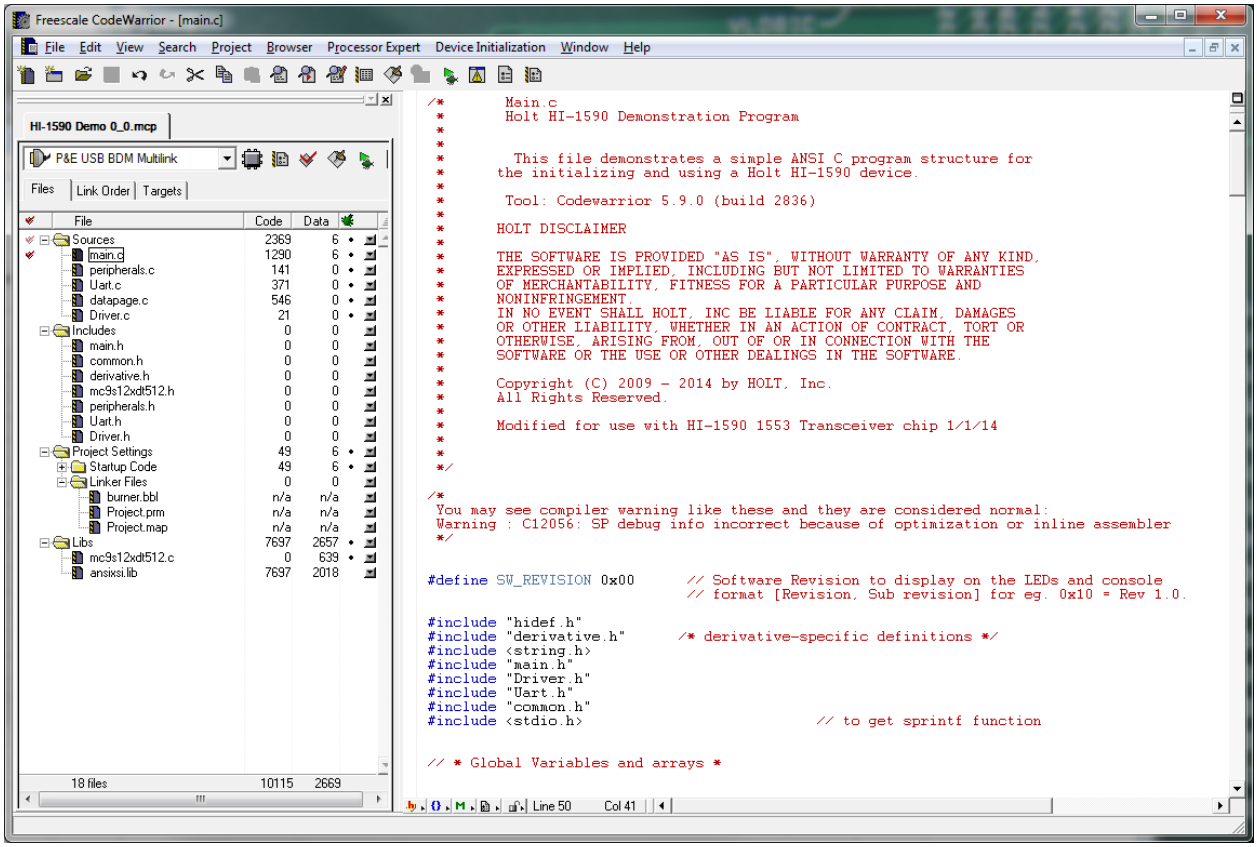
main.h	
Driver.h	
peripherals.h	
Uart.h	
common.h	Common defines for the project
derivative.h	Freescale IDE support file
mc9s12xdt512.h	Freescale IDE target part support file

CodeWarrior and Software Project Installation:

1. Download and install the CodeWarrior IDE from the Freescale website. The download links are provided below.

2. Unzip the HI-1590 x_x zip file into the directory you plan to use for your project.

3. Navigate to the HI-1590 project folder and double click the HI-1590 Demo x_x.mcp project file to launch this project with CodeWarrior. The IDE should open with the project files on the left side of the window, as shown below:

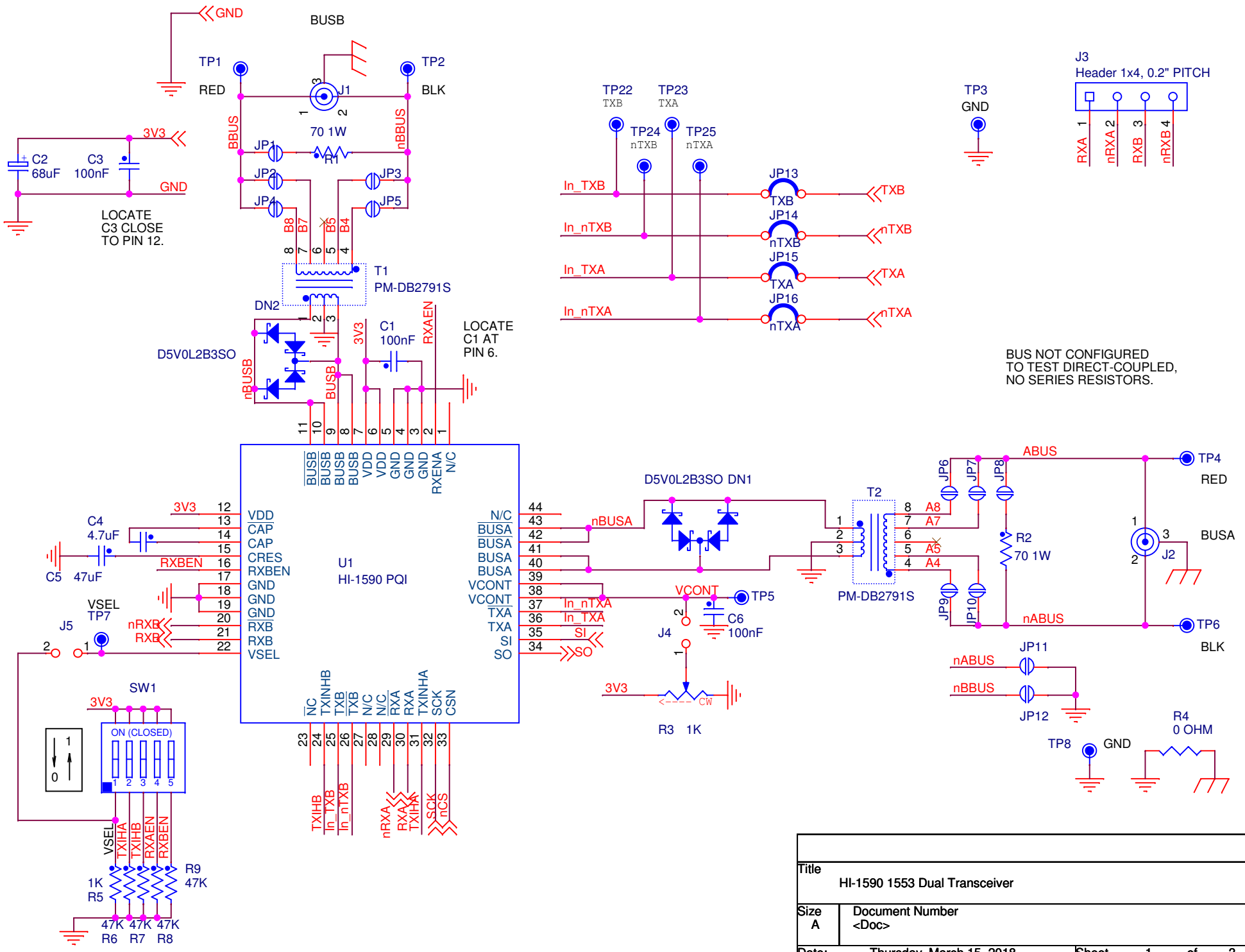


4. Plug the USB Multilink 6-pin debug cable into the Debug Header and power up the board with 3.3V.

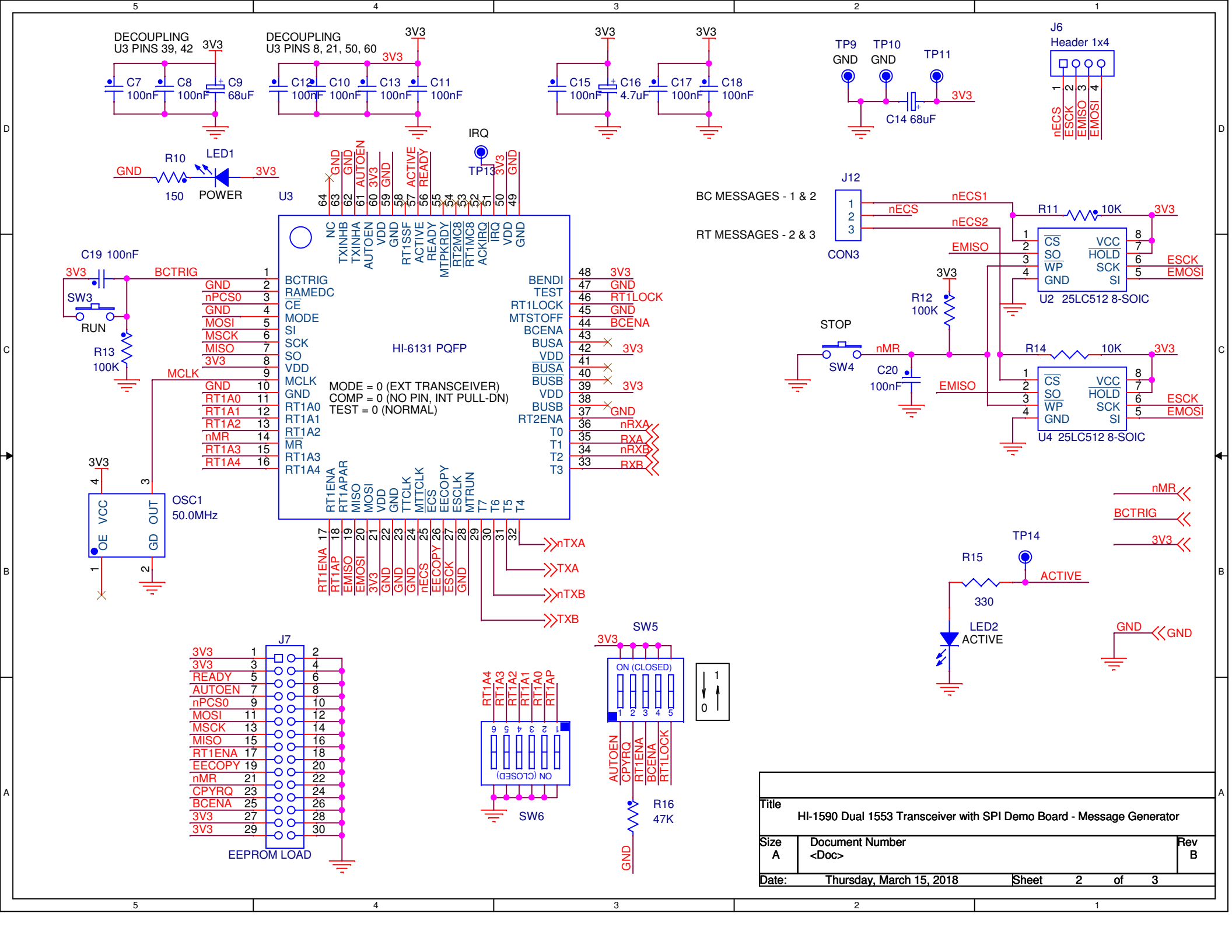
5. Click the green arrow on the screen to 'build' the Project . The project should build without errors. You may receive a dead assignment warning if for example some defines are set to a zero value. Once built, it should launch the debugger and download to the board.

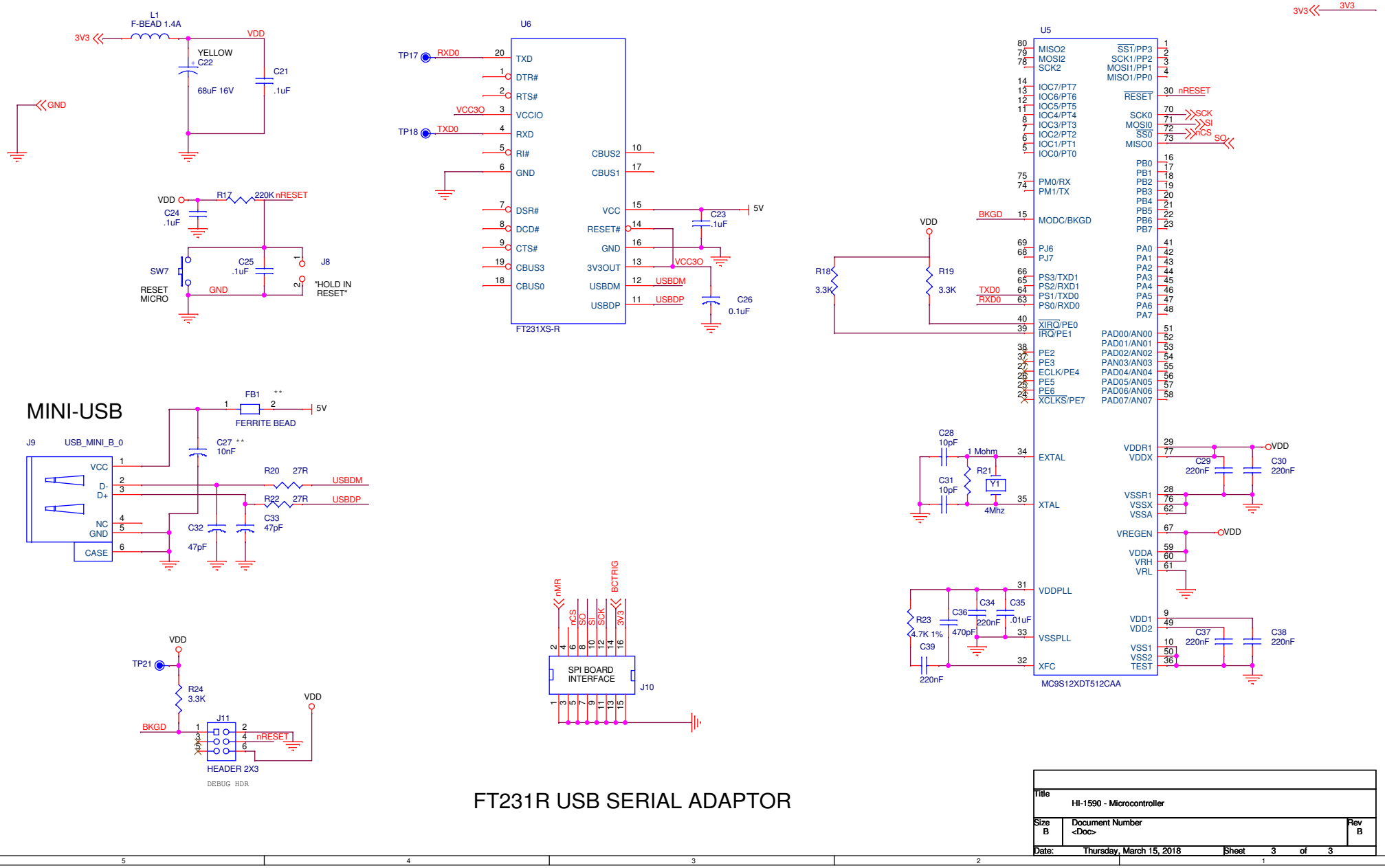
6. The first time you download, you may need to configure the debugger for the USB Multilink cable. After downloading is complete the debugger window should be displayed with the first line in main.c highlighted. Press the green horizontal arrow button to run the program. Since the program has been loaded you can power down the board and re power the board and the program should run automatically without the debugger. Holt HI-1590 project loaded with CodeWarrior 5.9.0.

Item	Qty	Description	Reference	DigiKey	Mfr P/N
1	1	PCB, Bare, Eval Board			Jet Tech 37850
2	19	Capacitor, Cer 0.1uF 20% 50V Z5U 0805	C1,C3,C6,C7,C8,C10-C13,C15,C17- C21,C23-C26	399-1176-1-ND	Kemet C0805C104M5UACTU
3	6	Capacitor, Cer 220nF 10% 50V X7R 0805	C29,C30,C34,C37,C38,C39	399-3491-1-ND	Kemet C0805C224K5RACTU
4	2	Capacitor, Cer 10pF 50V 5% NPO 0805	C28,C31	399-1108-1-ND	Kemet C0805C100J5GACTU
5	2	Capacitor, Cer 47pF 50V 5% NPO 0805	C32,C33	399-1117-1-ND	Kemet C0805C470J5GACTU
6	1	Capacitor, Cer 470pF 50V 5% X7R 0805	C36	399-1133-1-ND	Kemet C0805C471J5GACTU
7	2	Capacitor, Cer 0.01uF 20% 50V 7XR 0805	C27,C35	399-1160-1-ND	Kemet C0805C103M5RACTU
8	1	Capacitor, Cer 4.7uF 10% 6.3V X5R 0805	C16	399-3134-1-ND	Kemet C0805C475K9PACTU
9	1	Capacitor, Cer 4.7uF 10V 10% X5R 1210	C4	587-1379-1-ND	Taiyo Yuden LMK325BJ475KD-T
10	1	Capacitor, Cer 47uF 10V 20% X7R 1210	C5	587-2783-1-ND	Taiyo Yuden LMK325B7476MM-TR
11	3	Capacitor 68uF 10% 6.3V Tant 400 mOhm SMD EIA 2312	C2,C9,C14	399-10513-1-ND	Kemet T495C686K006ATE400
12	1	Capacitor 68uF 10% 16V Tant 400 mOhm SMD EIA 2917	C22	399-8397-1-ND	KemetT491D686K016AT
13	2	Connector 3-Lug Concentric Triax Bayonet Jack, Panel Front Mount TRB (BJ77)	J1,J2 **	MilesTek 10-06570	Trompeter Electronics BJ77
14	1	Connector, Receptacle USB Mini B R/A	J9	H2959CT-ND	Hirose UX60-MB-5ST
15	1	Header, Female, 30 Pos 0.1" Pitch, R/A	J7	S5568-ND	Sullins PPPC152LJBN-RC
16	1	Header, Female, 6 Pos 0.1" Pitch, R/A	J11	S5517-ND	Sullins PPTC032LJBN-RC
17	1	Header, Male 2x8 0.1" Pitch, 0.230" Pins	J10	S2012E-08-ND	Sullins PEC08DAAN
18	1	Header, Single 1x4, 0.1" pitch	J6 OPTIONAL	S1012E-04-ND	Sullins PEC04SAAN
19	3	Header, Single 1x2, 0.1" pitch	J4,J5,J8	S1012E-02-ND	Sullins PEC02SAAN
20	1	Shunt Connector Black	J4	S9000-ND	Sullins STC02SYAN
21	1	Header, single 1x4, 0.2" pitch	J3*	S1012E-07-ND	Sullins PEC07SAAN
22	12	Solder Jump 2 terminals	JP1-JP12 OPEN		
23	1	Solder Jump 3 Terminals	J12 OPEN		
24	1	LED Green 0805	ACTIVE	160-1179-1-ND	LiteOn LTST-C170GKT
25	1	LED Red 0805	POWER ON	160-1178-1-ND	LiteOn LTST-C170EKT
26	2	Resistor, 69.8 Ohm 1W 1%, 2512	R1,R2	RHM69.8BBCT-ND	Rohm MCR100JZHF69R8
27	1	Trim Pot 1K - 3/4 Turn w/ Knob	R3	3386P-102TLF-ND	Bourns 3386P-1-102TLF
28	2	Resistor, 27 5% 1/8W 0805	R20,R22	P27ACT-ND	Panasonic ERJ-6GEYJ270V
29	1	Resistor, 150 5% 1/8W 0805	R10	P150ACT-ND	Panasonic ERJ-6GEYJ151V
30	1	Resistor, 330 5% 1/8W 0805	R15	P330ACT-ND	Panasonic ERJ-6GEYJ331V
31	1	Resistor, 1K, 1/8W 5% 0805	R5	P1.0KACT-ND	Panasonic ERJ-6GEYJ102V
32	3	Resistor 3.3K, 1/8W 5% 0805	R18,R19,R24	P3.3KACT-ND	Panasonic ERJ-6GEYJ332V
33	1	Resistor, 4.7K, 1/8W 1% 0805	R23	P4.7KACT-ND	Panasonic ERJ-6GEYJ472V
34	2	Resistor, 10K 5% 1/8W 0805	R11,R14	P10KACT-ND	Panasonic ERJ-6GEYJ103V
35	5	Resistor, 47K 5% 1/8W 0805	R6,R7,R8,R9,R16	P47KACT-ND	Panasonic ERJ-6GEYJ473V
36	2	Resistor, 100K 5% 1/8W 0805	R12,R13	P100KACT-ND	Panasonic ERJ-6GEYJ104V
37	1	Resistor, 220K 5% 1/8W 0805	R17	P220KACT-ND	Panasonic ERJ-6GEYJ224V
38	1	Resistor, 1M, 1/8W 5% 0805	R21	P1.0MACT-ND	Panasonic ERJ-6GEYJ105V
39	1	Ferrite Bead, 220 Ohm 300mA 0805	FB1	732-1602-1-ND	Wurth 742792034
40	1	Ferrite Bead 330 Ohm 1.5A 0805	L1	490-5988-1-ND	Murata BLM21PG331SN1D
41	1	Osc, 50MHz 100ppm 3.3V SMD 5x7mm	OSC1	535-10087-1-ND	Abracon ASV-50.000MHZ-E-T
42	1	Crystal 4.00MHz, SMD, 30ppm 20pF load	Y1	631-1005-1-ND	FOXSDLF/040
43	2	DIP Switch 5-Position SMD	SW1,SW5	CT2195MST-ND	CTS 219-5MST
44	1	DIP Switch 6-Position SMD	SW6	CT2196MST-ND	CTS 219-6MST
45	3	Switch Tactile SPST-NO 0.05A 32V	SW3,SW4,SW7	P12943SCT-ND	Panasonic EVQ-Q2K03W
46	3	Test Point, Red Insulator, 0.062" hole	3V3,ABUS, BBUS	36-5010-ND	Keystone 5010
47	3	Test Point, Black Insulator, 0.062" hole	GND, nBusA, nBusB	36-5011-ND	Keystone 5011
48	3	Solid wire, 20 AWG, 3" Long per Board	GND Hookup	20WG Solid wire	Any 20 AWG Solid Wire
49	1	Test Point, Orange Insulator, 0.062" hole	VDD	36-5013-ND	Keystone 5013
50	1	Test Point, White Insulator, 0.062" hole	ACTIVE	36-5012-ND	Keystone 5012
51	1	IC, MC9S12XDT512CAA 80QFP,16-Bit MC	U5	MC9S12XDT512CAA-ND	MC9S12XDT512CAA-ND
52	1	IC USB Serial Full UART 20SSP	U6	768-1129-1-ND	FTDI FT231XS-R
53	2	IC, Serial EEPROM 512Kbit 20MHz SPI 8-SOIC, Microchip	U2,U4	25LC512-I/SN-ND	Microchip 25LC512-I/SN
54	2	TVS, Diode 5VWM 14VC SOT23	DN1,DN2	D5V0L2B3SO-7DICT-ND	Diode Inc. D5V0L2B3SO-7
55	1	IC HI-1590 44QFN	U1	HOLT IC	Holt IC
56	1	IC HI-6131 64-PQFP	U3	HOLT IC	Holt IC
57	2	Transformer MIL-STD-1553 Single, 1:2.50, PM-DB2791S	T1,T2	PM-DB2791S	Holt / Premier Magnetics PM-DB2791S
58	6	Stand-off, #4-40 Female Thread, 3/4" long		3481K-ND	Keystone 3481
59	6	Machine Screw, #4-40 x 1/4"		H342-ND	B&F Supply PMS 440 0025 PH
60	6	Lock Washer, Int.Tooth #4-40		H236-ND	B&F Supply INTLWZ 004
61	4	Hookup Solid wire - 20AWG - Black - 4" Long per Board	For J1 and J2	C2028B-XX-ND	General Cable C2028A.12.01



Title	HI-1590 1553 Dual Transceiver	
Size A	Document Number <Doc>	Rev B
Date: Thursday, March 15, 2018	Sheet 1 of 3	


DECOUPLING
U3 PINS 39, 42
C7 100nF
C8 100nF
C9 68uF
DECOUPLING
U3 PINS 8, 21, 50, 60
C12 100nF
C10 100nF
C13 100nF
C11 100nF
C15 100nF
C16 4.7uF
C17 100nF
C18 100nF
TP9 GND
TP10 GND
TP11
C14 68uF
J6
Header 1x4
nECS ESCK EMISO EMOSI
R10 150
LED1 POWER
IRQ
TP13
U3
HI-6131 PQFP
MODE = 0 (EXT TRANSCEIVER)
COMP = 0 (NO PIN, INT PULL-DN)
TEST = 0 (NORMAL)
BC MESSAGES - 1 & 2
RT MESSAGES - 2 & 3
J12
CON3
nECS1
nECS
nECS2
EMISO
R11 10K
R12 100K
R13 100K
R14 10K
C19 100nF
SW3 RUN
STOP
SW4
C20 100nF
U2 25LC512 8-SOIC
U4 25LC512 8-SOIC
OSC1 50.0MHz
MCLK
BCTRIG
nMR
TP14
R15 330
ACTIVE
LED2 ACTIVE
nTXA
TXA
nTXB
TXB
nRXA
RXA
nRXB
RXB
J7
EEPROM LOAD
SW5
ON (CLOSED)
SW6
R16 47K
AUTOEN CPYRQ RT1ENA BCENA RT1LOCK
Title
HI-1590 Dual 1553 Transceiver with SPI Demo Board - Message Generator
Size A
Document Number
<Doc>
Rev B
Date: Thursday, March 15, 2018
Sheet 2 of 3



FT231R USB SERIAL ADAPTOR

Title	HI-1590 - Microcontroller	
Size B	Document Number <Doc>	Rev B
Date: Thursday, March 15, 2018	Sheet 3 of 3	