ADK-2130mPCIe
Quick Start Guide

Dec, 20 2019

REVISION HISTORY

Revision	Date	Description of Change
QSG-2130mPCIe Rev. New	1/20/19	Initial Release

Introduction

The Holt Mini PCIe Mini card reference design features one or two Holt HI-2130 MIL-STD 1553 multi-channel dual redundant terminals with integrated transformers on a single size F2 Mini PCIe card. The card is designed to operate in a PC with a Linux OS. The Demo software uses the Holt API Library functions, providing an abstraction layer that greatly simplifies host programming. A console menu is presented in a terminal window where commands are executed. This Quick Start Guide provides instructions how to boot from the Holt Flash Drive and run the demonstration software.

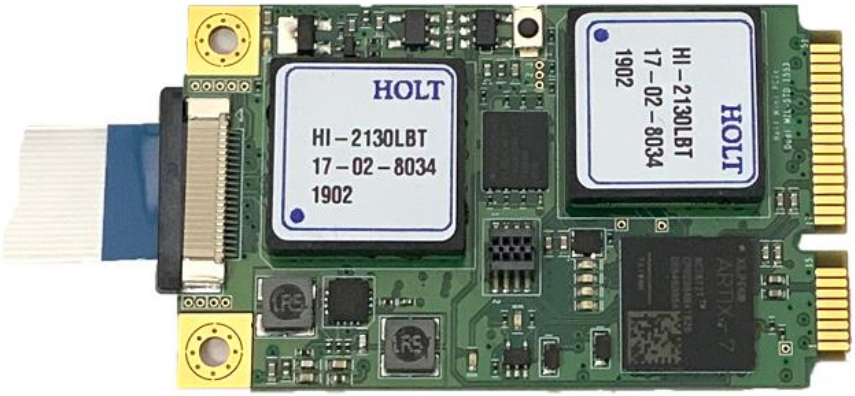


Figure 1 – Mini PCIe card EV-2130mPCIe-2F

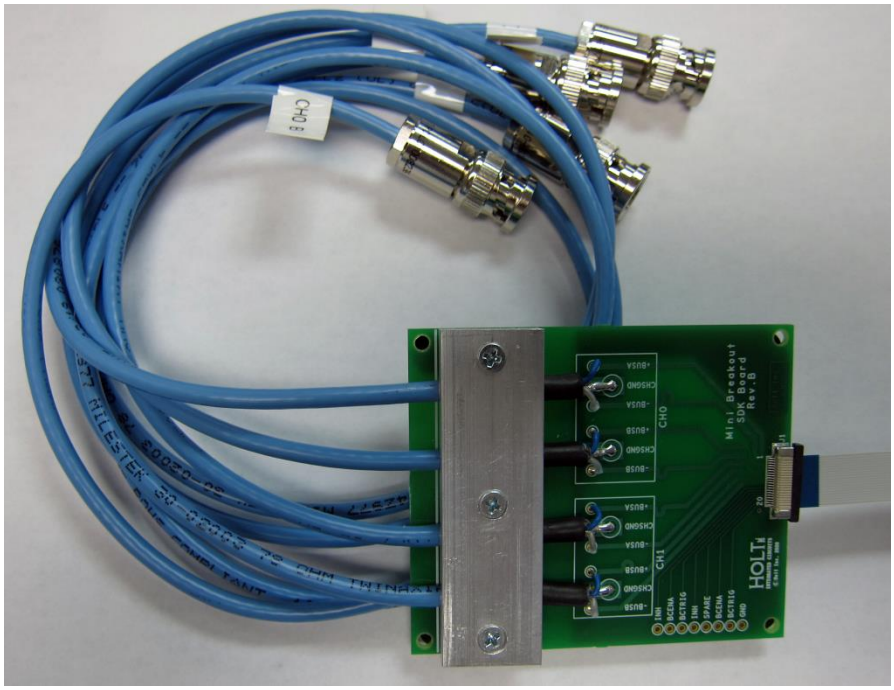


Figure 2 – Mini PCIe breakout board mPCIe_breakout-2F

Kit Contents

- Quick Start Guide (QSG-2130mPCIe).
- Mini PCIe card, Single HI-2130: EV-2130mPCIe-1F or Dual HI-2130: EV-2130mPCIe-2F.
- USB 3.0 128G flash drive with Bootable Ubuntu 16.04.6 LTS, 18.04 LTS.
- Holt Eclipse and Vivado projects.
- Mini PCIe Technical Manual (AN-2130mPCIe.
- Optional Break Out board:
    - mPCIe_Breakout-1F (single channel) or mMPCIe_Breakout-2F (dual channel).

Quick Start Demo Requirements

- PC requirements:
    - Mini PCIe Slot.
    - USB 3.0 port. USB 2.0 may not be bootable or will operate very slow - not recommended.
    - 4G RAM minimum. 8-16G is recommended for Eclipse and Vivado use –not required for the QSG demos presented here.

Demo configurations

The cables on the Break Out board should be connected to a MIL-STD 1553 bus coupler. See AN-551 for recommended bus connections.

The Holt Break Out board is connected to the Mini PCIe card using a small ribbon cable. The cable connector strain reliefs are delicate so care must be exercised to avoid damage. Since the HI-2130 shares the same 1553 bus pins (BUSA, nBUSA) with all four internal terminals (BC, RT, RT2 and SMT) in each device, the RT responds to commands transmitted by the BC in the same device.

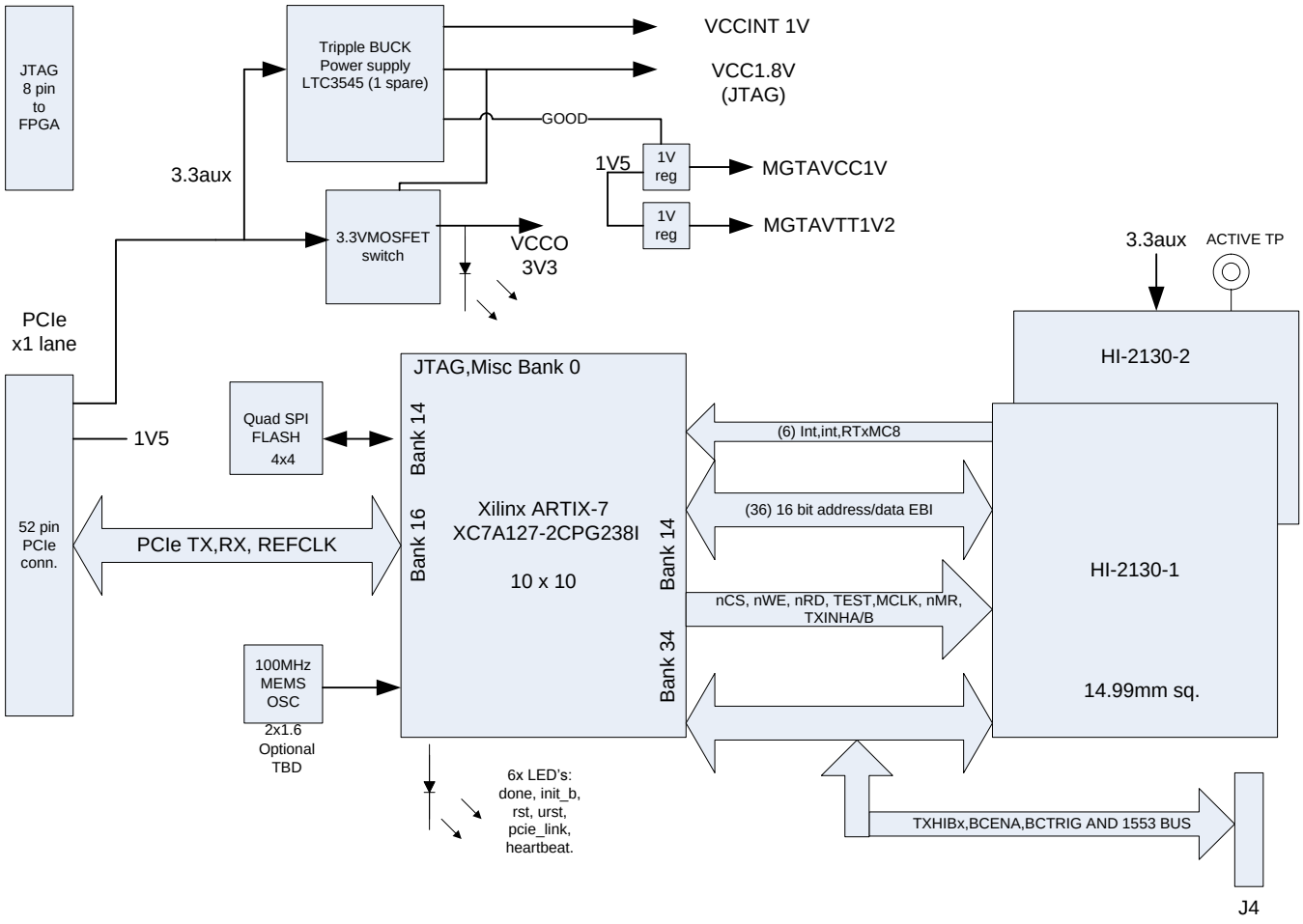


Figure 3 – Mini PCIe board block diagram

Table 1 – LEDs

PWR D1, Green	VCCO3V3 switched power.
Done D2, Green	FPGA initialized from SPI Flash
Complete D3, Green	FPGA initialize complete.
LED D6, Green	FPGA rst signal
LED D7, Green	FPGA urst signal
LED D8, Green	FPGA PCIe Link Up – must be on for the card to work.
LED D9, Green	FPGA Heart Beat

Getting Started

The Holt USB 3.0 flash drive (FD) contains a bootable version of Ubuntu Linux. The Home folder contains the project folders and script files to run the Demos. Booting from the Holt FD allows running the Demo in the fewest steps possible since the Demo and kernel module was prebuilt for the Ubuntu and kernel version installed on the FD. The user cannot just copy the files from the FD to the user's PC and run the demo program following these instructions, unless the OS and kernel versions are the same.

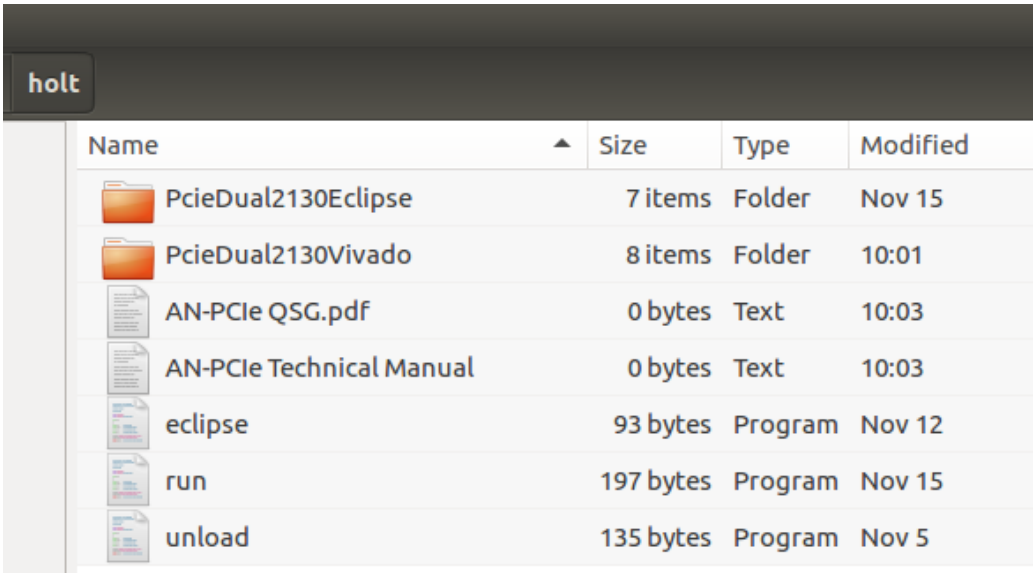
This Quick Start Guide assumes the user boots from the Holt FD. If the user's PC does not have a bootable USB 3.0 port the following instructions cannot be used. Refer to the Holt Technical Manual for instructions how to transfer the projects to a new computer and install Eclipse and rebuild the kernel module and Demo program.

Quick Start Demo Instructions – using the Holt USB 3.0 FD booted on a PC

These instructions assume the user has Linux experience using terminal commands.

1. Turn off the PC and install the Holt Mini PCIe card.
2. Carefully insert the small ribbon cable to the Mini Card J4 connector and the other end to the Break Out board. The cable is fine pitched and the connector plastic fasteners are delicate so care must be exercised to avoid damaging the connector.
3. Insert the Holt FD into a USB 3.0 port.
4. Before turning on the PC the user should be familiar how to boot from the external USB FD. Typically, the F11 or F12 key is quickly pressed after a BIOS screen is briefly displayed showing some boot options. The computer shows a boot up menu showing possible drives that are bootable.
5. Use the up or down arrow keys to select the Holt USB FD to boot from. Identify the Holt USB FD by the manufacturer name on the FD such as "SanDisk or Memorex". Select the Holt USB FD and press enter. The computer should begin the boot sequence from the Holt USB FD. An Ubuntu screen is displayed with an Ubuntu selection at the top, the user can wait for it to boot or press the enter key to start the boot-up immediately.
6. When the desktop appears enter "holtpcie" for the password. The same password is used for some terminal commands requiring sudo privileges.
7. Use the Ubuntu "Files" application shown on the launch menu on the left side of the desktop screen that looks like a file cabinet to navigate to folders and view files in the Holt folder.

8. Double click the ‘Holt’ folder to preview the Holt folder containing two project folders, bash scripts and documents.

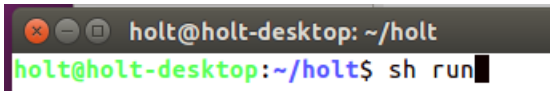


The program initializes the four RT’s with the following RT addresses (these can be changed later using command ‘9’). In some demos and in the software RT1 may also be referred to as RT. RT2 will always be referred to RT2.

Table 2 – Device RT Addresses

DEVICE/IC	RT	RT ADDRESS	ADK Board
Dev 0 / U7	RT (RT1)	**3**	**ADK-2130mPCIe-1F**
Dev 0 / U7	RT2	**1**	**ADK-2130mPCIe-1F**
Dev 1 / U8	RT (RT1)	**3**	**ADK-2130mPCIe-1F** **ADK-2130mPCIe-2F**
Dev 1 / U8	RT2	**1**	**ADK-2130mPCIe-1F** **ADK-2130mPCIe-2F**

9. Open a terminal window in the Holt folder and execute the ‘run’ script.



10. Linux will ask for the password, enter “holtpcie” and press return. The ‘run’ scripts checks the OS to see if the Xilinx Device 7011 PCIe device is found then executes two bash scripts to unload and reload the kernel module and lastly runs the Demo executable.
    The ‘unload’ script will be explained in the Technical Manual and is not used in this QSG. LED8 ‘LINK’ is an indicator that the PCIe OS link was successful. If this LED is not “on”, the board will not work. See trouble shooting section at the end of this document. If the console shows the message below “…Xilinx Corporation Device 7011” then it was OK.

```
holt@holt-desktop:~/holt$ sh run
06:00.0 Memory controller: Xilinx Corporation Device 7011
[sudo] password for holt:
Holt Linux driver unloaded
Holt Linux driver loaded
1553LibrarySrc_linkedfolder  Demo  _HI-613x_LINUX_DEMO makefile
objects.mk  sources.mk
Setting nMR chan 0 LOW Setting nMR chan 0 HIGH READY asserted
Setting nMR chan 1 LOW Setting nMR chan 1 HIGH READY asserted
Number of Devices found: 2


 Initial default RT addresses:
 DEV0:RT1=3 DEV0:RT2=1  DEV1:RT1=3  DEV1:RT1
 Optionally use console command '9' to change these RT addresses
BEFORE RUNNING RT

************************************************
 Holt Integrated Circuits
 Mini PCIe Dual HI-2130 API Demo
 Demo Rev: 1.0     Compiled: Dec 11 2019 08:41:16
 API Lib Rev: 03-5-0
************************************************

   BC On   SMT On    RT1 On   RT2 On

 Press 'a' or 'A' to run Dev0 or Dev1 BC Async demo.
 Press 'b' or 'B' to run Dev0 or Dev1 RT demo.
 Press 'c' or 'C' to run Dev0 or Dev1 RT2 demo.
 Press 'k' or 'K' to Enable Dev0 or Dev1 RTMT.
 Press 'l' or 'L' to send high priority BC message.
 Press 'h' or 'H' to send low priority BC message.
 Press 'n' or 'N' to run Dev0 or Dev1 BC Major Minor Frame demo.
 Press 'x' or 'X' to stop Dev0 or Dev1 BC transmissions.
 Press 'S' to run SMT demo.
 Press 't' to display RT Traffic Toggle.

 ------------ Utilities -------------
 Press 'r' or 'R' to Display Dev0 or Dev1 HI-2130 Registers.
 Press 'w' for Memory Watch window
 Press 'f' Reads J4 connector and FPGA control signals
 Press '1' for Register Write
 Press '2' for Memory Write
```

```
 Press '3' RT Mode Code data word reads
 Press '4' Master Reset and reinitializes terminals
 Press '5' Toggle Dev0 BCENA on/off
 Press '6' Toggle Dev1 BCENA on/off
 Press '9' Set RT addresses
 Press '0' Toggle between User and Demo(default) modes

Press 'M' for menu, or press any valid menu key. >>
```

The menu commands are very similar to other Holt ADK's such as the ADK-6138, ADK-6130-2 or ADK-6131. Lower case characters 'a', 'n, 'b', 'c' and 'r' executes commands on the (Dev0) and 'A', 'N', 'B', 'C' and 'R' executes commands on Dev1. With a -1F card (only one HI-2130) the upper case commands will not be presented.

Command 'r' and 'R' is used to display system registers names and values on the screen.

Command 'w' displays a memory dump of device memory showing up to 256 words. This is useful for viewing other areas of memory such as the illegalization tables, control blocks and data buffers.

Demo exercises using Device 0

1. BC transmits 15 messages and RT1 captures and displays the traffic data.

Commands 'n' or 'N' initializes the BC to transmit 15 messages. To display RT data traffic some additional commands must first be executed. Five sets of three repeating messages are transmitted by the BC. SA30 is configured for data loop-back. So the data transmitted to the RT from the first Receive command is loaded into the same buffer location the RT will reference when transmitting data back to the BC. Just these three commands verify that both A and B buses are properly communicating with the BC. The data word values will match the data from the first Receive command.

```
BC > RT Receive Cmd, SA30, 32 words, BusA: 03-R-30-00
RT > BC Transmit Cmd, SA30, 32 words, BusB  03-T-30-00
RT > BC Transmit Cmd, SA30, 32 words, BusA  03-T-30-00

Enter 'b' to enable Dev0 RT1
Enter 'k' to enable Dev0 RT1 with SMT
Enter 't' to enable RT traffic data displayed on the screen.
Enter 'n' to transmit 15 messages and stops.
```

The display should look similar to this below.

```
Press 'M' for menu, or press any valid menu key.
>> b
>k

RTMT Demo
>t
```

```
Traffic Enabled
>n
>
 Dev0 MSG #0000.  TIME = 00040628us    BUS A   TYPE0: BC to RT
            CMD1 1BC0 --> 03-R-30-00
            DATA 0101  0202  0303  0404  0505  0606  0707  0808
                 0909  1010  1111  1212  1313  1414  1515  1616
                 1717  1818  1919  2020  2121  2222  2323  2424
                 2525  2626  2727  2828  2929  3030  3131  3232

            STA1 1800

 Dev0 MSG #0001.  TIME = 00041324us    BUS B   TYPE1: RT to BC
            CMD1 1FC0 --> 03-T-30-00
            STA1 1800
            DATA 0101  0202  0303  0404  0505  0606  0707  0808
                 0909  1010  1111  1212  1313  1414  1515  1616
                 1717  1818  1919  2020  2121  2222  2323  2424
                 2525  2626  2727  2828  2929  3030  3131  3232


 Dev0 MSG #0002.  TIME = 00042020us    BUS A   TYPE1: RT to BC
            CMD1 1FC0 --> 03-T-30-00
            STA1 1800
            DATA 0101  0202  0303  0404  0505  0606  0707  0808
                 0909  1010  1111  1212  1313  1414  1515  1616
                 1717  1818  1919  2020  2121  2222  2323  2424
                 2525  2626  2727  2828  2929  3030  3131  3232


 Dev0 MSG #0003.  TIME = 00042720us    BUS A   TYPE0: BC to RT
            CMD1 1BC0 --> 03-R-30-00
            DATA 0101  0202  0303  0404  0505  0606  0707  0808
                 0909  1010  1111  1212  1313  1414  1515  1616
                 1717  1818  1919  2020  2121  2222  2323  2424
                 2525  2626  2727  2828  2929  3030  3131  3232

            STA1 1800

 Dev0 MSG #0004.  TIME = 00043416us    BUS B   TYPE1: RT to BC
            CMD1 1FC0 --> 03-T-30-00
            STA1 1800
            DATA 0101  0202  0303  0404  0505  0606  0707  0808
                 0909  1010  1111  1212  1313  1414  1515  1616
                 1717  1818  1919  2020  2121  2222  2323  2424
                 2525  2626  2727  2828  2929  3030  3131  3232
```

2. BC Transmits Major frames and Minor frames

   Command ‘a’ demonstrates the BC transmitting a continuous stream of messages in a Major/Minor frame format. To stop transmissions press ‘x’ followed by return. Only the first seven messages are shown here. Since the RT and SMT and traffic commands were already enabled from the last demo, press ‘a’ to execute this demo. Notice the RT to RT messages have a ‘no response’ error – this is because RT2 has not been enabled.

```
a
>
 Dev0 MSG #0015.  TIME = 00004238us    BUS A   TYPE0: BC to RT
            CMD1 1822 --> 03-R-01-02
            DATA 0005  0002
            STA1 1800

 Dev0 MSG #0016.  TIME = 00004286us    BUS A   TYPE2: RT to RT
            CMD1 182A --> 03-R-01-10
            CMD2 0C2A --> 01-T-01-10
 ERROR: NORES

 Dev0 MSG #0017.  TIME = 00004352us    BUS A   TYPE2: RT to RT
            CMD1 182A --> 03-R-01-10
            CMD2 0C2A --> 01-T-01-10
 ERROR: NORES

 Dev0 MSG #0018.  TIME = 00004416us    BUS B   TYPE2: RT to RT
            CMD1 182A --> 03-R-01-10
            CMD2 0C2A --> 01-T-01-10
 ERROR: NORES

 Dev0 MSG #0019.  TIME = 00104176us    BUS A   TYPE0: BC to RT
            CMD1 1822 --> 03-R-01-02
            DATA 0005  0002
            STA1 1800

 Dev0 MSG #0020.  TIME = 00104224us    BUS A   TYPE2: RT to RT
            CMD1 182A --> 03-R-01-10
            CMD2 0C2A --> 01-T-01-10
 ERROR: NORES

 Dev0 MSG #0021.  TIME = 00104290us    BUS A   TYPE2: RT to RT
            CMD1 182A --> 03-R-01-10
            CMD2 0C2A --> 01-T-01-10
 ERROR: NORES
```

3. Enable RT2.
   If the previous BC messages are still transmitting, press the ‘x’ key followed by return to stop the BC. Press the ‘c’ command to enable RT2 which is set to RT address 1.

4. Press ‘a’ again and this time the RT to RT messages will both respond properly without any ‘no response’ errors**.** Press ‘x’ and return to stop the BC to view messages. Only some messages are shown below.

```
>c
>a
>
 Dev0 MSG #0043.  TIME = 00127134us    BUS A   TYPE0: BC to RT
        CMD1 1822 --> 03-R-01-02
        DATA 0005  0002
        STA1 1800

 Dev0 MSG #0044.  TIME = 00127436us    BUS A   TYPE2: RT to RT
        CMD1 182A --> 03-R-01-10
        CMD2 0C2A --> 01-T-01-10
        STA1 0800
        DATA BBBB  0202  1414  0404  0505  0606  0707  0808
           0909  1010
        STA2 1800

 Dev0 MSG #0045.  TIME = 00096012us    BUS A   TYPE0: BC to RT
        CMD1 1822 --> 03-R-01-02
        DATA 0005  0002
        STA1 1800

 Dev0 MSG #0046.  TIME = 00096316us    BUS A   TYPE2: RT to RT
        CMD1 182A --> 03-R-01-10
        CMD2 0C2A --> 01-T-01-10
        STA1 0800
        DATA BBBB  0202  1414  0404  0505  0606  0707  0808
           0909  1010
        STA2 1800

 Dev0 MSG #0047.  TIME = 00064942us    BUS A   TYPE0: BC to RT
        CMD1 1822 --> 03-R-01-02
        DATA 0005  0002
        STA1 1800
```

Demo exercises using Device 1: ADK-2130mPCIe-2F

To demonstrate the second HI-2130 (Dev1), a Holt IC card with two HI-2130's is required, PN ADK-2130mPCIe-2F. Execute the same commands but with Upper case letters.
Press 'B', 'K' and 'N' all in upper case to exercise the second HI-2130 (Dev1) BC and RT1. Notice 'Dev1" is shown instead of 'Dev0' as in the previous exercises. The N command transmits the same 15 messages, (3 are shown below,) but this time the BC in the second HI-2130 (Dev1) is used.

```
>B

>K

RTMT Demo
>N

>
 Dev1 MSG #0075.  TIME = 00124310us    BUS A   TYPE0: BC to RT
            CMD1 1BC0 --> 03-R-30-00
            DATA 0101  0202  0303  0404  0505  0606  0707  0808
                 0909  1010  1111  1212  1313  1414  1515  1616
                 1717  1818  1919  2020  2121  2222  2323  2424
                 2525  2626  2727  2828  2929  3030  3131  3232

            STA1 1800

 Dev1 MSG #0076.  TIME = 00125006us    BUS B   TYPE1: RT to BC
            CMD1 1FC0 --> 03-T-30-00
            STA1 1800
            DATA 0101  0202  0303  0404  0505  0606  0707  0808
                 0909  1010  1111  1212  1313  1414  1515  1616
                 1717  1818  1919  2020  2121  2222  2323  2424
                 2525  2626  2727  2828  2929  3030  3131  3232


 Dev1 MSG #0077.  TIME = 00125714us    BUS A   TYPE1: RT to BC
            CMD1 1FC0 --> 03-T-30-00
            STA1 1800
            DATA 0101  0202  0303  0404  0505  0606  0707  0808
                 0909  1010  1111  1212  1313  1414  1515  1616
                 1717  1818  1919  2020  2121  2222  2323  2424
                 2525  2626  2727  2828  2929  3030  3131  3232
```

Demonstrating the Holt Mini PCIe RT with an external BC.

Any one of the four RT's can be used with an external BC tester. Choose the desired channel and set the RT address to match the BC message using command '9'. Connect the external BC to a bus coupler and connect a stub from the bus coupler to the BNC connector on the optional Holt breakout board. See AN-551 for proper bus connections.

To change the RT terminal address, press '9' BEFORE enabling the RT. If a RT was enabled by a 'b',B' 'c' or 'C' command use command '4' to reset the card first. The program first prompts for the channel number 0-4 followed by the RT address value.

Table 3 – Device RT Addresses and Channels

DEVICE/IC	RT	DEFAULT RT ADDRESSES	Command 9 channel
Dev 0 / U7	RT (RT1)	**3**	0
Dev 0 / U7	RT2	**1**	1
Dev 1 / U8	RT (RT1)	**3**	2
Dev 1 / U8	RT2	**1**	3

```
Press 'M' for menu, or press any valid menu key. >>
>9
Enter RT channel 0-3 for Dev0 RT1, Dev0 RT2, Dev1 RT1 or Dev1 RT2
0
Enter RT address: 5
 0 5
```

Enable the RT with a corresponding 'c', 'C', 'b' or 'B' command depending on which RT and channel is used.

Enable 'k' or 'K' and 't'. The RT is ready for BC command reception. Make sure the external BC message tester is set for the corresponding RT address or the message will be ignored. Traffic data display using the 't' command is optional but is recommended when first learning the card. BC message transaction occurs whether or not the 't' command is used since 't' just enables the ability to display the data on the console.

Demonstrating the Holt Mini PCIe BC with an external RT.

The BC demos transmit messages to RT addresses 3 and 1. To change these RT addresses the program must be modified and recompiled. See the Technical Manual for instructions on how to do this.

Connect the external RT to one of the tri-axial jacks on the break out board. A bus coupler should be used to connect the external RT to the card BC. See AN-551 for proper bus connections.

A possible bus conflict will occur if any of the on-card RTs has the same RT address. In this case change the RT address using command '9' to a different value or use command '4' to reset the card and reinitialize the terminals. This time don't enable any of the cards RT's.

Use command 'n' or 'N' to command the BC to transmit messages. The external RT should receive the message if the RT address matches the RT address in the BC command word, which for this card is either 3 or 1. To modify the BC commands for a different RT address see the Technical Manual.

Table 4 – Connector J-4 pin-out

20 Pin	NAME	DESCRIPTION
1	CHANNEL 0 APOS	MIL-STD-1553 CH0 A+ (BUSA)
2	CHANNEL 0 ANEG	MIL-STD-1553 CH0 A- (nBUSA)
3	Chassis GND	Mounting screw – no other connection.
4	CHANNEL 0 BPOS	MIL-STD-1553 CH0 B+ (BUSB)
5	CHANNEL 0 BNEG	MIL-STD-1553 CH0 B- (nBUSB)
6	Chassis GND	Mounting screw – no other connection.
7	CHANNEL1 APOS	MIL-STD-1553 CH1 A+
8	CHANNEL 1 ANEG	MIL-STD-1553 CH1 A-
9	Chassis GND	Mounting screw – no other connection.
10	CHANNEL 1 BPOS	MIL-STD-1553 CH1 B+
11	CHANNEL 1 BNEG	MIL-STD-1553 CH1 B-
12	Chassis GND	Mounting screw – no other connection.
13	CH0INHBIT0	Channel 0 Transmit Inhibit. 10K pull-up. Connects to an inverter which Inverted direct connect to 2130 inhibit pins.
14	CH0 BCENAB	Channel 0 BC Enable. 10K pull-up.
15	CH0 BCTRIG	Channel 0 BC Trigger. 10K pull-up.
16	SPARE INPUT	Unused.
17	CH1INHBIT1	Channel 0 Transmit Inhibit. 10K pull-up. Inverted direct connect to 2130 inhibit pins.
18	CH1 BCENAB	Channel 1 BC Enable. 10K pull-up.
19	CH1 BCTRIG	Channel 1 BC Trigger. 10K pull-up.
20	Logic GND	

Trouble shooting

1. Booting from the Holt USB Flash Drive. There are typically a few seconds from powering a PC to when a short DOS like message appears to allow pressing F11 or F12 to enter a boot menu. Some PC's might be configured to bypass in the bios. Check with your company IT person to see if they can help resolve this issue since they may already be familiar with the PC bios settings. Holt is not in a good position to assist with these types of PC problems.

2. If the PCIe Link fails (LED8 OFF), power off the PC and try uninstalling the card and reinstalling the card again to ensure a good fit. If the PC does not supply 1.5V on the PCIe Mini slot this will also cause a link failure. Check with the PC motherboard manual to see if there's a way to enable the 1.5V. The card requires 1.5V and there is no way to make it work without 1.5V.

   The 'run' script includes this terminal command which can be executed separately in a terminal window to see if Linux detected the PCIe link.

   ```
   holt@holt-desktop:~/holt$ lspci | grep Xilinx
   If this was displayed then the link was OK.
   "Memory controller: Xilinx Corporation Device 7011"
   ```

3. In some rare cases if the Demo fails to run try rebooting the PC and try again.

4. If 1553 bus traffic does not appear on the cable connectors try unplugging the ribbon cable from the card and break out board and reinsert it again while trying to make sure it as straight as possible.

Summary

This quick start guide provided simple steps on how to use the Holt Flash Drive to demonstrate Holt's Mini PCIe card. When booting from the Holt FD a minimal amount of work is required to run the demo since all the software is preinstalled. This is meant as an introduction to the use of the card and demo software.

To learn more about the design including using the development tools refer to the Technical Manual. To install the Holt demo project and import the projects into Eclipse to build and run the demo project on the user's PC, see the technical guide.