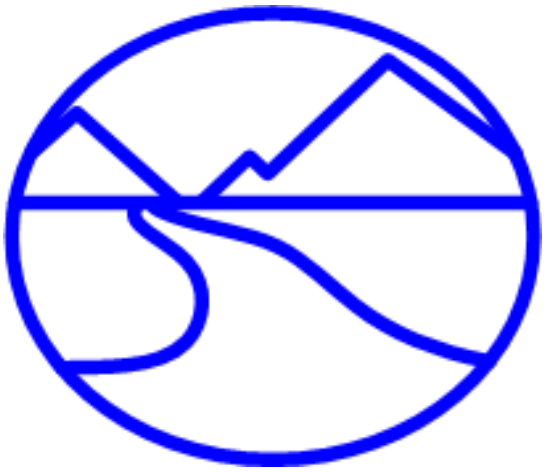

Gravity

HOTLink II Data Card

Users Manual

Instruction for using EFCDataTest with GRAV_HL2D_XXX cards

Rev H

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1 Gravity HLII Hardware Operation

The Gravity HLII hardware uses independent transmit and receive FIFO to move data on and off the card.

Typical Gravity Data card with FCN connectors – Dual Channel or pass through

1.1 Modes of operation

Mode	Description	Details
1	4 BYTE PACKETS, ONE K28.x SOM	SOM (Start of Message) Used to trigger
2	VARIABLE LENGTH	Flexible mode. No SOM or triggers. Data is stripped from all special chars on receive.
3	USER DEFINED PACKET LENGTH, ONE K28.x SOM	SOM (Start of Message) Used to trigger Packet length programmable

1.2 FIFO Operation general

Transmit FIFOs on the Gravity HLII card are 4096 long words deep (16,384 bytes) and the receive FIFOs on the Gravity HLII card are 16,384 long words deep (65,536 bytes). The following sections describe the operation of these FIFOs for transmitting and receiving data with the Gravity Card.

1.2.1 Transmit Operation

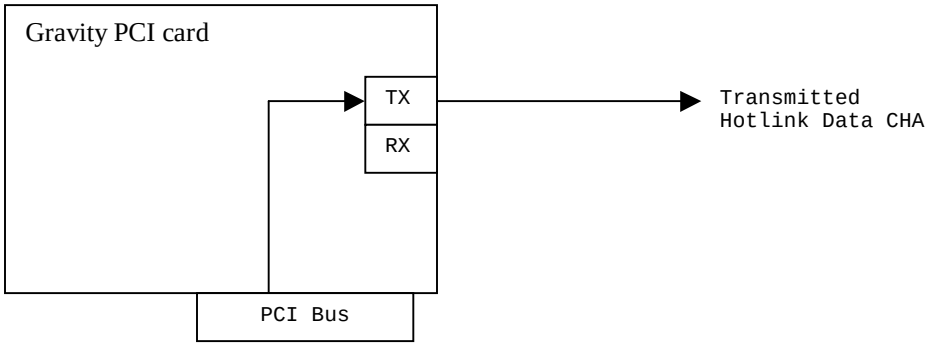
All data written to the transmit FIFO is automatically sent over the HOTLink output of the Gravity HLII card. When the transmit FIFO is empty, the Gravity HLII card transmits k28.5 characters. Since the FIFOs are organized as 32 bits wide, the smallest transmission packet achievable is 4 bytes.

The table below describes the three standard transmit modes for the Gravity HLII card and rules for the insertion of K28.5 characters in the HOTLink output. For transmission in modes 2 and 3, K28.5 characters will be inserted whenever the transmit FIFO becomes empty. These null characters can break up the outgoing data stream in an arbitrary manner.

Transmit mode	**Transmit FIFO**	**HOTLink Output Description**
MODE 1	EMPTY	Transmit K28.5
MODE 1	NOT EMPTY	Transmit 4 byte packets (One SOM char terminated with 7 K28.5 characters minimum)
MODE 2	EMPTY	Transmit K28.5
MODE 2	NOT EMPTY	Transmit all available bytes
MODE 3	EMPTY	Transmit K28.5 (can be during N byte packet)
MODE 3	NOT EMPTY	Transmit N byte packets - where N is user defined (One SOM char terminated with 7 K28.5 characters minimum)

Note that for MODE3, K28.5 characters can be inserted during (before completion of) the N byte packet. The transmission of data will resume when additional data becomes available in the transmit FIFO. Therefore, for larger values of N, and when PCI loading of the transmit FIFO may be delayed, the Gravity HLII card may insert strings of K28.5 characters in the output.

In MODE3 the complete N byte packet will be transmitted, and a new packet will not be initiated (lead by a SOM) until all N bytes of the previous packet have been sent. Since the transmit FIFO is 32 bits wide, the insertion of K28.5 data always occurs on 4 byte boundaries. The PacketFormat bit is used to specify that the packet count is Bytes or Long Words. When PacketFormat is set to Bytes the packet transmission will end on the last byte sent which may not be a long word boundary. Extra bytes of the last long word are not transmitted. The TX FIFO must be loaded with Long words regardless of the PacketFormat setting.



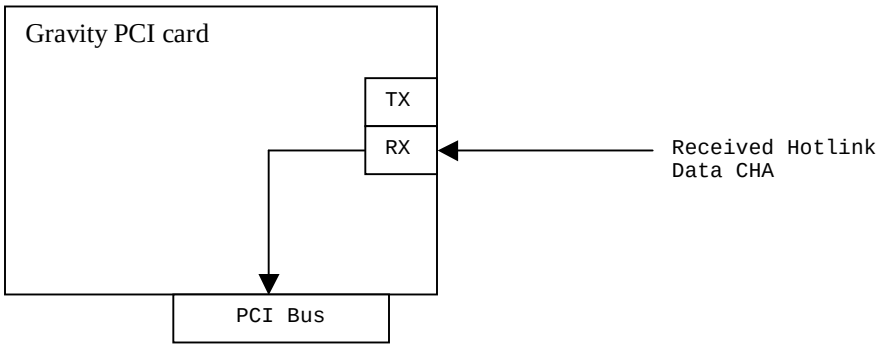
1.2.2 Receive Operation

The Gravity HLII hardware captures all non-special character data into a receive FIFO. Special characters, such as reframe and start of message (K28.x) characters, are not received into the FIFO and are not accessible via PCI.

Before received data is written to the FIFO, the Gravity HLII packs successive bytes into long words. For this reason, the three modes of operation require that the incoming data packet length be a multiple of 4 bytes. This is also true for the variable length mode. Trailing bytes that do not accumulate into a group of 4 will not be written to the receiver FIFO, and therefore, cannot be retrieved via PCI.

The Gravity HLII hardware generates PCI interrupts when the receive FIFO reaches a programmed threshold (see API User's Guide) . When the threshold value has been reached, an interrupt is sent through the API to request a DMA unloading of the FIFO.

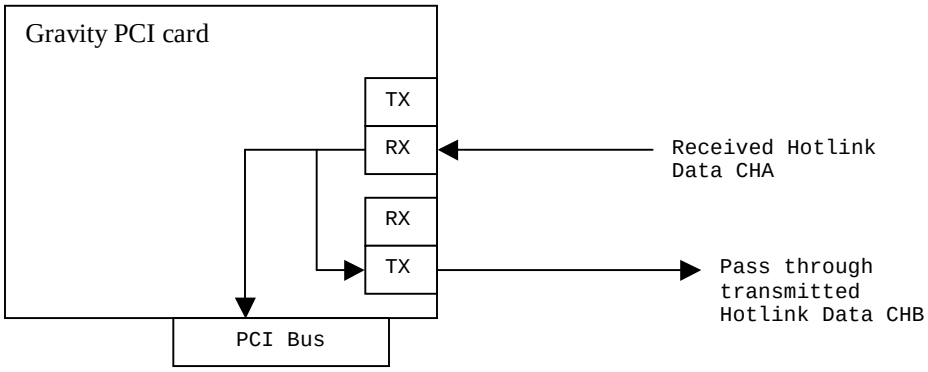
The Gravity HLII card has a register counter that indicates the number of long words currently in the FIFO. (This value is displayed in EFCDataTest as described in section 2.0). The count value of this register will decrement, by one, for each long word that is read via PCI. For each 4 bytes received, the counter value will increment by one.



In MODE3 with PacketFormat set to Bytes, when the last byte of the packet is received the RX FIFO is loaded with a complete long word. The users application must comprehend the packet size and disregard any bytes in the last long word that do not represent packet data. The non-packet data bytes of the last long word are stuffed with hex “00”:

1.2.3 Receive Operation with pass through (Line Spy)

The Gravity HLII hardware can also operate in a pass through mode were all of the incoming data from a receive port will be sent back out of a transmit port. This data will be retransmitted as near real time and will be unaltered. This mode works well for daisy chaining cards or using the HL2D card as a line spy. The standard receive port for single channel operation as described above is used and the re-transmitted data goes out of the channel 2 transmit port.



1.2.4 Transmit Operation – Dual Channel cards

As described in 1.1.1, all data written to the transmit FIFO is automatically sent over the HOTLink output of the Gravity HLII card. However, for dual channel cards operating in Dual Channel mode (0x01FFFF08 D1 = '1') data written to the transmit FIFO is sent out over both channels A and B.

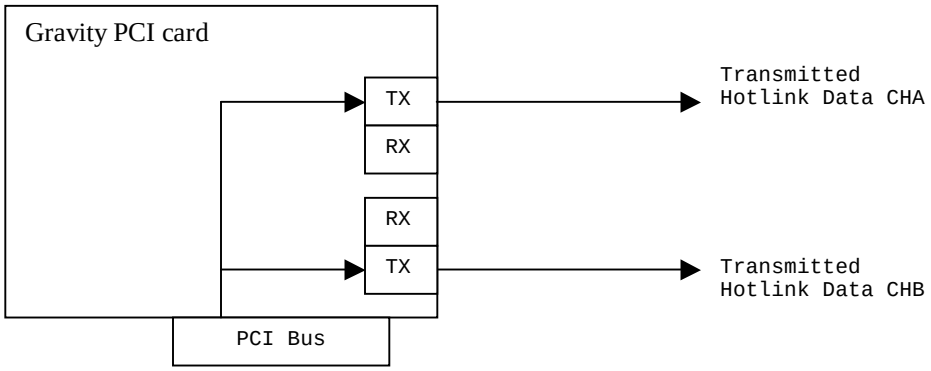
Long words in the transmit FIFO will be defined as follows:

D31 - D24	D23 - D16	D15 - D8	D7 - D0
CHB BYTE N	CHB BYTE N + 1	CHA BYTE N	CHA BYTE N + 1

Therefore, all bytes to be transmitted over channel B must be packed into the upper 16 bits and all bytes to be transmitted channel A must be packed into the lower 16 bits.

Dualmode is exclusive of MODE1, MODE2, and MODE3. Dualmode is a synchronous transmittion of data. Dualmode is not two independent transmit channels.

When the transmit FIFO is empty, the Gravity HLII card transmits k28.5 characters on both channels. The rules for each mode of operation are the same as that described in 1.1.1.



1.2.5 Receive Operation – Dual Channel cards

As with single channel cards, dual channel cards operating in Dual Channel Mode (0x01FFFF08 D1 = '1') capture all non-special character data into a receive FIFO. Special characters, such as reframe and start of message (K28.x) characters, are not received into the FIFO and are not accessible via PCI.

When data is received over two HOTLink II channels, consecutive bytes from channel A and channel B are packed into a single long word.

The relative phase of the channels will not be guaranteed, and therefore, the firmware logic includes circuitry for aligning the two channels. This circuit consists of two independent byte-wide FIFOs along with a control circuit for advancing one FIFO relative to the other.

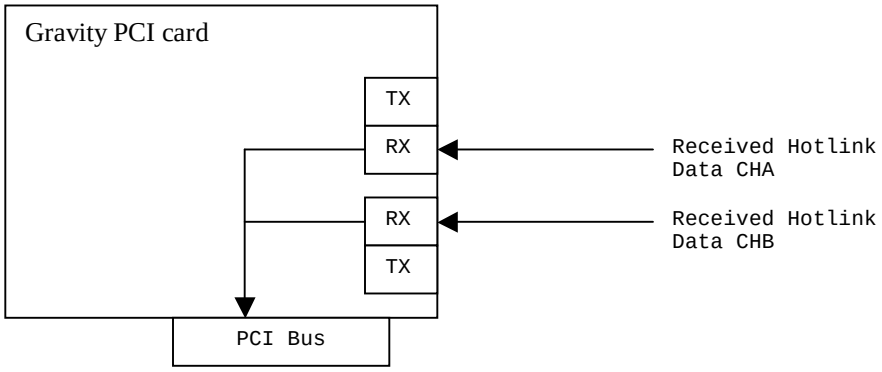
Dualmode is exclusive of MODE1, MODE2, and MODE3. Dualmode is a synchronous reception of data. Dualmode is not two independent receive channels.

Synchronization requires that no more that one character time of skew exist between the two incoming channels. For instance, for a 200 Mbps baud rate, the maximum delay due to cabling mismatch must be no more than 50 ns.

Consecutive bytes from channel A and channel B packed into a single long word as follows:

D31 - D24	D23 - D16	D15 - D8	D7 - D0
CHB BYTE N	CHB BYTE N + 1	CHA BYTE N	CHA BYTE N + 1

The result is that all bytes received from channel B are packed into the upper 16 bits and all bytes from channel A are packed into the lower 16 bits.



1.3 Control Register Description

All parameters for controlling the Gravity HLII card are contained in a 32 bit register (offset 0x01FFFF00) defined as follows:

MODE3 - PACKET SIZE	SOM CHAR	SP	MODE	CONTROL CODE
D31 … D16	D15 … D12	D11…D10	D9…D8	D7 … D0

These parameters are normally manipulated through the API (see the API Users Guide), however, they may be manipulated directly, by writing to address 0x01FFFF00. The value of this register is displayed in EFCDataTest as described in section 2.0.

Two additional bits are defined at offset 0x01FFFF08 for clearing latched flag conditions and for setting the card in dual channel operation.

1.3.1 Control Register Bit Definitions

The function of each control register bit is described below:

CONTROL BIT

D0 – **HOTLINK Rx ENABLE**
Setting this bit will enable the receiver FIFO and the associated HOTLink receiver Channel.

D1 – **HOTLINK Tx ENABLE**
Setting this bit will enable the transmit FIFO and the associated HOTLink transmit channel

D2 – **RECEIVER FIFO RESET**
Setting this bit will clear the receiver FIFO and set the FIFO counter value to zero.

D3 – **TRANSMIT FIFO RESET**
Setting this bit will reset the transmit FIFO. Any previously loaded data will be flushed without being transmitted.

D4 – **UNUSED**

D5 – **HL_OELE_L**
This bit toggles the Cypress HOTLink OELE_L bit (see Cypress HL II data sheet)

D6 – **HL_RSTZ_N**
This bit toggles the Cypress HOTLink RSTZ_N bit (see Cypress HL II data sheet)

D7 – **HL_BOE**

This bit toggles the Cypress HOTLink BOE0 through BOE7 simultaneously (see Cypress HL II data sheet)

1.3.2 Control Register Protocol Fields

The mode and speed selection bits are described below:

MODE
D9 – D8

00	UNUSED	
01	**MODE1**	4 BYTE PACKETS, ONE K28.x SOM
02	**MODE 2**	VARIABLE LENGTH
03	**MODE 3**	USER DEFINED PACKET LENGTH, ONE K28.x SOM

SP
D10 - **TRANSMISSION SPEED**
Setting this bit will double the HOTLink baud rate output. For Gravity HLII cards with standard firmware, setting this bit will increase the baud from 200 Mbps (250 Mbps) to 400Mbps (500 Mbps) when using an 80 MHz (100MHz) crystal oscillator

Packet Format
D11 - **Packet Format Bytes or LWords**
This bits sets the format for Mode3 Packet Count to Bytes when '0' and Lwords when '1'

The special characters used for modes 1 and 3 are selected as follows:

SOM CHAR

D15 – D12	Start of Message Character
0000	K28.0
0001	K28.1
0010	K28.2
0011	K28.3
0100	K28.4
0101	unused
0110	K28.6
0111	K28.7
1000	K23.7
1001	K27.7
1010	K29.7
1011	K30.7
1100 – 1111	unused

MODE 3 - PACKET SIZE
D31 – D16 - These 16 bits define the number of long words per packet when mode 3 is selected. Values can be 0x0001 through 0xFFFF (4 bytes through 262,140 bytes per packet).

Note: Care must be taken in selecting long data packet lengths since HOTLink II receivers typically require periodic K28.5 characters to reset internal elastic buffers. The maximum permissible number of data bytes (without K28.5s)

will be determined by the frequency difference between transmit and receive reference clocks.

1.3.3 Clearing Latched FIFO Full flags

The RX and TX FIFO full flags are latched such that the Application Software will not miss these error conditions. To reset these flag, the Application Software must write a '1', then a '0' to the LS bit of the Clear Flags Register (i.e., write a 0x00000001,and then 0x00000000, to offset 0x01FFFF08)

1.3.4 Setting Dual Channel mode

The Application Software must write a '1' to D1 of the Clear Flags Register (offset 0x01FFFF08) for the transmitter and receiver to operate in Dual channel mode. On the GUI for the EFCDataTest app, check or uncheck the "Dual" checkbox.

1.4 Status Register Description

Status registers for the Gravity HLII card are contained in two 32 bit registers (at offset 0x01FFFF80 and offset 0x01FFFF84) defined as follows:

Status 0 (Offset = 0x01FFFF80)

RESERVED			CHA FIFO FLAGS		
D31	…	D10	D9	…	D0

FIFO FLAGS

D0 – **TX_FIFO_NE** – ASSERTED WHEN THERE IS DATA IN THE TX FIFO
D1 – **TX_FIFO_25** – ASSERTED WHEN TX FIFO IS 25% FULL
D2 – **TX_FIFO_50** – ASSERTED WHEN TX FIFO IS 50% FULL
D3 – **TX_FIFO_75** – ASSERTED WHEN TX FIFO IS 75% FULL
D4 – **TX_FIFO_F** – LATCHED HIGH AFTER TX FIFO IS 100% FULL
D5 – **RX_FIFO_NE** – ASSERTED WHEN THERE IS DATA IN THE RX FIFO
D6 – **RX_FIFO_25** – ASSERTED WHEN RX FIFO IS 25% FULL
D7 – **RX_FIFO_50** – ASSERTED WHEN RX FIFO IS 50% FULL
D8 – **RX_FIFO_75** – ASSERTED WHEN RX FIFO IS 75% FULL
D9 – **RX_FIFO_F** – LATCHED HIGH AFTER RX FIFO IS 100% FULL

Status 1 (Offset = 0x01FFFF84)

RX FIFO COUNTER
D31 … D0

RX FIFO COUNTER - 32 BIT COUNTER THAT INDICATES THE CURRENT NUNBER OF 32 BIT WORDS IN THE RX FIFO

2 Overview of EFCDataTest

EFCDataTest (*Figure 2.0*) is provided as a useful tool to transmit and receive data in a variety of applications. EFCDataTest is geared towards image data, but also has a data view window that allows the user to view the raw data. The image view is useful as a way to easily inspect one MByte of captured data over the HOTLink interface. With EFCDataTest, you can easily check the health of the Gravity HLII cards by performing loop back testing or card-to-card testing.

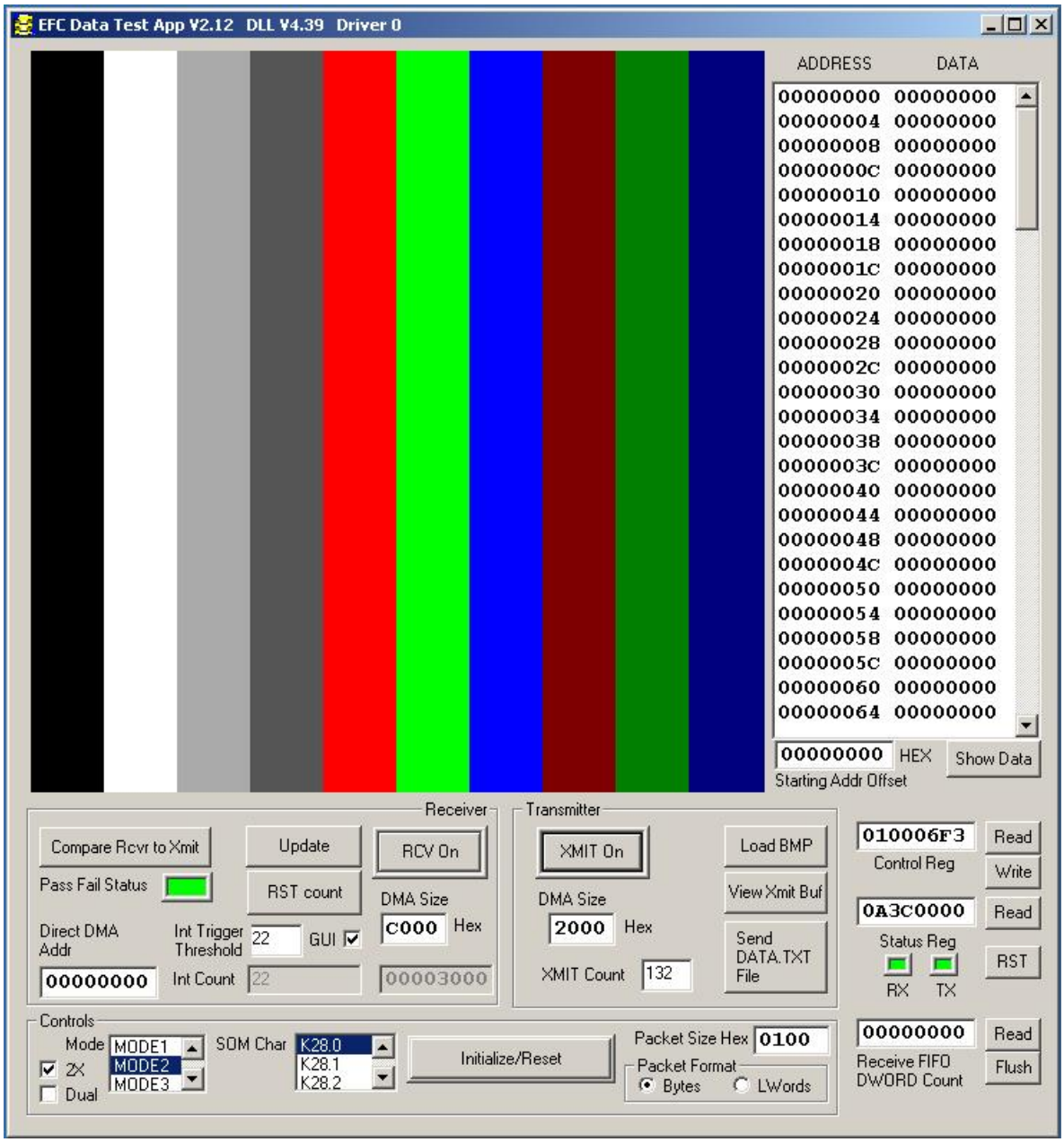


Figure 2.0

EFCDataTest can be useful for the test and debug of many systems using HOTLink II as a data interface. Several types of link errors are easily detected using EFCDataTest. For instance, the loss of a single byte within the one MByte sequence is detected by a vertical discontinuity in the image. Stuck bits are detected as color changes and any loss of entire packets (mode 3) can be easily detected visually.

EFCDataTest allows users to easily change the transmission mode to any of the three standard modes included in the Gravity HLII card. Users can change between various k28.x SOM characters used in mode 1 and mode 3 and the packet size of mode 3 can be adjusted using EFCDataTest.

The image view is organized as 512 x 512 pixels where each pixel is represented by a 4 byte value.

2.1 System Memory Allocation

EFCDataTest allocates large buffers in system memory to store transmit and receive data. The Application uses two MBytes of system memory total - one MByte for the transmit buffer and one MByte for the receive buffer. The sizing accommodates the 512 x 512 x 32bit images viewable in EFCDataTest view port. Customer developed applications can easily allocate more memory depth. The memory depth is only limited by the amount of total system memory.

When receiving data over the HOTLink interface, EFCDataTest uses the allocated receive memory as a ring buffer for the incoming image data. That is, once the incoming data exceeds 1 MByte (on complete image), the software will write the subsequent data starting at the 0x00000000 offset.

2.2 Setting Protocol Modes and Transmit Rate

EFCDataTest allows the user to easily set the protocol mode. (as described in section 1.1.1) Selecting the desired mode from the Mode selector window as shown in Figure 2.2.1 does this. The user can also select the desired start of message character for modes 1 and 2 using the **SOM Char** selector window as shown in Figure 2.2.2

Figure 2.2.1

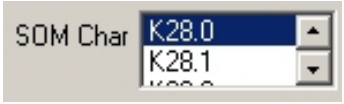
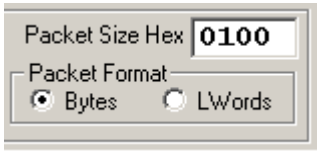


Figure 2.2.2

The 2x check box (Figure 2.2.1) should be checked for 400/500 MBaud transmission rates and unchecked for 200/250 MBaud transmission rates.

The packet size window in the lower left of the GUI is used for setting the packet size of Mode 3 (as discussed in section 1.1.1). This variable determines the number of long words or bytes per packet and has a default of 0x0100.



2.3 Transmit and Receive Control using EFCDataTest

Figure 2.2 shows transmit and receive controls for EFCDataTest.

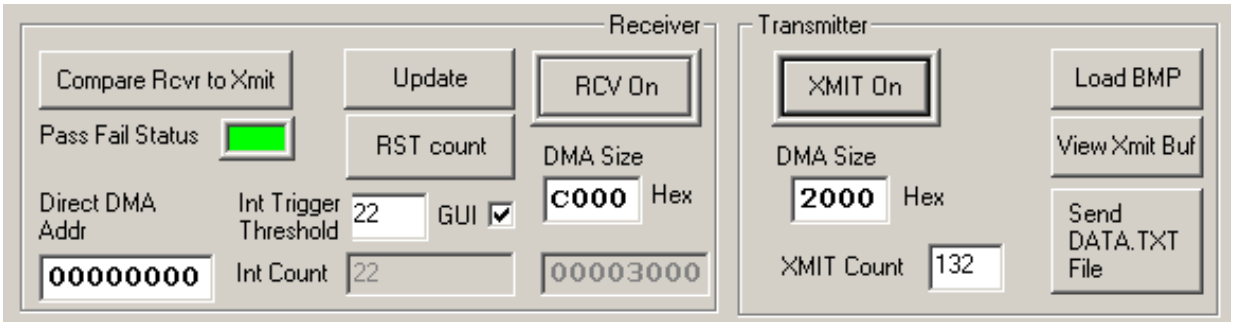


Figure 2.2

The Transmitter box allows for transmitting of two types of data – bitmap image data or data stored in a text file.

To load a bitmap image, click the **Load BMP** button in the transmitter section. A Windows selection box will allow users to load any previously created bitmaps. EFCDataTest will automatically size the bitmap to a 512 x 515 image. These images will be 32 bit true color images and, therefore, the resulting data volume will be 1 MByte. This data is loaded in the system memory allocated by the application (see section 2.1).

The **DMA Size** variable tells the application the desired DMA block size. The default value is 0x2000 (8,196 Bytes) which is half of the transmit FIFO depth. The application is able to sense the transmit FIFO half full flag to determine if there is enough space available to initiate a DMA block transfer.

The **XMIT Count** variable tells the application the desired number of consecutive DMA block transfers to perform. The default value is 132, which results in the full 1 MByte of data being transferred (just over one complete image).

Once a bitmap image has been loaded in system memory, clicking the **XMIT On** button will initiate DMA transfers of the bitmap data through the Gravity HOTLink II

card. When using the default settings, clicking the **XMIT On** button will result in 132 DMA transfers of 8,196 bytes each. These parameters can be reduced (either a smaller block size or fewer transfers) in order to transmit only a portion of the image.

Since EFCDataTest uses the same view port for both the transmitted and received images, the user may want to return to a view of the transmit buffer image after a new image has been received and displayed. To do this, click the **View Xmit Buf** button.

EFCDataTest also has a utility for transmitting the contents of a text file using the **Send DATA.TXT File** button. Clicking this button will transmit the entire contents of a file named "data.txt" that is located in the root directory where FCDATATEST.EXE resides. This file may be of any length.

The file should be formatted as shown below with each ASCII line interpreted as a one hex representation of a 32 bit value.

```
12345678
AABBCCDD

.
.
.
.
87654321
(eof)
```

It should be noted that the transfer of this data file to the Gravity card does not use DMA, but rather uses single long word writes to the card.

The Receiver box has controls for setting all parameters associated with receiving HOTlink II serial data. The **RCV On** Button enable the HOTLink receive channel on the card and will allow data to be captured by the application according to the other parameters set in the receiver box.

Similar to the transmitter, the receiver has a **DMA Size** variable for setting the DMA block size. The application receives an interrupt from the Gravity card whenever the receive FIFO reaches a DMA size threshold. The default value is 0xC000 (49,152 Bytes), which is 75% of the receive FIFO depth.

The **Int Count** field will always display the total number of interrupts received, indicating the number of DMA block moves that have occurred.

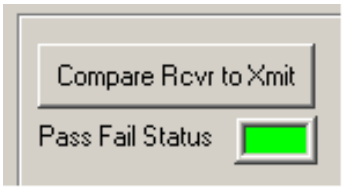
The **Int Trigger Threshold** variable determines the total number of interrupts that must occur before the data accumulated in the system memory receive buffer is displayed in the view port. The default value is 22, such that a complete one MByte image must be received before the view port is updated. The **Update** Button provides an easy way for the user to update the image view port *before* the interrupt threshold is reached. This is useful when HOTLink transmission has been

interrupted or halted and you wish to inspect the partial contents of the receive buffer.

The **RST count** button allows the user to reset the interrupt counter to zero. This will also clear the view port window to black.

2.4 Compare Rcvr and Xmit Buffers

The **Compare Rcvr to Xmit** Button can be used verify the data integrity of the receive data compared to the transmitted data.



The compare status is automatically updated after an image has bee received. The button can be selected at anytime to compare the transmit buffer to the receive buffer.

During initialization the status box is set to gray color. If a mismatch is detected after image is received, The **UPDATE** button is selected, or the Compare button is selected then the status box is set to red and the address of the first mismatch is set in the data view port. If the receive buffer matches the transmit buffer the status is set to green.

2.5 DMA Operation using EFCDataTest

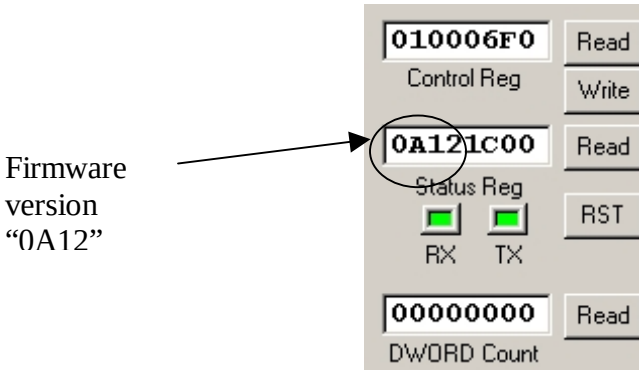
EFCDataTest allows for the adjustment of the DMA block sizes in the DMA Size field. This hex value represents the total number of bytes of the DMA transfer and can be set independently for transmit and receive DMA transactions.

Transmit FIFOs on the Gravity HLII card are 4096 long words deep (16,384 bytes) and the receive FIFOs on the Gravity HLII card are 16,384 long words deep (65,536 bytes).

The default value the DMA block sizes, for transmit and receive is set to 0x2000 and 0xC000 respectively. These are the maximum recommended DMA block sizes and they result in efficient (higher speed) PCI transactions. However, Customer Applications may set these block sizes to smaller values if required.

The Gravity HLII hardware generates PCI interrupts when the receive FIFO reaches a programmed threshold. In some user applications where the total size of incoming

data may be unknown, a residual amount of data may be left in the FIFO. This data may need to be recovered (and analyzed or stored) before additional incoming data brings the FIFOs to the next interrupt threshold. In order to deal with this, the Gravity HLII card has a register that indicates the number of long words currently in the receive FIFO. This value is displayed in the **Byte Count Reg** field as shown below. The user must click the **Read** button to update this field.
Note : This register also display the F/W version in the upper 4 nibbles.



In cases where incoming data ceases (before the FIFO interrupt threshold is reached) and a residual number of bytes is left in the receive FIFO, the value of this register may be used to initiate single reads to retrieve the remaining FIFO data. The value in the count register will decrement (by one) for each long word that is read from the FIFO.

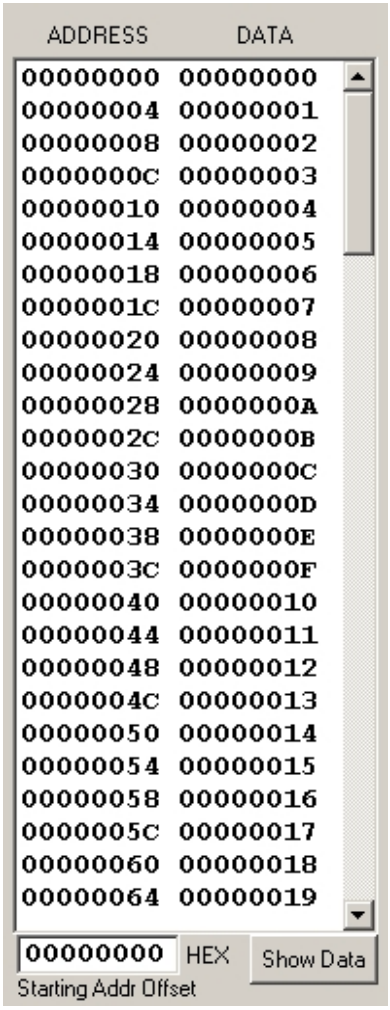
The GUI also shows the Latched FIFO full flags as shown above. These should be green typically and if ever become red from a latched bit, they can be cleared from the "RST" button. If a red condition exists, data has most likely been corrupted.

2.6 Initialization and Reset

The **Initialize/Reset** Button can be used to perform FIFO reset a bring the control register to it's initial conditions.

2.7 Data View Port Description

The Data view port is used to view the raw HEX values of the received data. Clicking the **Show Data** button will update the window and 128 long words will be displayed starting at the address entered in the **Starting Addr Offset** edit box. The data view can be scrolled to show all acquired data.



2.8 Application Initialization and Startup

The EFCDataTest application can be configured for different startup parameters using a file called **dataHOST.INI**. This file must be located in the root directory where EFCDATATEST.EXE resides. The file indicates the PCI card driver number and the default control register contents along with various GUI settings.

The format of this file is shown below. This file can be created and edited with any text editor application.

```
0
400002F0
C000
2000
22
132
1
(eof)
```

The first line is the card number and specifies which card in the PCI chassis to be opened for use. If there is only one card in the PCI chassis, this value should be set to 0. If there are multiply cards in the PCI chassis, and the user wishes to run multiple instances of EFCDataTest.exe, the recommended approach is to create a unique file folder for each desired instance. Each file folder can be tied to a particular card using the local **dataHOST.INI** file.

The second line of the file is the control register value. This value will be written to the control register at startup of the application and the GUI settings will be updated accordingly. Refer to the section 1.2 for details on the Control Register bits.

The Third line is the size of data DMA transfers for a receive interrupt. This value can also be changed in the GUI. The value shown in this example is set for C000H or 48K bytes which is the proper size for a 3/4 full interrupt from a 64K byte FIFO.

The Fourth line is the size of data DMA transfers for a transmit. This value can also be changed in the GUI. The value shown in this example is set for 2000H or 8K bytes which is the proper size for a 1/2 of the 16K byte Transmit FIFO.

The Fifth line is the number of Receive interrupt to trigger on before the GUI video image is refreshed. This value is also changeable form the GUI.

The Sixth line is the number of Transmit loops run to send data. This value is also changeable form the GUI.

The seventh and final line tells the application which type of Gravity Data card to open a driver for. Either a type 1 or a type 2. Type 1 is 32bit Gravity cards and type 2 is the 64bit Gravity cards. Type 1 is default if there is no entry for this item.

NOTE : If this dataHOST.INI file is not found, the card number will default to 0 and the control register will default to factory settings. The GUI settings will also default to a predefined factory value.

2.9 Loop Back Testing with EFCDataTest

Connect a loop back cable between the card's transmit and receive ports. (There is no internal loop back enabled). Start up the EFCDataTest Application. Make sure to leave the default settings as they are.

Next perform the following steps:

1. Click the **RCV On** button
2. Click the **XMIT On** button

This transmits the default image over the HOTLINK interface. (132 DMA transfers)

Notice that the **INT COUNT** box incremented by 22. The View Port on EFCDataTest Application will update whenever the number of RX interrupts (and subsequent block moves) reaches the threshold value.

Next try loading different images by clicking the **LOAD BMP** button. The images provided are useful for uncovering bugs. Note that the image selected is automatically loaded in the View Port.

The View Port is used to view both the XMIT buffer contents and the RX buffer contents of system memory (both having independent locations in system memory)

The View Port will not switch over to the RX buffer contents until you reach the **Int Trigger Threshold** value.

To transmit the loaded image perform the following steps:

1. Click the **RST Count** button
   This clears the interrupt counter AND also clears the view port.

2. Click the **XMIT On** button
   This transmits the image and, when the 22 interrupt threshold is reached, displays the contents of the RX buffer.

The **Induce INT** and **Update button** are troubleshooting features used for debugging the receiver.

The **Intitialize/Reset** button will get you back to a known state with the card.

If for any reason, you get EFCDataTest a mode where it is not working properly, follow these steps:

1. Set **Int Trigger Threshold** to 22 and **XMIT Count** to 132.
2. Click the **Initialize/Reset** button
3. Click the **RST count** button

4. Click the **Rcv On** button
5. Click the **XMIT On** button

If EFCDataTest is still not working reliably, try closing a re-opening the Application.

The data View Port on the right shows the data in RX system memory buffer. To see this, try loading and transmitting CHECKERS.BMP. When you receive this image, scroll down the data view port to see the captured data. It should alternate between FFFFFFFF (full intensity white) and 0000000 (black)

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