



**endace**  
a c c e l e r a t e d

**DAG 6.1S Card  
User Guide**  
EDM01-11

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## Typographical Conventions Used in this Document

- Command-line examples suitable for entering at command prompts are displayed in `mono-space courier font`. The font is also used to describe config file data used as examples within a sentence. An example can be in more than one sentence.

Results generated by example command-lines are also displayed in `mono-space courier font`.

- The software version references such as 2.3.x, 2.4.x, 2.5.x are specific to Endace Measurement Systems and relate to Company software products only.

## Protection Against Harmful Interference

When present on product this manual pertains to and indicated by product labelling, the statement "This device complies with part 15 of the FCC rules" specifies the equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the Federal Communications Commission [FCC] Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## Extra Components and Materials

The product that this manual pertains to may include extra components and materials that are not essential to its basic operation, but are necessary to ensure compliance to the product standards required by the United States Federal Communications Commission, and the European EMC Directive. Modification or removal of these components and/or materials, is liable to cause non compliance to these standards, and in doing so invalidate the user's right to operate this equipment in a Class A industrial environment.

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## **1.0 PREFACE**

**Introduction**      The installation of the Endace DAG 6.1S card on a PC begins with installing the operating system and the Endace software. This is followed by fitting the card and connecting the ports.

**Viewing this document**      This document, the DAG 6.1S Card User Manual is available on the installation CD.

**In this chapter**      This chapter covers the following sections of information.

- User Manual Purpose
- DAG 6.1S Card Product Description
- DAG 6.1S Card Architecture
- DAG 6.1S Card Extended Functions
- DAG 6.1S Card System Requirements

### **1.1 User Manual Purpose**

**Description**      The purpose of this DAG 6.1S Card User Manual is to describe:

- Installing DAG 6.1S Card
- Setting DAG 6.1S Card Optical Power
- Confidence Testing DAG 6.1S Card
- Running Data Capture Software
- Synchronizing Clock Time
- Data Formats Overview

## 1.2 DAG 6.1S Card Product Description

**Description** The DAG 6.1S card is of a series specifically designed for network surveillance applications. It is optimized to enable header-only or full packet capture from PoS OC-192c or STM-64c links, and 10 Gigabit Ethernet 10GBase-LR and 10GBase-LW links.

**Figure** Figure 1-1 shows the DAG 6.1S PCI-X card.

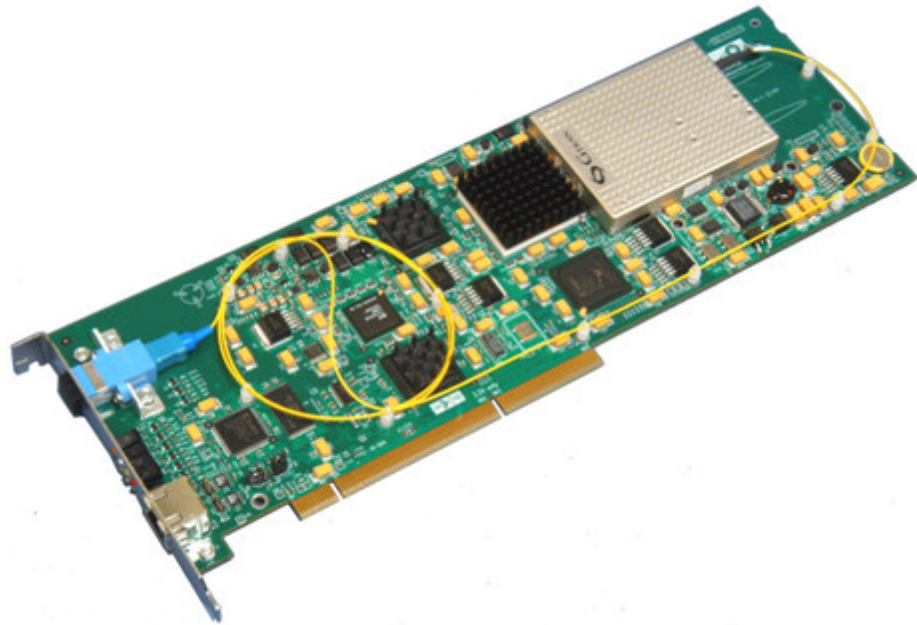


Figure 1-1. DAG 6.1S PCI-X Card.

Installed in a PCI-X 1.0 slot the DAG 6.1S card only operates at 66, 100, and 133 MHz PCI-X for full packet capture at line rate and allows recording of all header information and/or payload with a high precision timestamp.

The packet header and payload information can be stored for later in-depth analysis, or used in real-time for a variety of network monitoring applications, such as billing and intrusion detection systems.

IP header traces can also be used operationally to determine link performance and application mixes, find “top talkers” or generate source/destination AS matrices for specific network links.

## 1.3 DAG 6.1S Card Architecture

**Description** Serial optical data is received by the optical interface, and fed into a physical layer ASIC. The packet data is then fed immediately into the Rx FPGA. This FPGA contains the DUCK timestamp engine, and packet record processor.

Because of component close association, packets or cells are time-stamped accurately. Time stamped packet records are then stored in an external FIFO and passed into the PCI-X FPGA for transmission to the host.

**Figure** Figure 1-2 shows the DAG 6.1S card major components and data flow.

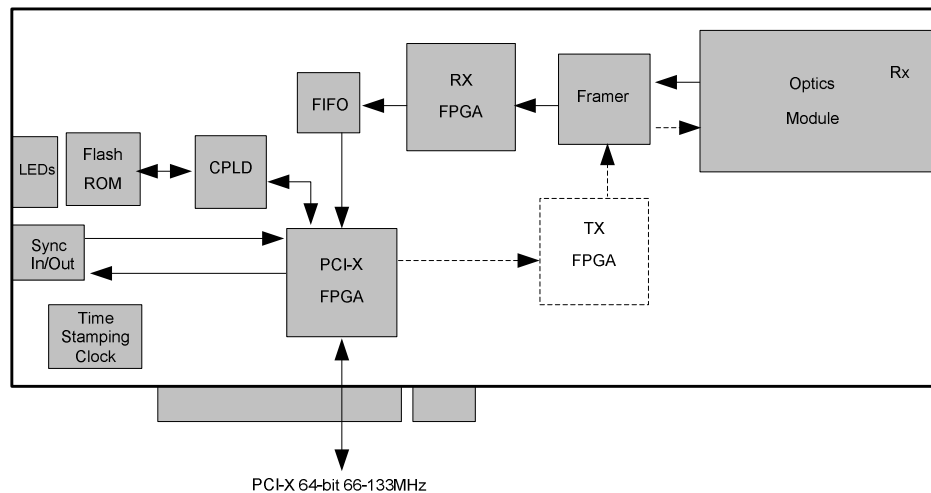


Figure 1-2. DAG 6.1S Card Major Components and Data Flow.

## 1.4 DAG 6.1S Card Extended Functions

**Description** The shipped version of the DAG 6.1S does not contain a transmit path, it is intended to be used with fibre optic splitters.

Contact the Endace customer support team at [support@endace.com](mailto:support@endace.com) to enable effective use of extended functions.

## 1.5 DAG 6.1S Card System Requirements

**Description** The DAG 6.1S card and associated data capture system minimum operating requirements are:

- PC, at least Intel Xeon 1.8GHz or faster
- Intel E7500, ServerWorks Grand Champion LE/HE or newer chip set
- 256 MB RAM
- At least one free PCI-X 1.0 slot supporting 66MHz operation
- Software distribution free space of 30MB

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## 1.5 DAG 6.1S Card System Requirements, continued

<b>Operating system</b>	For convenience, a Debian 3.1 [Sarge] Linux system is included on the Endace Software Install CD. Endace currently supports Windows XP, Windows Server 2000, Windows Server 2003, FreeBSD, RHEL 3.0, and Debian Linux operating systems.
<b>Different system</b>	For advice on using a system substantially different from that specified above, contact Endace support at <a href="mailto:support@endace.com">support@endace.com</a>

## **2.0 INSTALLING DAG 6.1S CARD**

**Introduction** Given the DAG 6.1S card can be installed in any free PCI-X 1.0 slot, it operates at 66, 100, and 133 MHz. The DAG 6.1S will not operate in 32 or 64-bit PCI slots.

Higher speed slots are recommended for best performance.

The DAG 6.1S should be the only device on the PCI-X bus if possible, as the cards make very heavy use of PCI-X bus data transfer resources.

Although the driver supports up to four DAG cards by default in one system, due to band width limitations there should not be more than one card on a single PCI-X bus.

**In this chapter** This chapter covers the following sections of information.

- Installation of Operating System and Endace Software
- Insert DAG 6.1S Card into PC
- Installation of Operating System and Endace Software

### **2.1 Installation of Operating System and Endace Software**

**Description** If the DAG device driver is not installed, before proceeding with the next chapter, install the software by following the instructions in EDM04-01 Endace Software Installation Manual.

Go to the next chapter of information when the DAG device driver is installed.

### **2.2 Insert DAG 6.1S Card into PC**

**Description** Inserting the DAG 6.1S card into a PC involves accessing the bus slot, fitting the card, and replacing the bus slot screw.

**Procedure** Follow these steps to insert the DAG 6.1S card.

**Step 1. Access bus Slot**

Power computer down.

Remove PCI-X bus slot cover.

---

*Continued on next page*

## 2.2 Insert DAG 6.1S Card into PC, continued

### Procedure, continued

#### Step 2. Fit Card

Insert into PCI-X bus slot.

Ensure free end fits securely into a card-end bracket that supports the card weight.

#### Step 3. Replace bus Slot Screw

Secure card with screw.

#### Step 4. Power up computer

## 2.3 Connect Card Ports

**Description** There is one square plastic SC-type optical connector on the 6.1S DAG card for the received optical signal. There is no TX port on the card.

The card has an 8-pin RJ45 socket for time synchronization input. This socket must never be connected to an Ethernet network or telephone line.

## **3.0 SETTING DAG 6.1S CARD OPTICAL POWER**

**Description** The optical power range depends on the particular device fitted on the DAG 6.1S card.

The DAG 6.1S card is shipped fitted with the GTRAN GT10-RXU 1310nm single mode receive module by default.

**Optical power measure** Optical power is measured in dBm – decibels relative to 1 mW where 10 dB is equivalent to a factor of 10 in power.

The numbers are all negative, showing powers below 1 mW. The most sensitive devices can work down to about -30 dBm, or 1 uW.

**Configuration** The following table describes the DAG 6.1S card optics power module configuration.

<b>Part No.</b>	<b>Fibre</b>	<b>Data Rate</b>	<b>Max Power [dBm]</b>	<b>Min Power [dBm]</b>	<b>Nominal Pwr [dBm]</b>
GT10-RXU	SMF	10Gbps	0	-17	-9

**In this chapter** This chapter covers the following sections of information.

- Interpreting DAG 6.1S Card LED Status
- DAG 6.1S Card LED Display Functions

### **3.1 DAG 6.1S Card Optical Power Input**

**Description** The optical power input into the DAG 6.1S card must be within a receiver's dynamic range.

When optical power is slightly out of range an increased bit error rate is experienced. If power is well out of range the system cannot lock onto the SONET frames. In extreme cases of being out range excess power will damage a receiver.

When power is above the upper limit the optical receiver saturates and fails to function. When power is below the lower limit the bit error rate increases until the device is unable to obtain lock and fails.

---

*Continued on next page*

### 3.1 DAG 6.1S Card Optical Power Input, continued

**Input power** The DAG 6.1S card is set up to measure the optical power at the receiver, and to make sure that it is well within the specified power range of -9 dBm.

Input power is adjusted by:

- Changing splitter ratio if power is too high or too low, or
- Inserting an optical attenuator if power is too high.

### 3.2 Splitter Losses

**Description** Splitters have the insertion losses marked on packaging or in accompanying documentation.

- A 50:50 splitter will have an insertion loss of between 3 dB and 4 dB on each output
- 90:10 splitter will have losses of about 10 dB in the high loss output, and <2 dB in the low loss output

The GT10-RXU uses 1310nm optics. Splitters used must be designed for 1310nm as the insertion loss will vary for different wavelengths.

**Single mode fibre loss** A single mode fibre connected to a multi-mode input has minimal extra loss.

**Multi-mode fibre loss** A multi-mode fibre connected to a single mode input creates large and unpredictable loss.

## 4.0 CONFIDENCE TESTING DAG 6.1S CARD

**Introduction** The confidence testing is a process to determine the DAG 6.1S card is functioning correctly.

The process also involves a card capture session, and demonstrates configuration in the style of 'What You See You Can Change', WYSYCC.

Interface statistics are also inspected during this process. There is also information in this section regarding reporting of problems.

**In this chapter** This chapter covers the following sections of information.

- Interpreting DAG 6.1S Card LED Status
- DAG 6.1S Card LED Display Functions
- Configuration in WYSYCC Style
- `dagsix` Utility
- DAG 6.1S Card Capture Session
- Inspect PoS Interface Statistics
- Inspect 10G Ethernet Interface Statistics
- Reporting Problems

### 4.1 Interpreting DAG 6.1S Card LED Status

**Description** The DAG 6.1S has a 8 status LEDs, three blue, one green, one orange, one yellow, and two red.

**Figure** Figure 4-1 shows the DAG 6.1S status LEDs.

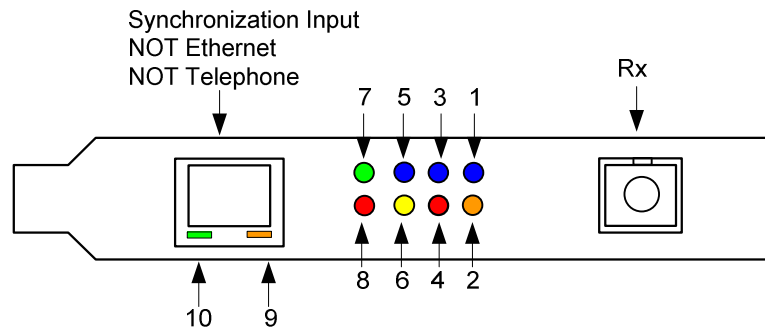


Figure 4-1. DAG 6.1S Card Status LEDs.

*Continued on next page*

## 4.1 Interpreting DAG 6.1S Card LED Status, continued

**LED definitions** The following table describes the LED definitions.

LED	Description
LED 1	RX FPGA successfully programmed.
LED 2	LOS: Loss of Signal; no valid optical signal seen by receiver.
LED 3	Reserved.
LED 4	Reserved.
LED 5	PCI-X FPGA successfully programmed
LED 6	Data capture in progress.
LED 7	Ethernet mode; OFF for PoS.
LED 8	Reserved.
LED 9	PPS Out: Pulse Per Second Out; indicates card is sending a clock synchronization signal
LED 10	PPS In: Pulse Per Second In; indicates card is receiving an external clock synchronization signal

The LED's labelled 'Reserved' may be in the ON or OFF state under varying circumstances and can be ignored.

## 4.2 DAG 6.1S Card LED Display Functions

**Description** When a DAG 6.1S card is powered up the blue coloured LED 5 should always come on, and the remaining LED's such as green and yellow display for specific functions.

**Figure** Figure 4-2 shows the correct LED state for DAG 6.1S card without optical input.

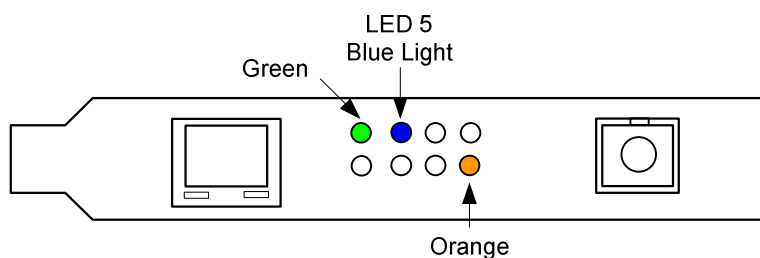


Figure 4-2. LED State for DAG 6.1S Card Without Optical Input.

### 4.3 Configuration in WYSYCC Style

**Description** Configuration in WYSYCC is the 'What You See You Can Change' style.

Running the command 'dagsix' alone shows the current configuration. Each of the items displayed can be changed as follows:

<b>Configuration options</b>	default	Set card to normal defaults.
	pos	Set framer into Packet-over-SONET [PoS] mode.
	[no]lsfcl	[un]set facility loopback on line side of phy.
	[no]lseql	[un]set equipment loopback on line side of phy
	[no]fcl	[un]set facility loopback on downstream side of phy.
	[no]eql	[un]set equipment loopback on downstream side of phy.
	[no]pscramble	[un]set Packet-over-SONET scrambling.
	[no]crc	Dis/enable PoS CRC32 checking.
	[no]crcstrip	[Do]Don't include CRC in ERF record or wlen count.
	[no]pmin	Dis/enable discard of packets smaller than a predefined minimum size.
	[no]pmax	Dis/enable discard of packets larger than a predefined maximum size.
	long=X	Maximum packet size for pmax.
	short=x	Minimum packet size for pmin.
	slen=X	Capture X bytes of packet data.
	eth	Set framer to 10G Ethernet mode. Defaults to LAN.
	lan	Set framer to Ethernet LAN mode 10GBase-LR
	wan	Set framer to Ethernet WAN mode 10GBase-LW

---

*Continued on next page*



### 4.3 Configuration in WYSYCC Style, continued

**Process** Follow these steps configure the DAG 6.1S card in what you see is what you can change style.

#### Step 1. Check FPGA Images

Before configuring the DAG 6.1S card, ensure the most recent FPGA image is loaded on the card. Loading the newest available Rx FPGA image. This will cause LED 1 to light.

Load the newest available PCI-X FPGA image.

```
dag@endace:~$ dagrom -rvp -d dag0 -f xilinx/dag61pcix-erf.bit
```

Load the newest available Rx FPGA image. This will cause LED 1 to light.

```
dag@endace:~$ dagld -x -d dag0 xilinx/dag61rx-erf.bit
```

```
dag@endace:~$ dagsix -d dag0
link    ETH nolsfcl nolseq1 nofcl noeql
sonet   slave
PoS     nopscramble nocrc nocrcstrip nopmin nopmax long=1502 short=9
packet  varlen slen=48 align64
packetA drop=0
pcix    66MHz 64-bit buf=32MB rxstreams=1 txstreams=0 mem=0:0
```

#### Step 2. Configure DAG 6.2S Card for Normal Use

The `dagsix default` command is always used:

```
dag@endace:~$ dagsix default
link    POS nolsfcl nolseq1 nofcl noeql
sonet   slave
PoS     pscramble nocrc nocrcstrip nopmin nopmax long=1502 short=9
packet  varlen slen=48 align64
packetA drop=0
pcix    66MHz 64-bit buf=32MB rxstreams=1 txstreams=0 mem=32:0
```

**NOTE:** The default command also sets the card to PoS mode, which will cause LED 7 to go out. For Ethernet mode use `dagsix default eth lan` or `dagsix default eth wan` as appropriate.

**NOTE:** After loading the Rx FPGA firmware, the `dagsix default` command must be issued immediately to initialise the thermal management systems of the to prevent overheating and protective shutdown.

---

*Continued on next page*

## 4.3 Configuration in WYSYCC Style, continued

Process, continued

### Step 3. Turn Pos Scrambling Off

Type:

```
dag@endace:~$ dagsix -d dag0 nopscramble
link      POS nolsfcl nolseq1 nofcl noeql
PoS       nopscramble nocrc nopmin nopmax long=1502 short=9
packet    varlen slen=48 align64
packetA   drop=0
pcix      133MHz 64-bit buf=32MB rxstreams=1 txstreams=0 mem=32:0
```

### Step 4. Set Configuration Options

Removing or adding the "no" prefix changes the configuration option settings.

### Step 5. Select Configuration Option

Choose from complete list of configuration options supported:

default	Set card framer to normal defaults.
pos	Set framer into Packet-over-SONET [PoS] mode.
[no]lsfcl	[un]set facility loopback on line side of phy.
[no]lseq1	[un]set equipment loopback on downstream side of phy.
[no]fcl	[un]set facility loopback on downstream side of phy.
[no]eql	[un] equipment loopback. This is for testing only.
[no]pscramble	[un]set Packet-over-SONET scrambling
[no]crcstrip	Do [not] include CRC in ERF record or wlen count.
[no]crc	Dis/enable PoS CRC32 checking.
[no]pmin	Dis/enable discard of packets smaller than a predefined minimum size.
[no]pmax	Dis/enable discard of packets larger than a predefined maximum size.
long=X	Maximum packet size for pmax.

### Step 6. Select Configuration Option, continued

short=x	Minimum packet size for pmin.
slen=X	Capture X bytes of packet data.
mem=X:Y	Configure memory allocated to streams 0, 1, ..
eth	Set framer to 10G Ethernet made defaults to LAN.
lan	Set framer to Ethernet LAN made 10G Base-LR.
wan	Set framer to Ethernet WAN made 10G Base-LW

## 4.4 dagsix Utility

**Description** The `dagsix` utility supports configuration status and physical layer interface statistics for DAG 6 series cards.

In a troubleshooting configuration options `-si` should be passed to the tool to watch the operational status of the optical, SONET and framing layers.

More details about the meaning of the various bits are supplied through the help page (`dagsix -h`) and below.

## 4.5 DAG 6.1S Card Capture Session

**Description** A successful DAG 6.1S card capture session is accomplished by checking receiver port optical signal levels and checking the card has correctly detected the link. This is followed by configuring the DAG card for normal use.

**Procedure** Follow these steps for a successful DAG 6.1S card capture session.

### Step 1. Check Receiver Ports Optical Signal Levels

The DAG 6.1S card supports 1310 nanometer singlemode fibre attachments with optical signal strength between 0 dBm and -17 dBm.

If there is doubt, check card receiver ports light levels are correct using an optical power meter. The card receiver port is the single SC-style connector.

### Step 2. Understand Link Layer Configuration

Learn about the link layer configuration in use at the network link being monitored. Important parameters include specific scrambling options in use.

If the information cannot be obtained reliably, the card can be made to work by varying the parameters until data is arriving at the host system.

### Step 4. List Current Settings

For DAG 6.1S framer configuration and statistics the `dagsix` tool is supplied. Calling `dagsix` without arguments lists current settings. The `dagsix -h` prints a help listing on tool usage.

### Step 3. Check Card is Locked to Data Stream

Configure card according to local settings.

Check through the physical layer statistics that the card is locked to the data stream.

---

*Continued on next page*

## 4.5 DAG 6.1S Card Capture Session, continued

Procedure, continued

### Step 4. List Current Settings.

The `dagsix` tool is supplied for the DAG 6.1S card framer configuration and statistics. Calling `dagsix` without arguments lists current settings. The `dagsix -h` prints a help listing on tool usage.

## 4.6 Inspect PoS Interface Statistics

**Description** Once the DAG 6.1S card has been configured for PoS mode, the PoS interface statistics are inspected to check the card is locked to the data stream.

```
dag@endace:~$ dagsix -d dag0 -si
```

The tool displays a number of status bits that have occurred since last reading. The following example shows the interval is set to one second via the `-i` option.

RAI	Receive Alarm Indication. The optics report a receive error. One or more of the following two bits will also be set.
RLE	Receive Lock Error. The optics report a failure in clock recovery from the received signal.
RPA	Receive Power Alarm. The optics report insufficient optical input power (<-30dBm).
LOS	Loss Of Signal. The framer reports there is either no signal at receiver, or optical signal strength is too low to be recognized.
LOC	Loss Of Clock. The framer is not receiving a valid clock from the optics.
OOF	Out Of Frame. The framer is not locked to the SONET frame stream.
LOF	Loss Of Frame. The framer has asserted OOF for more than 3 milliseconds.
LOP	Loss Of Pointer. The framer cannot lock to the SONET/SDH frame pointers.
FCS_ERR	Number of PoS FCS [CRC32] errors since last reading.
GOOD_PACKET	Number of PoS frames received since last reading.
RXF	Receive Fifo Errors. Framer receive FIFO errors since last reading.

---

*Continued on next page*

## 4.6 Inspect PoS Interface Statistics, continued

**Example** The following is an example of a card locked to a PoS OC-192c stream carrying no traffic load:

```
dag@endace:~$ dagsix -d dag0 -si
```

```
RAI    RLE    RPA    LOS    LOC    OOF    LOF    LOP    FCS_ERR    POS_PACKET    RXF
  0      0      0      0      0      0      0      0      4194303      0      255
  0      0      0      0      0      0      0      0      0      0      0
  0      0      0      0      0      0      0      0      0      0      0
  0      0      0      0      0      0      0      0      0      0      0
```

**NOTE:** The first second has high values as the counters have accumulated their values over more than one second and usually include pre-setup confirmation.

**Extended statistics** Extended statistics are also available.

```
dag@endace:~$ dagsix -d dag0 -ei
```

```
RAI    RLE    RPA    LOS    LOC    OOF    LOF    LOP    FCS_ERR    GOOD_PACKET    RXF    BIPI    BIP2    BIP3    C2    RX_PARITY    TEMP
  0      0      0      0      0      0      0      0      0      0      0      0      0      0      16      0      44
  0      0      0      0      0      0      0      0      0      0      0      0      0      0      16      0      44
  0      0      0      0      0      0      0      0      0      0      0      0      0      0      16      0      44
  0      0      0      0      0      0      0      0      0      0      0      0      0      0      16      0      44
```

**Extra counters** The following extra counters are available with the extended statistics option:

BIP1	Bit Interleaved Parity 1. SONET/SDH Section parity error count.
BIP2	Bit Interleaved Parity 2. SONET/SDH Line parity error count.
BIP3	Bit Interleaved Parity 3. SONET/SDH Path parity error count.
C2	Reflects content of SONET/SDH C2 overhead octet, or Path Signal Label. Typical settings are as follows: 16 PoS CF Cisco HDLC
RX_PARITY	Receive parity error count between the framer and receive FPGA.
TEMP	Temperature of the RX FPGA in degrees Celcius.

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## 4.6 Inspect PoS Interface Statistics, continued

### Optical light levels

The following situation indicates a problem with optical light levels.

```
dag@endace:~$ dagsix -d dag0 -si
```

RAI	RLE	RPA	LOS	LOC	OOF	LOF	LOP	FCS_ERR	POS_PACKET	RXF
1	1	1	0	0	1	1	1	0	0	0
1	1	1	0	0	1	1	1	0	0	0
1	1	1	0	0	1	1	1	0	0	0
1	1	1	0	0	1	1	1	0	0	0

Although no signal is present, RPA is high, LOS and LOC may not be asserted. This can occur if the optics module outputs random noise when no input is present. In this case RPA, the Framing [LOF, OOF] and Pointer [LOP] errors can still be used to detect an error condition.

### Correct configuration

In order to correct the configuration, proceed as follows:

- Ensure RAI, RLE and RPA, being the first three columns, are zero, check light levels
- Ensure no bip errors occur, otherwise check cabling and light levels
- Ensure scrambling settings are correct.

### Little or no data information

On Packet-over-SONET [PoS] links it can happen that there is very little or no data information received. This typically indicates incorrect scrambling settings. While a default that matches typical link settings is provided, the actual configuration varies from network to network.

In this situation, vary the pscramble option and retry.

## 4.7 Inspect 10G Ethernet Interface Statistics

**Description** Once the DAG 6.1S card has been configured for PoS mode, the 10G Ethernet interface statistics are inspected to check the card is locked to the data stream.

```
dag@endace:~$ dagsix -d dag0 -si
```

The tool displays a number of status bits that have occurred since last reading. The following example shows the interval is set to one second via the `-i` option.

For LAN mode, the following statistics are available.

### LAN Statistics

RAI	Receive Alarm Indication. The optics report a receive error. One or more of the following two bits will also be set.
RLE	Receive Lock Error. The optics report a failure in clock recovery from the received signal.
RPA	Receive Power Alarm. The optics report insufficient optical input power (<-30dBm).
LOS	Loss Of Signal. The framer reports there is either no signal at receiver, or optical signal strength is too low to be recognized.
LOC	Loss Of Clock. The framer is not receiving a valid clock from the optics.
LOF	Loss Of Frame. The framer has asserted OOF for more than 3 milliseconds.
BER	High Bit Error Rate detected, check optical level.
LFT	Local Fault, signal from peer is not being received correctly.
RFT	Remote Fault, peer is not receiving a signal correctly.
FCS_ERR	Number of Ethernet FCS errors since last reading.
BAD_PACKET	Number of errored packets received since last reading.
GOOD_PACKET	Number of correct packets received since last reading.
RXF	Receive Fifo Errors. Framer receive FIFO errors since last reading.

---

*Continued on next page*

## 4.7 Inspect 10G Ethernet Interface Statistics, continued

**WAN Statistics** For WAN mode, the following statistics are available.

RAI	Receive Alarm Indication. The optics report a receive error. One or more of the following two bits will also be set.
RLE	Receive Lock Error. The optics report a failure in clock recovery from the received signal.
RPA	Receive Power Alarm. The optics report insufficient optical input power (<-30dBm).
LOS	Loss Of Signal. The framer reports there is either no signal at receiver, or optical signal strength is too low to be recognized.
LOC	Loss Of Clock. The framer is not receiving a valid clock from the optics.
OOF	Out Of Frame. The framer is not locked to the SONET stream.
LOF	Loss Of Frame. The framer has asserted OOF for more than 3 milliseconds.
LOP	Loss Of Pointer. The framer cannot find the SONET/SDH frame pointers.
LOF	Loss Of Frame. The framer has asserted OOF for more than 3 milliseconds.
BER	High Bit Error Rate detected, check optical level.
LFT	Local Fault, signal from peer is not being received correctly.
RFT	Remote Fault, peer is not receiving a signal correctly.
BER	High Bit Error Rate detected, check optical level.
LFT	Local Fault, signal from peer is not being received correctly.
RFT	Remote Fault, peer is not receiving a signal correctly.
FCS_ERR	Number of Ethernet FCS errors since last reading.
BAD_PACKET	Number of errored packets received since last reading.
GOOD_PACKET	Number of correct packets received since last reading.
RXF	Receive Fifo Errors. Number of Framer receive FIFO errors since last reading.

---

*Continued on next page*



## 4.7 Inspect 10G Ethernet Interface Statistics, continued

**Example** The following is an example of a card locked to a 10G Ethernet LAN stream carrying no traffic load:

```
dag@endace:~$ dagsix -d dag0 -si
```

```
RAI RLE RPA LOS LOC LOF BER LFT RFT FCS_ERR BAD_PACKET GOOD_PACKET RXF
0 0 0 0 0 0 0 0 0 0 0 0 9090612 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

**Example** The following is an example of a card locked to a 10G Ethernet WAN stream carrying no traffic load:

```
dag@endace:~$ dagsix -d dag0 -si
```

```
RAI RLE RPA LOS LOC OOF LOF LOP LOF BER LFT RFT FCS_ERR BAD_PACKET GOOD_PACKET RXF
0 0 0 0 0 0 0 0 0 0 0 0 0 0 5458160 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

**NOTE:** The first second has high values as the counters have accumulated their values over more than one second.

**LAN Extended statistics** Extended statistics are also available. The following example shows extended statistics for the above LAN configuration.

```
dag@endace:~$ dagsix -d dag0 -ei
```

```
RAI RLE RPA LOS LOC LOF BER LFT RFT FCS_ERR BAD_PACKET GOOD_PACKET RXF RX_PARITY TEMP
0 0 0 0 0 0 0 0 0 0 0 0 64057561 0 0 67
0 0 0 0 0 0 0 0 0 0 0 0 14629029 0 0 67
0 0 0 0 0 0 0 0 0 0 0 0 14629444 0 0 67
0 0 0 0 0 0 0 0 0 0 0 0 14629463 0 0 67
```

**LAN Extra counters** The following extra counters are available with the extended statistics option:

<b>RX_PARITY</b>	Receive parity error count between the framer and receive FPGA.
<b>TEMP</b>	Temperature of Rx FPGA in degrees Celsius.

*Continued on next page*

## 4.7 Inspect 10G Ethernet Interface Statistics, continued

**WAN Extended statistics** Extended statistics are also available. The following example shows extended statistics for the above WAN configuration.

```
dag@endace:~$ dagsix -d dag0 -ei
```

```
RAI RLE RPA LOS LOC OOF LOF LOP LOF BER LFT RFT FCS_ERR BAD_PACKET GOOD_PACKET RXF BIP1 BIP2 BIP3 C2 RX_PARITY TEMP
1 1 0 0 0 1 1 1 1 0 1 0 1 1114253956 0 65535 65535 65535 01 0 49
1 1 0 0 0 1 1 1 1 0 1 0 0 0 0 32885 24725 24725 01 0 49
1 1 0 0 0 1 1 1 1 0 1 0 0 0 0 32994 24717 24717 01 0 49
1 1 0 0 0 1 1 1 1 0 1 0 0 0 0 33056 24711 24711 01 0 49
1 1 0 0 0 1 1 1 1 0 1 0 0 0 0 32991 24727 24727 01 0 50
```

**Extra counters** The following extra counters are available with the extended statistics option:

BIP1	Bit Interleaved Parity 1. SONET/SDH Section parity error count.
BIP2	Bit Interleaved Parity 2. SONET/SDH Line parity error count.
BIP3	Bit Interleaved Parity 3. SONET/SDH Line parity error count.
C2	Reflects content of SONET/SDH C2 overhead octet, or Path Signal Label. Typical settings are as follows: 16 PoS CF Cisco HDLC
RX_PARITY	Receive parity error count between the framer and receive FPGA.
TEMP	Temperature of Rx FPGA in degrees Celsius.

**Optical light levels in LAN mode** The following situation indicates a problem with optical light levels in LAN mode.

```
dag@endace:~$ dagsix -d dag0 -si
```

```
RAI RLE RPA LOS LOC LOF LOP LOF BER LFT RFT FCS_ERR BAD_PACKET GOOD_PACKET RXF RX_PARITY TEMP
1 1 1 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0 0 54
1 1 1 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0 0 54
1 1 1 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0 0 54
1 1 1 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0 0 54
```

**Optical light levels in WAN mode** The following situation indicates a problem with optical light levels in WAN mode.

```
dag@endace:~$ dagsix -d dag0 -si
```

```
RAI RLE RPA LOS LOC OOF LOF LOP LOF BER LFT RFT FCS_ERR BAD_PACKET GOOD_PACKET RXF BIP1 BIP2 BIP3 C2 RX_PARITY TEMP
1 1 1 0 0 1 1 1 1 0 1 0 0 0 0 65535 65535 65535 01 0 52
1 1 1 0 0 1 1 1 1 0 1 0 0 0 0 32972 24769 24769 01 0 52
1 1 1 0 0 1 1 1 1 0 1 0 0 0 0 33099 24755 24755 01 0 52
1 1 1 0 0 1 1 1 1 0 1 0 0 0 0 33120 24767 24767 01 0 52
```

Although no signal is present, RPA is high, LOS and LOC may not be asserted. This can occur if the optics module outputs random noise when no input is present. In this case RPA, the Framing [LOF, OOF] and Pointer [LOP] errors can still be used to detect an error condition.

*Continued on next page*

## 4.7 Inspect 10G Ethernet Interface Statistics, continued

### Correct configuration

In order to correct the configuration, proceed as follows:

- Ensure RAI, RLE and RPA (first three columns) are zero, check light levels
- Ensure no bip errors occur, otherwise check cabling and light levels
- Ensure the scrambling and CRC settings are ok

### Little or no data information

On WAN links it can happen that there is very little or no data information received. This typically indicates incorrect scrambling settings. While a default that matches typical link settings is provided, the actual configuration varies from network to network.

In this situation, vary the `pscramble` option and retry.

## 4.8 Reporting Problems

**Description** Support is provided with a service contract. When problems occur with a DAG card or supplied software, contact Endace Technical Support via the email address [support@endace.com](mailto:support@endace.com). Supplying sufficient information in an email enables effective response.

**Problem checklist** The exact information available to users for trouble, cause and correction analysis may be limited by nature of the problem. The following items assist a quick problem resolution:

Ref	Item
1.	DAG card[s] model and serial number.
2.	Host PC type and configuration.
3.	Host PC operating system version.
4.	DAG software version package in use.
5.	Any compiler errors or warnings when building DAG driver or tools.
6.	For Linux and FreeBSD, messages generated when DAG device driver is loaded. These can be collected from command <code>dmesg</code> , or from log file <code>/var/log/syslog</code> .
7.	Output of <code>daginf -v</code> .
8.	Firmware versions from <code>dagrom -x</code> .
9.	Physical layer status reported by:  <code>dagsix</code>
10.	Network link statistics reported by:  <code>dagsix -si</code>
11.	Network link configuration from the router where available.
12.	Contents of any scripts in use.
13.	Complete output of session where error occurred including any error messages from DAG tools. The typescript Unix utility may be useful for recording this information.
14.	A small section of a captured packet trace illustrating the problem.

## **5.0 RUNNING DATA CAPTURE SOFTWARE**

**Introduction** For a typical measurement session, ensure the driver is loaded, the firmware is downloaded, and the card has been configured.

**In this chapter** This chapter covers the following sections of information.

- Starting Data Capture Session
- High Load Performance

### **5.1 Starting Data Capture Session**

**Description** The various tools used for data capture are in the `tools` sub-directory.

Starting the capture of data involves a typical measurement session, the card operating in variable length mode, starting and stopping the session.

**Process** The following process describes starting a data capture session.

<b>Process</b>	<b>Description</b>
Typical measurement session.	<p>For a typical measurement session, first move to the <code>dag</code> directory, load the driver, then load the FPGA images to each DAG card. For example:</p> <pre>drv/dagload tools/dagrom -rvp -d dag0 -f xilinx/dag61pcix-erf.bit tools/dagld -x -d dag0 xilinx/dag6 rx-erf.bit</pre> <p>Then set, and check the integrity of the cards physical layer. This process is described in Chapter 4 of this document.</p> <pre>tools/dagsix -d dag0 default</pre>

*Continued on next page*

## 5.1 Starting Data Capture Session, continued

### Process (continued)

Process	Description
Variable length mode.	<p>The DAG 6.1S always operates in variable-length mode.</p> <p>The number of bytes collected from the packet is configured with <code>slen</code>. This defaults to 48, and can range from 48 to 2040, and be a multiple of 8.</p> <p>Packets longer than <code>slen</code> will be truncated to <code>slen</code>.</p> <p>Packets shorter than <code>slen</code> produce shorter records, saving bandwidth and storage space. For example, for full packet capture:</p> <pre>tools/dagsix -d dag0 slen=1552</pre> <p>Values of <code>slen</code> higher than the default may lead to increased packet loss during captures under high link load, due to limited PCI-X bandwidth.</p>
Starting a capture session.	<p>A capture session is started as follows:</p> <pre>tools/dagsnap -d dag0 -v -o tracefile0</pre> <p>The option <code>-v</code> is used to provide user information during capture; this can be omitted for automated trace runs.</p> <p>If the <code>tracefile</code> parameter is not specified the tool will write to <code>stdout</code>, which can be used to pipeline <code>dagsnap</code> with other tools from the <code>dagtools</code> package.</p>
Stopping <code>dagsnap</code> running	<p>By default <code>dagsnap</code> will run forever. <code>dagsnap</code> can be stopped with a signal:</p> <pre>killall dagsnap</pre> <p><code>dagsnap</code> can also be configured to run for a fixed number of seconds and then exit with the <code>-s</code> option.</p>

## 5.2 High Load Performance

**Detecting packet losses**      Until some data is read out of the buffer to free some space, any arriving packets subsequently are discarded by the DAG card.

Any loss can be detected in-band by observing the Loss Counter `lctr` field of the Extensible Record Format.

**Avoiding packet loss**      In order to avoid any potential packet loss, the user process must read records faster than they arrive from the network.

For Linux and FreeBSD, when the PC buffer becomes full, the message:

```
kernel: dagN: pbm safety net reached
```

is displayed on the PC screen, and printed to `log /var/log/messages`.

If the user process is writing records to hard disk, it may be necessary to use a faster disk or disk array. If records are being processed in real-time, a faster host CPU may be required.

**Increasing buffer size**      The host PC buffer can be increased to deal with bursts of high traffic load on the network link.

By default the `dagmem` driver reserves 32MB of memory per DAG card in the system. Capture at OC-12/STM-4 (622Mbps) rates and above may require a larger buffer.

128MB or more is suggested for Linux/FreeBSD.

For the DAG 6.1S card Windows operating system the upper limit is 256MB.

In Debian Linux the amount of memory reserved is changed by editing the file `/etc/modules`.

```
# For DAG 3.x, default 32MB/card
dagmem
#
# For DAG 4.x or 6.x, use more memory per card, E.G.
# dagmem dsize=128m
```

The option `dsize` sets the amount of memory used per DAG card in the system.

The value of `dsize` multiplied by the number of DAG cards must be less than the amount of physical memory installed, and less than 890MB.





## **6.0 SYNCHRONIZING CLOCK TIME**

- Description** The Endace DAG range of products come with sophisticated time synchronization capabilities, in order to provide high quality timestamps, optionally synchronized to an external time standard.
- The system that provides the DAG synchronization capability is known as the DAG Universal Clock Kit (DUCK).
- An independent clock in each DAG card runs from the PC clock. A card's clock is initialised using the PC clock, and then free-runs using a crystal oscillator.
- Each card's clock can vary relative to a PC clock, or other DAG cards.
- DUCK configuration** The DUCK is configured to avoid time variance between sets of DAG cards or between DAG cards and coordinated universal time [UTC].
- Accurate time reference can be obtained from an external clock by connecting to the DAG card using the synchronization connector, or the host PCs clock can be used in software as a reference source without additional hardware.
- Each DAG card can also output a clock signal for use by other cards.
- Common synchronization** The DAG card synchronization connector supports a Pulse-Per-Second (PPS) input signal, using RS-422 signalling levels.
- Common synchronization sources include GPS or CDMA (Cellular telephone) time receivers.
- Endace produces the TDS 2 Time Distribution Server modules and the TDS 6 units that enable multiple DAG cards to be connected to a single GPS or CDMA unit.
- More information is on the Endace website, <http://www.endace.com/accessories.htm>, or the TDS 2/TDS 6 Units Installation Manual.
- In this chapter** This chapter covers the following sections of information.
- Configuration Tool Usage
  - Time Synchronization Configurations
  - Synchronization Connector Pin-outs

## 6.1 Configuration Tool Usage

**Description** The DUCK is very flexible, and can be used in several ways, with or without an external time reference source. It can accept synchronization from several input sources, and can also be made to drive its synchronization output from one of several sources.

Synchronization settings are controlled by the `dagclock` utility.

### Example

```
dag@endace:~$ dagclock -h
Usage: dagclock [-hvVxk] [-d dag] [-K <timeout>] [-l
<threshold>] [option]

    -h  --help,--usage  this page
    -v  --verbose      increase verbosity
    -V  --version      display version information
    -x  --clearstats   clear clock statistics
    -k  --sync         wait for duck to sync before
                        exiting
    -d  dag            DAG device to use
    -K  timeout        sync timeout in seconds, default
                        60
    -l  threshold     health threshold in ns, default
                        596

Option:
    default          RS422 in, none out
    none             None in, none out
    rs422in         RS422 input
    hostin          Host input (unused)
    overin          Internal input (synchronize to
                    host clock)
    auxin           Aux input (unused)
    rs422out        Output the rs422 input signal
    loop            Output the selected input
    hostout         Output from host (unused)
    overout         Internal output (master card)
    set             Set DAG clock to PC clock
    reset           Full clock reset. Load time
                    from PC, set rs422in, none out
```

By default, all DAG cards listen for synchronization signals on their RS-422 port, and do not output any signal to their RS-422 port.

```
dag@endace:~$ dagclock -d dag0
muxin  rs422
muxout  none
status Synchronized Threshold 596ns Failures 0 Resyncs 0
error  Freq -30ppb Phase -60ns Worst Freq 75ppb Worst
Phase 104ns
crystal Actual 100000028Hz Synthesized 67108864Hz
input  Total 3765 Bad 0 Singles Missed 5 Longest
Sequence Missed 1
start  Thu Apr 28 13:32:45 2005
host   Thu Apr 28 14:35:35 2005
dag    Thu Apr 28 14:35:35 2005
```

## 6.2 Time Synchronization Configurations

**Description** The DUCK is very flexible, and can be used in several ways, with or without an external time reference source.

The use includes a single card with no reference, two cards with no reference, and a card with reference.

**In this section** This section covers the following topics of information.

- Single Card no Reference Time Synchronization
- Two Cards no Reference Time Synchronization
- Card with Reference Time Synchronization

### 6.2.1 Single Card no Reference Time Synchronization

**Description** When a single card is used with no external reference, the card can be synchronized to the host PC's clock.

The clock in most PC's is not very accurate by itself, but the DUCK drifts smoothly at the same rate as the PC clock.

If a PC is running NTP to synchronize its own clock, then the DUCK clock is less smooth because the PC clock is adjusted in small jumps. However, overall the DUCK clock does not drift away from UTC.

The synchronization achieved in this case is not as accurate as when using an external reference source such as GPS.

The DUCK clock is synchronized to a PC clock by setting input synchronization selector to overflow:

```
dag@endace:~$ dagclock -d dag0 none overin
muxin    overin
muxout   none
status   Synchronized Threshold 11921ns Failures 0 Resyncs
0
error    Freq 1836ppb Phase 605ns Worst Freq 143377ppb
Worst Phase 88424ns
crystal  Actual 49999347Hz Synthesized 16777216Hz
input    Total 87039 Bad 0 Singles Missed 0 Longest
Sequence Missed 0
start    Wed Apr 27 14:27:41 2005
host     Thu Apr 28 14:38:20 2005
dag      Thu Apr 28 14:38:20 2005
```

**NOTE:** `dagclock` should be run only after appropriate Xilinx images have been loaded. If the Xilinx images must be reloaded, the `dagclock` command must be rerun afterwards to restore the configuration.

## 6.2.2 Two Cards no Reference Time Synchronization

- Description** When two DAG cards are used in a single host PC with no reference clock, the cards are to be synchronized in some way if timestamps between the two cards are to be compared. For example, if two cards monitor different directions of a single full-duplex link.
- Synchronization between two DAG cards is achieved in two ways. One card can be a clock master for the second, or one can synchronize to the host and also act as a master for the second.
- Synchronizing cards** If both cards are to be accurately synchronized, but not so for absolute time of packet time-stamps being correct, then one card is configured as the clock master for the other.
- Locking cards together** Although the master card's clock will drift against UTC, the cards are locked together.
- The cards are locked together by connecting the synchronization connector ports of both cards with a standard RJ-45 Ethernet cross-over cable.
- Configure one of the cards as the master, the other defaults to being a slave.

```

dag@endace:~$ dagclock -d dag0 none overout
muxin    none
muxout   over
status   Not Synchronized Threshold 596ns Failures 0
Resyncs  0
error    Freq 0ppb Phase 0ns Worst Freq 0ppb Worst Phase
0ns
crystal  Actual 100000000Hz Synthesized 67108864Hz
input    Total 0 Bad 0 Singles Missed 0 Longest Sequence
Missed 0
start    Thu Apr 28 14:48:34 2005
host     Thu Apr 28 14:48:34 2005
dag      No active input - Free running

```

The slave card configuration is not shown, the default configuration is sufficient.

---

*Continued on next page*

## 6.2.2 Two Cards no Reference Time Synchronization, continued

### Preventing time-stamps drift

To prevent the DAG card clocks time-stamps drifting against UTC, the master can be synchronized to the host PC's clock which in turn utilises NTP. This then provides a master signal to the slave card.

The cards are locked together by connecting the synchronization connector ports of both cards with a standard RJ-45 Ethernet cross-over cable.

Configure one card to synchronize to the PC clock and output a RS-422 synchronization signal to the second card.

```
dag@endace:~$ dagclock -d dag0 none overin overout
muxin over
muxout over
status Synchronized Threshold 11921ns Failures 0 Resyncs
0
error Freq -691ppb Phase -394ns Worst Freq 143377ppb
Worst Phase 88424ns
crystal Actual 49999354Hz Synthesized 16777216Hz
input Total 87464 Bad 0 Singles Missed 0 Longest
Sequence Missed 0
start Wed Apr 27 14:27:41 2005
host Thu Apr 28 14:59:14 2005
dag Thu Apr 28 14:59:14 2005
```

The slave card configuration is not shown, the default configuration is sufficient.

## 6.2.3 Card with Reference Time Synchronization

### Description

The best timestamp accuracy occurs when a DAG card is connected to an external clock reference, such as a GPS or CDMA time receiver.

### Pulse signal from external sources

The DAG synchronization connector accepts a RS-422 Pulse Per Second [PPS] signal from external sources.

This is derived directly from a reference source, or distributed through the Endace TDS 2 [Time Distribution Server] module which allows two DAG cards to use a single receiver.

More cards can be accommodated by daisy-chaining TDS-6 expansion units to the TDS-2 unit, each providing outputs for an additional 6 DAG cards.

---

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### 6.2.3 Card with Reference Time Synchronization, continued

**Using external reference source** To use an external clock reference source, the host PC's clock must be accurate to UTC to within one second. This is used to initialise the DUCK.

The external time reference allows high accuracy time synchronization.

When the time reference source is connected to the DAG synchronization connector, the card automatically synchronizes to a valid signal.

```
dag@endace:~$ dagclock -d dag0
muxin rs422
muxout none
status Synchronized Threshold 596ns Failures 0 Resyncs 0
error Freq 30ppb Phase -15ns Worst Freq 2092838ppb Worst
Phase 33473626ns
crystal Actual 100000023Hz Synthesized 67108864Hz
input Total 225 Bad 0 Singles Missed 1 Longest Sequence
Missed 1
start Thu Apr 28 14:55:20 2005
host Thu Apr 28 14:59:06 2005
dag Thu Apr 28 14:59:06 2005
```

**Connecting time distribution server**

The TDS 2 module connects to any DAG card with a standard RJ-45 Ethernet cable and can be placed some distance from a DAG card.

Existing RJ-45 building cabling infrastructure can be used to cable synchronization ports.

**CAUTION:** Never connect a DAG card and/or the TDS 2 module to active Ethernet or telephone equipment.

**Testing signal**

For Linux and FreeBSD, when a synchronization source is connected the driver outputs some messages to the console log file `/var/log/messages`.

The `dagpps` tool is used to test a signal is being received correctly and is of correct polarity. To perform the test, run:

```
dagpps -d dag0.
```

The tool measures input state many times over several seconds, displaying polarity and length of input pulse.

Some DAG cards have LED indicators for synchronization (PPS) signals.

## 6.3 Synchronization Connector Pin-outs

**Description** DAG cards have an 8-pin RJ45 connector with two bi-directional RS422 differential circuits, A and B. The PPS signal is carried on circuit A, and the serial packet is connected to the B circuit.

**Pin assignments** The 8-pin RJ45 connector pin assignments are:

1.	Out A+
2.	Out A-
3.	In A+
4.	In B+
5.	In B-
6.	In A-
7.	Out B+
8.	Out B-

**Figure** Figure 6-1 shows the RJ45 plug and socket connector pin-outs.

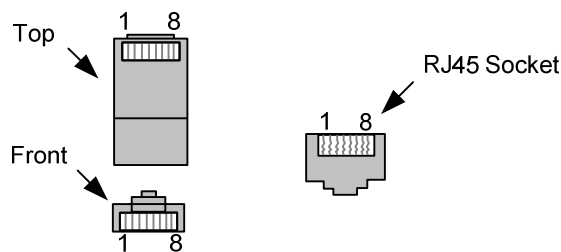


Figure 6-1. RJ45 Plug and Socket Connector Pin-outs.

**Out-pin connections** Normally the GPS input should be connected to the A channel input, pins 3 and 6. The DAG card can also output a synchronization pulse; used when synchronizing two DAG cards without a GPS input. Synchronization output is generated on the Out A channel, pins 1 and 2.

**Ethernet crossover cable** A standard Ethernet crossover cable can be used to connect the two cards.

TX_A+	1	3	RX_A+
TX_A-	2	6	RX_A-
RX_A+	3	1	TX_A+
RX_B+	4	7	TX_B+
RX_B-	5	8	TX_B-
RX_A-	6	2	TX_A-
TX_B+	7	4	RX_B+
TX_B-	8	5	RX_B-

**Support** For cables and further advice on using GPS and CDMA time receivers email [support@endace.com](mailto:support@endace.com).





## 7.0 DATA FORMATS OVERVIEW

**In this chapter** This chapter covers the following sections of information.

- Data Formats
- Timestamps

### 7.1 Data Formats

**Description** The DAG 6.1S card uses the ERF Type 1 POS HDLC Variable Length Record. Timestamps are in little-endian [Pentium native] byte order. All other fields are in big-endian [network] byte order. All payload data is captured as a byte stream, no byte re-ordering is applied.

**Table** Table 7-1 shows the generic variable length record. The diagram is not to scale.

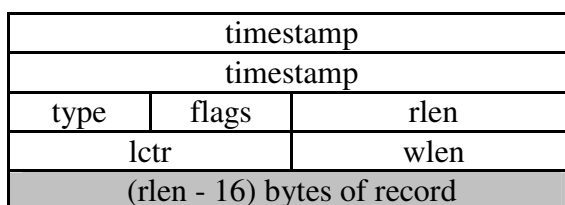


Table 7-1. Generic Variable Length Record.

**Data format** The following is an overview of the data format used.

Data Format	Description
type:	<p>This field contains an enumeration of the frame subtype. If the type is zero, then this is a legacy format.</p> <p>0: TYPE_LEGACY            1: TYPE_HDLC_POS: PoS w/HDLC framing            2: TYPE_ETH: Ethernet            3: TYPE_ATM: ATM Cell            4: TYPE_AAL5: reassembled AAL5 frame            5: TYPE_MC_HDLC: Multi-channel HDLC frame            6: TYPE_MC_RAW: Multi-channel Raw link data            7: TYPE_MC_ATM: Multi-channel ATM Cell</p>

*Continued on next page*

## 7.1 Data Formats, continued

Data Format	Description
flags:	This byte is divided into 2 parts, the interface identifier, and the capture offset.  1-0: capture interface 0-3 2: varying record lengths present 3: truncated record [insufficient buffer space] 4: rx error [link error] 5: 5: ds error [internal error] 7-6: reserved
Rlen: record length	Total length of the record transferred over PCI bus to storage.
Lctr: <i>loss counter</i>	A 16 bit counter, recording the number of packets lost since the previous record. Records can be lost between the DAG card and memory hole due to overloading on PCI bus. The counter starts at zero, and sticks at 0xffff.
Wlen: <i>wire length</i>	Packet length including some protocol overhead. The exact interpretation of this quantity depends on physical medium.

### Table

Table 7-2 shows the Type 1 POS HDLC variable length record. The diagram is not to scale.

timestamp		
timestamp		
type:1	flags	rln
lctr		wlen
HDLC Header		
(rln - 20) bytes of packet		

Table 7-2. Type 1 POS HDLC Variable Length Record.

*Continued on next page*

## 7.1 Data Formats, continued

**Table** Table 7-3 shows the Type 2 Ethernet variable length record. The diagram is not to scale.

timestamp		
timestamp		
type:2	flags	rlen
lctr		wlen
offset	pad	rlen-18
bytes of frame		

Table 7-3. Type 2 Ethernet Variable Length Record.

The Ethernet frame begins immediately after the pad byte so that the layer 3 [IP] header is 32Bit-aligned.

## 7.2 Timestamps

**Description** The ERF format incorporates a hardware generated timestamp of the packet's arrival.

The format of this timestamp is a single little-endian 64-bit fixed point number, representing seconds since midnight on the first of January 1970.

The high 32-bits contain the integer number of seconds, while the lower 32-bits contain the binary fraction of the second. This allows an ultimate resolution of  $2^{-32}$  seconds, or approximately 233 picoseconds.

Another advantage of the ERF timestamp format is that a difference between two timestamps can be found with a single 64-bit subtraction. It is not necessary to check for overflows between the two halves of the structure as is needed when comparing Unix time structures, which are also available to Windows users in the Winsock library.

Different DAG cards have different actual resolutions. This is accommodated by the lowermost bits that are not active being set to zero. In this way the interpretation of the timestamp does not need to change when higher resolution clock hardware is available.

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## 7.2 Timestamps, continued

**Example code** Here is some example code showing how a 64-bit ERF timestamp (erfts) can be converted into a struct timeval representation (tv).

```
unsigned long long lts;
struct timeval tv;

lts = erfts;
tv.tv_sec = lts >> 32;
lts = ((lts & 0xffffffffULL) * 1000 * 1000);
lts += (lts & 0x80000000ULL) << 1; /* rounding */
tv.tv_usec = lts >> 32;
if(tv.tv_usec >= 1000000) {
    tv.tv_usec -= 1000000;
    tv.tv_sec += 1;
}
```

---