19 Ixia GPS Auxiliary Function Device (AFD1)

This chapter provides details about Ixia GPS Auxiliary Function Device—its specifications and features.

The IXIA Auxiliary Function Device 1 (AFD1) provides the means for accurate worldwide timing using GPS technology. The IXIA AFD1 is shown in *Figure 19-1*.

Figure 19-1. Ixia AFD1

The IXIA AFD1 with integrated Global Positioning System (GPS) is designed for distributed end-to-end measurements of key metrics, including point-to-point latency and jitter.

The Ixia AFD1 GPS receiver is controlled by an Ixia chassis through a USB port. Chassis timing is provided by connecting the Sync Out of the AFD1 to the Sync In of the chassis. This configuration then enables the chassis to operate as a subordinate in a virtual chassis chain, with the Ixia AFD1 as the master.

Figure 19-2 on page 19-2 shows the AFD1 in operation with other chassis in a local chassis chain. Multiple local chassis chains can be collected through GPS into a virtual chassis chain.

Figure 19-2. AFD1 in a Chassis Chain

The IxExplorer GUI displays the status of the GPS interface to you. Figure 19-3 shows the Chassis Properties dialog with status information. The connection is determined to be either *locked* or *unlocked*. In the Locked state, the chassis is locked to GPS time (GMT) within 150nS. In the unlocked state, the AFD1 GPS hardware operates to acquire the minimum number of satellites required to achieve accurate GPS timing.

Caution: A chassis connected to an AFD1 chassis does not operate properly if set to Synchronous time source, unless the sync cable is disconnected.

The process of generating the Lock status for the AFD1 consists of getting GPS time lock and then synchronizing the internal clock to the GPS clock. The AFD1 does not enter the 'Lock' state until both of these conditions are met. In the unlocked state, the chassis in the unlocked chain are not accurately time synchronized to the rest of the chain.

In operation, once a chassis chain is constructed and the chassis are synchronized, you can clear the timestamps to provide a baseline time for all chassis in the chain. The chain operations are then locked until such time that the GPS lock is lost by a member of the chain. Data sent from one port in the chain to another provides one-way latency measurements by subtraction of the transmit time stamp from the receive time stamp.

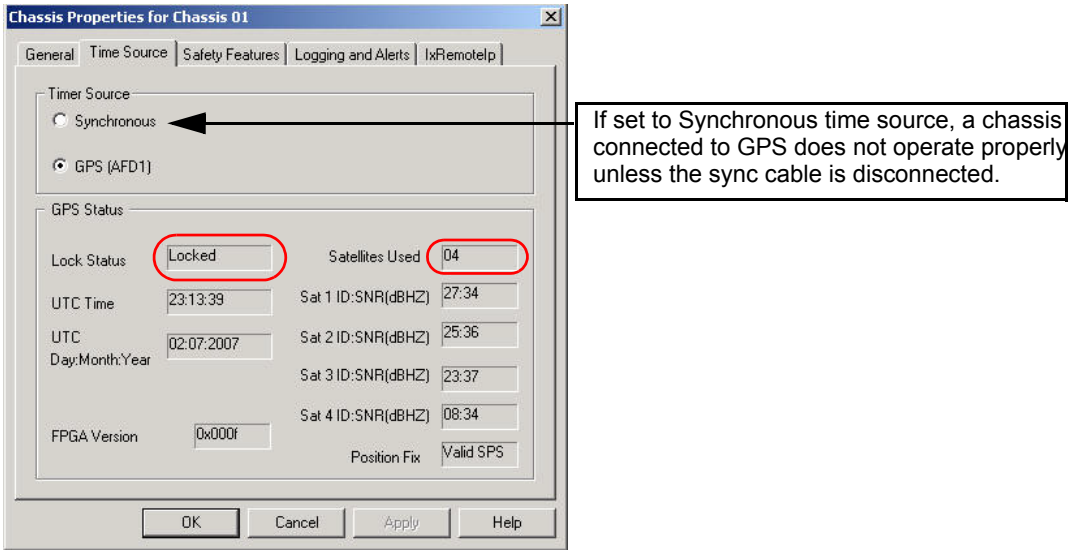
For large or very remote chassis chains, the chassis chain properties provide an offset delay. This delay is defaulted to five seconds. For chassis chains where the communication delays are significant, as in worldwide or large chains, a longer delay should be selected to allow for setup communication delays. The delay is the time of a particular chassis operation (for example, start transmit, stop transmit) plus the configured delay for any synchronous operation. When an operation for the entire chain is executed, this delay is added to the operation. A dialog opens indicating that the operation is in process when the delays are significant.

The chassis time is taken from any chassis with a GPS interface attached. The setup for the chassis chain requires that all chassis in the chain be locked. This is indicated in the IxExplorer GUI. The IxExplorer GUI also provides antenna information such as satellite strength, to enable installation of the antenna in a location with a good 'view' of the satellites.

The critical operation for a virtual chain is the reset of the System Time Stamps. All other actions are dependent on the synchronous execution of this operation.

To reset time stamps for a GPS-connected system, the reset operation needs to be executed for the chassis chain, and not for the individual chassis.

Figure 19-3. Chassis Properties AFD1-Time Source



AFD1 Setup

The AFD1 Kit:

The AFD1 kit comes with cables and items required to install and connect the AFD1 in a lab. The AFD1 kit does not include the cable and antenna for permanent installation at a particular site. The antenna and cable kits need to be ordered separately after a site survey determines the site requirements.

The kit contains the following items:

- AFD1 chassis
- AFD1 chassis rack mount ears
- 3-foot sync cable
- 6-foot USB cable
- Window antenna

The AFD1 installation uses the USB cable for communication and power. The Ixia chassis automatically detects the connections.

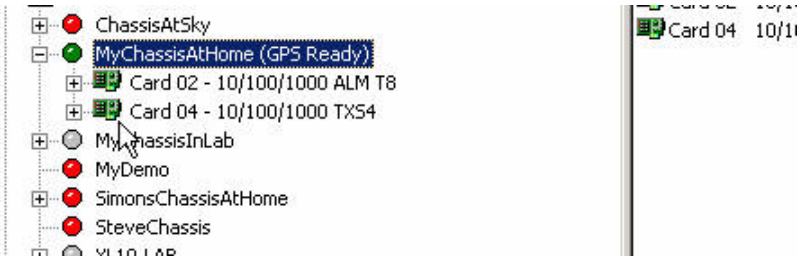
The window antenna is included in the kit for demo use only and does not reliably provide a stable lock environment. For permanent installations, order either the 75-foot or 200-foot cable and antenna kits.

Successful GPS Synchronization in IxExplorer

In the Chassis Properties dialog of IxExplorer, after selection of GPS as the timer source, the satellites used are displayed. In Figure 19-3 on page 19-3, satellite 04 is being used and the status is ‘locked’. In the chassis tree view of IxExplorer

(Figure 19-4), the chassis status is shown as ‘GPS Ready’ if it has successfully locked onto satellite signal. The highlighted chassis is GPS enabled and ready.

Figure 19-4. Chassis Tree View in IxExplorer



Enabling/Installing GPS Based Synchronization

This procedure to set the time source needs to be followed only for the initial installation of the AFD1 GPS unit. Thereafter, upon subsequent restarts, the chassis and AFD1 unit starts fully operational.

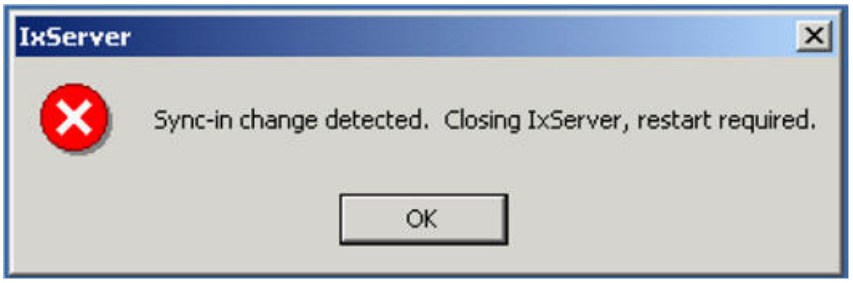
1. Start the chassis without attaching the AFD1 GPS unit. Note the message regarding timing source, as shown in the following figure.

Figure 19-5. IxServer Start Log Before Attaching AFD1

2. Attach the AFD1 GPS unit by plugging in the USB and the Sync cables.

   When the chassis detects the GPS (AFD1) unit, it prompts to restart the IxServer, as shown in the following figure.

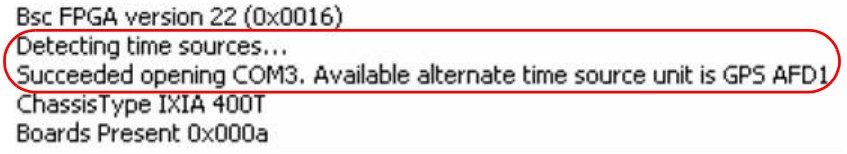
Figure 19-6. Sync-In Detection Prompt



3. Click **OK** to restart IxServer.

   IxServer restarts, then detects GPS as the timing source and configures the chassis as a subordinate, since the chassis is receiving its timing through sync cable from the ADF1 GPS source. The expected log messages are shown in Figure 19-7 and Figure 19-8.

Figure 19-7. IxServer Log - GPS AFD1 Detected



GPS AFD1 is detected and COM3 port is indicated as the communication channel between chassis and AFD1.

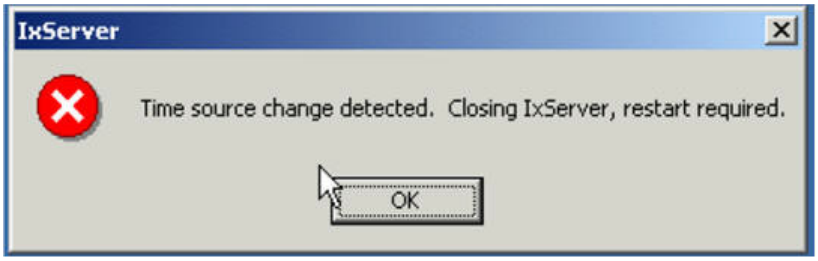
Figure 19-8. IxServer Log - Chassis Configured as Slave to AFD1

The chassis is configured as a subordinate to AFD1.

4. Open IxExplorer. In the **Chassis Properties** dialog box select GPS (AFD1) timer source, as shown in Figure 19-3 on page 19-3.

   Upon selection of GPS option, IxServer must be closed and restarted for the changes to take effect, as the prompt in Figure 19-9 shows.

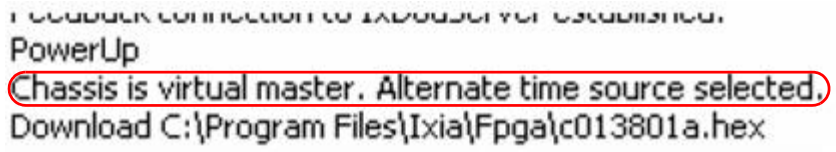
Figure 19-9. Time Source Change Detection Prompt



5. Click OK to restart IxServer.

   Once IxServer is restarted, the IxServer Log shows the AFD1 GPS unit is detected as the time source and the chassis is designated as 'Virtual Master' rather than subordinate (Figure 19-10).

Figure 19-10. IxServer Log - Chassis is Virtual Master



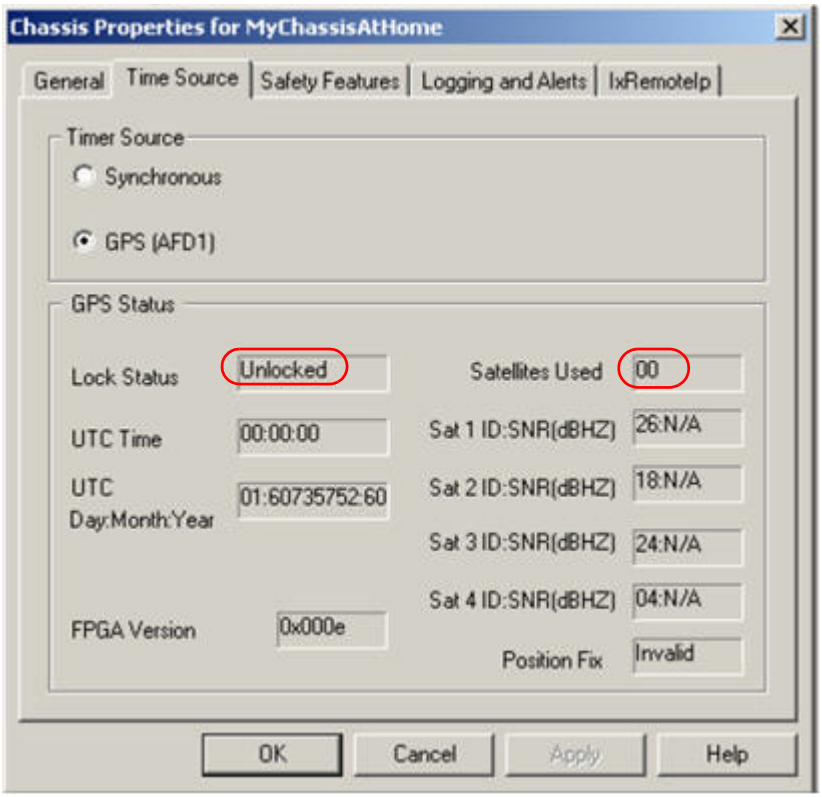
6. Check IxExplorer for GPS status, as shown in Figure 19-3 on page 19-3. Satellite details changes periodically showing satellite number and signal strength. A good signal strength has SNR reading of more than 35.

Now the chassis is ready for operation based on GPS time source.

Troubleshooting—GPS Unit 'Not Ready'

If, after completing installation by following the steps above, there is no GPS information and the status is 'Unlocked' in the Time Sources tab of Chassis Properties in IxExplorer (Figure 19-11 on page 19-6), then follow the steps mentioned here to ensure that the ADF1 unit comes up fully functional.

Figure 19-11. Chassis Properties AFD1 - Unsuccessful GPS Status



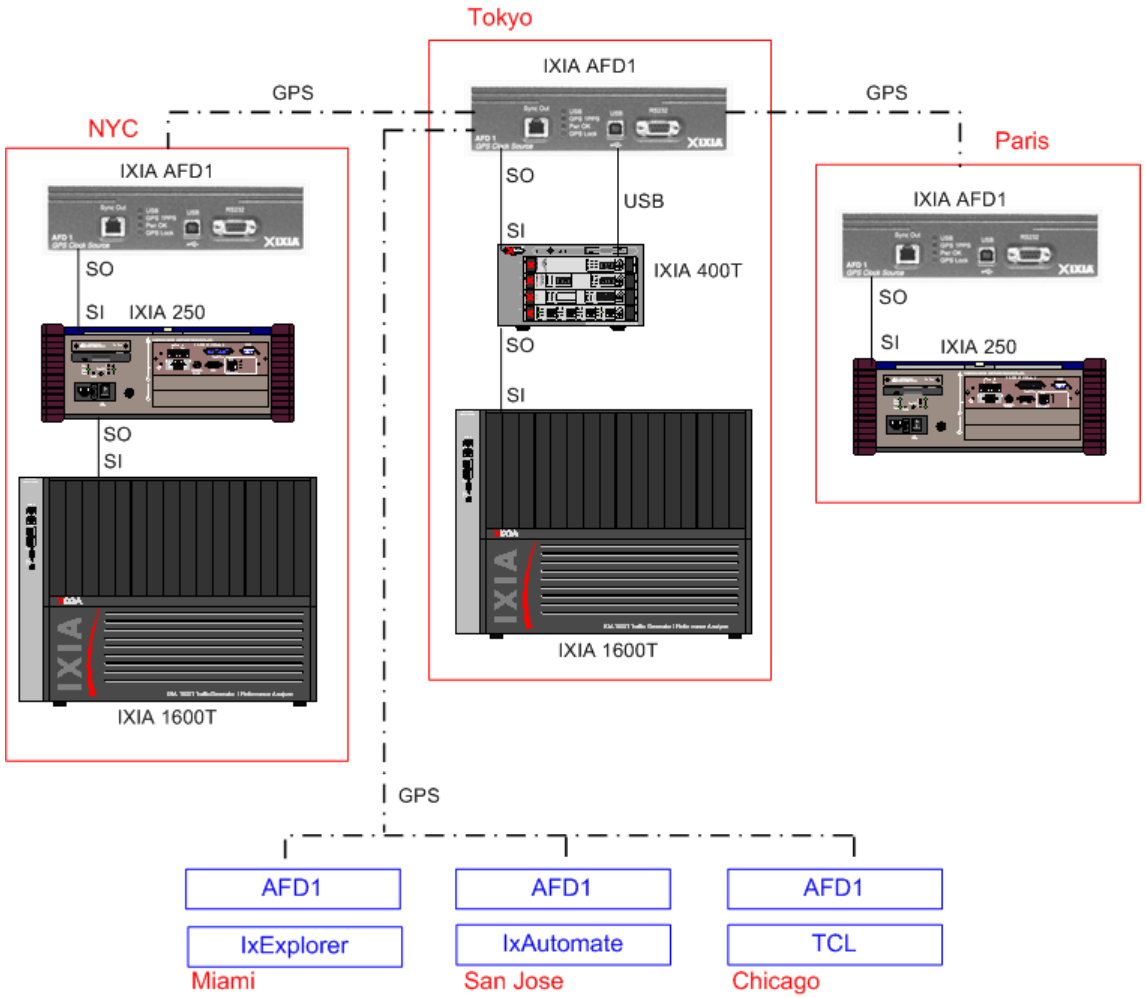
1. Ensure that the GPS Antenna has good positioning. Position the antenna outdoors with a clear view of the sky. Refer to Appendix C, *GPS Antenna Installation Requirements*.
2. Ensure that the antenna cabling is correctly fitted. Reseat the coaxial cable into the AFD1 unit.

   Allow five to 10 minutes to see GPS reception become established. A full lock requires three stable satellites.

Worldwide Synchronization

Two or more Ixia chassis connected to a time reference may be distributed worldwide forming a virtual chassis chain based on GPS and/or CDMA timing. One possible configuration is shown in *Figure 19-12* on page 19-7.

Figure 19-12. Worldwide Deployment of Synchronized Chassis



The ports on all of the chassis may be shared by one or more Ixia software users located likewise anywhere in the world. Where GPS and CDMA sources are used, all of the sources must have good quality time values in order for the trigger to be transmitted.

Once the timing features of the chassis is configured, operating a worldwide set of Ixia chassis is the same as local operation. The Ixia hardware and software program the clocks such that they all send a master trigger pulse to all Ixia chassis, within a tolerance of ±150 ns with GPS and ±100 us for CDMA.

Ixia chassis timing operates by resetting at a fixed time-of-day on all chassis from one source, and then maintaining the time accuracy through various different means. *Table 19-1* on page 19-8 describes the full set of options available and their approximate relative accuracies.

Table 19-1. Summary of Timing Options

Available on Devices	Timing Option	Time of Day Accuracy	Frequency Source	Frequency Accuracy
All Chassis	GPS	150 nanoseconds from GMT	Ixia AFD1	Stratum 1
Ixia 100, 400T, 1600T	Synchronous	N/A	Internal PC clock	1 microsecond/second
Ixia 250	CDMA	100 microseconds from GMT	CDMA	Stratum 2
Ixia 100	CDMA	100 microseconds from GMT	CDMA	Stratum 2
Ixia 100	GPS (with attached antenna)	150 nanoseconds from GMT	GPS	Stratum 1

Calculating Latency Accuracy for AFD1 (GPS)

Use the following calculation for latency accuracy for AFD1 (GPS) setups.

Latency A to B = Lab

Latency B to A = Lba

Transmit path A to B = T1

Transmit path B to A = T2

Time at A = Ta

Time at B = Tb

Time Absolute = T

Time Error at any site = Terr

Lab=Ta+T1-Tb

Lba=Tb+T2-Ta

Delta L = Lab – Lba

Delta L = Ta+T1-Tb – (Tb+T2-Ta)

Delta L = T1-T2+2(Ta-Tb)

Delta L = 2(Ta – Tb)

If Ta = T+/-Terr and Tb = T+/-Terr

Then

Delta L= 2(T+/-Terr – T+/-Terr)

Delta L= 2(|Terr|+|Terr|)

Delta L = 4Terr

Front Panel LEDs

The AFD1 has the following front panel LEDs:

Table 19-2. AFD1 LEDs

Label	Color	Description
USB	Green	Indicates that the docnnection is enabled, and blinks with USB activity.
GPS 1PPS	Green	Indicates that the '1 Pulse Per Second' heartbeat is being generated by the GPS hardware. The GPS hardware has acquired at least one satellite and is receiving time information.
Pwr OK	Green	The AFD1 power has been validated.
GPS Lock	Green	Indicates that the GPS hardware has acquired a fix and that the 1PPS timing is valid. It also Indicates that the internal PLL has locked to the 1PPS signal. Testing is invalidated if the GPS Lock signal is not illuminated.

IXIA AFD1 Specifications

The IXIA AFD1 specifications are contained in *Table 19-3* on page 19-9.

Table 19-3. Ixia AFD1 Specifications

General	
Physical	
Size	9.6"x7"x2.9" (with feet, 2.70" without feet)
Weight	3.15 lb
Avg. Shipping Wt.	6 lbs
Shipping Vibration	FED-STD-101C, Method 5019.1/5020.1
Environmental	
Temperature	
Operating	41°F to 122°F, (5°C to 50°C)
Storage	41°F to 122°F, (5°C to 50°C)
Power	Worst case power = 2.5W
	5V regulated source
Humidity	

Table 19-3. Ixia AFD1 Specifications

Operating	0% to 85%, non-condensing
Storage	0% to 85%, non-condensing
GPS Functionality	
Clock	12.5Mhz System clock
Pulse Width	80 ns
Rear Panel Switches	Reset switch
Front Panel Indicators	USB, GPS PPS, Pwr OK, GPS Lock
Front Panel Connectors	
USB Port	Type B
Sync Out	RJ14
Back Panel Connectors	
Antenna	SMA
Power	(not used) 2.0mm Power jack