BELAR

Broadcast Equipment

FMHD-1
Automatic Delay Correction
Software Module

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- **CUSTOMER SERVICE AT THE BELAR FACTORY.**

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All BELAR products are warranted against defects in materials and workmanship. This warranty applies for three years from the date of delivery, FOB factory or, in the case of certain major components listed in the instruction manual, for the specified period. BELAR will repair or replace products which prove to be defective during the warranty period provided that they are returned to BELAR pre-paid. No other warranty is expressed or implied. BELAR is not liable for consequential damages.

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- Please call (610-687-5550) or email (sales@belar.com) to request an RMA number to display on the outside of your shipping carton and all paperwork.
- A written statement with the name, address, telephone number & email address together with a brief description of the work requested, must accompany all returns.
- The customer shall be responsible for all costs of transportation and insurance to and from the BELAR factory, and all such costs must be prepaid.

PLEASE VISIT: WWW.BELAR.COM AND REGISTER YOUR PRODUCT SO WE MAY KEEP YOU INFORMED OF THE LATEST HARDWARE AND SOFTWARE UPDATES.

We no longer ship PC Control Software with the units. Please visit **www.belar.com** and download the latest **WizWin© and Server PC Control Software**. Software updates will be posted on our website periodically. The **FMHD-1** can be updated in the field using the PC Software.

Broadcast Equipment

FMHD-1
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Software Module

BELAR ELECTRONICS LABORATORY, INC.

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Broadcast Equipment

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BELAR ELECTRONICS LABORATORY, INC.

1 General Information
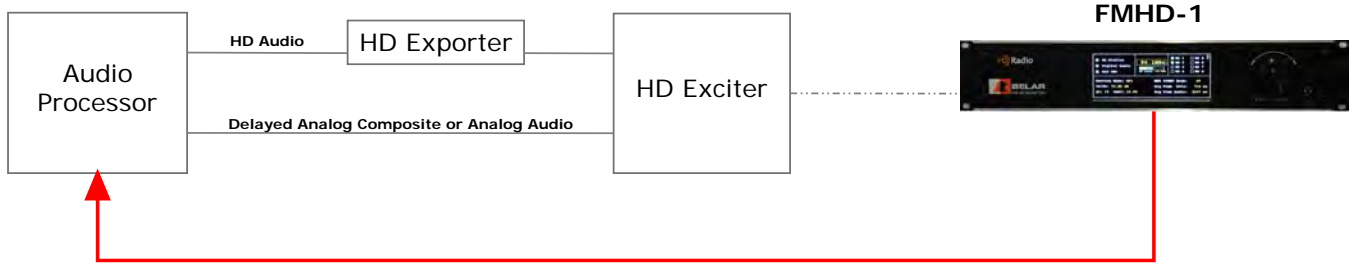
1.1 General Description

The **BELAR FMHD-1 Automatic Delay Correction Software Module** allows the monitor to communicate directly with the device containing the diversity delay in the broadcast chain. The communication is accomplished by establishing an IP connection between the devices with the **FMHD-1** being the host, and the delay device acting as the client. The diversity delay error is calculated in the FMHD1 and this error information is feedback to the delay device closing the loop and keeping the delay errors in check.

There are three places the diversity delay may be inserted into a broadcast chain to achieve the required delay between the Analog Main FM and HD1 Digital signals. On the analog side the delay can be applied to either the Analog Main Audio channel or the composite baseband signal, on the digital side the HD1 digital signal can be delayed. The total overall diversity delay can all be solely the analog Main Audio or Baseband Composite, or it may be made up of a combination of delays on the Analog and HD1 digital signals.

Currently, there are three types of delay devices which can communicate with the **FMHD-1** audio processors, precision delays, and exporters. Audio processors can typically adjust the delay of the Analog Audio and Baseband Composite; some can also adjust the delay on the HD1. Precision delays can be used on either the Main Analog or HD1 signals. Exporters have a delay line with AES input and outputs which can be used to delay the Analog Main or HD1, even thou this delay line was originally designed for the Analog Main the HD1 Main can be looped thru as well. See the examples of some typical broadcast chain setups below.

1.2   Examples of Analog Only Delay Correction

Audio Processor with Variable Analog Delay Only

```
                                                                    FMHD-1
┌──────────┐  HD Audio    ┌──────────────┐   ┌──────────┐
│  Audio   │──────────────│ HD Exporter  │───│          │
│Processor │              └──────────────┘   │HD Exciter│ ········  [FMHD-1 unit]
│          │  Delayed Analog Composite or Analog Audio   │
└──────────┘                                 └──────────┘
```
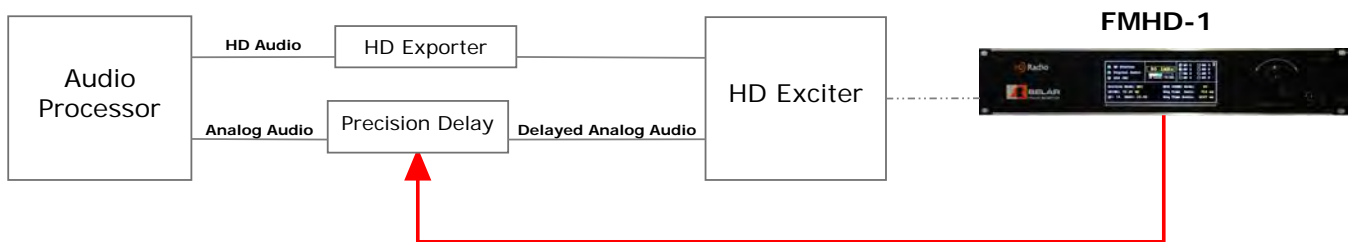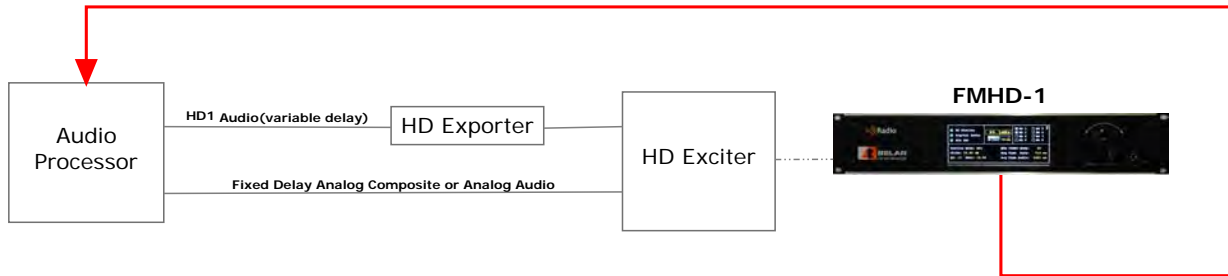
Audio Processor without Delay , Exporter Variable Delay

```
                                                                    FMHD-1
┌──────────┐  HD Audio    ┌──────────────┐   ┌──────────┐
│  Audio   │──────────────│              │───│          │
│Processor │              │ HD Exporter  │   │HD Exciter│ ········  [FMHD-1 unit]
│          │  Analog Audio│              │   │          │
└──────────┘              └──────────────┘   └──────────┘
                              Delayed Analog Audio
```
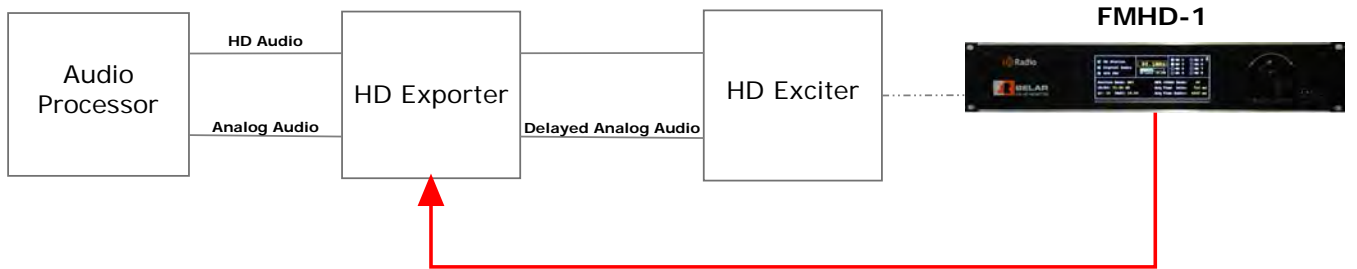
External Precision Variable Analog Delay

```
                                                                    FMHD-1
┌──────────┐  HD Audio    ┌──────────────┐
│  Audio   │──────────────│ HD Exporter  │───────┐  ┌──────────┐
│Processor │              └──────────────┘       └──│          │
│          │  Analog Audio┌──────────────┐          │HD Exciter│ ······  [FMHD-1 unit]
│          │──────────────│Precision Delay│─────────│          │
└──────────┘              └──────────────┘          └──────────┘
                              Delayed Analog Audio
```
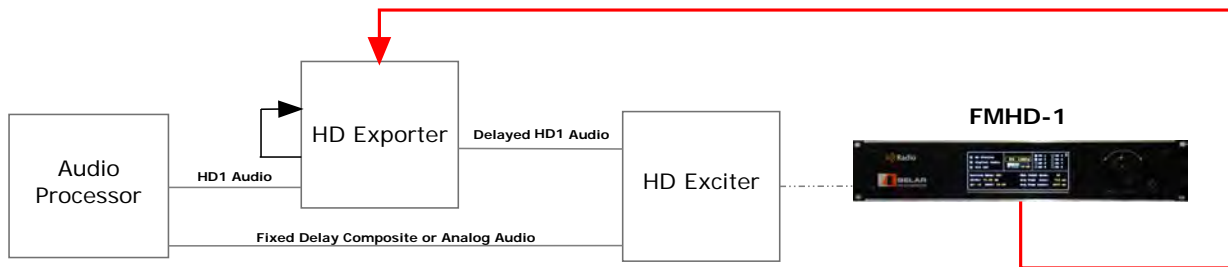
1.3   Examples of Fixed Analog Delay with Correction on the HD1 Digital

Audio Processor with Fixed Analog Delay and Variable HD1 Delay

FMHD-1

Audio Processor

HD1 Audio(variable delay)   HD Exporter

Fixed Delay Analog Composite or Analog Audio

HD Exciter

Exporter Variable HD1 Delay, Audio Processor with Fixed Analog Delay

FMHD-1

Audio Processor

HD1 Audio

HD Exporter   Delayed HD1 Audio

Fixed Delay Composite or Analog Audio

HD Exciter

2 Initial Setup

2.1 Getting Accurate Correlations between the Analog and HD Audio

In order for the **FMHD-1** to reliably calculate the diversity delay error the unit must be able to correlate the Analog and HD audio waveforms. The correlation operates on the time domain samples of the waveforms. It is insensitive to magnitude differences, but very sensitive to phase differences between the waveforms. Therefore, it is extremely important that the Analog and HD Main Audio are processed as identically as possible. This is most easy done by using the same audio processor for both audio signals and selecting the same preset/settings.

Bad correlations between the two audio channels will result in slow diversity delay corrections, out of range errors, and audio polarity errors.

2.2 Delay Center Value

The **Belar** ADC algorithm corrects plus or minus around a delay center, instead of trying to across the whole possible delay range. This allows the correlations to be computed faster resulting in more frequent corrections to keep the diversity delay aligned in real time. The delay center should to set to the nominal or average delay present in the broadcast chain. Because the delay correction can be the total analog delay, or some fraction of the analog or digital delay this delay center value can as small as 500 ms to over 9 seconds. It's important to get the setting correct otherwise the delay corrections can get out of range.

The time window is adjustable trading off the resolution of the calculated delay error for overall delay range. Expanding the delay range also effects the time required to perform the correlation and slows down the application of delay corrections. The sample resolution setting on the Level/Time Align Screen and has a range of 1 to 8 samples. See the table below for the delay window vs sample resolution,

Samples Resolution	Time Window	Correlation Time
1	± 350 ms	3 sec
2	± 700 ms	
3	± 1.050 sec	
4	± 1.400 sec	
5	± 1.750 sec	
6	± 2.100 sec	
7	± 2.450 sec	
8	± 2.800 sec	

The Sample Resolution can be set to Auto which will adjust the sample resolution automatically if the delay errors get out of range, and then reduce the sample resolution as the delay comes back in range.

If the diversity delay thru the broadcast chain is unknown, set the Sample Resolution to 8 samples and on the Settings: Outputs popup menu route the L+R Analog and HD1 L+R to the headphone outputs to aid in getting the initial alignment.

2.3   Modes of Operation

Most delay devices support three modes of operation, Direct, Manual, and Auto. In Direct mode the delay in the connected device can be set directly from the front panel of the monitor by adjusting the Delay Center value on the configuration screen for the active device. This is useful for initial setup to get the starting value for the Delay Center when the diversity delay is unknown. Manual mode calculates and displays the delay correction, but does not send the corrected value to the delay device unless the button is clicked. Finally, in Auto mode the monitor sends corrections automatically at the Rate time interval defined in the delay devices configuration.

For initial setup use Manual mode and check to make sure the system is working correctly by sending corrections manually and observing the time alignment screen. Once the proper operation is confirmed the mode can be changed to Auto.

2.4   Active Configuration

There are 6 device configuration screens labeled #1 thru #6., the current active configuration is determined by the active configuration number which is display on the time align status screen. To select a configuration, click on the APPLY button on the one of the six configuration screens. When Multi-Scan mode is disabled the unit will use continue to use the selected active configuration until another configuration is applied. When Multi-Scan mode is enabled the unit will automatically switch load a new configuration based on the settings on the Multi-Scan Screen.

2.5   Assign Tuning Frequency

Using the Multi-Scan screen assign a tuning frequency for each configuration that will be used. The unit will automatically tune to this frequency when the configuration is applied. If the tuning frequency is changed and doesn't match this value a Tuning Freq error will be displayed on the time align status screen.

2.6   Multi-Scan

Enabling the Multi-Scan mode allows the **FMHD-1** to measure and correct the diversity delay on up to 6 stations. This is accomplished by setting up delay device configurations for device and assigning the stations tuning frequency and time slot duration. When the Multi-Sync time is set to 0 that configuration will be skipped, once a number greater is entered the station will be included automatic scanning.

3 Validating SOFTWARE MODULE

3.1 Entering Option # Code
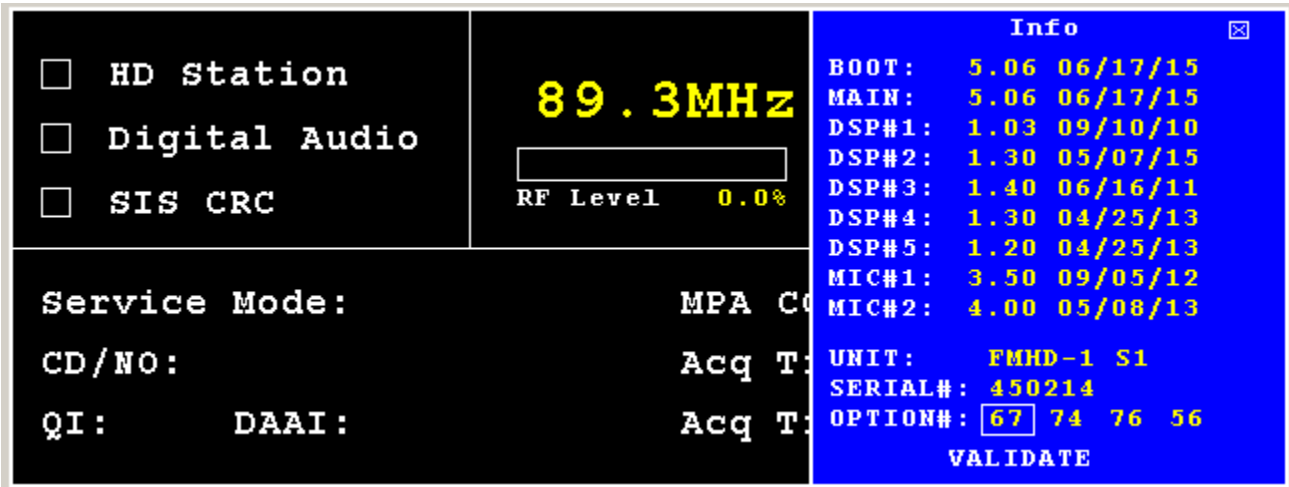
Before the Automatic Delay Correction software module is used it must first be activated. If you have an older unit, purchased before January 1st 2015, there is a one-time fee to activate this module. Please contact **Belar** for pricing and to obtain the validation codes. The codes are unique and tied to the **FMHD-1**'s serial number, once the feature is activated it will remain active for all future software updates.

To validate the software module, go to the Settings: Info popup menu and place the cursor on the first code, click on the code and use the rotary encoder to entry the code, click again, and proceed to the next code until they are all set. Once the codes are set, place the cursor on the VALIDATE text and click, the UNIT string should change from **FMHD-1** to **FMHD-1 S1** is the validation was successful. The codes will be permanently stored in the unit.

4   TIME/LEVEL ALIGNMENT

4.1   Time/Level Align Measurement Screen
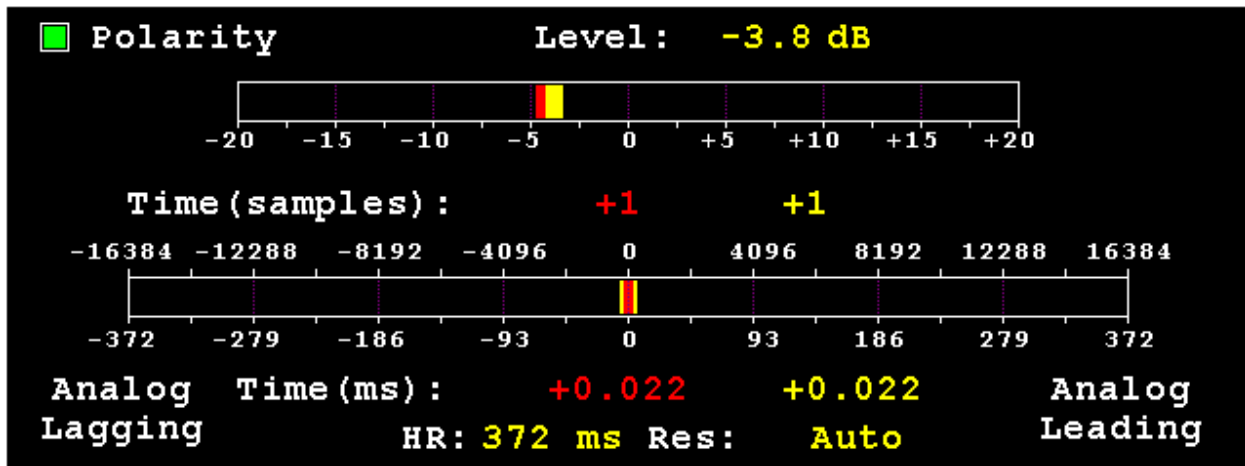
The level/time align screen displays continuous real-time level and time alignment measurements with the red indicator being a fast representation and the yellow being a slower average value.

Polarity: Indicates if Analog and HD signals are in phase(green) or 180 out of phase(red).
HR: Determines the resolution of the time alignment scale.
Res: The sample resolution of the time alignment measurement. The sample resolution is normally set to 1, but can be expanded out to 8 for a wider time window. Larger time windows and sample resolutions result in longer correlation times. Auto works with the ADC software module to automatically scale the window based on the delay error.

4.2 Time Align Status Screen
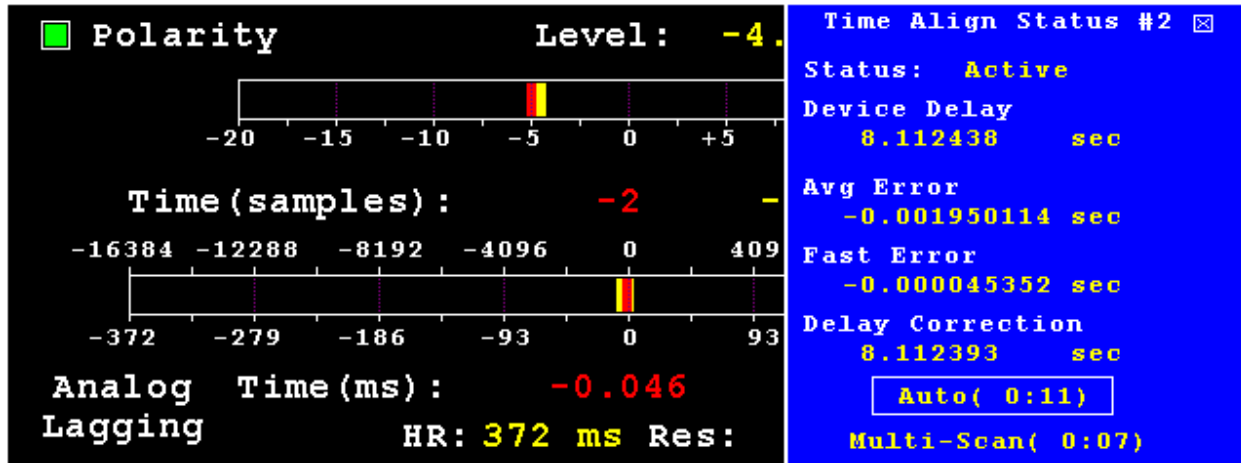
Active Configuration: The number displayed in the upper right hand corner is the current active configuration.

Status: Displays the status of the active configuration

Device Delay: When available, the current delay read from the delay device.

Avg Error: The average error calculated in seconds.

Fast Error: The fast error calculated in seconds.

Delay Correction: This is the current delay correction which will be sent to the delay device.

Update Device/Auto/Ramp Button: In Manual Mode clicking the "Update Device" button will send the current delay correction to the delay device. In Auto Mode the button displays the countdown timer until the next correction is automatically sent, this can be forced at any time by clicking on the Auto button.

Multi-Scan: The Multi-Scan count down timer shows how much time is left on this current configuration, before it switches to the next configuration. See the Multi-Scan screen for settings.

4.3   Time Align Multi-Scan Screen
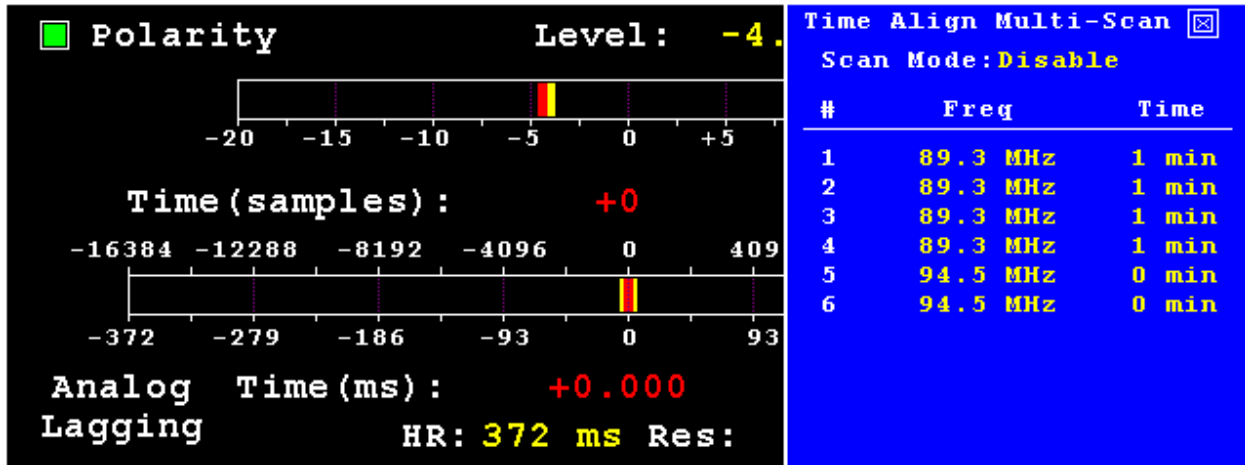
Scan Mode: Enables/Disables Multi-Scan mode

Freq: Set's tuning frequency for each configuration. These frequencies are used even if the Multi-Scan function isn't enabled.

Time: Determines the time-slot length for a station configuration in Multi-Scan mode. Setting the time to zero will skip the station when Multi-Scan is enabled.

4.4   Time Align Configuration Screen
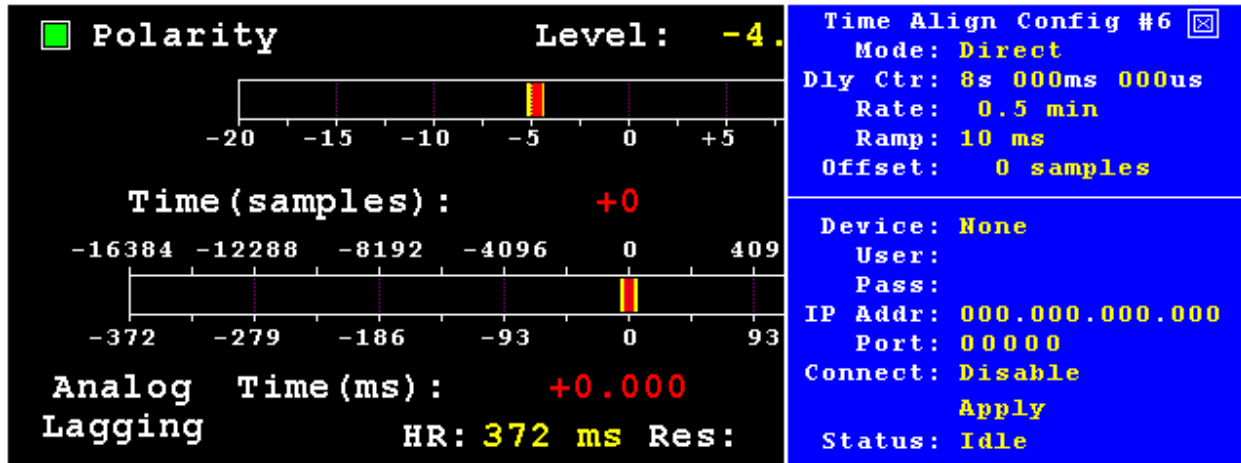
Mode: Direct, Manual and Auto. Determines how the delay device's internal delay is updated by the **FMHD-1**. In Direct Mode the delay can be adjusted by changing the Dly Ctr , this is useful for setting the initial delay setting in the delay device. Manual mode requires the user click on the Update Device button to send corrections. Auto sends corrections automatically at time intervals defined by the Rate setting.
Dly Ctr: The nominal delay required in the delay device for time alignment. The ADC algorithm calculates delay corrections around this center, plus or minus. If delay corrections are outside the correction window a "Dly Ctr Err" is shown.
Rate: The rate at which delay corrections will be sent to the delay device when Mode is set to Auto.
Ramp: Delay devices which jump directly to new delay settings can be ramped to that new setting in the steps. This is ramp step size, setting the value to 0 ms disables the ramping function.
Offset: This function is currently disabled.

Device : Delay Device hardware selection.
User: Delay Device Username if required.
Pass: Delay Device Password if required
IP Addr: Delay Device IP Address.
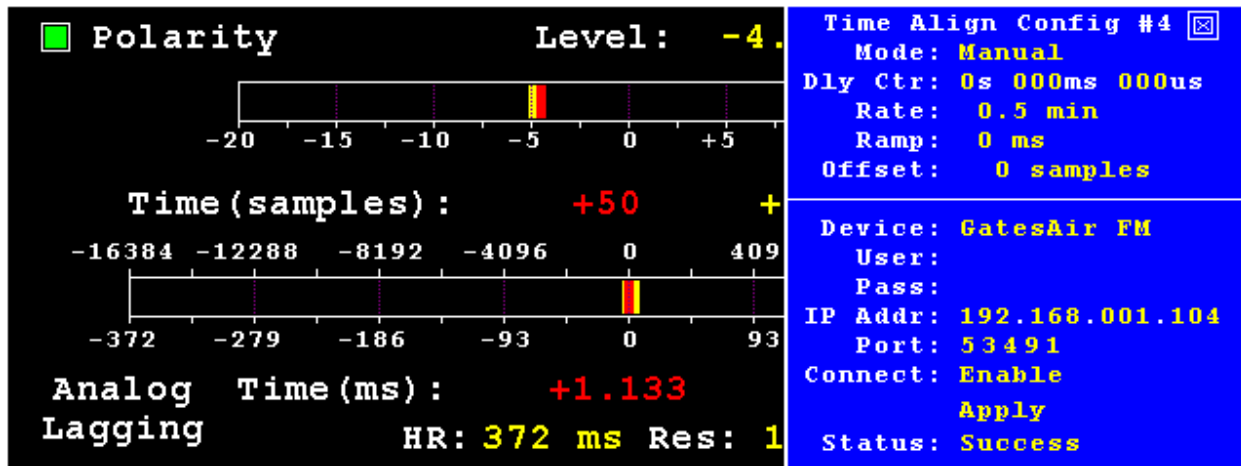**Port:** Delay Device IP port.
Connect: Enable or Disable IP connection to Delay Device.
Apply: To select this configuration as the active configuration click the Apply button. If a configuration parameter is changed which requires an Apply, the button will turn green.
Status: Displays the status of the Apply process.

5   GATESAIR

5.1   HDE-200 EXPORTER

Modes Supported: Manual and Auto only. If this is the initial setup use the Manual setting.
Delay Center: Must be set to 0.000000 sec. The HDE-200 only accepts incremental delay corrections and not the total delay in seconds. Corrections will be positive and negative increments.
Rate: All update rates are available; this parameter only applies when Mode is set to Auto.
Ramp: Should be set to 0 ms, which disables the ramping function in the **FMHD-1**. The exporter has an internal ramping function which should be used.
Offset: N/A

Devices Supported: HDE 200 Exporter. There are two device selections GatesAir FM when using the delay for Analog correction and GatesAir HD when looping the HD1 thru for correction.
User: N/A
Pass: N/A
IP Address: CPU IP Address which can be found on the Address Configuration Utility screen of the HDE-200 Control Center Software supplied with the Exporter.
Port: Default 53491. This information is located on the Diversity Settings screen of the HDE-200 Control Center Software. The External Correction Enable box must be checked on this screen for the exporter to accept corrections from the **FMHD-1**.
Connect: Enable, select and click on the green Apply to initiate the connection with the exporter, the Status will change to Configuring, and indicate Success or Failure. If the Apply fails, check the above settings and re-try. If the Apply was successful see the **FMHD-1** Time Align Status screen for real-time status.

6   NAUTEL

6.1   EXPORTER PLUS
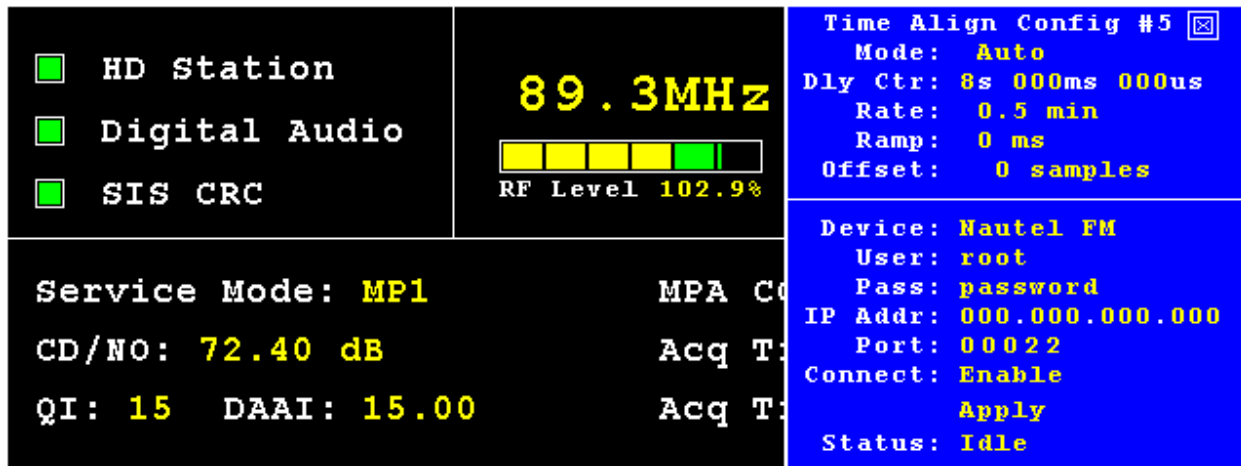
In order for the Nautel Exporter Plus to accept remote delay corrections you must contact Nautel customer service and get a Remote Configuration License.
The ramp function in the exporter should be set to "ramp down".
The **FMHD-1** embedded Lantronix device must be updated to version Lantronix 5_2_0_5_B15 using the WizWin software.

Modes Supported: Direct, Manual and Auto. If this is the initial setup use the Manual setting.
Delay Center: This should be set to your nominal or average delay in the exporter that is being corrected.
Rate: All update rates are available; this parameter only applies when Mode is set to Auto.
Ramp: Should be set to 0 ms, which disables the ramping function in the **FMHD-1**. The exporter has an internal ramping function which should be used.
Offset: N/A

Devices Supported: Nautel Exporter Plus. There are two device selections Nautel FM when using the delay for Analog correction and Nautel HD when looping the HD1 thru for correction.
**User:** Username for exporter login, should be set to "root"
Password: Password for login, can be up to 12 characters, default is "password".
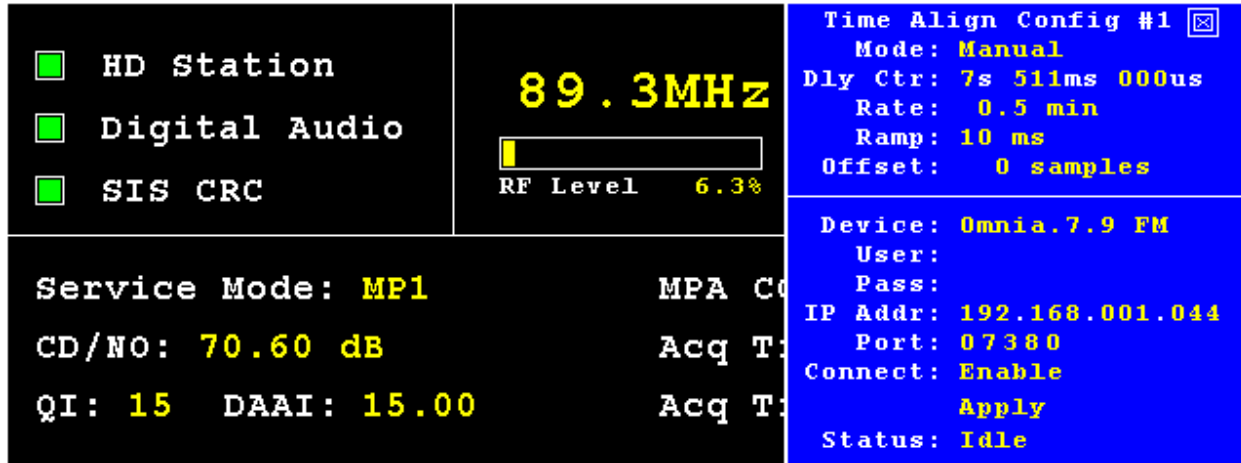**IP Address:** Exporter IP address
Port: Default 22.
Connect: Enable, select and click on the green Apply to initiate the connection with the exporter, the Status will change to Configuring, and indicate Success or Failure. If the Apply fails, check the above settings and re-try. If the Apply was successful see the **FMHD-1** Time Align Status screen for real-time status.

7 OMNIA

7.1 Omnia.7 and Omnia.9 AUDIO PROCESSORS

In order for the Omnia processor to accept remote delay corrections you must white list the IP address of **Belar FMHD-1** using Omnia NfRemote application.

Modes Supported: Direct, Manual and Auto. If this is the initial setup use the Manual setting.
Delay Center: This should be set to your nominal or average delay in the Omnia that is being corrected.
Rate: All update rates are available; this parameter only applies when Mode is set to Auto.
Ramp: Default is 10 ms. This determines the step size of the delay correction the **FMHD-1** will apply to the processor during ramping. Example, if the total delay correction was 100ms the **FMHD-1** would ramp to that delay in 10 steps of 10 ms each. This reduces an audible jump to a new delay setting by ramping in small steps.
Offset: N/A

Devices Supported: Omnia 7 and Omnia 9. These processors have separate internal delay lines for the analog and HD1 paths. There are two device selections Omnia FM which applies the correction to Analog Main and Omnia HD which corrects the HD1 delay.
User: N/A
Password: N/A
IP Address: This can be found on the front panel of the Omnia processor under System Config IP Configuration.
Port: Default 7380
Connect: Enable, select and click on the green Apply to initiate the connection with the exporter, the Status will change to Configuring, and indicate Success or Failure. If the Apply fails, check the above settings and retry. If the Apply was successful see the **FMHD-1** Time Align Status screen for real-time status.

7.2 OMNIA.11 PROCESSORS

```
┌─────────────────────────┬──────────────────┐  ┌──────────────────────────┐
│ ☐ HD Station            │                  │  │ Time Align Config #1 ⊠   │
│                         │   89.3MHz        │  │     Mode: Manual          │
│ ☐ Digital Audio         │ ┌──────────────┐ │  │ Dly Ctr: 7s 000ms 000us  │
│                         │ │████████████░ │ │  │     Rate:  0.5 min        │
│ ☐ SIS CRC               │ └──────────────┘ │  │     Ramp: 10 ms           │
│                         │ RF Level   95.2% │  │   Offset:    0 samples    │
├─────────────────────────┴──────────────────┤  │                          │
│                                             │  │   Device: Omnia.11 FM    │
│ Service Mode: MP1          MPA C(           │  │     User:                │
│                                             │  │     Pass:                │
│ CD/NO: 73.70 dB            Acq T:           │  │  IP Addr: 192.168.001.090│
│                                             │  │     Port: 04545          │
│ QI: 15   DAAI: 15.00       Acq T:           │  │  Connect: Enable         │
│                                             │  │           Apply          │
│                                             │  │   Status: Idle           │
└─────────────────────────────────────────────┘  └──────────────────────────┘
```

Modes Supported: Direct, Manual and Auto. If this is the initial setup use the Manual setting.
Delay Center: This should be set to your nominal or average delay in the Omnia that is being corrected.
Rate: All update rates are available, this parameter only applies when Mode is set to Auto.
Ramp: Default is 10 ms. This determines the step size of the delay correction the **FMHD-1** will apply to the processor during ramping. Example, if the total delay correction was 100ms the **FMHD-1** would ramp to that delay in 10 steps of 10 ms each. This reduces an audible jump to a new delay setting by ramping in small steps.
Offset: N/A
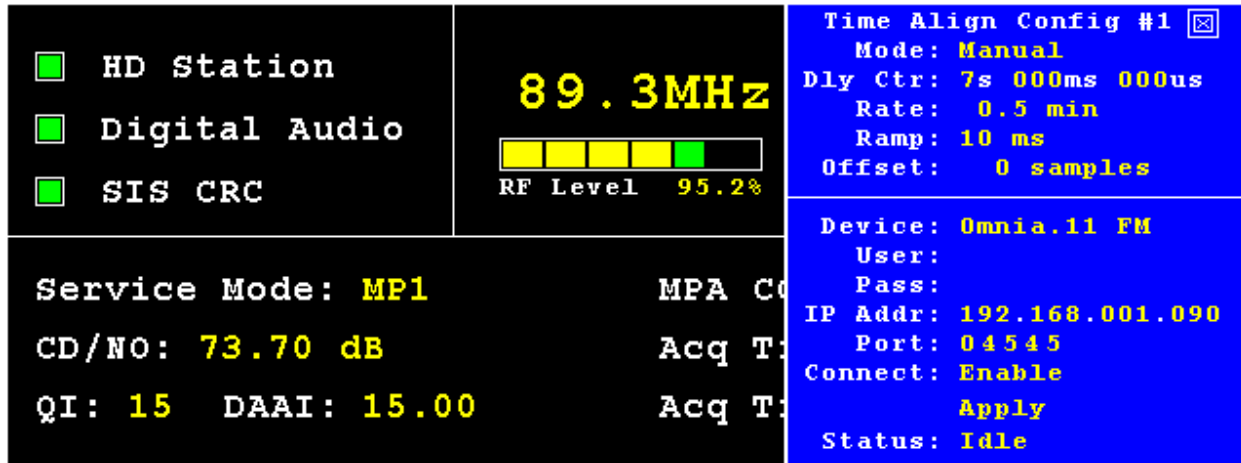
Devices Supported :   Omnia 11.
**User:** N/A
Password: N/A
IP Address: This can be found on the front panel of the Omnia processor under System Config IP Configuration.
Port: Default 4545
Connect: Enable, select and click on the green Apply to initiate the connection with the exporter, the Status will change to Configuring, and indicate Success or Failure. If the Apply fails check the above settings and re-try. If the Apply was successful see the **FMHD-1** Time Align Status screen for real-time status

8 ORBAN

8.1 5500, 5700, 8500, 8500S, 8600, 8600S PROCESSORS
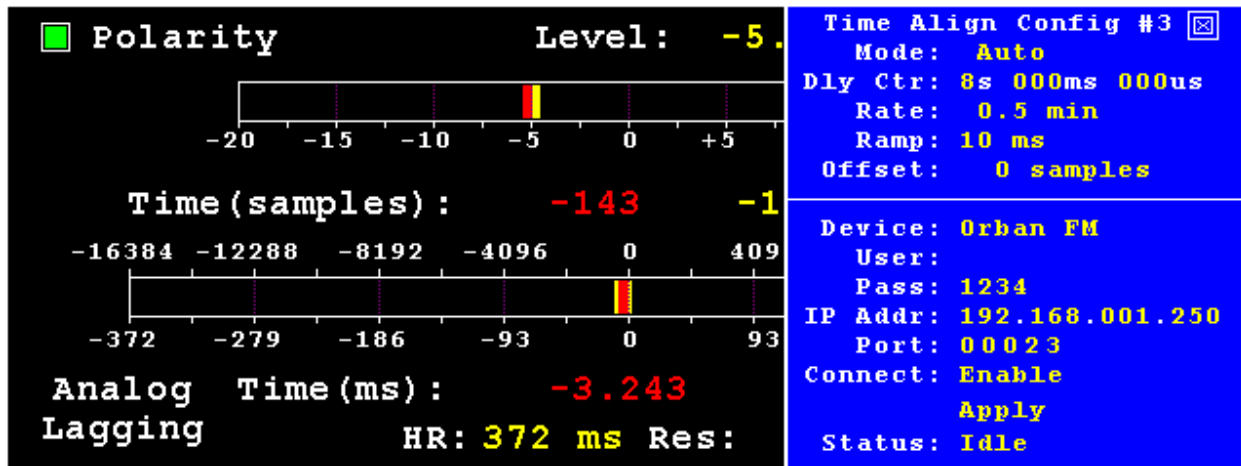
Modes Supported: Direct, Manual and Auto. If this is the initial setup use the Manual setting.
Delay Center: This should be set to your nominal or average delay in the Orban that is being corrected.
Rate: All update rates are available; this parameter only applies when Mode is set to Auto.
Ramp: Default is 10 ms. This determines the step size of the delay correction the **FMHD-1** will apply to the processor during ramping. Example, if the total delay correction was 100ms the **FMHD-1** would ramp to that delay in 10 steps of 10 ms each. This reduces an audible jump to a new delay setting by ramping in small steps.
Offset: N/A

Devices Supported : Orban 5500, 5700, 8500, 8500S, 8600, 8600S users are advised to upgrade to the latest software version at ftp.orban.com
User: N/A
Password: Orban's use a 4-digit numeric password which can be configured in the processor, please set or check the password on the processer and enter the digits in the first 4 characters.
**IP Address:** This is the processers IP address.
Port: Default 23
Connect: Enable, select and click on the green Apply to initiate the connection with the exporter, the Status will change to Configuring, and indicate Success or Failure. If the Apply fails check the above settings and re-try. If the Apply was successful see the **FMHD-1** Time Align Status screen for real-time status.

9   WHEATSTONE

9.1   AirAuraX3, FM-531HD, VP-8IP and FM-55 PROCESSORS
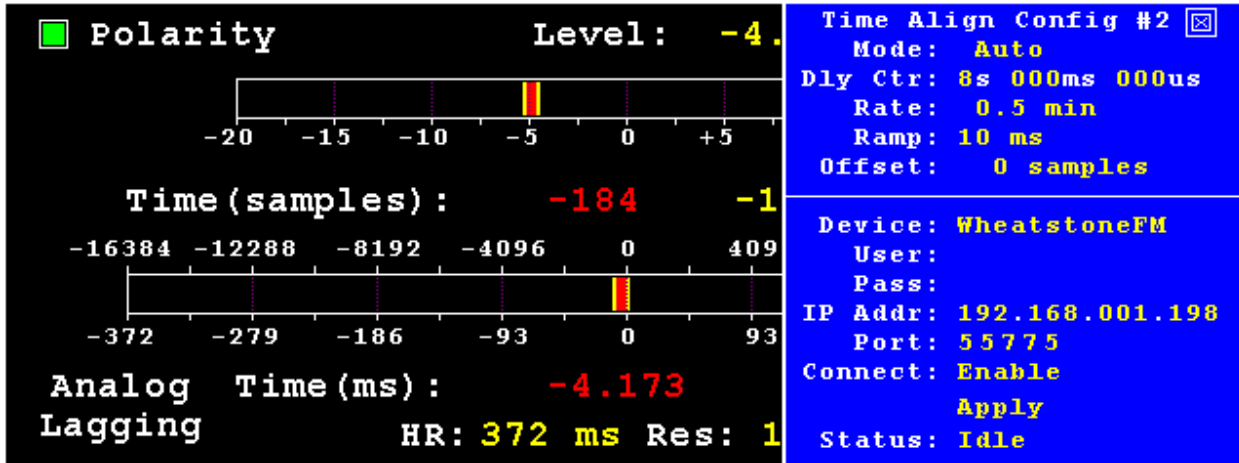
Modes Supported: Direct, Manual and Auto. If this is the initial setup use the Manual setting.
Delay Center: This should be set to your nominal or average delay in the Wheatstone that is being corrected.
Rate: All update rates are available; this parameter only applies when Mode is set to Auto.
Ramp: Default is 10 ms. This determines the step size of the delay correction the **FMHD-1** will apply to the processor during ramping. Example, if the total delay correction was 100ms the **FMHD-1** would ramp to that delay in 10 steps of 10 ms each. This reduces an audible jump to a new delay setting by ramping in small steps.
Offset: N/A

Devices Supported: Wheatstone AirAuraX3, FM-531HD, VP-8IP and FM-55
User: N/A
Password: N/A
IP Address: This is the processers IP address.
Port: Default 55775
Connect: Enable, select and click on the green Apply to initiate the connection with the exporter, the Status will change to Configuring, and indicate Success or Failure. If the Apply fails, check the above settings and re-try. If the Apply was successful see the **FMHD-1** Time Align Status screen for real-time status.

BELAR ELECTRONICS LABORATORY, INC.