COMARK
Communications

ADAPT IV

ATSC Digital Exciter

User's Guide

Document Number: 46745601-108
Revision: A
June 7, 2007

Manufactured in the United States of America

Introduction

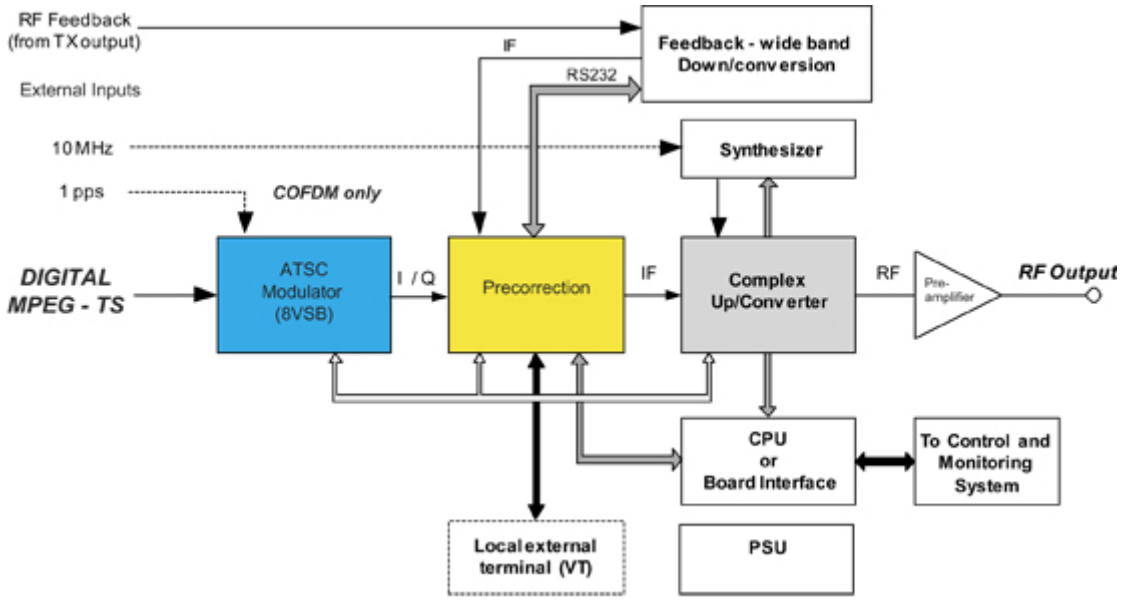
This User's guide contains information and instructions necessary to safely operate the Comark Broadcast and Multimedia ADAPT IV ATSC Digital Exciter. This section provides an overall physical description of the ADAPT IV exciter, a theory of operation, and operational procedures.

The ADAPT™ Advanced Digital Adaptive Pre-correction Technology IV ATSC Digital Exciter is the signal processing sub-assembly contained within a Comark television transmitter that converts an MPEG digital signal stream into a low-power 8-VSB modulated RF signal compliant to Advanced Television Standards Committee (ATSC) standards. This low-power RF signal is used to drive subsequent power amplification stages in the transmitter. The ADAPT IV exciter incorporates Digital Adaptive Precorrection (DAP) technology, which applies complementary pre-distortion to the RF drive signal to effectively cancel the linear and non-linear distortions produced by the transmitter power amplifier and channel filter systems.

Physical Description

The ADAPT IV exciter is comprised of a series of plug-in modules packaged in a standard EIA 19" rack mount chassis with a 2U height. Access to the module adjustments and indications are gained by opening the front and top covers. Connectivity to the transmitter is via connectors mounted on the back panel of the chassis.

Theory of Operation



Functional Overview:

ATSC Modulator: The exciter platform was developed specifically for ATSC channel modulation. An encoded MPEG video signal, in the form of a SMPTE310M compliant 19.39 Mbit/sec serial data stream or a DVB-ASI stream, is input to the ADAPT exciter. In both cases internal signal processing at the front of the exciter is used to convert the signal to an appropriate synchronous stream which is then provided to the modulator block. This allows locking of the modulator clock. The TS inputs automatically detect whether the input stream is SMPTE310M or ASI format. The exciter is equipped with two different inputs as a standard feature. The second input can be used for redundancy in the case where an operator wants to run two completely separate feeds to the transmitter system.

The **8-VSB** modulator takes the input signal and performs the following processes as required by the ATSC television standard:

- Removal of the MPEG sync byte
- Data randomization
- Reed-Solomon encoding
- Data interleaving
- Trellis coding
- Segment and field sync insertion
- Symbol mapping
- Pilot insertion
- VSB filtering

The outputs from the channel modulator are two digital baseband signals, each representing one half of the full 8-VSB signal: the in-phase (I) and quadrature (Q) signals. When properly combined, these two signals form the complete two-dimensional 8-VSB signal constellation. The I and Q baseband signals are passed to the Digital Pre-correctors for further signal processing.

Signal Processing: *Digital Adaptive Precorrection (DAP)* is the heart of the ADAPT IV exciter. It receives the output of the 8-VSB modulator as well as a transmitter output feedback sample. These signals are compared in order to calculate the correction required to compensate for the overall transmitter system distortion. This pre-correction takes the form of *non-linear* correction, based on a transfer curve look-up table (LUT) algorithm, and *linear* correction, based on a transversal delay line equalizer known as the Adaptive Linear Equalizer (ALE). The non-linear LUT corrector minimizes adjacent channel sidebands by compensating for non-linearities in the amplifying stages of the transmitter. The linear ALE corrector maximizes demodulated Signal to Noise Ratio (SNR) by compensating for the linear distortions in frequency response and group delay caused by the RF mask filter at the transmitter output. The outputs of the signal processing section are pre-corrected I and Q analog Intermediate Frequency (IF), which are sent to the up-converter.

UHF Synthesizer: The synthesizer sub-module provides the RF LO signal used for upconversion, and also for down-converting the transmitter feedback sample. It combines direct digital (DDS), and phase lock loop (PLL) technology to allow for wideband, low resolution, and low phase noise performance. Combing a DDS with a PLL in an RF synthesizer allows the frequency resolution and controllability of the DDS while maintaining the frequency range of the PLL system. The PLL can reduce DDS spurious whereas the DDS can decrease PLL multiplication factor, enhancing phase noise performance of the overall system. Together they can provide for a high performance RF synthesizer. The synthesizer frequency can be locked either to an internal oscillator, an external 10MHz or 1PPS reference, or the output of the ADAPT IV's internal GPS.

Up Converter: This block performs two functions: Firstly, it receives the precorrected I and Q IF signals from the signal processing block and upconverts those to a UHF frequency to form a single on-channel 8-VSB RF signal. Secondly, it receives an RF feedback signal from a transmitter output sample and down converts it to an IF signal to send back to the signal processing block. The feedback sample is used to calculate the required precorrection. The on-channel RF signal from this block is sent to a pre-amplifier module for final output.

Output Amplifier: This module amplifies the on-channel RF signal from the upconverter to an appropriate output level. There are different amplifier types depending on the frequency band and transmitter power level. The final on-channel signal exits the exciter at rear panel.

Control Interface: User control of the ADAPT IV exciter can be made through the use of the local touchscreen. (This local touchscreen is not provided in Ultimate, Optimum, or Elite transmitter systems. In those systems, local interface to the ADAPT IV is made through the transmitter system local interface. See the transmitter system manual for more information.)

Basic dry loop commands are provided on the back panel in addition. Control can also be managed either locally or remotely using a standard web browser connected to one of the Ethernet ports. In all cases, the exciter control is managed through a rugged, embedded microprocessor running LINUX. At no time does the main signal flow pass through this processor.

Exciter Description

The Exciter System is based on six main modules.

Digital Board (C)

This board is designed using FPGA hardware and contains firmware dedicated to ATSC modulation.

The serial incoming data stream signal is processed by the channel encoder, which provides an output complex digital signal in the form of parallel I and Q digital signals and a clock reference.

A front end allows the equipment to support automatic switching between dual Transport Stream (TS) inputs. Bit Rate Adaptation with PCR re-stamping is used for standard operation.

The digital board contains an embedded microprocessor that manages the daughter boards such as the GPS and Signal Processing Board. The microcontroller also provides a simple web interface, via Ethernet, to allow the remote upgrade of all software and firmware.

RS232, I2C and SPI buses are used for internal control and monitoring of the daughter boards.

External Control and Monitoring is done through RS232 and/or Ethernet and/or CAN bus.

The digital board distributes pilot clocks to daughter boards, 10MHz to the synthesizer and TS board, and system clock to the TS board.

Signal Processing Board (B)

The Signal Processing board receives, from the digital board, the output I&Q signals and clock reference.

These I&Q signals are processed by the Signal Processing board which includes: peak power management functions, Linear Equalization, and Non Linear pre-correction.

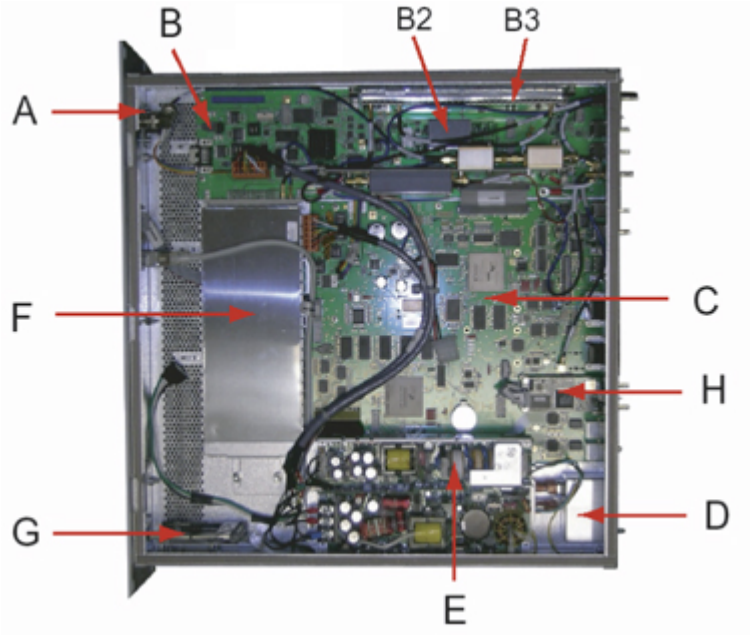
The non-linear automatic pre-correction function computes the best shoulder level at the output of the transmitter. The process is based on a LUT (Look Up Table) that is loaded from an iterative measurement of the shoulder level. The complex base band outputs of the LUT are then up-converted to an IF frequency.

The complex IF frequency signals are converted in the analog domain, filtered (B3) amplified and up converted to UHF by the Tx Board (B4).

A daughter board is fitted on the Signal Processing board in order to do the up conversion function (B4). External feedback which is coming from the RF signal at the output of the transmitter is used in order to control the shoulder, the linear correction process and to monitor the quality of the signal. The Signal Processing board then processes the feedback.

All these functions are plugged in a 19" 2U rack equipped with its own power supply.

A- LED Board
B- Signal Processing Board
B2- IF Filter board
B3- Tx Upconverter board
C- Digital Board
D- AC Transformer
E- Power Supply
F- Synthesizer
G- PC Slot (optional)
H- GPS Receiver



Power supply (E)

A specific power supply is used for the entire chassis to supply +12volts, -12 volts, +5 volts and + 3.3 volts.

Synthesizer (F)

A digitally programmable synthesizer is provided to deliver a sinusoidal signal at the transmitting frequency between 430 and 900 MHz with an output level of 10 dBm / 50 ohms.

GPS receiver (H)

This low power miniature GPS board provides a 1 PPS signal 10 µs pulse, UTC, and 10 MHz reference.

Miscellaneous

The frame of the exciter includes two complementary devices:

- An LED board for front panel indications. (A)
- A PC slot (optional) capable of housing a memory board used to save the configuration parameters of the exciter (G).

Exciter Interfaces

Removal of Advanced Front Panel

Figure 1 shows the Advanced Front Panel. To remove this panel, loosen the two thumb screws from the panel face-plate as shown in Figure 2. Once the thumb screws are fully loosened, gently slide the front panel forward. You will notice a ribbon connector on the right hand side of the assembly. Disconnect this ribbon cable as shown in Figure 3 to allow the front panel to be removed as in Figure 4.

Figure 1

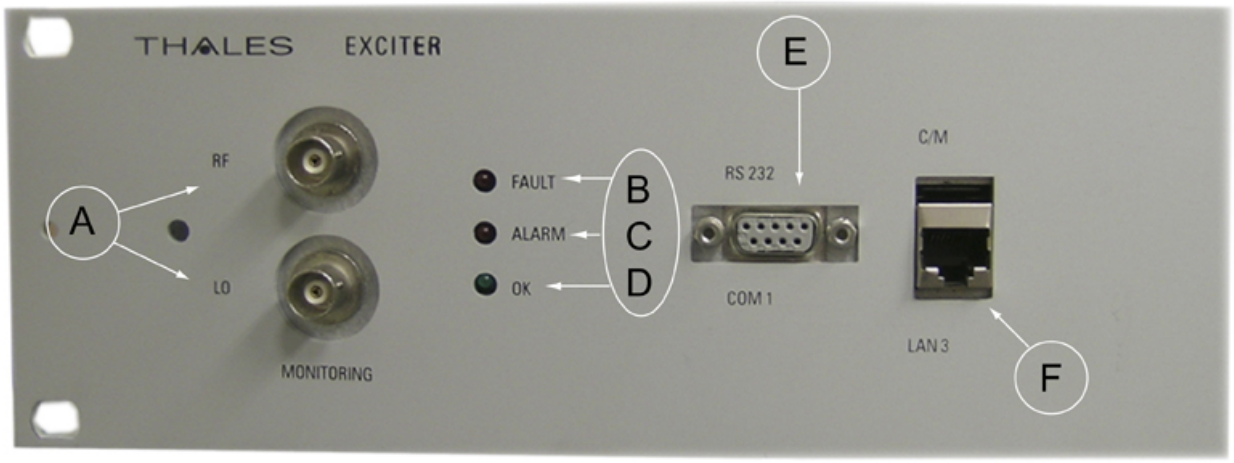
Figure 2

Figure 3

Figure 4

Basic Front Panel

The ADAPT IV is supplied in two versions, depending on the application. The first option is the "basic" front panel. The basic front panel is used most commonly in solid state transmitter configurations. The "advanced" front panel option is supplied for DCX and Affinity transmitter models. The basic front panel is described below. In products where the advanced front panel is supplied, the basic front panel can be accessed by removing the advanced front panel module.



Front panel monitoring (A)

RF –This is a monitoring port of the exciter back panel RF output.

Note: This front panel port is 10dB lower than the back panel RF output. For example, a rear RF output reading of -3dBm will produce a reading of +7dBm on the front panel RF monitoring port.

LO – The typical range for this LO output monitoring port is -5 to -10 dBm depending on the UHF frequency selected.

LED Indicators (B C D)

Normal operation for the LED indicators is as follows:

- (B) Red **FAULT** LED: Light should be **OFF**. (If ON, indicates "exciter hardware fault")
- (C) Red **ALARM** LED: Light should be **OFF**. (If ON, indicates MPEG input signal missing).
- (D) Green **OK** LED: Light should be **ON**. (If OFF, indicates power supply fault or exciter power-up fault).

Note: While powering up the exciter, the green LED is lit for approximately 15 seconds indicating power supply operation. It then turns off for approximately 5 seconds, indicating the starting up of the microprocessor. After completing this cycle the green LED turns on again and remains on during normal operation.

COM 1 connector (E)

RS232 input for programming the digital board. This serial connection is supplied for factory use only.

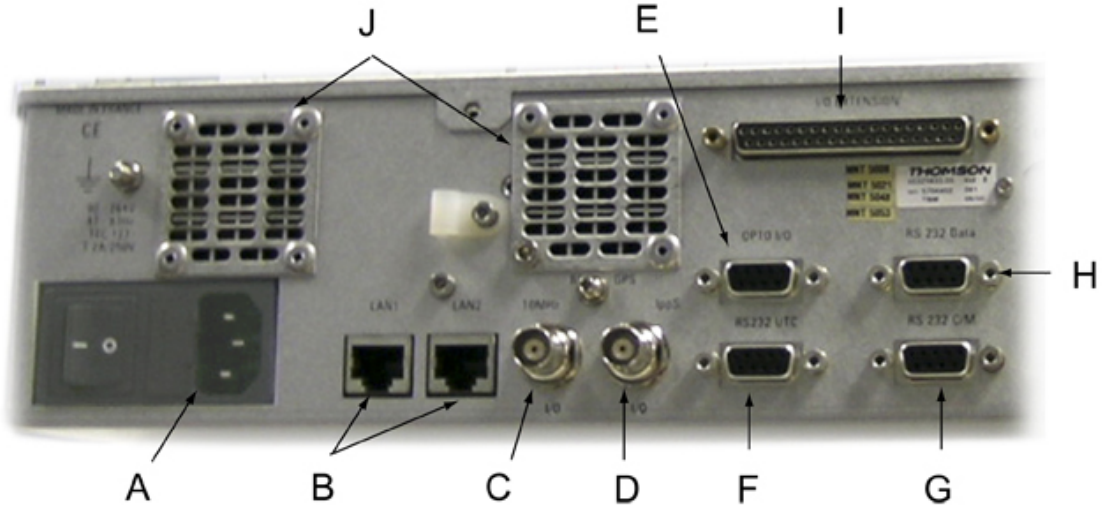
LAN connector (F)

Ethernet access for programming the digital board. In normal operation, this LAN connection is not used. For configuration purposes, this connection is called LAN3.

Exciter Back Panel Connections

Located at the backside of the exciter are the interconnection points used to integrate the exciter into the transmitter system.

Left side of Rack



A- AC Mains power supply input: 90 to 254 volts AC, 47 to 63 hertz

B- 2 RJ45 connections for Ethernet connectivity. The LAN2 connection is the one typically used to remotely access the exciter.

C- 10 MHz 50 ohm frequency external reference. This connector can be configured as an input when "External" clock mode is selected or as an output when "Internal GPS" clock mode is selected.

D- Timing reference external 1 PPS connector. This connector can be configured as an input when "External" clock mode is selected or as an output when "Internal GPS" clock mode is selected.

E- Double input and double output opto-coupled ports in connection with Digital Board. This connector is used only in some SS transmitter models.

F- DB9 RS232 UTC reference input for GPS

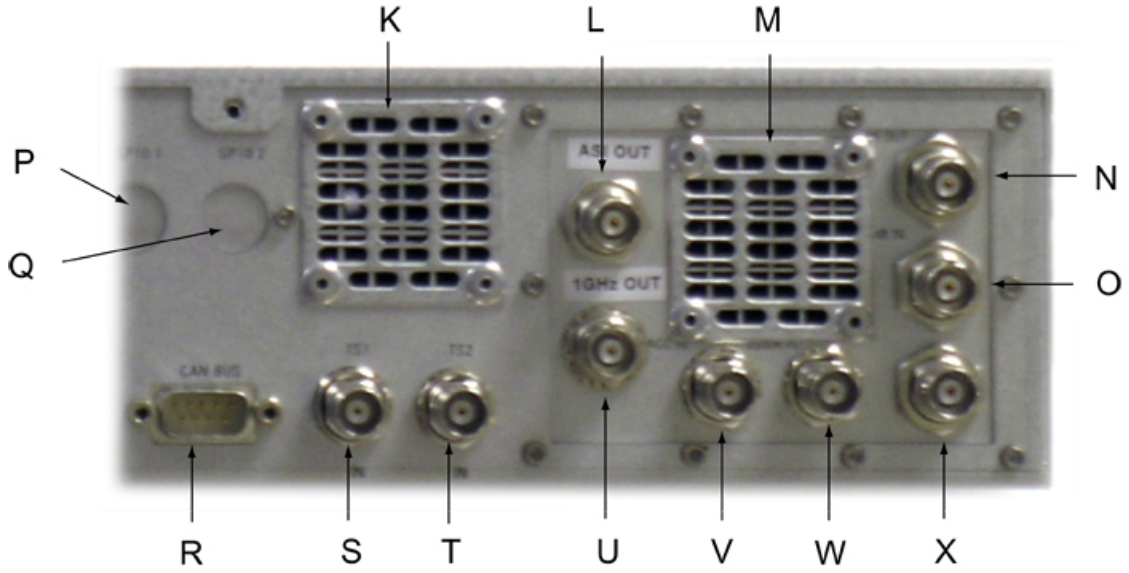
G- DB9 RS232 Local CM in connection with Digital Board for factory use only.

H- DB9 RS232 data for Digital Board for factory use only.

I- Multipoint connection I/O extension, monitoring and control interface via contact closure used in DCX transmitter systems.

J- Cooling air outlets

Right side of Rack



K- Cooling air outlet

L- Optional ASI output gives a copy of the TS stream being used by the modulator.

M- Cooling air outlet

N- RF output - This is the main RF output of the exciter, nominally 0dBm.

O- Feedback RF input (-15dBm+/-5dB) for linear and non linear correction.

P- GPIO connection (*not used*)

Q- GPIO connection (*not used*)

R- CAN bus (*not used*)

S- ATSC input TS #1 – Auto sensing SMPTE310M or DVB-ASI

T- ATSC input TS #2 – Auto sensing SMPTE310M or DVB-ASI

U- RF In is a provision for future applications.

V- Automatic gain control input

W- VSWR input (*not used*)

X- Linear feedback sample (*not used*)

General characteristics

Transmission Characteristics

Emission Standard:	ATSC
Norm:	ATSC doc A 53, ATSC T3/S9
Modulation scheme:	8VSB
Signal Bandwidth:	6 MHz
UHF 4&5	470 - 862 MHz

Environmental Conditions and Safety

Performances:	0° to 45° C up to 3000 m	**Working:**	-10° C to + 50°C
with derating:	Tmax - 5°C by 1000 m	**Maximum altitude :**	4000 m max
storage temperature:	-30° C to +60° C	**Relative humidity:**	≤ 95% non-condensing
EMC:	Standard ETS 300-385	**Safety:**	IEC 215, IEC 1010
CE Label:	Compliant	**Acoustic noise:**	IEC 179: < 65dBa

General Electrical Mechanical and Cooling Characteristics

Rack:	19" 1U desired, 2Umax, depth < 600mm
Main Consumption:	< 200 VA
Cooling:	Internal Fan, air input on front panel
Finish:	Comark Standard

Mains power supply:

Voltage: 230 V / 105 V ± 15% Frequency 47 to 63 Hz

Power Factor (at nominal operation) > 0.90

ON/OFF Switch on the rear panel

Accessible fuse

Automatic, manual, remote switchable for TS control or High Priority and Low Priority inputs for hierarchical mode

- Standard	MPEG 2 TS	- Format:	SMPTE310M or DVB-ASI
- Max. level	800 m Vpp	- Min. level	200 mVpp
- Baud rate	270M baud ± 100ppm	- ASI format	188, 204, 188+16
- Impedance	75 Ω	- Return loss	15 dB from 5 to 270 MHz
- Connector	BNC female		

- Maximum length of cable between the Network adapter and the TX input: < 50m

Ancillary Inputs

External 10 MHz Frequency Reference

- Standard	10 MHz	- Format:	Sinusoid or TTL
- Level 7 dBm	±1 dB	- Return loss	17 dB
- Connector:	BNC female	- Impedance	50 Ω

Phase noise

- Better than -104dBc at 20KHz

External Timing Reference (1 PPS)

- Pulse width min	50 μs	- Level	TTL
- Frequency	1pps	- Active Edge	choice for leading or falling edge
- Connector	BNC female	- Impedance	50 Ω

Input for precorrection (feedback)

- Input level:	-20 < N < -10 dBm	- Connector	BNC female
- Impedance	50 ohms	- Return Loss	>15 dB

AGC Input

- Average detected voltage: 1 < N < 2,5V -
- Connector BNC female - Impedance > 3K ohms
- Range: 10 dB - Rise time and fall time < 1s
- Switch over threshold for MGC 200mV

RF output characteristics

Standard

- ATSC 6 MHz Capability to follow possible modifications of the standards

Power

- Output power (rms)	0 dBm
- Adjustable	between +0 and –10 dB by 0.1 dB steps
- Output power stability	± 0.2 dB

Output connector

- Impedance	50 Ω
- Connector	BNC
- Return loss	≥ 20 dB

Frequency

- Frequency range (RF Output)	frequency agile, without tuning, from 470 to 862 MHz
- Step	1 Hz
- Intrinsic Frequency stability	< 1.10^{-7}/year
- Phase noise	compliant with ATSC A/64

Intrinsic In Band Output signal quality

Modulation shall be generated digitally

- Global SNR (ATSC)	≥ 36 dB
- BER before Viterbi (ATSC)	≤ 1 10^{-6}
- In Band spectrum flatness	≤± 0.2 dB
- Group delay ripple	≤± 10ns

Exciter Local User Interface

Front panel overview

This section outlines the controls of the transmitter while in Local mode of operation; many of these commands are available remotely via web access. The remote user should consult that section of the manual for details. The front panel can be broken into five major areas which are described in detail below.

1. LCD display: - The Liquid crystal display is a part of the Man-Machine-Interface (MMI) for local control and monitoring of the transmitter RF performance. Selecting function keys F1 through F6 can change the displayed menu. A screen saver and display intensity function is available. Press and hold the menu/shift button then select F1 to toggle to screen-saver mode, or press F3 to adjust display intensity.
2. Function Keys: - Buttons F1 through F6 allow the selection of multiple menu functions; each function key can have several pages. These are selected by depressing the particular function key in succession. The menu is organized into logical groupings. Consult the menu tree diagram, or refer to the specific menu description within this manual section for additional details.
3. Navigation & select keys: - The up, down, left, and right buttons allow menu navigation. Once a menu page that allows user defined settings is selected, these buttons can be utilized to highlight the particular menu parameter. The "OK" button when first pressed will allow access to the specific command; this is followed by a numeric entry via the keypad or by using the up / down arrow buttons to toggle to the value. If pressed a second time the new value entry is accepted.

4. Numeric keypad: - Allows numeric entries, also a clear / cancel ("C") button is provided. This button allows a user to cancel an entry prior to accepting the change. The button is also used for clearing an entry such as the alarms log. The button will function in appropriate manner depending on the menu parameter being accessed. The Menu/Shift button is only used for screen saver and for displaying intensity functions.

5. LED display: - The LED display provides a status indication for several key transmitter operating parameters. The bar-graph is used to visualize the transmitter output power status. The LED's are bi-colored, yielding four possible states: Green, Red, Amber, or unlit. In general a green LED indicates a good or passing condition. Amber is a warning signal. Red indicates an out-of-limit or failure status. An unlit LED indicates a missing or non-applicable condition.

Tx: - Indicator will be green when the transmitter is commanded to enter the transmit mode. This is different than the actual on-air status, and indicates the desire for the transmitter to go on-air. For example, there may be a condition where the transmitter is placed in transmit mode but an out of tolerance condition prevents the on-air status.

Fdb: - Indicator is green when the RF feedback sample for linear/non-linear correction is within acceptable limits.

SFN: - Indicator is used to denote the MFN (multiple-frequency-network) or SFN (single-frequency-network) status for the exciter. The LED is unlit while in MFN mode. The LED is lit green while in SFN mode and lit red while in SFN mode if a valid transport stream or timing reference is missing.

Ref: - Green LED indicates that the onboard reference oscillator is locked to a valid input. This timing reference can be from the internal GPS receiver card or from an external GPS input. The LED will be amber during the internal GPS satellite acquisition mode and red if an invalid timing reference is detected. The transmitter will remain muted if the reference LED is not green, unless in MFN mode.

Note: SFN mode requires highly accurate timing stability and therefore, the modulator cannot be operated in an internal free-running clock mode, this option is only available while in MFN operation.

In1: - Normally green, this indicates presence of a valid ASI (or SMPTE310M) transport stream on input TS1. See inputs configuration menu, for further details on ASI setup.

In2: - Normally green, this indicates presence of a valid ASI (or SMPTE310M) transport stream on input TS2, unless the second input is not used, then this LED remains unlit. See inputs configuration menu, for further details on ASI setup.

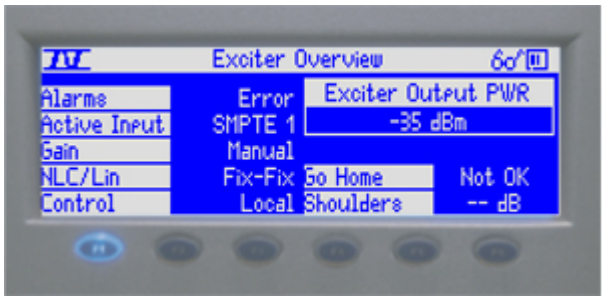
Rmt: - Green indicated the transmitter is in remote operation mode, note that the local MMI will not function while in remote mode. To access the transmitter menus locally, "Local" mode selection is required. This should always be returned to "Remote" mode prior to leaving the transmitter site. The mode is changed within the F3 power & control page menu.

Warning: All Ethernet connections must be removed from all exciters to ensure lockout of all remote control. When the exciter is in "Local" mode, all normal web page interface (ipaddress) commands are disabled. However, the commands from the special installation interface (ipaddress/ipaddress) remain active, even when the exciter is in "Local" mode. Be sure to disconnect Ethernet connections from the exciters whenever Local Only control is desired (i.e. during maintenance, servicing, etc.)

OnAir: - The green LED will flash on and off repeatedly when the exciter RF drive is enabled and the transmitter is on-air. The flashing is the result of a watchdog function, which indicates that the main software process is running within the exciter.

Function Key F1 Menus

Exciter Overview



The first page under the **F1** menu displays the transmitter overview. This screen provides the current status and mode for which the transmitter is operating. This is a status-only screen and no user adjustments are available. The transmitter overview screen functions are as follows:

Alarms: This is a general alarm and displays two possible messages: *OK* or *Error.* If *Error* is displayed the user should consult the current alarms page under the **F2** menu to diagnose the problem. *OK* indicates no alarms are present.

Active Input: Displays the active ASI transport stream

Gain: Indicates whether in manual gain control (MGC) or automatic gain control (ALC) mode.

NLC/Lin: Displays status of the Non-Linear precorrection (NLC) and Linear precorrection (Lin). An example might be *Adapt-Fixed*

Control: Can be local or remote mode.

Exciter Output PWR: Power output level at the RF out BNC connector located on the rear panel of the exciter

Go Home: This provides the service technician a quick indication of whether the transmitter has been left in a normal state prior to departing the site. It is a summation of on-air status and remote mode of operation.

Shoulders: Indicates the live shoulder level of the transmitter prior to the filter. This should be 36 dB minimum to meet FCC specification. Also, the sample comes from after the filter until such times as both feedback inputs are functional.

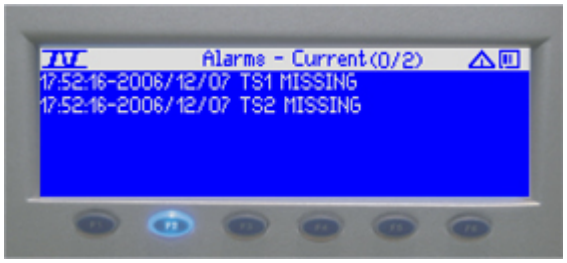
Software Versions

By pressing the F1 function key a second time, the current software and firmware versions of the Digital Board and TS Board installed within the exciter will be displayed.

Function Key F2 Menus

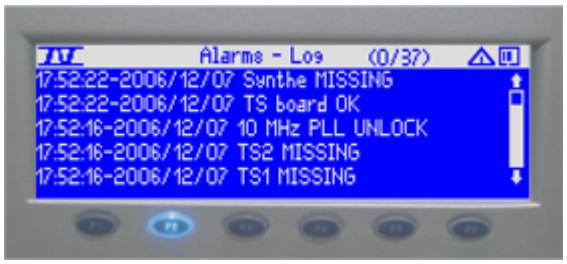
Alarms - Current

Within the F2 functions menu, current or active system alarms are displayed in chronological order upon the first press of the F2 button. There are numerous status alarms that can be displayed. The text descriptor is formatted for easy correlation to the fault or status condition being conveyed by the message.



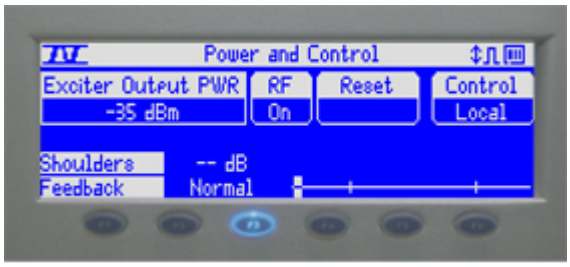
Alarms - Log

Selecting F2 again will toggle the display to the alarms log, which provides the history of events displayed in chronological order. Up to 1000 messages can be stored. If this number of records is exceeded, a first-in first-out (FIFO) approach is used. This log stores alarms, commands, and key status messages. Selecting the "C" clear button on the keypad will clear the log.



Function Key F3 Menus

Power and Control



The F3 menu is the first menu that has user controls; the first press of the F3 button displays the Power and Control page. The following controls are available:

Exciter Output PWR: Power output level at the RF out BNC connector located on the rear panel of the exciter.

RF: [Command] Allows user command to enable or disable RF drive power.

Reset: Not used for ATSC

Control: [Command] Allows exchange between local and remote control; while in remote the front panel commands are disabled with exception of this particular command. In contrast, while in local mode the remote web interface commands are unavailable.

Warning: All Ethernet connections must be removed from all exciters to ensure lockout of all remote control. When the exciter is in "Local" mode, all normal web page interface (ipaddress) commands are disabled. However, the commands from the special installation interface (ipaddress/ipaddress) remain active, even when the exciter is in "Local" mode. Be sure to disconnect Ethernet connections from the exciters whenever Local Only control is desired (i.e. during maintenance, servicing, etc.)

Shoulders: This is a repeated status of the shoulder level.

Feedback: This is a status indicator for the feedback level used for linear and non-linear precorrection. The slider bargraph provides a visual indication for the feedback level. The levels must be between the markers to allow the correction routine to work properly.

AGC Settings

Selecting F3 again will toggle the display to the AGC settings page:

Gain: [Command] User can toggle between MGC and AGC modes.

Limiter: [Command] This controls the "range" that the AGC can adjust within.

Attenuator: [Command] Controls the exciter output level. Useable range is between 0-20dB.

Set Reference: [Command] Sets and stores the AGC reference value; not used in MGC mode.

AGC Level: Displays AGC level; not used in MGC mode.

Reference: Displays AGC reference value; not used in MGC mode.

Exciter Lvl: Displays approximate exciter output level.

Image and LO Rejection

If the F3 function key is pressed a third time, the image and LO rejection control page is displayed. These controls are used to null the LO and image frequencies, the undesired products of the mixer stage. These are the results of the first upconversion stage within the transmitter used to convert the 27.5MHz IF to the UHF channel. A detailed procedure to accomplish the proper alignment of these parameters is outlined in the *ADAPT IV Installation Manual*.

Offset I: [Command] Used in conjunction with Offset Q to null the LO product.

Offset Q: [Command] Used in conjunction with Offset I to null the LO product.

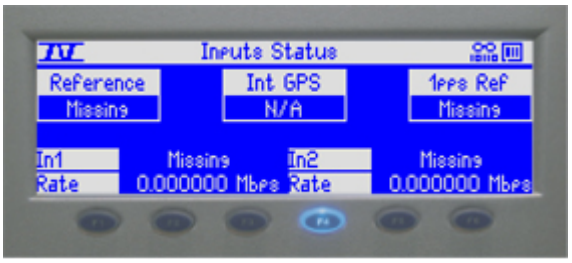
Gain: [Command] Used in conjunction with Phase to null the Image product.

Phase: [Command] Used in conjunction with Gain to null the Image product.

Save: [Command] The save button must be selected after any change to these values if the user desires that the values be retained in non-volatile memory after a power cycle.

Function Key F4 Menus

Inputs Status



The first page under the F4 function key depicts the input status of the exciter. These signals include the timing references and the transport stream inputs. The Inputs Status screen displays the following parameters:

Reference: Indication of 10MHz reference presence; this can normally be missing when an internal GPS card is used and selected. The internal GPS system uses an internally generated 1 pulse-per-second source to derive the 10MHz reference.

Int GPS: Displays critical status of the internal GPS, such as Antenna missing /faulted, satellite acquisition information, and all "OK" conditions. It remains N/A when an external input is selected and used.

1pps Ref: Indicates 1PPS presence from either the internal GPS or an externally supplied source.

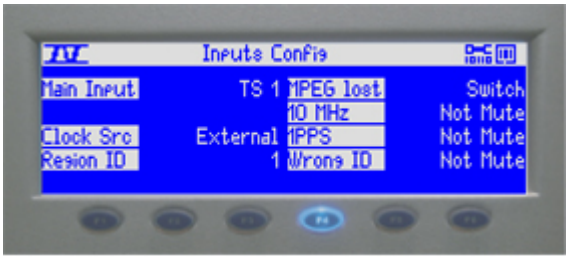
In1: Transport stream 1 status is displayed. This indicates ASI present, abnormal, or missing condition; these various states correspond with the LED display located on the front panel.

Rate: Displays the rate of the incoming stream for In1.

In2: Transport stream 2 status is displayed. This indicates ASI present, abnormal, or missing condition, these various states correspond with the LED display located on the front panel.

Rate: Displays the rate of the incoming stream for In2.

Input Config



The second page under F4 menu allows input configurations of the main MPEG input and clock sources. It also defines what actions will be taken in the event that one of these parameters falls outside the normal operating state.

Main input: [Command] allows the configuration of the primary input. If ASI 1 is selected as primary, then ASI 2 will act as a secondary input. If the primary feed is lost, an automatic switchover will occur (providing auto switching mode is selected). ASI 2 can also be selected as the primary input. If only one input will be used, the user should select ASI 1 only or ASI 2 only so that the error message warning for the missing transport stream will not occur. Manually selecting ASI 1 or ASI2 will set the selection as the active input.

Clock Src: [Command] User can select between internal GPS, External GPS, or internal OCXO modes. The internal OCXO mode is only available in MFN mode.

Region ID: [Command] User will set the appropriate region; this requires the inclusion of a number (1-255) within the transport stream uplink. When the exciter reads this information it will take appropriate action allowing only the proper region content to be emitted on-air. This action is dependant on the setting in Wrong ID

MPEG lost: [Command] Allows selection to mute on loss of ASI stream or output a PRBS test pattern, or switch to the reserve exciter.

10 MHz: [Command] May be set to mute the exciter output when missing 10MHz input, or provides for a no-muting option.

Wrong ID: [Command] May be set to mute the exciter output when a wrong region ID is sensed, or provides for a no-muting option.

1PPS Mute Delay: [Command] (Feature dependent, available on future software release) this is a GPS holdover feature. If the GPS loses satellite acquisition, the exciter can default to a free-running mode of operation. This feature allows for a holdover period to prevent an off-air condition. The mute delay allows the exciter to remain on-air in the free-running state for a specified time and will mute the RF output after the allotted time. The length of time can be varied in units of hours; the drift rate of the internal OXCO determines the ultimate value. Four hours roughly guarantees that the timing drift will not exceed 10☐s.

10 MHz Tuning

When F4 is pressed a third time the menu for 10MHz tuning is displayed. This menu displays status regarding the onboard reference source / PLL system. PLL adjustment is mostly used when both internal and external clock sources are missing, and the modulator is defaulted back to the internal OCXO.

Reference: This indicator differs from the other reference status; it specifically indicates the condition of the PLL system, which locks the onboard 10MHz OCXO clock source. This status also correlates to the Ref LED located on the front panel.

Mode: Indicates the capture mode for the internal PLL system. The value will increment between zero and nine with nine being the most stabile state of the system.

Int GPS: Same as above, this displays critical status of the internal GPS, such as Antenna missing /faulted, satellite acquisition information, and all "OK" conditions. It remains N/A when an external input is selected and used.

Ext 10 MHz: Indication of external 10MHz reference presence. This can normally be absent when internal GPS card is used and selected. The internal system uses the GPS internally generated 1 pulse-per-second to derive the 10MHz reference.

Ext 1PPS: Indicates 1PPS presence from externally supplied source.

PLL Adjustment: [Status/Command] displays the control value applied to the internal OCXO PLL system, this command can also be used to fine tune the OCXO frequency when in a free-running mode. Manual tuning the internal OCXO is only available in MFN operation. It is important to save this value, see Save Command

Clock Src: [Command] same as above; the user can select between internal GPS, External GPS, or internal OCXO modes. The internal OCXO mode is only available in MFN mode.

Save: [Command] this command must be used when manually tuning the OXCO frequency in internal clock source mode or after 30-minutes of external or internal GPS runtime with successful satellite lock. Once the proper value is set to align the frequency, save must be selected so the initial value will be retained in non-volatile memory after a power cycle. This improves startup time.

Function Key F5 Menus

Non-Linear Precorrection

The first menu within F5 function key is Non-Linear Precorrection. This allows compensation of the non-linear distortions that occur when maximizing the output power and efficiency of the power amplifier stages. This compensation is performed digitally by processing a feedback sample taken from the transmitter output, which has been down-converted and brought IF for digital signal processing.

NLC: [Command] Non-linear correction, the selections available are: Fixed mode manually initiated single passes of correction, Adaptive mode automatic correction if required by the limits set in the correction menu, and Flat mode no correction.

Clip: [Command] Allows a peak clipping table to be applied; can be helpful when correcting non-linear distortion on a demanding system.

Mem: [Command] Up to five fixed precorrection curves can be store in memory (not operational in current version).

One Shot: [Command] The one-shot command applies one-iteration of the adaptive precorrection algorithm. In most cases this command should be repeated more than once for optimum results.

Clear: [Command] applies a flat precorrection curve to the system.

Save: [Command] saves the current precorrection file to the specified memory location.

NLC/Lin: Provides mode status for non-linear precorrection and linear precorrection respectively.

Shoulders: Indicates the live shoulder level of the transmitter prior to the filter. This should be 36 dB minimum to meet FCC specification. Also, the sample comes from after the filter until such times as both feedback inputs are functional.

Feedback: This is a status indicator of the feedback level used for the precorrector. The slider bar graph provides visual indication of feedback level. This level should remain at approximately 75% of the graph for best performance.

Linear Precorrection

This menu is displayed when the F5 button is pressed twice. It is nearly identical in operation to the non-linear correction menu described above. Linear correction is currently operated in a fixed mode. This means that the linear coefficient table is preloaded at factory to correct for the channel filters frequency response and group delay. Although the fixed mode operation is sufficiently adequate over long-term operation, adaptive linear processing is incorporated allowing a digital signal-processing algorithm to compensate for linear distortions within the system. This requires that the feedback sample be taken after the filter. In today's system, this is typically done in a temporary fashion, where the technician moves the feedback sample from before the filter (needed for NLC) to after the filter. The system is allowed to run in linear adaptive mode for several passes then placed back into fixed mode. This allows automation of linear pre-distortion process. Since NLC is more dynamic, it is given higher priority and therefore the feedback sample remains prior to the filter. In future systems, there will be independent feedback inputs to support both linear and non-linear function simultaneously.

Correction Thresholds Config

This menu is displayed when the F5 button is pressed three times. It allows threshold configuration of various RF alarms.

Shoulder Limit: [Command] this is a target value for the adaptive non-linear precorrection algorithm to achieve; it should be set to an achievable limit to prevent divergence over time. The process will first attempt to achieve the best possible correction, so it is possible to see the shoulder level exceed this value. However, the digital signal processing will not restart until this target value is breeched.

Ripple Limit: [Command] this is a target value for the adaptive linear precorrection algorithm to achieve; it should be set to an achievable limit (typically 0.2dB).

Shoulders: indicates the live shoulder level of the transmitter prior to the filter. This value should be greater than 32dB at all times and typically is 35dB or greater. Consult the transmitters correction procedures found later in this section of the manual.

Feedback: This is a status indicator of the feedback level used for non-linear precorrection. The slider bar graph gives a visual indication of feedback level as well. This level should remain at approximately 75% of the graph for best performance.

RF High Alarm: [Command] a threshold setting for RF power high alarm.

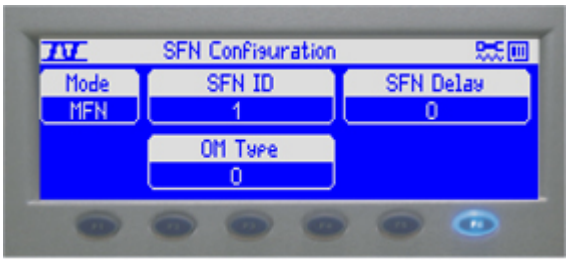
RF Low Alarm: [Command] a threshold setting for RF power low alarm.

RF Fault: [Command] a threshold setting for RF power fault alarm.

Shoulder Alarm: [Command] a threshold setting for shoulder level limits alarm.

Function Key F6 Menus

SFN Configuration



The second time the F6 button is pressed will yield the SFN configuration settings page.

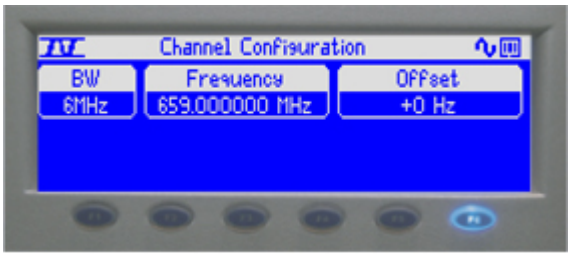
Mode: [Command] SFN or MFN mode selection.

SFN ID: [Command] Not used for ATSC.

SFN Delay: [Command] Not used for ATSC

OM Type: [Command] Not used for ATSC

Channel Configuration



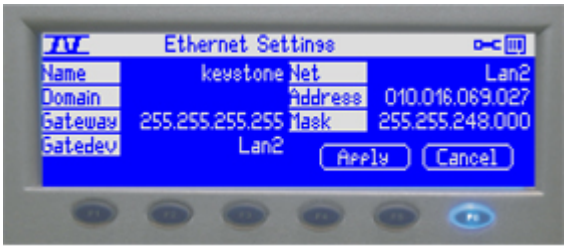
The third time the F6 button is pressed will yield the Channel configuration settings page.

BW: [Command] sets channel bandwidth frequency for 6MHz

Frequency: [Command] sets UHF channel frequency (1Hz resolution)

Offset: [Command] precision offset; allows fine frequency offsets in 1 Hz steps; typically set to 0Hz in SFN operation.

Ethernet Settings



The forth time the F6 button is pressed will yield the Ethernet settings page. Note the exciter must be rebooted if any network setting is changed. The change will not take affect until the unit has rebooted.

Name: [Command] allows the setting of a unit name; the default name is "keystone" which describes the exciter hardware platform.

Domain: [Command] allows domain name specification

Gateway: [Command] this allows the setting of the default gateway; typically it is set to the IP address of the local site management system or router.

Gatedev: [Command] Specifies the Ethernet connection (LAN 1, 2 or 3) to which the default gateway is applied.

Net: [Command] The Exciter platform supports multiple Ethernet networks, LAN1 is a dedicated local transmitter network typically used with a dual-drive controller system or other local device; LAN2 is the remote network connection and is the typical user interface; LAN3 is an auxiliary network interface. Once the network setting is selected, the Address, mask, and gateway settings are active for the network selected.

Address: [Command] allows IP address setting for the corresponding network. i.e. LAN2

Mask: [Command] allows the subnet mask setting for the corresponding network. i.e. LAN2; typically 255.255.255.240

Apply: [Command] Stores the desired settings in memory; if these are not applied, the settings will revert back to the values previously stored in memory. The exciter must be rebooted to complete any network setting change.

Cancel: [Command] Cancels any current selections, and reverts to previously stored values

Exciter Remote User Interface

Note: The Web interfaces are not fully ATSC compliant at this time. An update will be forthcoming to make all web pages fully ATSC functional.

Summary of Web Interfaces built into the ADAPT IV Exciter:

http://ipaddress – Main supervision page (All screens not currently updated to support ATSC). On/Off Control, Status Monitoring, Linear and Non-Linear Corrections, etc.)

http://ipaddress/update - Page for updating all exciter components with a single file. This is the preferred method for upgrades in the field.

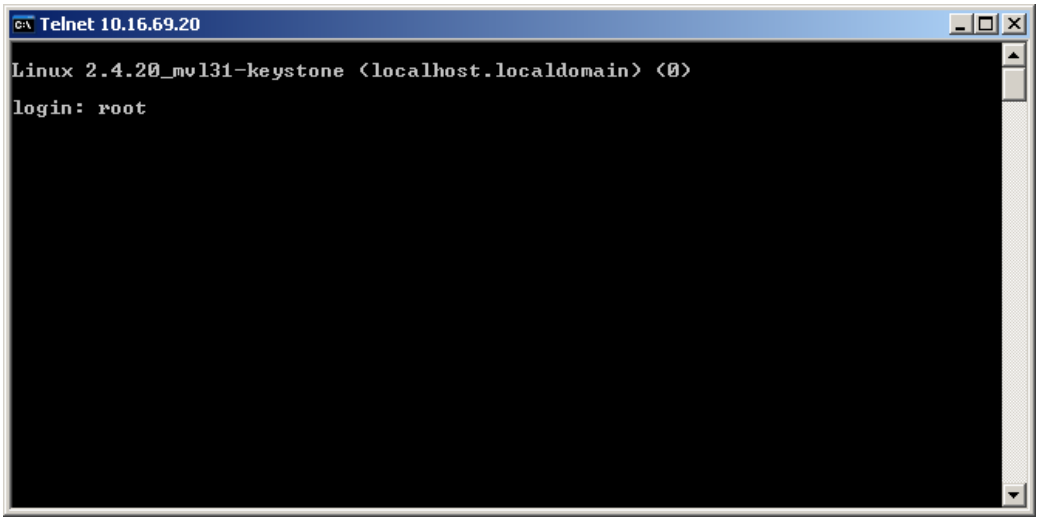
http://ipaddress/install - For installation setup (change freq, modulation type, MGC levels, Image and LO rejection, feedback measurement, etc..)

Warning: All Ethernet connections must be removed from all exciters to ensure lockout of all remote control. When the exciter is in "Local" mode, all normal web page interface (ipaddress) commands are disabled. However, the commands from the special installation interface (ipaddress/ipaddress) remain active, even when the exciter is in "Local" mode. Be sure to disconnect Ethernet connections from the exciters whenever Local Only control is desired (i.e. during maintenance, servicing, etc.)

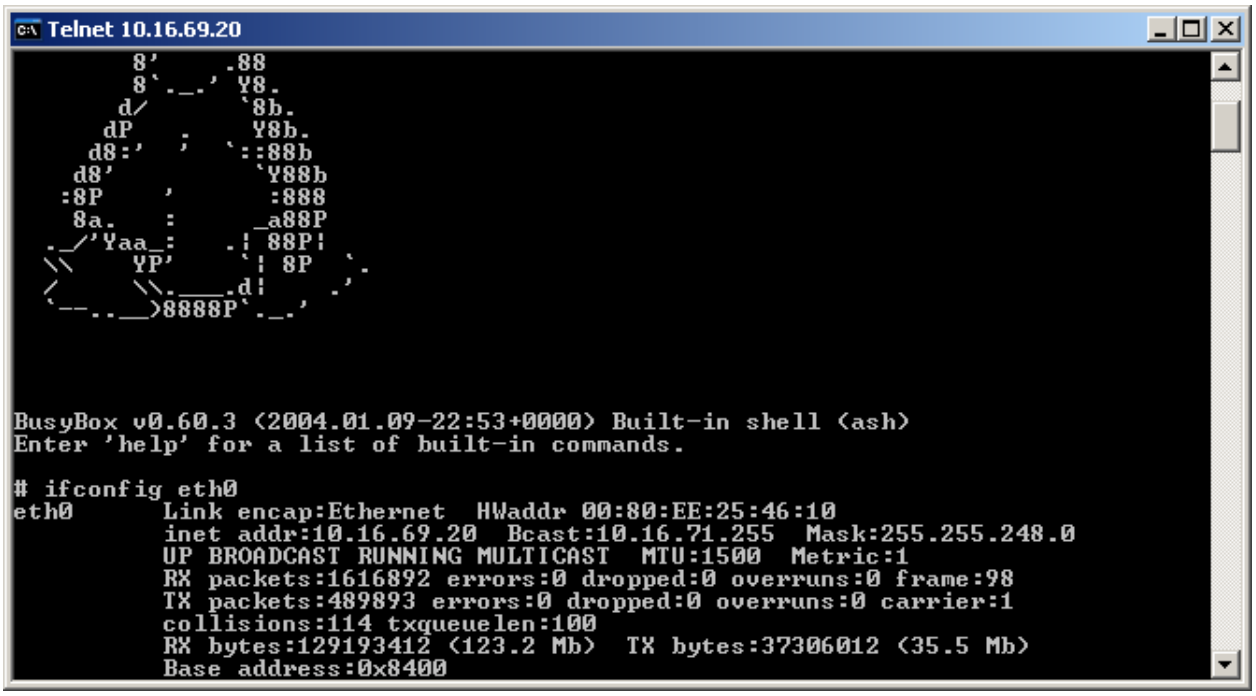
The Thales Sirius exciter may be remotely accessed for control and status monitoring via its built-in web interfaces. Follow the steps below to gain web page access to the exciter.

Gaining remote web access to the exciter—Setup:

a. Network a PC to the exciter via its back panel LAN2 Ethernet port connection (use a hub or a direct exciter-to-PC connection via an Ethernet cross-over cable). You can view and modify the LAN2 Ethernet IP address (factory default 192.168.0.1) via menu 6 on the front panel. If you don't have a graphical front panel (you can learn the IP address of the LAN2 rear panel connection via a 9600 Baud Hyperterm session to the front port serial connector. Cycle power on the exciter and let it boot all the way up. Then, press the "return" key in the Hyperterm session to arrive at the login prompt below. Type "root" to login.



You'll see the Linux penguin and the prompt as shown below. Type "ifconfig eth0" to learn the IP address of the LAN2 port (which is 10.16.69.20 in the example screen below).

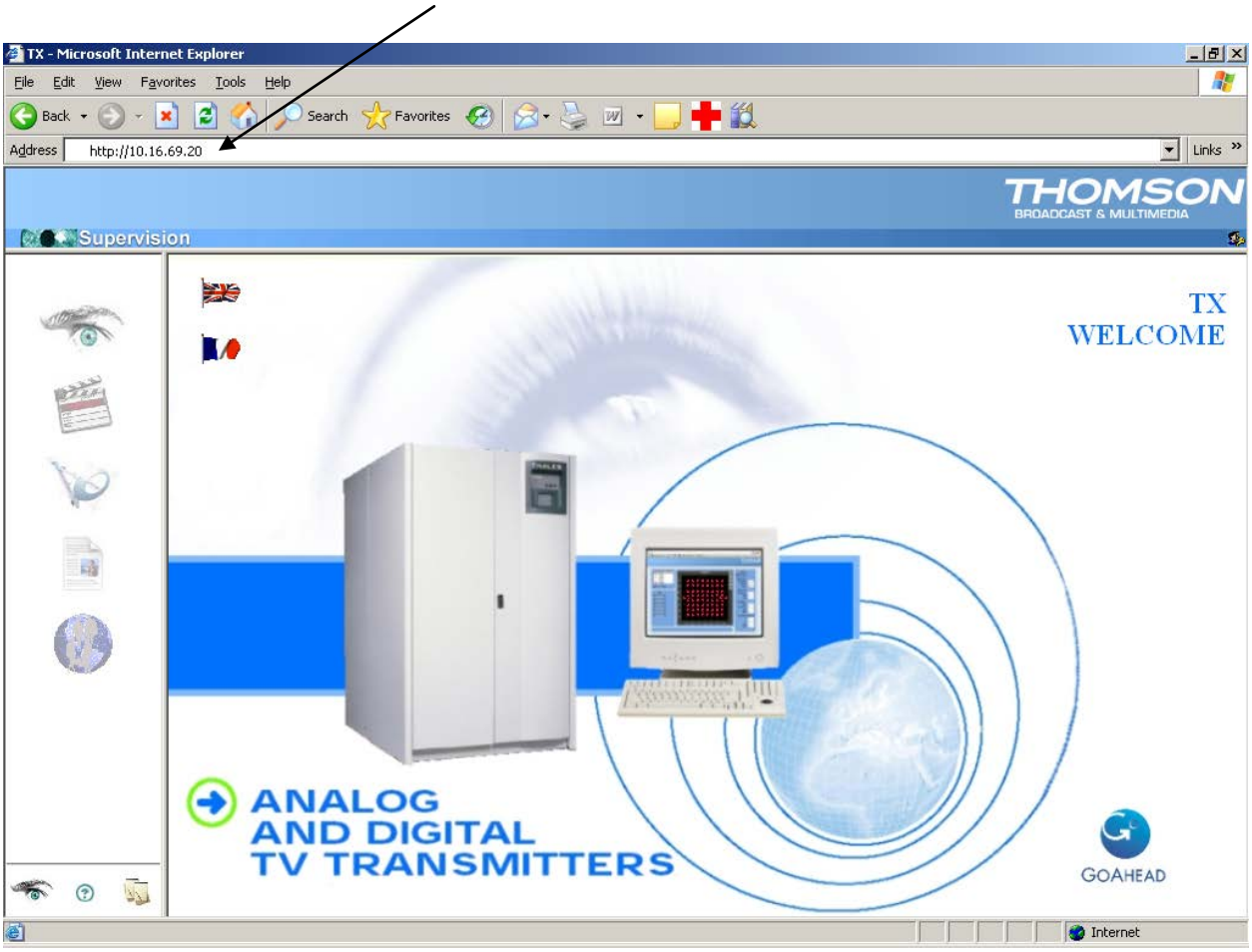


b. You can change this IP address by typing the following command. (Note: Alternatively, you could change the IP address of your computer to network to the exciter → choose a static IP address that is one off from the exciter with a proper subnet mask – in our example, you could set your PC IP address to 10.16.69.21 with a mask of 255.255.255.0)
    a. set_eth0 IP address subnet mask (example: set_eth0 192.168.0.12 255.255.255.0)

c. Once physical connections are made between exciter LAN2 and your PCs NIC, attempt to "ping" the exciter from the PC with the DOS prompt command → ping 10.16.69.20. Check connections if ping is unsuccessful.

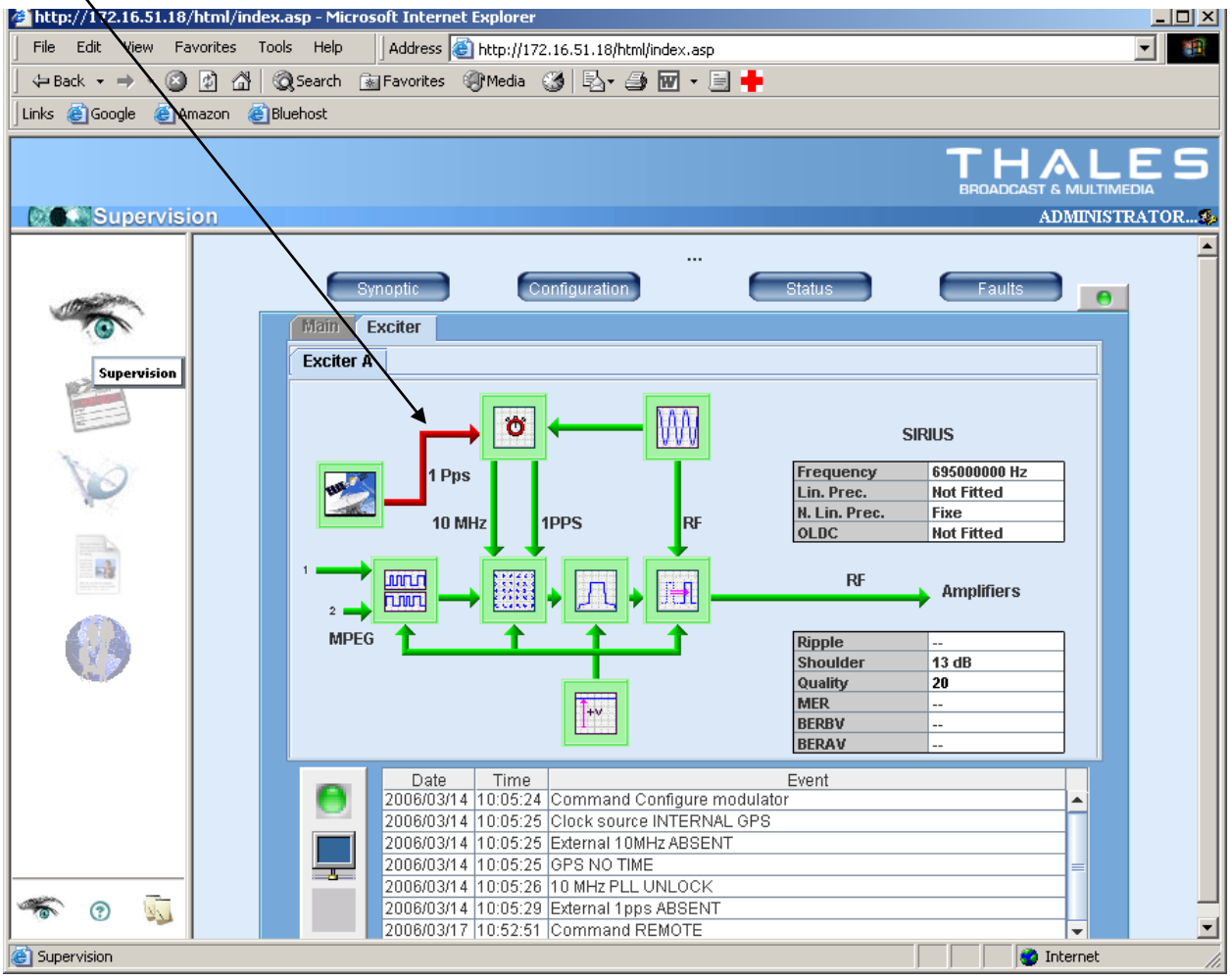
Launching the Web Interface:

a. Launch a web browser on your PC, such as Internet Explorer or Firefox, and type the exciter IP address into the URL, to arrive at the main web page shown below. Click on the various options to gain access to different functionality. (Note: some pages will show DVBT information that is not a valid. A forthcoming software release will remedy this situation.)

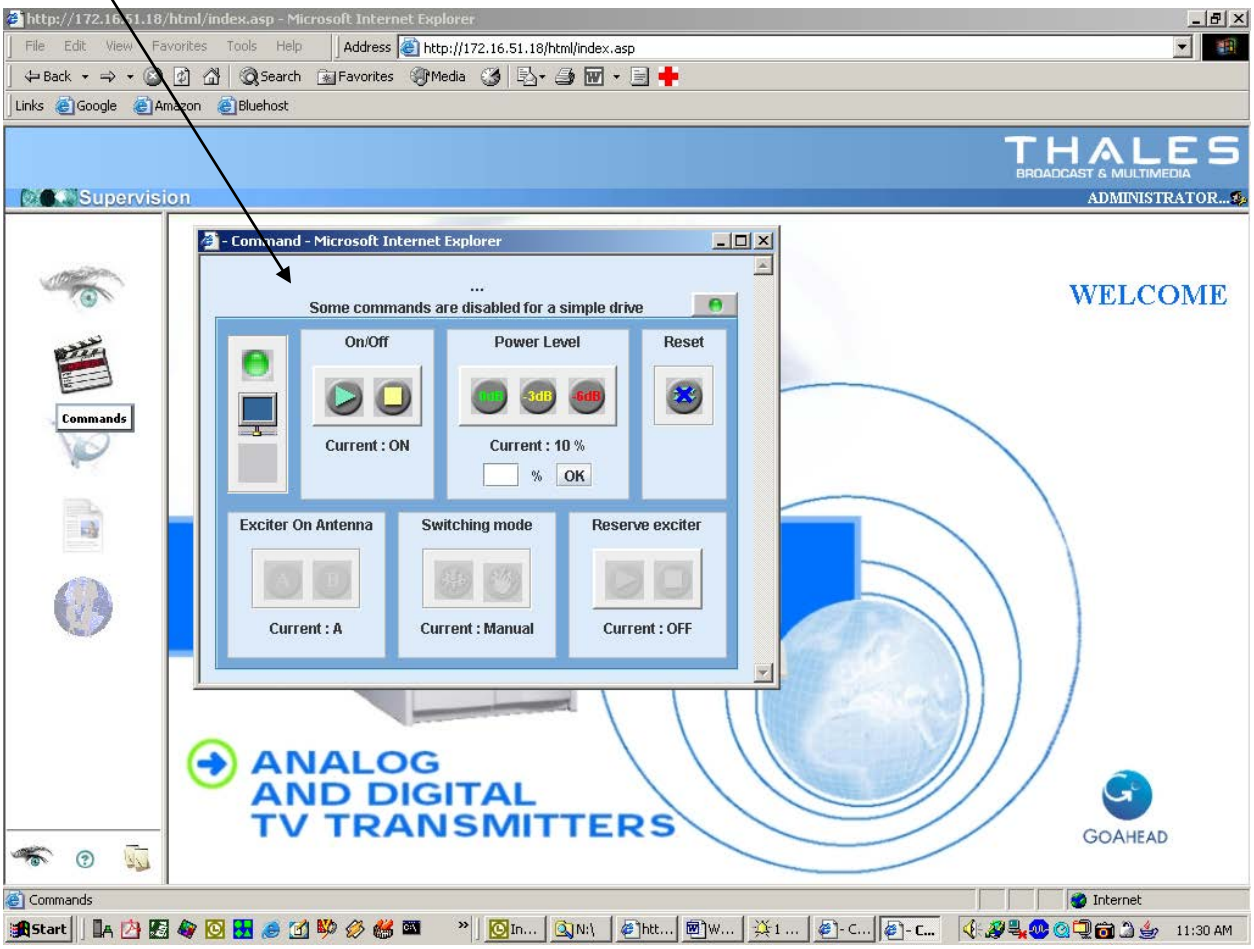


Navigating the Main Web Page:

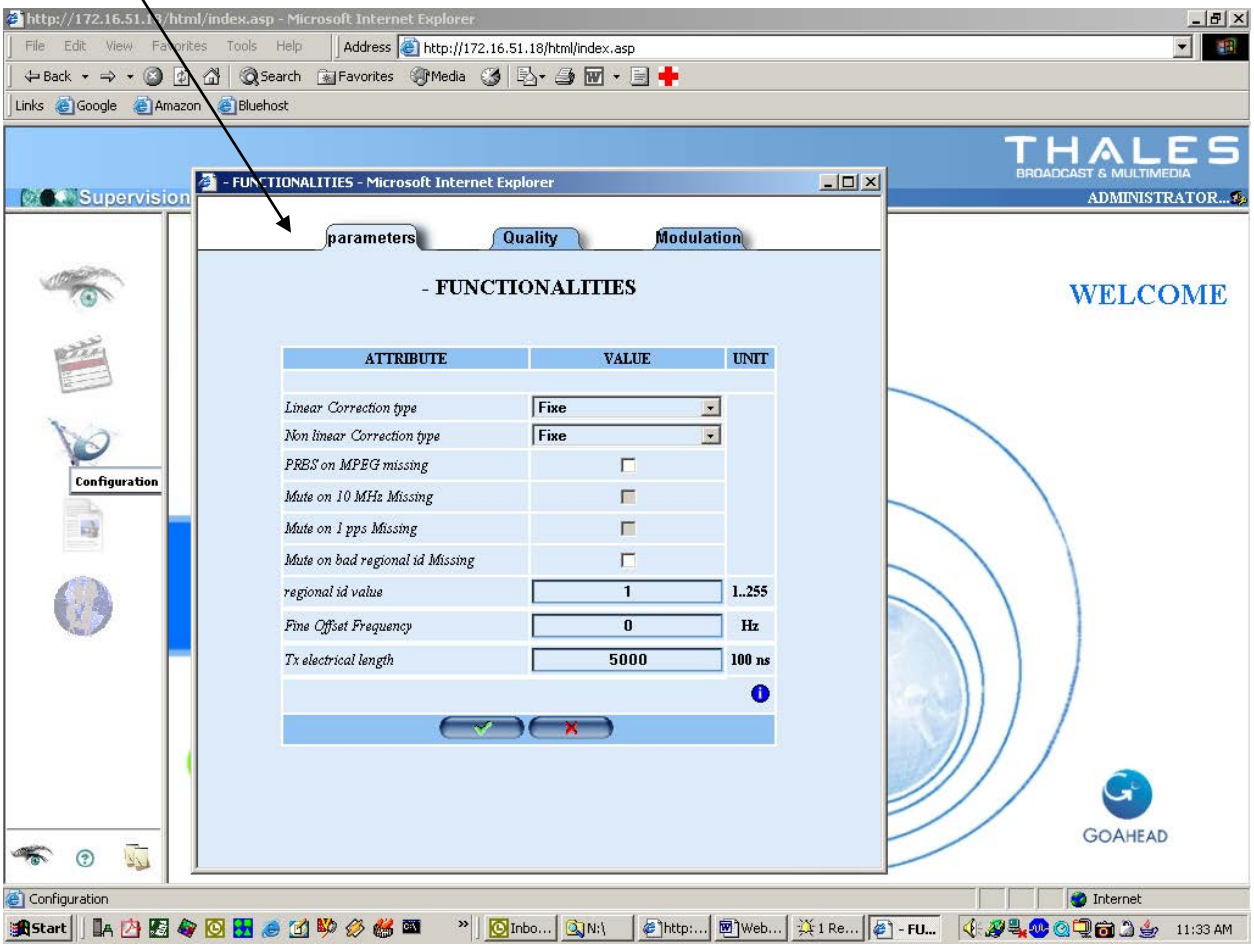
Supervision – Web pages provide summary of exciter configuration, status and faults. Note the RED signal flow below tells us we do not have a valid 1PPS external input to the exciter.



Commands – Web page provides on/off, power level, reset and exciter system level controls.

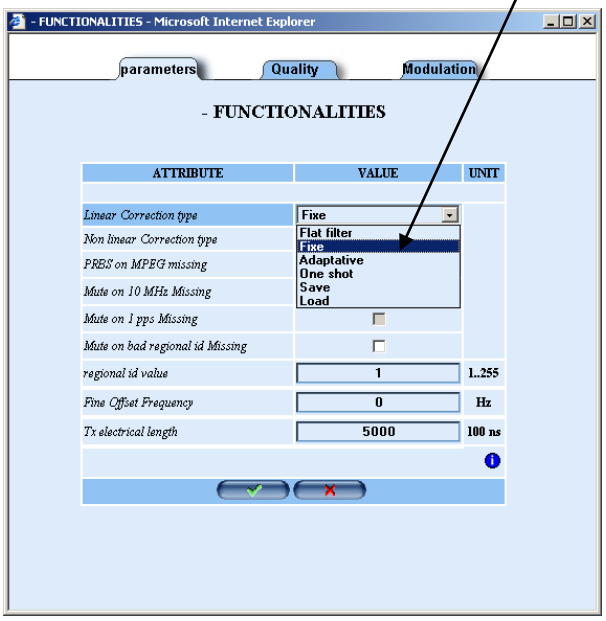


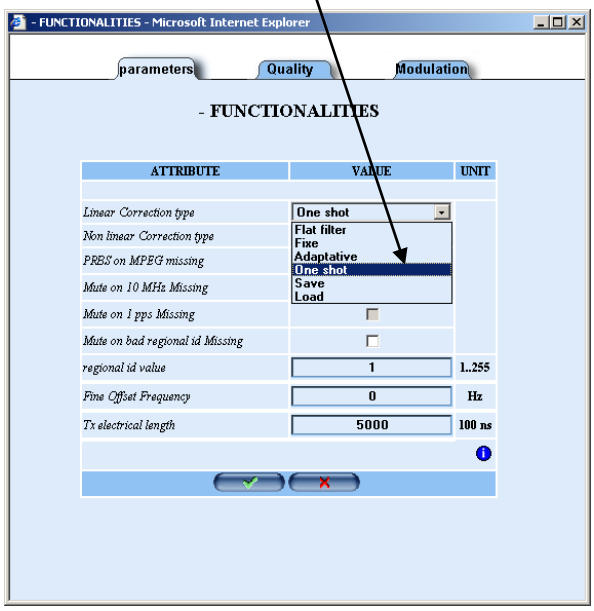
Configuration – Web pages provide means to run correction, set the automatic quality levels, and configure the detail of the modulation selected.



Configuration (cont)

The ***Parameters*** tab provides an interface to run correction. The examples below represent the commands to put the *linear* corrector into *fixed mode*, and then run a *one-shot* (a single computation and application of linear equalizer coefficients to compensate for linear distortion).



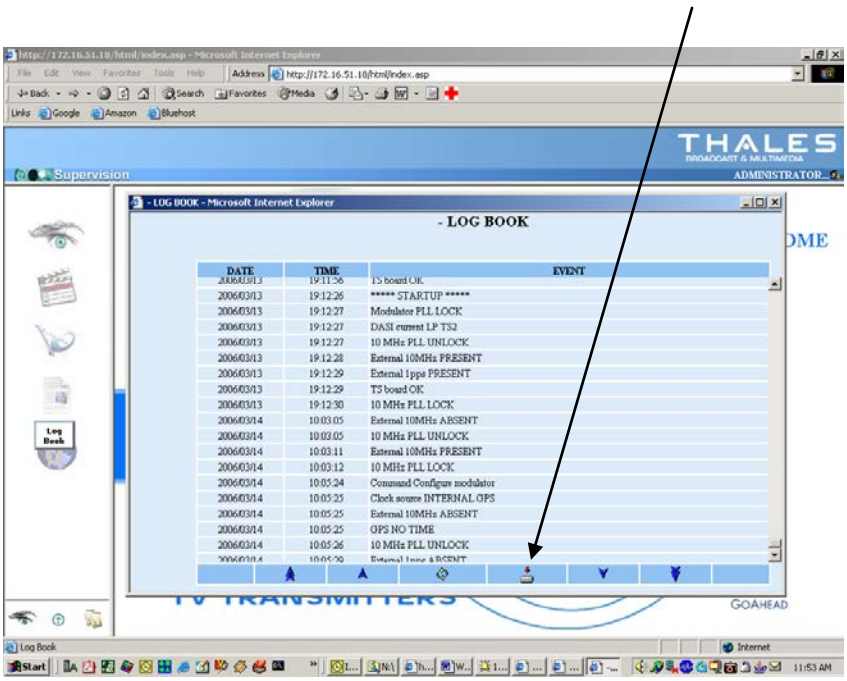


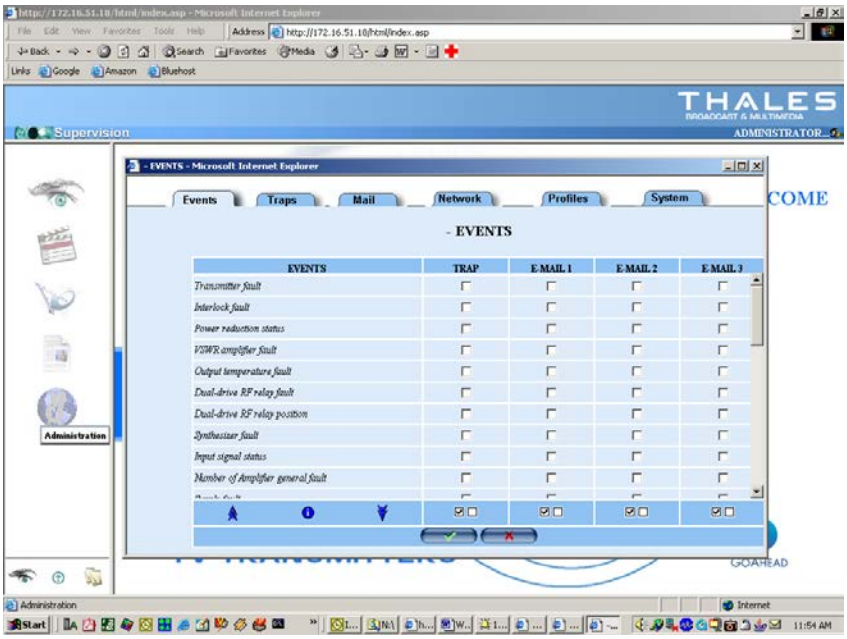
Command	Action
Flat Filter	Clears linear correction (sets coefficients to zero = no filtering)
Fixed	Fixed mode – correction does not change
Adaptive	Adaptive Mode – correction is automatically updated
One Shot	Algorithm computes correction and applies it once
Save	Correction parameters saved to non-volatile memory
Load	Loads previously saved correction parameters from memory

Configuration (cont)

The ***Quality*** tab provides an interface to set RF alarm levels as well as Adaptive correction Ripple and Shoulder target levels. The example below shows a target of 35db shoulders for Adaptive Non-linear correction. Thus, Adaptive Nonlinear correction will continue to run until 35 db shoulder levels are achieved. To make Adaptive run indefinitely, set this to an unattainable value, such as 100. (Note: Disregard all information under the "Modulation" tab, as it reflects DVBT and has not yet been updated for ATSC.)

The Main web page also provides an event *Log Book* and an *Administration* page as shown below. Click this icon to download the log book to a file.

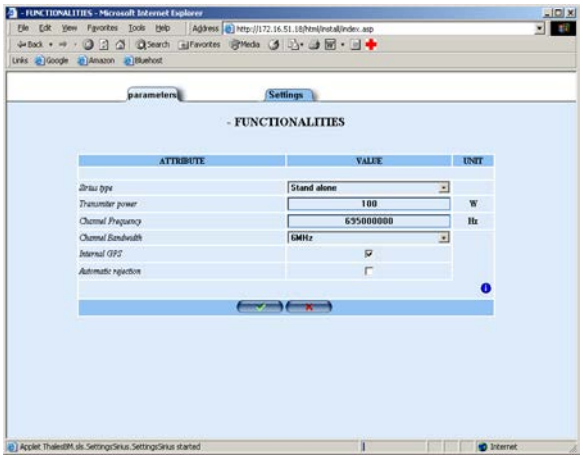


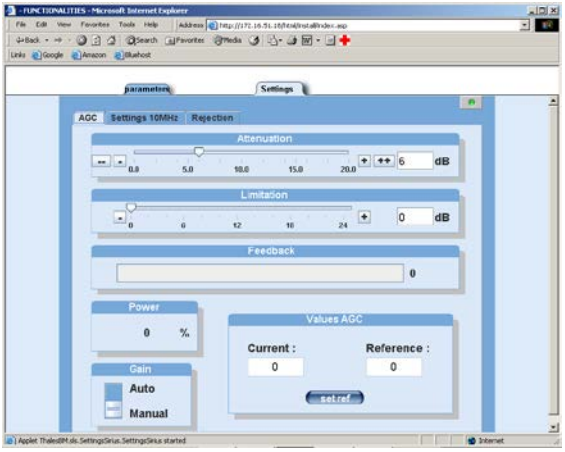


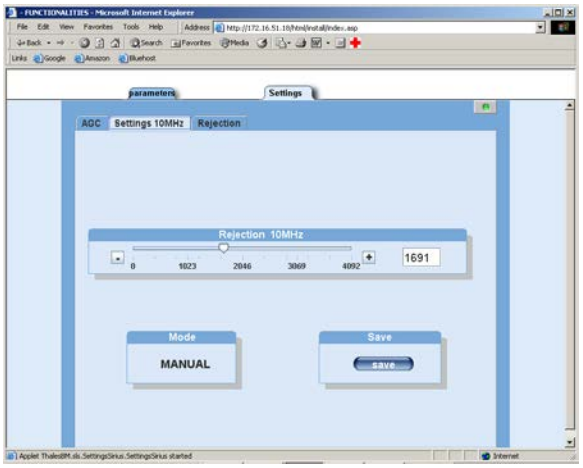
In addition to the Main Web Page (accessed at the exciter IP address), there are two additional web interfaces used for configuration during installaion. The first is the exciter installation (setup and configuration page) accessed at IP address/install, and the other is the Software Update page accessed at IP address/update.

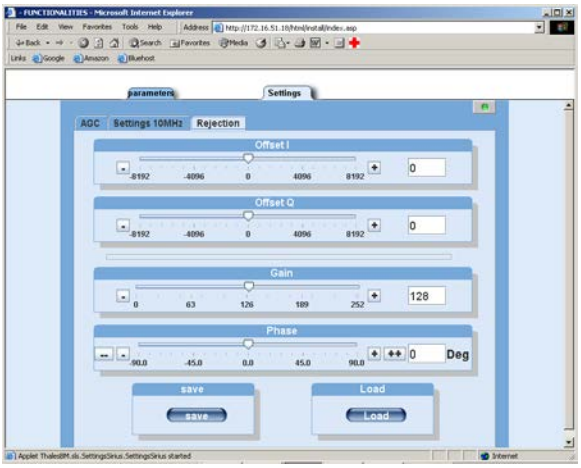
IP address/install : For installation setup (change freq, modulation type, MGC levels, AGC reference, perform Image and LO rejection, monitor feedback level, etc.)

Warning: All Ethernet connections must be removed from all exciters to ensure lockout of all remote control. When the exciter is in "Local" mode, all normal web page interface (ipaddress) commands are disabled. However, the commands from the special installation interface (ipaddress/ipaddress) remain active, even when the exciter is in "Local" mode. Be sure to disconnect Ethernet connections from the exciters whenever Local Only control is desired (i.e. during maintenance, servicing, etc.)

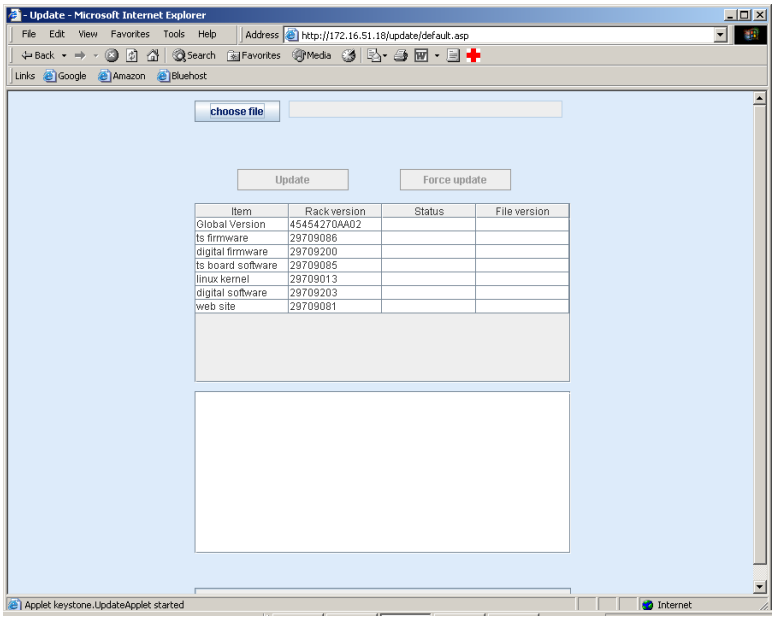








IP address/update – To check software and firmware versions and perform remote upgrades



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