RFM220
ISDB-Tb Measurement Demodulator
Specifications and Performance Verification

Technical Reference

077-0565-00

Tektronix

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This document applies to firmware version 1.0.

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- Worldwide, visit www.tektronix.com to find contacts in your area.

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

Use proper power cord. Use only the power cord specified for this product and certified for the country of use.

Ground the product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Power disconnect. The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

Do not operate without covers. Do not operate this product with covers or panels removed.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Use proper fuse. Use only the fuse type and rating specified for this product.

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.

Provide proper ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Terms in This Manual

These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

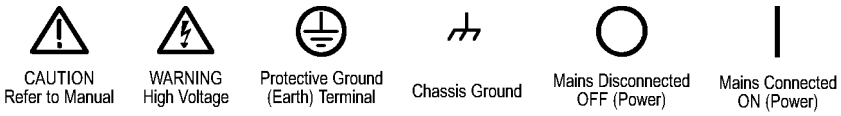
CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Symbols and Terms on the Product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

The following symbol(s) may appear on the product:



Preface

This manual contains the following information about the RFM220 ISDB-Tb Measurement Demodulator:

- *Specifications* lists the electrical, physical, and environmental specifications of the demodulator.
- *Performance Verification* contains a procedure to verify that the demodulator is operating normally.

Product Documentation

Table i lists the product documentation supporting the ISDB-Tb demodulator.

Table i: Product documentation

Item (Tektronix part number)	Purpose
RFM220 User Manual (071-2896-XX)	Provides installation and operational overviews
RFM220 Specifications and Performance Verification Technical Reference (077-0565-XX)	Provides complete product specifications and a procedure for verifying the operation of the instrument (this document)
RFM220 Declassification and Security Instructions (077-0567-XX)	Provides instructions for removing your proprietary information from the instrument
RFM220 Software License Notices Reference (001-1581-XX)	Provides the software licenses that cover the RFM220 software

Specifications

This section lists the electrical, environmental, and physical specifications of the RFM220 demodulator. All specifications are guaranteed unless labeled typical. Typical specifications are provided for your convenience and are not guaranteed. Electrical characteristics apply to test systems operating within the environmental conditions.

Electrical, Hardware, and Signal Specifications

Table 1: RFM220 Aggregator platform requirements

Characteristic	Description
Processor	Minimum: Commonly available dual-core system; for example, Intel Core 2 Duo CPU @ 2.66 GHz or similar Preferred: Commonly available quad-core system; For example, Intel Xeon CPU E5420 @ 2.5 GHz or similar
Operating System	Minimum: Microsoft Windows XP Pro or Windows 7 Preferred: Windows 7 with 64 bits
Disk Space	Minimum: 120 MB free disk space
RAM	4 GB
Ethernet	Dual 1 Gigabit interfaces

Table 2: RFM220 Client platform requirements

Characteristic	Description
Processor	Minimum: Commonly available dual-core system: For example, Intel Pentium D CPU @ 3.2 GHz or similar
Operating System	Microsoft Windows XP Pro or Windows 7
Disk Space	120 MB free disk space
RAM	4 GB
Ethernet	1 Gigabit interface
Display	1024 x 768 pixel or higher resolution
Installed Software	Microsoft .NET Framework 3.5 with Service Pack 1

Table 3: RF characteristics

Characteristic	Typical value
RF standard	ISDB-Tb
RF input connector	N type, 50Ω
RF input frequency range	VHF: 171 to 230 MHz UHF: 470 to 862 MHz
Frequency step	1 Hz
Frequency offset recovery	±50 kHz for fine MER and shoulder; ±340 kHz for demod, coarse MER, and SNR
Channel bandwidth	6 MHz
Input signal amplitude range	–90 to –30 dBm for a BER of <1e^{-4} 0 dBm maximum to avoid damage –40 to –20 dBm for best measurement performance
Noise figure	12 dB
Return loss	>13 dB
Adjacent channel rejection	Analog: >35 dB; Digital: >30 dB for receiver use case (not for fine measurement)
Demodulation format	ISDB-Tb, all modes except DQPSK

Table 4: Measurements

Characteristic	Typical value
Full band input level	–50 to –10 dBm Resolution: 0.1 dB Accuracy: ±1.5 dB
Channel input level	–90 to –30 dBm Resolution: 0.1 dB Accuracy: ±3 dB
Fine MER (Modulation Error Ratio)	Display range: 28 dB to at least 36 dB for input level from –40 dBm to –20 dBm with high quality signal (no echo, no Doppler, limited noise); up to 28 dB if input level is from –90 dBm to –30 dBm in Coarse mode Resolution: 0.1 dB Fine MER Accuracy: ±1.5 dB
C/N (Carrier to Noise Ratio)	Display range: 0 to 28 dB for input level from –50 dBm to –30 dBm Resolution: 1 dB
BER at Viterbi output accuracy (pre-Reed Solomon)	$1/10^8$
PER (Packet Error Rate) accuracy	1/frame
Constellation display	1,024 points Global (merged), layer A, layer B, layer C
Delay profile display	2048 points in Mode 1, 4096 points in Mode 2, 8191 points in Mode 3 Display over 252 µs in Mode 1, 504 µs in Mode 2, 1008 µs in Mode 3
Spectrum display	2,048 points of scale of 256
Left and right shoulders	44 dB maximum Resolution: 0.1 dB Accuracy: ±2 dB

Table 5: ASI input

Characteristic	Typical value
Format	DVB-ASI Mode: Burst or continuous (Packet)
Connector	BNC, 75Ω
Packet size	188 or 204 bytes
Maximum useful bit rate	50 Mbps
Maximum input jitter	±10 µs

Table 6: ASI output

Characteristic	Typical value
Format	DVB-ASI Mode: Continuous (Packet)
Connector	BNC, 75Ω
Packet size	188 or 204 bytes (ASI In source) Output format identical to input format
Maximum useful bit rate	50 Mbps
Maximum output jitter	±100 ms

Table 7: Clocks and synchronization

Characteristic	Typical value
Internal 10 MHz clock	Stability: ±2.5 ppm, 0 °C to 50 °C
External 10 MHz reference input	Connector: BNC, 50Ω Frequency: 10 MHz Level: 0 to +10 dBm recommended, typically will work from –15 dBm to +15 dBm

Table 8: Control

Characteristic	Typical value
RS-232	Baud rate: 9,600 to 115,200 (default 57,600) Data: 8 bits Stop bit: 1 STOP bit Parity: No parity bit Connector: MiniConnect for RS-232
Ethernet	10/100/1000 Base-T

Table 9: Default configuration [1]

Parameter	Setting
Address of the module	0x11
Channel bandwidth	6 MHz
Default frequency	665 142 857 Hz
TS input	Enabled
Right and left shoulder distance	3.15 MHz
TS output source	RF
Control port IP configuration	MAC: module unique address Address: 192.168.0.209 Mask: 255.255.255.0 Gateway: 192.168.0.254

1 See default values of registers in API for complete information.

Power Source Characteristics

Table 10: AC power source

Characteristic	Typical value
Source voltage	100 to 240 V_{AC}, fluctuations must not exceed ±10% of the nominal rate voltage
Frequency range	50/60 Hz
Power consumption	0.6 A maximum, 100-240 V, 50/60 Hz, single phase
Peak inrush current	1 A peak at 240 V_{AC}, 50 Hz
Fuse rating	2 A, 250 V, delay fuse, internal (not operator replaceable). Refer servicing to qualified service personnel.

Mechanical (Physical) Characteristics

Table 11: Mechanical characteristics

Characteristic	Description
Classification	Transportable platform, 1RU high Rack mounting is possible with this instrument: a. Use appropriate hardware to secure the front face plate of the instrument to the rack, restraining the cantilevered mass of the instrument. b. Use a rack shelf to support the instrument.
Overall Dimensions	Height: 45 mm (1.77 in) (1RU) Width: 495 mm (19.49 in) including the ears Depth: 352.2 mm (13.87 in)
Cooling air flow	Air intake is from the left side of the instrument, and exhaust is to the right side of the instrument. For proper cooling, at least two inches (51 mm) of clearance is needed on both sides of the instrument cabinet.
Weight	6.4 kg (14.1 lbs)
Shipping weight	9.4 kg (20.7 lbs)

Environmental Characteristics

Table 12: Environmental characteristics

Characteristic	Description
Temperature	Operating: +5 °C to +40 °C, 30 °C per hour maximum gradient, temperature of the intake air at the front and sides of the instrument Nonoperating: –20 °C to +60 °C, 30 °C per hour maximum gradient
Humidity	Operating: 20% to 80% relative humidity, noncondensing Nonoperating: 10% to 80% relative humidity, noncondensing
Altitude	Operating: 0 to 3,000 m (9,800 ft.) Nonoperating: 0 to 12,000 m (40,000 ft.)
Random vibration	Operating: 0.27 g_{RMS} total from 5 to 500 Hz Nonoperating: 2.28 g_{RMS} total from 5 to 500 Hz
Sine vibration	Operating: 0.013 in. peak-to-peak displacement 5 to 55 Hz
Functional shock	Nonoperating: 30 g, 11 ms half-sine

Performance Verification

Use the procedure in this section to verify that the RFM220 instrument is operating properly.

This procedure checks the Processing block in RFM220 module. (See Figure 1.) Although this procedure does not cover all of the major hardware inside the chassis, it provides good a indication of which component should be replaced in case of instrument failure.

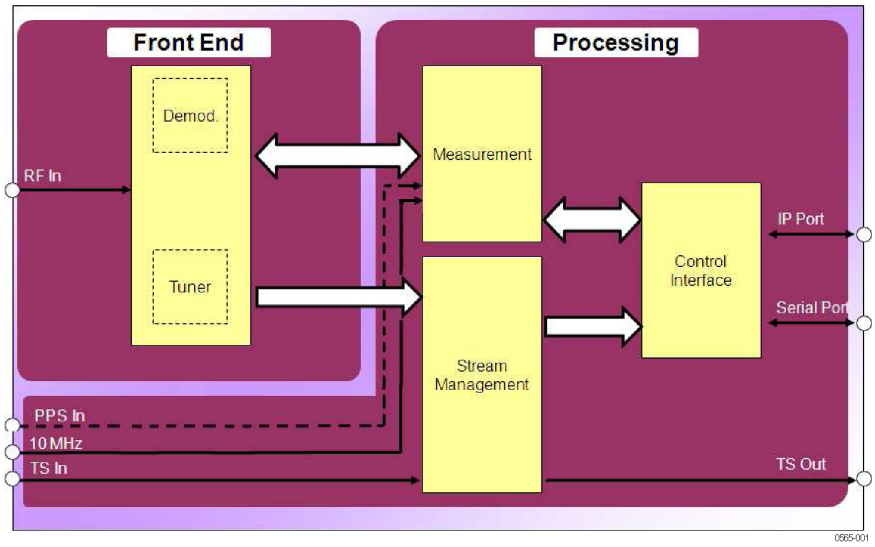


Figure 1: Block diagram of the internal RFM220 module

Requirements

Test Equipment

You will need the test equipment listed below to perform this procedure.

Table 13: Required test equipment

Item	Description
MPEG player and analyzer	Tektronix MTS400 Series MPEG Test System that is used to generate and analyze the test signal.
RFM220 Aggregator and Client applications	RFM220 software that is used to communicate with the RFM220 instrument. The software is located on the *RFM220 Software and Documentation CD* that was supplied with the product.
dvb_625_mcpc3.mpg test signal	Transport stream test signal file that is used as the signal input for this procedure. The file is located on the *RFM220 Software and Documentation CD* that was supplied with the product.
Signal cables	Two 75Ω coax cables that are used to connect the ASI signals between the MPEG player and analyzer and the RFM220 instrument.
Ethernet cable	Standard Ethernet cable that is used to connect the MPEG player and analyzer to the RFM220 instrument.

Procedure

This procedure assumes that the user has some knowledge of how to operate both the RFM220 and MTS400 instruments. If necessary, refer to the associated product documentation for more details.

Preliminary Tests

1. Power on the RFM220 instrument and wait for the initialization process to complete.
2. After the instrument has initialized, verify the following:
   - Both fans are running. This indicates that the Fan Power Supply module is OK.
   - The front panel Power On LED is on. This indicates that the Power Supply module and the internal fuse are OK.
   - The front panel Alarm LED is blinking and the Ready LED is off. This indicates that there is no input signal. If both LEDs are not on, this indicates that there is a problem with the RFM220 module inside the instrument.

Test Setup

3. Connect the RFM220 instrument to the MTS400 test system as shown in the following figure:
   a. Connect a 75Ω coaxial cable from the MTS400 ASI/SMPTE Out connector to the RFM220 Stream Input connector.
   b. Connect a 75Ω coaxial cable from the RFM220 Stream Output connector to the MTS400 ASI/SMPTE In connector.
   c. Connect an Ethernet cable from the MTS400 10/100/1000 Ethernet port to the RFM220 Gigabit port.

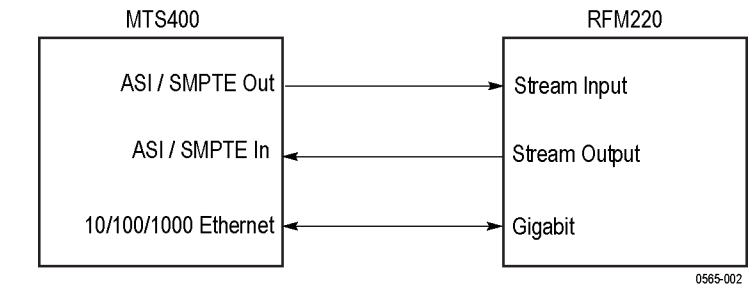


Figure 2: Connecting the RFM220 instrument to the MTS400 MPEG test system

CAUTION. *The MTS400 test system has two Ethernet ports: 10/100 and 10/100/1000. Be sure to use the 10/100/1000 port for this procedure.*

4. If necessary, install the RFM200 software on the MTS400 test system:

   a. If necessary, power on the MTS400 test system.

   b. Insert the *RFM220 Software and Documentation CD* into the CD drive of the MTS400 test system. The RFM220 CD browser window should open displaying the CD contents.

   c. In the RFM220 CD browser window, click the **Install RFM220 Software** button. This opens a Windows Explorer window showing the directory on the CD where the RFM200 software installation files are located.

   d. Copy the RFM220 software installation files to a location on the hard drive of the MTS400 test system.

   e. After the software installation files are copied to the MTS400 test system, double-click the **setup.exe** file to start the software installation process.

   If necessary, refer to the *RFM220 User Manual* for complete instructions on how to install the RFM220 software.

   f. When prompted, select to install both the RFM220 Aggregator and RFM220 Client applications.

   g. After the software installation is complete, the RFM220 Aggregator and RFM220 Client icons will appear on the desktop of the MTS400 test system.

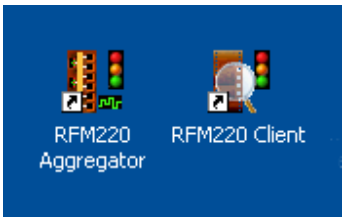


Figure 3: RFM220 shortcut icons

5. If necessary, install the dvb_625_mcpc3.mpg test signal file on the hard drive of the MTS400 test system:

   a. If necessary, insert the *RFM220 Software and Documentation CD* into the CD drive of the MTS400 test system. The RFM220 CD browser window should open displaying the CD contents.

   b. In the RFM200 CD browser window, click the **Performance Verification Test Signal** button. This opens a Windows Explorer window showing the directory on the CD where the test signal file is located.

   c. Copy the test signal file to a location on the hard drive of the MTS400 test system.

   d. Remove the *RFM220 Software and Documentation CD* from the CD drive of the MTS400 test system.

6. Configure the MTS400 test system to output the dvb_625_mcpc3.mpg test signal:

   a. On the MTS400 test system, open the MPEG Player application.

   b. Use the MPEG Player application to open the dvb_625_mcpc3.mpg test signal file that you copied to the MTS400 test system hard drive.

   c. Use the Play menu of the MPEG Player application to set the following parameters:

Table 14: MTS400 Play menu settings

Parameter	Setting
Interface	SPI/ASI/310M
Packet size	188
Clock	Fixed ES Rate (internal clock)
Update	On
Sync	TS Packet
Source	RAM
Auto Play	Off
Loop	On
Others	
Standard	DVB
Numeric	Hex
Ext Play Start	Off
SPI Output Enable	Unchecked
TDT/TOT	Check Original only
ISDB/P-TS	Check ISDB-Tsb, ISDB-T, and 192 Format (check all three boxes)
Update	Check Continuity Counter, PCR/PTS/DTS, TDT/TOT/STT, Reed Solomon (ISDB-T only), Update Method: Hardware. Do not check NPT.

   d. Use the SPI/ASI/310M menu of the MPEG Player application to set the following parameters:

Table 15: MTS400 SPI/ASI/310M menu settings

Parameter	Setting
BNC Port	ASI
Through Out	Off
ASI Format	Packet

7. After you configure the MPEG Player menu settings, click the green **Play** icon to start playing the test signal. Leave the test signal running while you perform the rest of this procedure.

8. Establish an IP connection between the MTS400 test system and the RFM220 instrument:

   a. Locate the current IP address of the RFM220 instrument. The factory default IP address is 192.168.0.209.

   NOTE. *If you cannot locate the IP address of the RFM220 instrument, perform the procedure for recovering the IP address that is located in the RFM220 User Manual.*

   b. If necessary, change the IP address of the MTS400 test system so that it is on the same network and subnet as the RFM220 instrument. Update the IP address by editing the Internet Protocol (TCP/IP) properties on the MTS400 test system for the 10/100/1000 Ethernet port.

   For example, if the IP address of the RFM220 is 192.168.0.209, then set the IP address of the MTS400 to 192.168.0.100. Set the Subnet Mask to 255.255.255.0 and leave the Default Gateway blank.

   c. On the MTS400 test system, navigate to the Aggregator configuration file:

   NOTE. *If you installed the RFM220 software to a location other than the default location, your path to the Configuration.xml file will be different.*

   - Windows 7:
     C:\Program Files (x86)\Tektronix\RFM220 Aggregator\Configuration.xml
   - Windows XP and below:
     C:\Program Files\Tektronix\RFM220 Aggregator\Configuration.xml

d. Right click on the Configuration.xml and select **Open With > Wordpad**. The file contains comment areas with parameter descriptions and instructions for editing the file.

The structure of the Configuration.xml file without the comment areas is shown below to clearly show the three configuration areas: Client Communications, SNMP Configuration, and Devices.

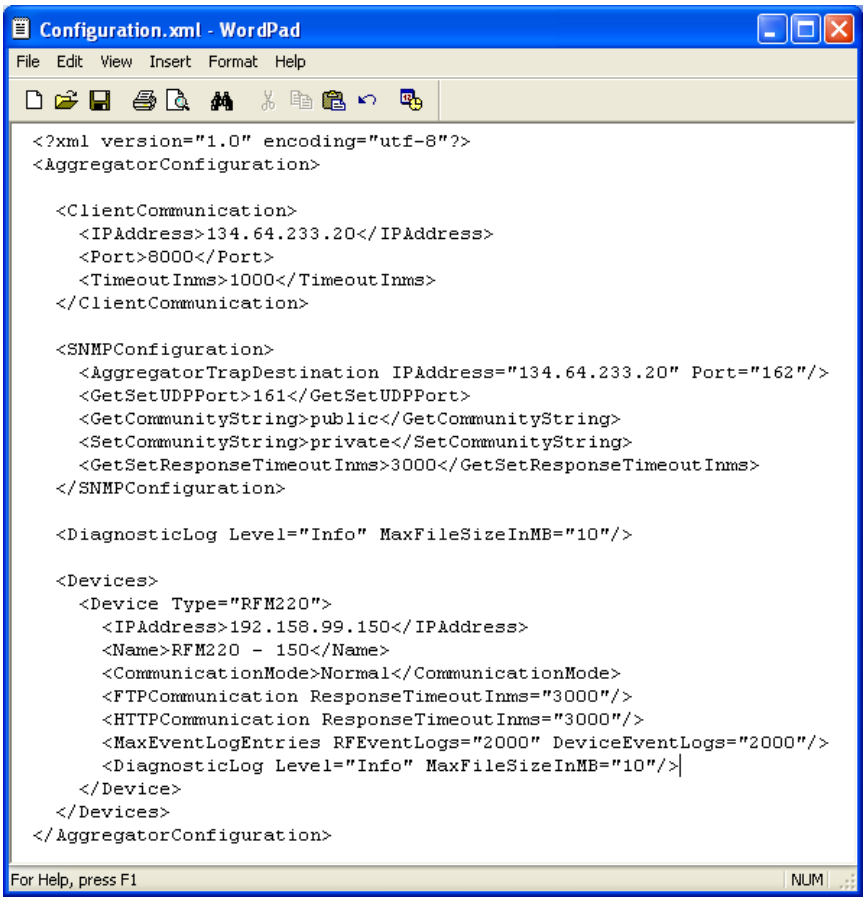


Figure 4: Structure of the Configuration.xml file shown in Wordpad

e. In the Client Communications section, change the IPAddress parameter value to the IP address of the MTS400 test system.

f. In the SNMP Configuration section, change the AggregatorTrapDestination IPAddress parameter value to the IP address of the MTS400 test system.

g. In the Devices section, change the IPAddress parameter value to the IP address of the RFM220 instrument you are testing.

9. Start the RFM220 Aggregator application by double-clicking on the desktop icon.

10. Start the RFM220 Client application by double-clicking on the desktop icon. The RFM220 Client Login window appears.

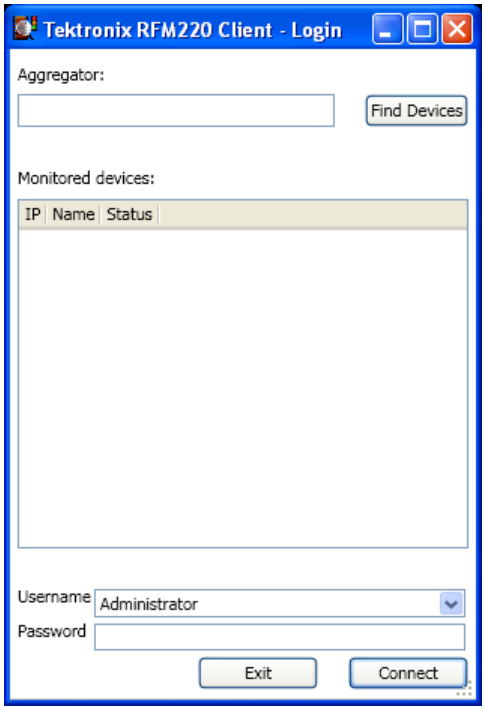


Figure 5: RFM220 Client Login window

11. Log in to the RFM200 Client application:

    a. Enter the IP address of the MTS400 test system in the Aggregator field, and then click the **Find Devices** button.

    b. The RFM220 instrument that is connected to the client PC should appear in the monitored devices list. Select the RFM220 demodulator (it should be highlighted).

    c. Log in as the **Administrator**. The default password is **tek**.

    d. Click the **Connect** button.

12. On the RFM200 Client application, configure the Stream Output connector of the RFM220 instrument as follows:

    a. Select **Edit Settings** from the Configuration menu.

    b. Select **ASI Input signal**, and then click **Ok**.

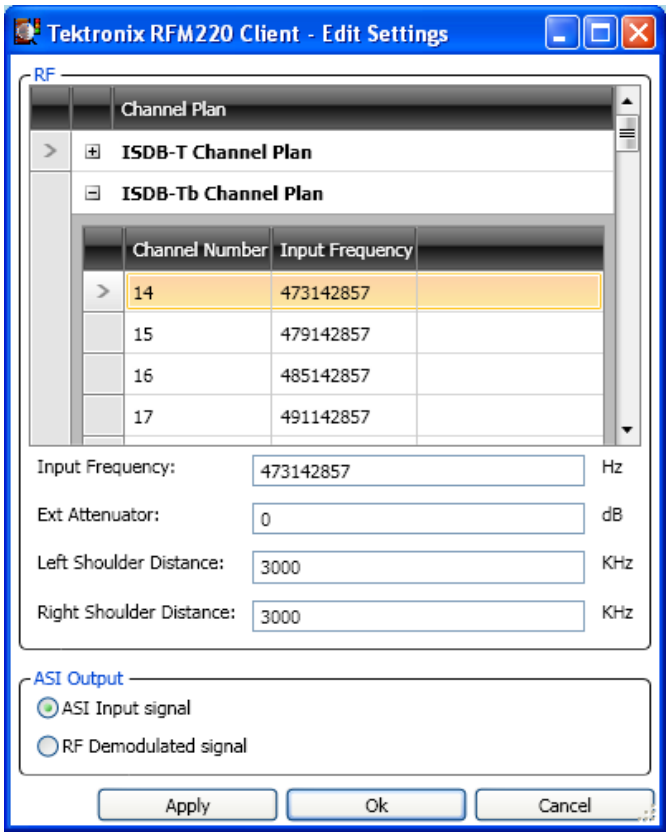


Figure 6: Configuring the RFM220 Stream Output signal

Checks

13. In the Metrics pane of the RFM220 Client application, verify that the ASI Input and ASI Output values match those shown below.

If the bit rates do not closely match, then there is a problem with the RFM220 module inside the instrument.

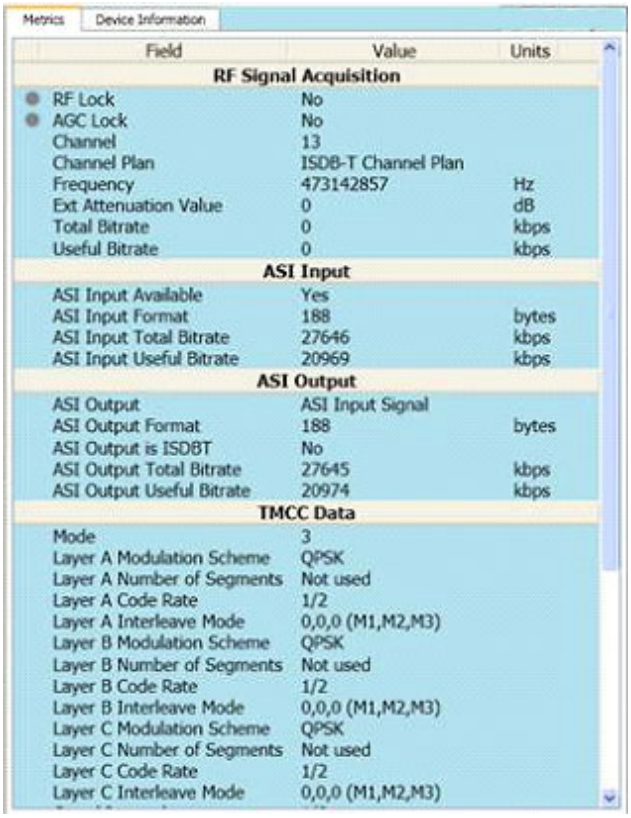


Figure 7: Verifying the ASI Input and ASI Output values

14. Set up the MTS400 test system to monitor the Stream Output signal from the RFM220 instrument to compare it with the source signal:

    a. On the MTS400 test system, open the TS Compliance Analyzer (TSCA) application.

    b. Select **ASI** as the interface, then click **Apply** and click **OK**.

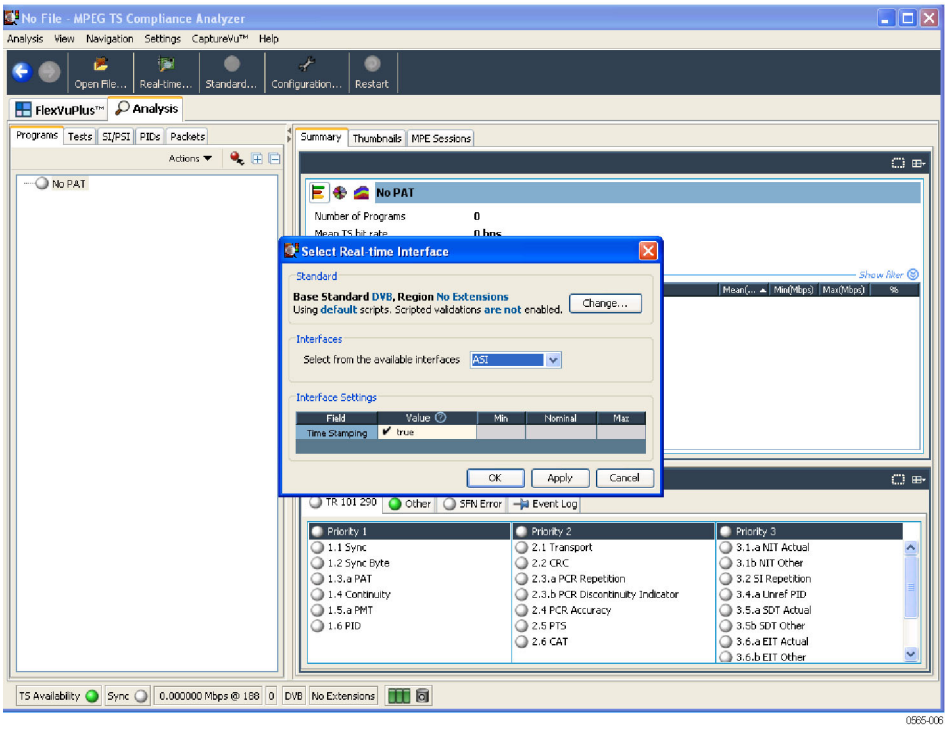


Figure 8: Selecting the ASI interface on the MTS400 test system

    c. Set the Standard to **DVB** and set the region to **AUS**.

    d. Select the **Tests** tab.

    e. Right click and select **Reset** to reset any error alarms.

    f. Select the **TR 101 290** tab, and then disable the **2.2 CRC** test. Disabled tests are indicated by black circle icons.

    g. Select the **SFN** tab, and then disable all SFN tests.

    h. Select the **Other** tab, and then disable all three PCR tests and the CAT_Timer test.

15. Verify that the TSCA display on the MTS400 test system matches the following two illustrations.

    If there are errors displayed (the LED indicators are red instead of green), then there is a problem with the RFM220 module inside the instrument.

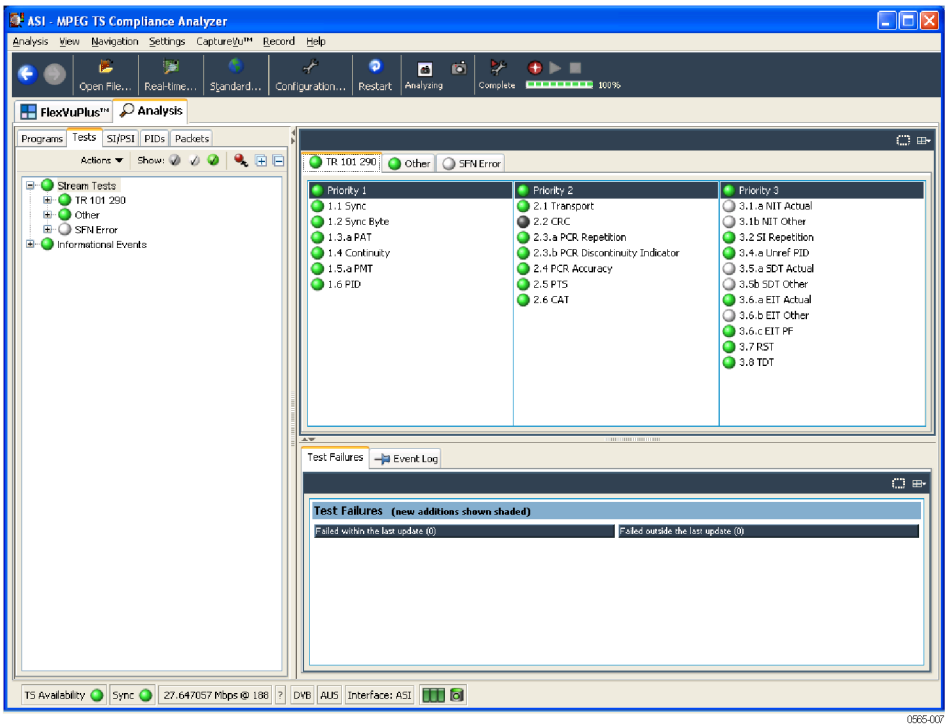


Figure 9: TR 101 290 error display on the MTS400 test system

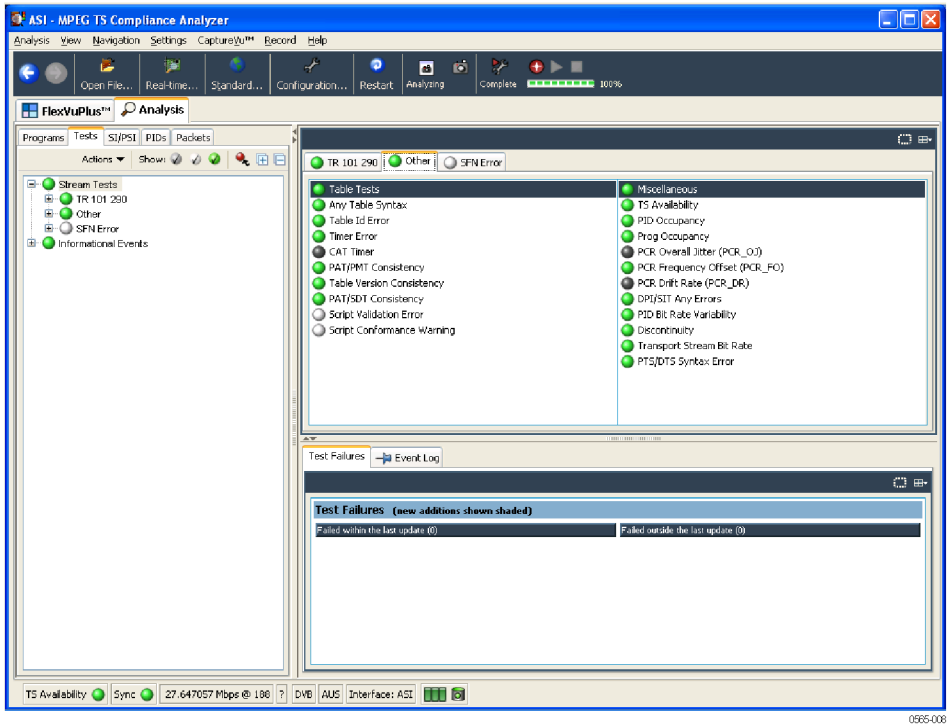


Figure 10: Other error display on the MTS400 test system