

# S7200

## TV Signal Spectrum Analyzer

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User Guide



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# Part I

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## S7200 Basics

## Safety Precautions

The following are general safety precautions that are not necessarily related to any specific part or procedure, and do not necessarily appear elsewhere in this publication. These precautions must be thoroughly understood, and they apply to all phases of operation and maintenance. Deviser Instruments, Inc. assumes no liability for the operator's failure to comply with these precautions

### WARNING

#### Plug Compatibility

Before connecting to AC power, please insure the adaptor plug fits the wall configuration on one end, and the power supply plug configuration on the other end. Incorrect configuration may damage the power supply.

### WARNING

#### Shock Hazard

To avoid the possibility of severe injury or death, observe the following precautions when using the S7200 TV Signal Spectrum Analyzer:

- Do not remove the system covers, and do not perform electrical tests if there are signs of shipping damage to the outer enclosure.
- When connecting test cables to a line, do not touch the cable's metal contact points, or allow the cable leads to touch each other.
- Use only the supplied power cords and connect only to a properly grounded wall outlet. Do not use extension cords that do not have a protective ground conductor.

### WARNING

#### Explosion Hazard

Do not operate the instrument in the presence of flammable gases or fumes.

### WARNING

#### Do Not Use If Damaged

Do not use this product if it shows visible damage, fails to perform, has been stored in unfavorable conditions, or has been subject to severe transportation stresses. Secure the product against any unintended operation and contact a Deviser Instruments, Inc. Factory Authorized Service Center for assistance.

### WARNING

#### Remove Power

Observe general safety precautions. Do not open the instrument with the power on.

### WARNING

#### Battery Care

Danger of explosion if the battery is incorrectly replaced. It is recommended to replace the battery only with the same type. Do not dispose of batteries in fire or trash. Batteries must be recycled or disposed of properly.

## Maintenance and Safety Considerations

### Calibrating the Meter

Any instrument with analog circuitry (including preamplifiers, filters, etc.) may change in performance over time. Regular calibration will keep your instrument in optimal working condition to support your test, design, troubleshooting, and manufacturing needs.

It is recommended to calibrate and verify the instrument at least once per year to ensure that it meets the stated performance specifications.

To avoid damaging the default calibration data stored in device memory, instrument calibration should only be performed with appropriate equipment by qualified personnel at a Deviser Instruments, Factory-Authorized Service Center.

#### Environmental conditions:

Calibration and verification tests should be performed in a laboratory where the ambient temperature and relative humidity can be controlled.

#### Warm up:

Allow up to at least 5 minutes' warm-up before calibrating the instrument. If the unit has been exposed to or stored in a high-humidity (condensing) environment, allow more time.

For detailed information on calibration procedures, please contact an authorized Deviser distributor.

### Other Safety and Maintenance Tips

Please charge and discharge the battery every 3 months to extend battery life. Recharge the battery only in the instrument; if left unused, a fully charged battery will discharge itself over time.

Never use a damaged or worn-out adapter or battery. During charge, the unit may be warm to the touch even if it is powered off. To avoid overheating, always disconnect the unit from the AC adapter before storing it in the carrying case.

**CAUTION:** Extreme temperatures will affect the ability of the battery to charge. Allow the battery to return to room temperature before use or charging. Storing a battery in extreme hot or cold temperatures will reduce its capacity and lifetime. It is recommended to store batteries at temperatures less than 25°C.

The unit cannot be used in its carrying case for more than 1 hour if the ambient temperature exceeds 35°C.

**CAUTION:** Use only the original AC-DC adapter and battery to power the unit. To charge, simply insert the battery into the unit's back panel, plug in the AC-DC adapter, and switch the power on if necessary. If the LED is red, the battery is charging. When fully charged, the LED will turn green. Time required to fully charge a depleted battery is approximately four hours, but may be longer if the instrument is in use while charging.

**CAUTION:** While updating firmware, the unit must remain connected to power and at more than 60% battery power. If power fails during the updating process, instrument function may be affected.

**DANGER:** The S7200 contains an optional VFL (Visual Fault Locator). To avoid eye damage, never look directly into the VFL output port while the light is on, and wear appropriate eye protection when necessary.

## Safety Symbols

The following are general definitions of safety symbols used on equipment and in manuals.



Dangerous voltage.



Protective ground.



Frame or chassis ground.



Alternating current.



Direct current.



Alternating or direct current.



Caution! Read the manual.

## Warranty

This Deviser Instruments, Inc. product is warranted against defects in material and workmanship for a period of 36 months from the date of shipment. Under warranty, Deviser Instruments, Inc. will, at its option, either repair or replace products which prove to be defective.

**Extended warranty options are available.** Please contact your local Deviser Instruments sales representative for more information.

For warranty service or repair, this product must be returned to a Deviser Instruments Factory Authorized Service Center designated. The buyer shall prepay shipping charges to Deviser Instruments Inc. or the service center and Deviser Instruments Inc. or the service center shall pay the shipping charges to return the product to the buyer. However, for products returned to Deviser Instruments Inc. or one of its authorized service centers outside the warranty period, the buyer is responsible for all shipping charges, duties, and taxes, both ways.

Deviser Instruments Inc. warrants that software and firmware designated by Deviser Instruments Inc. for use with an instrument will execute its programming instructions when properly installed on that instrument. Deviser Instruments Inc. does not warrant that the operation of the instrument or its software or firmware will be uninterrupted or error-free.

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### Limitation of Warranty

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Unauthorized repair or update, physical damage or improper operational voltage (at the power supply or RF input) will void this warranty. The main lithium battery is only covered for a period of 12 months.

The foregoing warranty shall not apply to defects resulting from the following:

- Improper or inadequate use or maintenance by Buyer
- Buyer-supplied software or interfacing
- Unauthorized modification or misuse
- Operation outside of the environmental specifications for the product.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. DEVISER INSTRUMENTS INC SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Updates, if any, may be downloaded from the Deviser web site at <http://www.deviserinstruments.com/>.

## Chapter 1: General Information

The **S7200** is a handheld TV Signal Analyzer that integrates multiple measurement applications in a single instrument, ideal for use by CATV field technicians and HE engineers. These applications provide most of the measurements required to maintain optimum performance of a CATV network.

The firmware installed on the S7200 is updated on a regular basis. This User Guide documents procedures for operating the instrument based on the most recent firmware version up to the date listed on the guide.

### 1-1 About the S7200 TV Signal Spectrum Analyzer

The product of revolutionary advances in TV signal analysis technology, the S7200 includes a host of features typically found in more expensive instruments and provides outstanding performance for value.

The S7200 enables field engineers to perform in-service measurements and identify interference signals that are invisible to many field instruments currently available on the RF test equipment market. The high-speed spectrum analysis tool supports multiple cable, terrestrial, and satellite digital TV standards, including DVB-C/C2, DVB-S/S2, DVB-T/T2, DTMB, DAB, and ATSC or ISDB-Tb (on select models – see below). It can measure frequencies of 4 ~ 1220 MHz for cable/terrestrial testing, and 950 ~ 2150 MHz for satellite applications.

The TV analyzer function also supports a wide range of video encoding formats, like MPEG2/4, H.264, H.265, AVS(+), and VC-1, with HD and SD image decoding (4K, 1080p, 720p, 576i, etc.) With the optional DVB-CI tool, users can even decode encrypted programs. The S7200 also supports mode 1/E BISS decryption.

Support for analog TV standards includes NTSC, PAL, and SECAM.

As 700 MHz becomes more popular for LTE service, LTE signals effectively occupy the same frequency band as CATV service. The S7200's time-domain EVS function allows users to check LTE interference without interrupting service.

The S7200 can perform TS (transport stream) analysis with the RF and ASI ports; simply record the output to a SATA SSD or USB device for easy playback. In line with recent strides in optical LNB use, optical power meter and optical receiver options are available. Other optional features include IPTV, WiFi analysis, and a GPS dongle for key location measurements.

Each instrument comes with basic TV and spectrum measurement functions for particular standards, based on the model. Optional functions may be enabled either at the time of purchase, or at a later date as your test needs evolve. See the following model and option guides.

#### Model Guide

Models	Features
S7200 Standard	DVB-C (J.83 Annex A/C), S/S2, T/T2, H, ASI Input & Output
S7200-ATSC	DVB-C (J.83 Annex A/B/C) S/S2, T/T2, H, ATSC, ASI Input & Output, Spectrum Emissions Mask
S7200-ISDB-Tb	DVB-C (J.83 Annex A/C) S/S2, T/T2, H, ISDB-Tb; ASI Input & Output

## 1-2 Accessories and Measurement Options

SKU No.	Type	Description
S7200-000	Accessory	S7200 English calibration certification
SFL10-KK	Accessory	TOKO Type-F(f) to Type-F(f) adapter
S7200-001	Accessory	S7200 carrying case
S7200-002	Accessory	Toolbox software & operation manual CD
S7200-003	Accessory	S7200 quick operation guide (English)
S7200-007	Accessory	Car charger
FSP060-DBAE1	Accessory	AC/DC adapter
S7200-801	Option	DVB-C2 support
S7200-802	Option	TR 101 290 Transport Stream analysis (MPEG-TS)
S7200-803	Option	IPTV Analysis, 10/100/1000 Mbps
S7200-804*	Option	DVB-CI Conditional Access Module (CAM) for channel decryption
S7200-805	Option	802.11 b/g/n Wi-Fi Analysis
S7200-201*	Option	Optical Receiver & Power Meter
KM200032SSD	Option	Serial AT attachment (SATA) disk
DS2500-704	Option	GPS (USB) Dongle
S7200-004	Option	English User Guide (hard copy)
AE4000-733	Option	Power adapter (EU)
AE4000-734	Option	Power adapter (US)
AE4000-735	Option	Power adapter (UK)
AE4000-736	Option	Power adapter (AUS)
S7200-005	Option	1-year extended warranty

## 1-3 Technical Support & Service

Deviser Instruments Inc. offers a 24-month warranty, and ongoing support and training services. Customers are eligible to receive initial on-site training from our technical support engineers in a “train the trainer” format. Our application engineers can also answer questions and provide ongoing technical support regarding software or equipment. For special applications, Deviser instruments offers custom software design at an extremely competitive rate and time-to-market.

Ongoing development and “maintenance engineering” is provided on all products; yearly maintenance programs are offered to ensure that customers fully benefit from the latest upgrades available. Technical documents and application guides are released on an ongoing basis.

## 1-4 Annual Service Verification

Accurate test measurements are critical to your business. Deviser Instruments recommends an annual calibration and performance verification as a means to keep your instrument in optimal working condition. Please contact Deviser Instruments for an RMA number and the location of the nearest Authorized Deviser Instruments service center. Our authorized service centers are skilled and certified in the calibration, service, repair, and performance verification of our products.

\* This option requires hardware modification at a Deviser-authorized service center.

## 1-5 Electrostatic Discharge Caution

The S7200 TV Signal Spectrum Analyzer, like other high-performance instruments, is susceptible to electrostatic discharge (ESD) damage. Coaxial cables and antennas often build up a static charge, which may damage the S7200 input circuitry. S7200 operators must be aware of the potential for ESD damage and take all necessary precautions.

It is recommended to discharge the static by connecting a short or load device to the cable or antenna before connecting them to the S7200. It is important to remember that the operator may also carry a static charge that can cause damage. Following the practices outlined in the above standards will ensure a safe environment for both personnel and equipment.

- When connecting a coaxial cable to the instrument for the first time that day, the center conductor of the cable and the outer braided shielding layer should be quickly grounded.
- During service, ensure that the technician is grounded before removing inner components or pulling out connecting cables.
- Ensure that the instrument is well grounded, so as not to store any static charges.
- Electrostatic protection of this instrument is up to standards of 6KV contact and 8KV air-gap.

## 1-6 Battery Care

The S7200 can be supplied with power in two different ways: with the built-in battery or with the power adapter provided.

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### 1-6.1 Battery

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The S7200 uses a 7.4V/13Ah lithium battery for autonomous operation. Battery life during continuous use (on a full charge) is estimated at more than 8 hours. When the voltage falls below 6.9V, the instrument will display an alert indicating low charge. At 6.7V or less, it will display a second alert and the battery icon will flicker. At 6.2V or less, following a third alert, the instrument will emit a long audible beep and shut down automatically. Further use requires that the unit be connected to an external AC or DC power source, which will also charge the battery. If the unit stays off, it will take about 4 hours to fully recharge. Charging time will be longer if the unit is in use.

**NOTE:** Use only Deviser Instruments-approved batteries, adapters, and chargers provided with this instrument.

**WARNING:** Low temperatures may cause a temporary reduction of the battery capacity. This will not damage the battery. High temperatures, however, may cause permanent damage to the battery. See stated specifications for environmental tolerances. Recommended charging temperature is 10-35°C.

**NOTE:** It is advisable to replace the battery when operational time falls below 50% of original capacity.

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## 1-6.2 Charging the Unit

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Please follow the following steps to charge the unit:

1. Place the instrument standing up with the screen facing you, then insert the DC connector into the VDC power inlet at the top left of the instrument.
2. When the charging indicator displays a gradually-filling battery icon in the status bar on the screen, the instrument is charging. The LED next to the power button indicates status: green means fully charged, red means charging in progress, and red and green flickering indicates no battery or abnormal battery.
3. Once the instrument reaches full charge, it is recommended to charge for one additional hour to help extend the operation time. After charging, unplug the DC connector, and then pull out the AC adaptor from the outlet.

**NOTE: Charge the instrument fully before using it for the first time.**

Adapter Specifications	
Model No.	FSP060-DBAE1
AC input	100-240V~, 1.5A, 50-60Hz
DC output	12.0V 5A MAX

## Glossary of Acronyms

AAC	Advanced Audio Coding
AC-3	Dolby AC-3 audio coding
ACPR	Adjacent Channel Power Ratio
AEC	Audio Engineering Society
AES	Advanced Encryption Standard
ATDMA	Advanced Time Division Multiple Access
ATSC	Advanced Television Systems Committee
AVG	Average
BAT	Bouquet Association Table
BER	Bit Error Rate
BPCP	Bidirectional Coded Picture
CAT	Conditional Access Table
CCIR	International Radio Consultative Committee
CCN	Carrier-to-Composite Noise Ratio
CRC	Cyclic Redundancy Check
CSO	Composite Second Order Beat
CTB	Composite Triple Beat
CM	Cable Modem
CLDI	Chrominance-Luminance Delay Inequality
CLGI	Chrominance-Luminance Gain Inequality
CMTS	Cable Modem Terminal System
CPE	Customer Premise Equipment
CVBS	Composite Video Broadcast Signal Color Video Blanking and Sync Composite Video, Blanking, Synchronization Composite Video Bar Signal
CW	Continuous Wave
DAVIC	Digital Audio Video Council
DCT	Discrete Cosine Transform
DFT	Discrete Fourier Transform
DG	Differential Gain
DHCP	Dynamic Host Configuration Protocol
DIT	Discontinuity Information Table
DOM	Depth of Modulation
DNS	Domain Name System
DOCSIS	Data-Over-Cable Service Interface Specifications
DP	Differential Phase
DTS	Decoding Time Stamp
DVB	Digital Video Broadcasting
DVB-C	Digital Video Broadcasting-Cable
EAP	Extensible Authentication Protocol
EBU	European Broadcasting Union
ECM	Entitlement Control Message
EIA	Electronic Industries Association
EIT	Event Information Table
EMM	Entitlement Management Message

eMTA	Embedded multimedia terminal adapter
EPG	Electronic Program Guide
ES	Elementary Stream
ETSI	European Telecommunications Standards Institute
ETT	Extended Text Table
EVM	Error Vector Magnitude
EVS	Error Vector Spectrum
ES	Errored second
FCC	Federal Communications Commission
FDD	Frequency division duplex
FEC	Forward Error Correction
FFT	Fast Fourier Transform
FIP	Fiber Inspection Probe
FM	Frequency Modulation
FSK	Frequency-Shift Keying
FTP	File Transfer Protocol
GCR	Ghost Cancellation Reference
GOP	Group of Pictures
GPS	Global Positioning System
HD	High Definition (video)
HFC	Hybrid Fiber-Coaxial
ICP	Intra Coded Picture
ICR	In Channel Frequency Response
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical & Electronics Engineers
IMD	Intermodulation Distortion
IP	Internet Protocol
IRD	Integrated Receiver Decoder
ISO	International Organization for Standardization
ITU	International Telecommunications Union
JCTEA	Japan Cable Television Engineering Association
LAN	Local Area Network
LSB	Least Significant Bit
LTE	Long term evolution
MAC	Media Access Control layer
MER	Modulation Error Ratio
MGT	Master Guide Table
MPE	MultiProtocol Encapsulation
MPEG	Moving Pictures Expert Group
MSB	Most Significant Bit
MSD	Minimum Signal Duration
NCTA	National Cable Television Association
NEG	Negative peak
NIT	Network Information Table
NTSC	National Television Standards Committee

NVOD	Near Video On Demand
OFDM	Orthogonal frequency division multiplexing
OFDMA	Orthogonal frequency division multiple access
OPM	Optical Power Meter
PAL	Phase Alternate Line
PAT	Program Association Table
PCP	Predictive Coded Picture
PCR	Program Clock Reference
PDCCH	Physical downlink control channel
PES	Packetized Elementary Stream
PID	Packet Identifier
PMT	Program Map Table
POS	Positive Peak
POI	Probability Of Intercept
PING	Packet Internet Groper
PPPoE	Point to Point Protocol over Ethernet
PSI	Program Specific Information
PSIP	Program and System Information Protocol
PSK	Phase Shift Key
PTS	Presentation Time Stamp
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature phase shift keying
RMS	Root Mean Square
RBW	Resolution Band Width
RRT	Ratings Text Table
RSSI	Received signal strength indicator
RST	Running Status Table
RF	Radio Frequency
SAM	Sample detector
SES	Severely errored second
SCDMA	Synchronous Code Division Multiple Access
SC-FDMA	Single carrier frequency division multiple access
SCTE	Society of Cable Telecommunication Engineers
SD	Standard Definition (video)

SDT	Service Description Table
SES	Severely errored second
SECAM	Sequential Color and Memory Sequential Couleur avec Memoire
SI	Service Information
SIT	Selection Information Table
SMPTE	Society of Motion Picture and Television Engineers
SNR	Signal-to-Noise Ratio
SSID	Service Set Identifier
ST	Stuffing Table
STB	Set Top Box
STC	System Time Clock
STD	System Target Decoder
STT	System Time Table
TDMA	Time Division Multiple Access
TDD	Time division duplex
TDT	Time and Date Table
TFTP	Trivial File Transfer Protocol
TKIP	Temporal Key Integrity Protocol
TOD	Time Of Day
TOT	Time Offset Table
TS	Transport Stream
TSDT	Transport Stream Description Table
TVCT	Terrestrial Virtual Channel Table
UCD	Upstream Channel Descriptor
UE	User equipment
UTC	Coordinated Universal Time
VBW	Video Band Width
VCT	Virtual Channel Table
VFL	Visual Fault Locator
V/A	Video to Audio carrier level ratio
VITS	Vertical Interval Test Signal
VoIP	Voice over Internet Protocol
VSB	Vestigial Sideband Modulation
WiFi	Wireless Fidelity
WEP	Wired Equivalent Privacy
WPA-PSK	Wi-Fi Protected Access -Pre-shared key

## Chapter 2: Instrument Overview

This chapter describes how to get started with the S7200 TV Signal Spectrum Analyzer. Topics covered in this section include:

- Overview of instrument panels, display, and operation
- Changing measurement modes and applications

### 2-1 Unpacking the S7200 Instrument

When unpacking your S7200 instrument for the first time, it is recommended that you follow these steps.

1. Open the package carefully. Check the box and packing material; keep them for potential future servicing of your product. If the packing material is damaged, the product may have sustained damage during shipping; please proceed with caution during the following steps. Keep detailed records and pictures of any physical damage to the box or the equipment inside. Remove the instrument, and search for any physical damage that could have occurred during shipping. Follow the stated instructions upon initial power-up. If repairs are required, contact your nearest Deviser Instruments Inc. representative.
2. Check that all accessories and materials are accounted for. If accessories or other components are missing, contact your nearest Deviser Instruments Inc. representative.
3. Connect the power supply to the instrument. Charge fully before using.

For a comprehensive list of compatible accessories, see Section 1-2.

### 2-2 Powering On the S7200



To turn on the S7200, press and hold the On/Off button on the front panel (see diagram in Section 2-3) for approximately 1-2 seconds. The instrument will take approximately 60 seconds to boot up and load the application software. The user profile screen will appear (left).

Here you can log in to an existing user profile, which applies the channel plan associated with that profile. Tap **Edit** to change the user's name, ID, or company. You can also add or delete users or change the system language.

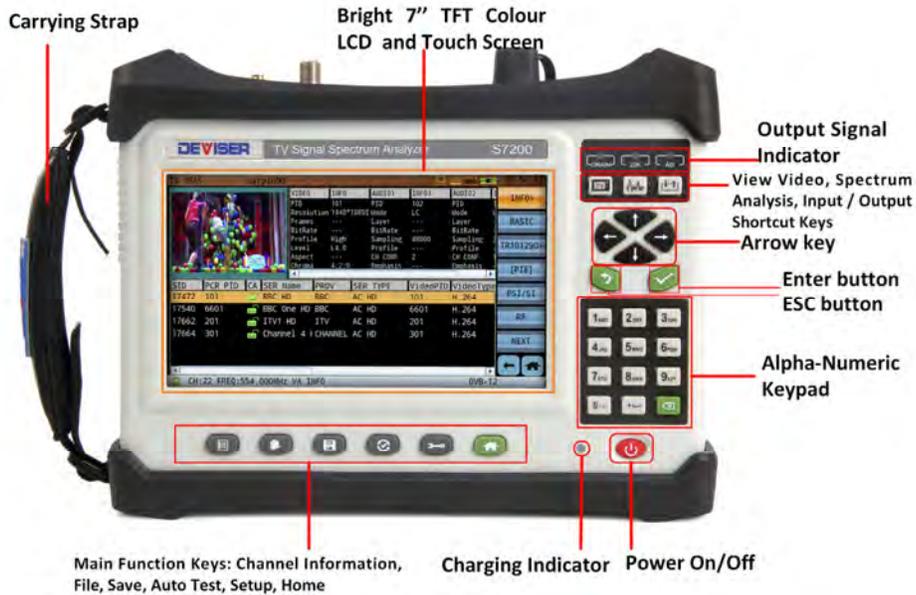
Tap **Login** to continue to the **home menu** and select a measurement mode.

**NOTE:** If desired, you may disable the multi-user startup menu, proceeding directly to the Home menu upon booting up the instrument. See Section 13-2.5 for instructions.

To turn the device off, either press the On/Off button briefly and select **Power Off**, or hold the On/Off button for approximately 1-2 seconds more. (This delay prevents shut-down in the event that the On/Off button is accidentally pressed.) You can also press the button and select **Reboot** to restart the instrument software. Press the green Back key to exit the dialog instead.

## 2-3 Front Panel Overview

The S7200 TV Signal Analyzer's front panel contains the software boot switch and a number of LED status indicator lights. It also bears the unit's model number.



### LED Charge Indicator

This light shows the battery charge status. When red, the battery is charging; when green, it is fully charged.

### Power ON/OFF

Press to turn the S7200's application software ON and OFF.

### Function Keys

The six main function keys are located horizontally below the screen. They offer convenient shortcuts to key system functions. From left to right:

- Press Channel (📺) to create a new channel / transponder plan or edit the current plan.
- Press File (📁) to view and manage files (e.g. images or data) saved to the internal hard drive.
- Press Save (💾) to capture screenshots or measurement data and save them to disk.
- Press Auto Test (🔍) to set up automatic pass/fail testing.
- Press Setup (⚙️) to adjust brightness and audio volume. Tap **More** for the main settings menu.
- Press Home (🏠) to return to the main measurement menu.

### Output Signal Indicators

The three lights in the top-right indicate the type of the current signal output. From left to right, they show Drain (output feeding current to satellite antenna), 22K (output 22kHz control signal to satellite antenna), and ASI (ASI input/output) respectively.

### Measurement Modes

The three keys below the output signal indicators serve as shortcuts to different measurement functions. From left to right, press **TV** for transport stream analysis; **Spectrum** for spectrum analysis; or **Input/Output** to change special option-specific settings.

### Dual Alphanumeric Keypad

The keypad can be used to input numerical entries or type words (e.g., for naming files). Press the green Back key to erase the last entry.

### Arrow Keys

The arrow keys to the right of the screen are used to adjust settings or move markers. Press the top arrow to increase the selected value and the bottom arrow to decrease it.

### Back and Enter Buttons

Press the Back button to cancel an entry or return to the previous application or menu. Press Enter to confirm a changed value or a highlighted setting.

## 2-4 Top and Side Panel Overview

The test instrument's top panel contains connectors and ports. See the diagram and descriptions below.

### RF Input

75  $\Omega$ , N-Type female connector. Input is DC ~100Hz, max 30VDC; 5 ~ 2150 MHz, max +70dBmV.

### Optical Port (by option only)

Used to connect a fiber for the optical power meter.

### CAM (by option only)

Conditional Access Module for channel decryption.  
(See subsection 6-12.12 for instructions.)

### USB Type-A port

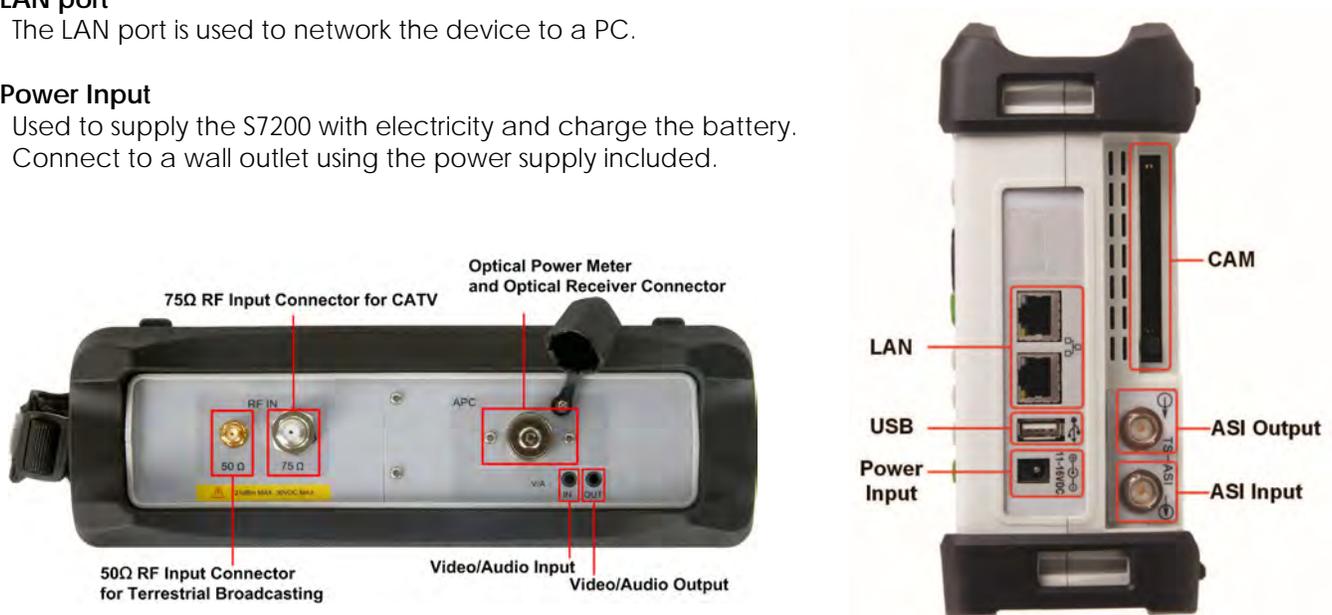
The S7200 has a Type-A USB 2.0 port that accepts USB storage devices for transferring measurements, setup files, screen images, GPS dongle option, and other data.

### LAN port

The LAN port is used to network the device to a PC.

### Power Input

Used to supply the S7200 with electricity and charge the battery.  
Connect to a wall outlet using the power supply included.



## 2-5 Control Overview

The S7200 employs a 7", 800x480 backlit color display that is configured for ease of use and navigation. You can easily and quickly change measurement functions using the hotkeys located on the right side of the screen, above the arrow keys. Each measurement application has its own layout and structure. In Part II: Settings and Measurements, we discuss each application's display and controls in detail.

In all applications, submenus will appear along the righthand side of the screen (marked with a ">"). You can expand a submenu to view the individual settings and tools within by tapping it with your finger or a stylus pen.

### 2-5.1 Selection Types

- **Inside brackets**, e.g. [DATA]: Using your finger or a stylus pen, tap the submenu key repeatedly to cycle through a list of available settings.
- **Alphanumeric entry**, e.g. choosing a filename: tap a text entry field to bring up the touchscreen keyboard (shown below). Touch the keys to type out an entry, then press the Enter key in the bottom-right to confirm.
- **Toggling between 2 settings**, e.g. either Auto or Manual but never both: Tap to choose. The setting is ON when highlighted in orange, and OFF when blue.
- When **multiple settings** are available for you to control: Tap the screen to select a parameter. You can then begin editing the value.



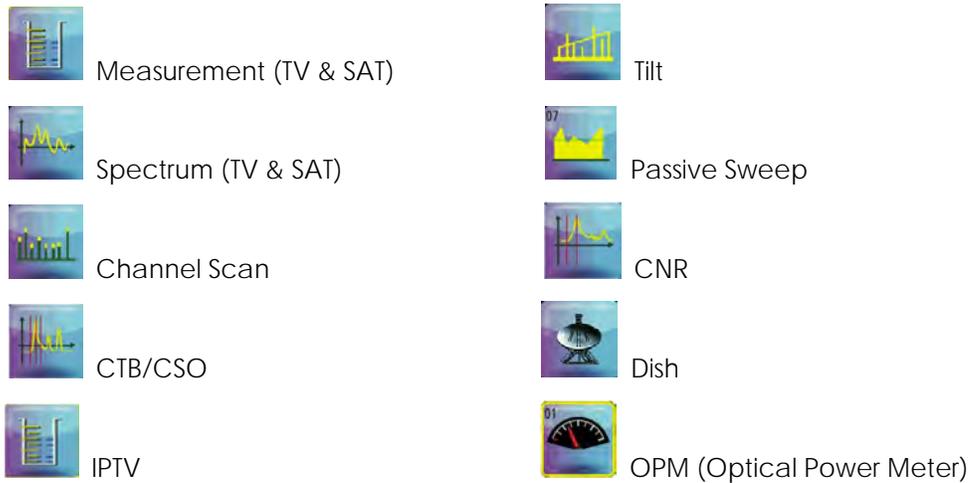
Jump to specific measurement functions using the **Transport Stream**, **Spectrum**, and **Input/Output** buttons (below, top), or access system tools like file management and setup with the row of hardkeys located along the bottom edge of the display (below, bottom).

Function-specific menu structures and controls will be discussed later in this guide.



## 2-6 Measurement Main Menu

The S7200 TV Signal Analyzer provides the following spectrum analysis measurement modes, aimed at simplifying the installation, maintenance and troubleshooting of a CATV broadcasting system. (**Note:** some measurements are only available by option. See Section 1-2 for option info.)



### 2-6.1 Status Bar

Look to the orange bar across the top of the screen for current battery charge, time & date, and more.



#### General Status Icons

	Wi-Fi function is active.		Searching for a GPS satellite signal.
	Wi-Fi hotspot function is active.		LNB feed currently active.
	USB storage device connected.		22kHz (DisEqC protocol) signal active.
	Solid state drive connected.		CAM/smart card recognized. Ready to decode.
	LAN cable connected.		TS-ASI input/output function active.
	50Ω input port active.		dCSS function active.
	75Ω input port active.		Antenna coefficient enabled.
	SATCR function active.		Optical port enabled.

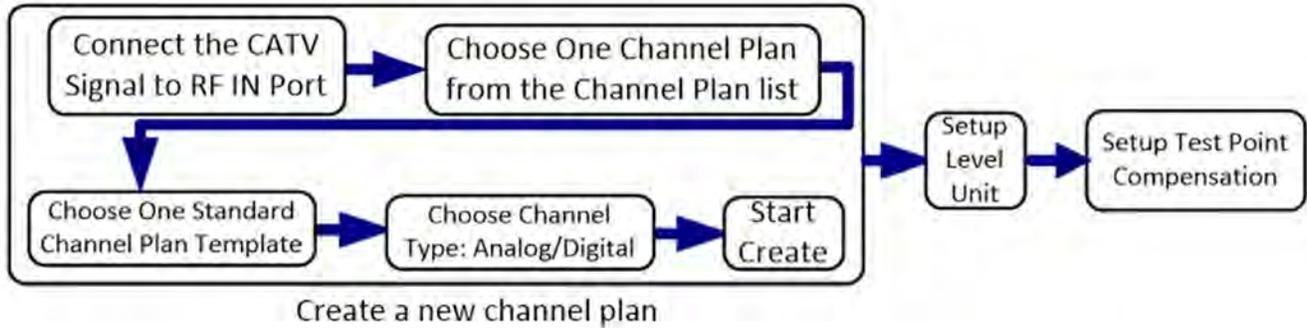
#### Power Icons

	Adapter connected.		Low battery.
	Full battery.		Empty battery.

## 2-7 Set Up Your Channel Plan First

Before launching a measurement with the S7200, it is recommended to set up the channel plan you wish to use for testing. You can do this from the Channel Plan Editor (press the  button below the screen).

For detailed instructions on channel plan creation and setup, see Chapter 3: Channel Plans.

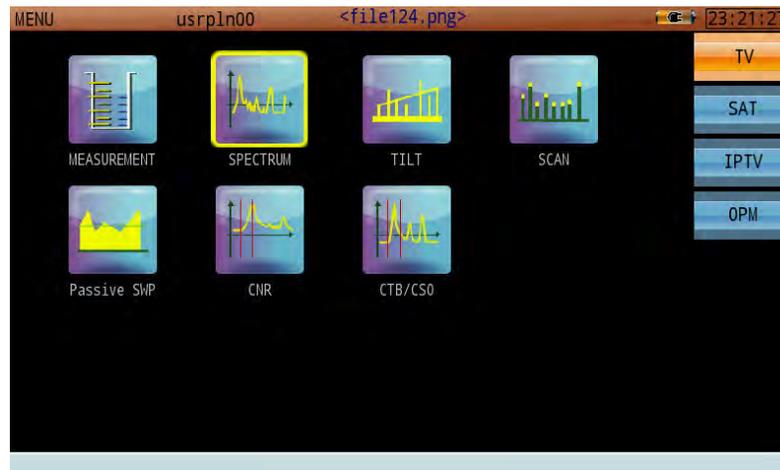


Use the plan creator (below, left) to establish and name a standard plan based on your region. Most North American users will base their plan on the NCTA standard. Check the boxes to establish whether your plan will include analog channels, digital channels, or both. When finished, press **Start** (F3) to auto-generate the channel plan based on a scan of local channel availability.

You can then edit the individual channels in your plan to suit your test needs (below, right).



## 2-8 Measurement Mode Selection



**S7200 Main Menu**

There are two ways to choose a measurement application. (To switch between TV, Satellite, IPTV, and Optical applications pages, tap the respective key on the touchscreen.)

1. Tap the desired icon to launch the measurement.
2. Use the arrow keys) to move the yellow selector on the screen. Highlight the application you want and press the Enter button to launch the measurement.

Optional measurement modes, not included in the S7200's standard measurements (see Section 2-6), can be purchased initially, or at a later date after the unit has been delivered. A software keycode must be entered to enable the desired function.

Once enabled, any optional modes and associated measurement applications will appear on the main menu. Please consult Section 1-2 regarding available product measurement options.

For instructions on using individual measurement functions, see Part 2: Settings and Measurements.

## 2-9 About the Soft Carrying Case

The S7200 can be operated while in the soft carrying case. On the back of the case is a large storage pouch for accessories and power supply.

### **To place the instrument into the soft carrying case:**

1. Place the carrying case face-down on a stable surface, with the front panel fully closed and lying flat.
2. Open the zippered back of the case.
3. Insert the instrument face-down into the case. Take care that the connectors fit properly through the openings in the case top and sides.

# Part II

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## Settings and Measurements

## Chapter 3: Channel Plans

Managing channel plans is a crucial component of CATV and satellite network maintenance. Accordingly, the S7200 stores and configures TV and Satellite channel plans separately. From the Home menu, first select the type of channel plan to view by tapping **TV** or **SAT**; then press the  button located below the S7200 display to open the channel plan manager for that type.\*

The channel plan manager is separated into two panes. Use the arrow keys + Enter button (or touchscreen) to switch between them and make selections.

- The **left** pane lists a total of 16 user plans (up to 100 plans may be stored on one S7200) that can be individually edited. By default, they are named "usrpln00" through "usrpln15", but can be renamed as the operator desires. An asterisk (\*) marks the channel plan currently in use.
  - It is possible to overwrite the active plan. Exercise caution when editing.
- The **right** pane lists details on the selected channel plan, including type and frequency info.

### 3-1 TV Channel Plans

#### 3-1.1 Creating a User Channel Plan

In the TV plan manager, tap **Create** to change the right-hand pane to a user plan creator. Select a plan template according to your global region: CCIR, CHINA, NCTA, or OIRT. (For example, operators in North America will select NCTA.)

Place checks in the Analog and/or Digital checkboxes to indicate which channel types the new plan will include.

The S7200 features an automatic channel plan builder. It will identify the peak signal levels and available analog carrier frequencies, as well as identifying digital carriers. Tap **Start** to begin a local scan and auto-generate the channel plan.



If the S7200's **DAB** option is enabled, it will create a DAB channel plan automatically on power-up. This plan only includes DAB channels, which cannot be modified to other types.

Also note that some cities use channel plans that are inconsistent with the standard. These plans may exhibit some frequency offset compared with standard plans. In this case, the "Frequency offset" option provides a simple solution for creating nonstandard channel plans to match local needs.

Once your channel plan has been generated, please verify that all channels in the created plan match your system's channel plan by having a check mark beside every active channel. In some cases, it is possible for channels to be omitted.

When finished, tap **List** to return to the channel plan list.

\* Content, reference materials, and technical consultation for this chapter provided by Bernie Cadieux, Deviser Instruments. <bcadieux@deviserinstruments.com>

### 3-1.2 Editing TV Channel Plans

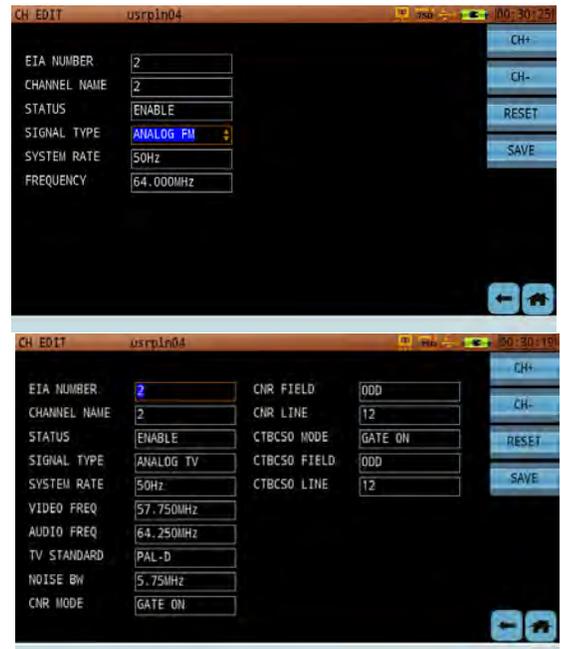
There are several ways to modify an existing channel plan. To change its name, highlight it in the left pane and tap **Edit**. Enter a new plan name using the touchscreen keyboard, then press OK to confirm.

To activate or deactivate all channels in a plan, highlight the plan and tap **Ena All / Dis All**. Please ensure that all active channels are checked, and that all inactive channel locations are unchecked.

You can also modify the plan channel-by-channel. Tap the plan in the left pane to activate it, then select a channel in the right pane and tap **Edit**.

In this screen, you can edit a variety of individual channel parameters. Settings vary by signal type, which include:

- Analog FM
- Analog TV
- DOCSIS
- DAB
- DVB-C
- DVB-C2
- DVB-T2
- DTMB
- DVB-T/H
- ATSC\*
- ISDB-TB\*



#### Analog (TV & FM) Channel Parameters

- Channel serial number
- Channel name: Edit with keypad
- Channel status: [Enable / Disable]
- System rate: [50Hz / 60Hz]
- Frequency: Edit with keypad
- Video frequency: Edit with keypad
- Audio frequency: Edit with keypad
- TV standard: [NTSC-M / PAL-B / PAL-D / PAL-G / PAL-H / PAL-I / PAL-K / PAL-M / PAL-N]
- Noise BW: Edit with keypad
- CNR mode: [Gate Off / Gate On]
- CNR field: [Odd / Even]
- CNR line: 525-line system: Field 1 (odd), line 1-263; Field 2 (even), line 2-262  
625-lines system: Field 1 (odd), line 1-313; Field 2 (even), line 2-312
- CTBCSO mode: [Gate Off / Gate On]
- CTBCSO field: [Odd / Even]
- CTBCSO line: 525-line system: Field 1 (odd), line 1-263; Field 2 (even), line 2-262  
625-line system: Field 1 (odd), line 1-313; Field 2 (even), line 2-312

**NOTE:** For Analog channels, you will need to instruct the S7200 where to look for "Gated" quiet line, GCR or Multiburst, CCR-7 VITS test signals, field and line location. If these changes are made during testing, said changes will not be saved for the next test. It is recommended to make initial edits to the channel plan prior to testing, in order to retain channel specifications.

\* On select models only.

### Supported Analog TV Standards

TV standard	Lines per frame	Field frequency	Color encoding method
NTSC-M	525	60Hz	NTSC
PAL-M	525	60Hz	NTSC
PAL-B,D,G,H,I,K	625	50Hz	PAL
PAL-N	625	50Hz	PAL

### Digital (DVB-C, -C2, -T2, T/H) & ATSC Channel Parameters

Channel serial number:

Channel name: Edit with keypad

Channel status: [Enable / Disable]

System rate: [50Hz / 60Hz]

Frequency: Edit with keypad

Measure BW: Edit with keypad

Modulation: [16QAM / 32QAM / 64QAM / 128QAM / 256QAM]

GI (Guard Interval): [ $\frac{1}{4}$  /  $\frac{1}{8}$  /  $\frac{1}{16}$  /  $\frac{1}{32}$ ]

FFT Mode: [2K / 8K]

Code Rate: [1/2 / 2/3 / 3/4 / 5/6 / 7/8]

Hierarchy: [None / 1 / 2 / 4]

Cell ID: Enter number

SR (System Rate): The symbol rate is auto-configured according to the modulation type and standard. It will set automatically once the modulation type and standard are selected. Users can input values manually, ranging between 4.00MS/s ~ 7.00MS/s.

STD (Standard): [J.83A / J.83B\* / J.83C / DOCSIS / EuroDOCSIS]

BER Statistical Time: The BER measurement time in BER statistical and auto test BER statistical functions.

**NOTE:** For Digital channels, the channel plan creator can tell the difference between Analog and Digital, but not between DVB-C and DOCSIS. You will need to instruct your channel plan in the editor mode on the 4th line in the channel edit window.

### US and EU Default Symbol Rate for DVB-C and DOCSIS

Standard and Modulation Type	Symbol Rate	Bandwidth
ITU-T J.83 Annex A 64QAM	6.952MS/s	8MHz
ITU-T J.83 Annex A 256QAM	6.952MS/s	8MHz
ITU-T J.83 Annex B 64QAM	5.057MS/s	6MHz
ITU-T J.83 Annex B 256QAM	5.361MS/s	6MHz
ITU-T J.83 Annex C 64QAM	5.274MS/s	6MHz
ITU-T J.83 Annex C 256QAM	5.274MS/s	6MHz
DOCSIS 64QAM	5.057MS/s	6MHz
DOCSIS 256QAM	5.361MS/s	6MHz
EuroDOCSIS 64QAM	6.952MS/s	8MHz
EuroDOCSIS 256QAM	6.952MS/s	8MHz

\* On select models only.

**DAB Channel Parameters**

Channel serial number:  
 Channel name: Edit with keypad  
 Channel status: [Enable / Disable]  
 Signal type: DAB only  
 System rate: [50Hz / 60Hz]  
 Frequency: Edit with keypad

**DTMB Channel Parameters**

Channel serial number:  
 Channel name: Edit with keypad  
 Channel status: [Enable / Disable]  
 Signal type: DTMB only  
 System rate: [50Hz / 60Hz]  
 Frequency: Edit with keypad  
 Measure BW: [6 MHz / 7 MHz / 8 MHz]

**ISDB Channel Parameters**

Channel serial number:  
 Channel name: Edit with keypad  
 Channel status: [Enable / Disable]  
 Signal type: ISDB-T only  
 System rate: [50Hz / 60Hz]  
 Frequency: Edit with keypad  
 Measure BW: [6 MHz / 8 MHz]

**NOTE: Some parameters are auto-coupled together. Editing one of these will auto-edit related settings as well, optimizing your configuration. If the auto-adjusted settings do not match your requirements, you may proceed to adjust them manually.**

Each signal type selection (i.e., Analog TV, DVB-C or DOCSIS) will automatically populate default values for the chosen standard. Use the CH+ and CH- keys to quickly switch from one channel to the next. When switching channels or exiting the edit dialog, you will be prompted to save your changes. Select **OK** to save, or **Cancel** to discard changes.

More channel plan templates are available in the S7200 Toolbox software. *Deviser may be able to write customer-specific channel plans upon request.*



### 3-1.3 Importing and Exporting TV Channel Plans

To transfer user channel plan data to and from the S7200, you will first need to insert a USB storage device into the instrument's top panel.

Once the application reads the USB device, the **Export** key appears. In addition, if the USB device already contains some channel plan data, **Import** appears. This indicates that plans can be imported to the S7200, as well as exported for use in a PC or other instrument.



#### Procedure:

1. Press **Export** to open a dialog, as shown above. The plans saved to the S7200's local memory appear on the right, with plans (if any) saved to the USB device on the left.
2. Using the arrow keys, highlight a plan in local memory and click the rotary knob to place a check mark next to it. Repeat until all plans for export are marked.
3. Then, turn the rotary knob to highlight the [**<<<<<<**] button between the two panes and click the knob to confirm.

The selected plan(s) will be transferred to the USB device.

If a plan with the same name already exists on the destination USB device, you will be prompted to replace it. Select **OK** to overwrite, or press **Esc** to cancel.

The process for importing channel plans to the S7200 is similar. Simply insert a USB storage device with saved channel plan data, select **Import** instead of **Export**, and select your desired plans in the left-hand pane. Then navigate to the [**>>>>>>**] button and confirm the copy operation.

### 3-2 Satellite Channel Plans

A satellite channel plan involves both satellites and satellite transponders. New satellites are launched each year, many of them using their own modified transponder settings. There is no uniform standard; thus, users must manually enter the satellite and transponder parameters in their satellite channel plans. For more information, see Chapter 9: Satellites and Transponders.

#### 3-2.1 Creating a User Channel Plan

In the Satellite plan manager, tap **Add** to change the right-hand pane to a user plan creator. Enter the satellite plan name (or select from the list to the left).

Enter the desired longitude up to 2 decimal places, and select either East or West. Finally, enter the TP (transponder) sum and select the DL-C or DL-Ku band if prompted. Tap **Add** below when finished, then tap **List** to return to the plan list.



#### 3-2.2 Editing Satellite Channel Plans

There are several ways to modify an existing satellite plan. To change its name, highlight it in the left pane and tap **Edit**. Enter a new plan name using the touchscreen keyboard.

To activate or deactivate all transponders in a plan, highlight the plan and tap **Ena All / Dis All**. Please ensure that all the transponders you wish to activate are checked.

You can also modify the plan transponder-by-transponder. Tap the plan on the left, then select a transponder and tap **Edit**.

In this screen, you can edit a variety of individual transponder parameters. Settings vary by signal type, which include:

- Analog TV
- DVB-S
- DSS
- DVB-S2

#### Satellite Transponder Parameters

- Longitude
- Low Oscillation: 1000 ~ 12000 MHz
- High Oscillation: 1000 ~ 12000 MHz
- TP Name: Edit with keypad
- Status: [Enable / Disable]
- DL-C: 2000 ~ 4200 MHz
- Measure BW: 1.35 ~ 60.75 MHz
- Signal Rate: 1 ~ 45 MS/s
- Code Rate: [3/5 / 2/3 / 3/4 / 5/6 / 8/9 / 9/10]
- Modulation: QPSK (*only option*)
- Roll Off: [0.2 / 0.25 / 0.35]
- Polarization: [OFF / Horiz-Left / Vert-Right]
- LNB Oscillation: [High / Low / Auto]



The LNB (Low Noise Block Down Converter) is composed of microwave LNA (Low Noise Amplifier) and LNC (Low Noise Converter). The LNC is itself composed of a mixer, local oscillator, and IF preamplifier.

First, the LNB amplifies signals it has received in the C (3.4-4.2GHz) or Ku (10.7-12.75GHz) frequency bands. Then it uses the signal frequency, minus the local oscillator frequency in the mixer – converting the different-frequency signals into an IF signal of uniform frequency (950-2150MHz) which can be processed by IRD. For more background on satellite functions, see Chapter 10: Satellites and Transponders.

### C Band Transponder Frequencies

Transponder	Polarization	Downlink Freq (MHz)	Bandwidth Range (MHz)
1	H	3720	3702 ~ 3738
2	V	3740	3722 ~ 3758
3	H	3760	3742 ~ 3778
4	V	3780	3762 ~ 3798
5	H	3800	3782 ~ 3818
6	V	3820	3802 ~ 3838
7	H	3840	3822 ~ 3858
8	V	3860	3842 ~ 3878
9	H	3880	3862 ~ 3898
10	V	3900	3882 ~ 3918
11	H	3920	3902 ~ 3938
12	V	3940	3922 ~ 3958
13	H	3960	3942 ~ 3978
14	V	3980	3962 ~ 3998
15	H	4000	3982 ~ 4018
16	V	4020	4002 ~ 4038
17	H	4040	4022 ~ 4058
18	V	4060	4042 ~ 4078
19	H	4080	4062 ~ 4098
20	V	4100	4082 ~ 4118
21	H	4120	4102 ~ 4138
22	V	4140	4122 ~ 4158
23	H	4160	4142 ~ 4178
24	V	4180	4162 ~ 4198

### Ku Band Satellite Channels

Channel	Downlink Freq. (MHz)	Channel	Downlink Freq (MHz)	Channel	Downlink Freq. (MHz)
1	11727.48	9	11880.92	17	12034.36
2	11746.66	10	11900.10	18	12053.54
3	11765.84	11	11919.28	19	12072.72
4	11785.02	12	11938.46	20	12091.90
5	11804.20	13	11957.64	21	12111.02
6	11823.38	14	11976.82	22	12130.26
7	11842.56	15	11996.00	23	12149.44
8	11861.74	16	12015.18	24	12168.62

**NOTE: Some parameters are auto-coupled together. Editing one of these will auto-edit related settings as well, optimizing your configuration. If the auto-adjusted settings do not match your requirements, you may proceed to adjust them manually.**

Each signal type selection (i.e., Analog TV, DVB-C or DOCSIS) will automatically populate default values for the chosen standard. Use the CH+ and CH- keys to quickly switch from one channel to the next. When switching channels or exiting the edit dialog, you will be prompted to save your changes. Select **OK** to save, or **Cancel** to discard changes.

More channel plan templates are available in the S7200 Toolbox software. *Deviser may be able to write customer-specific channel plans upon request.*

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### 3-2.3 Importing and Exporting Satellite Channel Plans

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To transfer user channel plan data to and from the S7200, you will first need to insert a USB storage device into the instrument's top panel.

Satellite channel plans can be imported and exported using the same steps as TV channel plans. See subsection 3-1.3 for instructions.

## Chapter 4: Analog TV Measurements

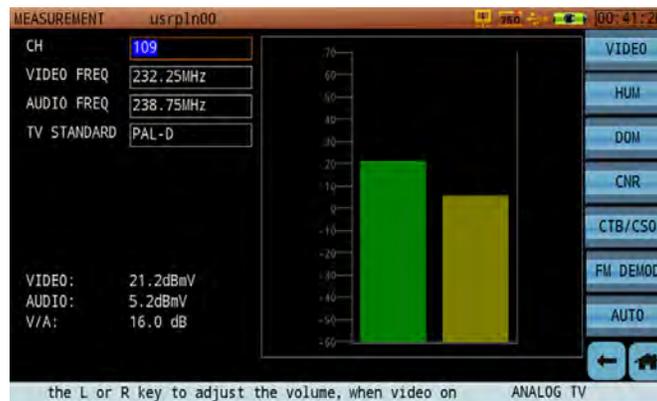
In this chapter, we discuss the S7200's powerful suite of TV signal measurement applications – including the Channel Measurement, Spectrum, TILT, Scan, Passive Sweep, CNR, and CTB/CSO functions.

### 4-1 Channel Measurement

In this mode, the S7200 measures the basic parameters of a channel. Supported channel types include analog FM, analog TV (pictured below), DVB-C, C2, T2, T/H, DOCSIS, and ATSC and ISDB-Tb (on select models). Note that the channel measurement menu (along the right side of the screen) displays different settings depending on the channel type being measured.

The Measurement function (shown below) can be used to read audio and video levels and V/A. A color-coded bar indicates the signal level of the video carrier (red and yellow indicate higher levels).

Use the left/right arrow keys to highlight the channel number, video/audio frequency, bandwidth, and other fields; then enter your desired values with the up/down arrow keys or the keypad.



#### 4-1.1 Settings

Channel:	The channel to measure. Select an active analog TV channel in the active plan.
Video Freq:	Input range 4-1220 MHz.
Audio Freq:	Input range 4-1200 MHz.
TV Standard:	Select NTSC-M, -N, -443; SECAM-BG, -DK, -L; PAL-B, -D, -G, -H, -I, -K, -M, or -N.

#### Button Operation

VIDEO	Displays analog TV video feed. (Only if the analog carrier has modulation info.) Use the Left/Right arrow keys to adjust volume.
HUM:	Switches to hum modulation function. (See Section 4-3.)
DOM:	Switches to Depth of Modulation function. (See Section 4-7.)
CNR:	Switches to Carrier-to-Noise Ratio function. (See Section 5-1.)
CTB/CSO:	Switches to Composite Second Order / Composite Triple Beat function. (See Section 5-2.)
FM DEMOD:	Switches to FM Demodulation function. (See Section 4-8.)
AUTO:	Auto-searches current frequency. (See Section 4-9.)

## 4-2 Analog FM

The Analog FM measurement screen, shown below, is primarily used to measure FM radio signal levels. You can also listen to the audio output.



### 4-2.1 Settings

- Channel: The channel to measure. Select any active analog or digital channel in the active channel plan.
- Frequency: Input range 4-1220 MHz;
- Step: Use the arrow keys to change the step size. Input range 1-1000 MHz.
- Test Result: The bar's length and color indicate the peak measured level of the carrier signal.

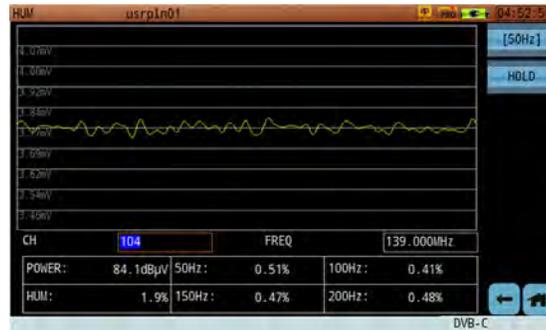
#### Button Operation

- Listen: Activates audio playback of the FM signal. Tap **Vol+** or **Vol-** to adjust the volume.

## 4-3 HUM Modulation

From the Channel Measurement mode, tap **HUM** to start the HUM modulation function.

Hum is an interference type that generates harmonics following AC frequencies. This phenomenon creates a visible distortion in television signals. With the Hum Modulation function, the S7200 measures the effects of this interference on analog and digital channels. The **analog** measurement screen is shown below.



### 4-3.1 Settings

Channel: The channel to measure. Select any active analog or digital channel in the active channel plan.  
 Frequency: Input range 4-1220 MHz.

#### Button Operation

[50Hz] / [60Hz]: Toggles the power frequency between 50Hz and 60Hz (depending on region).  
 Hold: Pauses the measurement. Press again to resume.

#### Test Results

Video Level: Displays the level of the current analog video signal.  
 Hum Modulation: Degree of hum modulation interference, as measured on the analog video carrier.  
 Freq Component: Displays the percentage of each frequency component.

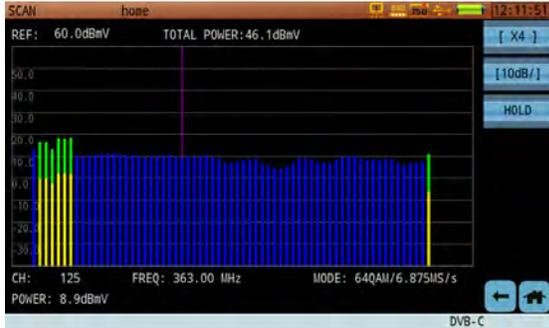
Low-frequency interference and interference harmonic will cause disruptions in an analog TV signal.

On the S7200, the highest measurable fourth harmonic is:

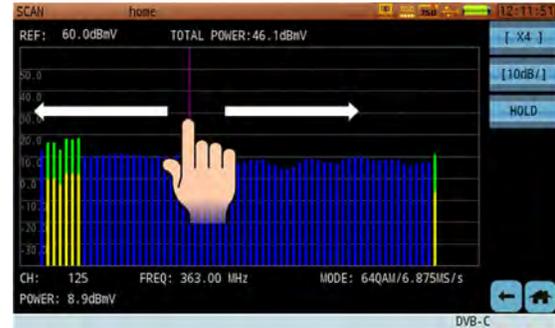
- **50Hz:** 50Hz, 100Hz, 150Hz and 200Hz
- **60Hz:** 60Hz, 120Hz, 180Hz and 240Hz

## 4-4 Channel Scan

The S7200 offers a channel scan function to quickly measure the flatness and amplitude of a CATV system (shown below). By default, the instrument scans all active analog or digital channels in the active channel plan. On **analog** channels, the Video Carrier level is displayed in green, and the Audio Carrier in yellow. On **digital** channels, Channel Power is displayed in blue, and MER in red.



**Channel Scan**



**Tap a marker line, then drag and release to move it.**

Channel Scan can fast-scan the amplitude of all channels in the system. In the figures above, yellow bars (audio carrier level) and green bars (video carrier level) represent analog TV channels, while the blue/red bars represent digital channels.

Users can increase and decrease the reference level with the Up/Down arrow keys, or view individual channel information with the Left/Right arrow keys. Detailed information is shown at the bottom of the screen. You can also zoom in up to x6 on the measurement by tapping the magnification key ( [x1] ) repeatedly.

### 4-4.1 Settings

#### Button Operation

- [X1] Changes the zoom level. Press repeatedly to cycle through x1, x2, x3, x4, x5 and x6 (depending on channel loading).
- [XdB/ ] Sets the amplitude scale size. Tap repeatedly to cycle through 10/5/2/1 dB per division.
- [Hold] Pauses the measurement. Press again to resume.

#### Test Results

- Total Power: The total power level measured over a specified bandwidth.
- Level/Power: Measurement results of a specified channel. The S7200 measures the sync pulse of an analog video carrier for analog channels, and channel power over the specified bandwidth for digital channels.

## 4-5 Passive Sweep

A stored passive sweep trace can be used as a reference. Up to 8 trace records can be saved to the S7200 for this purpose. This feature is primarily used when an active sweep reference generator is not in use at the HE or hub. First, tap **Save Ref** to store a trace. Enter a filename using the data keypad and tap OK.

Once at least 1 reference trace has been saved, tap **Load Ref** to select the desired reference trace from the hard drive. Then tap **Start** to compare it to a live trace being measured downstream. (When a saved trace is no longer needed, tap **Del Ref** to erase it from the hard drive. Deleted files cannot be recovered.)

The following figure is a comparison of two traces, before and after passing through a 4-way splitter. The amplitude shown by the marker is equal to the differentials of the two traces.

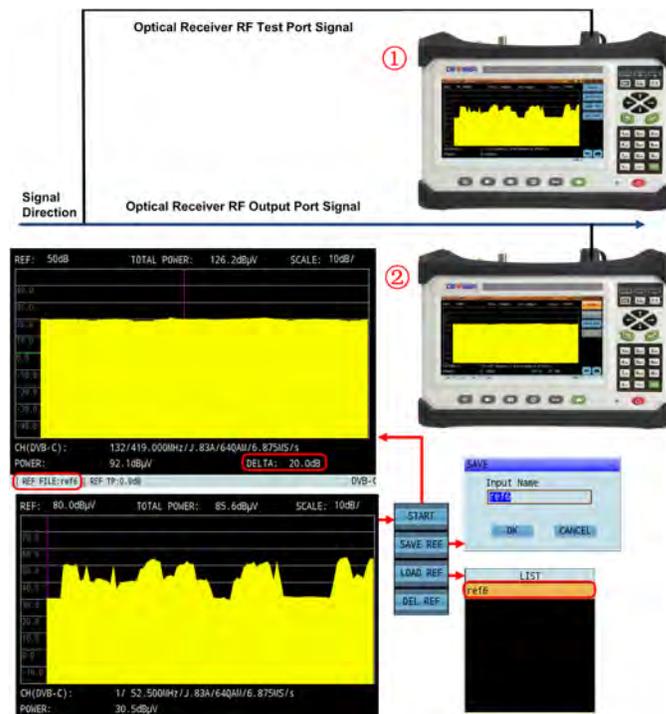


Diagram of Passive Sweep



Like the example above, first connect the S7200 to the input terminal of a splitter. Depending on the splitter used, we can see that the differential value is equal to the splitter port loss of an equal dB value. Begin a channel sweep measurement, and store the trace measurement result as a reference. Then switch the S7200 to the splitter's output port, and initiate a second channel sweep.

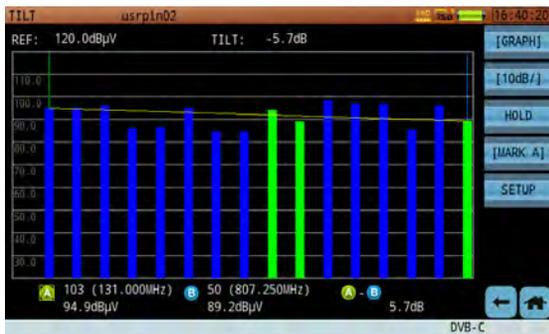
Compare the live measurement with the saved trace. We can see that the differential value is -7.1dB, which indicates that the signal has been attenuated 7.1dB – including 7dB attenuation for the splitter, connector attenuation, and signal fluctuation.

## 4-6 Tilt Measurement

The Tilt measurement helps to quickly measure the flatness of a CATV system and the gain of the splitters / taps. This feature provides power levels for up to 16 channels. Upon entering the Tilt function, you will be prompted to set the tilt plan. Select 4 - 16 channels from the channel plan window, then tap outside the window to start the measurement.

There are 2 markers, displayed as color-coded vertical lines, on the Tilt screen. Tap-and-drag a marker to move it left or right, or tap-and-drag the display up or down to change the reference level. When you move a marker over a channel in this way, its level and channel type are displayed.

The Tilt measurement has two different view modes. Tap **[Graph/List]** to toggle between them.



Tilt Measurement – Graph View



Tilt Measurement –List View

If you wish to re-select channels, tap **Setup** in the right menu. Channels are displayed with their type and frequency. (See below figure.)

### 4-6.1 Settings

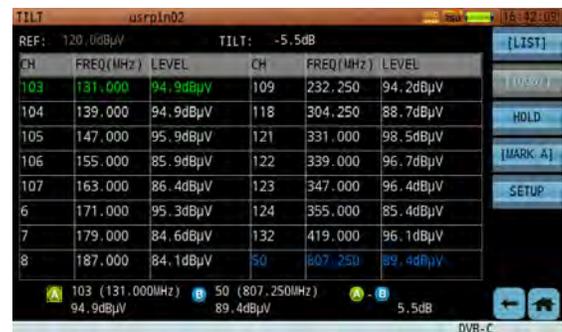
#### Button Operation

- [Graph] / [List]: Toggles the measurement display between Graph and List mode.
- Hold: Pauses the measurement. Tap to resume.
- [XdB/]: Sets the amplitude scale size. Tap repeatedly to cycle through 10/5/2/1 dB per division.
- Setup: Opens the tilt plan editing dialog, allowing you to select 4-16 channels to test.

#### Test Results

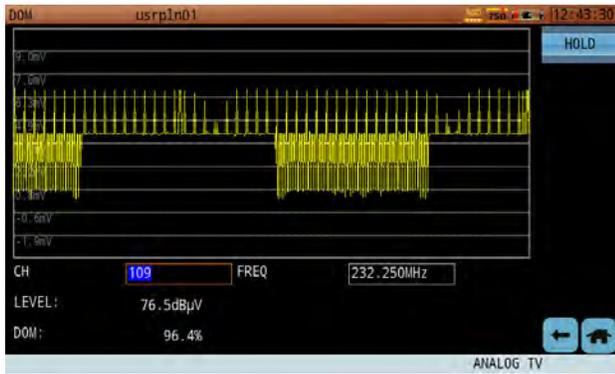
In Graph mode, all selected channels – no matter which – are organized by frequency from top to bottom. The tilt value is measured between the two markers.

Analog channels measure the peak sync pulse of the video carrier, while digital channels measure average power.



## 4-7 Depth of Modulation (DOM)

From the Channel Measurement mode, tap **DOM** to start the Depth of Modulation function. Depth of modulation is measured as the percentage of the total amplitude change of the carrier, as the signal progresses from sync tip to peak white.



You can measure depth of modulation on a TV channel with a vertical interval test signal (VITS). A test signal transmitted on the VITS of program video provides a reference to calibrate the video depth of modulation.

Transmission standards require that the DOM ratio be in the range of 87.5%. At horizontal sync position, the carrier reaches maximum amplitude. At the peak white color position, the carrier amplitude is 12.5% less than the maximum amplitude.

## 4-8 FM Demodulation

From the Channel Measurement mode, tap **FM DEMOD** to listen to FM audio broadcast / analog TV audio.



*FM Frequency Demodulation, Loop Count = 1*



*FM Frequency Demodulation, Loop Count > 1*

### 4-8.1 Settings

Channel: The channel to measure. Select any analog TV/FM channel in the active channel plan.  
 Frequency: Input range 4-1220 MHz.  
 Loop Count: Input range 1-100. If >1, the signal deviation trace appears, refreshing every 20 loops.

#### Button Operation

Listen: Activates audio playback of the FM signal. Tap **Vol+** or **Vol-** to adjust the volume.

#### Test Results

Level: Displays the level of the current analog signal.  
 FM Deviation: Signal deviation. See lower green bar. Disabled when **Listen** mode is on.  
 FM Max Deviation: Displays the maximum recorded FM Dev in the current session. See lower red bar.

## 4-9 Auto

The **Auto** function performs a rapid scan of all channels in the current channel plan. When activated, it reads the signal level and categorizes each channel as analog or digital. In a *digital* search, the Auto tool searches for DVB-C, DVB-T/H, DVB-T2, DTMB, DOCSIS, DVB-C2, ISDB-T, and ATSC in order.

Each channel type can be enabled or disabled in the search. If disabled, the Auto tool will skip over that type and continue searching at the next one.

As shown below, press the **Auto** key to determine whether the current signal is effective; the search will stop automatically if the signal is invalid. Effective signals will allow the scan to continue from DVB-T2; from there, a locked signal will cause the search to end.

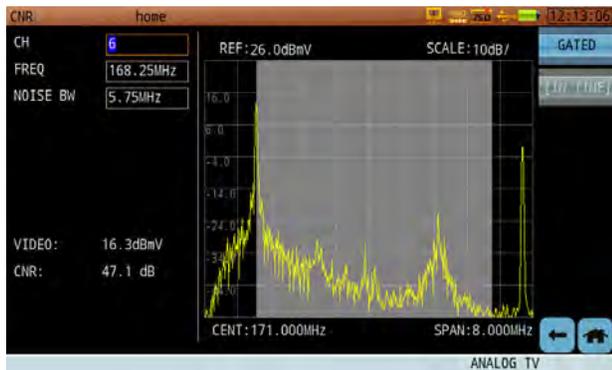
If no locked signals are present in any of the listed types, the search will start over from DVB-C and the message "Effective signal, not locked" will appear.



## Chapter 5: Analog Non-Linear Distortion Tests

This chapter contains instructions and concepts for the CNR (carrier-to-composite noise ratio) and CSO/CTB (composite second order/composite triple beat) measurements.

### 5-1 CNR



Before measuring CCN Ratio with your S7200 analyzer, visit the channel plan editor (see Chapter 3: Channel Plans) to set up the video carrier frequency and noise bandwidth correction as necessary for your test.

The noise bandwidth may differ depending on the channel bandwidth, which varies by location: NA, EU, or another region. For example, the NTSC-M system used in North America, as specified by the FCC, employs a 4MHz noise bandwidth correction; while PAL-D systems use a 5.75MHz noise correction.

Use the arrow keys to select and modify the fields on the left. First choose a channel to measure.

#### Noise measurement bandwidth for various TV standards

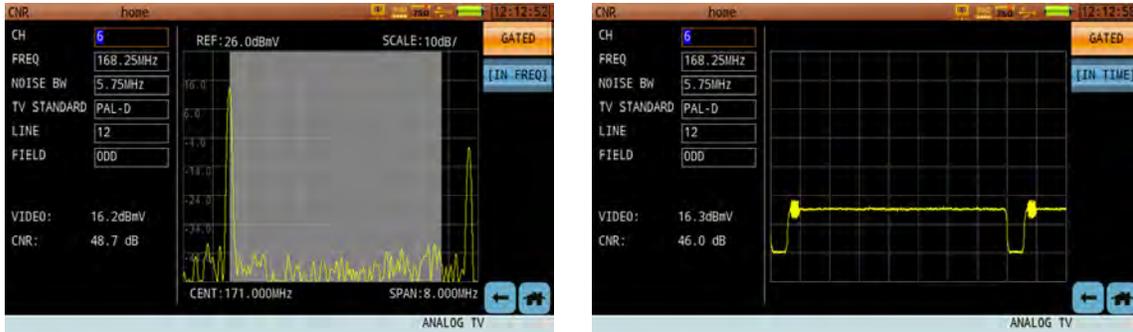
Standard	I	B, G	K1, L	D, K	M, N
Video bandwidth	6.75	5.75	7.25	6.75	4.95
Noise bandwidth	5.08	4.75	5.58	5.75	4.00

Typically, CCN measurements require that system engineers first measure the video carrier level (where the sync tip of the modulation is the absolute peak level); then remove the video modulation by shutting down the modulator - or simply remove the modulation from the carrier - to allow accurate noise measurement. Unfortunately, removing the modulation interrupts service.

A better way to measure CCN accurately is to perform an in-service "gated" measurement, with the help of gating technology and quiet line insertion in the vertical blanking interval of video signals that are off the viewable screen (usually below line 12). If you choose a higher VITS line, you may start encountering video modulation, and thus visible interference on the television picture.

In a gated CCN test, the S7200 will first measure peak carrier level, and then trigger on the appropriate VITS line # (preset for each channel; can be set in the channel plan editor) to measure noise. Occasionally, VITS lines are already quiet enough when video signals are delivered by the Broadcaster. It is highly recommended to use your own VITS inserter to remove any measurement uncertainty.

Many other types of test signals may be inserted for gated mode testing, including in-channel frequency response, differential gain, and differential phase. A quiet line is absolutely required for measuring CCN, CSO, CTB, or cross-modulation. The S7200 is equipped with triggering technology that accurately locks onto a specific VITS line and provides precise measurement results.



**Gated CCN Measurement – Frequency-Domain Waveform (left) and Time-Domain Waveform (right)**

To conduct a gated measurement, ensure that the video carrier frequency, noise bandwidth, TV signal standard, odd/even field, and line number are set properly in the channel plan editor. (See Section 3-2.) Then tap **Gated** to toggle it on.

CCN gated measurements support the following TV standards:

System & standard	Line/frame	Field frequency	Color encoding technique
NTSC-M	525	60Hz	NTSC
PAL-M	525	60Hz	NTSC
PAL-B, D, G, H, I, K	625	50Hz	PAL
PAL-N	625	50Hz	PAL

Per frame 525 lines system: Field 1 (odd field), line 1-263; Field 2 (even field), line 2-262  
 Per frame 625 lines system: Field 1 (odd field), line 1- 313; Field 2 (even field), line 2-312

## 5-2 CTB / CSO

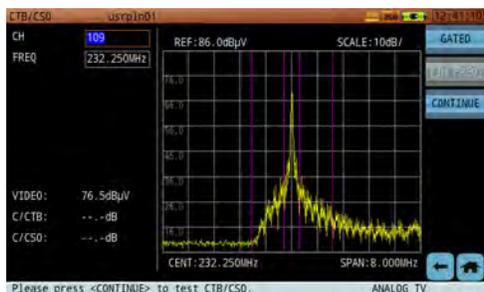
Typically, CTB/CSO measurements require that system engineers first measure the video carrier level (where the sync tip of the modulation is the absolute peak level); then remove the video modulation by shutting down the modulator - or simply remove the modulation from the carrier - to allow accurate noise measurement. Unfortunately, removing the modulation interrupts service.

A better way to measure CTB/CSO accurately is to perform an in-service "gated" measurement, with the help of gating technology and quiet line deletion/insertion in the vertical blanking interval of video signals that are off the viewable screen (usually below line 12). If you choose a higher VITS line, you may encounter video modulation, and thus visible interference on the television picture.

Occasionally, VITS lines are already quiet enough when video signals are delivered by the Broadcaster. It is highly recommended to use your own VITS inserter to remove any measurement uncertainty. CTB distortion falls exactly at the video carrier frequency. But CSO distortion typically falls  $\pm 0.75$  MHz and  $\pm 1.25$  MHz from the video carrier. In a PAL-D system, CSO production falls  $\pm 0.25$  MHz and  $\pm 1.25$  MHz from the carrier.

When we measure CSO and CTB, the test results are in terms of C/CSO and C/CTB. In the gated mode, the S7200 will first measure absolute carrier level, then trigger the appropriate VITS line # (preset for each channel - can be set in the channel plan editor) to measure noise.

The CTB interference signal, however, falls exactly under the video carrier frequency; and since the video carrier amplitude is likely to be higher than the interference, a gated CTB measurement **must** use a line-removing/inserter equipment to remove one line, or at least one field of one line, of the video carrier signal.

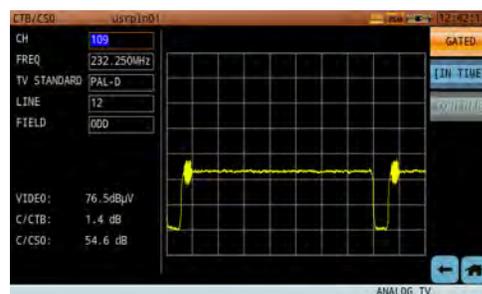
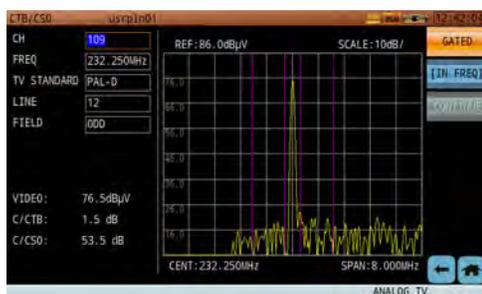


Many other types of test signals may be inserted for gated mode testing, including in-channel frequency response, differential gain, and differential phase. A quiet line is absolutely required for measuring CCN, CSO, CTB, or cross-modulation. The S7200 is equipped with triggering technology that accurately locks onto a specific VITS line and provides precise measurement results.

Use the arrow keys to select and modify the fields on the left. First choose a channel to measure.

At the screen above, press **Continue** (F3) to proceed to testing. "Please turn off the carrier!" will appear.

**NOTE:** Using such line-removing/inserter equipment for CTB measurements will cause an audible "ticking" noise in your television speaker output. This test requires that the test signal be inserted *only* for the duration of the actual test, and not left "on" all the time - so as to avoid customer concerns about audio problems.



**Gated CTB/CSO Measurement – Frequency-Domain Waveform (left) and Time-Domain Waveform (right)**

## Chapter 6: Digital Signal Measurements

Digital QAM analysis functions include the following channel measurements:

- DVB-C measurement
- Digital HUM
- Constellation diagram
- EVS (Error vector spectrum)
- Antenna editor
- DTMB measurement
- ATSC (8VSB) (in select models only)
- DVB-C2 measurement
- DVB-T/H measurement
- DVB-T2 measurement
- DVB-S/S2 measurement
- Transport stream analysis
- DAB/DAB+ measurement
- ISDB-T<sub>b</sub> (in select models only)

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### Parameter Settings

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The S7200's channel analysis function is fully automated, except for a few simple values such as frequency. Most parameters are acquired automatically. (They may still be manually adjusted to user preference).

Adjustable parameters and range of the DVB-C function of the S7200 are as follows.

Parameter	Key	Value Range	
Channel number	CH	All active digital channels in the active channel plan	
Center frequency	FREQ	4~1200 MHz	
Channel bandwidth	BW	1~50 MHz	
Modulation mode	MODE	<b>J.83A:</b>	16 / 32 / 64 / 128 / 256 QAM
		<b>J.83B / C:</b>	64 / 256 QAM
Symbol Rate (MS/s)	SR	2~7 MS/s	
Interleave Depth	(n/a)	Self-adaptive only. Setting is displayed in status bar.	

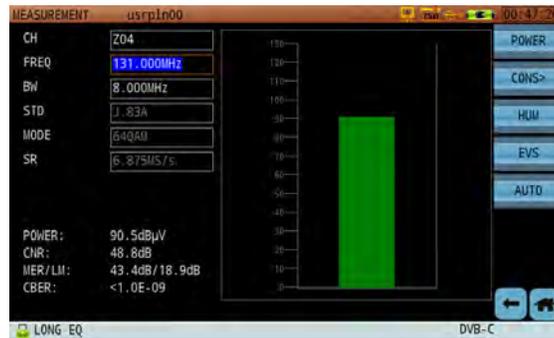
#### Relevant Icons

-  QAM signal losing lock
-  QAM signal lock
- I12-J17** Interleave depth of the I & J signals

## 6-1 DVB-C Measurement

The digital channel measurement screen (shown below) displays basic digital metrics after demodulation.

Tap the screen (or use the arrow keys) to move between parameters: channel, frequency and bandwidth. When the cursor highlights a field, you can adjust the value with the arrow keys or input your desired value with the keypad.



### 6-1.1 Settings

#### Button Operation

[POWER]	Opens average power function.
[CONS>]	Opens constellation diagram function.
[HUM]	Opens digital hum function.
[EVS]	Opens EVS function.
[AUTO]	Auto-searches current frequency. (See Section 4-9.)

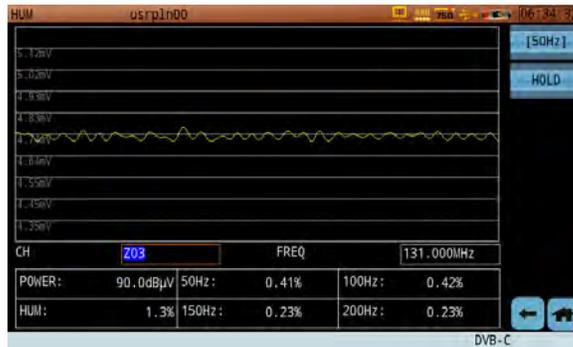
#### Test Results

LM (Link Margin): Difference between actual received MER value and MER threshold standard.

The threshold standard value varies by channel type, modulation type, and code rate.

## 6-2 Digital HUM

Hum modulation, or power source frequency modulation distortion, comes from a power source frequency interference. HUM modulation generally degrades MER values of a digital carrier. The S7200 supports hum modulation measurements for digital channels. The measurement interface is shown below.



### 6-2.1 Settings

**Channel** The channel to measure. You can select any active channel in the active channel plan.  
**Frequency** Input range 4-1220 MHz.

#### Button Operation

**[50Hz] / [60Hz]** Toggles the power frequency between 50Hz and 60Hz.  
**Hold:** Pauses the measurement. Press again to resume.

#### Test Results

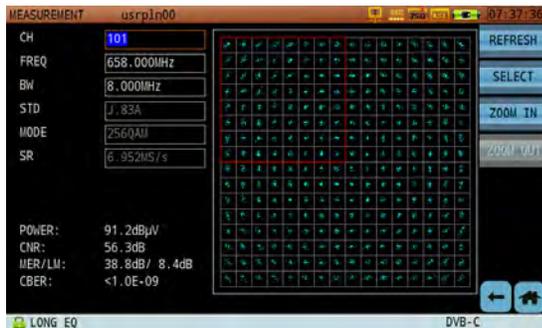
**Average Power:** Measured over the occupied bandwidth (Level).  
**Hum Modulation:** Degree of hum modulation interference, as measured under the digital QAM carrier. (DOCSIS specification recommends not to exceed 5%; the less, the better.)  
**Freq Component:** Displays the percentage of HUM for each of the distortion frequencies.

You can choose the AC power frequency according to your local region. The S7200 can measure the following low-frequency interference and interference harmonics:

- **50Hz:** 100Hz, 150Hz and 200Hz
- **60Hz:** 120Hz, 180Hz and 240Hz

## 6-3 Constellation Diagram

In the constellation diagram, you can refresh and zoom the display. To zoom in, first tap **Select** repeatedly to place the red border over a quadrant to view. After choosing the quadrant, tap **Zoom IN**. The selected quadrant will expand to fully occupy the screen. (See below.)



*Constellation – Quadrant Select*



*Constellation – Zoom In & Zoom Out*

Use the arrow keys (or tap the screen) to move between parameters: channel, frequency and bandwidth. When the cursor highlights a field, you can adjust the value with the arrow keys or input your desired value with the keypad.

### 6-3.1 Settings

#### Button Operation

- Auto: Auto search the current frequency.
- Refresh: Clears accumulated data points and restarts measurement.
- Select: Press repeatedly to select the desired quadrant for zooming.
- Zoom In/Out: Zoom in on the selected quadrant. Press again to zoom out to the original display.

## 6-4 Error Vector Spectrum (EVS) Function

The EVS function is a powerful tool for locating signal interference under the QAM (DVB-C or DOCSIS) in-service. Traditional methods require briefly interrupting the QAM signal, in order to see any distortion products mixed with the noise floor underneath. This is non-ideal in today's HFC preventive network maintenance practices.

The EVS function helps find interference signals under the QAM signal without interrupting service. It works two different ways: in the time domain, and in the frequency domain. The frequency domain function is typically used to find interference signals of much narrower bandwidth than the QAM signal.



**Error Vector Spectrum – Frequency Domain (left) and Time Domain (right)**

However, when the interference is broadband in nature – meaning that its bandwidth is close or wider than the QAM bandwidth (5MHz, or 10MHz in the case of LTE signals) – the time domain function is the right tool. In recent years, the most common and disruptive broadband signals are cellular LTE signals that may creep into an HFC network and interfere with QAM signals being transmitted over Cable at the same frequencies.

Frequently used LTE bandwidths include 5, 10, and 20MHz. These types of bandwidth are all close to or wider than the DVB-C signal bandwidth. Both LTE and DVB-C are digital signals, and are similar to noise. The S7200 uses the EVS time-domain function to display LTE sub-frames coming in every 1ms (above).

## 6-5 ATSC (8VSB) Measurement

The S7200-ATSC model supports the ATSC (8VSB) signal measurement option.

**Note that ATSC (8VSB) is a hardware upgrade option. Contact your Deviser representative for details.**

For 8VSB signals, the S7200 provides a variety of measurement functions: average power, constellation diagram, eye diagram, digital HUM, and spectrum mask. (Digital HUM focuses mainly on cable transmission 8VSB signals.)

### 6-5.1 Measurement Setup

In order to demodulate 8VSB signals, the user must first set up the following parameters:

Pilot position: the S7200 has the unique ability to auto-set the pilot position. It can be set to the left (low) side or the right (high) side of the spectrum.

Center frequency: the carrier center frequency

Modulation type: 8VSB

Symbol rate: 10.762MS/s

If the above settings are in place and a clear signal is received, the S7200 can correctly demodulate 8VSB.

### 6-5.2 Average Power

In the Average Power interface, 8VSB signal power (below, left) is displayed as a histogram. MER, Pre-BER and Post-BER readings are listed in the lower-left.

### 6-5.3 Constellation Diagram

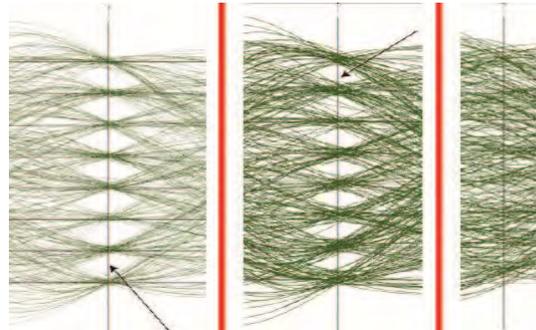
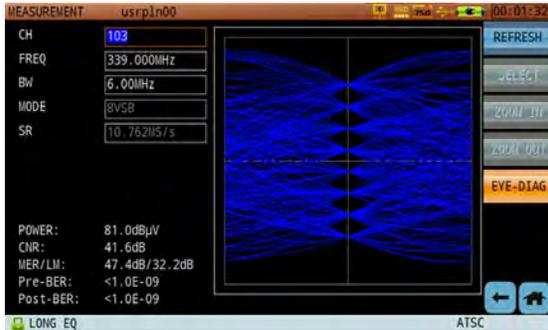
The constellation diagram (below, right) is split into 8 vertical fields. Each field is populated by an increasing number of data points. For each point, the horizontal coordinate carries data, while the vertical coordinate does not. The thinner the vertical line, the better the signal. A perfectly compacted signal appears as a straight vertical line.

The constellation diagram can be used to quickly check signal quality. Bowed lines indicate amplitude errors, such as clipping or nonlinear expansion (AM-AM distortion). S-shaped lines indicate phase error (AM-PM distortion). Lines that appear frayed at the edges indicate phase noise problems.



### 6-5.4 Eye Diagram

Another way to determine the signal quality is with the eye diagram. Look for the seven “eyes” down the center of the display, formed by intercrossing lines. If some eyes are not fully “open”, the signal is not clear enough. A perfectly compacted signal appears as clear open eyes.

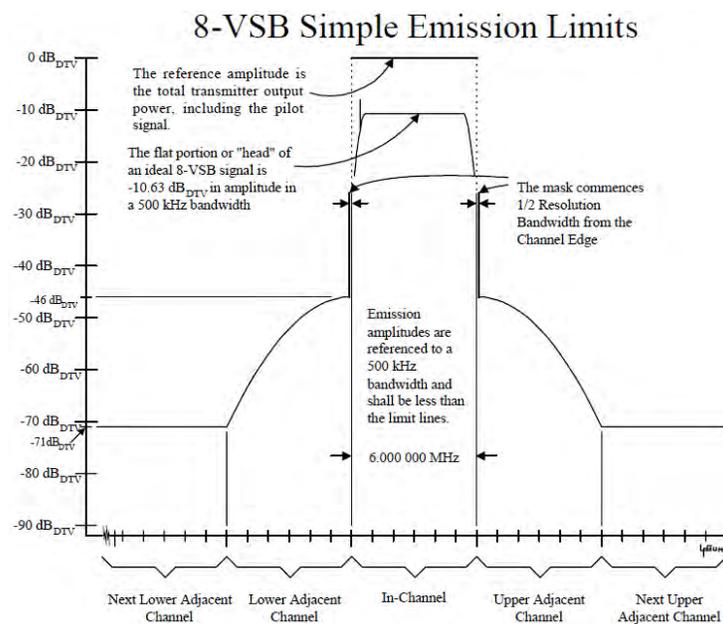


### 6-5.5 Spectrum Mask

In the US, the FCC has specified different emission masks for different types of 8-VSB DTV transmitters. One mask is specified for Full Service digital transmitters. Two other masks – termed “Simple” and “Stringent” – are specified for digital LPTV (Low-Power Television) transmitters, Class A digital transmitters and digital TV translators. The conditions imposed by the licensing process and the FCC’s regulations should be consulted to determine which mask is appropriate for a given digital transmitter (below, right).

If you receive a “FAILED” message immediately on entering the spectrum mask function, you may need to adjust the attenuation. Tap **ATT** to open the attenuation submenu, then tap **Input** to enter a value or **Inc/Dec** to adjust it up or down.

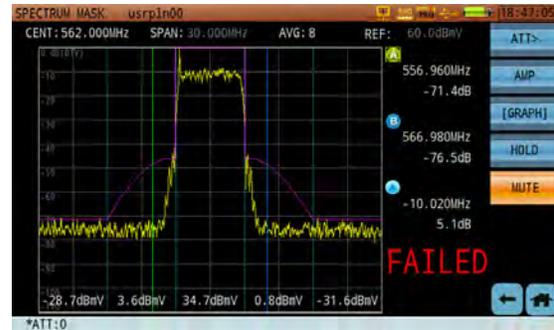
The spectrum mask function also supports a list display mode, showing major frequency points and the pass/fail rating and signal strength at each (below, left).



The S7200-ATSC supports 8-VSB Simple Emission Limits with pass-fail testing (shown below). If the signal does not meet the "Simple" emissions mask requirements, an audio alarm will sound and the message "FAILED" will appear in red. (Tap Mute to stop the alarm.)



**Spectrum Mask Test – Pass**



**Spectrum Mask Test – Fail**

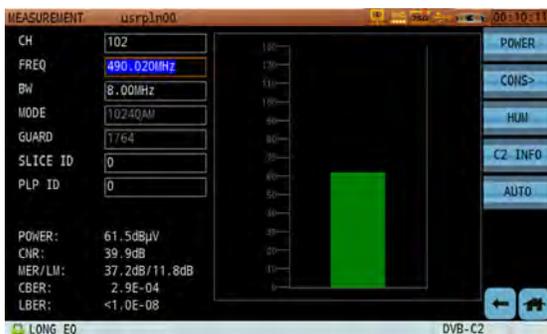
A screenshot of the Spectrum Mask test interface in list view, showing a table of test results for 12 different bands. Each row includes the band number, the measured value, the mask value, and the status (PASS or FAILED).

Band	VALUE	MASK	STATUS	Band	VALUE	MASK	STATUS
-12	-74.6dB	-69.0dB	PASS	1	-48.0dB	-46.0dB	PASS
-11	-73.9dB	-65.1dB	PASS	2	-58.4dB	-46.4dB	PASS
-10	-74.5dB	-61.7dB	PASS	3	-73.3dB	-47.1dB	PASS
-9	-73.5dB	-58.5dB	PASS	4	-73.9dB	-48.1dB	PASS
-8	-73.4dB	-55.8dB	PASS	5	-73.6dB	-49.5dB	PASS
-7	-73.8dB	-53.3dB	PASS	6	-73.8dB	-51.3dB	PASS
-6	-73.5dB	-51.3dB	PASS	7	-74.1dB	-53.3dB	PASS
-5	-74.1dB	-49.5dB	PASS	8	-73.8dB	-55.8dB	PASS
-4	-73.3dB	-48.1dB	PASS	9	-74.1dB	-58.5dB	PASS
-3	-72.5dB	-47.1dB	PASS	10	-74.3dB	-61.7dB	PASS
-2	-57.9dB	-46.4dB	PASS	11	-74.4dB	-65.1dB	PASS
-1	-45.5dB	-46.0dB	FAILED	12	-74.3dB	-69.0dB	PASS

**Spectrum Mask – List View**

## 6-6 DVB-C2 Measurement

The S7200 supports DVB-C2 signal demodulation, including 1024QAM and 4096QAM signal. Users can also find L1 and SLICE ID information here.



**DVB-C2 Power Measurement**



**DVB-C2 4096 QAM Constellation**

A DVB-C2 frame begins with preamble symbols, which are repeated every 7.61MHz and have a width of 3408 carriers each. These are followed by a total of 448 data symbols. The preamble symbols are used both for time/frequency synchronization and for signaling the Layer-1 (L1) parameters; they are arranged such that a receiver with a bandwidth of 7.61Mhz will get all the data necessary for determining the Layer-1 parameters.

There are no longer any channels in DVB-C2; instead, there are two channel rasters of either 6 or 8 MHz. Channels can be bundled together to form a channel with a total width of approx. 450MHz. There are no gaps (guard bands) between the original channels, enabling more effective frequency spectrum use and a higher data rate overall. However, interfering signals and other disturbances are common. These can be notched out in DVB-C2 by simply switching off certain OFDM carriers. This notching process produces gaps in the frequency spectrum.

## 6-7 DVB-T/H Measurement

The S7200 supports DVB-T/H signal measurement.

For DVB-T/H signals, the S7200 provides a variety of measurement functions: average power, constellation diagram, MER/BER, single-carrier or multi-carrier constellation, and single-frequency network echo.

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### 6-7.1 Measurement Settings

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In order to demodulate 8VSB signals, the user must first set up the following parameters:

Channel type: the first step is to set the channel type to DVB-T/H in the channel plan editor (see Chapter 3 for details).

Center Frequency: the carrier center frequency

All other parameters will be auto-set according to the pilot and TPS carrier. (Note: DVB-H 4k carrier mode is not supported.) If the above settings are in place and a clear signal is received, the S7200 can correctly demodulate 8VSB.

---

### 6-7.2 CBER and VBER

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CBER and VBER indicate the quality of the signal provided to the receiver. A TV receiver can identify and correct certain amounts of error in the transmission channel. Error correction takes place in two distinct stages: Viterbi (or "outer") and Reed Solomon (or "inner") correction.

The bit error rate (BER) prior to Viterbi correction is known as CBER, pre Viterbi BER, raw BER, or channel BER. CBER indicates errors that are present before any correction has taken place in the TV, set-top box, or test instrument. Therefore, CBER is a very important factor in digital TV measurements. Ideally, it should be better than  $2E-2$  (2 errors in every 100 bits of data) for good-quality TV reception.

The BER after Viterbi correction is known as VBER or post Viterbi BER. Ideally, it should be better than  $2E-4$  (2 errors in every 10000 bits of data).

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### 6-7.3 Average Power

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In the Average Power interface, DVB-T/H signal power is displayed as a histogram. MER, CBER, and VBER readings are listed in the lower-left.

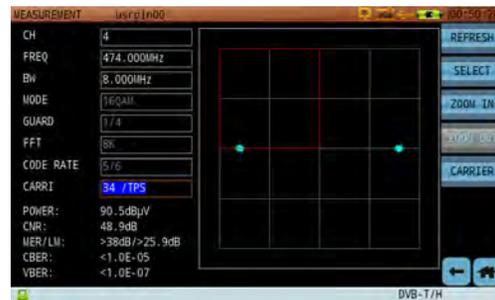
### 6-7.4 Constellation Diagram

The DVB-T/H constellation function features two display modes: single-carrier, multi-carrier, and hierarchical modulation constellation. Multi-carrier (right) is the default mode. Tap **Carrier** to select a different carrier number from the dropdown box. If a carrier number is followed by "DATA", that carrier is used for data transmission; if "TPS", it is used for Transport Parameter Signaling transmission.



The DVB-T 8k mode has 6817 sub-carriers, while 2k has 1705 sub-carriers. All sub-carriers are one of three types:

- Data carriers. Used to transmit digital TV transport stream MPEG-2 signals. (Below, left.)
- TPS (Transport Parameter Signaling) carriers. Used to transport receiver parameter requirements. For instance: modulation type (QPSK, 16QAM, 64QAM), FEC coding (1/2, 2/3, 3/4, 5/6, 7/8), 2k or 8k mode, guard interval (1/4, 1/8, 1/16, 1/32). (Below, right.)
- Pilot carriers. Used to help the receiver calibrate and receive signal amplitude and phase.



For 8k mode: total carrier amount 6817 = 6048 (Data) + 68 (TPS) + 701 (Pilot).  
 For 2k mode: total carrier amount 1705 = 1512 (Data) + 17 (TPS) + 176 (Pilot).

2K Mode TPS Carrier Position	8K Mode TPS Carrier Position
34, 50, 209, 346, 413, 569, 595, 688, 790, 901, 1073, 1219, 1262, 1286, 1469, 1594, 1687	34, 50, 209, 346, 413, 569, 595, 688, 790, 901, 1073, 1219, 1262, 1286, 1469, 1594, 1687, 1738, 1754, 1913, 2050, 2117, 2273, 2299, 2392, 2494, 2605, 2777, 2923, 2966, 2990, 3173, 3298, 3391, 3442, 3458, 3617, 3754, 3821, 3977, 4003, 4096, 4198, 4309, 4481, 4627, 4670, 4694, 4877, 5002, 5095, 5146, 5162, 5321, 5458, 5525, 5681, 5707, 5800, 5902, 6013, 6185, 6331, 6374, 6398, 6581, 6706, 6799

#### DVB-T Hierarchical Modulation

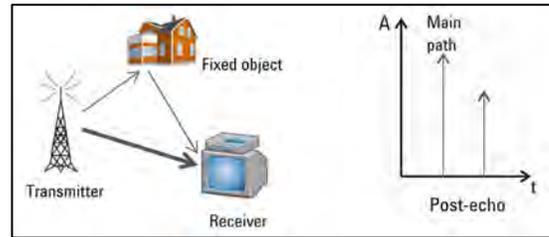
DVB-T introduces *hierarchical modulation*, where symbols from adjacent quadrants are mapped non-uniformly. DVB-T defines a parameter factor  $\alpha$ , where  $\alpha = 1, 2, 4$ . This factor  $\alpha$  stands for the distance at which a symbol is closest to the X and Y axes. When  $\alpha = 1$ , it means there is no hierarchical modulation. When  $\alpha = 2$  or 4, there is hierarchical modulation.



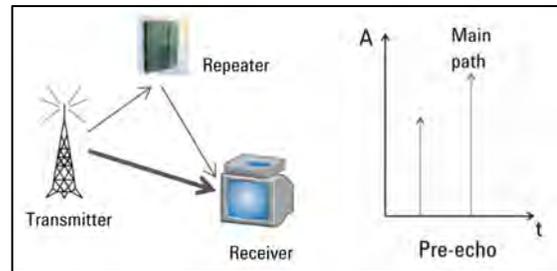
In hierarchical modulation, two separate data streams are modulated onto a single DVB-T stream. One, the "High Priority" (HP) stream, is embedded within the "Low Priority" (LP) stream.

DVB-T/H Echo Pattern

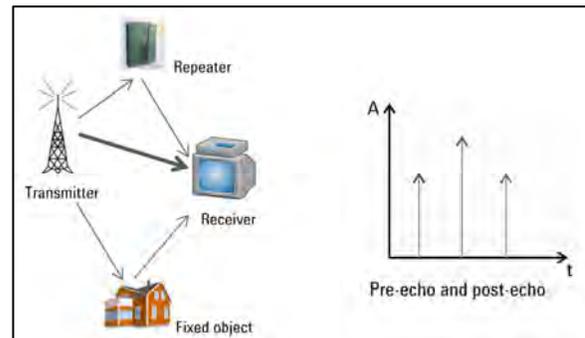
- Post-echo: In this scenario, the strongest path (main path) leads from the nearest transmitter tower, and the other paths are either from transmitters located further away or from reflections which arrive after the main path and have lower power levels. (Below, only one echo is shown.)



- Pre-echo: Pre-echoes often occur when there are repeaters nearby. In this scenario, the main path is re-transmitted from the repeater and doesn't arrive first. The LOS (line of sight) path arrives first but has a lower power level.



- Pre-echoes and post-echoes: This scenario occurs when both a pre- and post-echo exist in the transmission channel. The main path is re-transmitted from the repeater. The LOS signal arrives first but it has a lower power level and the paths that arrive later may be from reflections.



- Impulse response: Here, the main path signal is at the center of the pattern (below). On the left side of the main path is pre-echo, on the right is post-echo. The non-shaded area shows the guard interval. Different guard interval settings produce different shaded areas in the echo pattern. In the echo list, tap an echo entry to move the marker there. You can also view the distance and delay time from the echo transmitter to the main transmitter.



## 6-8 DVB-T2 Measurement

The DVB-T2 (standard EN 302755) measurement's version history includes v1.1.1, v1.2.1, and v1.3.1. v1.3.1 added a "T2-Lite" profile, intended for simpler receiver implementations and very low capacity applications such as mobile broadcasting; although it may also be used with conventional stationary receivers. T2-Lite is a "light" version of DVB-T2 standard (T2-Base) with some complex components removed, allowing for implementation of mobile devices with low complexity and power consumption. T2-Lite is specified in an updated version of the DVB-T2 standard (published by ETSI in 2012 [EN 302 755 v.1.3]).

The S7200 supports the DVB-T2 signal test in EN 302 755 v1.1.1, v1.2.1 and v1.3.1. A variety of measurement functions are available: average power, MER, CBER, VBER, constellation test, echo pattern, and L1 and PLP information.

### 6-8.1 Measurement Settings

In order to demodulate 8VSB signals, the user must first set up the following parameters:

Channel type: the first step is to set the channel type to DVB-T/H in the channel plan editor (see Chapter 3 for details).

Center Frequency: the carrier center frequency

Other DVB-T2 parameters will be auto-set according to the pilot, P1 symbol, and L1 pre-signaling and post-signaling. If the above settings are in place and a clear signal is received, the S7200 can correctly demodulate 8VSB. Tap **T2 Info** to view P1 symbol and L1 pre/post-signaling info.

### 6-8.2 CBER and VBER

See subsection 6-7.2 above.

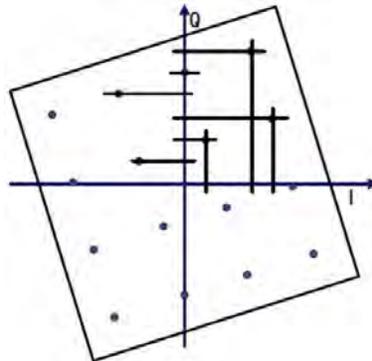
### 6-8.3 Average Power

In the Average Power interface, DVB-T2 signal power is displayed as a histogram. MER, CBER, and VBER readings are listed in the lower-left.



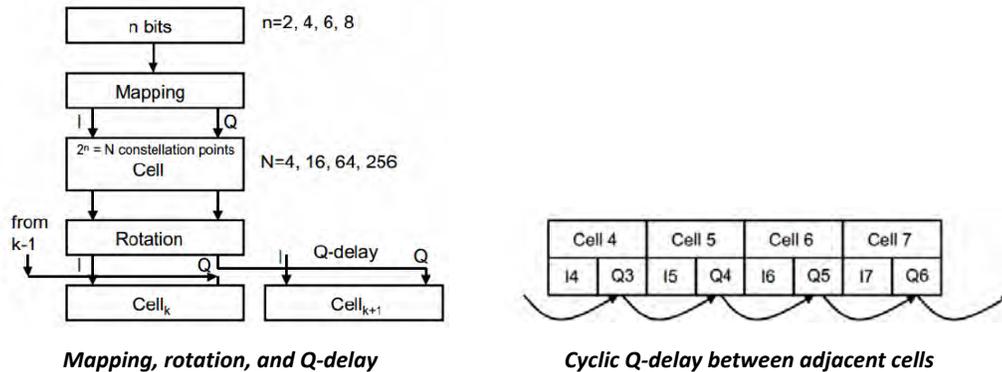
6-8.4 Constellation Diagram

New to DVB-T2, rotated constellations help improve system performance in fading scenarios by means of signal-space diversity. Here, rotation is applied to the constellation symbols so that the 2 components in the imaginary plane – in-phase I and quadrature Q – carry all the binary info. Then, the real and imaginary parts of each symbol are cyclically delayed and end up being transmitted in different subcarriers. This raises the reception robustness in the presence of deep fades, but requires a high demodulation complexity.



**Discrete mapping of constellation points on the I and Q axes, with a rotated constellation diagram**

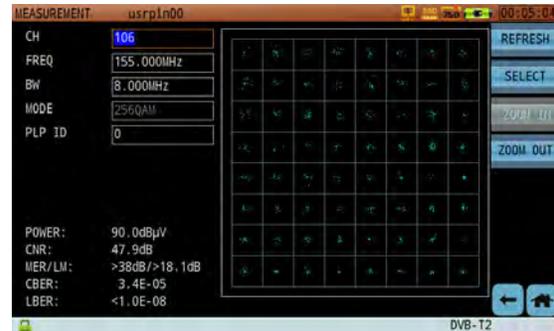
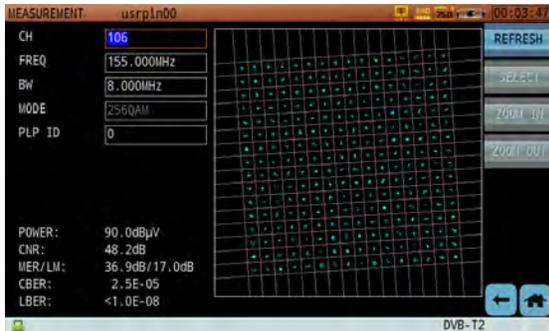
In reality, however, the whole process is slightly more complex. With a rotated diagram, the Q component is not transmitted on the same carrier (or more precisely, in the same “cell”), but with delay on another carrier (see below) or better in another cell. From one QAM, virtually 2 ASKs (Amplitude Shift Keying modulations) in the I and Q direction are produced, which are then transmitted on independent carriers – “cell” which are disturbed differently in practice and are thus intended to contribute to the reliability of demodulation.



**Mapping, rotation, and Q-delay**

**Cyclic Q-delay between adjacent cells**

The S7200 measures DVB-T2 rotated constellation, as shown below. This constellation is only for PLP content. If the DVB-T2 signal includes multiple PLPs, tap **PLP ID** to select one. Changing the PLP will also affect the constellation display (if each PLP has a different modulation type).



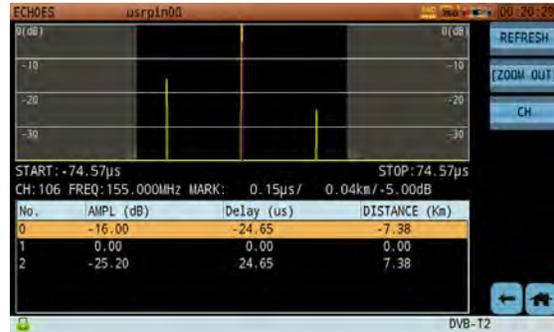
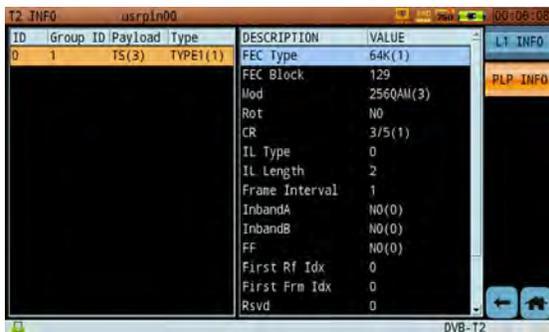
The physical layer signaling in DVB-T2 is transmitted inside preamble symbols, known as P1 and P2 symbols, at the beginning of each T2 frame. The P1 symbol is the first OFDM symbol transmitted in the T2 frame and is intended for fast identification of available T2 signals. P2 symbols are transmitted right after the P1 symbol, and carry Layer 1 (L1) signaling divided into pre- and post-signaling. L1 pre-signaling consists of very basic information (200 bits) and is always transmitted with the most robust configuration available (BPSK and code rate 1/5). L1 post-signaling, meanwhile, enables the reception of the actual data and is transmitted with constellations BPSK, QPSK, 16QAM or 64QAM and code rate 1/2. L1 post-signaling is composed of two parts: configurable and dynamic. The configurable portion signals the configuration of the PLPs and is seldom changed during the transmission of T2 signals. The dynamic portion signals the position of the PLPs in each frame and changes from frame to frame.

Use the **L1 Info** key to view signaling information (see right).

The term PLP (Physical Layer Pipe) was introduced for DVB-T2. In Mode A, only one data stream is being fed into the DVB-T2 modulator; in Mode B, there are multiple inputs. This standard can be used to transmit data with different robustness and data rates, a function called Variable Coding and Modulation (VCM).



Use the **PLP Info** key to view PLP information (see below).



## 6-9 ISDB-T<sub>b</sub> Measurement

The ISDB system was designed for high-quality audio, video, and associated data. Originally developed by and for Japan, ISDB was slightly modified for a Brazilian market in 2006, becoming the ISDB-TB\* standard. This has become the terrestrial broadcast choice for most of South America. In ISDB-T<sub>b</sub>, COFDM is used in 2K, 4K, and 8K mode. The 6MHz-wide channel can be subdivided into 13 sub-bands, in which different modulation parameters can be selected and different content transmitted. Time interleaving can be switched on in various stages. With an actual channel bandwidth of 6MHz, the useful band only has a width of 5.57MHz; that is, there is a guard band of about 200kHz each for the upper and lower adjacent channels. One sub-band of the ISDB-T channel has a width of 430kHz.

**Note:** The ISDB-T<sub>b</sub> measurement is only available on model S7200-ISDB. See Section 1-1 for details.

It is possible to select different types of modulation in ISDB-T:

- QPSK with channel correction
- 16QAM with channel correction
- 64QAM with channel correction
- DQPSK without channel correction

There are 3 possible modes (using 6MHz channel as example):

Mode	Carriers/sub-band	Subcarrier spacing	Carriers within channel	IFFT points
I	108	3.986 kHz	1404	2048
II	216	1.9841 kHz	2808	4196
III	432	0.99206 kHz	5616	8192

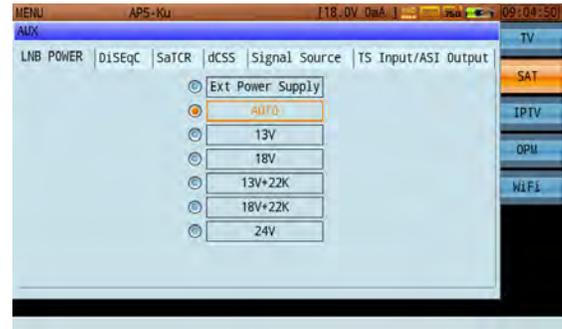
The individual segments in ISDB-T can be combined to form a total of 3 layers in which different transmission parameters (type of modulation and error protection) can be selected. In the 3 hierarchical layers, different data can then be error-protected to different degrees and transmitted with varying modulation robustness. The number of segments to be combined in one layer is selectable, but all segments must use the same transmission parameters. In the case of 3 layers, in principle, 3 associated mutually independent data streams must then be supplied.



\* The main differences of ISDB-TB compared to ISDB-T are source code (H.264 for video and MPEG-4 HE AAC for audio); middleware (Ginga); and adoption of VHF/UHF bands for channels 7–13 and 14–69, respectively. For ISDB-T, the MPEG-2 method was chosen as the source coding for the digital TV signals to be transmitted.

## 6-10 DVB-S/S2 Measurement

In order to measure satellite signals, tap the **SAT** key from the home menu to switch to satellite mode. Here, press the button and connect an RF cable from the satellite antenna to the instrument's RF input port. In the dialog that appears, choose the appropriate LNB power supply option & receiver for your satellite signal. (See right; for more information on this menu, see Section 13-4.)



Depending on the selected satellite channel plan, you can launch the **Measure** mode to view measurement results for a transponder on the current satellite.

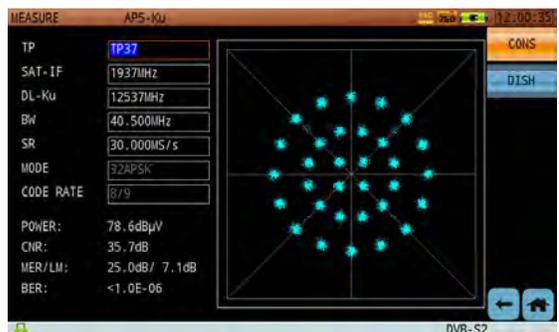
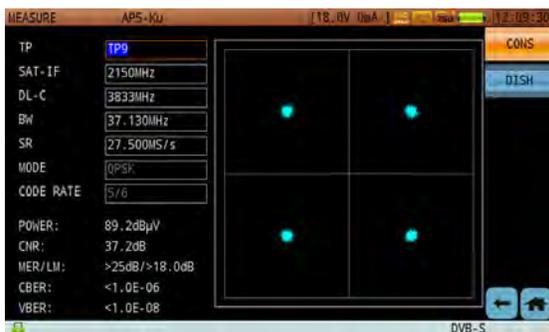
The S7200 supports DVB-S (below, left) and DVB-S2 (below, right) signal demodulation. For DVB-S2, only QPSK and 8PSK demodulation are supported.



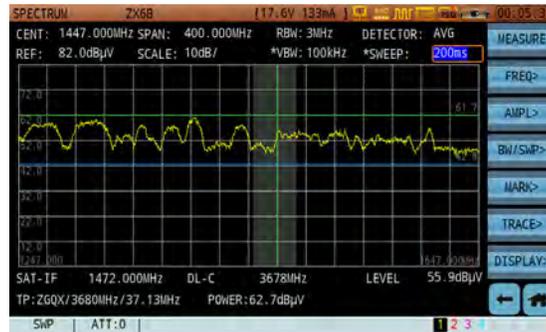
### 6-10.1 Settings

- TP: Transponder name. Use the up/down arrow keys to switch transponders.
- SAT-IF: Satellite IF, LNB output frequency. Range: 950 - 2150MHz.
- Satellite freq: DL-Ku band (10.75 - 12.75GHz), DL-C band (3.4 - 4.2GHz)
- BW and SR: Bandwidth and Symbol Rate (1 - 45MS/s).  $BW = (1 + \alpha)SR$ , where  $\alpha$  represents roll-off factor. You can find the roll-off factor value, modulation type, and code rate in the transponder setup screen.

Tap **CONS** to launch the constellation display.



In satellite mode, tap **Spectrum** to launch the satellite IF spectrum analysis function. See Section 6-15 for detailed instructions on spectrum analysis.



## 6-11 Antenna Edit

The antenna editor and satellite location tools offer a quick and dynamic way to check the signal strength and quality of one or more transponders. These functions are useful for installation and trouble-shooting satellites, or simply for routine maintenance.

**Note:** This function lists up to 10 active transponders on the screen. If the satellite has more than 10 active transponders, the instrument will automatically select the 10 strongest signals.



This display is used to observe the overall satellite signal environment. Users can switch between satellites, or between transponders on that satellite. Tap **SAT+/SAT-** to change satellites. You can manage the active transponders from the satellite channel plan editor; see Section 3-2 for details.

Once you have selected a satellite and transponder, set up the LNB power supply according to satellite parameters and local antenna conditions. Installation technicians will need to know the following:

Antenna GPS location (right). The S7200 offers a GPS module, allowing users to auto-acquire coordinates; or you can manually input the longitude / latitude (see below).

Azimuth Angle (0 ~ 180 degrees). Indicates the current horizontal deflection angle and direction of the satellite antenna. ("S" for South, "N" for North.)

Elevation Angle (0 ~ 90 degrees). Indicates the current vertical deflection angle/direction of the satellite antenna.

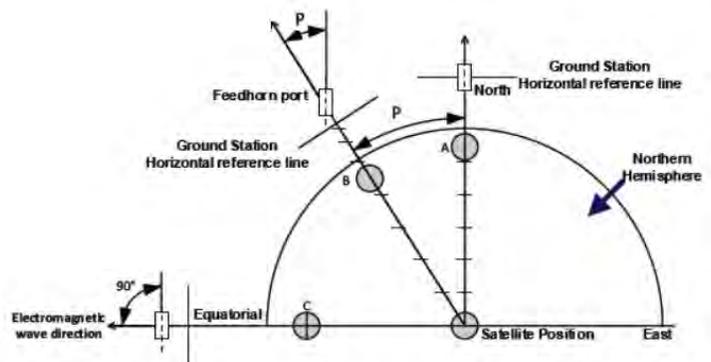
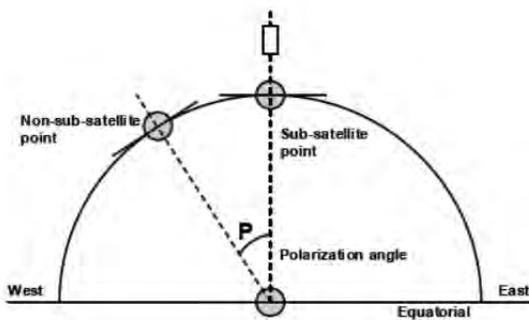
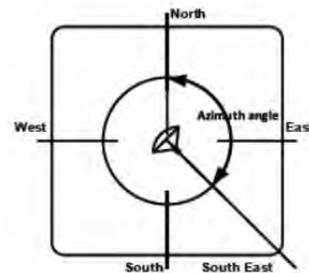
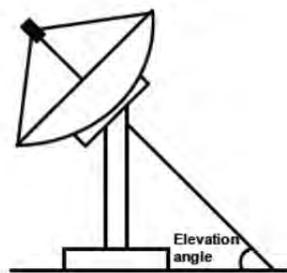
LNB polarization angle



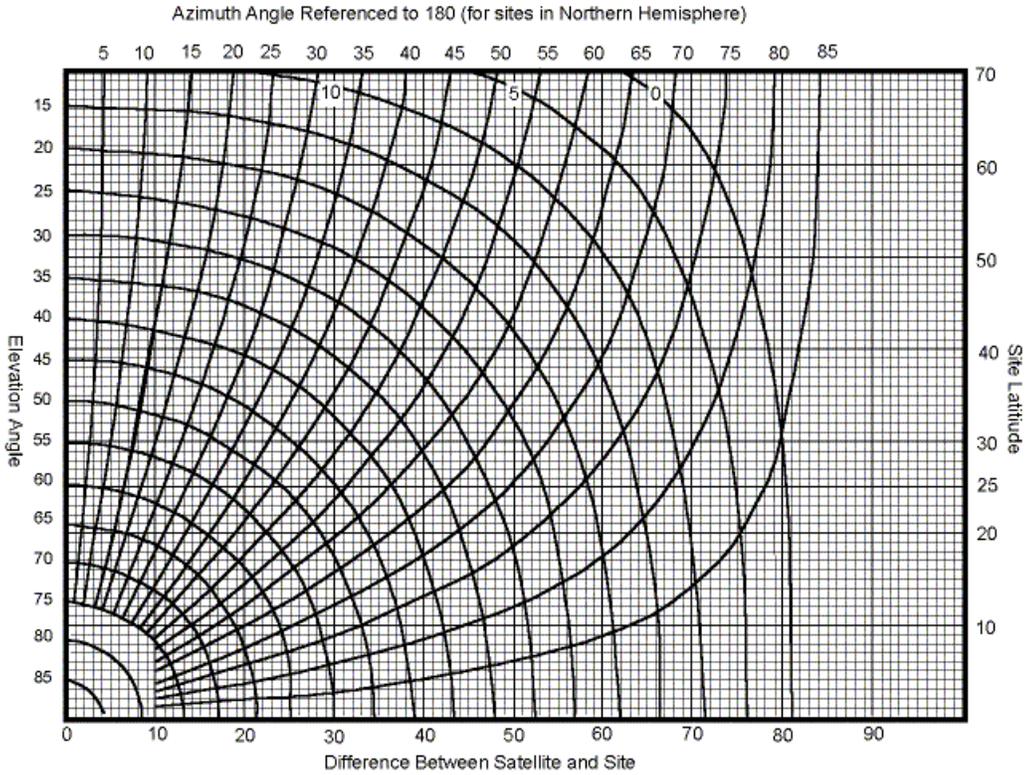
Once you select a satellite and determine the local coordinates, the unit can auto-calculate the azimuth, elevation, and LNB polarization angles. Each transponder test result uses a different color display based on preset thresholds (limits). Tap **THRESHOLD** to open the threshold setup dialog (below).

WEAK(S) :	<input type="text" value="40"/>
STRONG(S) :	<input type="text" value="80"/>
LOW(Q) :	<input type="text" value="40"/>
HIGH(Q) :	<input type="text" value="80"/>

First, consider the elevation angle. A line, traced backwards from the direction the satellite is pointing, coincides with the ground to form the elevation angle. The azimuth angle, meanwhile, spans from direct north to the direction the antenna is pointing, measured clockwise. As shown, a satellite located straight to north has an azimuth angle of 0 degrees, to the east has an azimuth angle of 90 degrees, to the south is 180 degrees and west is 270 degrees.



*Azimuth,*



In the application, tap **FIX** to halt the transponder scan. Tap **MEASURE** to enter the measurement interface.

During a transponder scan, a failed test will activate an audio alarm. Tap **Mute** to silence the alarm.

Finally, tap **DRIVE** to open a polar antenna control window (below). Enter a value using the keypad, then tap **SEND** to transmit the control value to the polar antenna.



## 6-12 Transport Stream Analysis

The TS analysis function supports DVB and ATSC standard real-time TS analysis. Measurements include Basic Information, TR 101 290 Priority 1, 2 and 3 Tests, PID Viewer, PCR Analysis, Program List, and Data Capture.

Supported Standards:

MPEG-1	1) ISO-IEC-11172-2(Video) 2) ISO-IEC-11172-3(Audio)
MPEG-2	1) ISO/IEC 13818-1 (System) 2) ISO/IEC 13818-2 (Video) 3) ISO/IEC 13818-3 (Audio) 4) ISO/IEC 13818-6 (DSM-CC) 5) ISO/IEC 13818-7 (AAC)
MPEG-4	1) ISO/IEC 14496-2 (Video) 2) ISO/IEC 14496-3 (Audio)
H264	1) ITU-T H.264 2) ISO/IEC 14496-10 (AVC)
H256	1) ITU-T H.265 2) ISO/IEC 23008-2 (HEVC)

### 6-12.1 Real-Time Analysis

Real-time analysis parses the information from audio and video ES. It supports MPEG-1/2/4, H.264, H.265, AVS/AVS+, and VC-1 video and MPEG-1/2/4, AAC/AAC+, and DRA audio. Up to two programs' audio information can be displayed at once.

This function is separated into two panes. The top pane lists all programs' SID, Service Name, CA, provider, service type, video PID, video type, Audio1 PID, Audio2 PID, and audio type.

The bottom pane displays the video/audio information of a selected program. Video information includes resolution, frame rate, bit rate, profile, level, aspect ratio, and chroma type.

Audio information includes mode, layer, bit rate, sampling, profile, channel configuration, and emphasis.

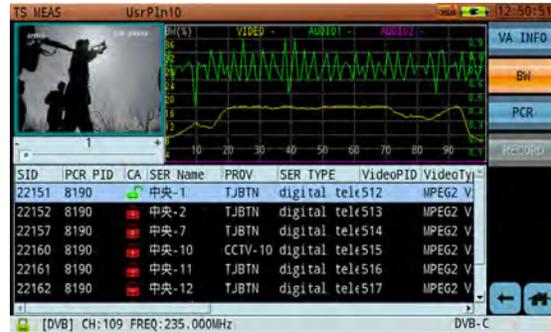
These settings may differ according to the audio/video format (displayed to the bottom-left). If a setting is not recognized or the program is encrypted, " --- " will appear in the lower-right. If the program has no video information, the message "No PAT" will appear.

SID:	The program number, in decimal or hexadecimal.
Service Name:	The service name of the program.
CA:	 indicates an unencrypted program;  indicates an encryption.
Provider:	The program provider.
Service Type:	A brief description of the service type of the program.
Video PID:	The video PID of the selected program.
Video Type:	The video type of the program.
Audio PID1/2:	The audio PID of the selected programs.
Audio Type:	The audio type of the program, e.g. MPEG2.

Program information is displayed at the bottom of the screen.

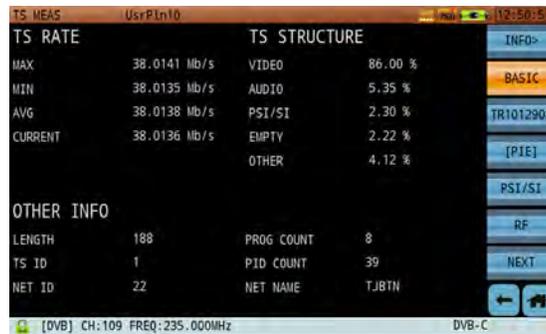


The S7200 displays a real-time picture feed in the upper-left corner of the screen. Drag the slide control under the picture to adjust audio volume. If the program signal is encrypted, the picture feed may not be immediately available; you may need to insert a decryption card to access the image. Press the **Enter** button to view the feed full-screen; press Enter again to return to normal view. (See below, left.)



Real-time TS analysis has two submenus: video/audio information and bandwidth. (See above, right.) Bandwidth shows the selected program's bandwidth info in the highlighted program list. The video BW rate is drawn as a yellow trace (if video information is included in the program), while the first and second audio BWs are drawn in green and purple (if audio information is included). The percentage of current over time is mapped to the X-axis, while the percentage of video and audio bandwidth are mapped to the left and right Y-axes respectively. If the program is not a digital TV program, no trace will be displayed.

6-12.2 Basic Information



This screen displays basic information for the transport stream.

- TS RATE: The stream's transport rate per second (Mb/s). Includes min, max, avg and current rate.
- TS STRUCTURE: Describes the components of the TS and the percentage of each component, including video, audio, PSI/SI, empty packet and other types of information (e.g., encryption or data information).
- OTHER INFO: Describes miscellaneous stream information.
- LENGTH: The length of the packets in bytes. There are 188 bytes and/or 204 bytes type in a given transport stream structure.
- PROG COUNT: The total number of programs.
- TS ID: Different channels have different TS IDs. This indicates the number of channels.
- PID COUNT: The number of PIDs in a stream.
- NET ID: The PID of NIT indicated by PAT), if provided.
- NET NAME: The provider (Operator) name, if provided.

### 6-12.3 TR 101 290 Priority 1, 2 and 3 Tests

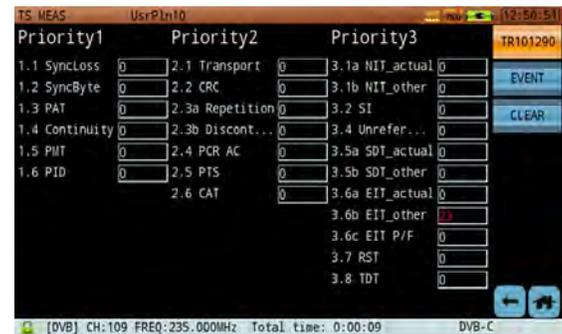
The DVB group has established a group of recommended measurements to perform on transport streams, set forth in the ETSI TR101290 publication. Based on TR 101 290 advisories, errors to be detected by means of these recommended tests are graded into three levels of priority: Priority 1, 2, and 3.

Priority 1 - no decidability

Priority 2- partially no decidability

Priority 3- errors in the supplementary information/SI

Due to hardware resource limits, the S7200's TS analysis does not include buffer-test-related parameters.



#### Priority 1 Parameters

- (1) TS\_sync\_loss: It is suggested that five consecutive correct sync bytes are sufficient for sync acquisition, and two or more consecutive corrupted sync bytes indicate a sync loss. The loss of transport stream synchronization, which may occur either because of severe interference or simply because of a break in the line, is called "TS\_sync\_loss". "TS\_sync\_loss" occurs when the content of the sync bytes of at least 3 successful transport stream packets is not equal to 0x47.
- (2) Sync\_byte\_error is set as soon as the correct sync byte (0x47) does not appear after 188 or 204 bytes. This is fundamental, since this structure is used throughout the channel encoder and decoder chains for synchronization. It is also important for the decoder to check every sync byte for correctness since the encoders may not necessarily check the sync byte. Some encoders may use the sync byte flag signal on a parallel interface to control the randomizer re-sending a byte inversion without checking that the corresponding byte is a valid sync byte. A "sync\_byte\_error" occurs when the content of a sync byte in the transport stream header is not equal to 0x47.
- (3) PAT\_error: The Program Association Table (PAT) only appears in PID 0x0000 packets. It tells the decoder what programs are in the TS and points to the Program Map Tables (PMT), which in turn point to the component video, audio, and data streams that make up the program. If the PAT is missing then the decoder cannot decode programs. A PAT error occurs when:
  - The PAT is missing,
  - The repetition rate is greater than 500 ms,
  - The PAT is scrambled, or
  - The table ID is not equal to zero.

- (4) **Continuity\_count\_error:** Each transport stream packet contains a 4-byte-long header, a 4-bit counter which counts from 0 to 15 in a loop, and then begins at zero again after an overflow (modulo 16 counter). However, each transport stream packet for each PID has its own continuity counter, i.e. packets with a PID=100, e.g., have a different counter, as do packets with a PID=200. This counter helps recognize missing or repeated transport stream packets of the same PID in order to draw attention to any multiplexer problems.

Such problems can also arise as a result of errors in remultiplexing or due to random bit errors in the transmission link. Although MPEG-2 allows discontinuities in the transport stream, they must be indicated in the adaptation field, e.g. after a switch-over (discontinuity indicator=1). In the case of zero packets (PID=0x1FF), discontinuities are allowed and are not verified.

A continuity\_error occurs when

- The same TS packet is transmitted twice without a discontinuity being indicated,
- A packet is missing (count incremented by 2) without a discontinuity being indicated, or
- The sequence of packets is wrong.

- (5) **PMT\_error:** For each program, a Program Map Table (PMT) is transmitted at maximum intervals of 500 ms. The PIDs of the MAPs are listed in the PAT. The PMT contains the respective PIDs of all elementary streams belonging to this program. If a PMT referenced in the PAT is missing, the set top box or decoder will be unable to demultiplex or decode them. If a PMT is listed in the PAT but is either missing, errored or scrambled, will lead to the error message "PMT\_error".

A "PMT error" occurs when

- A PMT listed in the PAT is missing,
- A section of the PMT is not repeated after 500 ms or less,
- A PMT is scrambled, or
- The table ID is not 2.

- (6) **PID\_error:** The PIDs of all elementary streams of a given program are contained in the associated program map table (PMT). The PIDs are pointers to the elementary streams: they are used to access the corresponding packets of the elementary stream to be decoded. If a PID is listed in a PMT but not contained in the transport stream, the decoder cannot access the corresponding elementary stream.

A "PID\_error" occurs when

- Transport stream packets with a PID referenced in a PMT are not contained in the stream, or
- Their repetition rate exceeds a user-definable limit (usually 500 ms or less).

### Priority 2 Parameters

- (1) **Transport\_error:** Every MPEG-2 transport stream packet contains a bit called Transport Error Indicator which is transmitted right after the sync byte. This bit flags any errors in the transport stream packets at the receiver. During the transmission, bit errors may occur for various reasons. If error protection (at least Reed Solomon in DVB and ATSC) is no longer able to repair all errors in a packet, this bit is set indicating this packet can no longer be utilized by the MPEG-2 decoder and must be discarded.  
A transport\_error occurs when the transport error indicator bit in the TS header is set to 1.
- (2) **CRC\_error:** During transmission, all tables in the MPEG-2 transport stream, whether they are PSI tables or other private tables according to DVB (SI tables) or according to ATSC (PSIP tables), are protected by a CRC checksum. It is 32 bits long and transmitted at the end of each sector. Each sector, which can be composed of many transport stream packets, is thus additionally protected. A CRC error has occurred if these checksums don't match the content of the actual section of the respective table. The MPEG-2 decoder must then discard this table content and wait for this section to be repeated.  
A CRC\_error occurs when a table (PAT, PMT, CAT, NIT,...) in a section has a checksum that doesn't match its content.
- (3) **PCR\_repetition\_error:** The PCRs are used to re-generate the local 27 MHz system clock. If the PCRs are not transmitted with sufficient regularity, then this clock may jitter or drift. The receiver/decoder may even go out of lock. In DVB, a repetition period of not more than 100 ms is permitted.  
A PCR\_error occurs when
  - The difference between two successive PCR values of a program is greater than 100 ms, and no discontinuity is indicated in the adaptation field or Header Optional adaptation field, or
  - The time interval between two packets with PCR values of a program is more than 40 ms.
- (4) **PCR\_discontinuity\_indicator\_error:** Occurs when a discontinuity of the PCR values has not been signalled appropriately by the discontinuity indicator.
- (5) **PCR\_accuracy\_error:** Occurs when the PCR jitter exceeds  $\pm 500$  ns.
- (6) **PTS\_error:** Occurs when the spacing between two PTS values is greater than 700 ms.
- (7) **CAT\_error:** An MPEG-2 transport stream packet can contain scrambled data, but only the payload must be scrambled, never the header or the adaptation field. A scrambled payload is flagged by two special bits in the TS header, called the Transport Scrambling Control bits. If both bits are set to zero, there is no scrambling. If one of the two is not zero, the payload part is scrambled and a Conditional Access Table (CAT) is needed to descramble it. If this is missing or only rarely there, a CAT\_error occurs. The CAT has a 1 as PID and also a 1 as table ID. Apart from the EIT in the case of the transmission of a program guide, all DVB tables must be unscrambled.

### Priority 3 Parameters

- (1) NIT\_actual\_error: Network Information Tables (NIT) as defined by DVB, contain information on frequency, code rates, modulation, polarization, etc. of various programs which the decoder can use. It is checked whether the NIT related to the respective TS is present in this TS and whether it has the correct PID.
- (2) NIT\_other\_error: Further NITs may be present under a separate PID and refer to other TSs to provide more information on programs available on other channels. Their distribution is not mandatory and the checks should only be performed if they are present.
- (3) SI\_repetition\_error: For SI tables, a maximum and minimum periodicity are specified in EN 300 468 and TR 101 211 documents. This indicator should be set in addition to other indicators of repetition errors for specific tables.
- (4) Unreferenced\_PID: Each non-private program data stream should have its PID listed in the PMTs.
- (5) SDT\_actual\_error: The SDT (Service Description Table) describes the services available to the viewer. It is split into sub-tables containing details of the contents of the current TS (mandatory) and other TS (optional). Without the SDT, the receiver is unable to give the viewer a list of what services are available. It is also possible to transmit a BAT on the same PID, which groups services by type.
- (6) SDT\_other\_error: This check is only performed if the presence of a SDT for other TSs has been established.
- (7) EIT\_actual\_error: The EIT (Event Information Table) describes what is on now and next on each service, and optionally details the complete programming schedule. The EIT is divided into several sub-tables, with only the "present and following" information for the current TS being mandatory. If there are no 'Present' or 'Following' events, empty EIT sections will be transmitted according to TR 101 211. The EIT schedule information is only accessible if the TS is not scrambled.
- (8) EIT\_other\_error: This check is only performed if the presence of an EIT for other TSs has been established.
- (9) EIT\_PF\_error: If either section ('0' or '1') of each EIT P/F subtable is present, both should exist. Otherwise a EIT\_PF\_error has occurred.
- (10) RST\_error: The RST is a quick updating mechanism for the status information carried in the EIT.
- (11) TDT\_error: The TDT carries the current UTC time and date information. In addition to the TDT, a TOT can be transmitted which gives information about a local time offset in a given area.

No.	TIME	DESCRIPTION
1	2000/02/12 07:08:22 3.6s	Interval between sections '1' with t...
2	2000/02/12 07:08:22 3.6s	Interval between sections '1' with t...
3	2000/02/12 07:08:22 3.6s	Interval between sections '1' with t...
4	2000/02/12 07:08:22 3.6s	Interval between sections '0' with t...
5	2000/02/12 07:08:22 3.6s	Interval between sections '0' with t...
6	2000/02/12 07:08:22 3.6s	Interval between sections '0' with t...
7	2000/02/12 07:08:22 3.6s	Interval between sections '0' with t...
8	2000/02/12 07:08:22 3.6s	Interval between sections '0' with t...
9	2000/02/12 07:08:22 3.6s	Interval between sections '0' with t...
10	2000/02/12 07:08:22 3.6s	Interval between sections '0' with t...
11	2000/02/12 07:08:22 3.6s	Interval between sections '0' with t...
12	2000/02/12 07:08:22 3.6s	Interval between sections '0' with t...
13	2000/02/12 07:08:22 3.6s	Interval between sections '0' with t...
14	2000/02/12 07:08:22 3.6s	Interval between sections '0' with t...
15	2000/02/12 07:08:22 3.6s	Interval between sections '0' with t...

The TR 101 290 Priority 1, 2 and 3 Tests Event List (above) lists information on each event, including the number, timestamp, and error details.

### 6-12.4 PID Viewer

Lists the summary, value(%), PID, and CR of every PID in the stream.

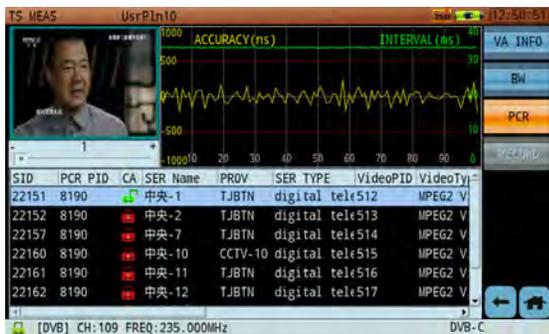
Section	Simplified Info	Value(%)	PID	CR(Mbps)
TS	TS Info	100	---	50.682
PSI/SI	Info	0.988	---	0.501
	PAT	0.024	0	0.012
	PMT-0401	0.071	0810	0.036
	PMT-0403	0.080	0830	0.040
	PMT-0404	0.071	0840	0.036
	PMT-0410	0.024	1400	0.012
	PMT-0411	0.027	1410	0.013
	PMT-0412	0.024	1420	0.012
	PMT-0417	0.071	1470	0.036
	PMT-0419	0.071	1490	0.036
	PMT-0421	0.071	2410	0.036
	PMT-0422	0.074	2420	0.037
	PMT-0423	0.071	2430	0.036



- Section: The PID type, e.g., PSI/SI, video PID or Audio PID.
- PID: The PID value.
- CR: The bitrate of the PID.

The Value and CR are calculated in one-second increments. Tap **PID VIEW** to display as a pie chart.

### 6-12.5 PCR Analysis



Displays the PCR accuracy and PCR interval of the selected program.

As shown (left), the top half of the screen displays detailed PCR information in one transport stream, including PCR PID, min/max accuracy and min/max interval. If no PCR exists, "--" is displayed. (Different programs can have the same PCR, and/or each program can have its own PCR.)

Use the arrow keys to choose programs in the top pane of the screen. PCR accuracy and PCR interval traces display in the same area. The left Y-axis describes PCR accuracy (ns), and the right Y-axis PCR intervals (ms). Two red lines outline PCR accuracy limits. Accuracy should be within  $\pm 500$  ns, and intervals between 0-40 ms.

6-12.6 Program List



Lists all programs in the current transport network by ascending frequency. Info includes program number, frequency, SID, service name, CA, provider, and service type. Depending on the encoding method, the program information may be displayed differently; you might see the program information of the selected frequency, or the program information of all frequencies. The CA may be different from the real-time and PROG INFO subfunctions, as they acquire the CA value differently.

The CA of this subfunction is retrieved directly from the transport stream, so users can easily find the channel and program of corresponding frequencies. During troubleshooting, the field engineer can more easily identify which QAM carrier to focus on based on the particular program complaint from the customer.

A program list can be saved in the instrument’s memory, so that the next time the instrument is powered on, users can directly recall the program list by pressing **Start** again. Note that the stored list will overwrite the old list, even if the new list has not yet completed initialization.

6-12.7 PSI/SI Table Analysis

“Program Specific Information” (PSI) is similar to the program list described above. The PAT has a PID of zero and begins with a table ID of zero. The PMT has the PIDs defined in the PAT as PID and has a table ID of 2. The CAT has a PID and a table ID of 1 in each case. The PSI can be composed of one or more transport stream packets for PAT, PMT and CAT depending on content.

Apart from the PSI tables PAT, PMT and CAT, another table, the “network information table” (NIT) is provided in principle but not standardized in detail. It was actually implemented as part of the DVB (Digital Video Broadcasting) project.

All tables are implemented through the mechanism of sections. There are non-private sections, which are defined in the original MPEG-2 Systems Standard, and private sections, which include all others. Non-private sections include the PSI tables, while the private ones include the SI sections of DVB which are used for data broadcasting. The header of a table contains the version number of a table and information about the number of sections that make up a table.

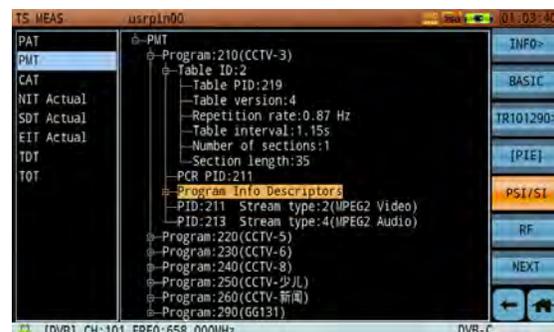
Taking advantage of the “private section” and “private table” features, the European DVB Group has introduced numerous additional tables intended to simplify the operation of the set-top boxes or quite generally of the DVB receivers. Called “service information” (SI), they are defined in ETSI Standard ETS300468. These include the following tables (right).

PAT	Program Association Table	MPEG-2 PSI Program Specific Information
PMT	Program Map Table	
CAT	Conditional Access Table	
(NIT)	Network Information Table	
Private Sections / Tables		
NIT	Network Information Table	DVB SI Service Information
SDT	Service Descriptor Table	
BAT	Bouquet Association Table	
EIT	Event Information Table	
RST	Running Status Table	
TDT	Time&Date Table	
TOT	Time Offset Table	
ST	Stuffing Table	

7200 PSI/SI analysis includes PAT, PMT, CAT, NIT Actual, SDT Actual, EIT Actual, and TDT. (See below.) The following screenshots highlight more detailed analysis information. Tap the screen to choose a table, then tap the “+” symbol to expand into multiple levels.



PSI/SI Analysis –PAT



PSI/SI Analysis – PMT



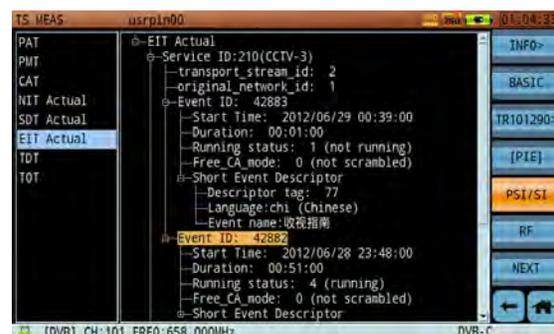
PSI/SI Analysis –CAT



PSI/SI Analysis – NIT



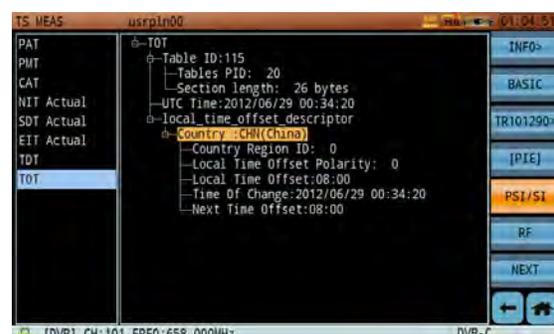
PSI/SI Analysis –SDT



PSI/SI Analysis – EIT



PSI/SI Analysis – TDT



PSI/SI Analysis – TOT

**Service Information Allocation**

Table	PID Value	PID Decimalism Value
PAT	0x0000	0
CAT	0x0001	1
TSTD	0x0002	2
NIT	0x0010	16
SDT, BAT, ST	0x0011	17
EIT, ST	0x0012	18
RST, ST	0x0013	19
TDT, TOT, ST	0x0014	20
DIT	0x001E	30
SIT	0x001F	31

**PID & Table ID of PSI/SI Tables**

Table	PID	Table_ID
PAT	0x0000	0x00
PMT	0x0020... 0x1FFE	0x02
CAT	0x0001	0x01
NIT	0x0010	0x40...0x41
BAT	0x0011	0x4A
SDT	0x0011	0x42, 0x46
EIT	0x0012	0x4E...0x6F
RST	0x0013	0x71
TDT	0x0014	0x70
TOT	0x0014	0x73
ST	0x0010...0x0014	0x72

## 6-12.8 PSI/PSIP Table Analysis

Like the SI tables, DVB & ATSC also provide PSIP tables.

PSIP stands for "program and system information protocol" and lists info similar to that given on DVB SI.

In ATSC, the following tables are used: the Master Guide Table (MGT), the Event Information Table (EIT), the Extended Text Table (ETT), the System Time Table (STT), the Rating Region Table (RRT), and the Cable Virtual Channel Table (CVCT) or the Terrestrial Virtual Channel Table (TVCT).

According to ATSC, the PSI tables defined in MPEG-2 and provided in the MPEG Standard are used for accessing the video and audio streams, i.e. the transport stream carries one PAT and several PMTs. The conditional access information is also referenced via a CAT.

The actual ATSC tables are implemented as "private tables". The MGT contains the PIDs for some of these ATSC tables; it can be recognized by the packet ID = 0x1FFB and the table ID = 0xC7. The transport stream must contain at least four EITs (EIT-0, EIT-1, EIT-2, EIT-3) and the PIDs for these EITs are found in the MGT. Up to 128 further EITs are possible, but are optional. An EIT contains a 3-hour section of an electronic program guide (EPG). Together with the 4 mandatory EITs, it is possible to cover a period of 12 hours. Furthermore, ETTs may optionally be accessed through the MGT. Each existing ETT is allocated to one EIT. Thus, e.g. EIT-0 contains extended text information for EIT-0. It is possible to have up to a total of 128 ETTs.

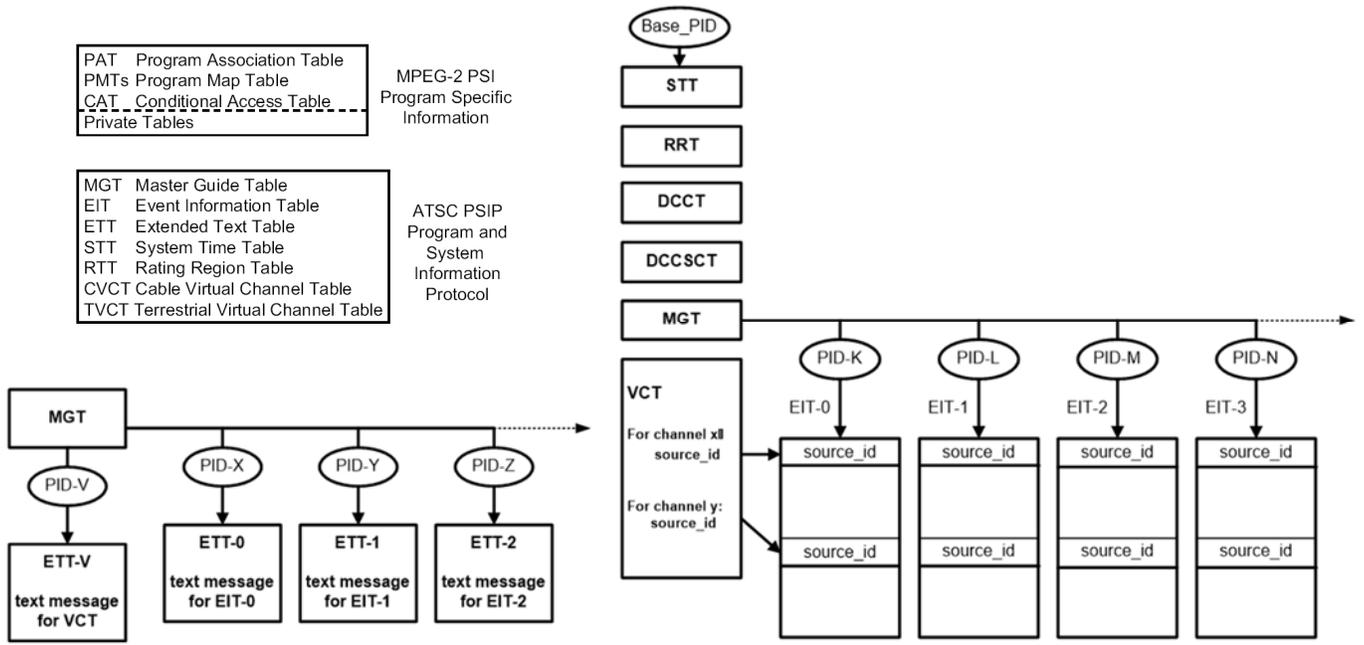
**PSIP Table ID Ranges & Values**

Table	PID	Table ID Value (hex)
PAT	0x0	0x0
PMT	Per PAT	0x2
CAT	0x1	0x1
MGT	0x1FFB	0xC7
TVCT	0x1FFB	0xC8
CVCT	0x1FFB	0xC9
RRT	0x1FFB	0xCA
EIT	per MGT	0xCB
ETT	per MGT	0xCC
STT	0x1FFB	0xCD

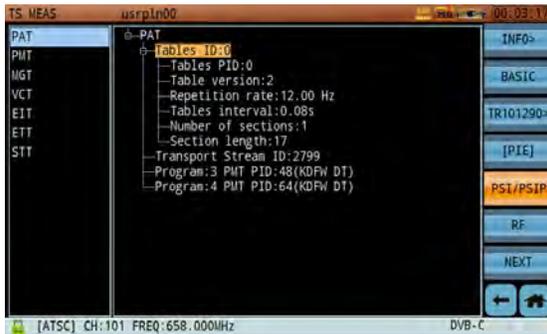
In the Virtual Channel Table – which may exist either as Terrestrial (TVCT) or Cable (CVCT) depending on the transmission path – identification for the virtual channels (programs) contained in a multiplexed transport stream are transmitted. The VCT lists program names and other data. The VCT is thus comparable to the SDT table in DVB.

In the System Time Table (STT), all the necessary time information is transmitted. The STT can be recognized by the packet ID = 0x1FFB and the table ID = 0xCD. In the STT, the GPS time and time difference between GPS and UTC (Universal Time Coordinated (= GMT)) is transmitted. The Rating Region Table (RRT) can be used for restricting the size of the audience in terms of age or region. It includes info about the broadcast region (e.g. a Federal State in the US), as well as info about the minimum age set for the program currently being shown. Using the RRT, a type of parental lock can be implemented in the set-top box. The RRT is recognized by the packet ID = 0x 1FFB and the table ID = 0xCA.

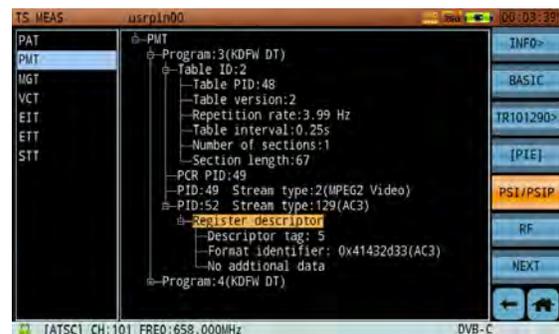
The PIDs and Table IDs of the PSIP tables are listed in Table: PSIP Table ID Ranges and Values (above).



ATSC PSIP tables (top-left); Extended Text Tables (ETTs) defined to carry text to describe virtual channels/events (bottom-left); PSIP table hierarchy (right)



PSI/PSIP Analysis -PAT



PSI/PSIP Analysis - PMT



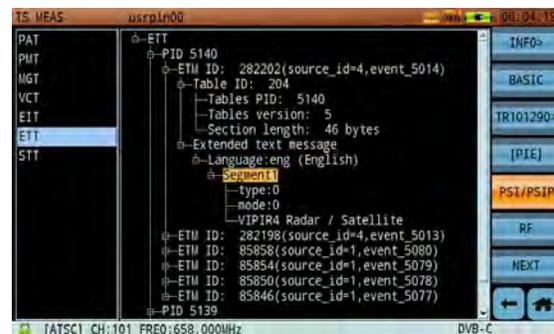
PSI/PSIP Analysis -MGT



PSI/PSIP Analysis - VCT



**PSI/PSIP Analysis –EIT**



**PSI/PSIP Analysis – ETT**



**PSI/PSIP Analysis - STT**

## 6-12.9 Data Capture

The image above shows captured transport package data according to PID value. This function divides the PID into six types: video, audio, PCR, PSI/SI, ECM/EMM and DATA. Choose a type and press **Enter** to confirm; the related PID value will display in PID position. Next, enter a capture number (up to 255). Then tap **Start** to begin capturing data.



The lower left corner displays captured data. Detailed content info appears to the right, in hexadecimal format. The data capture function only supports real-time capture. Once capture is complete, use the arrow and Enter keys to select a data item for closer viewing.

When finished, tap **Clear** to clear all captured data.

### 6-12.10 EPG (Electronic Program Guide)

Currently, the S7200 only supports the EPG function for ATSC (8VSB). From the TS analysis screen, tap **NEXT** and locate the **EPG** key. This key is unavailable in DVB mode; user must set the standard to ATSC to activate the EPG function.

In this guide, select a program from the list in the left-hand panel. In the right, you can browse all events related to that program.



### 6-12.11 Record and Replay Transport Stream

#### Recording the Transport Stream

The S7200 can be used to record transport stream data to a solid-state drive (if the SATA SSD option has been purchased) or to a storage drive connected to the unit's USB port.

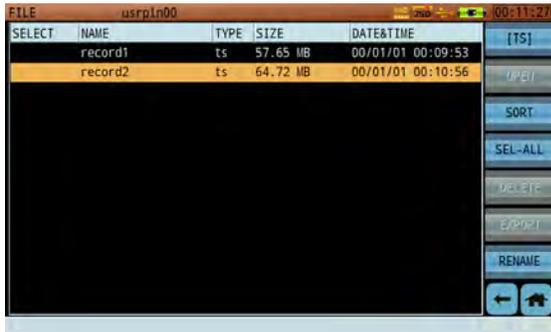
First, press the (or TS measurement) button. Tap **INFO**, then **RECORD** to open a recording dialog. Select the file destination (USB disk or SATA SSD) and enter a filename using the touchscreen keyboard. Once the transport stream has started, the recording information is displayed on the bottom status bar.



### Record Playback

When you have recorded the transport stream successfully, you can use the S7200 to review the recording. Press the button and tap the top key repeatedly until **TS** is displayed. (Note that only files saved to the SSD, not to a separate USB drive, are shown here.)

In order to play back saved transport stream files, ensure that the TS input is set to **DISK**. Configure this setting from the TS menu; see below, right.



When finished, press the button and open the transport stream analysis function. Tap **DISK** and choose your desired file from either the SATA SSD or USB file list. The program will read the TS file, after which the text "Analysis finished!" will appear.

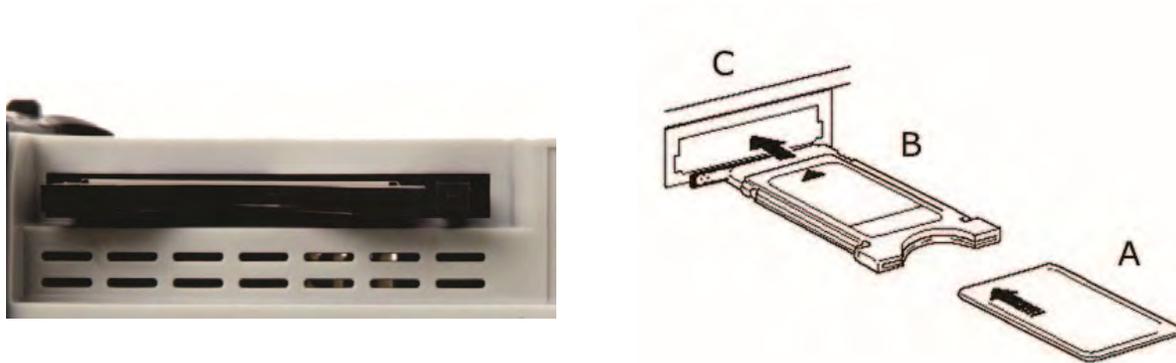


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### 6-12.12 Using the Conditional Access Module

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With the appropriate decryption card inserted, the S7200 can be used to decode encrypted programs. When the CAM module and smart card have been correctly installed in the DVB-CI port, the CAM icons (   ) will appear in the top status bar. However, even if the hardware is installed, successful decryption is not guaranteed. Certain programs may require special decryption cards.



The Smart Card, CA Module, and DVB-CI port (labeled A, B, and C) should be connected as shown.

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### 6-12.13 BISS Decryption

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BISS (Basic Interoperable Scrambling System) is a tool developed by the European Broadcasting Union and a consortium of hardware manufacturers for scrambling satellite signals.

Before BISS, "ad hoc" or "occasional use" satellite newsfeeds were transmitted with proprietary encryption methods such as RAS or PowerVu, or else with no encryption at all. Unencrypted feeds could be viewed by anyone with the correct equipment.

Proprietary encryption methods were determined by encoder manufacturers, placing major compatibility limitations on the type of satellite receivers (IRD) that could be used for each feed. BISS was an attempt to create an open-platform encryption system that could be used across many manufacturers' equipment.

#### Fields for Entering BISS Keys on an Ericsson RX8200 IRD

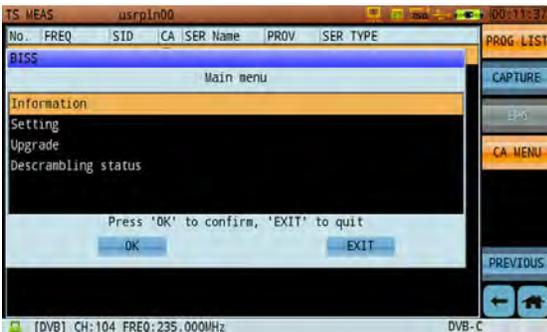
There are two major types of BISS encryption.

- BISS-1 transmissions are protected by a 12 digit hexadecimal "session key" that the transmitting and receiving parties agree upon prior to transmission. The key is entered into both the encoder and decoder, and then forms part of the encryption of the digital TV signal. Thus, any receiver with BISS support and the correct key can decrypt the signal.
- BISS-E is a variation where the decoder stores one *secret* BISS key, which may be entered by a rights-holder (for instance). This key is unknown to the decoder's user. This user receives a 16-digit hexadecimal code, which is entered as a "session key". The session key is then mathematically combined internally to calculate a BISS-1 key that can decrypt the signal.

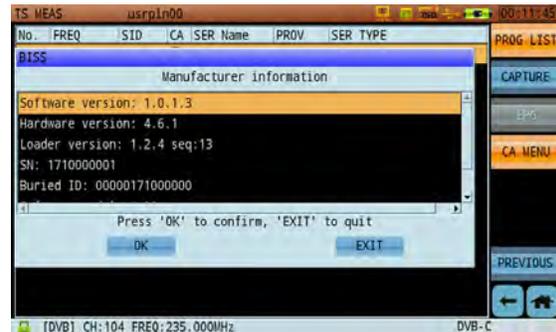
Only a decoder with the secret key will be able to decrypt a BISS-E feed. This gives rights-holders control of which decoders can be used to decrypt a specific feed. Any BISS-E encrypted feed will have a corresponding BISS-1 key that unlocks it. BISS-E is used by EBU, among others, to protect UEFA Champions League and other high-profile satellite feeds.

The S7200 supports BISS Mode 1 and Mode E decryption. The BISS CAM card is different from common DVB CA CAMs; it lacks the functions of a smart card, and so must be manually informed of the Service ID – as well as the encryption mode of the locked program and whether to employ BISS-1 or BISS-E methods.

After inserting the BISS decryption card into the CAM slot, the  icon will appear in the status bar. In TS mode, tap **CA Menu** to view the decryption card main menu (shown below). Select **Information** to view BISS information, including software/hardware/loader versions, serial number, and Buried ID.



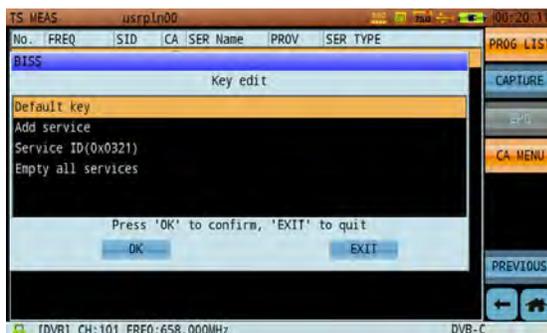
**BISS main menu**



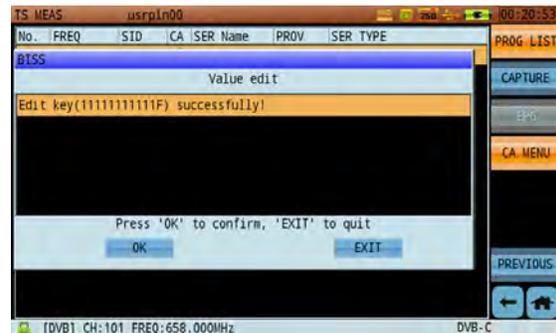
**BISS manufacturer information**

Use the touchscreen to select **Setting**. From here, you can set the BISS input mode, active ID, secret key, BISS language, and if necessary, trigger a factory reset.

- Secret keys and other entry fields permit decimal and hexadecimal input.
- The active ID may be either Buried ID or Inject ID. Choose one to proceed to an entry list.
- The S7200's BISS CAM can receive OTA upgrades. Contact your Deviser representative.
- BISS currently supports 2 languages: English and German.



**Setting a key**



**Key successfully changed**

In the key edit dialog, you can select Default Key, Add Service, Service ID, and Empty All Services.

If there is no existing Service ID, you will need to add one. Tap **Add Service**; the S7200 will auto-recognize the correct Service ID. You may then choose whether to **Modify Key** or **Delete Service**. To modify, select either **Mode-1** or **Mode-E**; then use the Up/Down keys to input your desired code.

Editing the **Default Key** is a similar process. If several programs use the same key, you only need to set the default key. Simply select the proper mode and then input your key.

Finally, the **Status** field displays the result of the descrambling process next to the Active ID and mode that you configured.

## 6-13 IPTV Measurement

Currently, the S7200's IPTV function only supports MPEG-2 TS over IP.



First, connect an Ethernet cable to the S7200's RJ-45 port. From the Home screen, tap **IPTV** to launch the IPTV function. The instrument will automatically detect IPTV streams in the network, and list them at the bottom of the screen.

Tap an IPTV stream to display test results on the screen. To view program images or other video information, tap **TS MEAS** to open the transport stream analysis mode. (See Section 6-12.)

### 6-13.1 Settings

#### Button Operation

- TS Meas: Opens the transport stream measurement function. (See Section 6-12.)
- Add: Input an IPTV protocol, destination IP address, and port number to add the selected IPTV stream to your favorites list.
- Fav List: Opens the favorites list. Select a destination IP address to switch to its IPTV measurement.

### 6-13.2 Important Concepts

#### Transport protocol for real-time applications (RTP)

Real-Time Protocol (RTP) is a transport protocol that was developed for streaming data. RTP includes extra data fields not present in TCP. It includes a timestamp and sequence number to facilitate data transport timing, and allows control of the media server so that the video stream is served at the correct rate for real-time display. The media player then uses these RTP fields to assemble the received packets into the correct order and playback rate.

RTP usually runs on UDP, and uses its multiplexing and checksum features. Note that RTP does not provide any control of the quality of service or reservation of network resources.

#### Real-Time Control Protocol (RTCP)

RTCP is used in conjunction with RTP. It gives feedback to each participant in an RTP session that can be used to control the session. The messages include reception reports, including number of packets lost and jitter statistics (early or late arrivals). This information can potentially be used by higher layer applications to modify the transmission. For example, the bit rate of a stream could be changed to counter network congestion. Some RTCP messages relate to control of a video conference with multiple participants.

#### Media Delivery Index

IETF RFC 4445 describes Media Delivery Index (MDI), a single figure of merit used to quantify 2 IP transport impairments: Packet Jitter (Delay) and Packet Loss. These two test parameters are defined as Media Delay Factor (MDI-DF) and Media Loss Rate (MDI-MLR).

- Delay Factor indicates how long a data stream must be buffered (i.e. delayed) at its nominal bit rate to prevent packet loss.
- The Media Loss Rate is the number of packets lost during a period of 1 second.

## 6-14 Optical Power Measurement and Optical Receiver

### 6-14.1 Optical Connectors and Adapters

Fiber connectors are the most common passive device used in the field of fiber-optic communications. These components connect the endfaces of two optical fibers, allowing the continuous transmission of optical signal. In an optical communications system, connectors appear at nearly every juncture: fiber end-faces, passive and active optical components' input and output ports, fiber jumpers, and more.

An optical fiber connector is composed of a pin and connector. For example, with the FC/PC connector type, "FC" specifies one of several external connection types. (Other external connection formats include SC, ST, LC, MU, MT-RJ, D4, and E2000.) "PC" indicates the shape of the pin (or "endface"), which can be of the PC, APC, or UPC standards.

Let's take a closer look at these different types of fiber endface.

#### Straight physical contact (PC)



The fiber ends are pressed together in the connector. There is no air gap left to cause reflections. The return loss is 30 – 55 dB. This is the most common connector type for single mode fibers (e.g. FC/PC, ST, SC/PC, DIN, HMS, and E2000 connectors).

#### Slanted (angled) physical contact (APC)



In these connectors, the ends of the fibers are slanted. Again, no air gap is left. This gives the best return loss (60-80 dB). These connectors are used for high-speed telecom and CATV links (e.g. FC/APC, SC/APC, and E2000-HRL connectors).

#### Straight air gap



Inside these connectors is a small air gap between the two fiber ends. Their return loss is less than 14 dB and the reflection is fairly high. Straight air gap connectors (e.g. ST connectors), are used for multimode fibers.



**FC Connector**



**SC Connector**

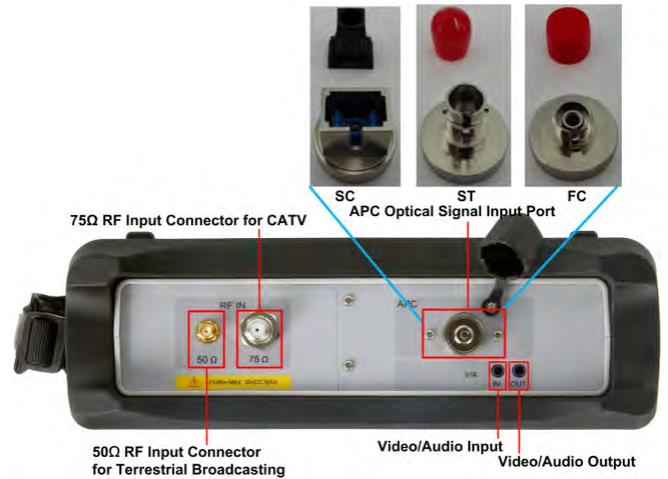
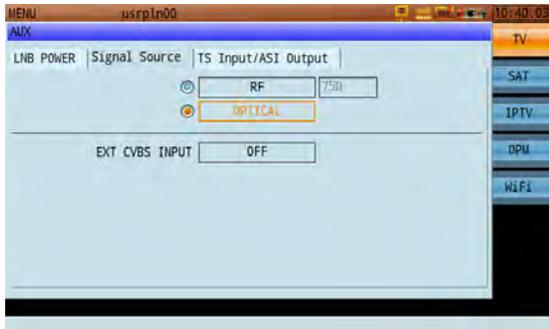


**ST F Connector**

The S7200 uses the FC/SC/ST replaceable universal connector interface. Users may replace these with different connector interfaces as needed for field applications.

### 6-14.2 Optical to RF Conversion

The S7200 can be optionally equipped with an optical receiver. First, change the "Optic to RF" setting to **YES** (see below). Then connect a length of optical fiber directly to the unit's FC/APC port. Optical signal can now be transmitted to the S7200, allowing you to measure the demodulated electric signal.



*Replaceable FC/SC/ST universal connector interface*

### 6-14.3 Optical Power Measurement



The S7200 also features an optical power meter (OPM). (The optical receiver option is required; but you do not need to activate "Optic to RF".)

Simply connect an optical fiber to the FC/APC port. The unit will auto-detect the wavelength of the incoming signal.

Tap **REF** to set a limit value. If the optical power exceeds this value, a "SUCCESS" message will appear at the top of the screen. Otherwise, "FAILED" will appear (shown, below).

You can set different limit values (-50 ~ +27dBm) for different wavelengths: 1310nm, 1490nm, and 1550nm. Tap the entry field and use the numpad to enter a value.

Then tap **Save Ref** to confirm your entry.



If used for an extended period of time in a single session, the optical power meter can gradually become offset. The test results should be corrected periodically by adding/ removing compensation. Tap **COMPENS** to open the compensation dialog (below, right).



Displayed test results = True optical power + (offset value, e.g. -1, +1 or any other value)  
 Example: displayed test result = 10 + (-1) = 9dBm.

First, perform a power cycle by turning the S7200 off and on again. Return to the OPM function. Tap **COMPENS**, and tap the **Offset** field for the relevant wavelength signal. Type a value and press Enter to confirm.

After the first correction, test results should maintain accuracy for some time. Eventually, however, the test readings will become offset. Each time you enter a new offset value and reboot the instrument, the S7200 will recall the previous offset value and re-calculate the compensation.

Compensation value = 1<sup>st</sup> offset + 2<sup>nd</sup> sffset + 3<sup>rd</sup> offset...

Finally, the **Threshold** tool (above, left) adds a visual aid for quickly identifying whether the optical signal is within acceptable parameters. Tap it to set two values: **Weak** and **Strong**. Each tested wavelength appears as a bar, color-coded to represent the current signal power.

Current Optical Power ( <i>P</i> )	Bar Color
Weak > <i>P</i>	Red
Weak < <i>P</i> < Strong	Yellow
Strong < <i>P</i>	Green

Once the optical receiver is working, you may plug the fiber into the APC port on the top of the instrument to conduct photoelectric signal conversion under different functions (shown below).



Photoelectric Conversion Test – Spectrum Analysis



Photoelectric Conversion Test - Constellation

dBm		mW
30.0	1W	1000
20.0	100mW	100
10.0	10mW	10
7.0	5mW	5
0.0	1mW	1
-3.0	500 $\mu$ W	0.5
-10.0	100 $\mu$ W	0.1
-20.0	10 $\mu$ W	0.01
-30.0	1 $\mu$ W	0.001
-40.0	100nW	0.0001

**Conversion Table: common dBm values vs mW**

## 6-15 Downstream Spectrum Analysis

The spectrum frequency band of the S7200 covers cable, terrestrial and satellite frequency bands. The following sections contain instructions for setting up downstream spectrum analysis functions.

The spectrum analysis function is one of the primary and most powerful functions of the S7200.

*For several decades, it has been suggested that a good spectrum analyzer is one of the most effective troubleshooting tools a field CATV engineer can use to help identify impairments on a HFC network.*

In the spectrum analysis mode, editable measurement parameters appear in two rows above the display. Tap a parameter and use the up/down arrow keys (or tap a value) to modify it.

### 6-15.1 Spectrum Analyzer Display Overview

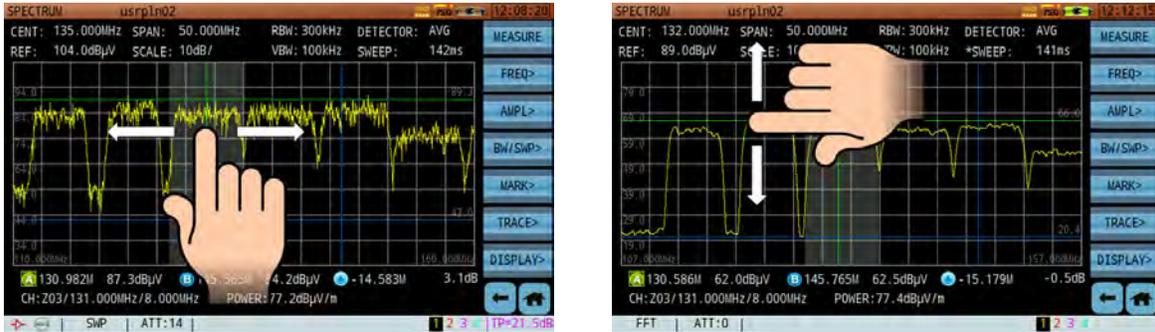
Tap **Spectrum** on the Home menu's TV page to launch the application. To explore the Spectrum Analyzer display interface, refer to the numbered figure and associated definitions below.

1. Channel plan name.
2. Center frequency.(CENT)
3. Span. (SPAN)
4. Resolution bandwidth filter. (RBW)
5. Video bandwidth filter. (VBW)
6. Sweep time. (SWEEP)
7. Detector mode. (DETECTOR)
8. Reference level. (REF)
9. Vertical display scale. (SCALE)
10. Scale reference.
11. Markers.
12. When the spectrum and QAM analysis are displayed simultaneously, the lock icon is green or red to indicate whether the QAM signal is locked or not.
13. Pre-amplifier: icon appears when the pre-amp is switched on.
14. Spectrum hold: icon appears when the spectrum sweep is paused.
15. Attenuation. (ATT)
16. Frequency and level of marker A
17. Frequency and level of marker B
18. Delta variation between marker A and B (in frequency and level)
19. Active trace: up to 4 traces can appear at once on the S7200. Only 1 trace is controlled at a time.
20. Test Point Compensation. (TP)
21. Multi-function touchscreen keys: a button followed by an arrow ">" means there is a sub-menu available. A button with a bracket "[ ]" means the button has multiple modes available.

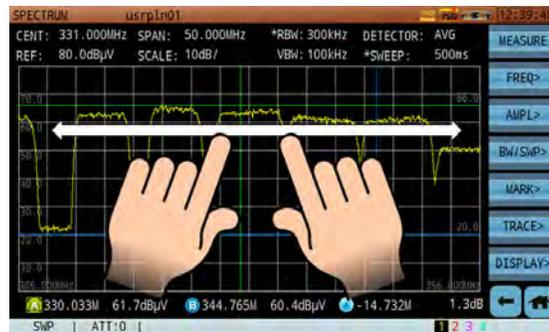


Note that you can adjust the frequency, span, reference level, and marker position using the touchscreen. Using one finger, drag left or right on the screen to explore different sections of the frequency spectrum. Drag up or down to shift the reference level accordingly.

Note that touching the **markers** (green or blue horizontal/vertical lines) will allow you to move the markers.



Place two fingers on the touchscreen and slowly spread them apart to decrease the frequency span, “zooming in” on the selected area. Reverse the motion to increase the span, “zooming out” to view more of the spectrum.



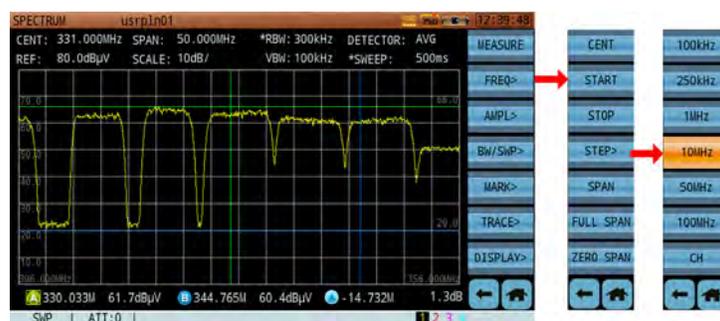
### 6-15.2 Frequency and Span Settings (CENT, START, STOP, SPAN)

Tap **FREQ** to enter the frequency menu. From here, tap the keys along the right to access various submenus (shown below). Some parameters, such as the center frequency (4-1220 MHz), can be manually entered with the numerical keypad or adjusted with the arrow keys. The default frequency step is 10MHz but can be manually changed to 100kHz, 250kHz, 1MHz, 50MHz, 100MHz, or CH (based on active channels in the active channel plan). Press the Enter button to confirm your setting.

Also in the FREQ submenu, tap **Span** to set the span (range 0 – 1220 MHz) with the numerical keypad. You can also adjust the current value with the arrow keys. Press Enter to confirm. The span will be calculated automatically if you set the **Start/Stop** frequencies.

Tap **Full Span** to set the span to its maximum (widest) value, or **Zero Span** to set it to zero (narrowest).

You can also touch the screen and “drag” the trace left or right to change the center frequency. Using two fingers, “pinch” the trace in and out to change the span. Release to set.



*Frequency and Span Setting Menu*

### 6-15.3 Amplitude Settings (REF, ATT, UNIT, SCALE, AMP)

Tap **AMPL** to enter the amplitude menu. Amplitude settings include reference level, attenuation, unit & scale reference, and pre-amplifier on/off.

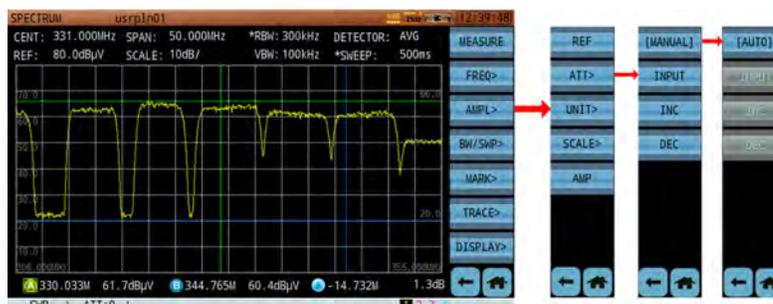
#### Reference Level

The reference level can range from -80 ~ +70dBmV and is displayed at the top of the display window. Tap **REF**, then use the arrow keys to change the reference level value in steps of 10dB. You can also touch the screen and “drag” the trace up or down to change the reference level. Release to set.

#### Attenuation

There are two ways to set the attenuation level: manual or automatic. In manual mode, an asterisk (\*) will appear at the attenuator icon below the trace.

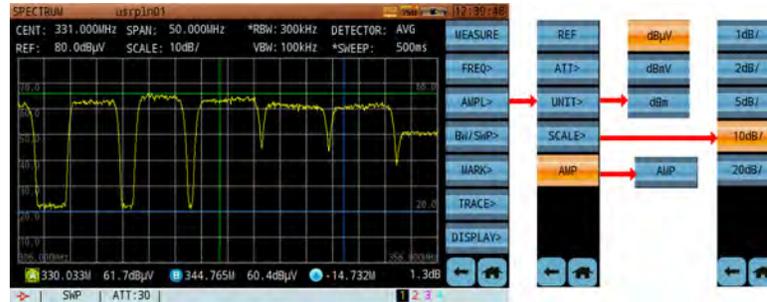
In the amplitude menu, tap **ATT** to enter the attenuation submenu (shown, right). The top key shows the current setting: [Manual] or [Auto].



To manually set the attenuation, select Manual and tap **Input** to enter a new value (0 – 30dB) – or tap **INC** or **DEC** to increase or decrease the value. Press Enter to confirm your selection.

**Unit & Scale**

In the amplitude menu, tap **Scale** to set the vertical span of the measurement display. The default value is 10dB/division. Divisions of 1, 2, 5, 10, and 20dB are available.



**Amplitude Setting Menu – Unit, Scale & Amplifier**

Still in the amplitude menu, tap **Unit** to set the amplitude unit of measure. You may choose dBuV, dBmV, or dBm. (For your convenience, conversion factors are listed below.)

$$dBm = dBuV - 108.8$$

$$dBmV = dBuV - 60$$

$$dBm = dBmV - 48.8$$

**Pre-Amplifier**

In the amplitude menu, tap **AMP** to toggle the pre-amplifier ON (orange) and OFF (blue). When the pre-amplifier is on, the noise floor will fall and a red amplifier icon will appear at the extreme lower-left corner of the screen. (See image above.)

**6-15.4 Bandwidth and Sweep Settings (RBW, VBW, SWEEP)**

In the bandwidth menu, you can set up RBW, VBW, and sweep time values; spectrum calculation mode; and trace hold features.

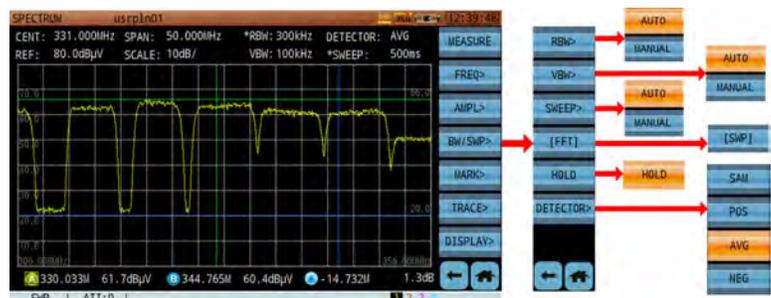
**WARNING**

Changing RBW, VBW, and sweep time settings in manual mode may produce inaccurate measurement results. If analyzer measurements are uncalibrated because of faulty relation between RBW, VBW, and sweep time settings, an "uncal" message will appear in the bottom toolbar." For most uses, it is recommended to leave these settings in their "Auto" mode.

**Resolution and Video Bandwidth (RBW & VBW) Filter**

The RBW and VBW filters can be used in manual or automatic mode. In manual mode, an asterisk (\*) appears on the relevant parameter at the top of the screen.

Tap **BW/SWP** to enter the menu (shown, right), and then RBW or VBW as desired. Select **Auto** to allow the S7200 to choose a suitable bandwidth according to sweep speed and span settings, or **Manual** to choose a new RBW/VBW value (1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, or 3 MHz).



### Sweep Speed

There are two ways to set the sweep speed: manual and automatic. In manual mode, an asterisk (\*) appears near the sweep speed parameter at the top of the screen.

In the bandwidth menu, tap **Sweep**. Select **Auto** to allow the S7200 to choose a suitable sweep time according to the active Span, VBW, and RBW settings; or **Manual** to enter a new value. Press Enter to confirm.

Note that Spectrum analyzers normally couple sweep time, span, and resolution bandwidth automatically. This allows the measured signal enough time to achieve full amplitude within the RBW for an accurate & calibrated measurement.

If any of the parameters are manually set, "UNCAL" appears in the status bar at the bottom of the screen.

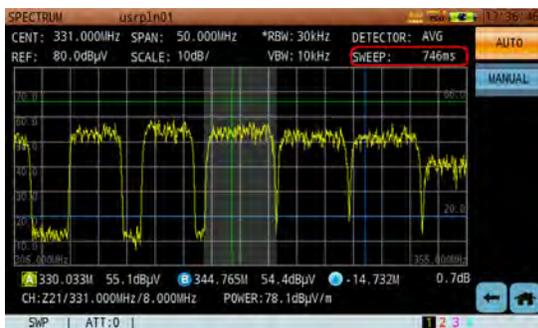
### Spectrum calculation mode

The S7200 has two spectrum calculation modes: FFT and DFT (fast / discrete Fourier transform, respectively). Tap [DFT]/[FFT] in the bandwidth menu to toggle between them.

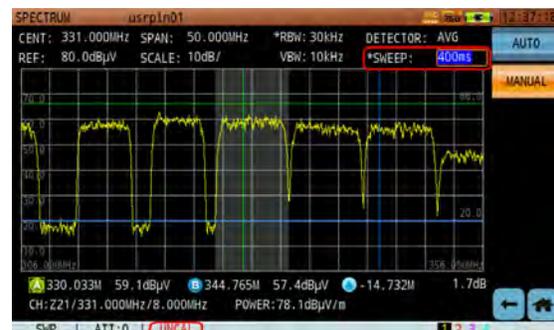
DFT is the foundation of FFT, and FFT is the fast algorithm of DFT. Every result calculated with DFT represents a pixel point of the spectrum trace, while every result calculated with FFT represents a limited segment of the spectrum trace. In general, FFT is better suited for high sweep speeds.

### Spectrum hold

In the BW/SWP menu, tap Hold to pause the trace for detailed analysis. Press Hold again to resume normal operation.



*Auto Sweep Time*



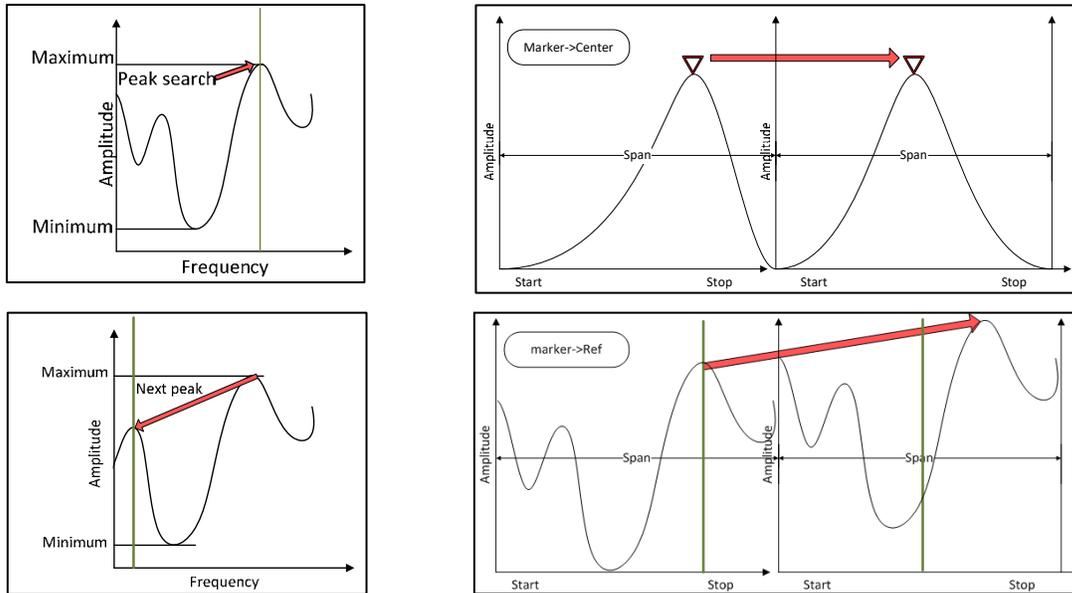
*Manual Sweep Time, causing UNCAL warning*

### 6-15.5 Markers

The spectrum analysis measurement has two markers, A and B, displayed on the trace as color-coded vertical lines. Their current frequency and amplitudes are shown below the trace. (See above.)

Touch a marker and slide it left or right to adjust the frequency.

Tap **Mark** to enter the marker menu. These tools allow you to move the active marker (the one you last moved) directly to important spots on the trace.



#### Peak

Automatically finds the highest current signal strength on the spectrum curve. (above, top-left).

#### Next Peak

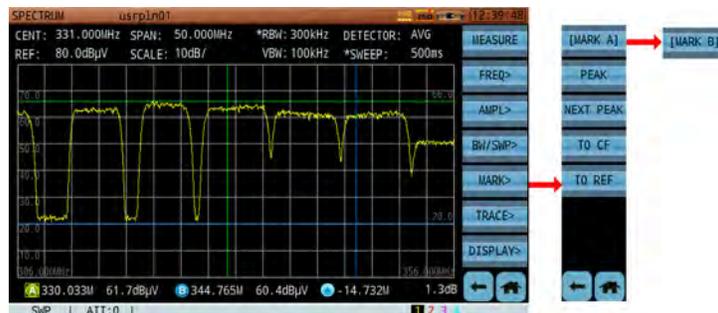
Automatically finds the next highest signal strength on the spectrum curve (above, bottom-left).

#### Marker -> REF

Positions the active marker at the reference level (above, bottom-left).

#### Marker to the center frequency

Positions the active marker at the center frequency of the on-screen spectrum curve (above, bottom-right).



## 6-15.6 Trace Setting

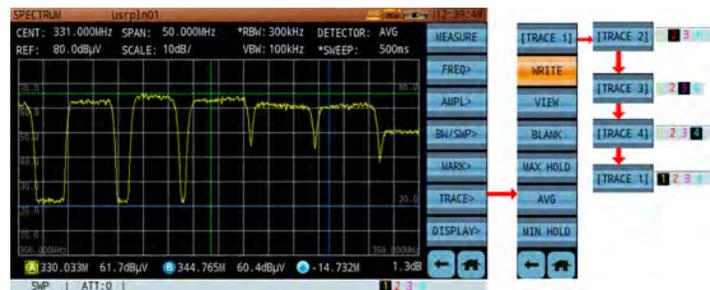
The S7200 can display up to 4 color-coded traces at once, each coded to a different trace calculation method: normal ("write"), maximum hold, minimum hold, and average. Tap **Trace** to open the trace menu.

Here, repeatedly tap the [Trace #] key at the top of the submenu to cycle through the traces numbered 1-4. To activate the chosen trace in normal mode, tap **Write**; to deactivate it, tap **Blank**.

In the bottom-righthand corner of the screen (see below), the currently selected trace number will appear highlighted in black.



*Four Traces Display Simultaneously*



*Trace Setting Menu*

### Max Hold, Min Hold, and Average Trace

In the trace menu, you can change the trace display calculation for the selected trace. Tap Max Hold, Min Hold, or Average to apply that behavior to the trace.

- Max Hold: records the highest signal strength of each sweep along the frequency span.
- Min Hold: records the lowest signal strength of each sweep along the frequency span.
- Average: over several sweeps, calculates the mean signal strength at each point along the frequency span.

## 6-15.7 Detector Settings

Tap **Detector** to enter the detection mode menu. Here, you may choose 1 of 4 detection modes:

- Sample detection (**SAM**)
- Positive peak detection (**POS**)
- Average detection (**AVG**)
- Negative peak detection (**NEG**)



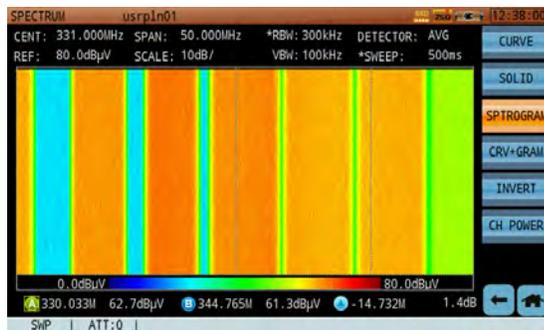
6-15.8 Display Settings

The spectrum analysis function offers 4 display modes: curve, solid, spectrogram, curve/spectrogram, and inverted (print) mode. Tap **Display** to enter the menu, then select from the following modes.



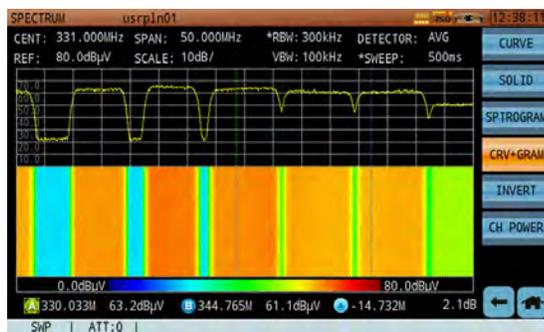
**Curve mode**

Curve is the standard Spectrum Analysis display mode.



**Solid mode**

The solid mode fills the area below the signal with solid yellow, shown left.

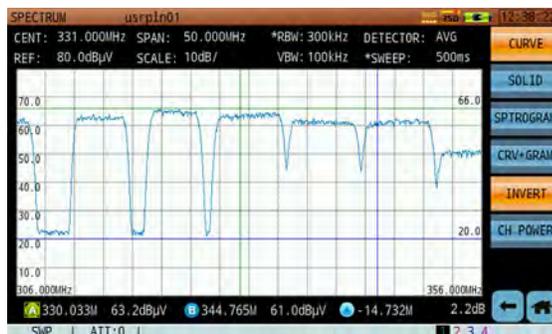


**Spectrogram mode**

The scrolling three-dimensional display is useful for tracking frequency and power over time. Use Spectrogram mode to verify a signal's stability over time, or to identify intermittent interference signals. The X-axis (horizontal) shows frequency, the Y-axis time (with new data scrolling bottom-to-top), and amplitude is represented by color (red for a high level signal and blue for the noise floor).

**Curve+Spectrogram mode**

The best setting for many scenarios, the simultaneous spectrum trace and scrolling three-dimensional display provides a definite advantage in using the combined mode from a visual stand-point. (It will be much easier to visualize signal variations, such as a hopping frequency signal.)



**Print Mode**

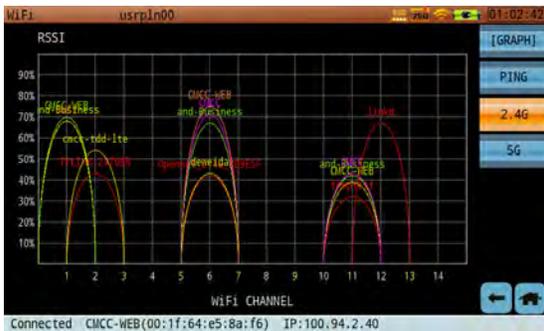
New to the S7200 is Print mode. By inverting the screen colors from dark background and a light trace color to a light background and a dark trace color, printing hard copies of saved traces is more cost-efficient. This mode also makes traces easier to see in strong sunlight.

## 6-16 WiFi Analysis

The WiFi analysis mode is primarily used to display the surrounding WiFi channels, their SSID, their designated channel within the WiFi band used, and their relative amplitude level from the S7200 location. (See the figures **Error! Reference source not found.** below for the graphical interface.)

The WiFi Analysis function has two display modes: **graphical** and **list**. The list mode shows the name, status, channel, relative signal strength, MAC address, and encryption method of the SSID carriers detected.

Currently, the WiFi analysis function supports WLAN of 2.4G and 5G.



2.4G WiFi Channel - Graphical Display



5G WiFi Channel - Graphical Display

The list display shows a table of detected WiFi channels. The status bar at the bottom shows 'Connected CMCC-WEB(00:1f:64:e5:8a:ea) IP:100.94.2.40'. The table contains the following data:

NAME	STATUS	CH	LEVEL	MAC	ENCI-
Linkd-5G	---	153	71%	04:a1:51:d2:53:c2	[WP
CMCC-WEB	Connected	1	67%	00:1f:64:e5:8a:ea	NON
Linkd	---	12	66%	04:a1:51:d2:53:c3	[WP
CMCC	---	1	62%	00:1f:64:e7:8a:ea	[WP
CMCC	---	6	59%	00:1f:64:e7:8a:f6	[WP
and-Business	Saved	6	59%	00:1f:64:e6:8a:f6	NON
and-Business	Saved	1	58%	00:1f:64:e6:8a:ea	NON
CMCC-WEB	Connected	6	54%	00:1f:64:e5:8a:f6	NON
cmcc-tdd-lte	---	2	52%	c8:3a:35:45:1e:30	[WP
CMCC-WEB	Connected	11	43%	00:1f:64:e5:8a:ec	NON
CMCC	---	11	42%	00:1f:64:e7:8a:ec	[WP
Openwrt_2.4G_809E	---	6	40%	a2:63:91:8d:9e:5f	[WP
and-Business	Saved	11	40%	00:1f:64:e6:8a:ec	NON

Wifi Channel - List Display

## 6-17 DTMB Measurement

The DTMB (Digital Terrestrial Multimedia Broadcast, the TV standard for mobile and fixed terminals used in China, Cuba, Hong Kong, and Macau) measurement function allows users to read signal power, CNR, MER, LM, BER, constellation, and other data.

**NOTE**  
To ensure optimal test sensitivity, maintain a distance of at least 80cm between the analyzer and the DTMB antenna connection.

When the DTMB signal has been demodulated, press the **VIEW** button to view the video data. You can expand to fullscreen by pressing **Enter**.



**DTMB Average Power**



**DTMB Video Details**

### 6-17.1 Settings

Channel The channel to measure. You can select any digital channel in the active channel plan.  
 Frequency Input range 4-1220 MHz.  
 Bandwidth Select 6 MHz, 7 MHz, or 8 MHz.

#### Button Operation

[POWER] Opens average power function.  
 [CONS>] Opens constellation diagram function.  
 [HUM] Opens digital hum function.  
 [ECHOES] Opens echo pattern function.  
 [SHOULDER] Opens band shoulder test function. (See subsection 6-17.2 below.)  
 [AUTO] Auto-searches current frequency. (See Section 4-9.)

#### Test Results

Power: Average power reading.  
 CNR: Carrier to composite noise ratio.  
 MER/LM: Difference between actual received MER value and MER threshold standard.  
 BER: Bit error rate.

The threshold standard value varies by channel type, modulation type, and code rate.

## 6-17.2 Signal Shoulder Test

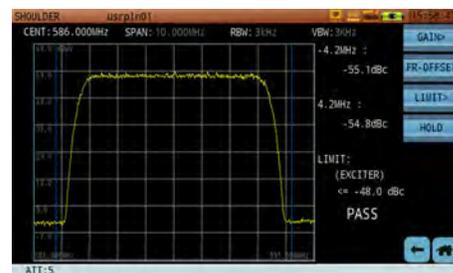
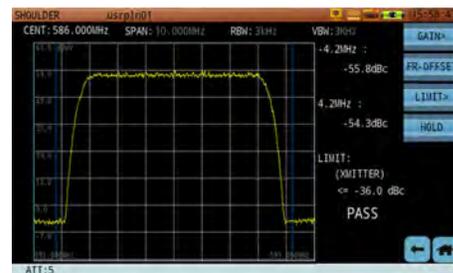
When the digital TV signal is amplified, the intermodulation output outside the channel is an approximate continuous spectrum. The continuous spectrum outside the channel generates "shoulder" effects, called the *band shoulder*. The "shoulder ratio" is the ratio of the power level at the center frequency to that of a single point deviating from the center frequency outside the carrier. For example, a Chinese TV channel bandwidth of 8MHz will have a band shoulder ratio (measured in dBc) of:

$$\frac{\text{Power at Center Frequency}}{\text{Power at } \pm 4.2 \text{ MHz from Center Frequency}}$$

Power amplifiers are the main nonlinear component in transmitters used for terrestrial digital broadcasting. Their efficiency and linearity are inversely related: a high-efficiency power amplifier will generally exhibit strong nonlinearity, which causes signal distortion. The resultant in-band/out-band interference is reflected on the spectrum as the shoulder ratio difference. Shoulder ratio is a key technical specification of digital TV RF output; it expresses the linear level of the digital TV transmitter power amplifier.

As shown below, a signal shoulder measurement requires a transport stream source, a transmitter, and a spectrum analyzer. For terrestrial digital broadcasting, transmitter shoulder performance is  $\leq -36\text{dBc}$ .

An alternative measurement method employs a terrestrial digital TV actuator instead of a transmitter. This measurement's performance spec is  $\leq -48\text{dBc}$ .



### Button Operation

- [GAIN>] Set attenuation to Auto/Manual. In Manual mode, use **ATT+/-** to set attenuation.
- [FR-OFFSET] Set deviation from center frequency (4.2 MHz in above example). Range 1-5 MHz.
- [LIMIT>] Set pass/fail limit on test. Preset limit for **Xmitter** (transmitter) is  $\leq -36\text{dBc}$ ; preset limit for **Exciter** (actuator) is  $\leq -48\text{dBc}$ . Otherwise, choose **User Def** to set a custom limit value.
- [HOLD] Pauses the measurement. Press again to resume.

## 6-18 DAB/DAB+ Measurement

The DAB (Digital Audio Broadcasting) system originated at the 1980 German Institute of Radio Technology. Based on the Eureka-147 system, DAB was developed to research terrestrial digital audio broadcasting tech, and define an Eureka-147 DAB standard. It has seen wide adoption in Europe.

Following in the footsteps of AM (amplitude modulation) and FM (frequency modulation) broadcasting, digital broadcasting presents the advantages of high spectrum utilization, anti-interference, encryption, and the capacity for high-quality audio. The DAB standard uses the MPEG Audio Layer II coding method, while DAB+ uses MPEG-4 High Efficiency AAC v2.

The S7200 supports both DAB and DAB+ measurements on the 1.536MHz band. The available frequency range is 167.392 ~ 239.968 MHz – accurate to the nearest kHz.



*DAB measurement*

When the signal is locked, the S7200 will automatically search for all programs, sub-channel ID, DAB type, and encryption data of the selected channel. If audio issues are detected, tap **Listen** to activate the audio feed. Use **Vol+/-** to adjust the volume.

# Part III

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## Background and Concepts

Unit Conversion Chart

Unit	Impedance 50Ω	Impedance 75Ω
μV	1μV=10 <sup>-6</sup> V	1μV=10 <sup>-6</sup> V
mV	1mV=1000μV	1mV=1000μV
dBμV	0dBμV=1μV	0dBμV=1μV
dBmV	0dBmV=1mV	0dBmV=1mV
dBm	0dBm=107dBμV	0dBm=108.8dBμV

## Chapter 7: Analog TV Standards & Color Systems

There are many different TV standards in use around the world, defining in detail the acceptable baseband and RF structure of a signal. For broadband engineers / technicians, there are three key points: bandwidth, the dimensions of the lower (vestigial) and upper sidebands, and the frequency & amplitude relationships of the video (luminance), color (chrominance) and audio subcarriers.

In terms of these parameters, the vast majority of TV transmissions fall into six categories, which are illustrated in the following diagrams.

**(Note:** These diagrams do not define parameters such as field frequency, line frequency, or color encoding technique, points which distinguish the NTSC, PAL and SECAM systems.)

Today, there are 10 primary TV standards in use around the world. These standards are: B, D, G, H, I, K, K1, L, M, and N. There are three types of color transmission system: PAL, NTSC, and SECAM.

Different standards and systems have different field frequencies, line frequencies, and color encoding techniques. For example, Europe and China use the PAL-D color transmission system and TV standard, while North America (USA, Canada & Mexico) use NTSC-M color transmission system and TV standard.

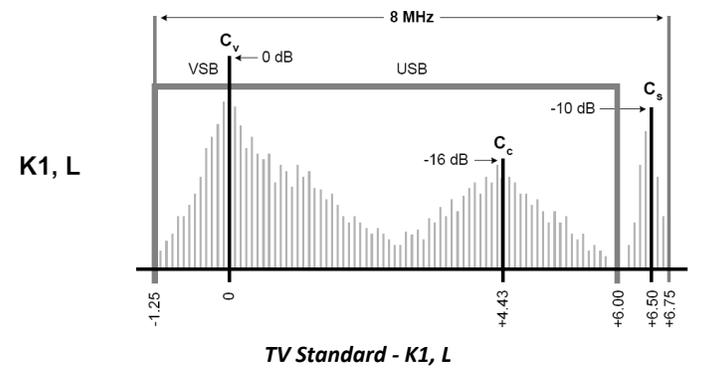
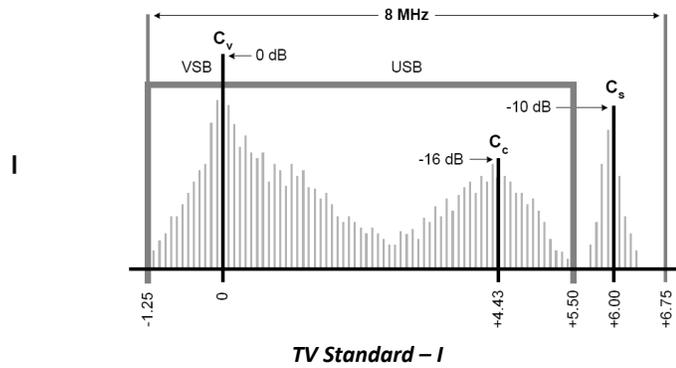
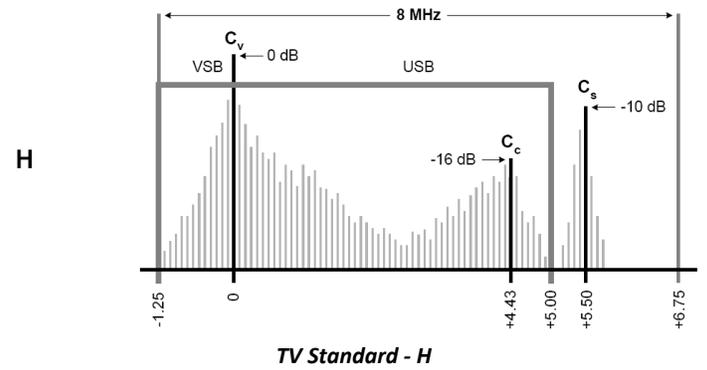
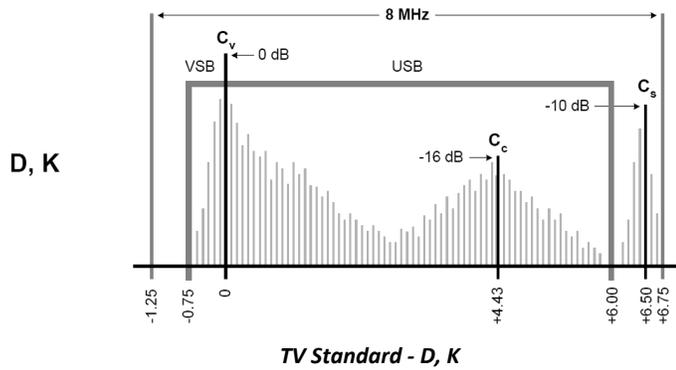
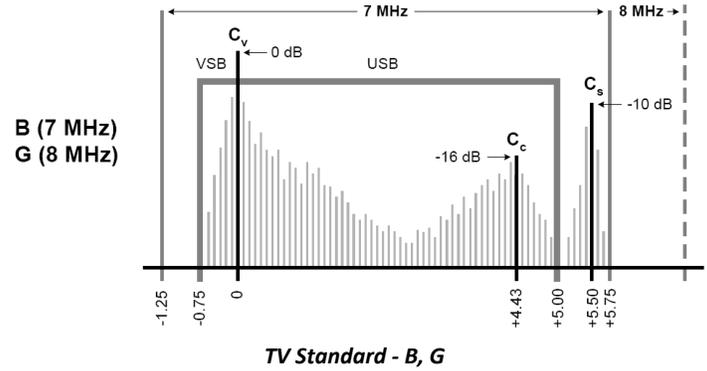
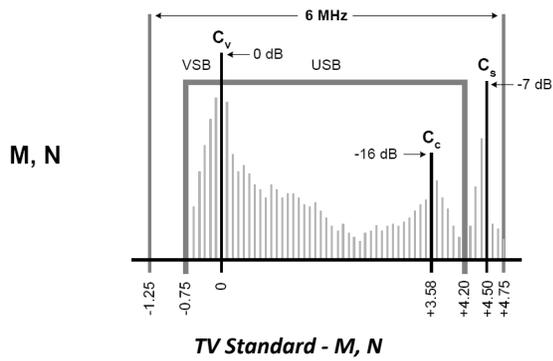
Refer to the table below for information on TV-standard/color system compatibility. Letters (e.g. B, G, M) refer to TV standards. Encoding techniques (e.g. NTSC, PAL) refer to systems.

### TV Standard and Color Transmission System Relationships:

Standard	Compatible with:
B	PAL, SECAM
D	SECAM
G	PAL, SECAM
H	PAL, SECAM
I	PAL
K	SECAM
K1	SECAM
L	SECAM
M	NTSC, PAL
N	PAL

**Reference for the Following Diagrams:**

- Cs: Audio carrier
- Cv: Video carrier
- Cc: Color subcarrier
- VSB: Vestigial Sideband
- USB: Upper Sideband



**Color system parameter setup for various TV standards**

TV Standard	Lines per frame	Field frequency	Color encoding	Color subcarrier
NTSC-M	525	60Hz	NTSC	3.58MHz
PAL-M	525	60Hz	NTSC	3.58MHz
PAL-B, D, G, H, I	625	50Hz	PAL	4.43MHz
PAL-N	625	50Hz	PAL	4.43MHz
PAL-N combo	625	50Hz	PAL	3.58MHz
SECAM	625	50Hz	SECAM	4.406MHz 4.250MHz

**Audio frequency and bandwidth for various TV standards**

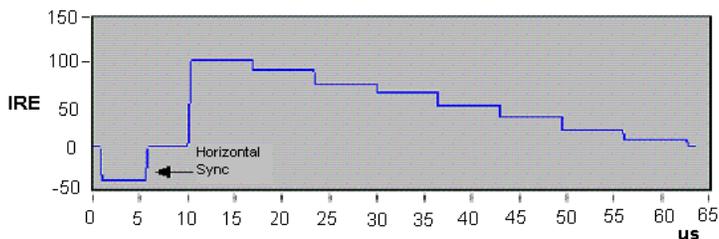
Analog TV standard	Audio 1 offset (MHz)	Audio 2 offset (MHz)	Channel bandwidth (MHz)
NTSC-M	4.50	4.50	6.00
PAL-B	5.50	5.85	7.00
PAL-D	6.50	6.85	8.00
PAL-H	5.50	5.85	8.00
PAL-I	6.00	6.50	8.00
PAL-K	6.50	6.85	8.00
PAL-M	4.50	4.50	6.00
PAL-N	4.50	4.50	6.00
SECAM-B	5.50	5.85	7.00
SECAM-D	6.50	6.85	8.00
SECAM-G	5.50	5.85	8.00
SECAM-H	5.50	5.85	8.00
SECAM-K1	6.50	6.85	8.00
SECAM-K	6.50	6.85	8.00
SECAM-L	6.50	6.85	8.00

## Chapter 8: Analog TV Baseband Signals

### 8-1 Understanding Composite Video Signal

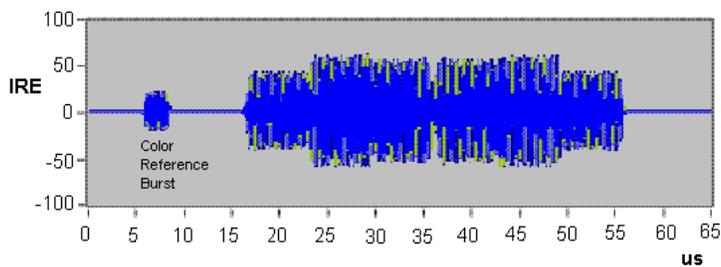
A composite video signal is a signal containing all three main components required to generate video. These components are:

- The **luminance signal** contains the intensity (brightness) information of the video image.
- The **chrominance signal** contains the color information of the video image.
- The **synchronization signal** controls the scanning of the signal on a display such as a TV screen.



The monochrome composite signal (or "Y signal") is constructed from two of these components: luminance and synchronization.

(Here, the luminance steps from white to black.)

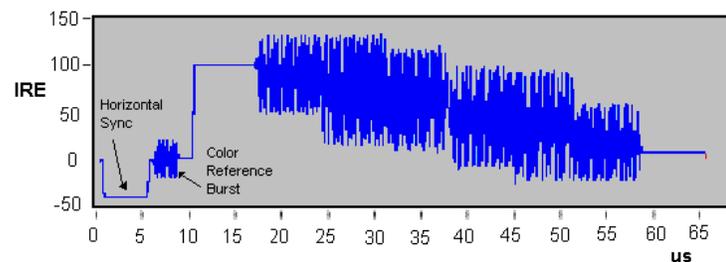


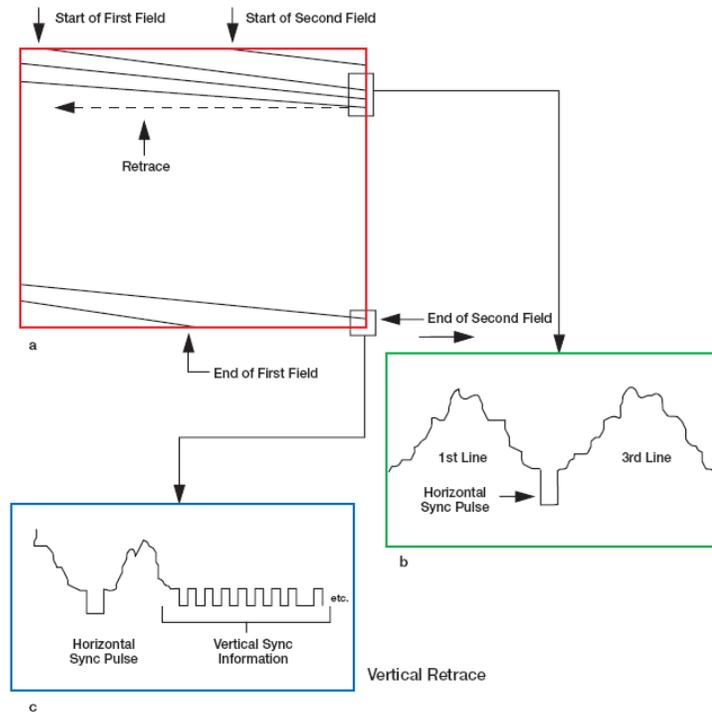
The chrominance signal is also called the "C

signal".

Finally, the composite color video signal (or "Color Video, Blank, and Sync" (CVBS) signal) is the sum of the Y and C signals.

$$CVBS = Y + C$$





**The synchronization signals in an analog composite baseband**

To reproduce an image, both the camera and the video display are scanned horizontally and vertically (see graph **a** in the above figure). The horizontal lines on the screen are scanned alternately – first the odd-numbered lines, then the even – as in interlaced scanning systems, or they might be scanned sequentially as in progressive scanning systems.

Both the camera and display must be synchronized to scan the same part of the image at the same time. This synchronization is handled by the horizontal sync pulse, which is part of the baseband video signal. The horizontal sync pulse starts a horizontal trace. During the horizontal blanking interval, the beam returns to the left side of the screen and waits for the horizontal sync pulse before tracing another line. This is called “horizontal retrace” (see graph **b** in above).

When the beam reaches the bottom of the screen, it must return to the top to begin the next field / frame. This is called the “vertical retrace” and is signaled by the vertical sync pulse (see graph **c** above). Vertical retracing takes much longer than a single horizontal retrace, so a longer synchronizing interval – called the “vertical blanking interval” – is employed. No information is written on the video screen during the horizontal or vertical blanking intervals.

Each video standard sets a series of synchronization signals that controls how the video signal is displayed. For instance, PAL signals display a video frame 25 times a second and a frame contains 625 video lines, while NTSC signals display a video frame 30 times a second, but with only 525 lines.

**Active Image Value**

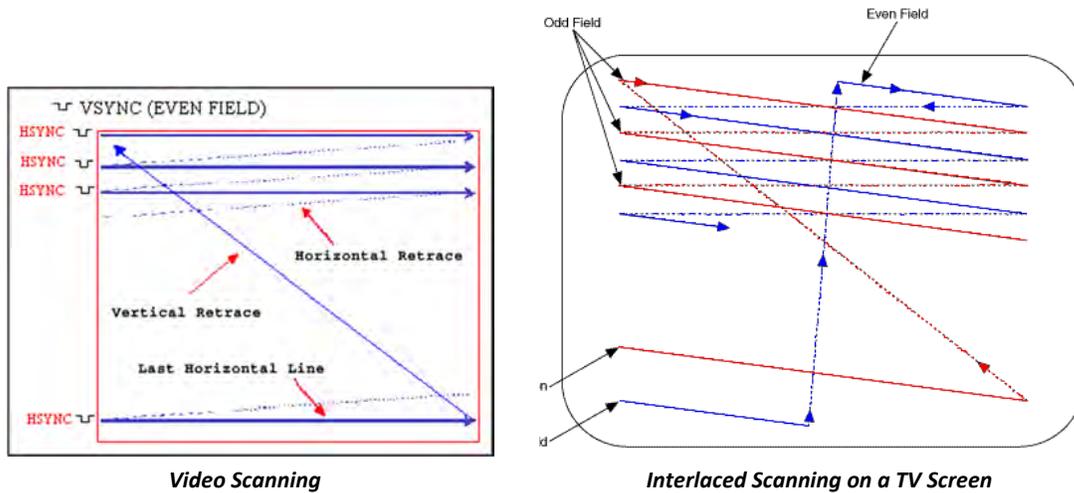
Video Format	Lines/Frame	Active Lines	Frame Rate (frames/sec)	Line Duration	Active Line Duration
NTSC	525	480/486	29.97	63.55 $\mu$ s	52.2 $\mu$ s
PAL/SECAM	625	576	25.00	64.00 $\mu$ s	52.0 $\mu$ s

The active video image resulting from the scanning always has an aspect ratio (horizontal/vertical) of 4/3, regardless of the video format. The color composite video signal shows that the scanning process requires some additional room on the left and right sides of each line, as well as on the top and bottom, of the active video image region. This additional room includes the synchronization signals, color bursts, and other format-specific information, like the ITS, which are not part of the active video image. Approximately 90% of all the lines, and 80% of each line, can transmit the active image information. The exact values depend on the video format, as shown in the table above.

"Active Lines" represents the number of lines that are actually used to transmit the image information. For example, only 480 lines out of 525 lines per frame transmit the image information in NTSC. Likewise, on each line, the image information is transmitted only during the active lines sequence, which is shorter than the entire line duration. For example, of 63.55  $\mu$ s, only 52.2  $\mu$ s are the active line duration in NTSC. Frame rate is the scanning speed.

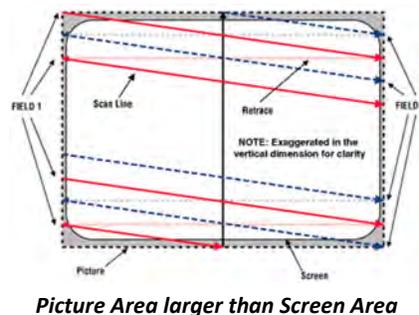
## 8-2 Principles of Interlaced Scanning

All composite video systems display the video image on a TV screen using an interlaced scanning technique. The figure below depicts the concept of interlaced scanning.



The analog video signal includes synchronization pulses that control the scanning line by line from left to right and field by field from top to bottom. The pulses that control the line-by-line scanning are called the horizontal synchronization pulses (H-Sync). The pulses that control the vertical scanning are called the vertical synchronization pulses (V-Sync).

Two interlaced fields compose a complete frame. The first field, called the odd field, scans the odd lines of the video image. The second field, called the even field, scans the even lines of the video image. The process repeats for every frame.



## 8-3 Principles of Gated Measurements

### Field

A television image, or frame, is composed of 525 (or 625 lines). When displayed, these are delivered in two successive fields of 262.5 (or 312.5 lines) interlaced together on a CRT. When **Field** is set to **Entire Frame**, the line count starts at line one in field one (often referred to as the "odd field") and ends at 525 (or 625) in field two (often referred to as the "even field"). When **Field** is set to **Field One** or **Field Two**, the line count begins at "1" with the first full line in the selected field and ends at count 263 (or 313) for Field One, and 262 (or 312) for Field Two.

### Sync

Analog broadcast or cable television signals are usually amplitude-modulated on an RF carrier. For NTSC and PAL broadcasts, typically the RF carrier amplitude is maximized at the sync tips of the baseband video waveform and minimized at the "white" level. This results in a demodulated waveform on the analyzer where the sync pulses are on top, or positive (**Sync [Pos]**). With SECAM broadcasts, typically the RF carrier amplitude is minimized at the sync tips of the video waveform and maximized at the "white" level. This results in a waveform on the analyzer where the sync pulses are at the bottom, or negative (**Sync [Neg]**). A normal baseband video waveform for all TV standards will have the sync tips on the bottom. When **TV Source** is set to **Ext Video In**, **Sync** should be set to **Neg**.

Composite color TV video signal is composed by the modulated chrominance, and is added to the luminance information along with appropriate horizontal and vertical sync signals, blanking signals, and color burst signals. In a system of 625 scanning lines, there are 25 blanking lines, lines 623~22 in odd field and line lines 311~335 in even field. These lines are used to transmit blanking signal for the electron beam at the end of the line scanning and field scanning can come back to the start point of the picture. In a system of 625 scanning lines, every field has 25 lines as the flyback line, so every frame only has 575 effective lines.

When engineers test TV systems, they often use full-field test signals, requiring interruption of TV broadcast. Obviously, if we want to test the dynamic parameters, we cannot conduct measurements and broadcast TV programs at the same time. As the TV industry has continued to develop, TV program broadcast hours continuously increase. TV program service providers hope to monitor TV system performance parameters and judge whether the broadcast equipment is sufficient or not according to these parameters. They can modify this equipment according to these parameters. This requirement is very important for TV program service providers.

Vertical blanking interval is not used to transmit any information. Later, researchers use these free lines to convey auxiliary signals for increasing the bandwidth utilization ratio. Vertical Interval Test Signal (VITS) can give important system dynamic performance parameters without influencing the TV program broadcast. VITS also provides the possibility to automatically monitor, modify and broadcast. Inserting test signals in the vertical blanking interval is used in real time monitoring, helping to modify and improve TV transmission quality by at least determining which parameter is below acceptable quality or does not meet mandatory thresholds prescribed by the FCC. Now, the VITS signal is an indispensable part of international and domestic TV signals.

Some signals can measure video parameters: in-channel frequency response, luminance nonlinear distortion, Differential Gain, Differential Phase, Chrominance Luminance Gain Inequality and Chrominance Luminance Time Delay Inequality. These test signals are combined into some composite test signals meeting the video transmission line signal and insert vertical blanking interval after the field sync pulse. These composite signals are called VITS signal and these vertical blanking interval line are called insert test line.

### 8-3.1 CCN, C/CSO and C/CTB Gated Measurements

CCN, C/CSO and C/CTB can all perform gated measurements, but C/CTB gated measurements are slightly different from C/N's and C/CSO's: C/CTB interference falls right at the video carrier frequency. First, we shall discuss CCN and C/CSO gated measurement.

CCN gated measurements must measure video signal carrier peak levels and corrected noise levels (over a specified bandwidth) on a quiet line during the vertical blanking interval. These two results are then used to calculate CCN.

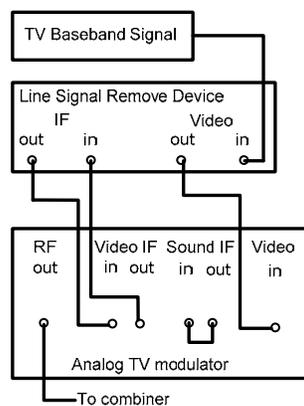
A C/CSO gated measurement also needs to measure video signal carrier peak level and second order beat on a quiet line during the vertical blanking interval, and then uses the results to calculate C/CSO.

C/CTB gated measurements differ from CCN and C/CSO, because the third order beat coherent distortion is located directly at the video carrier frequency. By definition, this signal is covered by the video carrier. In order to measure the third order beat, you must shut off the video signal carrier. Using traditional methods, you would need to shut off the modulator, let the video carrier level disappear, and then measure the third order beat right at the video carrier frequency. In gated measurement mode, however, it is suggested that you use a quiet line inserter, which gates off at the necessary time (at the specified field).

The S7200 first measures the video carrier peak level during the sync pulse. Then, while the quiet line inserter removes a specified line at the same time in every frame, the instrument uses the gated function to measure third order beat. The instrument uses two results to calculate the C/CTB. The effects of removing a quiet line during a specific vertical blanking interval are the same as if you shut off the modulator, but at a very brief, specific time.

The figure below illustrates how a quiet line inserter should be installed behind each modulator to be tested. The advantage of using a quiet line inserter is that, prior to inserting a quiet line, it removes the line to be used for insertion of the quiet line first. Using this method, C/CTB measurements are *almost* undetectable by the end user customer: a low-level audible sound is emitted, but this is a better solution than removing modulation, which renders TV picture and sound inoperable for the duration of the test.

When performing a C/CTB measurement with a quiet line inserter (remembering to remove the line first) by removing/inserting only one of the 2 video fields, the audible distortion coming out of the speaker of your television is almost indistinguishable. (If both fields are used, the pitch of the audible distortion is higher and more noticeable.)



**CTB quiet line removing equipment connection**  
**Quiet line inserter in this example: TVMS4200.**

8-3.2 Video Parameters Gated Measurement

**VITS (Vertical Interval Test Signal)**

In the past, engineers often used full-field test signal to test TV systems. This particular test process requires the field or HE engineer to interrupt the specific channels from broadcasting. In today's HFC networks, for competitive and other reasons, this is no longer a feasible plan. With the continuous growth of the CATV industry, it is critical that broadcast TV programs are not interrupted during testing and monitoring of CATV system performance. VITS, a method of inserting undetectable test signals during the vertical blanking interval, allows CATV operators to conduct performance testing without disrupting service to customers.

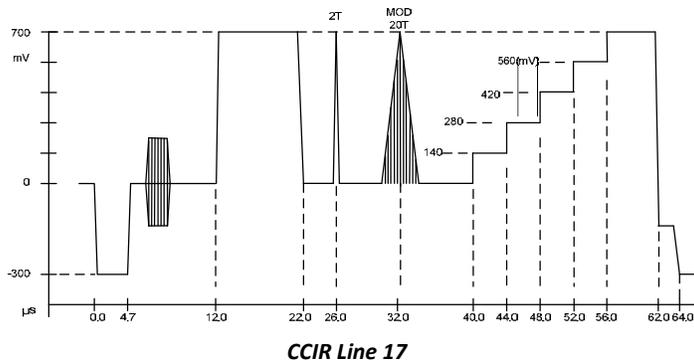
1. VITS insert position provision.

The composite test signal is inserted into an empty, unimportant or undesired line of the vertical blanking interval behind the sync pulse field, e.g. lines 16-22 or line 329-335 in a 625-line system. (These particular lines do not typically show, and/or cannot be visualized on the viewable portion of your television screen.)

In 1969, CCIR changed its recommendation for usage of international TV programs from 625 line systems to VITS. The recommended VITS insertion position is as follows:

Insertion Line	Application
16 (329)	Data and communication signal
17, 18 (330, 33)	International VITS signal position, for
21 (334)	Teletext broadcast

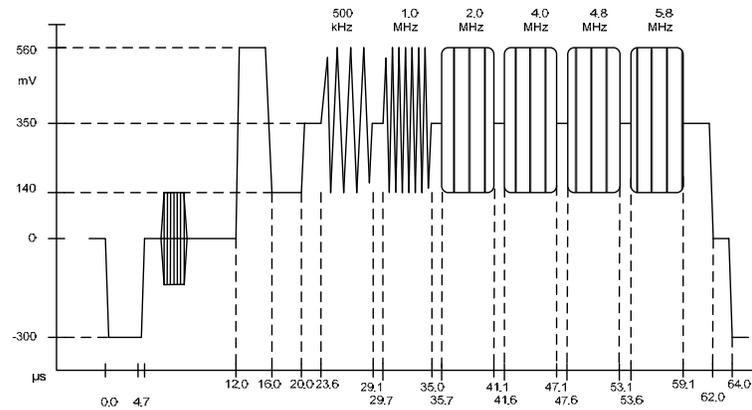
The following figures illustrate some of the most widely used VITS signals.



**CCIR17 test signal**

The first peak from the left is a white flag with peak amplitude of 700mV (relative to blanking level) and a width of 10µs; a zero carrier reference (base white) for measuring video signal amplitude and depth of modulation. The second from the left is 2T pulse with a half-amplitude width of 200ns, it is used to measure K factor. Cable TV systems use K-2T factor to replace echo measurement.

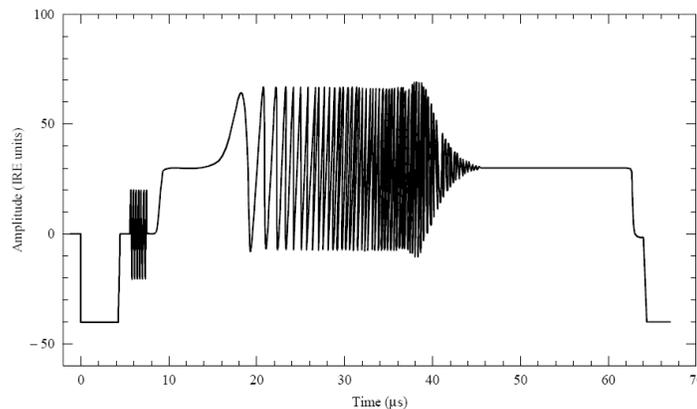
The third from the left is a composite sine square pulse with a half-amplitude width of 20T (2µs). The 4.43MHz color subcarrier sine wave is filled in the 20 sine square envelope (standard for luminance signal), 20T modulated chrominance pulse is used to measure Chrominance-Luminance Delay Inequality and Gain Inequality. The fourth from the left is 5-step luminance staircase signal; every staircase step is 140mV, which is used to measure luminance nonlinear characteristic.



**CCIR Line 18(multiburst)**

**CCIR 18 test signal**

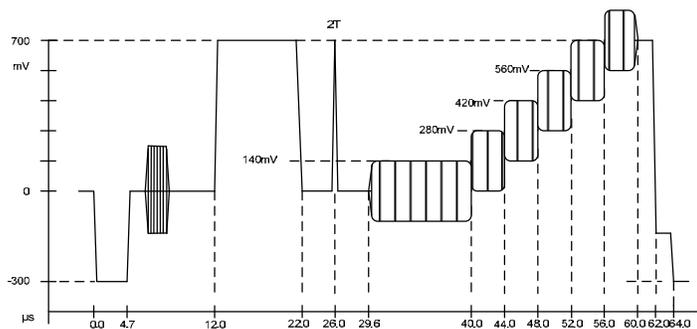
CCIR 18, also called a multiburst signal, consists of a set of single frequency sine wave signals with equal amplitude. The left side is a white flag with a peak amplitude 420mVp-p and provide amplitude standard for the following multiburst signals. Followed by six sine wave frequency packets, each frequency packet is: 0.5, 1.0, 2.0, 4.0, 4.8, and 5.8MHz. The multiburst signal is used to measure transmission system video bandwidth frequency and amplitude response characteristic.



**GCR signal line A for 525-line systems**

**Ghost Cancellation Reference (GCR)**

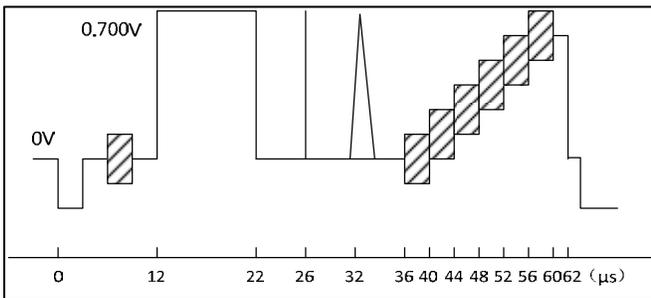
This signal is also often used to measure in-channel frequency response.



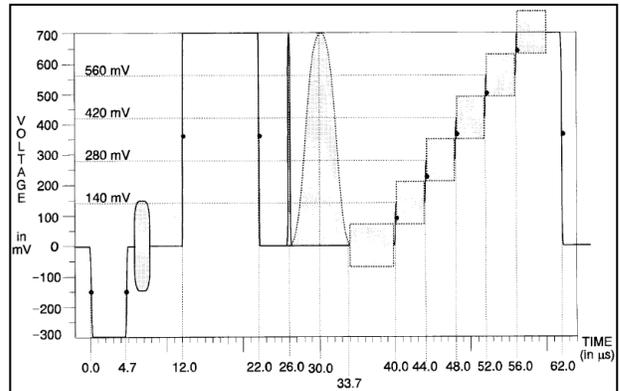
**CCIR Line 330**

**CCIR 330 test signal**

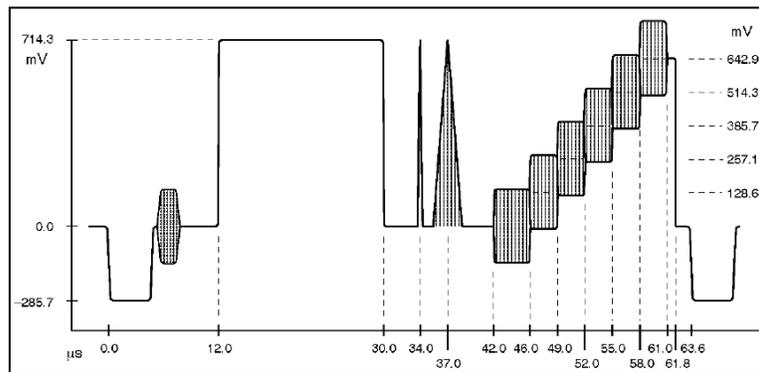
The first peak from the left is a white flag with peak amplitude of 700mV (relative to blanking level) and a width of 10µs; a zero carrier reference (base white) for measuring video signal amplitude and depth of modulation. The second from the left is 2T pulse with a half-amplitude width of 200ns, it is used to measure K factor. Cable TV systems use K-2T factor to replace echo measurement. The third from the left is the blanking level and 5 luminance steps superimposed with a 4.43MHz color subcarrier sine wave; the color burst is 280mV and used to lock color signal phase. The 5-step luminance staircase and blanking is used to represent six different luminance levels. This third part of the signal is used to measure DG and DP.



**GB19**



**NTC-7 Composite**



**UK ITS1**

The VITS composite signals are composed of several basic types of test signal:

1. 0.7±7mV line bar, as the standard level;
2. 2T pulse: used to measure high frequency character of channel;
3. 10T or 20T pulse made up of a sine-squared luminance pulse and a chrominance packet with a sine-squared envelope: used to measure Chrominance-Luminance Inequality character of a channel.
4. 5-step luminance staircase signal: used to measure Luminance nonlinear distortion of channel.
5. Luminance steps superimposed with modulated chrominance: used to measure chrominance amplitude and phase distortion caused by luminance amplitude change of a channel.
6. Multiburst: used to measure the flatness of a channel in 6MHz video bandwidth.

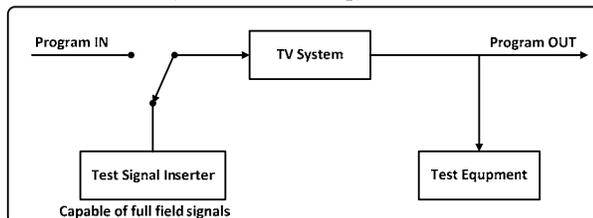
### Applications of VITS Signals

Measurement Parameter	VITS Signal
A brief waveform distortion	2T pulse (CCIR 17)
CLDI	10T pulse is made up of a sine-squared luminance pulse and a chrominance packet with a sine-squared envelope (CCIR 17)
Chrominance nonlinear distortion	Three-level chrominance bar (CCIR 331)
Overshoot distortion	2T pulse (CCIR 17)
Luminance nonlinear distortion	5-step luminance staircase signal
In Channel Frequency Response	Multiburst (CCIR 18)
Differential Gain and Differential Phase	luminance steps superimposed with modulated chrominance (CCIR 330)
Intermodulation Distortion	Three-level chrominance bar (CCIR 331)

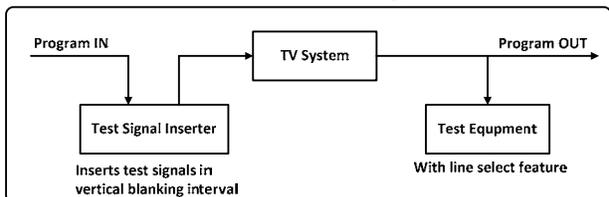
VITS test signals combine several types of test signals into one composite signal. This composite test signal is inserted in an empty or unused line of the vertical blanking interval behind the field sync pulse. The line position of these VITS signals are typically off the viewable portion of your television screen. These signals are inserted at the top of every field signal. They are specifically designed to meet non-intrusive measurement practices.

Gated video signal measurements need VITS signal generators and/or test signal inserters. VITS signal generators are used to generate basic test signals. The video test signal inserter is typically used to insert a VITS signal on the blanking line of a video signal. The following two figures illustrate the signal connection methods of out-of-service testing and/or in-service testing.

#### Out-of-Service (Full Field Testing)



#### In-Service (VITS or ITS Mode Testing)



## Chapter 9: Satellites and Transponders

This chapter will provide a basic overview of satellite transmission concepts, related to designing a satellite channel plan. For instructions on creating a satellite channel plan on the S7200, see Section 3-2.

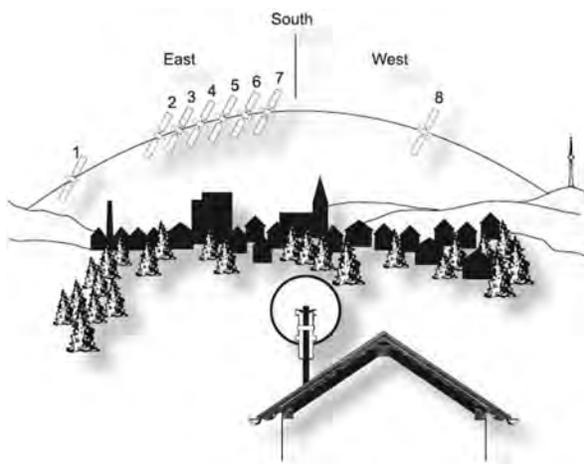
A satellite channel plan is composed of satellites and satellite *transponders*. A transponder is a device that receives signals transmitted from ground stations on Earth, amplifies them, and transmits them back down to the desired receiver. New satellites are launched into orbit every year, and over their lifetime, many of these satellites will modify their transponder settings. There is currently no universal standard; thus, users will need to manually design a satellite channel plan and update transponder parameters to suit their needs.

Satellites used for broadcast are kept in geosynchronous orbit over the equator on a fixed position point, in order for them to cover the designated service area. Broadcast satellites are launched at latitude  $0^\circ$ ; for longitude, a given country will use the point of intersection between the earth's center and the satellite connection with the relevant equatorial position (sub-satellite point). This ranges from  $0 \sim 360^\circ$ . Eastern longitudes are abbreviated as  $^\circ\text{E}$ , western as  $^\circ\text{W}$ .

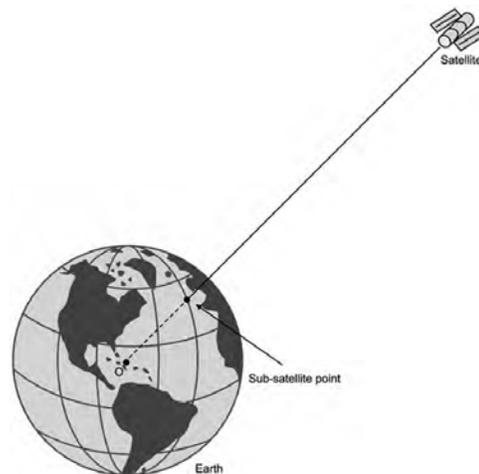
### 9-1 Sub-Satellites

In order to determine the angle and direction of a satellite, its precise location must be known (below, left). The location of a satellite is very often determined by the position of the sub-satellite point (below, right) – the location on the surface of the Earth that lies directly between the satellite and the Earth's core. To an observer on the sub-satellite point, the satellite will appear to be directly overhead.

The most commonly-used satellite broadcast frequency bands are the C band (3.4 ~ 4.2GHz) and Ku band (10.7 ~ 12.75GHz).

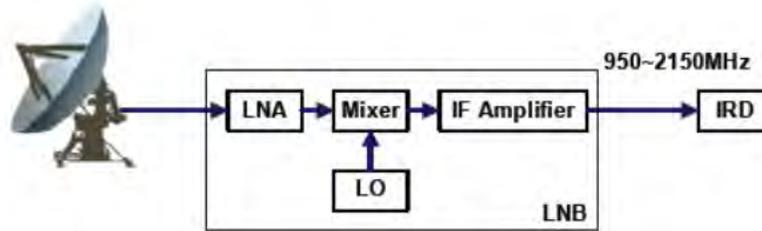


**Description of Satellite Position**



**Sub-Satellite Point**

## 9-2 Polarization and LNB



Satellite signals have two types of polarization: circular and linear. Circular polarization can be divided into right-handed (or clockwise) and left-handed (or counterclockwise); while linear polarization can be divided into horizontal and vertical. Most satellites use the horizontal and vertical polarization transmission signals. Today, many new products combine the LNB and Feedhorn into one: LNBF (LNB with Feedhorn).

The LNBF usually provides two mutually perpendicular probes in different feedhorn positions. One probe receives horizontal-polarization signal and the other vertical; then they couple the signal to microwave LNA. The IRD uses the 13V/18V signal to control two polarization paths and turn the power amplifier on or off.

The C band downlink frequency range (3.7GHz to 4.2GHz) and LNB are universal. But in the Ku band, each satellite uses a different range (e.g., some satellites use 11.7-12.2GHz while others use 12.25-12.75 GHz). Users receiving Ku band signals should choose the correct frequency band LNB for their satellite's range.

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### About the LNB Local Oscillator

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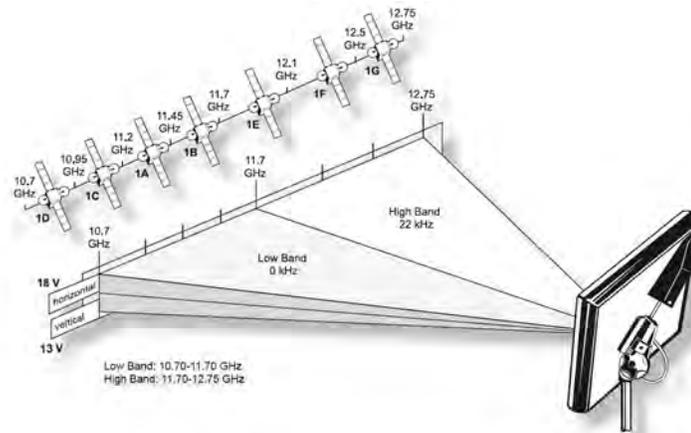
The LNB single local oscillator uses the frequencies 5150MHz and 5750MHz on the C-band. The IRD receives frequencies between 950-2150MHz, and the C-band's full bandwidth is only about half of this, at around 500 MHz. Some recent products provide two sets of circuits to handle horizontal and vertical polarization signals respectively. Two local oscillators respectively occupy the frequencies of 5150MHz and 5750MHz. After signal mixing, the horizontal and vertical polarization respectively output 950-1450MHz ( $5150 - 4200 = 950$ ,  $5150 - 3700 = 1450$ ) and 1550-2050MHz ( $5750 - 4200 = 1550$ ,  $5750 - 3700 = 2050$ ). These signals fall within the IRD's received frequency range.

Ku band downlink frequencies can range from 10.7 ~ 12.75GHz, with bandwidth of about 2.05GHz (about 4 times the C band bandwidth). Using a local oscillator frequency to receive full bandwidth signal is difficult on Ku band. So the 2.05GHz bandwidth can be divided into several frequency bands, each using a different local oscillator frequency such as 9.75GHz, 10.6GHz, 10.75GHz, 11.25GHz, 11.3GHz, etc.

The table below lists all local oscillator frequencies and corresponding received frequencies/IF ranges.

LO (GHz)	Received Signal Freq. (GHz)	LNB Output IF Range (GHz)
9.75	10.7 ~ 11.9	950 ~ 2150
10	10.95 ~ 12.15	950 ~ 2150
10.6	111.55 ~ 12.75	950 ~ 2150
10.75	11.7 ~ 12.75	950 ~ 2000
11.25	12.2 ~ 12.75	950 ~ 1500
11.3	12.25 ~ 12.75	950 ~ 1450

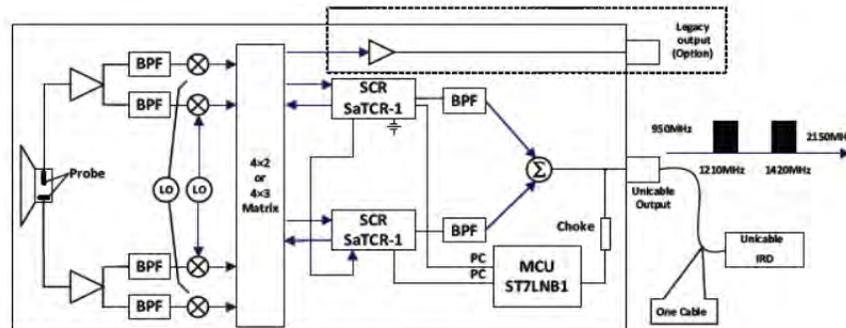
Some manufacturers provide double local oscillators for Ku band LNB. With two sets of circuits and local oscillators for different polarizations (9.75GHz and 10.6GHz are commonly-used), users can use a 0/22kHz impulse signal to control low-frequency and high-frequency band LO.



***Ku-band low and high frequencies***

### 9-3 SaTCR Overview

Unicable LNBS (see below) receive Ku-band satellite signals the same way that traditional LNBS do. The difference is the addition of SCR and MCU chips.



When the receiver's low-noise amplifier receives satellite signals, they may be of four different frequency bands: low- and high-LO vertical polarization (V/L and V/H), and low- and high-LO horizontal polarization (H/L and H/H). These signals pass the bandpass filter to filter out useless signals. When signals with low LO and high LO are mixed, the result is converted to the L band. These L band signals are input into a circuit matrix switch.

Some components, such as the SaTCR-1 (Satellite Channel Router), target the LNB, multi-switch, and SMATV market. The SaTCR-1 can translate a transponder to any location in the satellite bandwidth (950~2150MHz). With multiple SaTCR devices coupled with band-pass filters and an RF matrix, it is possible to combine transponders from different polarizations and bands on a single coaxial cable.

In order to receive all available channels in the Ku-band using a conventional LNB, a set top box has to select the polarization and the local oscillator corresponding to the desired transponder. The polarization is selected by changing the voltage of the LNB supply (13V for vertical, 18V for horizontal). The local oscillator is selected by adding or omitting a 22kHz tone on the LNB supply. (When the 22kHz tone is present, the highest LO is selected). The local oscillator frequency can be 9750 or 10600 MHz, depending on the location of the transponder. If the respective transponder is in the lower part of the spectrum (<11700MHz) the 9750MHz LO is selected; otherwise the 10600MHz LO is selected. The tuner must be set to the correct frequency using the following formula:

$$F_{\text{tuner}} = F_{\text{transponder}} - F_{\text{LO}}$$

With a LNB-integrating SaTCR-1 device, transponders are selected (polarization, LO selection and frequency translation) through a single DiSEqC command, **ODU\_ChannelChange**.

The first stage of a SaTCR LNB (up to the matrix) is similar to a conventional LNB. Consequently, the transponder frequency at the input of a SaTCR device is the same as  $F_{\text{tuner}}$  with a classical LNB:

$$F_{\text{satcr\_input}} = F_{\text{transponder}} - F_{\text{LO}}$$

Then, the SaTCR device should translate the transponder inside the bandwidth of its associated band-pass filter. To perform this operation, the SaTCR VCO must be set according to the following formula:

$$F_{\text{satcr\_voc}} = F_{\text{satcr\_input}} + F_{\text{bpf}} = |F_{\text{transponder}} - F_{\text{LO}}| + F_{\text{bpf}}$$

In addition, SaTCR LNB includes new features that allow auto-detection of its settings.

## Chapter 10: Resolution and Video Bandwidth

### 10-1 Resolution Bandwidth filter (RBW)

The frequency resolution is the ability to clearly distinguish 2 input sine wave signal responses of a spectrum analyzer. The ability of a spectrum analyzer to distinguish signals is generally described within 3dB of the available bandwidth IF filter.

**For analog intermediate frequency:**

The bandwidth of the smallest intermediate frequency filter generally determines the resolution bandwidth capability of an instrument.

Switching from one filter to another offers a different resolution of the measurement. Wide resolution bandwidth filters require less time to scan, are more stable when the sweep time is shorter (faster), require less time for the signal to reach full amplitude within the filter shape as it is scanning through. However, they offer less resolution, dynamic range and lower S/N range. Narrower bandwidth filters requires more time, or slower sweep time setting to allow the full amplitude of the signal to be measured, to be reached within the filter as it is scanning, but it does offer a much higher resolution, better dynamic range and better S/N.

The S7200 offers automatic or manual RBW selection depending on frequency/span/sweep time selection and/or what the user is looking for. The S7200 uses digital IF and leverages DSP (Digital Signal Processing) techniques of implementation, so the digital filters won't drift as analog filters would in older spectrum analyzers. Digital IF technology provides VERY good measurement stability with a much wider selection of Frequency/Span/Sweep times, and still provide a very stable and accurate measurement.

### 10-2 Video Bandwidth filter (VBW)

In order to reduce the influence of noise variations in the display of signal amplitude, Spectrum Analyzers typically smooth or average the trace display. The selectable video bandwidth filter in a spectrum analyzer is used for that purpose.

It is a low-pass video filter, which determines the bandwidth of the video signal located behind the envelope detector. The value of this video filter is typically lower than the RBW selected. The intended purpose is to average or smooth the displayed signal.

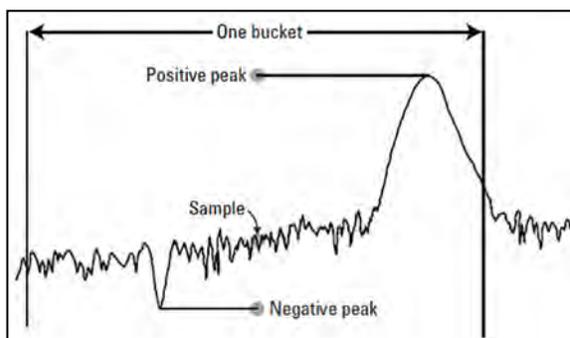
## Chapter 11: Detector Mode

When measuring and analyzing different types of signals with a spectrum analyzer, the detector mode should be set correctly. "Pixel point" is an important concept related to the detector mode of a spectrum analyzer. Suppose the spectrum curve is divided into "n" pixel points. When the span of the spectrum is large, each pixel point contains a relatively large frequency range of information (acquired data or acquisitions).

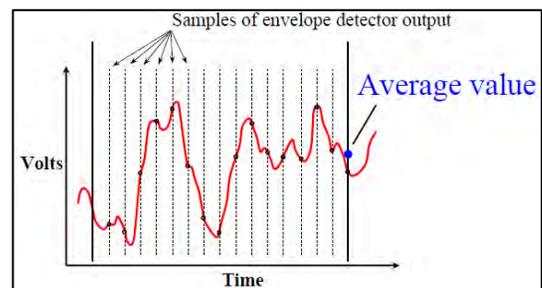
Screen size and resolution limits the amount of pixels that can be displayed on the screen, and since each pixel point can only show one value, each pixel may represent multiple measurement (or sample or acquisition) points. It is clear that not all data points can be displayed on the screen of a small portable piece of equipment so each displayed pixel on the screen must be processed to reduce the number of displayed pixels.

### Detector modes & applications

Detector Mode	Recommended Applications
Positive peak detection	CW signal and peak signal level measurements. Effective for detecting the maximum value from all sample points of a pixel point to display.
Sample detection	Noise signal measurements. Randomly selects a sample point from all acquisitions (or sample) points. It represents random noise fluctuations very well.
Negative peak detection	Small-resolution signal measurements. Effective for detecting the minimum value from all sample points of a pixel point to display.
Average detection	ACPR and channel power measurements. Each pixel point represents multiple sample points & amplitude data. Average detection uses each sample point's data for each pixel point, averaging the linear value of all sample points dedicated to each pixel point.
RMS (Root-Mean-Square) detection	Total power measurements or noise-like signals (e.g., CDMA, QAM). Calculates value of all sample points allocated to each pixel point; the result corresponds to the signal power in the selected bandwidth. In RMS detection mode, it is recommended that the VBW filter be $\geq 3$ times the RBW filter.



The number of trace points saved in memory is based on detector algorithm



Principle of Average Detector

## Chapter 12: International CATV Standards

### System and Standards by Country

Country	System	Standard	Country	System	Standard
Afghanistan	PAL	D	El Salvador	NTSC	M
Albania	PAL	B/G	Equatorial Guinea	PAL	B
Algeria	PAL	B	Estonia	PAL	B/G
Argentina	PAL	N	Ethiopia	PAL	B
Angola	PAL	I	Finland	PAL	B/G
Australia	PAL	B	France	SECAM	L
Antigua & Barbuda	NTSC	M	French Guiana	SECAM	K
Austria	PAL	B/G	Gabon	SECAM	K
Azores (Portugal)	PAL	B	Germany	PAL	B/G
Bahamas	NTSC	M	Ghana	PAL	B
Bahrain	PAL	B	Gibraltar	PAL	B
Bangladesh	PAL	B	Greece	SECAM	B/G
Barbados	NTSC	M	Greenland	NTSC	M
Belgium	PAL	B/G	Granada	NTSC	M
Belize	NTSC	M	Guadeloup	SECAM	K
Bermuda	NTSC	M	Guam	NTSC	M
Bolivia	NTSC	N	Guatemala	NTSC	M
Brazil	PAL	M	Haiti	SECAM	M
Bosnia	PAL	B/H	Honduras	NTSC	M
Brunei	PAL	B	Hong Kong	PAL	I
Bulgaria	SECAM	D	Hungary	PAL	B/G
Burma (Myanmar)	NTSC	N	Iceland	PAL	B
Cambodia	SECAM	M	India	PAL	B
Cameroon	PAL	B	Indonesia	PAL	B
Canada	NTSC	M	Iran	SECAM	B
Canary Islands	PAL	B	Iraq	SECAM	B
Central African Rep.	SECAM	K	Ireland (Republic of)	PAL	I
Chad	SECAM	K	Israel	PAL	B/G
Chile	NTSC	M	Italy	PAL	B/G
China	PAL	D	Ivory Coast	SECAM	K
Colombia	NTSC	M	Jamaica	NTSC	M
Congo	SECAM	D	Japan	NTSC	M
Costa Rica	NTSC	M	Jordan	PAL	B
Cuba	NTSC	M	Kenya	PAL	B
Cyprus	PAL	B/G	Korea (P.D.R.)	PAL	D
Czech Republic	SECAM	D/K	Korea (South)	NTSC	M
Denmark	PAL	B/G	Kuwait	PAL	B/G
Dominican Rep.	NTSC	M	Laos	PAL	M
Ecuador	NTSC	M	Latvia	PAL	B/G
Egypt	SECAM	B	Lebanon	PAL	B/G
Eire (Ireland)	PAL	I	Liberia	PAL	B
Libya	PAL	B	Sierra Leone	PAL	B
Lithuania	PAL	B/G	Singapore	PAL	B
Luxembourg	PAL	B/G	Slovakia	SECAM	D/K
Malaysia	PAL	B	Slovenia	PAL	B/G
Mali	SECAM	K	Somalia	PAL	B
Malta	PAL	B/G	South Africa	PAL	I
Martinique	SECAM	K	Spain	PAL	B/G
Mauritius	SECAM	B	Sri Lanka	PAL	B

Mexico	NTSC	M	Sudan	PAL	B
Monaco	SECAM	L/G	Surinam	NTSC	M
Mongolia	SECAM	D	Swaziland	PAL	B/G
Montenegro	PAL	B/H	Sweden	PAL	B/G
Morocco	SECAM	B	Switzerland	PAL	B/G
Mozambique	PAL	G	Syria	SECAM	B
Nepal	PAL	B	Tahiti	SECAM	K
Netherlands	PAL	B/G	Taiwan	NTSC	M
New Zealand	PAL	B/G	Tanzania	PAL	I
Nicaragua	NTSC	M	Thailand	PAL	B
Niger	SECAM	K	Tonga	NTSC	M
Nigeria	PAL	B	Trinidad y Tobago	NTSC	M
Norway	PAL	B/G	Tunisia	SECAM	B
Oman	PAL	B/G	Turkey	PAL	B
Pakistan	PAL	B	Uganda	PAL	B
Panama	NTSC	M	Ukraine	SECAM	D
Paraguay	PAL	N	U. A. Emirates	PAL	B/G
Peru	NTSC	M	United Kingdom	PAL	I
Philippines	NTSC	M	U.S.A.	NTSC	M
Poland	PAL	D/K	Uruguay	PAL	N
Portugal	PAL	B/G	Uzbekistan	SECAM	D
Puerto Rico	NTSC	M	Venezuela	NTSC	M
Qatar	PAL	B	Vietnam	PAL	M
Reunion	SECAM	K	Virgin Islands (U.S.)	NTSC	M
Romania	PAL	G	Yemen (A.R.)	PAL	B
Russian Federation	SECAM	D	Yemen (P.D.R.)	PAL	B
Rwanda	SECAM	K	Yugoslavia	PAL	B/H
St Kitts & Nevis	NTSC	M	Zaire	SECAM	K
St Lucia	NTSC	M	Zambia	PAL	B
St Vincent	NTSC	M	Zimbabwe	PAL	B
Samoa	NTSC	M			
Saudi Arabia	SECAM	B			
Senegal	SECAM	K			

Common CATV Channel Plans: North America

EIA channel		Standard		Incremental		Harmonic	
new	old	Video	Audio	Video	Audio	Video	Audio
T7	none	7.0000	11.5000	NA	NA	NA	NA
T8	none	13.0000	17.5000	NA	NA	NA	NA
T9	none	19.0000	23.5000	NA	NA	NA	NA
T10	none	25.0000	29.5000	NA	NA	NA	NA
T11	none	31.0000	35.5000	NA	NA	NA	NA
T12	none	37.0000	41.5000	NA	NA	NA	NA
T13	none	43.0000	47.5000	NA	NA	NA	NA
2	2	55.2500	59.7500	55.2625	59.7625	54.0027	58.5027
3	3	61.2500	65.7500	61.2625	65.7625	60.0030	64.5030
4	4	67.2500	71.7500	67.2625	71.7625	66.0033	70.5033
1	A-8	NA	NA	73.2625	77.7625	72.0036	76.5036
5	5	77.2500	81.7500	79.2625	83.7625	78.0039	82.5039
6	6	83.2500	87.7500	85.2625	89.7625	84.0042	88.5042
95	A-5	91.2500	95.7500	91.2625	95.7625	90.0045	94.5045
96	A-4	97.2500	101.7500	97.2625	101.7625	96.0048	100.5048
97	A-3	103.2500	107.7500	103.2625	107.7625	102.0051	106.5051
98	A-2	109.2750	113.7750	109.2750	113.7750	Cannot lock to comb ref: refer to FCC regs.	
99	A-1	115.2750	119.7750	115.2750	119.7750		
14	A	121.2625	125.7625	121.2625	125.7625	120.0060	124.5060
15	B	127.2625	131.7625	127.2625	131.7625	126.0063	130.5063
16	C	133.2625	137.7625	133.2625	137.7625	132.0066	136.5066
17	D	139.2500	143.7500	139.2625	143.7625	138.0069	142.5069
18	E	145.2500	149.7500	145.2625	149.7625	144.0072	148.5072
19	F	151.2500	155.7500	151.2625	155.7625	150.0075	154.5075
20	G	157.2500	161.7500	157.2625	161.7625	156.0078	160.5078
21	H	163.2500	167.7500	163.2625	167.7625	162.0081	166.5081
22	I	169.2500	173.7500	169.2625	173.7625	168.0084	172.5084
7	7	175.2500	179.7500	175.2625	179.7625	174.0087	178.5087
8	8	181.2500	185.7500	181.2625	185.7625	180.0090	184.5090
9	9	187.2500	191.7500	187.2625	191.7625	186.0093	190.5093
10	10	193.2500	197.7500	193.2625	197.7625	192.0096	196.5096
11	11	199.2500	203.7500	199.2625	203.7625	198.0099	202.5099
12	12	205.2500	209.7500	205.2625	209.7625	204.0102	208.5102
13	13	211.2500	215.7500	211.2625	215.7625	210.0105	214.5105
23	J	217.2500	221.7500	217.2625	221.7625	216.0108	220.5108
24	K	223.2500	227.7500	223.2625	227.7625	222.0111	226.5111
25	L	229.2625	233.7625	229.2625	233.7625	228.0114	232.5114
26	M	235.2625	239.7625	235.2625	239.7625	234.0117	238.5117
27	N	241.2625	245.7625	241.2625	245.7625	240.0120	244.5120
28	O	247.2625	251.7625	247.2625	251.7625	246.0123	250.5123
29	P	253.2625	257.7625	253.2625	257.7625	252.0126	256.5126
30	Q	259.2625	263.7625	259.2625	263.7625	258.0129	262.5129
31	R	265.2625	269.7625	265.2625	269.7625	264.0132	268.5132
32	S	271.2625	275.7625	271.2625	275.7625	270.0135	274.5135
33	T	277.2625	281.7625	277.2625	281.7625	276.0138	280.5138
34	U	283.2625	287.7625	283.2625	287.7625	282.0141	286.5141
35	V	289.2625	293.7625	289.2625	293.7625	288.0144	292.5144
36	W	295.2625	299.7625	295.2625	299.7625	294.0147	298.5147
37	AA	301.2625	305.7625	301.2625	305.7625	300.0150	304.5150
38	BB	307.2625	311.7625	307.2625	311.7625	306.0153	310.5153
39	CC	313.2625	317.7625	313.2625	317.7625	312.0156	316.5156

40	DD	319.2625	323.7625	319.2625	323.7625	318.0159	322.5159
41	EE	325.2625	329.7625	325.2625	329.7625	324.0162	328.5162
42	FF	331.2750	335.7750	331.2750	335.7750	330.0165	334.5165
43	GG	337.2625	341.7625	337.2625	341.7625	336.0168	340.5168
44	HH	343.2625	347.7625	343.2625	347.7625	342.0171	346.5171
45	II	349.2625	353.7625	349.2625	353.7625	348.0174	352.5174
46	JJ	355.2625	359.7625	355.2625	359.7625	354.0177	358.5177
47	KK	361.2625	365.7625	361.2625	365.7625	360.0180	364.5180
48	LL	367.2625	371.7625	367.2625	371.7625	366.0183	370.5183
49	MM	373.2625	377.7625	373.2625	377.7625	372.0186	376.5186
50	NN	379.2625	383.7625	379.2625	383.7625	378.0189	382.5189
51	OO	385.2625	389.7625	385.2625	389.7625	384.0192	388.5192
52	PP	391.2625	395.7625	391.2625	395.7625	390.0195	394.5195
53	QQ	397.2625	401.7625	397.2625	401.7625	396.0198	400.5198
54	RR	403.2500	407.7500	403.2625	407.7625	402.0201	406.5201
55	SS	409.2500	413.7500	409.2625	413.7625	408.0204	412.5204
56	TT	415.2500	419.7500	415.2625	419.7625	414.0207	418.5207
57	UU	421.2500	425.7500	421.2625	425.7625	420.0210	424.5210
58	VV	427.2500	431.7500	427.2625	431.7625	426.0213	430.5213
59	WW	433.2500	437.7500	433.2625	437.7625	432.0216	436.5216
60	XX	439.2500	443.7500	439.2625	443.7625	438.0219	442.5219
61	YY	445.2500	449.7500	445.2625	449.7625	444.0222	448.5222
62	ZZ	451.2500	455.7500	451.2625	455.7625	450.0225	454.5225
63	63	457.2500	461.7500	457.2625	461.7625	456.0228	460.5228
64	64	463.2500	467.7500	463.2625	467.7625	462.0231	466.5231
65	65	469.2500	473.7500	469.2625	473.7625	468.0234	472.5234
66	66	475.2500	479.7500	475.2625	479.7625	474.0237	478.5237
67	67	481.2500	485.7500	481.2625	485.7625	480.0240	484.5240
68	68	487.2500	491.7500	487.2625	491.7625	486.0243	490.5243
69	69	493.2500	497.7500	493.2625	497.7625	492.0246	496.5246
70	70	499.2500	503.7500	499.2625	503.7625	498.0249	502.5249
71	71	505.2500	509.7500	505.2625	509.7625	504.0252	508.5252
72	72	511.2500	515.7500	511.2625	515.7625	510.0255	514.5255
73	73	517.2500	521.7500	517.2625	521.7625	516.0258	520.5258
74	74	523.2500	527.7500	523.2625	527.7625	522.0261	526.5261
75	75	529.2500	533.7500	529.2625	533.7625	528.0264	532.5264
76	76	535.2500	539.7500	535.2625	539.7625	534.0267	538.5267
77	77	541.2500	545.7500	541.2625	545.7625	540.0270	544.5270
78	78	547.2500	551.7500	547.2625	551.7625	546.0273	550.5273
79	79	553.2500	557.7500	553.2625	557.7625	552.0276	556.5276
80	80	559.2500	563.7500	559.2625	563.7625	558.0279	562.5279
81	81	565.2500	569.7500	565.2625	569.7625	564.0282	568.5282
82	82	571.2500	575.7500	571.2625	575.7625	570.0285	574.5285
83	83	577.2500	581.7500	577.2625	581.7625	576.0288	580.5288
84	84	583.2500	587.7500	583.2625	587.7625	582.0291	586.5291
85	85	589.2500	593.7500	589.2625	593.7625	588.0294	592.5294
86	86	595.2500	599.7500	595.2625	599.7625	594.0297	598.5297
87	87	601.2500	605.7500	601.2625	605.7625	600.0300	604.5300
88	88	607.2500	611.7500	607.2625	611.7625	606.0303	610.5303
89	89	613.2500	617.7500	613.2625	617.7625	612.0306	616.5306
90	90	619.2500	623.7500	619.2625	623.7625	618.0309	622.5309
91	91	625.2500	629.7500	625.2625	629.7625	624.0312	628.5312
92	92	631.2500	635.7500	631.2625	635.7625	630.0315	634.5315
93	93	637.2500	641.7500	637.2625	641.7625	636.0318	640.5318
94	94	643.2500	647.7500	643.2625	647.7625	642.0321	646.5321
100	100	649.2500	653.7500	649.2625	653.7625	648.0324	652.5324

101	101	655.2500	659.7500	655.2625	659.7625	654.0327	658.5327
102	102	661.2500	665.7500	661.2625	665.7625	660.0330	664.5330
103	103	667.2500	671.7500	667.2625	671.7625	666.0333	670.5333
104	104	673.2500	677.7500	673.2625	677.7625	672.0336	676.5336
105	105	679.2500	683.7500	679.2625	683.7625	678.0339	682.5339
106	106	685.2500	689.7500	685.2625	689.7625	684.0342	688.5342
107	107	691.2500	695.7500	691.2625	695.7625	690.0345	694.5345
108	108	697.2500	701.7500	697.2625	701.7625	696.0348	700.5348
109	109	703.2500	707.7500	703.2625	707.7625	702.0351	706.5351
110	110	709.2500	713.7500	709.2625	713.7625	708.0354	712.5354
111	111	715.2500	719.7500	715.2625	719.7625	714.0357	718.5357
112	112	721.2500	725.7500	721.2625	725.7625	720.0360	724.5360
113	113	727.2500	731.7500	727.2625	731.7625	726.0363	730.5363
114	114	733.2500	737.7500	733.2625	737.7625	732.0366	736.5366
115	115	739.2500	743.7500	739.2625	743.7625	738.0369	742.5369
116	116	745.2500	749.7500	745.2625	749.7625	744.0372	748.5372
117	117	751.2500	755.7500	751.2625	755.7625	750.0375	754.5375
119	119	763.2500	767.7500	763.2625	767.7625	762.0381	766.5381
120	120	769.2500	773.7500	769.2625	773.7625	768.0384	772.5384
121	121	775.2500	779.7500	775.2625	779.7625	774.0387	778.5387
122	122	781.2500	785.7500	781.2625	785.7625	780.0390	784.5390
123	123	787.2500	791.7500	787.2625	791.7625	786.0393	790.5393
124	124	793.2500	797.7500	793.2625	797.7625	792.0396	796.5396
125	125	799.2500	803.7500	799.2625	803.7625	798.0399	802.5399
126	126	805.2500	809.7500	805.2625	809.7625	804.0402	808.5402
127	127	811.2500	815.7500	811.2625	815.7625	810.0405	814.5405
128	128	817.2500	821.7500	817.2625	821.7625	816.0408	820.5408
129	129	823.2500	827.7500	823.2625	827.7625	822.0411	826.5411
130	130	829.2500	833.7500	829.2625	833.7625	828.0414	832.5414
131	131	835.2500	839.7500	835.2625	839.7625	834.0417	838.5417
132	132	841.2500	845.7500	841.2625	845.7625	840.0420	844.5420
133	133	847.2500	851.7500	847.2625	851.7625	846.0423	850.5423
134	134	853.2500	857.7500	853.2625	857.7625	852.0426	856.5426
135	135	859.2500	863.7500	859.2625	863.7625	858.0429	862.5429
136	136	865.2500	869.7500	865.2625	869.7625	864.0432	868.5432
137	137	871.2500	875.7500	871.2625	875.7625	870.0435	874.5435
138	138	877.2500	881.7500	877.2625	881.7625	876.0438	880.5438
139	139	883.2500	887.7500	883.2625	887.7625	882.0441	886.5441
140	140	889.2500	893.7500	889.2625	893.7625	888.0444	892.5444
141	141	895.2500	899.7500	895.2625	899.7625	894.0447	898.5447
142	142	901.2500	905.7500	901.2625	905.7625	900.0450	904.5450
143	143	907.2500	911.7500	907.2625	911.7625	906.0453	910.5453
144	144	913.2500	917.7500	913.2625	917.7625	912.0456	916.5456
145	145	919.2500	923.7500	919.2625	923.7625	918.0459	922.5459
146	146	925.2500	929.7500	925.2625	929.7625	924.0462	928.5462
147	147	931.2500	935.7500	931.2625	935.7625	930.0465	934.5465
148	148	937.2500	941.7500	937.2625	941.7625	936.0468	940.5468
149	149	943.2500	947.7500	943.2625	947.7625	942.0471	946.5471
150	150	949.2500	953.7500	949.2625	953.7625	948.0474	952.5474
151	151	955.2500	959.7500	955.2625	959.7625	954.0477	958.5477
152	152	961.2500	965.7500	961.2625	965.7625	960.0480	964.5480
153	153	967.2500	971.7500	967.2625	971.7625	966.0483	970.5483
154	154	973.2500	977.7500	973.2625	977.7625	972.0486	976.5486
155	155	979.2500	983.7500	979.2625	983.7625	978.0489	982.5489
156	156	985.2500	989.7500	985.2625	989.7625	984.0492	988.5492
157	157	991.2500	995.7500	991.2625	995.7625	990.0495	994.5495
158	158	997.2500	1001.7500	997.2625	1001.7625	996.0498	1000.5498

## Common CATV Channel Plans: People's Republic of China (PAL; standard D/K)

Channel Bandwidth: 8MHz					
Ch. No.	Video	Audio	Ch. No.	Video	Audio
DS1	49.75	56.25	DS13	471.25	477.75
DS2	57.75	64.25	DS14	479.25	485.75
DS3	65.75	72.25	DS15	487.25	493.75
DS4	77.25	83.75	DS16	495.25	501.75
DS5	85.25	91.75	DS17	503.25	509.75
Z1	112.25	118.75	DS18	511.25	517.75
Z2	120.25	126.75	DS19	519.25	525.75
Z3	128.25	134.75	DS20	527.25	533.75
Z4	136.25	142.75	DS21	535.25	541.75
Z5	144.25	150.75	DS22	543.25	549.75
Z6	152.25	158.75	DS23	551.25	557.75
Z7	160.25	166.75	DS24	559.25	565.75
DS6	168.25	174.75	Z38	567.25	573.75
DS7	176.25	182.75	Z39	575.25	581.75
DS8	184.25	190.75	Z40	583.25	589.75
DS9	192.25	198.75	Z41	591.25	597.75
DS10	200.25	206.75	Z42	599.25	605.75
DS11	208.25	214.75	DS25	607.25	613.75
DS12	216.25	222.75	DS26	615.25	621.75
Z8	224.25	230.75	DS27	623.25	629.75
Z9	232.25	238.75	DS28	631.25	637.75
Z10	240.25	246.75	DS29	639.25	645.75
Z11	248.25	254.75	DS30	647.25	653.75
Z12	256.25	262.75	DS31	655.25	661.75
Z13	264.25	270.75	DS32	663.25	669.75
Z14	272.25	278.75	DS33	671.25	677.75
Z15	280.25	286.75	DS34	679.25	685.75
Z16	288.25	294.75	DS35	687.25	693.75
Z17	296.25	302.75	DS36	695.25	701.75
Z18	304.25	310.75	DS37	703.25	709.75
Z19	312.25	318.75	DS38	711.25	717.75
Z20	320.25	326.75	DS39	719.25	725.75
Z21	328.25	334.75	DS40	727.25	733.75
Z22	336.25	342.75	DS41	735.25	741.75
Z23	344.25	350.75	DS42	743.25	749.75
Z24	352.25	358.75	DS43	751.25	757.75
Z25	360.25	366.75	DS44	759.25	765.75
Z26	368.25	374.75	DS45	767.25	773.75
Z27	376.25	382.75	DS46	775.25	781.75
Z28	384.25	390.75	DS47	783.25	789.75
Z29	392.25	398.75	DS48	791.25	797.75
Z30	400.25	406.75	DS49	799.25	805.75
Z31	408.25	414.75	DS50	807.25	813.75
Z32	416.25	422.75	DS51	815.25	821.75
Z33	424.25	430.75	DS52	823.25	829.75
Z34	432.25	438.75	DS53	831.25	837.75
Z35	440.25	446.75	DS54	839.25	845.75
Z36	448.25	454.75	DS55	847.25	853.75
Z37	456.25	462.75	DS56	855.25	861.75

Common CATV Channel Plans: Europe (PAL; standard B/G)

Channel Bandwidth: 7 and 8 MHz					
Ch.No.	Video	Audio	Ch.No.	Video	Audio
7MHz channel spacing			8MHz channel spacing		
E2	48.25	53.75	S21	303.25	308.75
E3	55.25	60.75	S22	311.25	316.75
E4	62.25	67.75	S23	319.25	324.75
			S24	327.25	332.75
S2	112.25	117.75	S25	335.25	340.75
S3	119.25	124.75	S26	343.25	348.75
S4	126.25	131.75	S27	351.25	356.75
S5	133.25	138.75	S28	359.25	364.75
S6	140.25	145.75	S29	367.25	372.75
S7	147.25	152.75	S30	375.25	380.75
S8	154.25	159.75	S31	383.25	388.75
S9	161.25	166.75	S32	391.25	396.75
S10	168.25	173.75	S33	399.25	404.75
			S34	407.25	412.75
E5	175.25	180.75	S35	415.25	420.75
E6	182.25	187.75	S36	423.25	428.75
E7	189.25	194.75	S37	431.25	436.75
E8	196.25	201.75	S38	439.25	444.75
E9	203.25	208.75	S39	447.25	452.75
E10	210.25	215.75	S40	455.25	460.75
E11	217.25	222.75	S41	463.25	468.75
E12	224.25	229.75			
			E21	471.25	476.75
S11	231.25	236.75	E22	479.25	484.75
S12	238.25	243.75	E23	487.25	492.75
S13	245.25	250.75	E24	495.25	500.75
S14	252.25	257.75	E25	503.25	508.75
S15	259.25	264.75	E26	511.25	516.75
S16	266.25	271.75	E27	519.25	524.75
S17	273.25	278.75	E28	527.25	532.75
S18	280.25	285.75	E29	535.25	540.75
S19	287.25	292.75	E30	543.25	548.75
S20	294.25	299.75	E31	551.25	556.75
			E32	559.25	564.75
			E33	567.25	572.75
			E34	575.25	580.75
			E35	583.25	588.75
E36	591.25	596.75	E53	727.25	732.75
E37	599.25	604.75	E54	735.25	740.75
E38	607.25	612.75	E55	743.25	748.75
E39	615.25	620.75	E56	751.25	756.75
E40	623.25	628.75	E67	759.25	764.75
E41	631.25	636.75	E58	767.25	772.75
E42	639.25	644.75	E59	775.25	780.75
E43	647.25	652.75	E60	783.25	788.75
E44	655.25	660.75	E61	791.25	796.75
E45	663.25	668.75	E62	799.25	804.75
E46	671.25	676.75	E63	807.25	812.75
E47	679.25	684.75	E64	815.25	820.75

E48	687.25	692.75	E65	823.25	828.75
E49	695.25	700.75	E66	831.25	836.75
E50	703.25	708.75	E67	839.25	844.75
E51	711.25	716.75	E68	847.25	852.75
E52	719.25	724.75	E69	855.25	860.75

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Common CATV Channel Plans:- United Kingdom (PAL; ITU-R standard I)

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Channel Bandwidth: 8 MHz					
Video	Audio	Video	Audio	Video	Audio
8.0	14.0	296.0	302.0	584.0	590.0
16.0	22.0	304.0	310.0	592.0	598.0
24.0	30.0	312.0	318.0	600.0	606.0
32.0	38.0	320.0	326.0	608.0	614.0
40.0	46.0	328.0	334.0	616.0	622.0
48.0	54.0	336.0	342.0	624.0	630.0
56.0	62.0	344.0	350.0	632.0	638.0
64.0	70.0	352.0	358.0	640.0	646.0
72.0	78.0	360.0	366.0	648.0	654.0
80.0	86.0	368.0	374.0	656.0	662.0
88.0	94.0	376.0	382.0	664.0	670.0
96.0	102.0	384.0	390.0	672.0	678.0
104.0	110.0	392.0	398.0	680.0	686.0
112.0	118.0	400.0	406.0	688.0	694.0
120.0	126.0	408.0	414.0	696.0	702.0
128.0	134.0	416.0	422.0	704.0	710.0
136.0	142.0	424.0	430.0	712.0	718.0
144.0	150.0	432.0	438.0	720.0	726.0
152.0	158.0	440.0	446.0	728.0	734.0
160.0	166.0	448.0	454.0	736.0	742.0
168.0	174.0	456.0	462.0	744.0	750.0
176.0	182.0	464.0	470.0	752.0	758.0
184.0	190.0	472.0	478.0	760.0	766.0
192.0	198.0	480.0	486.0	768.0	774.0
200.0	206.0	488.0	494.0	776.0	782.0
208.0	214.0	496.0	502.0	784.0	790.0
216.0	222.0	504.0	510.0	792.0	798.0
224.0	230.0	512.0	518.0	800.0	806.0
232.0	238.0	520.0	526.0	808.0	814.0
240.0	246.0	528.0	534.0	816.0	822.0
248.0	254.0	536.0	542.0	824.0	830.0
256.0	262.0	544.0	550.0	832.0	838.0
264.0	270.0	552.0	558.0	840.0	846.0
272.0	278.0	560.0	566.0	848.0	854.0
280.0	286.0	568.0	574.0	856.0	862.0
288.0	294.0	576.0	582.0	864.0	870.0

# Part IV

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## System Functions

## Chapter 13: System Settings

This chapter provides instructions for S7200 system settings and features. To access the settings menu, press the  button along the bottom of the screen; then under the brightness and volume controls, tap **More**. There are three main settings tabs: **About**, **General**, and **Measure**.

### 13-1 About (System Information)

The About tab lists information about the S7200 system configuration, including the serial number, date of last calibration, and version numbers for various installed firmware modules. This information is crucial for troubleshooting procedures.

Here, you will find:

- Serial no.
- Software version
- System version
- Bootloader version
- Hardware version
- Calibration date
- MAC address
- CM version
- CM MAC
- Deviser website URL

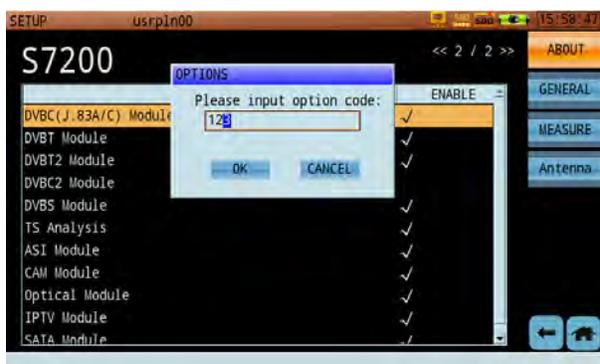
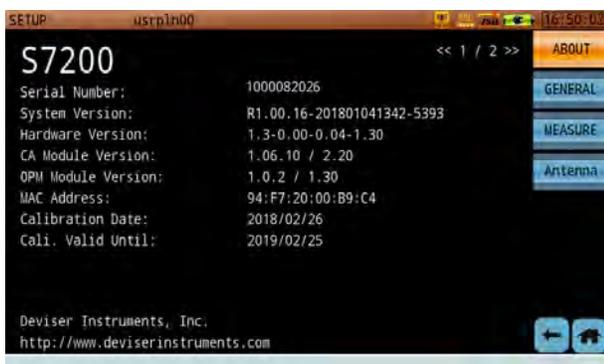
There are two pages to the About screen. Use the Left/Right arrow keys to change pages.

Page 2 contains a table listing all measurement option modules available on your S7200. The righthand column contains a check mark for each module that is currently enabled on the instrument. Consult this page to see what options you have currently activated.

#### Activating Purchased Options

Software-activated options that you order at the time of purchase will come pre-enabled on your S7200 instrument. However, to enable a purchased option in the field, scroll to page 2 of the About screen (below right). On the data keypad, enter the sequence: **1 2 3 4 5 6**.

A dialog box will appear. Enter the activation code provided by Deviser when the option was purchased and press OK. The instrument will automatically restart. If the code was not correct, the message “Code Error” will appear; check the code and try again, or contact Deviser Instruments.



## 13-2 General Settings

The General tab contains general system settings that apply to most instrument functions. This tab is divided into different categories, listed on the left-hand side of the screen; tap a category or use the up-down arrow keys to change pages and begin editing settings. Press Esc to go back.

### 13-2.1 Network Settings



This page contains settings for allowing the S7200 to interact with other networked devices via Ethernet LAN cable or Wi-Fi. This includes the **Local IP**, **Net Mask**, **Gateway**, and **DNS** addresses and the **DHCP** option. Tap DHCP to activate it, or deactivate to keep a static IP.

To change an address, tap the field to highlight one of its bytes and enter up to 3 digits using the keypad. Press the left/right arrow keys to continue as needed until the address is complete.

If "WiFi" is checked, the WiFi connection is active and the WiFi icon will appear in the status bar. If both "WiFi" and "DHCP" are checked, the S7200 will connect to the WiFi network automatically. If "WiFi", but not "DHCP", is checked, you can setup a static IP address as well as all other network configuration requirements such as MASK, Gateway and DNS.

#### Using Ethernet

In Network Settings, the default connection is through the Ethernet port on the connector panel. Uncheck the Wifi box and plug in an Ethernet cable from an active network to the S7200. Set up the static IP information to connect.

(If DHCP is checked, the unit will auto-set a network address and configuration.)

#### Wifi Hotspot

The S7200 offers a WiFi hotspot function, which can be used to support software that connects to a mobile phone or tablet computer. Engineers can use this tool to connect the S7200 to a public network in the field. When active, the WiFi icon will appear blue instead of orange (see right, bottom).

If no good network signal is present, the engineer can use this function to complete the measurement task and upload measurement results remotely. Currently, only Android functionality is supported; other mobile device types are planned for future releases. Contact your Deviser Instruments representative for more info.



Hotspot settings include:

- SSID: Service Set ID. Tap the entry field to enter a name.
- Password: Tap the entry field to enter a password.
- IP Address: Fixed IP address. Users cannot modify it.

### 13-2.2 Ping

The PING tool is a practical way to verify your network connectivity status and speed.

In the URL field at the top, input the network or IP address to be tested (e.g., www.bing.com or 192.168.1.1). Then tap **START** to begin the network test. Tap **STOP** to interrupt the test. Test results in the lower panel.



#### Test Results

- "-n": Packet Count, the number of data packets sent by the assigned PING order.
- "-t": "Unlimited". If this box is checked, the PING function will be continuous until the test is interrupted by pressing the stop button.
- "-l": "Packet length", the packet length of the PING request.
- "-i": "Interval", time interval between ping packets, in milliseconds (ms).

### 13-2.3 Display & Battery

This page contains power-saving settings to extend battery life on a charge. It also displays the current internal temperature of the instrument in degrees centigrade/Celsius and Fahrenheit.

#### Auto Power Off

If the device remains on for a certain amount of time (3, 5, 10, or 30min) without input, it will automatically shut down to preserve power. Tap this setting and select a time period from the dropdown box, or use the arrow and Enter keys. Set to **DISABLE** to disable automatic shutdown; the device will continue running until the battery is depleted.

#### Backlight Off

If the device remains on for a certain amount of time (3, 5, 10, or 30min) without input, it will automatically dim the backlit screen to preserve power. Tap this setting and select a time period from the dropdown box, or use the arrow and Enter keys. Set to **DISABLE** to disable auto-dim; the backlight will stay at max brightness until the battery is depleted.

### 13-2.3 Date & Time

This page allows you to set the instrument's internal clock. Tap each entry field and use the dropdown box or touchscreen numpad to set the current year, month, day, hour, minute, and second.

The topmost field allows you to change the date display format:

- **Y/M/D** (ex.: 2016 Mar 31)
- **D/M/Y** (ex. 31 Mar 2016)
- or **M/D/Y** (ex. Mar 31 2016)

### 13-2.4 Language

On this page, you can set the system language. Once set, all system text, instructions, and data will appear in the selected language. English, Russian, and Chinese (simplified) are currently supported.

### 13-2.5 User Management



This page allows you to view information and make changes to the user account you are currently logged into. (See Section 2-2.) It displays your user ID number, user name, and listed company. The UserID list shows a persistent ID number for each user, in cases when multiple users share the same instrument.

Toggle the **Multi-User** feature to enable or disable multiple user profiles. If disabled, the instrument will treat every operator as the same user, and will bypass the multi-user startup menu and go directly to the main menu.

After making changes, press **Save** to record the current user configuration. You must restart the system for changes to take effect.

### 13-2.6 GPS

If the GPS functionality is enabled, and a USB GPS antenna is connected to the instrument's connector panel, this page will display the current longitude and latitude coordinates of the device. This is useful for pinpointing interference and other applications. If GPS is disabled, the page will display zeroes.

An animated dish icon (left) indicates that the GPS module is searching for a satellite signal. When it stops on a full dish icon , the module has successfully locked on to the signal and acquired the user's location info. The status will appear in the "GpsStatus" field. "LOCK(6)" indicates that the GPS module has located 6 satellites, while "UNLOCK" indicates that the device cannot detect any usable satellites.



Once signal location is successful, latitude and longitude information will be added to any measurement operation data saved by the user.

GPS coordinates are recorded at all times when a clear GPS positioning antenna has clear line of sight to the skies. The GPS coordinates are saved when a measurement is saved in "DATA" format, however, the GPS coordinates will not be displayed on a "Picture" file format.

### 13-2.7 Disk Management

In this tab, you can check the current data usage on the S7200's local hard drive, a SATA SSD (if installed), and/or a connected USB storage device. To format a drive, use the Up/Down keys to highlight Local or SATA and tap **Format**. NOTE: This will erase **all** saved data on the selected drive! Use with caution.

### 13-2.8 Factory Reset

Here, you can reset all parameters and return the instrument to initial factory settings. Use this feature with caution to avoid erasing a preferred configuration. **User profiles, saved measurement data, and current firmware version are not affected.** A confirmation prompt will appear. Press the Enter key to confirm the factory reset process. The instrument will reboot.

## 13-3 Measure Settings

The third settings menu, **Measure**, includes miscellaneous settings for various measurement functions.

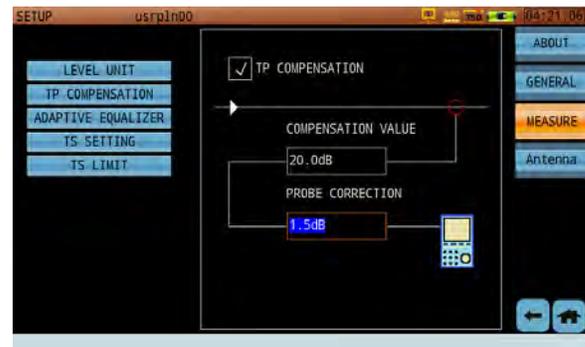
### 13-3.1 Level Unit

On this page, you can select the default unit in which signal magnitude measurements are displayed. Tap (or use the arrow and Enter keys) to select one of the radio buttons: dB $\mu$ V, dBmV, or dBm.

### 13-3.2 Test Point Compensation

Test Point compensation can be edited and applied only if the **TP Compensation** box is checked.

The typical optical receiver test point loss is 20dB. Older CATV active equipment, however, may have down test points of 30dB; if so, the user can input the required compensation here. (20dB in this example.) Some probes, along with specific cable lengths, may account for 1.5dB loss (in this example). The user can input that loss value in the probe correction box.

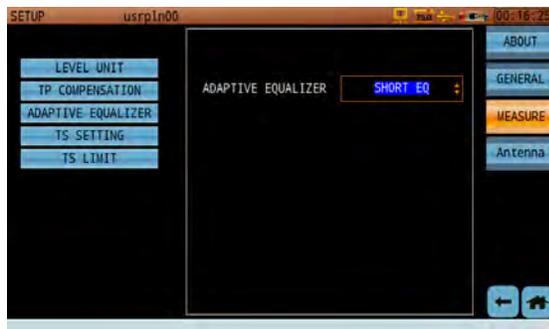


In this example, the total correction value is 21.5dB. In the measurement interface, the unit will display TP=21.5dB in the status bar at the lower right corner of the screen. After total compensation, the test result will display the true network measurement values.

### 13-3.3 Adaptive Equalizer

The S7200 offers two adaptive equalizer settings: Long EQ and Short EQ. Long EQ suppresses ISI (Inter-Symbol Interference) and co-frequency interference more effectively. Short EQ enables better selective filtering, and provide better performance in fully-loaded CATV plants.

Simply tap the selection field and select Long EQ or Short EQ. The current setting will appear in the lower-left corner of the measurement display. (See below.)



### 13-3.4 Transport Stream Settings

The TS analysis function supports DVB and ATSC standards. For different regional settings, select DVB or ATSC according to local standards. The DVB setting displays PSI/SI analysis, while ATSC displays PSI/PSIP analysis (below, right).



STANDARD	ATSC	STANDARD	DVB
FORMAT	DEC	FORMAT	HEX
Aspect	4:3	Aspect	16:9
AUDIO SELECT	1	AUDIO SELECT	2
CLOSED CAPTION	CLOSE	CLOSED CAPTION	OPEN

Two data formats are available: decimalism (PID value 850) and hexadecimal (PID value 0x352).

VIDEO	INFO	AUDIO1	INFO1	AUDIO2	INFO2
PID	0x352	PID	0x353	PID	---
Resolution	720*480I	Mode	stereo	Mode	---
Frames	29.97	Layer	II	Layer	---
BitRate	15000000	BitRate	256 Kbps	BitRate	---
Profile	main	Sampling	48 kHz	Sampling	---
Level	main	Profile	---	Profile	---
Aspect	4:3	CH CONF	---	CH CONF	---
Chroma	4:2:0	Emphasis	none	Emphasis	---

VIDEO	INFO	AUDIO1	INFO1	AUDIO2	INFO2
PID	850	PID	851	PID	---
Resolution	720*480I	Mode	stereo	Mode	---
Frames	29.97	Layer	II	Layer	---
BitRate	15000000	BitRate	256 Kbps	BitRate	---
Profile	main	Sampling	48 kHz	Sampling	---
Level	main	Profile	---	Profile	---
Aspect	4:3	CH CONF	---	CH CONF	---
Chroma	4:2:0	Emphasis	none	Emphasis	---

**Image Aspect Ratio**

Adjusts the vertical/horizontal dimensions of the onscreen image, stretching or compressing it accordingly.

**Audio Select**

If a transport stream includes multiple audio channels (for example, different language options), use Audio Select to switch channels.

**Closed Captions**

Displays captions of the current audio channel. Toggle on/off to show or hide captions. Only available in the ATSC standard.

You must select the appropriate character encoding for your local operator's preferred language, country, and/or district. Incorrect encoding will cause the parser program to garble the information. Use the "Auto Detect" tool to automatically recognize the proper encoding setting.



The S7200 supports the fellow character encoding options:

- |                                     |                                      |
|-------------------------------------|--------------------------------------|
| Auto Detect                         | Romanian (ISO 8859-16)               |
| West European (ISO 8859-15)         | Celtic (ISO 8859-14)                 |
| Baltic (ISO 8859-13)                | Thai (ISO 8859-11)                   |
| North European (ISO 8859-10)        | West European & Turkish (ISO 8859-9) |
| Latin/Hebrew (ISO 8859-8)           | Latin/Greek (ISO 8859-7)             |
| Latin/Arabic (ISO 8859-6)           | Latin/Cyrillic (ISO 8859-5)          |
| North (-East) European (ISO 8859-4) | South European (ISO 8859-3)          |
| East European (ISO 8859-2)          | West European (ISO 8859-1)           |
| Simplified Chinese (GB-2312-1980)   | GBK                                  |
| GB18030-0                           | Traditional Chinese (Big5 subset)    |
| EUC-KR                              | JISX0201-0                           |
| JISX0208-0                          | JISX0201-1                           |
| JISX0208-1                          | UTF-8                                |
| UTF-16 LE                           | UTF-16 BE                            |

13-3.5 TS Limit Settings

In this menu, you can modify the limit profile for TR 101 290 Priority 1, 2 and 3 test parameters. This dictates limit alerts for the transport stream analysis function.



Reference values for some parameters appear in the table below. For more setup help, see Section 6-12.3.

PSI/SI Table Repetition Time

Service Information	Max. Interval (complete table)	Min. Interval (single sections)
PAT	0.5s	25ms
CAT	0.5s	25ms
PMT	0.5s	25ms
NIT	10s	25ms
SDT	2s	25ms
BAT	10s	25ms
EIT	2s	25ms
RST	-	25ms
TDT	30s	25ms
TOT	30s	25ms

## 13-4 External Interface Setup

You can access an additional settings menu by pressing the  button, under the “ASI” indicator light on the S7200’s front panel. This menu contains settings for various measurements and options, and its contents differ between TV and satellite mode. This menu contains the following tabs:

In TV mode: LNB Power, Optical/RF, and TS Input/ASI Output.

In SAT mode: LNB Power, DiSEqC, SaTCR, Optical/RF, and TS Input/ASI Output.

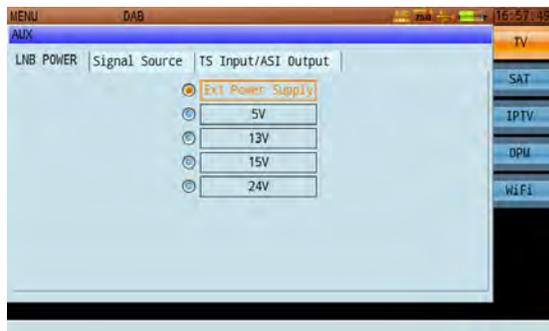
### 13-4.1 LNB Power Setup

#### In TV Mode

Sets the voltage used to power the LNB or preamplifier. Settings include Ext. Power Supply, 5V, 3V, 15V, 24V.

#### In SAT Mode

Sets the voltage used to power the LNB or preamplifier, as well as control different types of switches in LNB. Settings include Ext power supply, Auto, 13V, 18V, 13V+22kHz, 18V+22kHz, 24V. When receiving signal from multiple satellites or by multiple users, you must select 13/18V, 0/22kHz, and set up the appropriate DiSEqC configuration. (See subsection 13-4.2 ahead.)



**TV Mode Power Settings**



**Satellite Mode Power Settings**

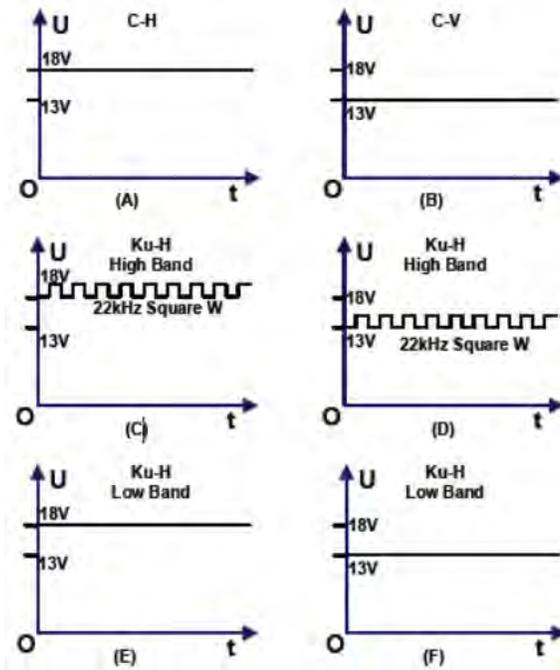
When setting LNB control switch options, the 18V setting is used to control horizontal polarization and 13V is used to control vertical polarization. A 0/22kHz signal is used to control high-band and low-band Ku switches. A 22kHz square-wave signal with 1V peak-to-peak value is superimposed on 13V or 18V.

To receive C band horizontal polarization signals, select **18V**.

To receive C band vertical polarization signals, select **13V**.

For Ku high-band polarization signals, the 22kHz square-wave signal must be superimposed on the signal. Select **18V+22K** for horizontal, or **13V+22K** for vertical.

For Ku low-band polarization signals, the 22kHz square-wave signal must *not* be superimposed on the signal. Select **18V** for horizontal, or **13V** for vertical.



Satellite IF Signal Switch operation principle

Power	Application
Auto	According to satellite auto-setup
13V	Vertical polarization, low LO
18V	Horizontal polarization, low LO
13V+22K	Vertical polarization, high LO
18V+22K	Horizontal polarization, high LO
24V	24V

13-4.2 DiSEqC

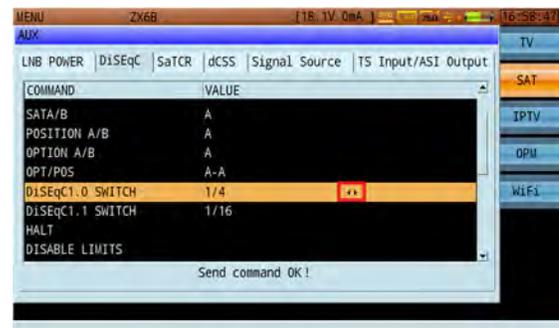
In the 1990s, EUTELSAT (European Telecommunication Satellite Organization) and Philips jointly developed the DiSEqC (Digital Satellite Equipment Control) technology. Today, several versions of DiSEqC exist. All versions are backwards-compatible.



The S7200 supports DiSEqC versions 1.0, 1.1, 1.2, and 2.x.

The DiSEqC menu is a scrolling list of LNB commands. Tap a command to transmit it. (If an error occurs, make sure that "LNB Power" is set correctly; see subsection 13-4.1 above.)

If a highlighted line contains the icon in the right-hand column, you can customize the value using the Left/Right arrow keys.



## DiSEqC Version Guide

Version	Directivity	Description
1.0	Unidirectional	Basic DiSEqC instruction set. Includes Tone Burst function and four LNB controls. Can transmit various commands: polarization, high & low bands, antenna position, etc. Unidirectional system, meaning that the receiver sends instructions to the corresponding system module. Instructions are only sent once, not repeated..
1.1		Based on v1.0, v1.1 adds the C band LNB control function and four custom functions. Transmits instructions with Improved accuracy by allowing the same instruction to be sent repeatedly.
1.2		Expansion of v1.1. Adds polar antenna remote control capability.
2.0	Bidirectional	v2.0 is a bidirectional system otherwise similar to v1.0. System modules can both receive instructions and respond to confirm successful execution. Receivers can also use this response to detect existing modules.
2.1		Combines all functions of v1.1 and v2.0.
2.2		Expansion of v2.1. Adds polar antenna remote control capability.

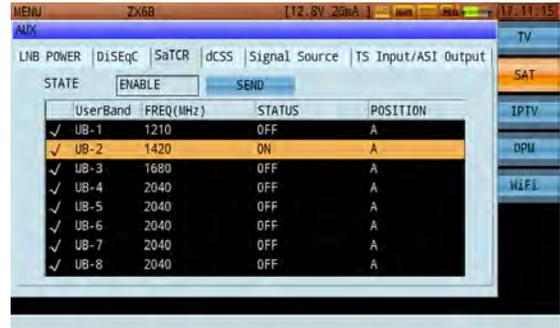
## DiSEqC Protocol Command List

Class	Command	Parameter
General	RESET	----
	STANDBY	----
	POWER ON	----
Switch control	SAT A/B POSITION A/B OPTION A/B OPT/POS	A/B A/B A/B A-A/A-B/B-A/B-B
	DiSEqC1.0 SWITCH	1 to 4
	DiSEqC1.1 SWITCH	1 to 16
Polar base control	HALT	. ----
	DISABLE LIMITS	----
	SET LIMIT EAST	----
	SET LIMIT WEST	----
	DRIVE EAST SEC	1 to 127
	DRIVE EAST STEPS	1 to 127
	DRIVE WEST SEC	1 to 127
	DRIVE WEST STEPS	1 to 127
	STORE POSITION	1 to 255
	GOTO POSITION	1 to 255
	GOTO X.X°	-80° to 80°
GOTO 0	----	

13-4.3 SaTCR

The SaTCR protocol is a DiSEqC protocol extension. This protocol allows satellite STB (set-top box) to control an external device connected via coaxial cable – in this case, an LNB based on the SaTCR standard. (For background information on SaTCR, see Section 9-3.)

The S7200 supports SatCR/SCR (EN50494) and dCSS/SCR2 (EN50607). SaTCR and dCSS offer different equipment control and configuration settings.



In the SaTCR menu, set the state to **Enable** to activate SaTCR function. Channels can be assigned a frequency from 950 ~ 2150 MHz.

Once enabled, the  icon will appear in the status bar. Use the touchscreen to edit the frequency, status, or position of the selected user channel, then tap **Send** to transmit the command. You can check/uncheck each channel to determine whether or not it is tested. An unchecked channel will not be used. See the table below.

(If an error occurs, make sure that "LNB Power" is set correctly; see subsection 13-4.1 above.)

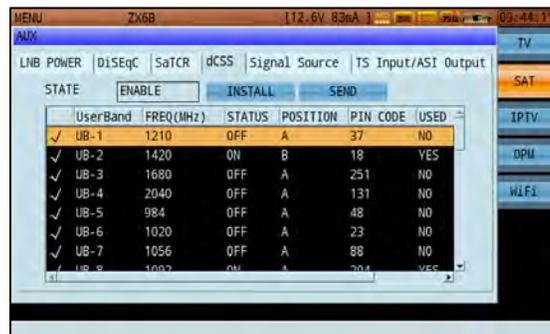
SaTCR Command Settings

Command	Parameter	Description
SaTCR status	Enable/Disable	Enable/disable SaTCR function.
Select	√	Check/uncheck highlighted channel
Status	On/Off	Sets highlighted channel status
Position	A/B	Switch SaTCR LNB

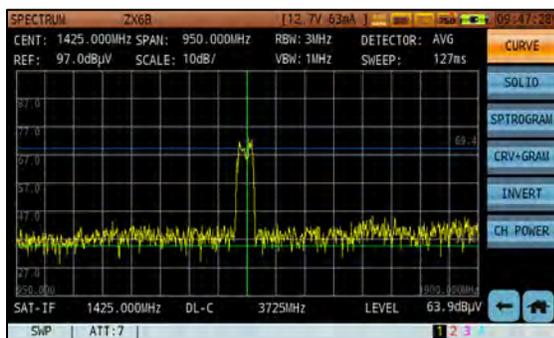
### 13-4.4 dCSS

The dCSS (digital Channel Stacking Switch) LNB can support several users on a single cable distribution system by allocating specific user bands for each of them. Note that dCSS can only be used if your field strength meter communicates using EN50494 (SATCR, UNICABLE) and EN50607 (dCSS, JESS, UNICABLE II) standard protocols.

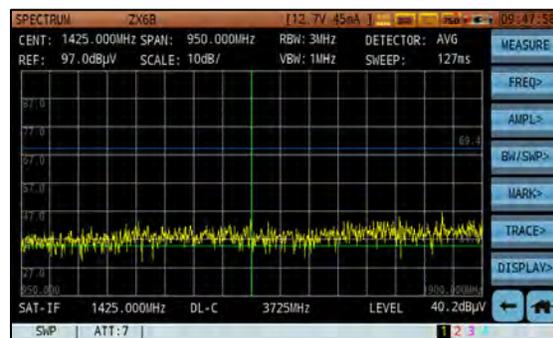
Using the dCSS function, the S7200 supports channel controls for up to 32 users. Users can set up channels and install equipment. For the first use, in the dCSS tab, select **Install** to automatically search for compatible channels. The external feed setting must then be activated (**JESS**) in order to transmit dCSS commands. Set the **State** field to **Enable**. (See below.) Use the scroll bars to view the full channel list.



**dCSS Channel List**



**UB-2 Channel Enabled**



**UB-2 Channel Disabled**

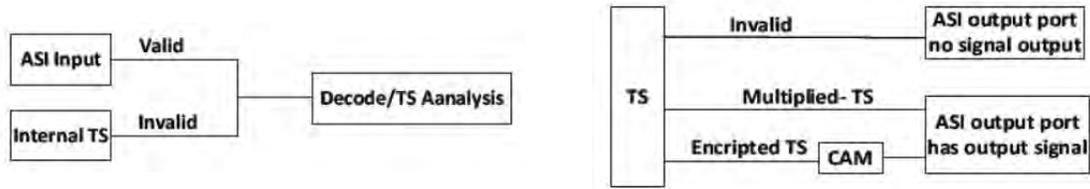
Column	Description
Enabled/Disabled	Enabled channels have a check mark. If disabled, the channel cannot be used.
UserBand	User channel ID, such as UB-2.
Frequency (MHz)	The frequency of the selected channel. Depends on device parameters.
Status	Active channels are shown as ON. Inactive channels are shown as OFF.
Position	Set A or B
PIN code	PIN used to lock the channel while in use. For example, if UB-2's PIN is 18 and "Protect" status is "YES", other users must input the same PIN code or reboot the device in order to use this channel.
Used	If YES, channel is already in use. If NO, channel is free and unoccupied.
Protect	If YES, another user is using this channel and has locked it with a PIN code. If NO, it is unlocked.

13-4.5 ASI Input/Output

The ASI input/output ports are located on the S7200's connector panel. When the ASI input status is marked **valid**, the  icon appears in the status bar.

To validate the ASI input port, set the transport stream input to **ASI**. Selecting DISK or IPTV will mark the output port invalid and the port will not output signal. See the charts below.

If the RF or ASI input ports receive an unencrypted multiplex stream, the output port can output the stream. But if the input signal *is* encrypted, a "No CA Found!" error will occur. Note that a decryption card is required in order to use the ASI output EncropTS function. See subsection 6-12.12.

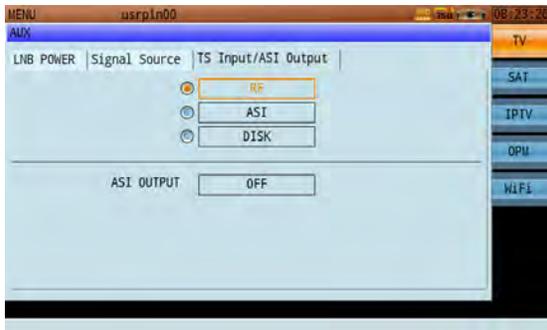


### 13-4.6 Transport Stream Input

In this menu, you can select a transport stream input type: RF, ASI, DISK, or IPTV.

#### RF Input

Cable, terrestrial, and satellite signals from the RF input port. The transport stream is demodulated from the RF signal, then enters the TS analysis module. In RF input mode, the TS analysis display shows channel/frequency info in the lower-left corner.



#### ASI Input

Baseband TS signal from the ASI input port, which then enters the TS analysis module. In ASI input mode, the TS analysis display shows "ASI INPUT" in the lower-left corner.



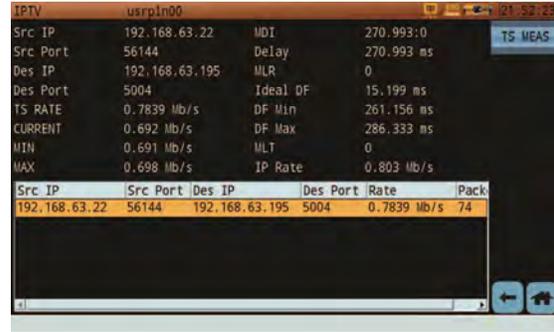
#### DISK Input

Data stored on the internal SATA SSD (Solid State Disk) or inserted USB drive, which then enters the TS analysis module. When the SSD option has been installed, the status bar displays the icon, indicating that users can now save and load transport stream recordings on the drive. For instructions, see subsection 6-12.11. In DISK mode, the TS analysis display shows the record's filename and timestamp in the lower-left corner.



### IPTV Input

IPTV signal from network. Must connect an Ethernet cable to the RJ-45 port on the connector panel. First, launch the IPTV analysis function from the Home screen. The instrument will automatically capture IPTV signals and list available program streams. Then tap **TS MEAS** to enter TS analysis. In IPTV input mode, the TS analysis display shows "IPTV" in the lower-left corner.



### 13-4.7 Signal Source

Recent years have seen increasing use of fiber LNB technology, converting RF signal to optical signal.

A control voltage of 13V or 18V (via coaxial cable) determines whether the received LNB signal is vertically- or horizontally-polarized, while a 22kHz control signal can be used to switch between low or high frequency bands. The low band covers satellite frequencies of 10.7 ~ 11.75 GHz; the high band, 11.8 ~ 12.75 GHz. These two factors permit four different combinations for conversion, covering frequencies from 0.95 ~ 5.45 GHz.

Finally, when the RF signal is converted to optical signal and transmitted through optical fiber, fiber LNB has been achieved. At the other end of the fiber, photoelectric conversion equipment converts the optical signal is converted into a satellite-recognizable standard.



The S7200 can be used to demodulate optical signal. In the **Signal Source** menu (left), toggle between **RF** and **Optical**. On the Optical setting, the S7200 can be used to test optical power; the **OPT** icon will appear in the status bar. Simply insert the fiber into the unit's APC port.

Use the dropdown box to select 75Ω (default) or 50Ω according to the connected cable. Your selection will appear in the status bar.

Meanwhile, the S7200 can receive an external CVBS signal via the audio jack. When the external CVBS input is open, the video feed will be displayed in full-screen mode. Exit the feed by pressing **Enter**.



CVBS Line

## 13-5 Antenna Settings

In the Antenna Settings menu, you can edit and manage data for antennas used in FM, DAB/DAB+, and DTMB measurement applications. The menu is separated into two panes. The left-hand pane lists all saved antenna files of the selected type, while the right-hand pane shows the ID, frequency, and coefficient data saved in the highlighted file.

Tap the topmost submenu key [**FM/DAB/DTMB**] repeatedly to cycle through antennas of different types. For example, to see DAB antenna files saved to the S7200, tap until [**DAB**] appears.

Tap an antenna file from the left pane to select it. An asterisk (\*) will mark the selected antenna.

FILE NAME	ID	FREQ (MHz)	Coefficient (dB)
fm1	7	80.700	0.0
fm2	8	80.800	0.0
fm3	9	80.900	0.0
* fm4	10	81.000	0.0
fm_factordef	11	81.100	0.0
	12	81.200	0.0
	13	81.300	0.0
	14	81.400	0.0
	15	81.500	0.0
	16	81.600	0.0
	17	81.700	0.0
	18	81.800	0.0
	19	81.900	0.0

*FM antenna settings*

FILE NAME	ID	FREQ (MHz)	Coefficient (dB)
dab1	0	174.928	0.0
dab2	1	176.640	0.0
* dab_factordef	2	178.352	0.0
	3	180.064	0.0
	4	181.936	0.0
	5	183.648	0.0
	6	185.360	0.0
	7	187.072	0.0
	8	188.928	0.0
	9	190.640	0.0
	10	192.352	0.0
	11	194.064	0.0
	12	195.936	0.0

*DAB antenna settings*

### 13-5.1 Renaming Antennas

To rename an antenna, highlight its file name in the left pane and tap **Edit**. Use the touchscreen keypad to enter the new filename. (Only letters and numbers may be used. Special characters, including hyphens, slashes, periods, and spaces, are not recognized. Uppercase and lowercase letters are valid.)

When finished, press **Enter** to confirm. Press **Back** once to recall the previous filename, or again to cancel the operation.

### 13-5.2 Deleting Antennas

When you no longer need one or more antenna files, you can erase them from the S7200's internal hard drive. Highlight a file in the left pane, and the **Delete** option will become available. (Note: "fm\_factordef" is the default antenna file, and cannot be deleted.)

When you press Delete, you will be prompted to confirm the deletion. Press OK to erase the data, or Cancel to go back. You may also wish to export existing data to an external USB storage drive first; see Section 14-2 for details.

### 13-5.3 Antenna ON/OFF

In order to conduct measurements using a properly configured antenna, you will need to turn the antenna function **ON**. Tap the submenu key repeatedly to toggle antenna function on/off.

Only one type of antenna can be used at a time; e.g., when viewing the FM antenna list, FM antennas can be used. To change types, simply tap the FM key to swap to DAB or DTMB, then toggle function **ON** again. When the current channel is the enabled antenna type, the 📶 icon will appear in the status bar.

For example, when measuring an Analog FM channel while the FM antenna function is active, 📶 appears in the status bar. The measurement unit is the same as that for field strength. Test results will include the antenna coefficient; see below.



*Successful antenna test*

### 13-5.4 Importing and Exporting Antenna Files

To export antenna (.DAT) files to a USB storage device, first connect the device to the S7200's USB port. The USB icon will appear in the status bar. In the antenna settings menu, tap **Export** to open a new dialog.

On the left are the contents of the USB device, and on the right, the S7200 hard drive. Select/check files on the right, then tap the <<< key in the middle to copy them to the USB device. (Importing is similar; select files on the USB device (left), then tap >>> to copy them to the hard drive.) When finished, press the **Back** key.)

Copying files to USB will create a new folder called S7200\_Antenna. FM files will go to the FmCoff subfolder, DAB files will go to DABCoff, etc. (If these folders already exist, files will be copied to them as normal.)

You can directly edit .DAT-format antenna files from your PC. Simply copy the antenna file to USB, insert the USB device into your PC, and open the file using a PC-based text editor such as Notepad. Then modify the antenna attributes, as shown (right).

The contents of the .DAT file are split into 2-value pairs, marked by a comma (e.g. "80000,0" in the example shown).

- The first value is frequency (measured in kHz). The frequency range should be consistent with frequency range that the used antenna supports.
- The second value is the antenna coefficient (measured in 1dB, where 1 = 10% of 1dB). The coefficient range is  $\pm 500$ , equal to  $\pm 50$ dB.

	0	1,0
1	80000,0	
2	80100,0	
3	80200,0	
4	80300,0	
5	80400,0	
6	80500,0	
7	80600,0	
8	80700,0	
9	80800,0	
10	80900,0	
11	81000,0	
12	81100,0	
13	81200,0	
14	81300,0	
15	81400,0	

Save the modified .DAT file to the same directory that the S7200 created, then return the USB device to the S7200. If a readable antenna file is detected, **Import** will be available.



*Importing antenna file*



*Exporting antenna file*

## 13-6 Updating System Firmware

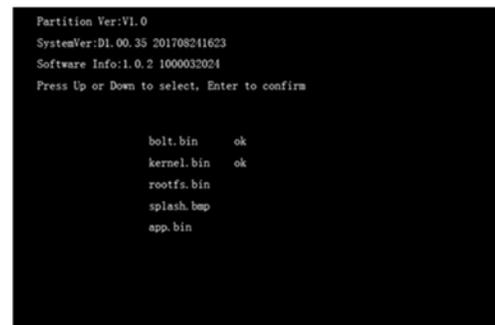
The S7200 receives periodic updates to improve device function. To check if your device currently has the latest firmware, please contact Deviser Instruments.

To install a firmware update, follow these instructions. You will need a standard USB storage/flash drive. Ensure that the drive is empty, and formatted in FAT or FAT32.

1. Locate update files "initrd.bin" and "PKGMO1R1.00 [...] .bin". (Filename will contain a time/date stamp.) Connect the USB drive to your PC, and transfer these files to the root (top-level) directory of the drive. Safety eject the drive.

**NOTE:** Do not alter the names of update files. They must remain exactly as issued by the Deviser team, or the update will fail.

2. With the S7200 turned OFF, insert the drive into the USB port.
3. Press and hold the  button, then turn on the instrument while continuing to hold . Release once the upgrade menu is displayed.
4. Select **Upgrade from USB** using the arrow keys and Enter button.
5. The process will take several minutes. After updating, the unit will reboot automatically.



## Chapter 14: File Management

The ability to save and manipulate data is a key feature of using the S7200 TV Signal Analyzer. From the File Management utility – accessible by pressing the **File** (📁) key under the display – you can delete, view, move, and sort data files saved to the system’s internal hard drive.

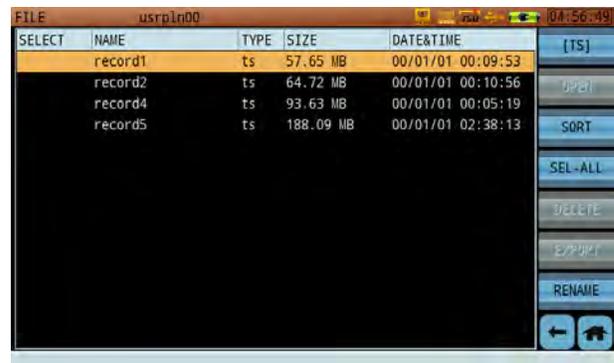
Files can also be transferred to a USB storage device. Simply connect the drive to the Type-A USB port on the S7200’s connector panel, and look for the USB 🗄️ icon to appear in the status bar.

### 14-1 File Operations

In the file management menu, you can view all readable files currently saved to the S7200’s internal hard drive. These files are separated by type. Image files appear in one list, data files in another, and so on.



**File Management Menu: Measurement Data**



**File Management Menu: Transport Stream Recordings**

#### 14-1.1 Open

In the above-left image, the top function key is labeled **[PICTURE]**. This indicates that the user is viewing a list of all picture files saved to the instrument. Tap this key to switch between **picture** and **data** files.

By default, files are listed alphabetically and bear timestamps according to when the data was recorded. (See subsection 14-1.2.) Use the arrow keys to locate and highlight files.

Tap **Open** to view the highlighted file. If available, use the function keys to shift between tabs.

- **Pictures** will be displayed on the S7200’s screen.
- **Data** will display a summary of the time, GPS location, associated work order, and system serial # on which the data was taken. You can view additional data about the captured measurement, including testing parameters, data points, and a screenshot of the measurement trace. Auto test results show channel level/frequency, chan-scan, tilt, and spectrum measurements separately.

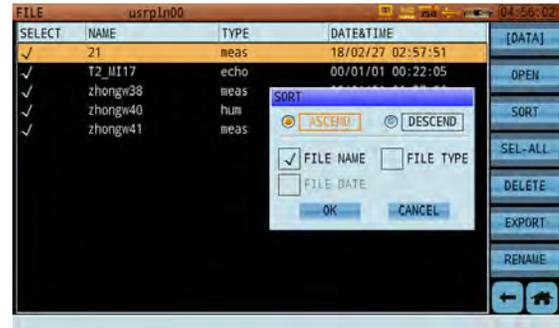
You may only open one file at a time. When you have finished viewing files, press the Back key to go back.

### 14-1.2 Sort

As discussed, files are listed alphabetically by default. If you wish to list files in a different order, press **Sort** to open the Sort dialog (shown, right).

Highlight and select options with the arrow and Enter keys. Place a check next to "File Name" to sort files alphabetically, "File Date" to sort by timestamp, or "File Type" to sort by format. Use the radio button to select Ascending or Descending order.

When you have finished changing settings, tap **OK** to sort files as specified.



### 14-1.3 Rename

To rename a particular file, highlight it and press **Rename**. Use the touchscreen keypad to enter the new filename. (Only letters and numbers may be used. Special characters, including hyphens, slashes, periods, and spaces, are not recognized. Uppercase and lowercase letters are valid.)

When finished, press Enter to confirm. Press Back once to recall the previous filename, or again to cancel the operation.

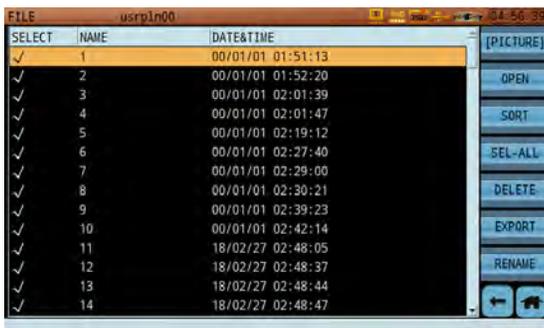
### 14-1.4 Delete

When you no longer need one or more files, you can erase them from the S7200's internal hard drive. Highlight files with the arrow keys and press Enter to select them. **Delete** will become available.

When you press Delete, you will be prompted to confirm the deletion. Press **OK** to erase the data, or **Cancel** to go back. You may also wish to export existing data to an external USB storage drive first; see Section 14-2 for details.

## 14-2 Importing and Exporting Data

To export files to a USB storage device, first ensure the device is connected via the S7200's connector panel. The USB icon will appear in the status bar. Use the arrow keys to highlight the desired file, press Enter to select files to export, and then tap **Export**.



Upon transfer to USB, new directories will be automatically created on the storage device. (If these folders already exist, files will be copied to them as normal.)

Measurement data files will be placed in "S7200\_file" and screenshot / image files in "S7200\_bmp". Data files will export in CSV format, which can be opened with Microsoft Excel or another spreadsheet software. The Toolbox PC software can also review and analyze S7200 exported files.

## Chapter 15: Saving Data

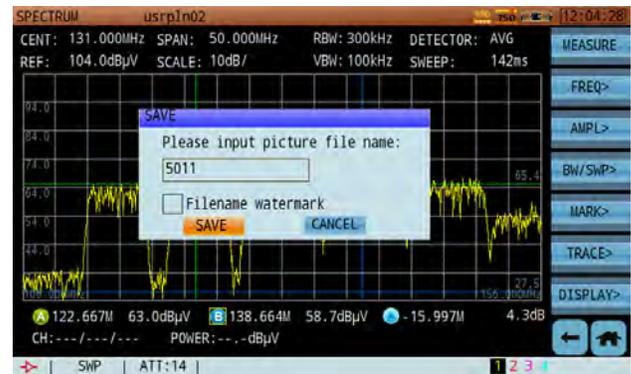
The ability to save and manipulate data is a key feature of using the S7200 TV Signal Analyzer. From the Save dialog— accessible by pressing the **Save** (  ) key under the display – you can create screenshots of the current display, record detailed tables of measurement data, or generate printable work orders with the click of a button. Saved files are automatically stored in the system’s 1GB internal hard drive. At maximum capacity, this drive will hold approximately 2,000 saved screenshots and setup files.

Once saved, files be renamed, moved, or deleted as the user wishes. See Chapter 14: File Management for detailed instructions.

### 15-1 Screenshots

You can save nearly any moment of S7200 operation to an image, including tests, menu navigation, data tables, system settings pages, file management, and more. Simply press the **Save** key to open a dialog (shown right). If prompted, tap to select PICTURE.

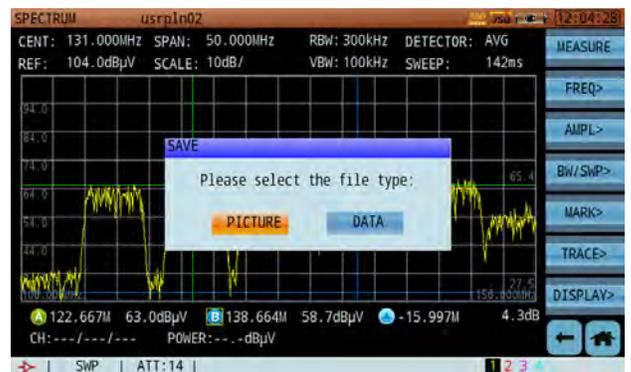
Use the touchscreen keypad to input a filename. (See Section 2-5 for control instructions.) You may also check the **Filename Watermark** box; this imprints the captured image with its own filename, helping to easily identify the image afterward. Finally, tap **Save** to confirm.



### 15-2 Measurement Data

Saving measurement data is much like saving an image. Just press **Save** while a S7200 measurement application is active, then tap DATA when prompted.

Saved data includes all measurement information available: test parameters, system serial number and software info, the time and date (remember to set the system clock in Setup – see subsection 13-2.3), and even individual data points.



## Specifications

Spectrum Analysis	
Frequency Range	4 ~ 1220 MHz (Cable) 950 ~ 2150 MHz (Satellite)
Frequency Span	0 ~ 1216 MHz, full span
Frequency Step	1 kHz
Resolution Bandwidth (-3dB)	30kHz, 100kHz, 300kHz, 1 MHz, 3 MHz
Level Measurement Range	-50 ~ +60dBmV (TV) -30 ~ +60dBmV (Satellite)
Measurement Accuracy	< 1.5dB
Reference Level	-30 ~ +60dBmV
Markers	2 vertical markets
Analog TV Measurement	
Standards	B/G, I, D/K, L/L', M/N
Color Standards	NTSC, PAL, SECAM
Frequency Step	10kHz
Hum Measurement	1 ~ 15%
C/N	> 50dB
Level Measurement Range	-30 ~ +60dBmV
Measurement Accuracy	< 1.5dB
Level Resolution	0.1dB
DVB-T/H Measurement	
Frequency Range	42 ~ 1002 MHz
Modulation Type	QPSK, 16 QAM, 64 QAM
Power Level Range	-35 ~ +50dBmV
Level Resolution	0.1dB
Power Level Accuracy	±1.5dB (C/N >20dB)
MER Measurement	>35dB
MER Accuracy	±2.0dB
DVB-T2 Measurement	
Frequency Range	42 ~ 1002 MHz
Modulation Type	QPSK, 16 QAM, 64 QAM, 256 QAM
Power Level Range	-35 ~ +50dBmV
Level Resolution	0.1dB
Power Level Accuracy	±1.5dB (C/N >20dB)
MER Measurement	>38dB
MER Accuracy	±2.0dB

ATSC Measurement	
Modulation Type	8VSB
Power Level Range	-35 ~ +50dBmV
Level Resolution	0.1dB
Power Level Accuracy	±1.5dB (C/N >20dB)
MER Measurement	>40dB
MER Accuracy	±2.0dB
ISDB-Tb Measurement	
Modulation Type	DQPSK, QPSK, 16 QAM, 64 QAM
Modulation Bandwidth	6 MHz
Power Level Range	-35 ~ +50dBmV
Level Resolution	0.1dB
Power Level Accuracy	±2.0dB (C/N >20dB)
MER Measurement	>40dB
MER Accuracy	±2.0dB
CBER	1E-1 ~ 1E-5
VBER	1E-1 ~ 1E-7
DVB-C Measurement	
Frequency Range	42 ~ 1002 MHz
Modulation Type	16/32/64/128/256 QAM ITU-T J.83 Annex A, B*, C
Symbol Rate	1.8 ~ 7.0 MS/s
Power Level Range	-30 ~ +50dBmV
Level Resolution	0.1dB
Power Level Accuracy	±1.5dB (C/N >20dB)
MER Measurement	>42dB
MER Accuracy	±2.0dB
BER	1E-3 ~ 1E-9
DVB-C2 Measurement	
Power Level Range	-30 ~ +50dBmV
Power Level Accuracy	±1.5dB (C/N >20dB)
Guard Interval	1/64, 1/128
Bandwidth	6 MHz and 8 Mhz
Spectrum Inversion	Auto
PLP Code Rates	2/3, 3/4, 4/5, 5/6, 8/9, 9/10
PLP Constellation	16, 64, 256, 1024, 4096 QAM
Data Slices	Support type 1 & 2, up to 7.61 MHz
Cell / Network / CS System ID	Detected from Transmitter Station

\* J.83 Annex B only available on model S7200-ATSC.

DVB-S/S2	
Modulation Type	QPSK, 8PSK
Symbol Rate	2 ~ 45 MS/s (DVB-S) 1 ~ 45 MS/s (QPSK DVB-S2) 1 ~ 45 MS/s (8 PSK DVB-S2) 1 ~ 45 MS/s (16 APSK DVB-S2) 1 ~ 38 MS/s (32 APSK DVB-S2)
Power Level Range	-20 ~ +50dBmV
Level Resolution	0.1dB
Power Level Accuracy	±1.5dB (C/N>20dB)
MER Measurement	>25dB
MER Accuracy	±2.0dB
BER	DVB-S (CBER/VBER) DVB-S2 (CBER/LBER)
Transport Stream Analysis	
Standard Interface	En 50083-9 (DVB SPI, ASI)
DVB-ASI Interface	75Ω BNC
DVB-ASI Clock	270 MHz
DVB-ASI Max Data Rate	0 ~ 72 Mbps
DVB-ASI Output Signal Level	1.0 Vp-p nominal
DVB-ASI Return Response	>15dB
DVB-ASI Input Level	800mV ± 10%
Real-Time Analysis	Real-time transport stream info, including service name, ID, provider info, video/audio PIDs. Audio/video details for unencrypted programs.
TR 101 290 Priority 1,2,3	TR 101 290 Priority 1, 2, 3 real-time testing & monitoring. (No buffer test.)
Basic Information	Various TS details, including data type % breakdown; transmission speed; packet length; network info.
PID List	Displays PIDs in current stream w/ type, symbol rate, and % of each.
PCR Monitor	Calculates PCR interval / accuracy; real-time dynamic graph of results; max/min interval / accuracy data.
PSI/SI List	Displays PSI/SI info (PAT, PMT, CAT, NIT, SDT, TDT, EIT) in tree view.
Program List (EPG Info)	Transport stream EPG, including program #, service name & ID, carrier frequency, provider info, modulation type & symbol rate.
PID Capture	Capture specified PID by type: video, audio, PSI (PAT, PMT, NIT, TDT, RST, SDT, EIT). Displays data in HEX format.
Record/Replay	32GB SSD for TS recording
IPTV Analysis	
Supported protocols	UDP; RTP
Supported transport types	MPEG-2 TS over IP
Broadcast types	Unicast, multicast

Video/Audio Decoder	
Video	MPEG 2/4, H.264, H.256, VC-1, AVS(+)
Video Resolution	4K, 1080p, 720p, 576i
Audio	MPEG 1/2/4, AAC
CAM Module	EN50221 (DVB-CI) PCMCIA interface
WiFi Analysis	
Frequency	2.4G, 5G
Standard	802.11 a/b/g/n
Security Mode	WPA/WPA2/WPA-PSK/WPA2-PSK
Encryption	WEP/AES/TKIP
Test Parameters	SSID, Level, Channel
Optical Power Measurement	
Measurement Wavelength	1310nm, 1490nm, 1550nm
Measurement Range	-50 ~ +27dBm
Accuracy	±0.17dB (±3%)
Linearity	0.07 / 10dB
Resolution	0.01dBm
Interface	FC/SC/ST/APC general optical adapter
Level Adjustable Step	1dB
DTMB	
Carrier Type	C = 1,3780
Power Level Range	-35 ~ +50dBmV
Level Resolution	0.1dB
Power Level Accuracy	±2.0dB (C/N>20dB)
MER Measurement	>36dB
MER Accuracy	±2.0dB
BER	1E-1 ~ 1E-5
Constellation	√
Echo Pattern	-64.02 ~ +64.02μs (PN420) -87 ~ +87μs (PN595) -133.47 ~ +133.47μs (PN945) Scalable; ,max hold function; supports up to 50 markers
Optical to RF Converter	
Dynamic Range of Conversion	< 10dBm
RF Band Conversion (optical cable and DTT links)	65 ~ 1000 MHz
RF Band Conversion (optical IF-satellite Installation)	950 ~ 2150 MHz
Interface	
RF Input	75Ω F
USB	1x USB 2.0 port
LAN	2x 100/1000 M
CAM	1x PCMCIA
TS-ASI input/output	2x 75Ω BNC
DC supply input	12V / 5A
GPS input	USB dongle

Miscellaneous	
Display	7" TFT LCD 800x480 touchscreen
AC/DC Adapter	AC: 100 ~ 240V/50-60Hz DC: 12V/5A
Battery	Li-ion, 7.4V/13Ah
Charge Time	~5 hrs.
Working Time	>5 hrs.
Remote Feeding	5/13/15/18/24V, 5W max
22kHz control signals	DiSEqC 1.2 & SaTCR
Dimensions (WxHxL)	253mm x 194mm x 84mm (10.0" x 7.6" x 3.3")
Weight	~2.4kg (5.3 lbs)
Operating Temperature	-10 ~ +50°C

For a list of S7200-compatible accessories and software-enabled measurement options available from Deviser, please see Section 1-2.



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