

DS2831

Digital TV Spectrum Analyzer

User Guide



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Part I

DS2831 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 DS2831 Digital TV 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 DS2831 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.

Statement of FCC Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

In some situations, operation of this equipment in a residential area may cause harmful interference, in which case the user will be required to correct the interference at his or her own expense.

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 to 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.

Limitation of Warranty

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 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 **DS2831** is a Digital TV spectrum analyzer that integrates multiple measurement applications in a single instrument, ideal for use by CATV field technicians and HE engineers.

The firmware installed on the DS2831 is updated on a regular basis. This User Guide describes procedures for operating the instrument, based on the most recent firmware version up to the date listed on the guide.

1-1 About the DS2831 Digital TV Spectrum Analyzer

With the latest in RF test and measurement technology, this DS2831 spectrum analyzer includes a host of features typically found in more expensive instruments and provides outstanding performance for value. The RF front end of this true spectrum analyzer offers a dynamic range of 80dB @ 30kHz RBW.

The state-of-the-art cable modem supports DOCSIS 3.1 measurements; in addition to standard SCQAM capabilities (32 downstream carriers, 8 upstream carriers), the DS2831 now offers OFDM demodulation for downstream channels up to 192 MHz wide and upstream channels either 48 or 96 MHz wide.

The DS2831 adds a capacitive LCD touchscreen and a host of crucial functions, enabling field engineers to perform in-service measurements and identify interference signals that are invisible to many field analyzers currently available on the RF test equipment market. Spectrum & QAM analyses are shown simultaneously, allowing the user to verify analog / digital characteristics of the same carrier at the same time. With the upstream spectrum analysis tool, users can perform persistence tests (up to a span of 206MHz) to find intermittent impairments that traditional spectrum analyzers fail to see.

Gated C/N, CSO, and CTB measurements, triggering on VITS test signals, allow for non-interfering in-service basic CATV channel tests. By using the appropriate VITS test signal on a specific video line, the DS2831 can also perform video parameter measurements such as differential gain/phase – which the FCC requires to be tested every 3 years. With the advent of LTE interference ingress signals, the DS2831's EVS (Error Vector Spectrum) Frequency or Time function enables non-interfering tests "under the QAM signal".

As another example of the DS2831's exceptional versatility, it also supports MPEG TS (transport stream) analysis. This function provides the MPEG program information and channel frequency list – so that, when attempting to troubleshoot, a field engineer can easily identify the QAM carrier of interest based on the particular program complaint from the customer. When used in conjunction with the **DS1610 broadband network monitoring system**, the instrument can also capture a sweep response trace of the upstream path.

The DS2831 is supported by the cloud-based Deviser EDGE platform for asset & data management.

Each instrument comes with Measurement, Constellation, Spectrum, Tilt, Scan, and Mini-Scan downstream functions, and Cable Modem, Spectrum, Ping, FTP, Traceroute, PPPoE, and Browser modes. Optional tools may be enabled either at the time of purchase, or at a later date as your test needs evolve.

- In-service C/N, CSO, and CTB gated testing
- Supports optical fiber tools, such as power meter, fault locator, & inspection probe
- Analog TV video gated measurement
- Upstream spectrum persistence analysis
- Wi-Fi measurements
- Upstream signal generator (up to QAM256)
- Data management app, Deviser EDGE
- EVS: in-service interference location under a QAM carrier (e.g. LTE)
- TR 101 290 monitoring
- Reverse path sweep
- Analog CATV measurement suite
- 32x8 cable modem with OFDM

1-2 Accessories and Measurement Options

The following components and options are available with your DS2831 Digital TV Spectrum Analyzer.

Model No.	Description	Order No.
DS2831-002	DS2831 Digital TV Spectrum Analyzer	0110.2800.02
SFL10-KK	TOKO F-F Connector	6190.0500.01
DS2831-003	CD (Toolbox Software and Operation Manual)	6190.0600.70
DS2831-004	Quick Start Guide	6190.0600.71
FSP060-DBAE1	AC/DC Adapter	6290.0700.01
DS2831-008	Soft Carrying Case	6110.0600.14
DS2831-010	Carabiner Red Deviser Logo	6110.0600.17
DS2831-011	Carabiner Blue Deviser Logo	6110.0600.18
DS2831-012	Plated Key Ring	6110.0600.19
DS2831-013	DS2831 Inspection Certificate	6110.0600.32
DS2831-700	Extended Spectrum (1220 ~2150 MHz)	2110.2800.27
DS2831-800	DPS (Digital Persistence Spectrum)	2110.2800.28
DS2831-801	C/N, CSO, CTB Gated Measurement	2110.2800.29
DS2831-802	Analog Video Parameters Measurement (DG/DP, CLDI, ICR, DOM)	2110.2800.30
DS2831-803	EVS (Error Vector Spectrum)	2110.2800.31
DS2831-804	TS Analysis	2110.2800.32
DS2831-805	WiFi Analysis	2110.2800.33
DS2831-806	Reverse Path Sweep	2110.2800.34
DS2831-212	DS2831 FSK Unit	2110.2800.06
DS2831-807	Upstream Signal Generator with FEC	2110.2800.35
CDA-20360	Built-in DOCSIS 3.0 8x4 Cable Modem	5110.0000.13
DS2831-809	DOCSIS 3.1 Cable Modem (32x8)	2110.2800.38
DS2831-811	Passive Sweep	2110.2800.01
OPM	Optical Power Meter and VFL Module	2130.7000.29
DS2831-204	Visual Fault Locator	2110.2800.02
DS2831-210	Optical Power Measurement (OPM)	2110.2800.03
DI-1000	Fiber Microscope DI-1000 LighTel	6250.0900.11
DS2831-211	GPS	2110.2800.04
DS2831-005	DS2831 operation manual hard copy	6190.0600.75
AE4000-733	Power Cord Plug Type (EU)	6290.0500.03
AE4000-734	Power Cord Plug Type (US)	6290.0500.04
AE4000-735	Power Cord Plug Type (UK)	6290.0500.05
AE4000-736	Power Cord Plug Type (Australia)	6290.0500.06

1-3 Technical Support & Service

Deviser Instruments Inc. offers a 3-year standard 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.

1-5 Electrostatic Discharge Caution

The DS2831 Digital TV 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 DS2831 input circuitry. DS2831 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 DS2831. 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 DS2831 can be supplied with power in two different ways: with a battery or with the power adapter provided.

1-6.1 Battery

The DS2831 uses a 7.4V/10Ah 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 7.15V, the instrument will display an alert indicating low charge. At 6.8V or less, it will display a second alert and the battery icon will flicker. At 6.5V 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.

1-6.2 Charging the Unit

There are two ways to charge the DS2831 battery: with the traditional AC/DC adapter plug, or with the DS2831 dual-slot charging deck.

With the DC Port

Using the plug, you can recharge the battery while continuing to operate the device.

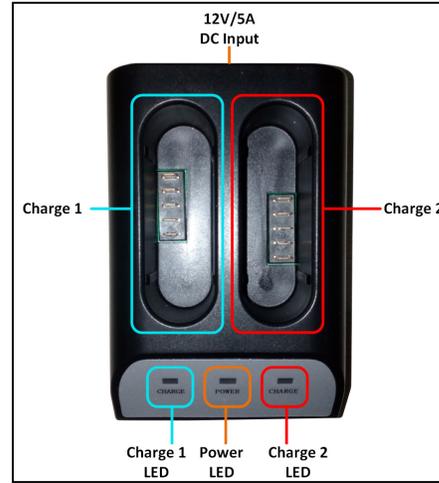
1. Connect the adapter cord to the power supply; then insert the DC connector into the VDC power inlet at the top left of the instrument (while facing the screen). You can continue to operate the meter while plugged in.
2. When the charging indicator displays a gradually-filling battery icon in the status 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.

With the Charging Deck

The new high-speed charging deck accommodates two battery packs at once.

1. Connect the adapter cord to the power supply. Then insert the DC connector into the DC input pocket of the charging deck. (The "Power" LED will turn red.)
2. Ensure the DS2831 is OFF. Remove the DS2831's battery pack using the rear access panel and a flat-head screwdriver. Insert the battery, contact points down, into the Charge1 or Charge2 slot. Its LED will turn red if successful; when fully charged, it will turn green.
3. Remove the battery when complete, then disconnect the AC power adapter.





High-speed charging deck, with dual battery slots

With either method, once the instrument reaches full charge, it is recommended to charge for 1 additional hour to help extend the operation time. After charging, unplug the DC connector, and then pull out the AC adapter from the outlet.

To avoid overheating, do not leave the AC adapter and power supply connected while storing.

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
EIT	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
SMPTTE	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
VSF	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 DS2831 Digital TV Spectrum Analyzer. Topics covered in this section include:

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

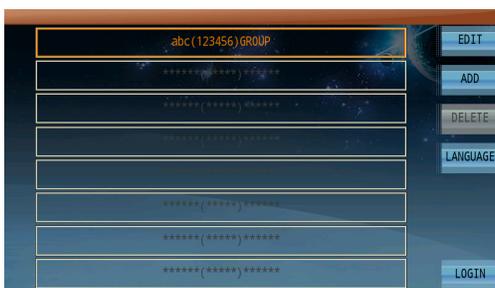
2-1 Unpacking the DS2831 Instrument

When unpacking your DS2831 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 DS2831



To turn on the DS2831, 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 complete power warm-up and load the application software. When finished, the user profile screen will appear (left).

On this screen, you can login to an existing user profile, which will apply the channel plan associated with that profile. You can also edit the user's name, ID, or company by tapping **Edit**; 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 30-2.5 for instructions.

To power the device off, press the On/Off button briefly and select **Power Off**. You can also set the device to **Standby** mode, which reduces boot time and power consumption while the unit sleeps.

Press the button and select **Reboot** to restart the instrument software. Press the green Esc key (below the function keys, F1-F7) to exit the dialog instead.

2-3 Front Panel Overview

The DS2831 Digital TV Spectrum 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. You can use the LCD touchscreen to navigate most basic functions; just use your finger or the provided stylus to tap the desired icon or setting.



1. LED Charge Indicator

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

2. Power ON/OFF

Press to turn the DS2831's application software ON and OFF. Press while ON to shut down, reboot, or place the unit in standby mode.

3. Brightness Control

With the unit powered on, press the green button to the left of the power button to launch the DS2831 screen brightness control. Use the arrow keys (8) or rotary knob (9) to adjust the setting from 0-100%, then press this button again to confirm.

4. Function Keys

Keys F1-F7 are used to select corresponding settings or features displayed on the screen. Press one of these keys to select the menu item displayed closest to it. For example, when selecting "Downstream" or "Upstream", the listed settings will appear next to the F1 and F2 keys, respectively. Press F1 to select Downstream and F2 to select Upstream.

5. Measurement Modes

The four keys located next to the rotary knob will activate different measurement modes. Press **SPECT** for the spectrum analysis mode; **SLM** for channel measurement; **CM** for cable modem; and **AUX** for simultaneous QAM and spectrum analysis (provided that the DS2831 is tuned to a digital carrier frequency and is in FFT acquisition setting).

6. Navigation Keys

The six keys located along the bottom of the screen activate different DS2831 management menus. Press **CH** for the Channel Editor menu; **FILE** to manage or view saved files; **SAVE** to save a screenshot or data file; **AUTO** to access the auto test menu; **SETUP** to change system settings; and **HOME** to return to the measurement application menu.

7. 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, if you entered an unintended value.

8. Arrow Keys

The arrow keys above and below the rotary knob are used to adjust settings or move markers. Press the top arrow to increase the selected value and the bottom arrow to decrease it.

9. Rotary Knob

This spinning knob can be used to change the parameter to control, or to move marker lines. Place a finger in the round depression (or along the protruding lip on the right side) and turn the knob clockwise to move right, or counter-clockwise to move left. Push the knob in, like a button, to confirm the entry.

10. Esc Button

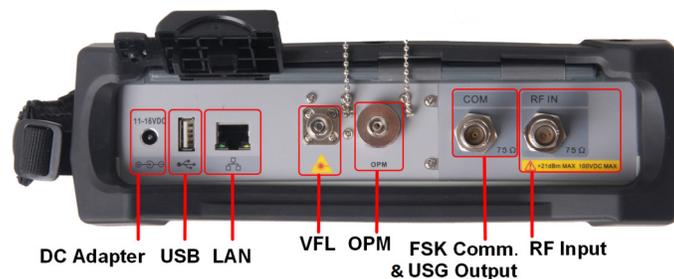
Press the Esc button to cancel an entry or return to the previous application or menu.

11. Touchscreen

The DS2831 features a capacitive LCD touchscreen as an alternate means of operating the unit. Tap the screen to select icons, explore menus, and more.

2-4 Top Panel Overview

The test instrument's top panel contains connectors and ports used to transfer data, charge the instrument, display data on a PC, and other functions. See the diagram and descriptions below.



Adapter

Used to supply the DS2831 with electricity and charge the battery. Connect to a wall outlet using the power supply included.

USB Type-A port

The DS2831 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 connect the device to a PC. The Deviser EDGE platform provides an easy method to manage, archive, analyze, and print measurement data.

VFL port

Generates a red beam that highlights faults, stresses, and bends in an optical fiber connected to the port. For safety, do not look directly into the VFL port when the light is on.

OPM port

Measures magnitude of optical signal transmitted through a fiber connected to this port. Has FC/SC/ST replaceable adapter.

FSK Communication (COM) port / USG Output

Used to facilitate FSK (Frequency Shift Keying) communications in some applications. For details, see Chapter 13: Reverse Path Sweep and Chapter 14: Upstream Signal Generator.

RF Input

75 Ω, N-Type female connector. Maximum input is +21 dBm at 100 VDC.

2-5 Control Overview

The DS2831 employs a 7", 800x480 capacitive color touchscreen that is configured for ease of use. You can quickly and easily change measurement functions by tapping the screen with a finger or the included stylus pen; or by pressing the function softkeys (F1–F7) located off the right side of the screen. Each measurement application has its own menu structure. In Part II, Settings and Measurements, we discuss each application's display and controls in detail.

In any given application, 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, or by pressing the **function key** (F1-F7) next to it. These tools can be edited with the function keys.

2-5.1 Selection Types



Inside brackets, e.g. **[DATA]**: Press the related function key repeatedly (or tap the desired submenu) to cycle through a list of available settings.

Numerical entry: e.g. setting a frequency range: Use the alphanumeric keypad to enter a value, or adjust the current value with the arrow keys and rotary knob.

Alphanumeric entry, e.g. choosing a filename: Press a key (shown left) to cycle through the characters printed on it. Uppercase letters come after lowercase. Ex.: hit 7 repeatedly to cycle through 7, s, t, u, S, T, U, 7. (A USB keyboard may be connected for easier data entry.)

Toggling between 2 settings, e.g. either Auto or Manual but never both: Use the function keys to choose. The setting highlighted in orange is the active one.

When multiple settings are available for you to control: Press the rotary knob once and turn it to select a parameter, then press the knob again to confirm. You can then begin editing the value.

Jump to specific measurement modes using the **SPECT**, **SLM**, **CM**, and **AUX** buttons, or access system tools like file management and setup with the row of hardkeys located along the bottom edge of the display.

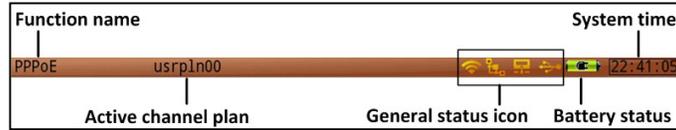
Function-specific menu structures and controls will be discussed later in this guide.



2-6 Measurement Main Menu

The DS2831 Digital TV Spectrum Analyzer provides various spectrum analysis measurement modes aimed at simplifying the installation, maintenance and troubleshooting of a CATV broadcasting system. Upstream and downstream measurements are available. These include the following.

	Channel Measurement		Constellation Diagram
	DS Spectrum Analysis		Tilt
	Channel Scan		CCN
	CSO/CTB		TS Measurement
	Mini SCAN		Passive Sweep
	DOCSIS 3.1 Cable Modem		PING
	OFDM		1Gbps / 3Gbps Throughput
	Upstream Spectrum Analysis		FTP
	Upstream Signal Generator		Traceroute
	PPPoE		Browser
	Reverse Sweep		Wi-Fi
	DPS		OPM (Optical Power Meter)
	VFL (Visual Fault Locator)		FIP (Fiber Inspection Probe)



Status bar

General Status Icons

-  Wi-Fi function is active.
-  Wi-Fi hotspot function is active.
-  USB storage device connected.
-  PPPoE icon.
-  The 32x8 Cable Modem function is active. If the four dots are red, the Cable Modem is initializing; if white, it is in the registration process with the CMTS; if green, the Cable Modem has successfully registered with the CMTS.
-  LAN cable connected.
-  The GPS module is searching for a GPS satellite signal.

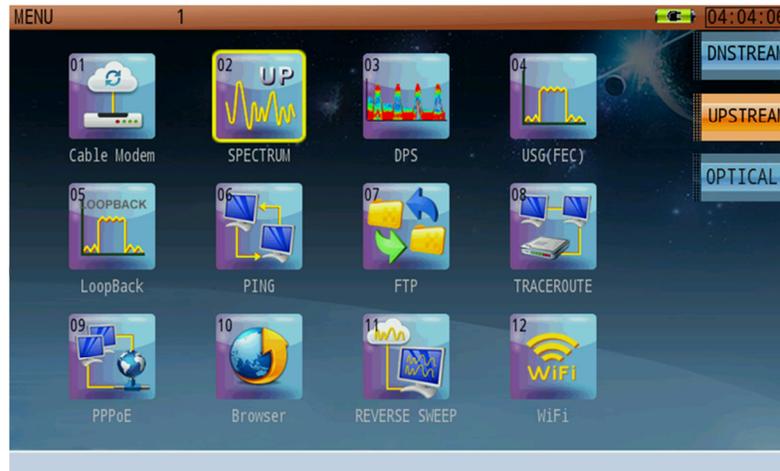
Signal Transmission Icons

-  Signal received / transmitted from the RF IN port.
-  Signal received / transmitted from the COM port.
-  Loopback test. The arrow indicates that the signal is being transmitted from the COM port and received by the RF IN port.

Power Icons

-  Adapter connected;
-  Full battery;
-  Low battery;
-  Empty battery.

2-7 Measurement Mode Selection



DS2831 Main Menu

There are three ways to choose a measurement application. (To switch between Downstream, Upstream, and Optical applications pages, tap the named submenus to the right.)

1. Tap the desired measurement icon with your finger or the included stylus pen.
2. Turn the rotary knob (or use the arrow keys) to move the yellow selector on the screen. Highlight the application you want and press the rotary knob to start the measurement.
3. Each application has a small number in its icon. Use the data keypad to enter the number of the desired application, starting the measurement.

Optional measurement modes, not included in the DS2831'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.

When enabled, any optional modes and associated measurement applications will also be displayed 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.

2-8 About the Soft Carrying Case

The DS2831 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:

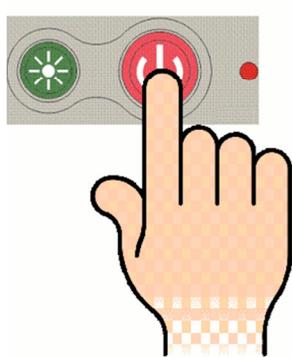
1. Place the carrying case face-down on a stable surface, with the front panel fully closed and lying flat.
2. Open the zippered back of the case.
3. Insert the instrument face-down into the case. Take care that the connectors fit properly through the opening in the case top.

Chapter 3: Quick Start Guide (Making a Measurement)

This chapter will provide the basics of setting up and performing select measurements with the DS2831.

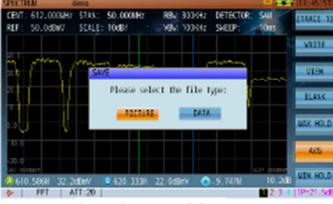
Press the Power button (shown below) and use the arrow keys and F7 to log in to an existing user profile (or press F2 to create one). This places you at the **Home** menu, where you can select from all measurement applications currently enabled on the instrument.

Power On/Off





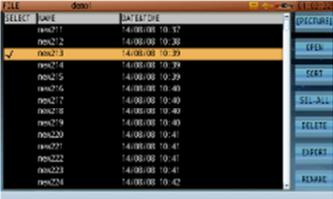
11 Save picture and data



1 Spectrum analysis



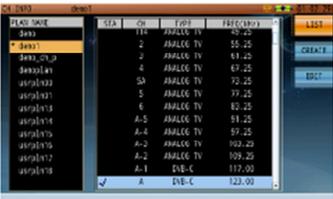
10 File operation



2 Channel measurement



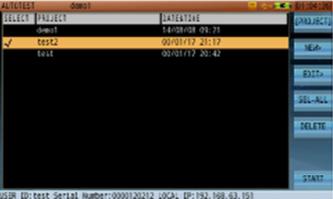
9 Create and edit channel plan



3 Cable Modem measurement



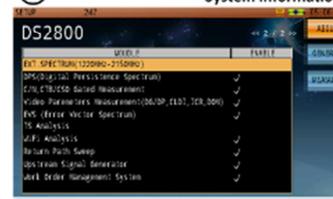
8 Autotest



4 Simultaneous display of Spectrum & QAM Analysis



7 System information



6 Home page



5 Modify screen brightness



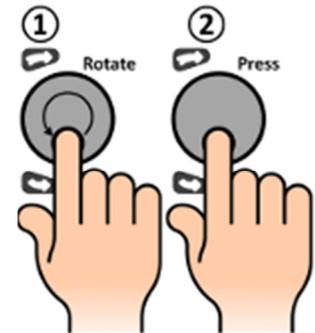


Using the Rotary Knob & Arrow Keys

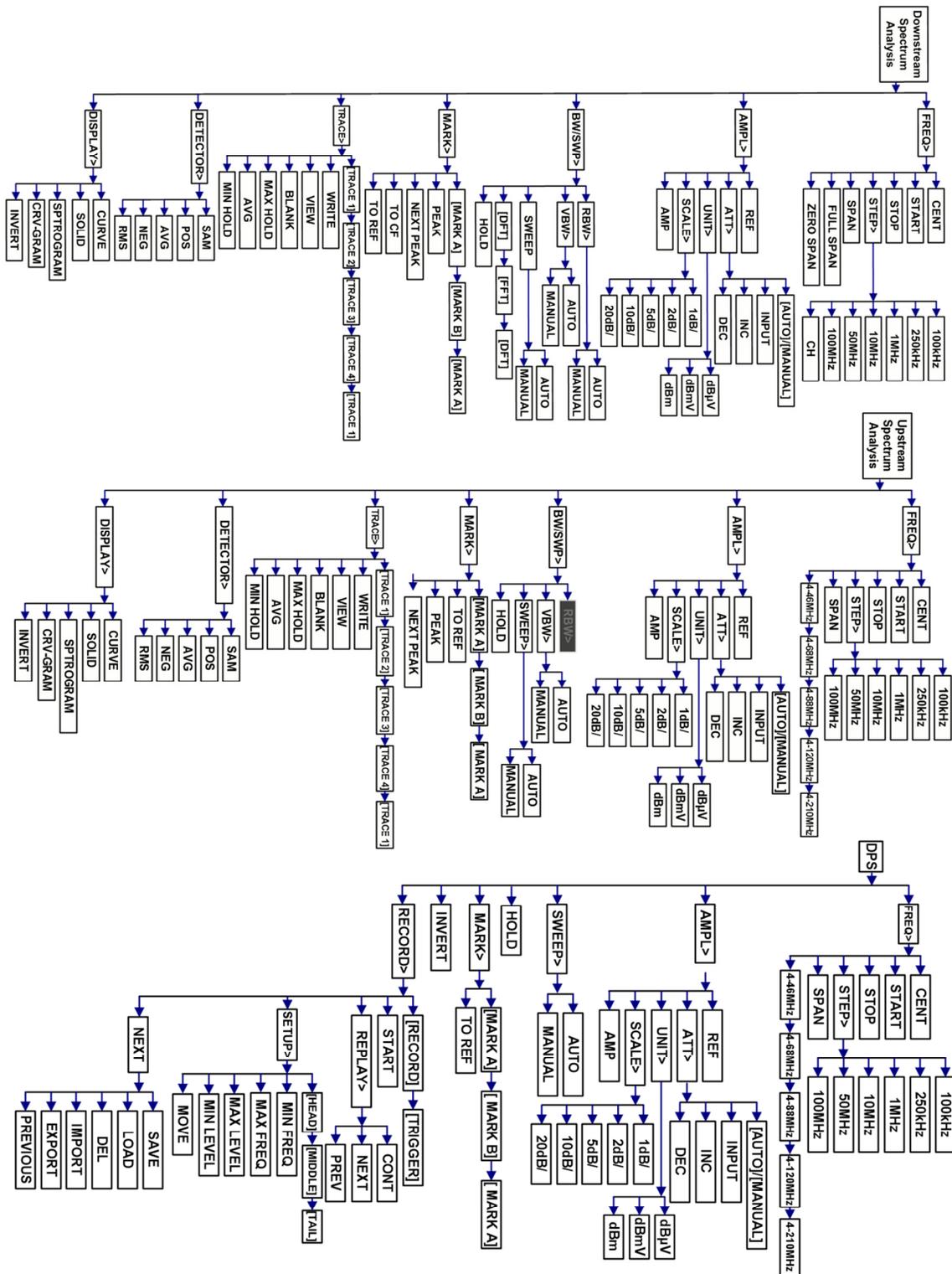
When operating any menu on the DS2831, such as the **Home** measurement menu (shown above), you can use the **rotary knob** to make selections. In addition, each icon has a number; simply enter that number on the keypad to launch its measurement. (Alternatively, simply tap that icon on the touchscreen.)

Turn the knob to move the cursor  until it is highlighting your selection. Then press the knob in to confirm your choice.

Press the **arrow keys** above and below the knob to change pages or scroll up and down lists.



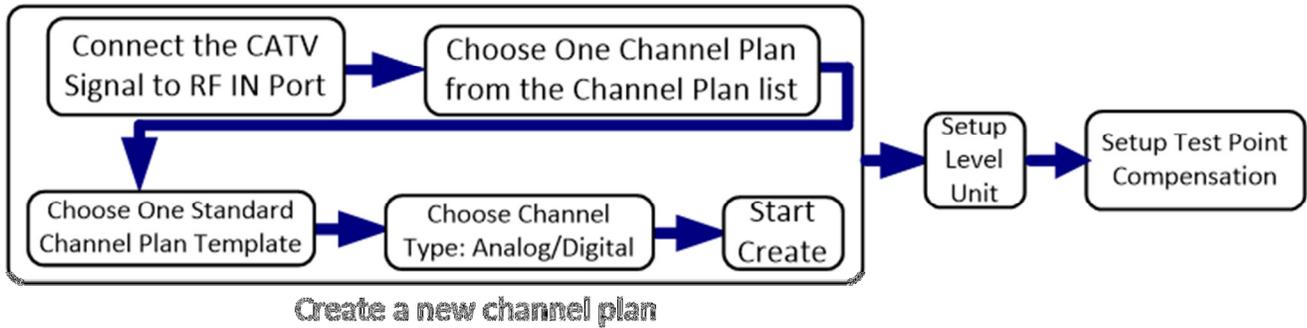
Spectrum Analysis Menu Maps: Downstream, Upstream, & DPS



Set Up Your Channel Plan First

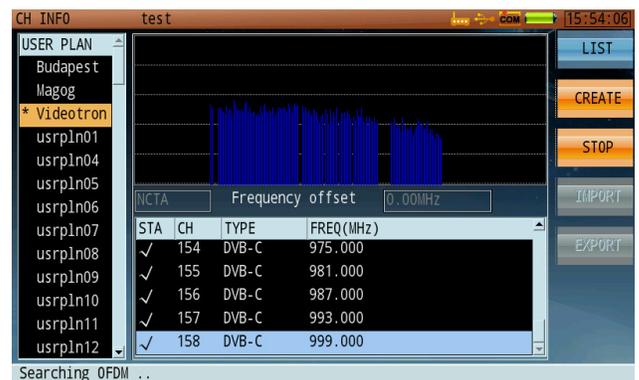
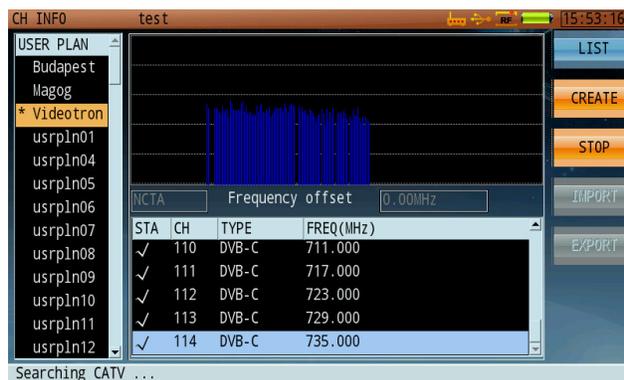
Before launching a measurement with the DS2831, it is recommended to set up the channel plan you wish to use for testing. You can do this from the Channel Plan Editor (press CH below the screen).

For detailed instructions on channel plan creation and setup, see Chapter 4: 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. Channel auto-detection takes ~2 minutes on a fully loaded spectrum.

The DS2831 can recognize analog, digital, and OFDM carriers. However, it cannot distinguish between a digital DVB-C or DOCSIS carrier, so be sure to properly identify your DOCSIS SC-QAM carriers (once only) as the DOCSIS signal type (with other parameters, such as Symbol Rate & Standard). (See below, bottom-left.)



STA	CH	TYPE	FREQ (MHz)
✓	28	DVB-C	634.00
✓	29	DOCSIS	642.00
✓	30	DOCSIS	650.00
✓	31	DOCSIS	658.00
✓	32	DOCSIS	666.00
✓	33	DOCSIS	674.00
✓	34	DOCSIS	682.00
✓	35	DOCSIS	690.00
✓	36	DOCSIS	698.00
✓	37	DVB-C	706.00
✓	38	DVB-C	714.00
✓	39	DVB-C	722.00
✓	40	DVB-C	730.00

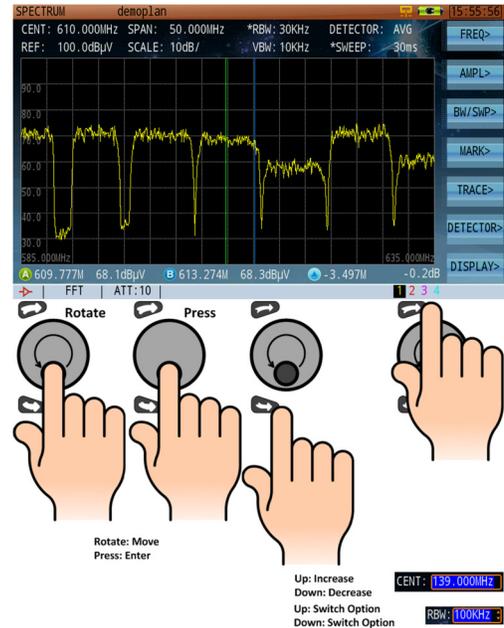


Spectrum Analysis

In Spectrum Analysis mode, press the rotary knob to bring up the highlight selector. Then turn the knob to highlight the setting you wish to modify. (Alternatively, just tap the setting on the touchscreen.)

Then use the rotary knob or arrow keys to quickly set the desired value.

Press the function buttons (labeled **F1 ~ F7**) to navigate the measurement settings submenus, as shown.

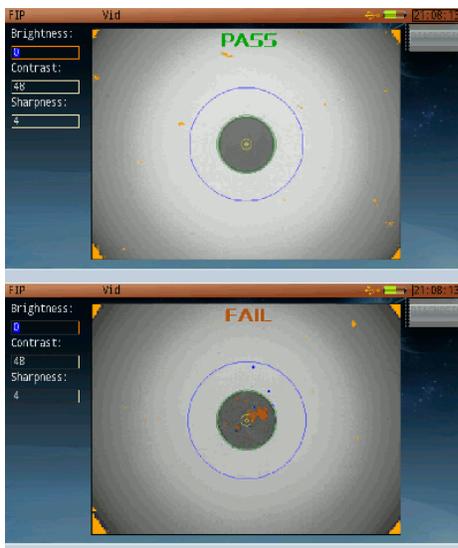


Optical Power Meter

Connect the fiber for testing. Press **Length** (F1), then use the function keys (F1-F7) to select a measurement wavelength. You can also set the reference level with the rotary knob or arrow keys.

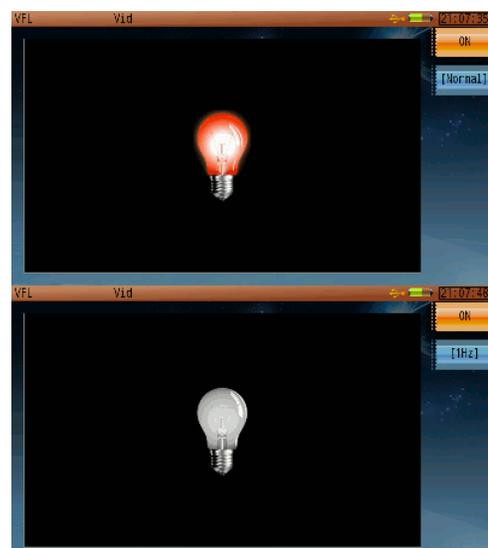
Fiber Inspection

Connect the fiber, adjust the view settings/focus, then press **Diagnosis** (F1) for Pass/Fail testing.



Visual Fault Location

Connect the fiber, then press **ON** to illuminate. Press 1 or 2 Hz to flash.



Reverse Path Sweep

The DS2831 features two ways to sweep your reverse path. The first, "Active Reverse Sweep", synchronizes together with the Kingstone monitoring platform.

1. On the DS2831, set up measurement parameters for reverse path sweep.
2. Log in to the DS1610 "KingStone" to activate reverse path sweep.
3. View measurement traces simultaneously at the DS1610 (as it is viewed locally at the HE) and the DS2831 (as viewed in the field). Compare traces for level and Frequency Response delta.
4. Transmit the US sweep signal, store a reference, move to another location, and compare the stored reference with the live reference.
5. View sweep reference traces simultaneously with Spectrum Analyzer traces on the same screen.

REVERSE SWEEP usrp1n00
 START: 4.000MHz STOP: 65.000MHz RBW: 300kHz DETECTOR: POS
 REF: 10.0dBmV SCALE: 10dB/VBW: 300kHz SWEEP: 500ms

SETUP
 PILOT FREQ: 5.000MHz
 DOWN LINK FREQ: 105.000MHz
 UP LINK FREQ: 65.000MHz
 PILOT LEVEL: 35.0dBmV
 IP COMPENSATION: 8.0dB
 REVERSE SWEEP SLOPE: 5.0dB
 RESERVE SWEEP PORT: COM

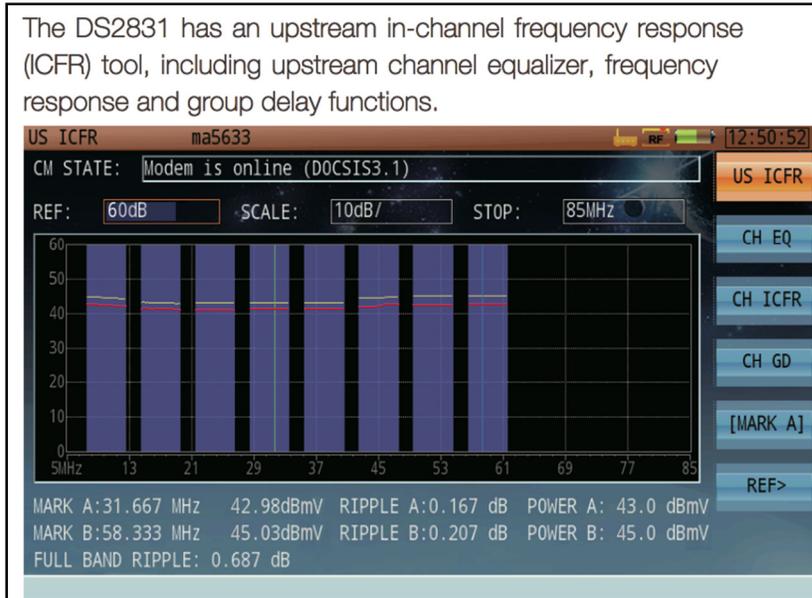
LIST
 HEADEND INPUT LEVEL: 0.0dBmV

NO.	FREQ	TX LEVEL
1	5.00 MHz	8.0dBmV
2	10.00 MHz	8.3dBmV
3	11.00 MHz	8.7dBmV
4	15.00 MHz	9.0dBmV
5	20.00 MHz	9.4dBmV
6	25.00 MHz	9.7dBmV
7	32.00 MHz	10.1dBmV
8	34.00 MHz	10.5dBmV

LOAD REF
 Ref. file: ref1

The second way to conduct reverse path sweep is with the **PNM method**, which relies on the US SC-QAM adaptive EQ power coefficients. This function provides much higher sweep resolution, with up to 24 sweep reference points in each of your 6.4MHz US channels (up to 8 US channels, and enables hi-res sweep traces up to 51.2MHz wide.

In the case below, the DS2831 would perform at 8 resolution points fewer than the 192 sweep resolution points in the Passive Sweep app offered with the DS2831.



In addition to the Sweep reference function, this mode provides individual in-channel frequency response information, as well as Group Delay and Equalizer coefficients for each of the individual US channels.

32x8 Cable Modem Measurement

USER PLAN	STA	CH	TYPE	FREQ(MHz)
* usrpIn00	✓	72	DVB-C	513.000
usrpIn01	✓	73	DVB-C	519.000
usrpIn02		74	DVB-C	525.000
usrpIn03	✓	75	DOCSIS3.1	600.000
usrpIn04		76	DVB-C	537.000
usrpIn05		77	DVB-C	543.000
usrpIn06		78	DVB-C	549.000
usrpIn07		79	DVB-C	555.000
usrpIn08		80	DVB-C	561.000
usrpIn09		81	DVB-C	567.000
usrpIn10		82	DVB-C	573.000
usrpIn11		83	DVB-C	579.000
usrpIn12		84	DVB-C	585.000

Procedure:

1. After properly identifying DOCSIS channels in your channel plan, set parameters for your testing needs. Be sure to set up your DOCSIS channels correctly before initiating the cable modem.
2. In the Cable Modem application, open the DOCSIS channel list and select your desired channel. This speeds up testing.
3. Press "OK" to confirm. Note status. If connection does not succeed, re-check measurement parameters.
4. Note: the CM can receive signals of -10 ~ +20dBmV. Signals outside this range will prevent CMTS connection. Adjust the attenuation level to fit this range.

DS FREQ

DOCSIS Channel: ---, 375.00MHz, 261

Downstream Frequency: 375.00MHz

Upstream Channel ID: 261

Downstream Level Correction: 0.0dB

Upstream Level Correction: 0.0dB

OK CANCEL

DOCSIS 3.1 usrpIn00 15:46:33

CM STATE: Modem is online (DOCSIS3.1)

DOWNSTREAM INFO

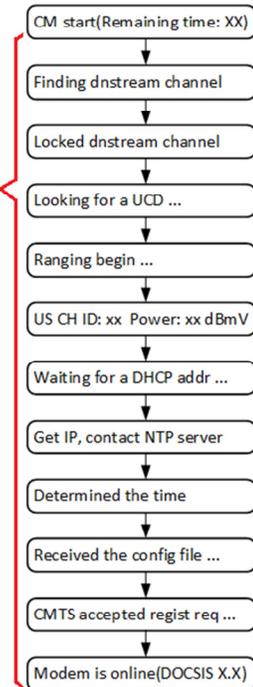
FREQ(MHz)	BW	P(dBmV)	MER	PRE/CORR	POST/UIC
261(256Q)*	6.0	18.2	40.9	<1E-09	<1E-09
267(256Q)*	6.0	18.2	40.9	<1E-09	<1E-09
273(256Q)*	6.0	18.1	43.4	<1E-09	<1E-09
279(256Q)*	6.0	17.9	43.4	<1E-09	<1E-09
285(256Q)*	6.0	17.8	43.4	<1E-09	<1E-09
291(256Q)*	6.0	17.6	40.9	<1E-09	<1E-09
297(256Q)*	6.0	17.3	43.4	<1E-09	<1E-09
303(256Q)*	6.0	17.0	40.9	<1E-09	<1E-09
309(256Q)*	6.0	16.8	43.4	<1E-09	<1E-09
217(256Q)*	6.0	16.0	40.0	<1E-09	<1E-09

UPSTREAM INFO

ID	FREQ(MHz)	P(dBmV)	BW
1	10.0(64Q)	30.8	6.4
2	17.0(64Q)	29.8	6.4
3	24.0(64Q)	29.0	6.4
4	31.0(64Q)	29.3	6.4
5	38.0(64Q)	29.0	6.4
6	45.0(64Q)	29.5	6.4
7	52.0(64Q)	30.3	6.4
8	59.0(64Q)	30.8	6.4
66-106(2K)		40.8	39.0
108-204(2K)		40.5	95.0

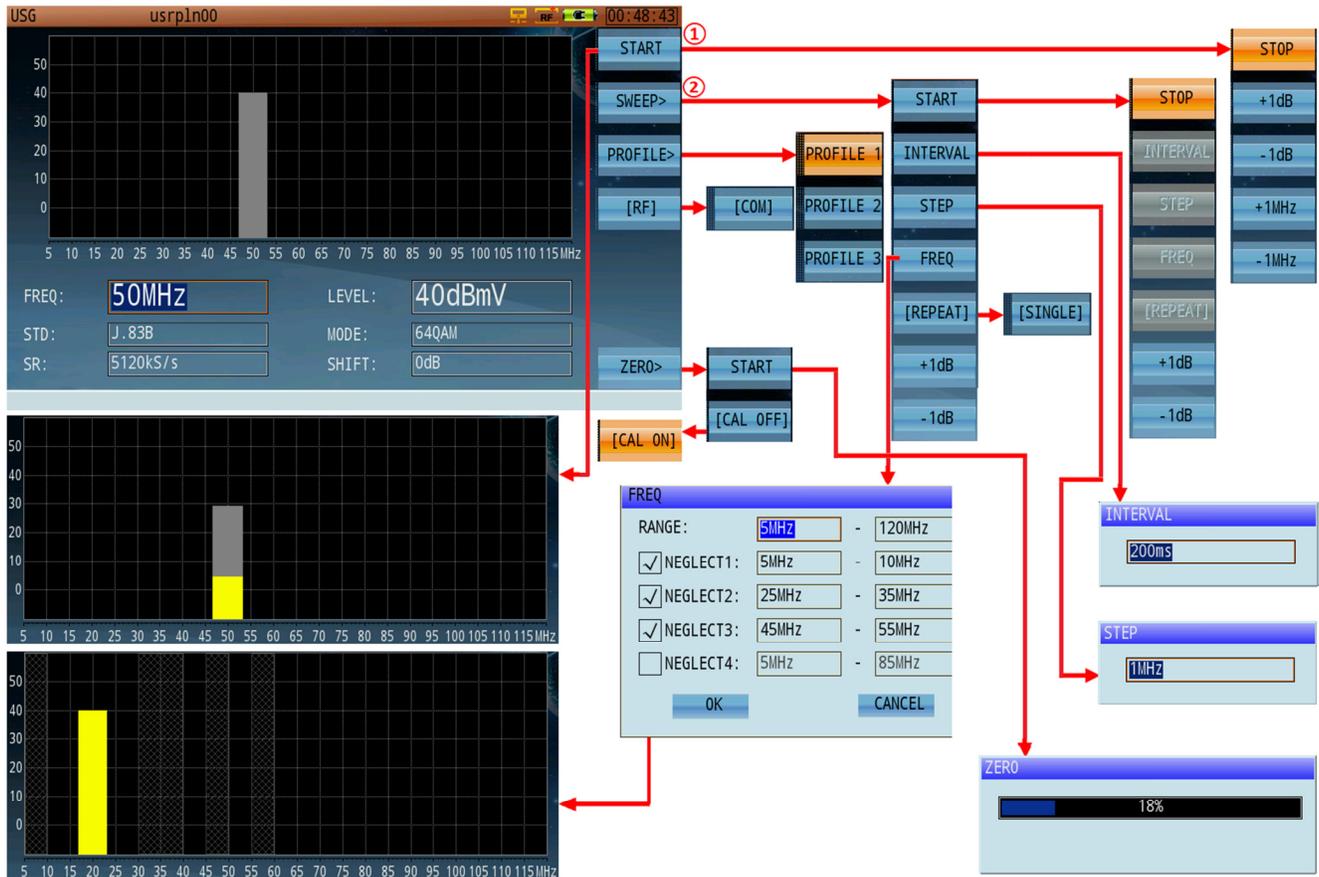
LOCAL IP: 192.168.1.102

CM INFO [DS] IP INFO CFG FILE DS FREQ REFRESH NEXT



Advanced Upstream Signal Generator (FEC)

- 1. Fixed frequency mode.
- 2. Sweep frequency mode.



Part II

Settings and Measurements

Chapter 4: Channel Plans

Controlling and managing channel plans is a crucial component of HFC network maintenance, among other tasks common to cable & broadband technicians. Press the **CH** button located below the DS2831 display to open the channel plan manager utility.

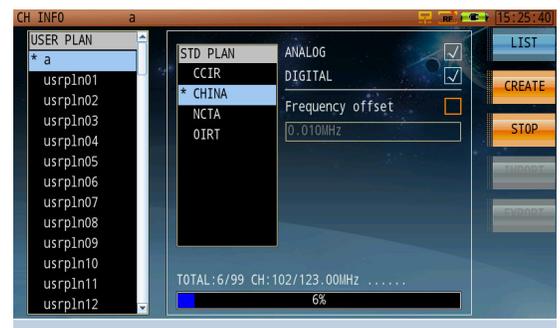
The channel plan manager is separated into two panes. Turn the rotary knob to switch between them, and press the arrow keys to move up and down.

- The **left** pane lists a total of 16 user plans (up to 100 plans may be stored on one DS2831) 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.

4-1 Creating a User Channel Plan

In the plan manager, press **Create** (F2) to change the right-hand pane to a user plan creator. Use the rotary knob to select a plan template according to your global region: CCIR, CHINA, NCTA, or OIRT. (For example, operators in North America will select NCTA.)

You may then choose a mode. Fast Mode scans through all analog and digital channels, measuring the carrier levels to verify the presence of each channel. Normal Mode includes an extra step of demodulating every digital channel to check its locking ability and internal configuration parameters, adding this information to the new channel plan. Normal mode takes slightly longer to generate.



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

The DS2831 features an automatic channel plan builder. It will identify the peak signal levels and available analog carrier frequencies, as well as identifying digital carriers. Press **Start** (F3) to begin a local scan and auto-generate the channel plan. Channel auto-detection takes approximately 2 minutes on a fully loaded spectrum.

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, press **List** (F1) to return to the channel plan list.

NOTE:

The DS2831 can recognize analog, digital, and OFDM carriers. However, it cannot distinguish between a digital DVB-C or DOCSIS carrier, so be sure to properly identify your DOCSIS SC-QAM carriers (once only) as the DOCSIS signal type (with other parameters, such as Symbol Rate & Standard). (See below, bottom-left.)

STA	CH	TYPE	FREQ (MHz)
✓	110	DVB-C	711.000
✓	111	DVB-C	717.000
✓	112	DVB-C	723.000
✓	113	DVB-C	729.000
✓	114	DVB-C	735.000

Searching CATV ...

STA	CH	TYPE	FREQ (MHz)
✓	154	DVB-C	975.000
✓	155	DVB-C	981.000
✓	156	DVB-C	987.000
✓	157	DVB-C	993.000
✓	158	DVB-C	999.000

Searching OFDM ..

STA	CH	TYPE	FREQ (MHz)
✓	28	DVB-C	634.00
✓	29	DOCSIS	642.00
✓	30	DOCSIS	650.00
✓	31	DOCSIS	658.00
✓	32	DOCSIS	666.00
✓	33	DOCSIS	674.00
✓	34	DOCSIS	682.00
✓	35	DOCSIS	690.00
✓	36	DOCSIS	698.00
✓	37	DVB-C	706.00
✓	38	DVB-C	714.00
✓	39	DVB-C	722.00
✓	40	DVB-C	730.00

CH EDIT test

EIA NUMBER: 98

CHANNEL NAME: A-2

STATUS: ENABLE

SIGNAL TYPE: DVB-C

SYSTEM RATE: 60Hz

FREQUENCY: 111.000MHz

CHANNEL BW: 6.00MHz

MODULATION: 256QAM

SR: 5.361MS/s

STD: J.83B

BER Count Time: 60Secs

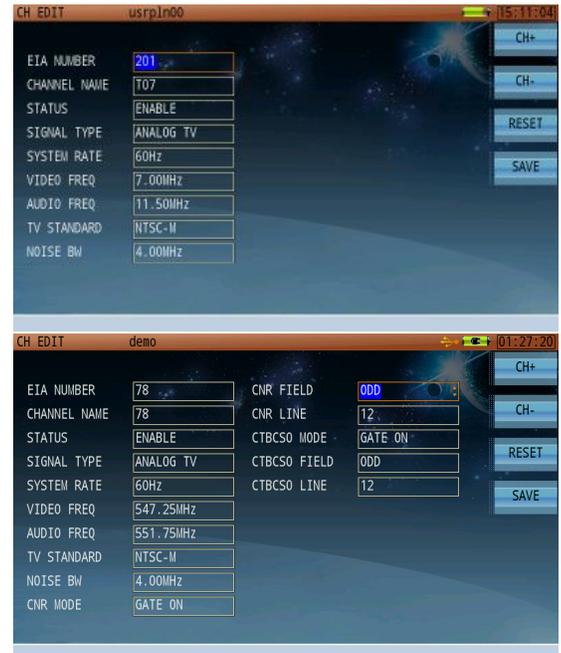
4-2 Editing Channel Plans

There are several ways to modify an existing channel plan. To change its name, highlight it in the left pane and press **Edit** (F3). Enter a new plan name using the alphanumeric keypad, then press OK to confirm.

To activate or deactivate all channels in a plan, highlight the plan and press **Ena All / Dis All** (F6). 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. Highlight it in the left pane and press the rotary knob to make it the active plan. Turn the knob to highlight the right-hand pane. Use the arrow keys to highlight the channel and press **Edit** (F3).

In this screen, you can edit a variety of individual channel parameters. For a list of all available selections, see below.



Analog TV Channel Parameters

- Channel serial number
- Channel name: Edit with keypad
- Channel status: [Enable / Disable]
- Signal type: [Analog FM / Analog TV / DOCSIS / DVB-C]
- 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 DS2831 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.

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 Channel Parameters

- Channel serial number:
- Channel name: Edit with keypad
- Channel status: [Enable / Disable]
- Signal type: [Analog FM / Analog TV / DOCSIS / DVB-C]
- System rate: [50Hz / 60Hz]
- Frequency: Edit with keypad
- Measure BW: Edit with keypad
- Modulation: [16QAM / 32QAM / 64QAM / 128QAM / 256QAM]
- 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 / EurDOCSIS]
- BER Statistical Time: The BER measurement time in BER statistical and auto test BER statistical functions.

NOTE: For Digital channels, the plan editor knows Analog from Digital, but not DVB-C from DOCSIS. You must instruct your channel plan on the line 4 of 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

Turn the rotary knob to move the cursor to the parameter you want to modify. Press the and arrow keys to choose your setting.

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 (F1 and F2) 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.

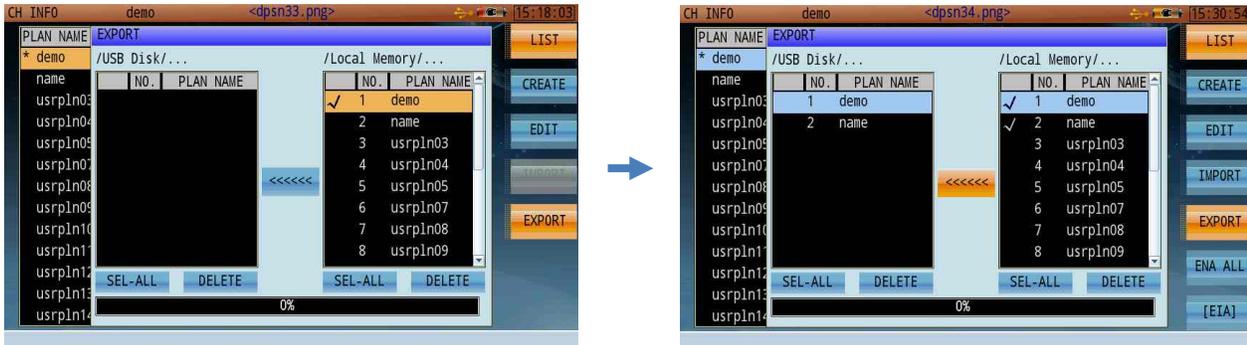
More channel plan templates are available in the DS2831 Toolbox software. *Deviser may be able to write customer-specific channel plans upon request.*



4-3 Importing and Exporting Channel Plans

To transfer user channel plan data to and from the DS2831, 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** (F5) key appears. In addition, if the USB device already contains some channel plan data, **Import** (F4) appears. This indicates that plans can be imported to the DS2831, 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 DS2831'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, a message will pop up asking if it is to be replaced. Click OK to overwrite, or press **Esc** (below F7) to cancel.

The process for importing channel plans to the DS2831 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.

Chapter 5: Analog TV

In this chapter, we discuss the DS2831's powerful suite of Analog TV signal measurement applications – including the Channel Measurement, Analog FM, FM Demodulation, HUM Modulation, Channel Scan, Passive Sweep, and Tilt functions.

5-1 Channel Measurement

In this mode, the DS2831 measures the basic parameters of a channel. Currently-supported channel types are analog TV, analog FM, and DVB-C. Note that the channel measurement menu (along the right side of the screen) displays different settings depending on the channel type being measured.

The Analog TV application (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 rotary knob to highlight the channel number, video frequency, and audio frequency fields, then enter your desired values with the data keypad. You can also use the arrow keys to adjust the current values, such as moving to the next active channel in the channel list.



5-1.1 Settings

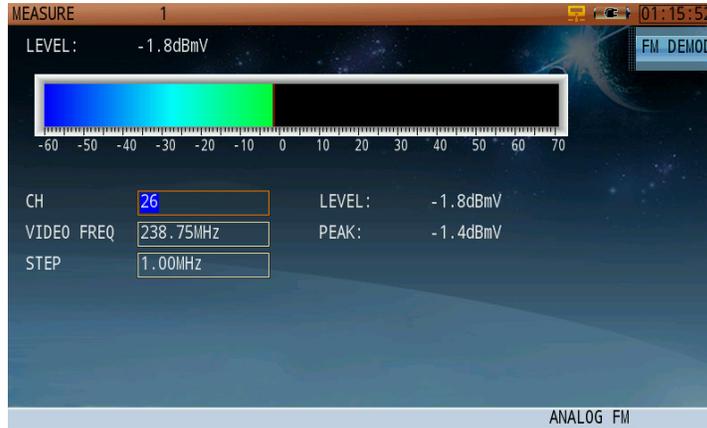
Channel:	The channel to measure. Select any active analog or digital channel in the active channel plan.
Video Freq:	Input range 5-1200 MHz.
Audio Freq:	Input range 5-1200 MHz.

Button Operation

HUM:	Switches to hum modulation function.
DOM:	Switches to Depth of Modulation function.
CLDI:	Switches to Chrominance-Luminance Time Delay Inequality function.
DG/DP:	Switches to Differential Gain/ Differential Phase function.
ICR:	Switches to In-Channel Frequency Response function.

5-2 Analog FM

The Analog FM measurement screen, shown below, is primarily used to measure FM radio signal levels.



5-2.1 Settings

- Channel: The channel to measure. Select any active analog or digital channel in the active channel plan.
- Frequency: Input range 5-1200 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.

5-3 FM Demodulation

The FM Demodulation function allows users to listen to audio from FM broadcast and analog TV. (When this function is active, the FM Deviation measurement is disabled.)



FM Listening

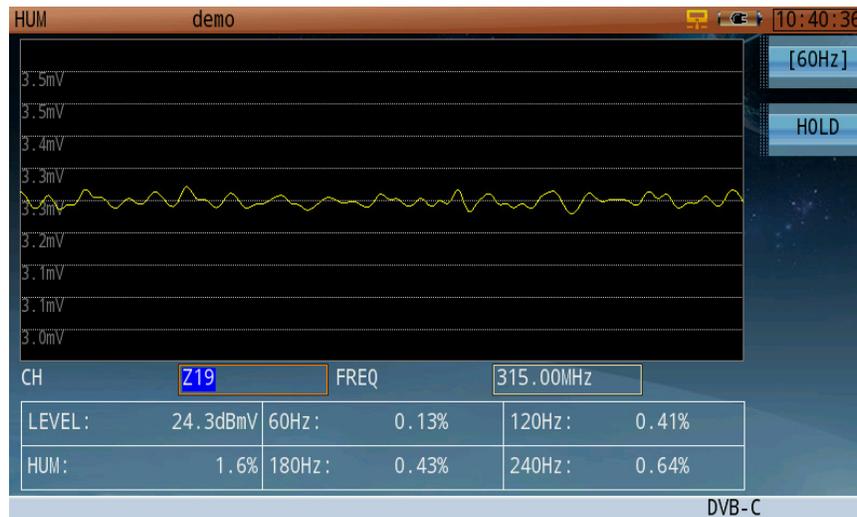
FM Frequency Deviation- Loop Count = 20

Press **Listen** (F1) to toggle audio playback. (Press **Volume** (F2) to toggle the volume control on and off.) Use the Channel and Audio Freq fields to search within the FM band. As soon as "Listen" is toggled off again,, FM Deviation will automatically restart.

Loop Count determines the frequency with which the maximum positive and negative frequency deviation traces will be recorded on the screen: if set to 20, the traces will be recorded every 20 loops and the peak hold trace will refresh. The peak / current FM Deviation readings are displayed as overlapping red and green bars below the measurement trace.

5-4 HUM Modulation

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 DS2831 measures the effects of this interference on analog and digital channels. The analog measurement screen is shown below.



Digital TV Hum Measurement

5-4.1 Settings

Channel: The channel to measure. Select any active analog or digital channel in the active channel plan.
 Frequency: Input range 5-1200 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.

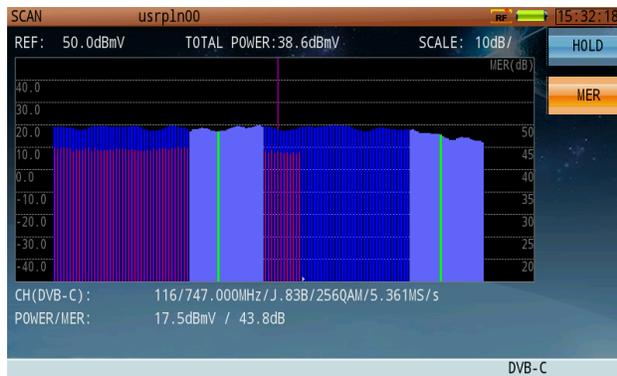
On the DS2831, the highest measurable fourth harmonic is:

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

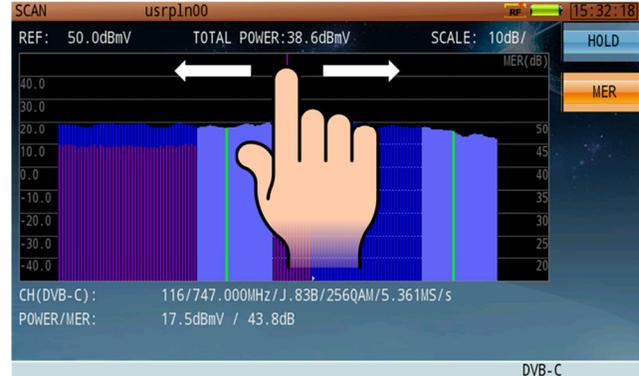
5-5 Channel Scan

The DS2831 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.

Using the touchscreen, move the vertical slider to select a channel to measure.



Channel Scan Identifies OFDM Signals



Channel Scan Touchscreen Controls

5-5.1 Settings

Button Operation

- [HOLD] Pauses the measurement. Press again to resume.
- [MER] Performs a quick MER scan of all digital channels present. Note that the unit must be connected with a valid active channel plan that includes digital signals. MER readings will appear as red bars.

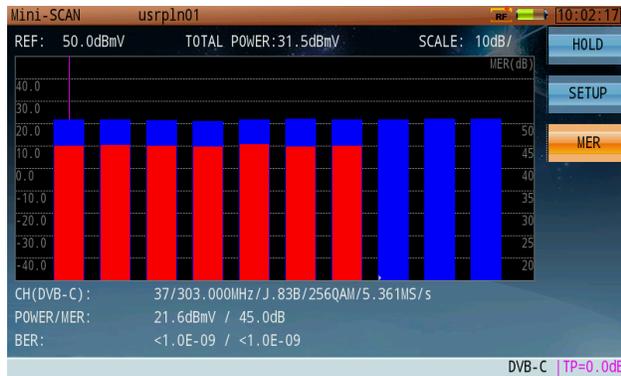
Test Results

- Total Power: The total power level measured over a specified bandwidth.
- Level/Power: Measurement results of a specified channel. The DS2831 measures the sync pulse of an analog video carrier for analog channels, and channel power over the specified bandwidth for digital channels.

5-6 Mini-Scan

An alternative channel scan function, the Mini-Scan, is included in new DS2831 models. Where the standard channel scan looks at all channels in the active plan, Mini-Scan allows the user to examine up to 16 select channels of special interest. When launching this mode, you must select 2 or more channels from the active channel plan to measure.

You can perform a mini-scan in two ways: normal mode and fast mode. Normal mode measures both the MER value and average power of a digital channel, while fast mode measures only average power.



Mini-Scan



Channel Setup

5-7 Downstream Passive Sweep

Use Passive Sweep mode to save spectrum data as a reference trace for later comparison. Up to 8 trace records can be saved to the DS2831 as reference traces. This feature is primarily used when an active sweep reference generator is not in use at the HE or hub. Press **Start** (F1) to begin the measurement.

When a reference trace has been saved by pressing **Save Ref** (F2), (it will appear at the top of the screen to indicate this), it can be compared to a live trace downstream from a location at which the live trace is being measured. Press **Load Ref** (F3) to open a list of reference traces saved to the internal hard drive. Use the rotary knob to select one.

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.

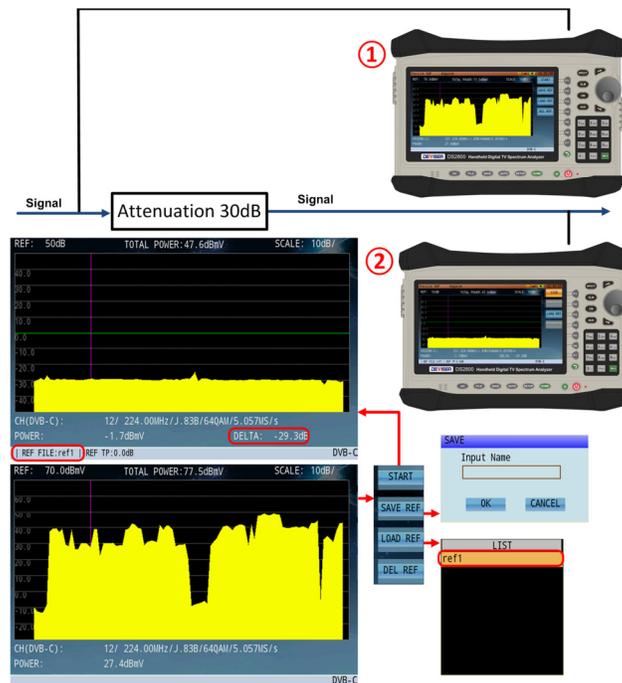
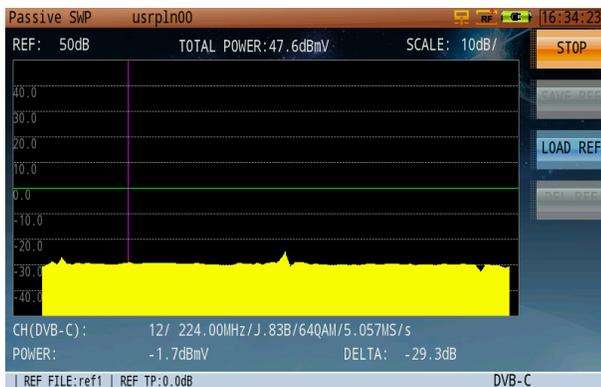


Diagram of Passive Sweep



As above, first connect the DS2831 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 save the trace result as a reference. Then switch the DS2831 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.

TIP: In Channel Scan, position the marker to a specific digital channel, then press the Aux (**AUX**) key to view the channel scan and QAM analysis side-by-side.

The DS2831 features two ways to sweep the reverse path. The first, "Active Reverse Sweep", works in concert with the Kingstone monitoring platform.

1. On the DS2831, set up measurement parameters for reverse path sweep.
2. Log in to the DS1610 "KingStone" to activate reverse path sweep.
3. View measurement traces simultaneously at the DS1610 (as it is viewed locally at the HE) and the DS2831 (as viewed in the field). Compare traces for level and Frequency Response delta.
4. Transmit the US sweep signal, store a reference, move to another location, and compare the stored reference with the live reference.
5. View sweep reference traces simultaneously with Spectrum Analyzer traces on the same screen.

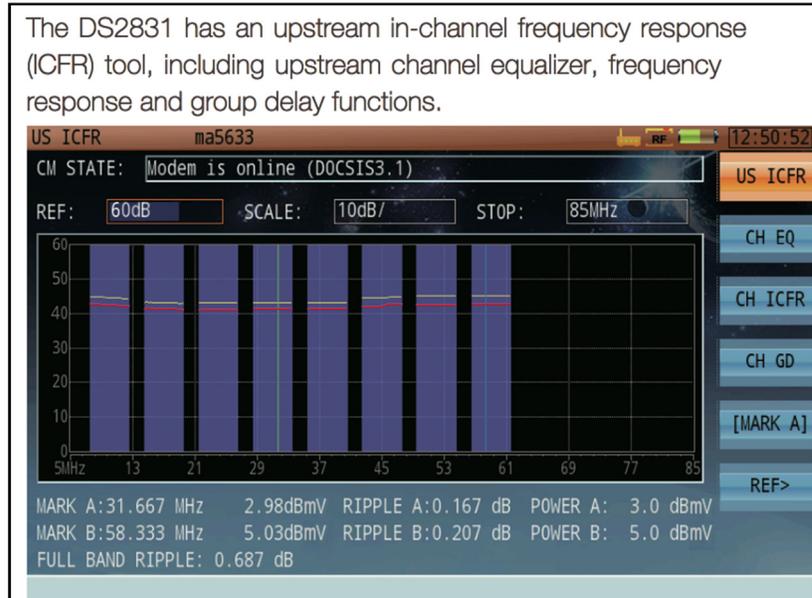
The image illustrates the configuration and execution of a reverse path sweep on the DS2831. The main interface shows a spectrum analyzer with parameters: START: 4.000MHz, STOP: 65.000MHz, RBW: 300kHz, DETECTOR: POS, REF: 10.0dBmV, SCALE: 10dB/, VBW: 300kHz, SWEEP: 500ms. The 'SETUP' menu is shown with parameters: PILOT FREQ: 5.00MHz, DOWN LINK FREQ: 105.00MHz, UP LINK FREQ: 65.00MHz, PILOT LEVEL: 35.0dBmV, IP COMPENSATION: 8.0dB, REVERSE SWEEP SLOPE: 5.0dB, and RESERVE SWEEP PORT: COM. The 'LIST' menu shows a table of sweep points:

NO.	FREQ	TX LEVEL
1	5.00 MHz	8.0dBmV
2	10.00 MHz	8.3dBmV
3	11.00 MHz	8.7dBmV
4	15.00 MHz	9.0dBmV
5	20.00 MHz	9.4dBmV
6	25.00 MHz	9.7dBmV
7	32.00 MHz	10.1dBmV
8	34.00 MHz	10.5dBmV

The 'LOAD REF' dialog shows a 'ref1' file. The main screen also displays 'Terminal' and 'Headend' traces, and a 'RF' label.

The second way to conduct reverse path sweep is with the **PNM method**, which relies on the US SC-QAM adaptive EQ power coefficients. This function provides much higher sweep resolution, with up to 24 sweep reference points in each of your 6.4MHz US channels (up to 8 US channels, and enables hi-res sweep traces up to 51.2MHz wide.

In the case below, the DS2831 would perform at 8 resolution points fewer than the 192 sweep resolution points in the Passive Sweep app offered with the DS2831.



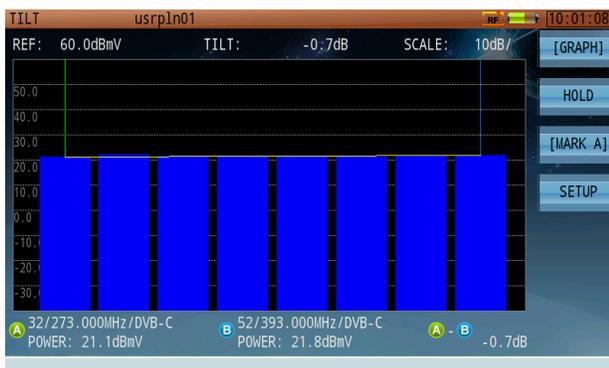
In addition to the Sweep reference function, this mode provides individual in-channel frequency response information, as well as Group Delay and Equalizer coefficients for each of the individual US channels.

5-8 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 channel plan. A minimum of 4 channels is required to begin measuring.

There are 2 markers in the tilt measurement screen. Press **Mark A** (F3) to activate MarkerA on the screen; press F3 again to activate **Mark B**. You may only control the marker that's currently active. When you move the marker over a channel using the arrow keys, its level and channel type are displayed.

The Tilt measurement has two different view modes: **Graph** and **List**. Press F1 to toggle between them.



Tilt Measurement – Graph Display



Tilt Measurement – Channel Listing Display

You can select the channels in your tilt plan from the tilt editing dialog (shown right). Choose 4-16 channels from the list of active channels in the active channel plan to perform a tilt measurement.

All active channels in the channel plan are listed and available in the tilt plan editing dialog.



5-8.1 Settings

Button Operation

- [Graph] / [List]: Toggles the measurement display between Graph and List mode.
- Hold: Pauses the measurement. Press again to resume.
- [MarkA] / [MarkB]: Toggles the active marker between A and B.
- 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 automatically organized by frequency from left to right. The tilt value ("A-B") is measured between Markers A & B. Analog channels measure the peak sync pulse of the video carrier, while digital channels measure average power.

Chapter 6: Analog Non-Linear Distortion Measurement

In this chapter, we discuss technical background and instructions for using the Analog Non-Linear Distortion function on the DS2831.

6-1 Carrier-to-Composite Noise Ratio

Before measuring CCN Ratio with your DS2831 analyzer, visit the channel plan editor (see Chapter 4: Channel Plans) to set up the video carrier frequency and noise bandwidth correction as necessary for your measurement. The noise bandwidth may differ depending on the channel bandwidth, which itself depends on your location: NA, EU, or another region. 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.

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



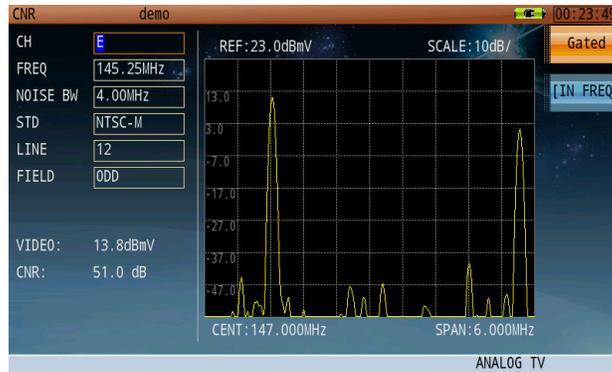
Typically, CCN measurements require that system engineers first measure the video carrier level (where the sync tip of the modulation is the absolute peak level); then remove the video modulation by shutting down the modulator - or simply remove the modulation from the carrier - to allow accurate noise 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 DS2831 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 DS2831 is equipped with triggering technology that accurately locks onto a specific VITS line and provides precise measurement results.



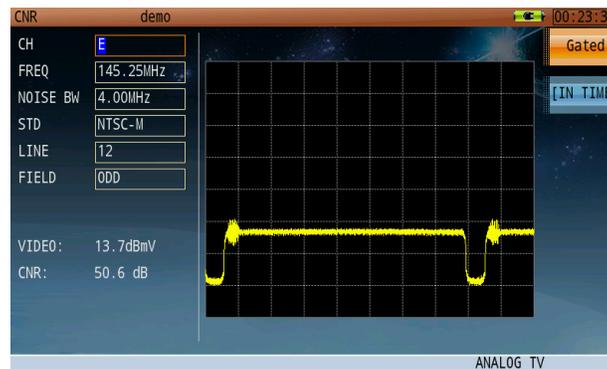
Gated CCN Measurement – Frequency Domain Waveform

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 4-2.)

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



Gated CCN Measurement – Time Domain Waveform

6-2 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 ± 0.75 MHz and ± 1.25 MHz from the video carrier. In a PAL-D system, the CSO production falls ± 0.25 MHz and ± 1.25 MHz from the carrier.

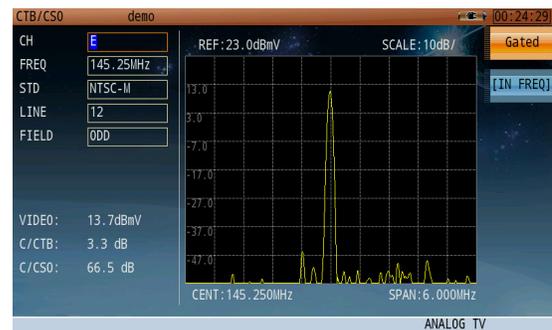
When we measure CSO and CTB, the test results are in terms of C/CSO and C/CTB. In the gated mode, the DS2831 will first measure absolute carrier level, then trigger the appropriate VITS line # (preset for each channel - can be set in the channel plan editor) to measure noise.

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 DS2831 is equipped with triggering technology that accurately locks onto a specific VITS line and provides precise measurement results.

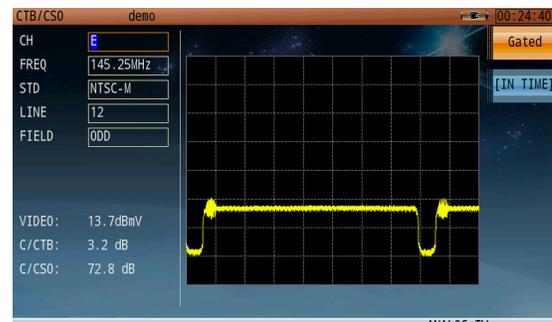


CSO/CTB Measurement



Gated CSO/CTB Measurement – Frequency Domain Waveform

NOTE: Using such line-removing/inserter equipment for CTB measurements will cause a slightly audible "flicking" noise in your television set 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 CSO/CTB Measurement – Time Domain Waveform

Chapter 7: Analog TV Video

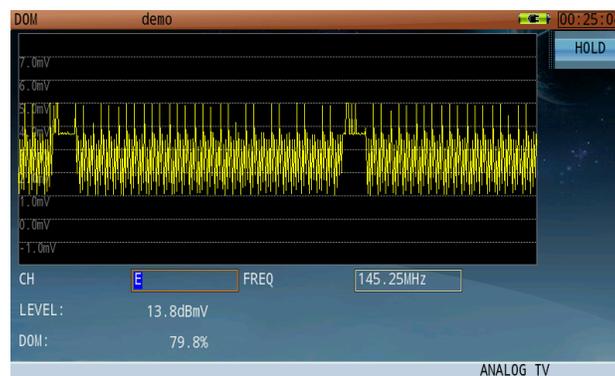
Analog TV video measurements required by the FCC include: Depth of Modulation, In-Channel Frequency Response, Differential Gain, Differential Phase, and Chrominance-Luminance Delay Inequality. To make these measurements in the gated mode, you must use a VITS inserter to insert the various test signals needed for specific measurements.

You may find that those test signals are already part of the video feed provided by the broadcaster. Still, it is highly recommended to perform your own VITS signal insertion. The reasons for this are twofold: first, to maximize accuracy; and second, to ensure that your results are not hindered by the possible lower-quality feed from the broadcaster.

7-1 Depth of Modulation (DOM)

From the Channel Measurement application (**SLM**), press **DOM** (F2) to enter the Depth of Modulation menu. 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.



Depth of Modulation Measurement

7-2 In-Channel Frequency Response

In-channel frequency response (ICFR) is used to measure the amplitude response flatness of a channel, anywhere on the HFC network. The ICR measurement can be made with a vertical interval test signal (VITS). The DS2831 supports the following test signals:

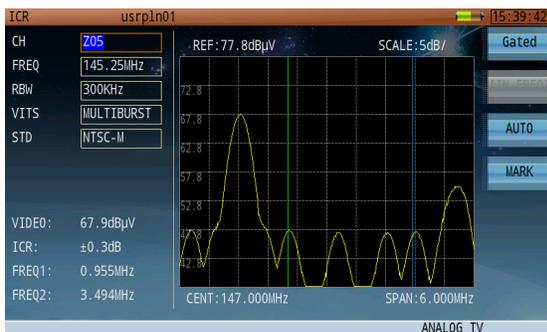
- Ghost Cancellation Reference (GCR)
- Multiburst

If using a GCR test signal, it is not necessary to set up the multiburst packet frequencies. But if using a cable multiburst, make sure that the analyzer multiburst packet frequencies match the test signal frequencies. (You can preset these settings in the channel plan editor; see Section 4-2.) Failure to set up the multiburst packet frequencies may produce faulty measurement results, as the DS2831 does not scan automatically for these frequencies.

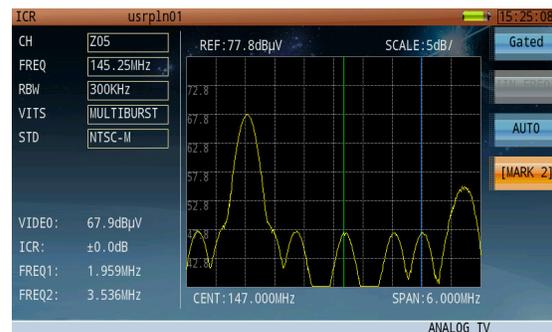
A typical multiburst signal includes six discrete frequencies in TV signal video bandwidth. These frequencies differ between PAL-D and NTSC-M standards:

- PAL-D: 500kHz, 1.0MHz, 2.0MHz, 4.0MHz, 4.8MHz, 5.8MHz
- NTSC-M: 500kHz, 1.0MHz, 2.0MHz, 3.0MHz, 3.58MHz, 4.2MHz

Press the **ICR** function key to enter the ICR menu. The default ICR measurement mode is in frequency domain, gated mode off (inactive). If a VITS signal is present in the baseband input signal (full field), users can use the frequency domain mode to measure ICR. Press **Gated** (F1) to toggle the gated mode ON/OFF.



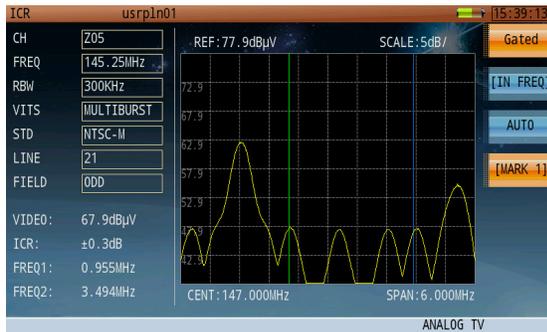
ICR – Full Field Multiburst Signal



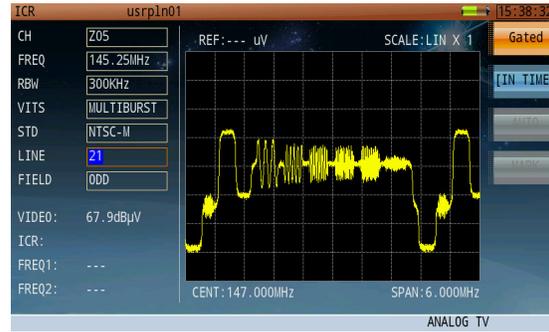
ICR – Marker Operation

Markers can be used in either auto or manual mode. Toggle between them by pressing **Auto** (F3). In Auto mode, the DS2831 will automatically detect the higher and lower levels and display measurement results. In manual mode, the **Mark** function (F4) is now enabled. Pressing the F4 repeatedly to cycle between Marker 1 and Marker 2. Use the rotary knob to move the marker to the desired frequency.

In gated mode, two interfaces are available: frequency domain and time domain. Press **In Freq/In Time** (F2) to toggle between them.



Gated ICR– Frequency Domain Waveform



Gated ICR–Time Domain Waveform

In the time domain interface, the user can view the VITS signal waveform.

Note that the resolution bandwidth filter (RBW) can be changed to obtain better measurement results.

7-2.1 Settings

The ICR function allows you to change the following settings. Possible values are listed when applicable.

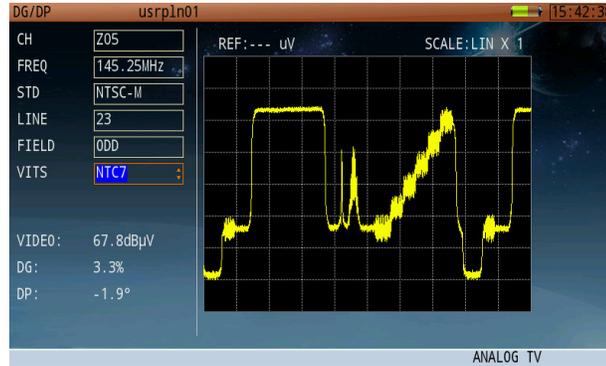
RBW: 100kHz, 300kHz
 VITS signal type: Multiburst, GCR
 Supported TV standards:

System and TV standard	Line/Frame	Field frequency	Color encoding
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

7-3 Differential Gain and Differential Phase

From the Channel Measurement application, press **DG/DP** to open the Differential Gain / Differential Phase measurement menu.



Differential Gain and Differential Phase are defined as variations of the amplitude and phase of a Color Sub-carrier superimposed on a luminance signal of varying IRE. Common practice is to use a luminance variation in a staircase (5 or 10 stairs), or a continuous ramp above the 0 IRE and reaching 90 IRE.

The measurement of Diff Gain & Phase is based on variations of the demodulated color sub-carrier that is the Color Vector. The amplitude and phase of the Color Vector is measured at each step, and the peak-to-peak variation is termed the Differential Gain & Phase.

Modern signal processing enables users to position the sample locations on the test signal, while providing measurement averaging and calculating the Peak-to-peak variations & acceptance limits comparison.

A Note About the IRE

The IRE is a unit equal to 1/140 of the peak-to-peak amplitude of the video signals – typically 1 volt. The 0 IRE point is at blanking level, with sync tip at -40 IRE and white extending to +100 IRE. IRE stands for Institute of Radio Engineers, the organization that defined the unit.

7-3.1 Settings

The DG/DP function allows you to change the following settings. Possible values are listed when applicable.

VITS signal:

Per frame 525 lines system, the VITS signal is: **FCC and NTC-7**

Per frame 625 lines system, the VITS signal is: **CCIR330, UK ITS, GB19**

The above VITS signals include the modulated staircase signal superimposed over the color subcarrier. (Detailed VITS signal information is documented in Section 25-3 of this User Guide.)

TV Standard and System	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

7-4 Chrominance to Luminance Delay Inequality

Chrominance and luminance are measured together with the 12.5T test signal. The Chrominance to Luminance Delay measurement is required by the FCC because a large delay displaces the color vs luminance, degrading the edges in the picture. Error in gain, meanwhile, merely changes color saturation.

The 12.5T signal is the sum of a low frequency pulse (also sine²) and a burst of color sub-carrier modulated with an envelope that is exactly the same as the low frequency pulse. The burst is then shifted up such that the bottom is now flat. Gain or delay errors will distort the flat bottom. Gain smaller than 1 forces the bottom up, while gain larger than 1 lowers it. Chroma delay creates an "S" shape on the bottom, which is inverted when the delay is negative. The analysis of the 12.5T is a measurement of the normalized distortion of that bottom: ratio and peak-to-peak values of the peak and valley.

When the test signal was first developed, engineers used charts to visually calculate Y to C delay and gain. Now, automated measurements perform the same task by analyzing the envelope of the signal. For analog TV channels, press **CLDI** to enter the Chrominance-Luminance Delay Inequality menu.



7-4.1 Settings

The DG/DP function allows you to change the following settings. Possible values are listed when applicable.

Chrominance pulse values required for various combination test signals:

CCIR17: 20T	UK-ITS: 10T
NTC7: 12.5T	GB19: 10T

VITS signal:

For per frame 525 lines system, VITS signal: FCC and NTC-7

For per frame 625 lines system, VITS signal: CCIR17, UK ITS, GB19

(Detailed VITS signal information is documented in Section 25-3 of this User Guide.)

TV 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

Chapter 8: Digital Signal Measurement

DVB-C QAM analysis functions include the following channel measurements:

- Constellation diagram
- Channel power
- Equalizer coefficient display and distance to fault
- In-band frequency response
- In-band group delay
- MER & BER statistics analysis
- EVS (Error vector spectrum)
- Simultaneous spectrum & channel scan
- Digital channel SNR
- Digital Hum

Parameter Settings

The DS2831's DVB-C analysis function is fully automated, except for a few simple parameters like frequency. All other parameters are acquired automatically (but may still be manually adjusted at the user's wish).

Adjustable parameters and range of the DVB-C function of the DS2831 are as follows.

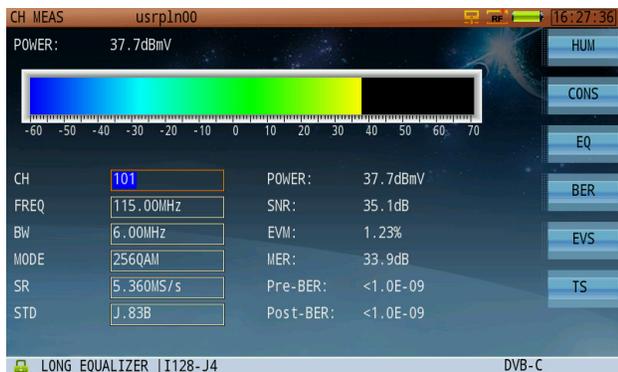
Parameter	Key	Value Range	
Channel number	CH	All active channels in the active channel plan	
Center frequency	FREQ	5~1200 MHz	
Channel bandwidth	BW	1~50 MHz	
Modulation mode	MODE	J.83A / C:	16 / 32 / 64 / 128 / 256 QAM
		J.83B:	64 / 256 QAM
Symbol Rate (MS/s)	SR	J.83A / B / C:	4~7 MS/s, self-adaptive
		J.83D:	Fixed at 10.762 MS/s
DVB-C Standard	STD	J.83A, B, & C, self-adaptive (<i>J.83D by option only</i>)	
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

8-1 DVB-C Measurement

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



Use the rotary knob 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.

Note:
When switching to a different channel, the DS2831 will automatically run a channel-locking sequence. This refreshes the parameter list and test results.

8-1.1 Settings

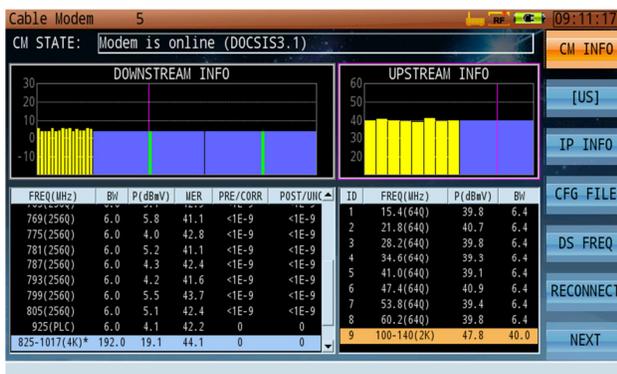
Button Operation

- HUM Opens Digital HUM function.
- CONS Opens Constellation diagram function.
- BER Opens BER & MER statistics diagram function.
- EQU Opens Equalizer coefficient & in-band response function.
- EVS Opens EVS function.
- TS MEAS Opens MPEG-2 TS analysis function.

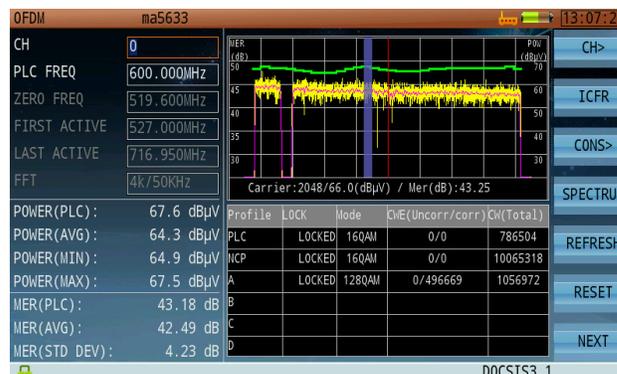
8-2 OFDM

The DS2831's DOCSIS 3.1 cable modem includes upstream and downstream OFDM functionality. OFDM (Orthogonal Frequency Division Multiplexing) distributes a signal among multiple subcarriers, optimizing overall speed and mitigating the effect of impairments that may affect some but not all subcarriers.

OFDM subcarriers may be either 25 or 50kHz, while bonded channels may be as wide as 192 MHz for downstream transmissions and 48 or 96 MHz for upstream transmissions.



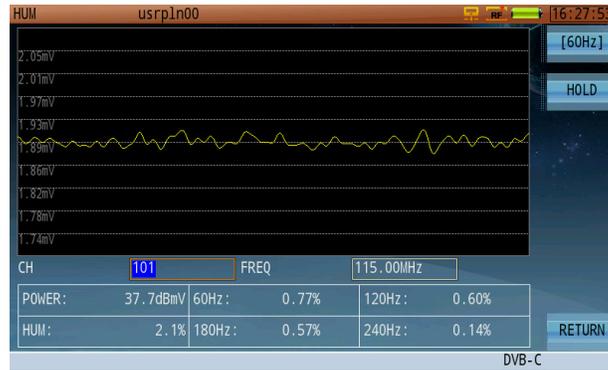
DOCSIS 3.1 DS/US OFDM Demodulation



EVS Captures Interference Under OFDM Carriers

8-3 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 DS2831 supports hum modulation measurements for digital channels. The measurement interface is shown below.



8-3.1 Settings

Channel The channel to measure. You can select any active channel in the active channel plan.
 Frequency Input range 5-1200 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 DS2831 can measure the following low-frequency interference and interference harmonics:

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

8-4 Constellation Diagram

From the main measurement menu (**Home**), use the rotary knob to select the Constellation application. The DVB-C constellation diagram function interface is shown to the right.

Press the **Next** function key to open the constellation diagram menu. Here, you can refresh and zoom the constellation. To zoom in, first press **Select** to select one quadrant to view. After choosing the quadrant, press **Zoom IN**. The selected quadrant will expand to fully occupy the screen. (See below.)



Constellation Zoom – Select a Quadrant



Constellation Zoom – Zoom In & Zoom Out

Use the rotary knob 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.

8-4.1 Settings:

Button Operation

Measure:	Opens the channel measurement function.
Equalizer:	Opens the Equalizer coefficient & in-band response function.
BER Statistics:	Opens the MER & BER statistics diagram function.
EVS:	Opens the EVS function.
HUM:	Opens the digital HUM function.
TS Measurement:	Opens the MPEG-2 TS analysis.
Next:	Switch to next page of the menu.
Refresh:	Clear the current constellation diagram and refresh.
Select:	Select a quadrant to focus on.
Zoom In/Out:	Zoom in on the selected quadrant. Press again to zoom out to the original display.
Previous:	Switch to previous page of the menu.

8-5 MER & BER Statistics Graph

The DVB-C MER & BER statistics function, shown below, provides analysis over time.



BER & MER Statistical Graph



BER & MER Statistical History Record

The statistics interface is divided into two parts: a statistical graph of change over time, and a summary of current measurement settings. The graph displays Pre-BER in yellow and Post-BER in red (per the reference scale on the left). MER is displayed by the blue line and referenced to the scale on the right.

Two bar graphs appear under the statistical curve: ES (Errored Seconds) and SES (Severely-Errored Seconds). When Pre-BER measures worse than $1.0E-09$, the ES bar records and displays yellow lines. When Post-BER measures worse than $1.0E-03$, the SES bar records and displays red lines.

Press **Time** (F1) to set the recording duration from 1 min to 48 hrs. in 1-sec. intervals (see right). Note that an errored second (ES) is one in which 1 bit error occurs within 1s. A severely errored second (SES) is one in which the error rate is equal to or worse than $10E-3$.



8-5.1 Settings

NOTE: the parameters listed below the graphical interface cannot be edited directly. For any modifications, press the **CH** key below the display to open the Channel Plan Editor. (See Chapter 4 for more details.)

MER:	Modulation error ratio.
PRE-/POST-BER:	Bit error rate before / after error correction.
ES:	Errored second. If one or more correctable or uncorrectable bit errors occurs in a one-second time window, the ES increases by 1.
SES:	Severely-errored second. If the number of uncorrectable bit errors divided by the total number of transmitted bits is equal or more than $1.0E-3$, then the SES increases by 1.
TIME:	Duration of the test.
COR / UNCOR:	Total number of corrected / uncorrected bit errors.
SUM:	Total number of received bits.
Pre-BER (SUM):	The bit error rate before total error correction. Pre-BER (SUM) = (COR+UNCOR)/SUM.
Post-BER (SUM):	The bit error rate after total error correction. Post-BER (SUM) = UNCOR/SUM.

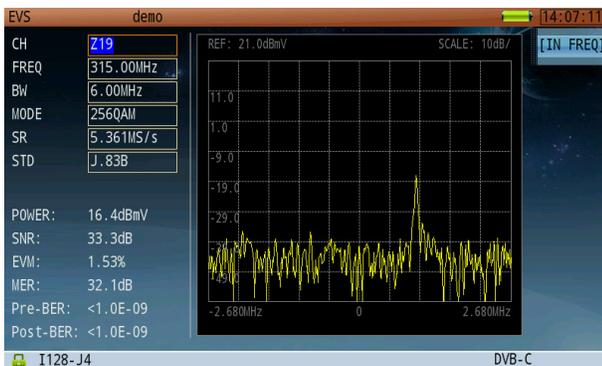
Button Operation

Time:	Set the duration of the test.
Start:	Start/end the test.

8-6 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



Error Vector Spectrum – Time Domain

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 DS2831 uses the EVS time-domain function to display LTE sub-frames coming in every 1ms (above, right).

8-7 Adaptive Equalizer, Frequency Response, and Group Delay

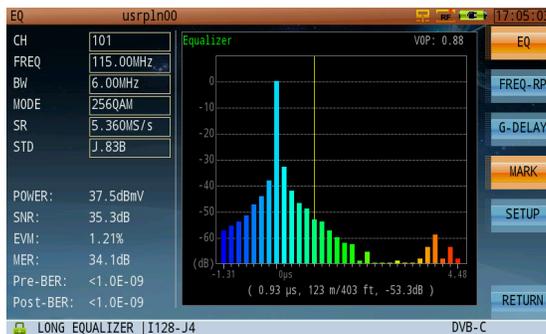
A digital equalizer is an adaptive filter that "optimizes" the received signal – in this case, a MER signal – before demodulation. Equalizers were originally used to minimize inter-symbol interference, the residual effects of one symbol on its neighbors as caused by filters in the communication channel and reflections. Digital equalizers are filters whose amplitude and phase responses are the inverse of the communication channel's, such that the overall response restores the original signal.

Although impairments may be linear or non-linear, digital adaptive equalization will compensate only for linear distortions. These are caused by the distortion of the signal by the transmission channel. Examples include frequency response, group delay, micro-reflections, phase noise, etc. These distortions qualify as linear distortions as they apply *linearly*, or equally, to the whole signal. Non-linear impairments don't apply equally to all symbols.

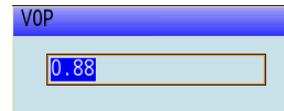
Equalizer filters add a little of the values of all the other stages to the main tap. The filter is adaptive, so it adjusts the multiplying coefficient of the stages in order to optimize the MER. The mechanism of control slightly modifies the coefficients for each stage in order to decide if the modification improves or degrades the MER. If the complex coefficients of the filter are known, it is possible to calculate the power contribution from each stage. So each stage's power contribution corresponds to the power of correction of the linear distortion. The nonlinear power of distortion (obtained from MER after equalization) added to the linear power of distortion (obtained from equalizer coefficients) gives us a total power of distortion corresponding to an MER without equalization.

Why expend so much effort for such a small difference? Even a very small improvement in MER is sufficient to reduce the error rate (BER) by several orders of magnitude.

Another benefit of the digital adaptive equalizer is its ability to use reflections (impedance mismatch) to help determine the location of faults. When you turn the rotary knob on the equalizer display interface, moving the marker on different tap, the bottom of the graph displays additional details such as time (of the selected tap away from the main tap); distance (feet or meters); and the relative amplitude level of that tap. When looking for reflections, you can see in the adaptive EQ graph that one or several taps exceed the amplitude of all the others. Move the marker to that tap position to measure an approximate distance to the fault.



Adaptive Equalizer Analysis



Velocity of Propagation

8-7.1 Frequency Response Function

The frequency response menu is used to measure in-band flatness of the selected channel. There are two horizontal markers which will detect min/max automatically and provide you with flatness information in dB displayed at the top right corner of the graph. A vertical marker is available for frequency and amplitude information at every point of the curve; turning the rotary knob will provide this information at different frequencies. The data is displayed at the bottom of the screen.

In this mode, if there is an impedance mismatch somewhere downstream of the measurement location, the DS2831 will display "standing waves" in the frequency response trace. You can determine the approximate distance to the fault or impedance mismatch by using the following formula:

$$D = 492(VP/F)$$

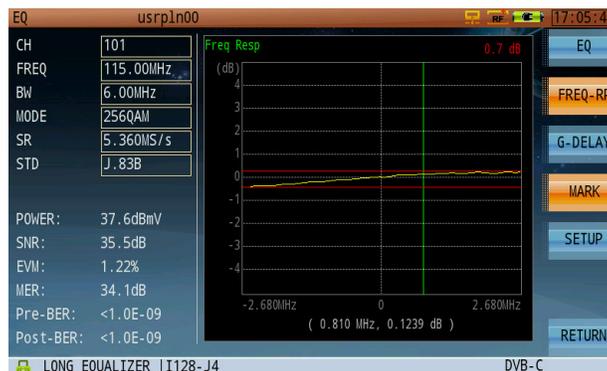
D = distance in feet to the impedance mismatch

VP = coaxial cable's velocity of propagation (generally 87% or 0.87)

F = frequency in MHz separating each standing wave ripple—that is, the bandwidth spanned by one cycle of the standing wave

For example, assume a standing wave is visible in the sweep receiver's frequency response display, and there is 0.4 MHz from the peak of one ripple to the next. If the feeder cable VP is 87% (0.87), then the distance to the fault is just under 1100 feet.

$$D = 492(0.87/0.4) \quad D = 492(2.18) \quad D = 1070 \text{ feet}$$

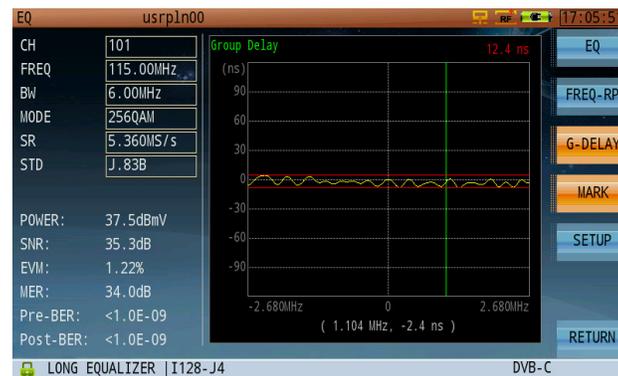


In-Band Frequency Response Analysis

8-7.2 Group Delay Analysis

The group delay function is primarily used to verify flatness of the usable frequency band close to filter rolloffs, typically on the upper side of a reverse diplex filter (42MHz in US, 55MHz in Japan, 65MHz in Europe, but soon to be considered at 85MHz or even 200MHz when entering an extended D3.0 or D3.1 network environment). This is especially true when more than one active is in cascade, and would potentially make the rolloff curve worse. DOCSIS does specify a theoretical maximum group delay of 200ns / MHz, but using 75ns/MHz or less is recommended for best results.

There are two horizontal markers available automatically detecting min/max delay. The differential value is displayed at the top right corner of the graph. A vertical marker is available to measure frequency and time delay value at every point of the curve by rotating the rotary knob. The data is displayed at the bottom of the screen.



Group Delay Analysis

Button Operation

Equalizer:	Display the equalizer coefficient.
Freq Response:	Display the in-band frequency response.
Group Delay:	Display group delay information.
Marker:	Control manual marker operation.

Chapter 9: Transport Stream Analysis

The Transport Stream (TS) analysis function supports DVB & ATSC standard real-time TS analysis. Functions include:

- Basic Information
- TR 101 290 Priority 1, 2 and 3 Tests
- PID Viewer
- Program Information
- PCR Analysis
- Program List
- PSI/SI
- Data Capture

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

9-1 Transport Stream Real-time Analysis

This function parses the information from audio and video ES. It supports MPEG-1/2/4, H.264 video format and MPEG-1/2/4, AAC audio format. Up to two sets of audio information can be displayed.

It lists all programs' SID, Service Name, CA, provider, service type, video PID, video type, Audio1 PID, Audio2 PID, Audio type in the top pane.

The bottom pane displays video/audio information of the 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 parameters may be different according to the audio/video format (below, left) If the parameter is not parsed or the program is an encrypted program, '---' will be displayed (below, right). If the program has no video information, the message "No PAT" will appear.

SID	SER Name	CA	PROV	SER TYPE	VideoPID	VideoType	Audio1	Audio2	AudioType
49	-- QAM 2/1	DSNET	DIG TV	850	MPEG2 Video	85			
50	-- QAM 2/1	DSNET	DIG TV	866	MPEG2 Video	86			
52	-- QAM 2/1	DSNET	DIG TV	897	MPEG2 Video	89			
55	-- QAM 2/1	DSNET	DIG TV	945	MPEG2 Video	94			
57	-- QAM 2/1	DSNET	DIG TV	977	MPEG2 Video	97			

VIDEO	INFO	AUDIO1	INFO1	AUDIO2	INFO2
PID	850	PID	851	PID	---
Resolution	720*480	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	---

Transport Stream: Real-Time Analysis

SID	SER Name	CA	PROV	SER TYPE	VideoPID	VideoType	Audio1	Audio2	AudioType
22213	Local	TJBTN	DIG TV	421	MPEG2 Video	42			
22216	New3	TJBTN	DIG TV	451	MPEG2 Video	45			
22214	New5	TJBTN	DIG TV	431	MPEG2 Video	43			
22217	New7	TJBTN	DIG TV	461	MPEG2 Video	46			
22228	tese	TJBTN	DIG TV	441	MPEG2 Video	44			

VIDEO	INFO	AUDIO1	INFO1	AUDIO2	INFO2
PID	421	PID	422	PID	---
Resolution	---	Mode	---	Mode	---
Frames	---	Layer	---	Layer	---
BitRate	---	BitRate	---	BitRate	---
Profile	---	Sampling	---	Sampling	---
Level	---	Profile	---	Profile	---
Aspect	---	CH CONF	---	CH CONF	---
Chroma	---	Emphasis	---	Emphasis	---

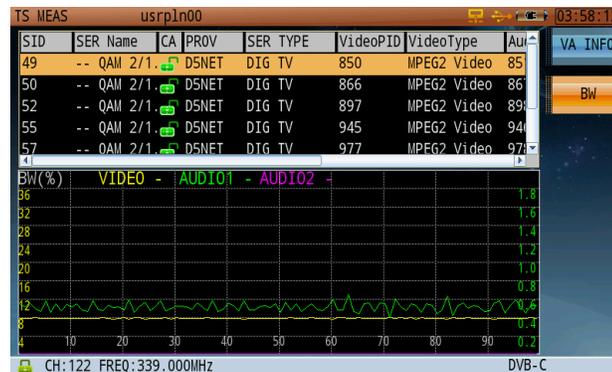
Encrypted Program Information

9-1.1 Settings

- SID: The program number in decimal or hexadecimal according to the Setup.
- Service Name: The service name of the program. '---' is displayed if the description doesn't exist.
- CA: stands for not encrypted, and stands for encrypted.
- Provider: The provider of the program. '---' is displayed if the description doesn't exist.
- 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. '---' is displayed if video information is not available.
- Audio PID1: The first audio PID of the selected program.
- Audio PID2: The second audio PID of the selected program.
- Audio Type: The audio type of the program, e.g. MPEG2 Audio.

Program information is displayed at the bottom of the screen.

The real-time analysis option offers two submenus: video/audio information and bandwidth. Bandwidth shows the selected program's bandwidth information in the highlighted program list. The yellow curve is the video BW rate curve (if video information is included in the program). The green and purple curves are the first and second audio BW curves (if audio information is included). The horizontal coordinate describes the percentage of the current over a period of time. The vertical coordinates on the left and right respectively describe the percentage of the video bandwidth and audio bandwidth in the program. If the program is not a digital TV program, no curve will be displayed.



Occupied Bandwidth Analysis

9-2 Basic Information



Transport Stream Basic Information

This screen displays basic information for the transport stream.

- TS RATE:** Shows the stream's transport rate in a second (Mb/s). The DS2831 displays ; Min, Max, Avg and Current TS rate of the last second interval.
- 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 (example: data or encryption information).
- OTHER INFO:** Describes miscellaneous information of the stream.
- LENGTH:** The length of the packets in bytes, there are 188 bytes and/or 204 bytes type in any given transport stream structure.
- PROG COUNT:** Shows the total number of programs.
- TS ID:** Different channels have different TS ID, this indicates the number of IDs (or channels).
- PID COUNT:** The sum of PIDs of a stream.
- NET ID:** The PID of NIT indicated by PAT, if not indicated, '---' is displayed.
- NET NAME:** The provider (Operator) name, '---' is displayed if it is not provided in the steam.

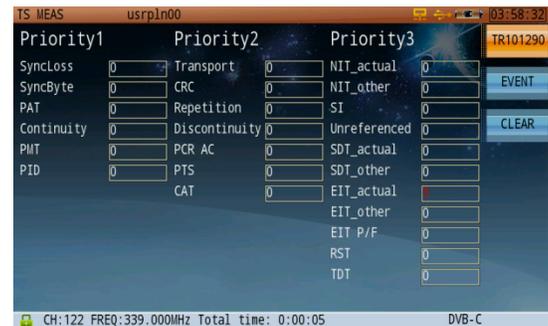
9-3 TR 101 290 Priority 1, 2 and 3 Tests

The DVB group has established a battery of recommended measurements to perform on transport streams, set forth in the ETSI TR101290 document. 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 DS2831's TS analysis does not include buffer-test-related parameters.

9-3.1 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, 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 can decode no programs.
A PAT error occurs when: 1.- the PAT is missing, 2.- the repetition rate is greater than 500 ms, 3.- the PAT is scrambled or 4.- 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. It is the purpose of this counter to enable one to 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, or
- If 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 referred to 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,
- 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 to 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 will be unable to access the corresponding elementary stream.

A "PID_error" occurs when

- Transport stream packets with a PID referred to in a PMT but not contained in the transport stream or
- Their repetition rate exceeds a user-definable limit which is usually 500 ms or less.

9-3.2 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 wrong checksum which 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, previously a max of 40ms was recommended.

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.

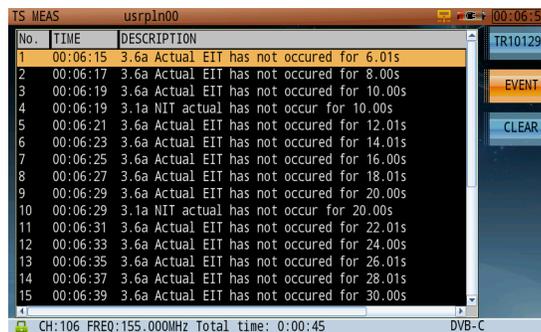
- (4) PCR_discontinuity_indicator_error: The PCR_discontinuity_indicator_error is set in the case that a discontinuity of the PCR values occurs and has not been signalled appropriately by the discontinuity indicator.
- (5) PCR_accuracy_error: If the PCR jitter exceeds ± 500 ns, a PCR_accuracy_error will be set.
- (6) PTS_error: The spacing between two PTS values must not be greater than 700 ms to avoid a PTS error.
- (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, 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.

9-3.3 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 Network Information Tables (NIT) can 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 EIT_PF_error should be indicated.
- (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.

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



TR 101 290 Priority 1, 2 and 3 Tests Event List

TR 101 290 Priority 1, 2 and 3 Tests Event List describes the detailed information for every event, including the number, record time and error detailed information.

9-4 PID Viewer

Describes the information with section, simplified info, value(%), PID and the CR of every PID of the stream.



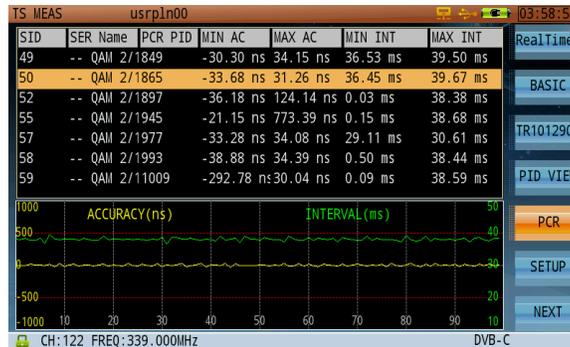
PID View

- 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.

9-5 PCR Analysis

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



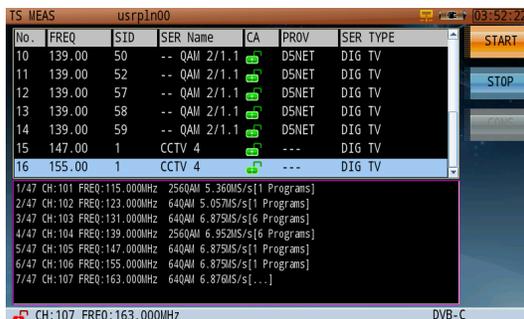
PCR Accuracy and PCR Interval Analysis

As shown above, 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 the PCR doesn't exist, '---' 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 half of the screen. PCR accuracy and PCR interval traces display in the same area. The left vertical coordinates shows PCR accuracy coordinates in ns. The right vertical coordinates shows PCR interval coordinates in ms. Two red lines show the PCR accuracy limits. PCR accuracy of the selected program should be within ±500 ns, and PCR interval between 0~40 ms.

9-6 Program List

Lists program information in ascending order of frequency in the current transport network. Available 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, so 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 because they acquire the CA value differently. The CA of this subfunction is retrieved from TS directly. Users can quickly find the corresponding channel frequency program. When troubleshooting, the field engineer can more easily identify which QAM carrier to focus on based on the particular program complaint from the customer.



Creating Program List



Complete Creating Program List

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. The old program list will be replaced by the stored program list, even if the new list has not yet completed initialization.

9-7 PSI/SI Table Analysis

The “Program Specific Information” (PSI) has exactly the same structure. 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 and private sections. Non-private sections are defined in the original MPEG-2 Systems Standard. All others are by default private. The non-private sections include the PSI tables and 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 of which a table is made of.

PAT	Program Association Table	MPEG-2 PSI Program Specific Information
PMT's	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	

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. They are the following tables:

DS2831 PSI/SI analysis includes PAT, PMT, CAT, NIT Actual, SDT Actual, EIT Actual, and TDT.

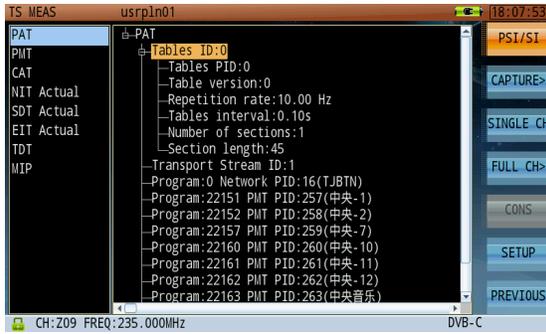
The following screenshots highlight more detailed analysis information. On the left side, use the arrow keys to move the cursor within a table, then press the rotary knob to make your selection. The cursor will then move to the right side of the screen, where the user can then turn the rotary knob to move on to a different level on the table.

Service Information Allocation

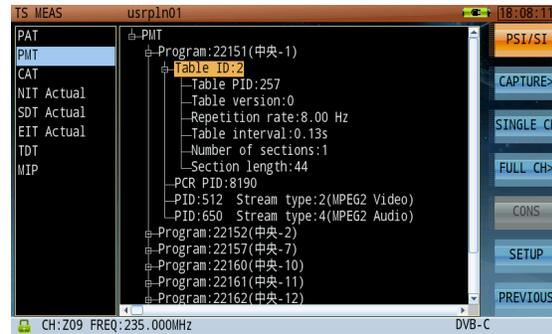
Table	PID Value	PID Decimalism Value
PAT	0x0000	0
CAT	0x0001	1
TSTD	0x0002	2
NIT	0x0010	16
SDT,BAT,ST	0x0011	17
EIT,ST	0x0012	18
RST,ST	0x0013	19
TDT,TOT,ST	0x0014	20
DIT	0x001E	30
SIT	0x001F	31

PIDs and table IDs of the PSI/SI tables

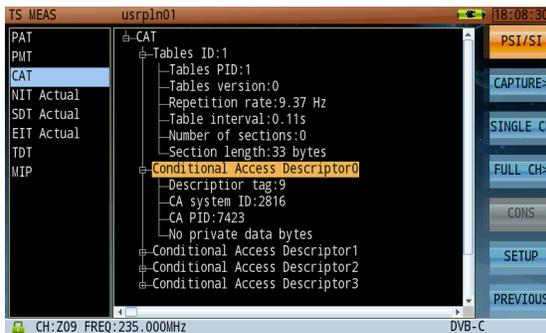
Table	PID	Table_ID
PAT	0x0000	0x00
PMT	0x0020...0x1FFE	0x02
CAT	0x0001	0x01
NIT	0x0010	0x40...0x41
BAT	0x0011	0x4A
SDT	0x0011	0x42, 0x46
EIT	0x0012	0x4E...0x6F
RST	0x0013	0x71
TDT	0x0014	0x70
TOT	0x0014	0x73
ST	0x0010...0x0014	0x72



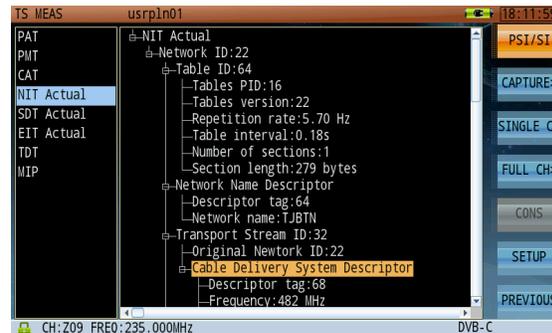
PSI/SI Analysis-PAT Table



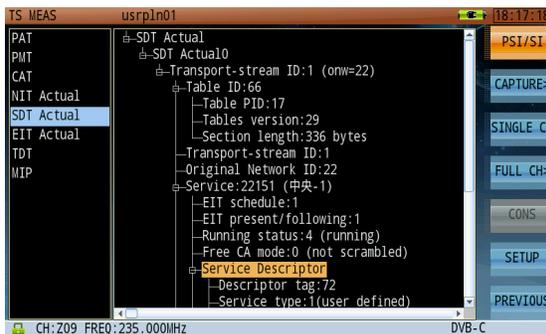
PSI/SI Analysis-PMT Table



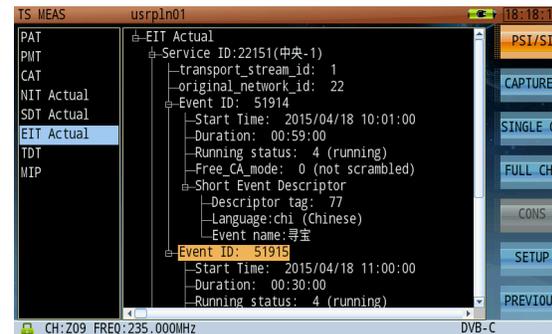
PSI/SI Analysis-CAT Table



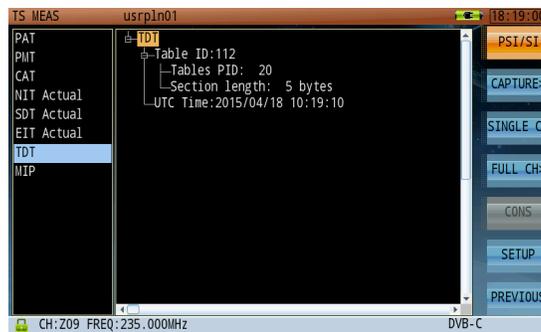
PSI/SI Analysis-NIT Table



PSI/SI Analysis-SDT Table



PSI/SI Analysis-EIT Table



PSI/SI Analysis-TDT Table

9-8 PSI/PSIP Table Analysis

Like the SI tables, DVB & ATSC also provide PSIP (Program and System Information Protocol) tables.

PSIP stands for "program and system information protocol" and represents a similar store of information 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 Master Guide Table, contains the PIDs for some of these ATSC tables. The Master Guide Table can be recognized by the packet ID = 0x1FFB and the table ID = 0xC7. The transport stream must contain at least four Event Information Tables (EIT-0, EIT-1, EIT-2, EIT-3) and the PIDs for these EITs are found in the Master Guide Table. Up to 128 further Event Information Tables are possible but also 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, Extended Text Tables may optionally be accessed through the MGT. Each existing Extended Text Table (ETT) is allocated to one EIT. Thus, e.g. ETT-0 contains extended text information for EIT-0. It is possible to have up to a total of 128 ETTs.

PSIP Table ID Ranges and Value

Table	PID	Table ID Value (hex)
Program Association Table (PAT)	0x0	0x0
Program Map Table (PMT)	per PAT	0x2
Conditional Access Table (CAT)	0x1	0x1
Master Guide Table (MGT)	0x1FFB	0xC7
Terrestrial Virtual Channel Table (TVCT)	0x1FFB	0xC8
Cable Virtual Channel Table (CVCT)	0x1FFB	0xC9
Rating Region Table (RRT)	0x1FFB	0xCA
Event Information Table (EIT)	per MGT	0xCB
Extended Text Table (ETT)	per MGT	0xCC
System Time Tables (STT)	0x1FFB	0xCD

In the Virtual Channel Table, which can be present either as Terrestrial Virtual Channel Table (TVCT) or as Cable Virtual Channel Table (CVCT) depending on the transmission path, identification information for the virtual channels, i.e. programs, contained in a multiplexed transport stream are transmitted. The VCT contains, among other things, the program names. The VCT is thus comparable to the SDT table in DVB.

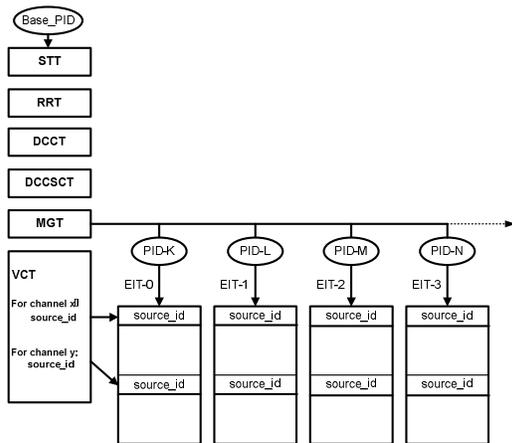
In the System Time Table (STT), all the necessary time information is transmitted. The STT can be recognized by the packet ID = 0x1FFB and the table ID = 0xCD. In the STT, the GPS (Global Positioning System) time and the time difference between GPS time and UTC (Universal Time Coordinated (= GMT)) is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

The PIDs and Table IDs of the PSIP tables are listed in Table: PSIP Table ID Ranges and Value.

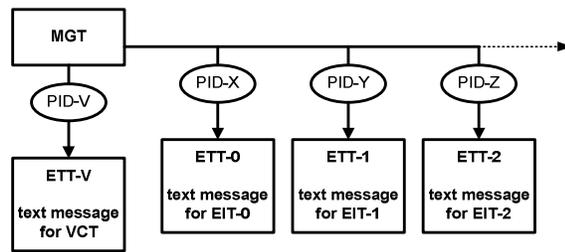
PAT	Program Association Table	MPEG-2 PSI Program Specific Information
PMTs	Program Map Table	
CAT	Conditional Access Table	
Private Tables		

MGT	Master Guide Table	ATSC PSIP Program and System Information Protocol
EIT	Event Information Table	
ETT	Extended Text Table	
STT	System Time Table	
RTT	Rating Region Table	
CVCT	Cable Virtual Channel Table	
TVCT	Terrestrial Virtual Channel Table	

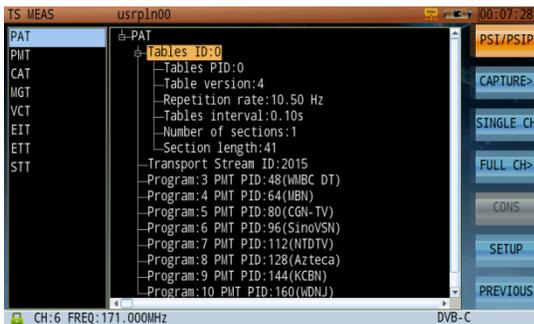
ATSC PSIP tables



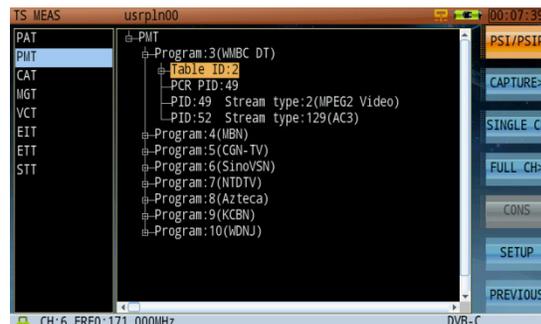
PSIP table hierarchy



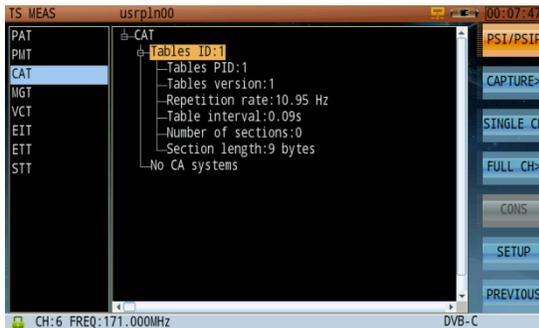
ETTs carry text messages for describing virtual channels and events.



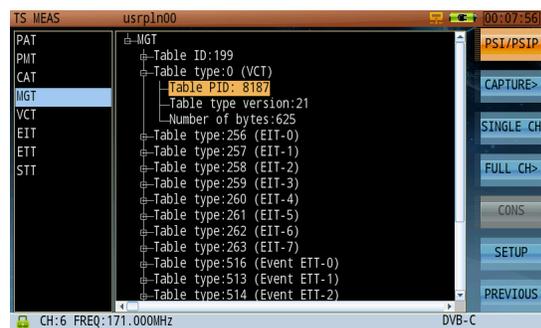
PSI/PSIP Analysis-PAT Table



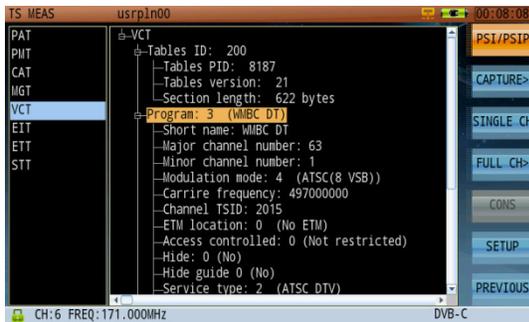
PSI/PSIP Analysis-PMT Table



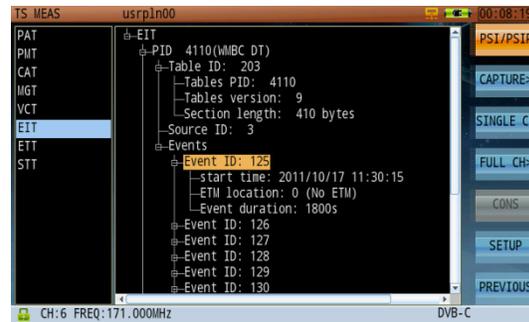
PSI/PSIP Analysis-CAT Table



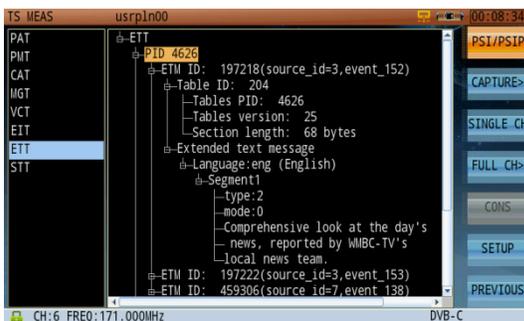
PSI/PSIP Analysis-MGT Table



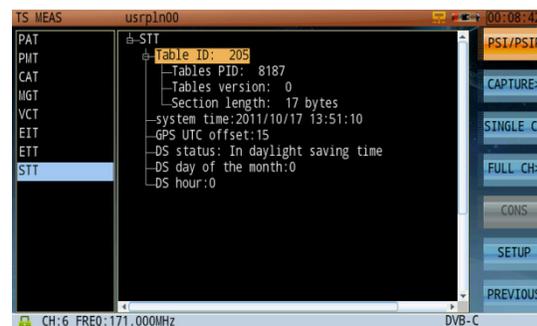
PSI/PSIP Analysis-VCT Table



PSI/PSIP Analysis-EIT Table

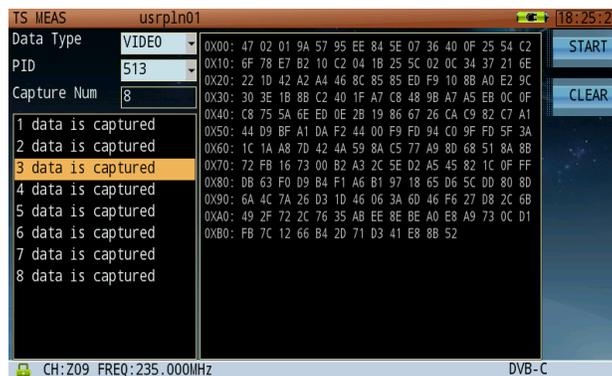


PSI/PSIP Analysis-ETT Table



PSI/PSIP Analysis-STT Table

9-9 Data Capture



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 the rotary knob to confirm; the related PID value will display in PID position. Next, input a capture number (up to 255). Press **Start** (F1) to capture data. Press **Clear** (F2) to clear all captured data.

The left pane displays captured data files; their contents appear on the right in hexadecimal format. Use the rotary knob to highlight a file in order to view its contents.

Note that the data capture function only supports real-time capture.

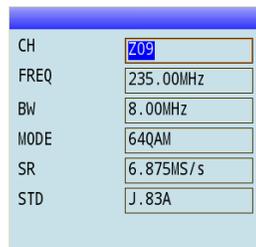
PAT	0.5s	SI	0.025s
PMT	0.5s	Unreferenced	0.5s
PID Delay	1.0s	SDT_act Min	0.025s
PCR	50.00ms	SDT_act Max	2.0s
PCR Discontinuity	100.0ms	SDT_other	10.0s
PCR AC +/-	500.0ns	EIT_act Min	0.025s
PTS Max	700.0ms	EIT_act Max	2.0s
NIT_act Min	0.025s	EIT_other	10.0s
NIT_act Max	10.0s	EIT P/F	1.0s
NIT_other	10.0s	TDT Min	0.025s
		TDT Max	30.0s

TR 101 290 Priority 1, 2 and 3 Parameter Limits

You can set measurement limits on TR 101 290 Priority 1, 2 and 3 tests, applying them to real-time TS analysis. (See above.) Closing and re-opening the TS analysis mode will reset all limits back to default values.

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



Channel Parameters Setup



Other Parameters Setup

You can select from two standards: DVB and ATSC. Choose DVB to view PSI/SI analysis, and ATSC to view PSI/PSIP analysis (shown, right).

DVB (PSI/SI: Program Specific Information/ Service Information)
 ATSC (PSI/PSIP: Program Specific Information /Program and System Information Protocol)



For data format, you can select either decimalism or hexadecimal. Their PID values are 514 and 0x202, respectively.

Note that you must select the correct character encoding according to your local operator's preferred language and region. If an incorrect data format is used, the parser program will show garbled information. Simply use the "Auto Detect" option to automatically recognize the proper character encoding.

VIDEO	INFO	AUDIO1	INFO1
PID	514	PID	670
Resolution	720*480	Mode	stereo
Frames	29.97	Layer	II
BitRate	15000000	BitRate	256 Kbps
Profile	main	Sampling	48 kHz
Level	high	Profile	---
Aspect	4:3	CH CONF	---
Chroma	4:2:2	Emphasis	none
VIDEO	INFO	AUDIO1	INFO1
PID	0x202	PID	0x29E
Resolution	720*480	Mode	stereo
Frames	29.97	Layer	II
BitRate	15000000	BitRate	256 Kbps
Profile	main	Sampling	48 kHz
Level	high	Profile	---
Aspect	4:3	CH CONF	---
Chroma	4:2:2	Emphasis	none

Auto Detects	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



The filter has two options: "video+audio" or "all". The filter only takes effect for the signal channel program list and overall program list. Some transport streams only include the audio signal in the network; choosing "video+audio" for these may filter the audio signal, possibly preventing the audio program from appearing in the the program list.

Chapter 10: Downstream Spectrum Analysis

The spectrum frequency band of the DS2831 covers cable, terrestrial and satellite frequency bands. The following sections contain instructions for setting up spectrum analysis functions.

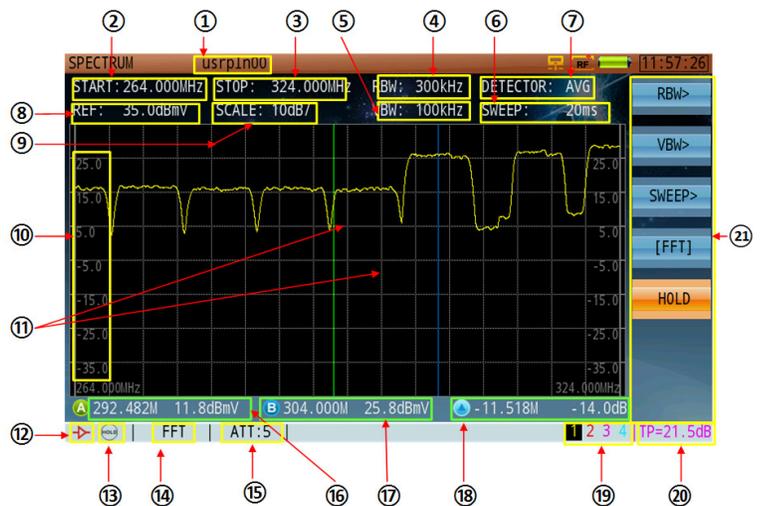
Press **Downstream** (F1) in the home screen and tap **Spectrum** to launch the application.

The spectrum analysis function is one of the primary, basic and most powerful functions of the DS2831. *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.*

Spectrum Analyzer Display Overview

In the spectrum analysis mode, use the rotary knob or touchscreen to select a measurement parameter. Edit with the keypad or arrow keys, then confirm by pressing the rotary knob or Enter to set. Refer to the numbered figure and associated definitions below.

1. Channel plan name.
2. Start frequency.
3. Stop frequency.
4. Resolution bandwidth filter. (RBW)
5. Video bandwidth filter. (VBW)
6. Sweep time.
7. Detector mode.
8. Reference level.
9. Graph display scale, in dB per division.
10. Amplitude scale.
11. Markers.
12. During simultaneous spectrum & QAM analysis, the lock icon is red (QAM signal locked) or green (unlocked).
13. Pre-amplifier: icon appears when pre-amp is activated. Otherwise empty.
14. Spectrum analysis mode: DFT or FFT.
15. Attenuation level.
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 DS2831. Only 1 trace is controlled at a time.
20. Test Point Compensation. (TP)
21. Multi-function soft-keys: a button followed by an arrow ">" means there is a sub-menu available. A button with a bracket "[]" means the button offers multi-functions.



The 7 function keys (F1-F7) on the first level menu represent the frequency, amplitude, bandwidth/sweep, marker, trace, detector and display control parameter settings.

10-1 Frequency Settings

Press **FREQ** (F1) to enter the frequency menu. From there, you can access the various submenus by pressing F1-F7 (shown below). Some parameters, such as the center frequency (4-1220 MHz, or 4-2150 MHz if the frequency extension option has been purchased), 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 rotary knob to confirm your setting.



Frequency and Span Setting Menu

10-1.1 Span Settings

In the same submenu for Frequency, press **Span** (F5) to set the span with the numerical keypad. You can also adjust the current value with the arrow keys (10 MHz step). Press the rotary knob to confirm. (Max span range is 0-1216 MHz, or -2146 MHz if the frequency extension option has been purchased). The span can also be set automatically by dialing in the start/stop frequency.

10-2 Amplitude Settings

Amplitude settings include reference level, attenuator, unit & scale reference, and pre-amplifier on/off.

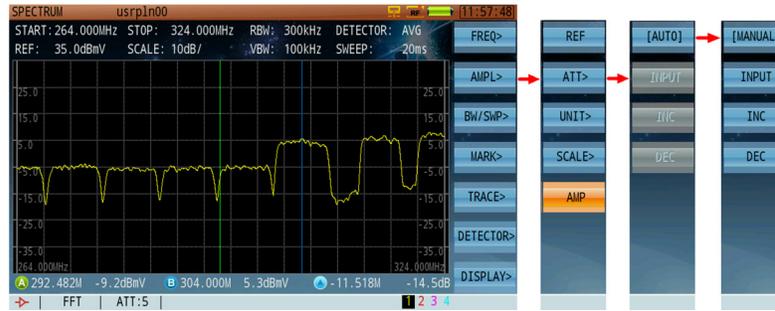
10-2.1 Setting the Reference Level

The reference level can range from -80 ~ +70dBmV and is displayed at the top of the display window (REF). In the amplitude submenu, press the **Reference** (F1), then use the arrow keys to change the reference level value in steps of 10dB.

10-2.2 Setting the Attenuator

There are two ways to set the attenuator: manual or automatic. In manual mode, an asterisk (*) will appear before the attenuator icon at the bottom of the screen.

In the amplitude submenu, press **ATT>** (F2) to enter the attenuation submenu. If the attenuator is currently set to automatic, press **Auto** (F1) to toggle it to manual, or vice-versa. To manually control the attenuator, set it to Manual and press **Input** (F2) to input the attenuation value with the numerical keypad (within 1dB). Press the rotary knob to confirm your selection. Press **INC** (F3) or **DEC** (F4) to increase or decrease the value. The adjustable range of the attenuator is 0- 30dB. Pressing the arrow keys adjusts attenuation by 5dB.



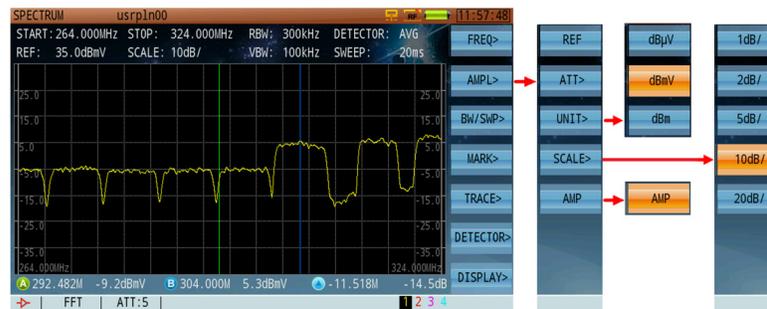
Amplitude Setting Menu - Attenuator

10-2.3 Setting the Pre-Amplifier

Press **AMPL>** (F2), then **AMP** (F5) to toggle the pre-amplifier ON (orange) and OFF (blue). When the pre-amplifier is on, an amplifier icon will appear at the lower left corner of the screen.

10-2.4 Setting the Amplitude Scale and Unit

Press **AMPL>** (F2) and then **Scale** (F4) to open the scale setting sub-menu. 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, press **Unit** (F3) to open the unit setting sub-menu. You may choose dBμV, dBmV, or dBm. For your convenience, conversion factors are listed below.

$$\text{dBm} = \text{dB}\mu\text{V} - 108.8$$

$$\text{dBmV} = \text{dB}\mu\text{V} - 60$$

$$\text{dBm} = \text{dBmV} - 48.8$$

10-3 RBW & VBW Bandwidth/Sweep Setting

In this section, we cover procedures for setting up RBW, VBW and sweep time values; spectrum calculation mode; and trace hold features.

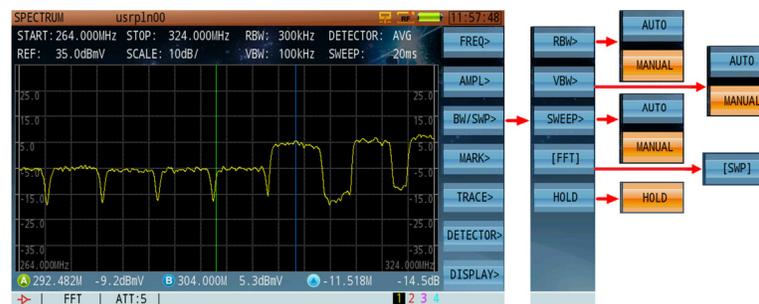
WARNING

For less experienced users: 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."

10-3.1 Resolution Bandwidth (RBW) Filter

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

Press **BW/SWP>** (F3) to enter the submenu and then **RBW>** (F1). Select **Auto** to allow the DS2831 to choose a suitable RBW according to sweep speed, span and VBW selections, or Manual to choose an RBW from the following choices: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz and 3 MHz.



Bandwidth/Sweep Menu

10-3.2 Video Bandwidth (VBW) Filter

The VBW can be used in manual and automatic mode. In manual mode, an asterisk (*) appears before the VBW parameter under the RBW parameter at the top of the screen.

Press **BW/SWP>** (F3) to enter the submenu and then **VBW>** (F2). Select **Auto** to allow the DS2831 to choose a suitable VBW according to sweep speed, span and RBW selections, or Manual to choose a VBW from the following choices: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz and 3 MHz.

10-3.3 Sweep Time (SWP)

There are two ways to set the sweep time: manual and automatic. In manual mode, an asterisk (*) appears before the sweep time parameter.

Press **BW/SWP>** (F3) to enter the submenu and then **Sweep>** (F3). Select **Auto** to allow the DS2831 to choose a suitable sweep time according to the active Span, VBW and RBW settings, or Manual to choose a sweep speed using the arrow keys in steps of 10ms. Press the rotary knob to confirm.

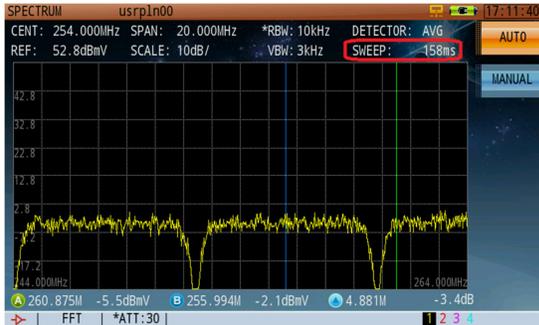
Spectrum analyzers normally couple sweep time, span setting and resolution bandwidth selections automatically. This allows the signal to be measured enough time to achieve full amplitude within the RBW for an accurate & calibrated measurement. If any of the parameters are not in "sync", an "UNCAL" message will appear in the status bar at the bottom of the screen.

Control and spectrum calculation mode

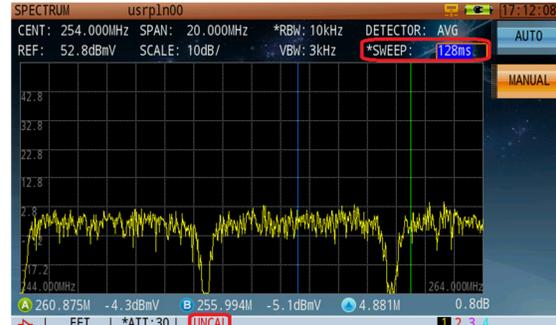
The DS2831 offers two spectrum calculation modes, FFT and DFT. The DFT is the foundation of FFT, and the FFT is the fast algorithm of DFT. Every result calculated with DFT represents a pixel point of the spectrum trace, while every result calculated with FFT represents a segment of the spectrum trace. If a faster sweep speed is required, the FFT mode is better suited for the task. In the digital persistence mode introduced later, only the FFT mode can be used.

Spectrum hold mode

While in the DS Spectrum analyzer mode, press F7 to reveal the **Hold** button. This pauses the trace for analysis. Press Hold again to resume normal operation.



Auto Sweep Time



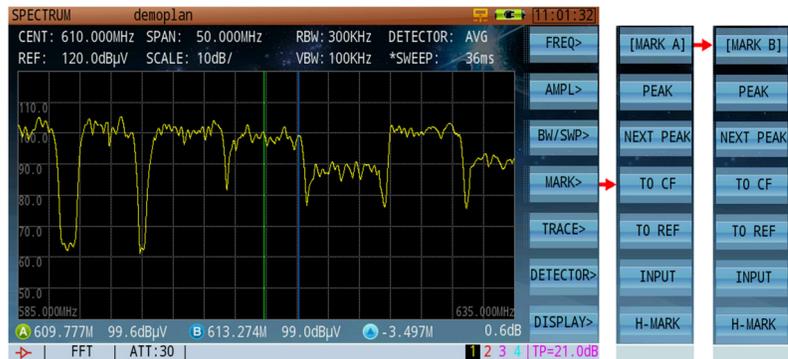
Manual Modify Sweep Time Cause UNCAL Information

10-4 Markers

The DS2831 offers two markers; A and B. Press **Mark** (F4) to enter the submenu. Then press F1 to toggle between **Mark A** and **Mark B**. Only one can be active at a time.

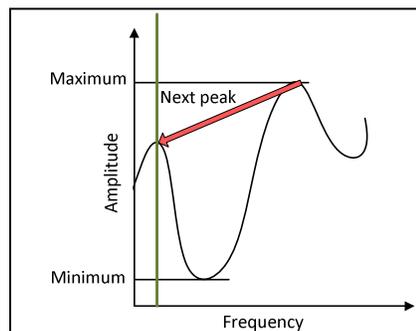
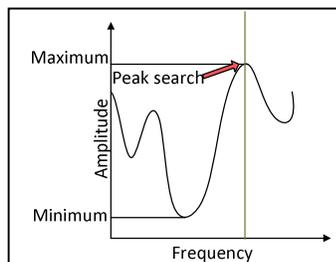
Peak Search

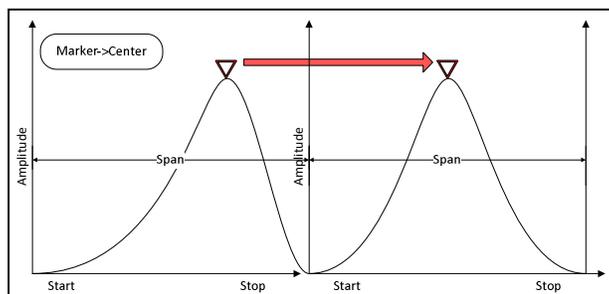
Automatically finds the highest amplitude peak on the spectrum analyzer trace (below, left).



Next Peak

Automatically finds the next highest amplitude peak on the spectrum analyzer trace (below, right).



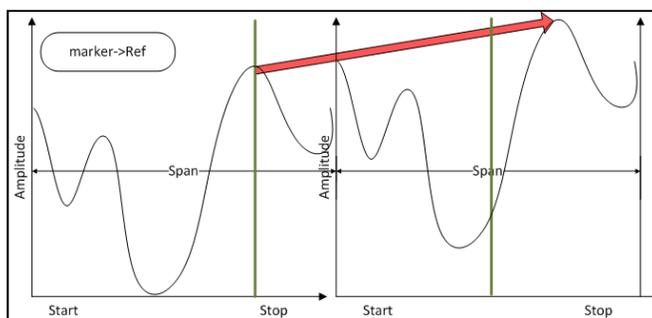


Marker to center frequency

Moves the active marker to the center frequency of the spectrum trace (shown above).

Marker -> REF

Moves the active marker to the reference level (shown below).



10-5 Trace Setting

The DS2831 can display 4 traces simultaneously. The display settings are: max. hold, min. hold, average and normal. Each trace is actively displayed on the screen, individually or simultaneously, each with a different color, 1, 2, 3 or 4 traces at a time. You can toggle in a circular way when pressing F1 repeatedly. Press **Write** (F2) to activate the desired trace. Press **Blank** (F4) to deactivate and turn off the current trace. Each trace is identified at the bottom right (1-2-3-4) to the left of the TP value. In any of the Spectrum Analysis modes, the number highlighted in black at the bottom right is the active (controllable) trace.



Four Traces Display Simultaneously



Trace Setting Menu

Max Hold, Min Hold, and Average Trace

Press **Trace** (F5) to enter the submenu. Here, Max Hold, Min Hold, Average or normal trace (Write) behavior can be applied to the trace display mode.

10-6 Detector Type Setting

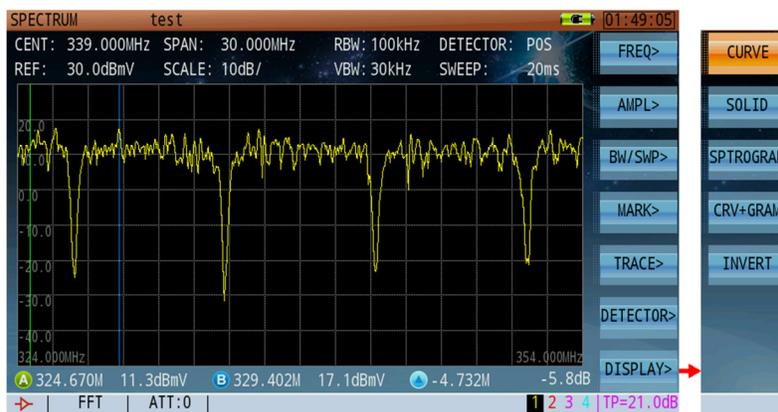
Press **Detector>** (F6) to enter the detector mode submenu. Here, you may choose 1 of 5 detector modes:

- **SAM** (sample detector, F1)
- **POS** (Positive peak detector, F2)
- **AVG** (Average detector, F3)
- **NEG** (Negative peak detector, F4)
- **RMS** (Root mean square detector, F5).



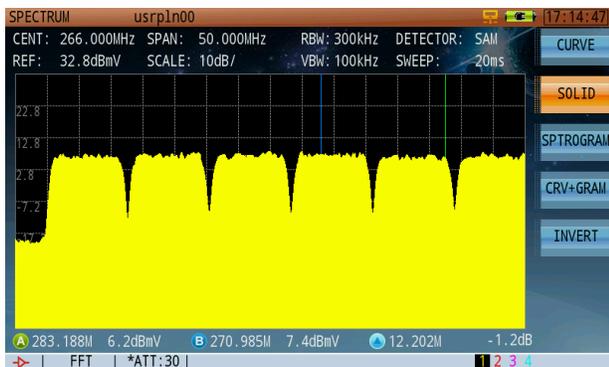
Detector Mode Setting

10-7 Display Mode Setting



Display Mode Setting

The spectrum analysis function offers 4 display modes: curve, solid, spectrogram, and combined Curve/Spectrogram. Press **Display>** (F7) to enter the submenu, then press **Curve** (F1), **Solid** (F2), **SPO** (F3), or **CRV+SPO** (F4) to select your desired display mode.

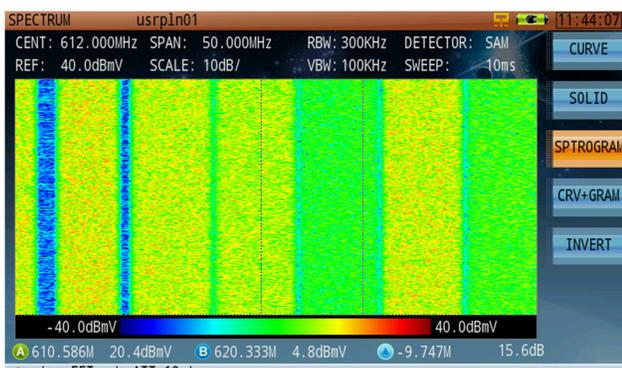


Curve mode

The curve mode is the standard default Spectrum Analysis mode

Solid mode

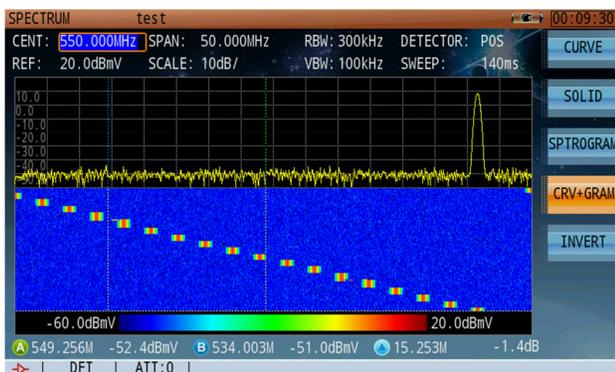
The solid mode fills the area below the signal with solid yellow, shown left.



Spectrogram mode

The scrolling three-dimensional display is useful for its ability to track frequency and power behavior over time, particularly intermittent signals. You can use the spectrogram mode to analyze the stability of a signal over time, or to identify intermittent interference signals. The X-axis (horizontal) represents frequency, amplitude is represented by color, (red for a high level signal and blue for the noise floor). The Y-axis (vertical) represents time, with the most recent trace acquisition displayed at the bottom of the graph to the oldest acquisition at the top of the graph. (upwards

movement of acquisitions)

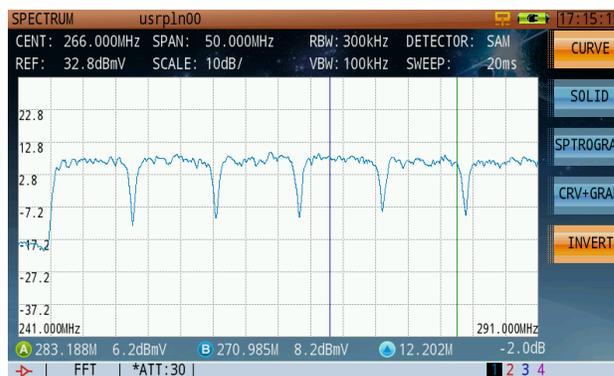


Curve+Spectrogram mode

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.)

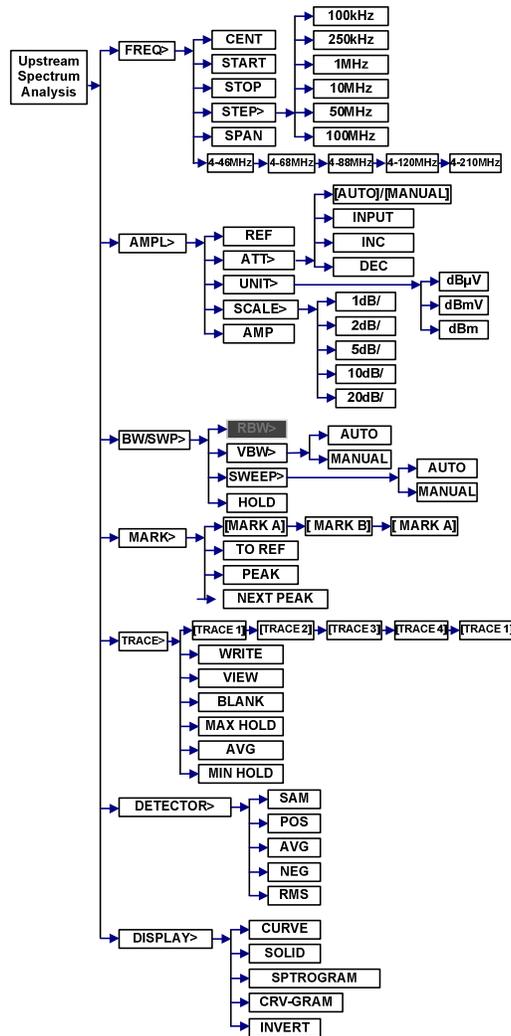
Print Mode

New to the DS2831 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.



A Note on Upstream Spectrum Analysis

The DS2831's downstream & upstream spectrum analysis functions are almost the same, with a few exceptions. First, for quick ease of use, US spectrum analysis SPAN presets offer several fixed modes: 4-46 MHz, 4-68 MHz, 4-88 MHz, 4-120 MHz and 4-210MHz, however, you can tune any specific SPAN setting either with START/STOP or Center Freq/Span, max span is 206MHz. Although the RBW is fixed at 300KHz in this mode, the sweep and trace settings are flexible to enhance the ability to troubleshoot US events.



Upstream Spectrum Analysis Menu Tree

Chapter 11: Persistence Analysis

11-1 Introduction to Persistence Theory

Spectrum persistence analysis is the latest in digital processing technology, usually found in much more expensive equipment. With the DS2831 and other powerful test equipment, Deviser has introduced this technology into more cost-effective equipment, providing an ideal solution for CATV operators.

Persistence testing can capture a "bursty" (interfering-undesired) signal hiding under a bursty Bonded US DOCSIS (desired) signal – or even Common Path distortions whose low levels make them difficult to detect. Traditional spectrum analysis is often incapable of isolating these undesired interfering signals unless desired signal transmissions are turned off. Persistence technology captures "bursty" signals and displays them in an easy-to-read display.

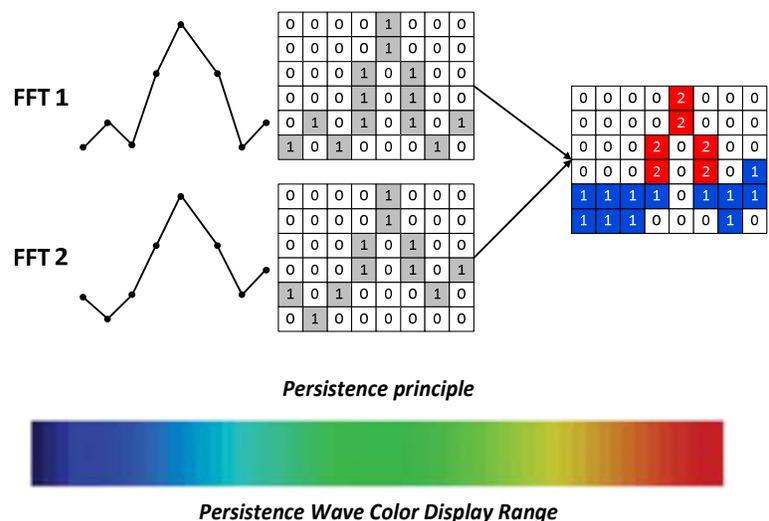
Interfering lower level bursty signals are often found under the desired signals, and detection can pose a significant challenge. Persistence technology can help you capture, isolate and visualize hard-to-find signals, similar to the EVS function (Section 8-5). EVS technology is used to find those continued broadcast QAM signal covered interference signals at higher frequencies, while persistence technology is mostly used to find those TDMA covered interference signals.

For a more thorough treatment of the DS2831's DPS function, see the Application Note: A Study of Digital Persistence Analysis (pg. 155) following Chapter 28 of this user guide.

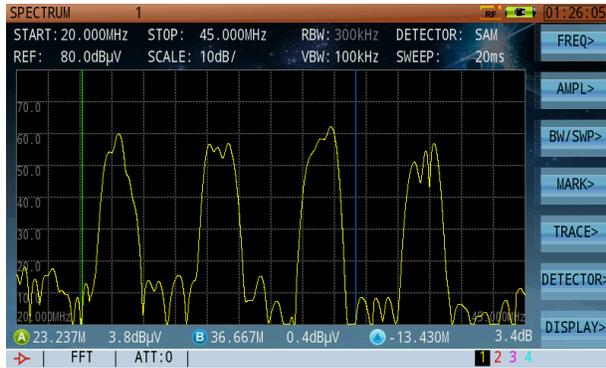
11-2 Introduction to Persistence Technology

To open the Persistence function from the **Home** menu, first press **Upstream** (F2) then select **DPS**.

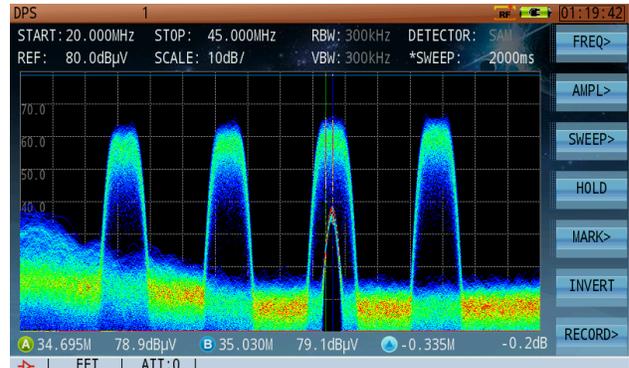
A persistence waveform is a bitmap, not a trace. In this mode, every pixel uses a different color (shown below), based on how often the signal occupies the same pixel. A "cold" color (blues and indigos) shows a pixel with less signal presence, and a "warm" color (reds and oranges) shows a pixel with a high presence of signal. In the DPS display mode, when the sweep time is increased or decreased, the waveform color display will dynamically adapt to the new setting in a real time mode. In the DPS mode, the sweep time range is 20ms to 25secs.



As shown below, when viewing a DOCSIS upstream channel in the normal spectrum analysis mode, you can only see the noise floor and the DOCSIS upstream signal transmission. Using the persistence mode, you can easily and clearly identify both the DOCSIS upstream signal transmission and the underlying low level interference signal normally covered by upstream signal and otherwise undistinguishable interference signal. It is important to note that this method identifies the interference signal without service interruptions.



Low-Level Signals Covered by High-Level Signal



Persistence Shows Ingress Signal Covered by DOCSIS Upstream Signal

11-3 Introduction to Persistence Application

In the Persistence mode, 4 markers are available: 2 vertical and 2 horizontal. When **MARK A** is highlighted, vertical marker A is controlled with the rotary knob, and the horizontal marker with the arrow keys. In this mode, because the measurement is made over a pre-selected period of time buffer, the amplitude range of the same signal cannot be measured by a single vertical marker at any given frequency. Hence, the need to use the horizontal marker to evaluate the level of the interference carrier.

It is recommended to use the vertical marker to best tune on the interferer frequency, and the horizontal marker to measure the level of the interferer. Once the horizontal marker has been set to the peak level of the interferer, press **To Ref** (F2) to set the horizontal marker as the reference level.

The persistence mode is fixed at sample detection by default. RBW and VBW are also fixed at 300 kHz each. FFT sweep mode is also used by default and cannot be changed.

11-4 Persistence Recording

Persistence recording is related to several parameters. Possible values are listed where applicable.

- Sweep Time: 100 ~ 5000ms.
- Record Frames: 50 frames max.
- Max Saved Files: 5 files.

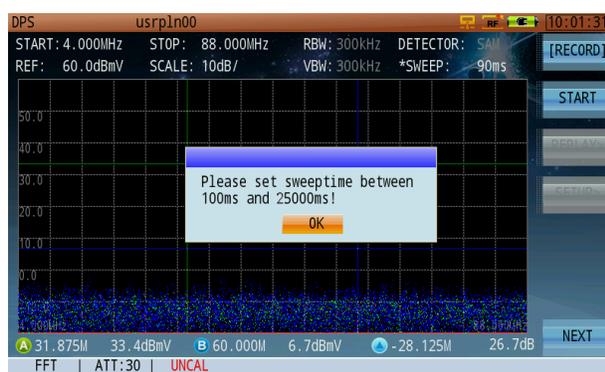
The DS2831 offers two persistence recording methods: normal record and trigger record.

11-4.1 Normal Record

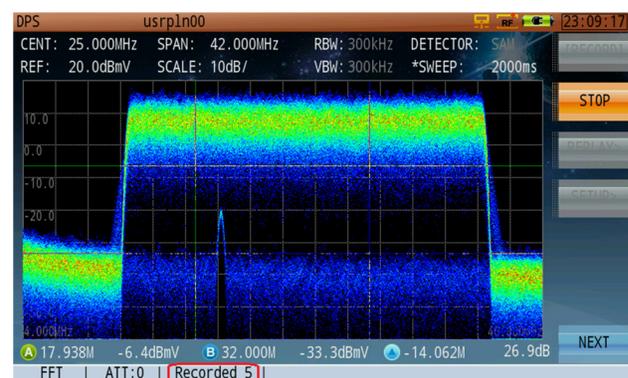
This method allows the user to freely record any useful persistence spectrum information.

To use this method, enter persistence mode and enter the following sequence: **Record** (F7), **Start** (F2), **Stop** (F2), **Next** (F7), **Save** (F1). Before you save the persistence record file, please confirm that the persistence files number fewer than five. If there are more than five files, an error message will appear. To save more records, you must delete an old one.

Normal persistence recording is as shown (below, right). The area outlined in red indicates the serial number of the current recorded frame; the user may stop the recording process at any time before this number reaches 50. Unless interrupted, the instrument will record up to 50 frames. Users must save recordings to the hard drive, or the data will remain in temporary memory (RAM) and be lost upon instrument shutdown.



Error Caused by Invalid Sweep Time



Persistence Record Frame's Serial Number

11-4.2 Trigger Record

To use trigger recording, you will first need to define a signal pattern for the instrument to recognize. If the received signal matches your pattern, the DS2831 will automatically begin recording. If the signal is not recognized, no persistence recording will occur.

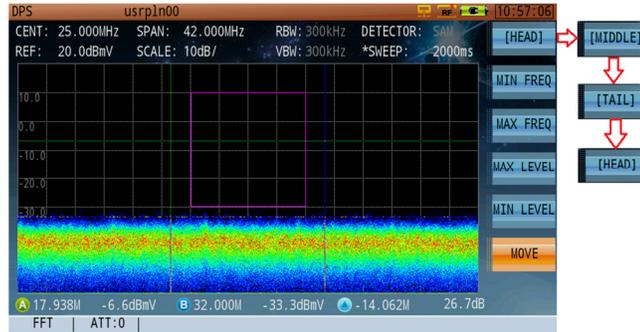
To set up trigger recording:

1. In persistence mode, navigate through the following menus: **Record** (F7); **Trigger** (F1); **Setup** (F4). Set up the trigger pattern as desired. (See "Trigger Modes" and "Setting Up The Trigger Pattern" below.)
2. To start searching for a matching signal: **Record** (F7); **Trigger** (F1); **Start** (F2).
3. Recorded data will be auto-saved to to DS2831's 1GB internal hard drive.

Trigger Modes

Select your preferred recording mode in Trigger > Setup. Use F1 to cycle through modes.

- RISE: Rise frame trigger. The DS2831 begins recording the instant that a signal matching the trigger pattern is recognized.
- MIDDLE: Middle frame trigger (Pre-trigger). The DS2831 begins recording at the midpoint of a signal matching the trigger pattern.
- FALL: Fall frame trigger. The DS2831 begins recording at the point when a signal matching the trigger pattern begins to decline.



Trigger Recording Setup

Trigger Condition

In the figure above, the purple rectangle indicates the *trigger condition*. If the signal amplitude is higher than the amplitude range covered by this area, or if the signal enters the trigger area from the left or right sides, then persistence recording will not trigger. Recording will only occur if the signal enters the "rectangle from below, and does not reach higher than the top side. If these conditions are met, the signal will trigger the persistence recording function.

Setting Up the Trigger Pattern

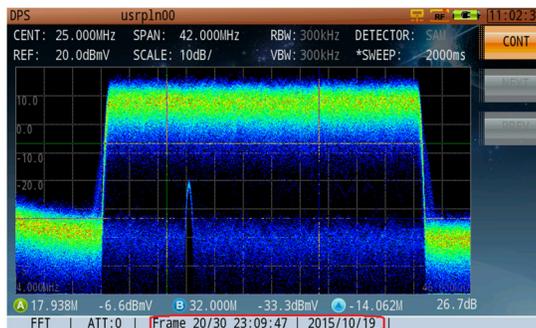
1. In Record > Trigger > Setup, press **Min Freq** (F2) and use the arrow keys to shift the rectangle's left side (minimum frequency) left or right. You can also turn the rotary knob for more sensitive adjustments, 10% the speed of the arrow keys. Then press **Max Freq** (F3) and define the rectangle's right side (maximum frequency).
2. Press **Max Level** (F4) and use the arrow keys and rotary knob to shift the rectangle's top side (max signal level) up or down. Then press **Min Level** (F5) and define the rectangle's bottom side (min. signal level).
3. Press **Move** (F6). Here, you can adjust the entire trigger zone's position on the measurement grid. Use the arrow keys to move it up or down, and the rotary knob to move it left or right.

11-4.3 Playing Back Persistence Recordings

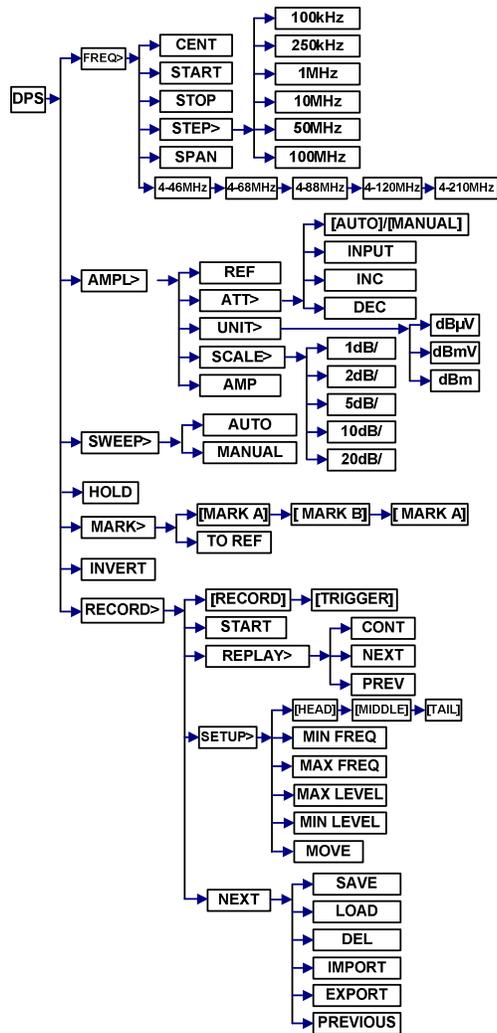
To play back a recording, enter the following sequence: **Record** (F7); **Next** (F7); **Load** (F2). Choose one of the listed recordings and click the rotary knob to confirm. Go back to the last menu page (F7) and press **Replay** (F3) to view the recording.

You can view recordings at normal speed by pressing **Cont** (F1), or use the **Next** (F2) and **Prev** (F3) keys to examine the current recording frame-by-frame. The current frame number and timestamp are displayed at the bottom of the screen.

Alternatively, you can view recordings on a PC with the proper software. Contact Deviser Instruments for more information.



Playback Persistence Record



Persistence Analysis Menu Tree

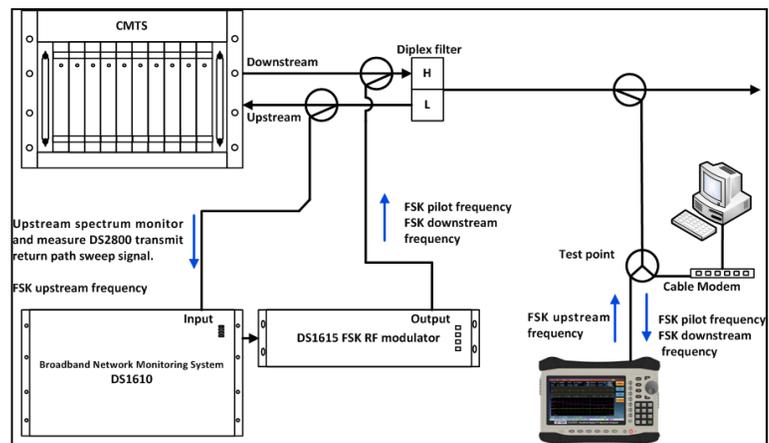
Chapter 12: Reverse Path Sweep

This chapter provides instructions and test principles, parameters, setup methods, to connect the DS2831 sweep function with the DS1610: Deviser's HE return sweep receiver.

12-1 System Architecture

As shown (right), the DS1610-1D upstream receiver at the headend (or hub) receives FSK modulated communication data and RF discrete frequency points, which are transmitted upstream by the DS2831. In the downstream direction, the DS1610 sends data back to **up to 4 DS2831 units** deployed to the field via the DS1615 FSK modulator – broadcasting received DS2831 data back upstream to the DS2831s in the field.

Each unit receives only its own data (IDed by serial number). The RF and COM ports of DS2831 are well identified as (COM) for upstream USG transmission and FSK communication, (RF IN) for the downstream spectrum receiver.



12-2 Operation Principle

The DS1610 uses TDMA and half-duplex communication methods to manage multiple DS2831 units. One DS1610 will connect with up to four DS2831 field units in quasi-real-time at once, and communicates with one of these units at a time.

The registration process is controlled by the DS1610. The two devices are synchronized with FSK pilot carriers. When a new DS2831 sends a registration request (in the form of a pilot signal transmission) in the upstream path to the DS1610, the DS1610 briefly interrupts communication with all other connected instruments and processes the new DS2831's request. Once registered, the DS2831 will receive a confirmation from the DS1610. If the DS2831 doesn't receive this confirmation within a fixed period, it will automatically re-transmit its request. The DS1610 listens for registration requests in real time at the pilot frequency, detecting received signals whether or not the pilot carrier from DS2831s or DS2500Cs are at the preferred range level.

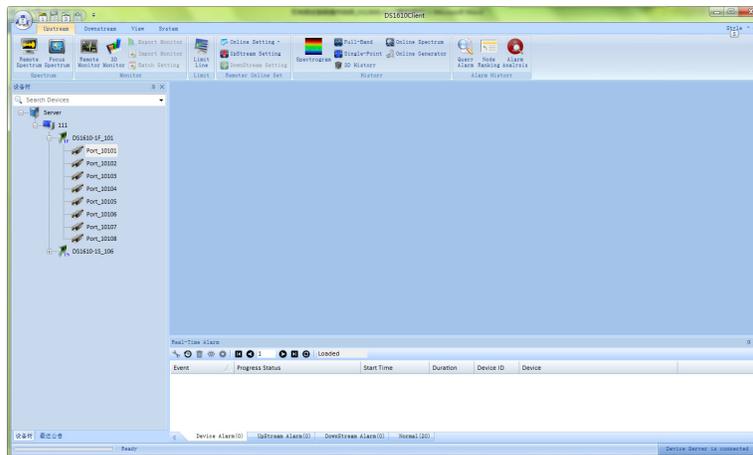
When a pilot signal is detected, the system automatically enters the registration process. A bi-directional FSK communication is initiated to establish communication and allow data transmission at that frequency channel. Note that the DS1610 and DS2831 must use the same FSK pilot frequency for US & DS communication; otherwise, the registration process will fail.

12-3 Measurement Setup

12-3.1 Headend Equipment Setup

DS1610 communication setup:

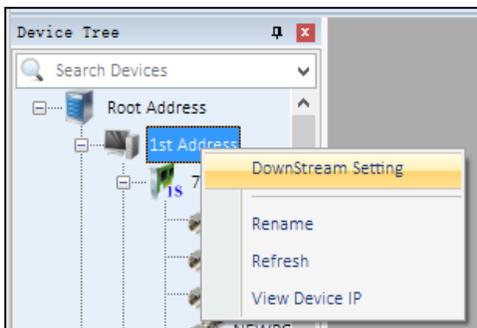
Using a PC server, log in to the DS1610 client interface (shown below). Note that proper login credentials are required to access the system and all configuration settings. Contact your system administrator for more information.



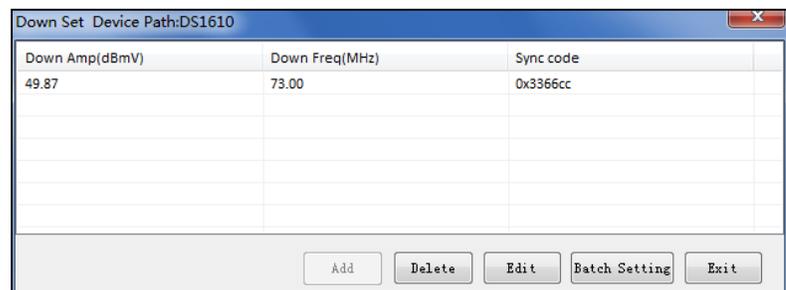
DS1610 Login Interface

DS1615 downstream FSK communication setup:

1. Right-click the DS1610 icon (shown below, left) and select Downstream Settings.
2. If entering the downstream parameter setup menu for the first time, click the "Add" button. If a set of parameters already exists, click to highlight it and select **Edit**.

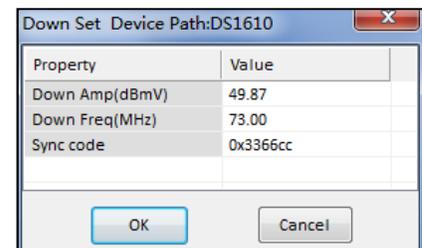


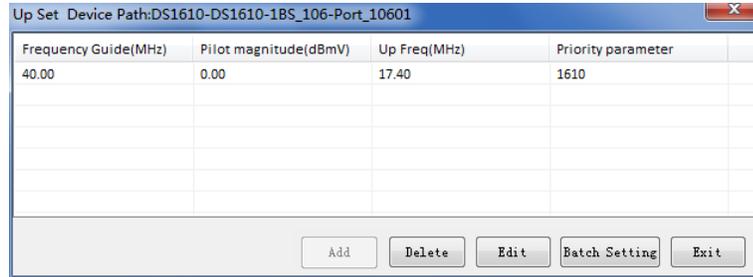
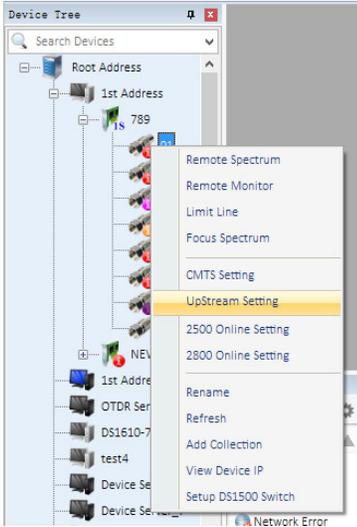
Find out DS1615 Parameters Setting Menu



Open DS1615 Downstream Parameters Setting Interface

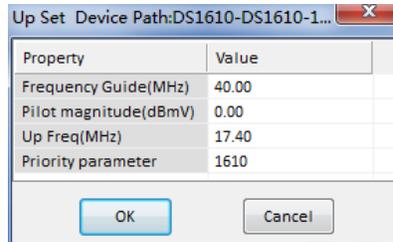
3. In the parameter settings menu (right), input the downstream amplitude and frequency. Click OK to save the new settings. If settings fail to save, verify that the software was installed properly and that the network connection is valid.
4. The "Batch Setting" function can be used to set several DS1615 units to the same parameters simultaneously.





DS1610-1D Upstream Channel Settings

1. Right click the DS1610-1D icon (left) and select Upstream Setting.
2. If entering the upstream parameter setup menu for the first time, click the "Add" button. If a set of parameters already exists, click to highlight it and select Edit.
3. In the parameter settings menu (below), input the upstream pilot frequency and level, then click the "OK" to save the new settings. If settings fail to save, verify that the software was installed properly and that the network connection is valid.

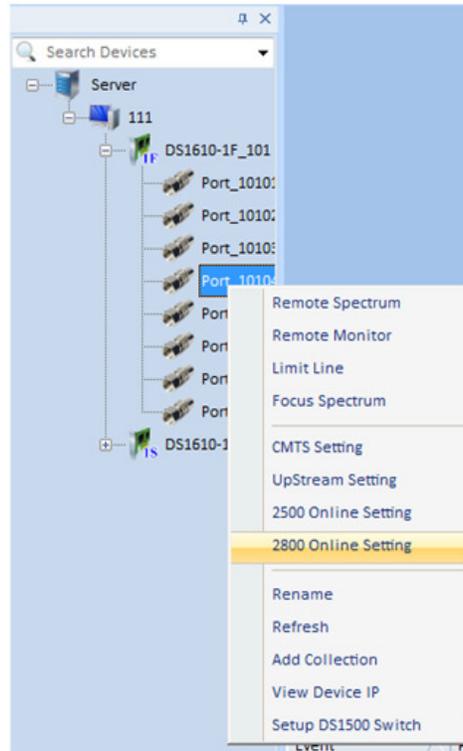


Edit DS1610 Upstream Parameters

4. The "Batch Setting" function can be used to set several DS1610-1D boards to the same parameters simultaneously.

Online Troubleshooting, Frequency and Amplitude settings

1. Right-click the DS1610-1D icon (shown below) and select "2800 Online Setting".



Open Online Troubleshooting Device Parameters Setting Function

2. Setup menu: Amplitude, TP, Time step and Frequency.

 A screenshot of a dialog box titled 'DS2800 Remoter Online Plan DevicePath:DS1610-DS1610-1BS_106-Port_10601'. It contains a table with the following data:

Entrance Level(dBmV)	TP(dB)	Time Step(ms)	Fre
20.00	39	10	5.0

 Below the table are buttons for 'Add', 'Delete', 'Edit', 'Batch Setting', and 'Exit'.

Online Troubleshooting Device Parameters List

3. Groups of frequency and amplitude can be set for each port (1~16). Click "OK" to save these settings. If settings fail to save, verify that the software was installed properly and that the network connection is valid.
4. The "Batch Setting" function can be used to set several DS1610-1D boards to the same parameters simultaneously.

 A screenshot of a dialog box titled 'DS2800 Remoter Online Plan DevicePa...'. It contains a table with the following data:

Property	Value
Entrance Level(dBmV)	20.00
TP(dB)	39
TimeSpan(ms)	10
Freq(MHz)1	5.00

 Below the table are buttons for 'OK' and 'Cancel'.

12-3.2 DS2831 Sweep Parameters Setting

1. From the **Home** menu, press **Upstream** (F2) and use the rotary knob to open the Reverse Sweep mode.
2. In this mode, press **Setup** (F4). Configuring Reverse Sweep involves setting 6 different communication parameters: Pilot Frequency, Down Link Frequency, Up Link Frequency, Pilot Level, IP Compensation (Insertion point compensation), Reverse Sweep Slope and Reverse Sweep Port.



DS2831 Main Menu – (reverse sweep)



DS2831 Reverse Sweep Communication Settings

12-3.3 Reverse Path Sweep Display Overview

To explore the Reverse Path Sweep display interface, refer to the numbered figure and associated definitions below.

1. Spectrum analyzer settings. Copied from upstream spectrum mode.
2. Green line depicts signal levels transmitted to / received from HE DS1610.
3. Assembled sweep frequency response trace.*
4. Reverse sweep transmission parameters. In this example:
 [10]:50MHz, (frequency of the active marker is the 10th inserted sweep point of the reverse sweep trace, at 50MHz), 8dBmV (DS2831 US transmit level) -- 2.6dBmV (received DS level from the DS1610)=10.6dB loss in the US path being measured.



[SHIFT]: -3dB

[SLOPE]: 5.0dB

[SHIFT]: Adjusts the transmitted signal level for all frequency points.

[SLOPE]: Transmitted level difference between 1st and last inserted sweep points. -10~ +10dB.

5. The DS2831 upstream sweep transmit frequencies (sweep points) received by DS1610 at the headend.
6. FSK sync icon. If the DS2831 and DS1610 are not synced, it will remain red and display "Offline". When registration starts, it will show "Send Pilot..." & "Waiting Pilot...". When registration is successful and remains active, the icon will alternate between yellow and green.
7. DS1610 upstream ID#. For example, for the 01/01/Port_10101 shown above, the first 01 is the board # of the DS1610, the second 01 is the port # of the DS1610 - 01 board, and Port_10101 is the port name.
8. Headend test point compensation
9. Insertion point compensation:
10. The difference in amplitude level between the local spectrum trace and the received headend/Hub spectrum trace at the marker position.
11. Field spectrum trace: at the DS2831 field location.
12. The spectrum trace sent to the DS2831 as it is received by the DS1610 at the headend, from the DS2831
13. Local test point compensation value.

* The example here shows a trace formed from 16 connected discrete-frequency RF signals initially transmitted upstream by the DS2831, then received by the DS1610 at HE. The DS1610 then re-transmits those sweep points through the FSK DS carrier frequency, back to the DS2831. Up to 16 discrete-frequency RF signals can be transmitted upstream by the DS2831. The sweep technician will determine how many sweep points can be used based on the local network health, spectrum space available, and amount of bandwidth already occupied by live signals.



Reverse Path Sweep Full Screen Display

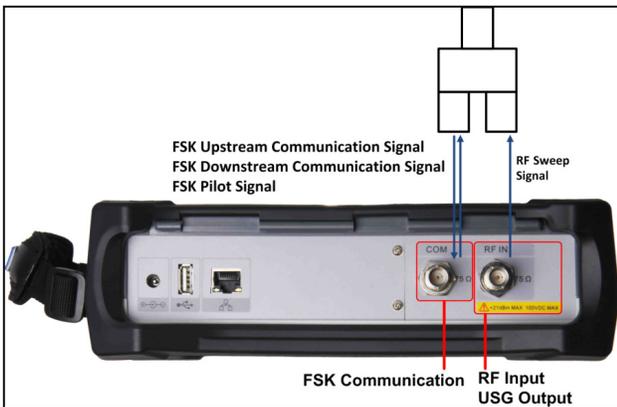
14. Reference return sweep trace.
15. Reference return sweep trace transmit and receive parameters.
16. The reference return sweep trace upstream sweep transmit frequencies (sweep points) received by DS1610 at the headend.

12-3.4 Reverse Path Sweep Operation

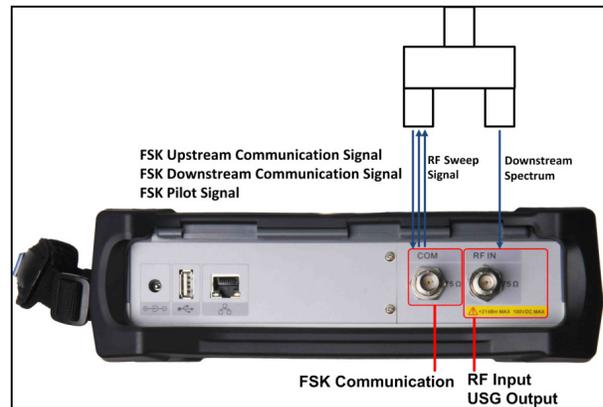
From the **Home** menu, press **Upstream** (F2) and use the rotary knob to open the reverse path sweep mode.

First, press **Setup** (F4). Set up the following parameters as desired for your measurement: pilot frequency, uplink frequency, downlink frequency, pilot level, insertion point compensation, reverse path sweep slope and reverse sweep port.

Reverse sweep port can be toggled between the RF port and COM port. The FSK communication port must use COM port. If the user sets up the RF port as a reverse sweep port, the port signals should be configured as shown (below, left). In this configuration, the RF port cannot view the local spectrum image at the same time as reverse path sweep.



RF Port as Reverse Path Sweep Port



COM Port as Reverse Path Sweep Port

If the user sets up the COM port as a reverse sweep port, the port signals should be configured as shown (above, right). Now RF port can receive local spectrum.

Once the parameters listed above have been set, press **Login** (F1). Synchronization messages will appear in the lower left corner of the display: "Send pilot ...", "Waiting Pilot..." (with a red icon). When the icon begins alternating between yellow and green, the DS2831 and DS1610 are connected and the DS2831 will start displaying the sweep frequency response trace.

12-4 Bidirectional Test System Parameters and Range Setup

12-4.1 Downstream Communication Signal Parameters

1. Down Freq = the DS communication signal frequency from the DS1615. The comms carrier bandwidth is less than 300 kHz. **Note:** Take special care to avoid inserting these comms channels on an occupied spectrum where active signal is present.

Input range value = 42~120MHz (**Note:** This is an intrusive carrier signal. Take special care to ensure the spectrum space is empty and available). The comms signal frequency must be identical to the "Down Link Freq" set in the DS2831.

2. Down Amp = the DS output communication signal (comms) amplitude from the DS1615. The amplitude of the signal should be about the estimated downstream distance (in dB of loss) from the HE. (As a general safe practices, always start the comms signal level as low as possible and work your way up to the point of "sync", so not to introduce unnecessary additional RF power and potentially overdrive your lasers and introduce non-linear distortions on your network, ensuring high enough levels to maintain a reliable communication between the HE and field location. (2-3dB additional headroom is acceptable) Input range = 25~50dBmV.
3. Sync Code: This is reserved for system extension function and normally does not need to be modified, it is recommended to use the default value.

12-4.2 Upstream Communication Signal Parameters

1. Pilot Frequency: this signal frequency is required for a valid DS2831 registration with the HE equipment. **Do not** insert the pilot frequency channel where active signals may be present (e.g. DOCSIS channels). Valid range = 5~65MHz. The value must be the same as the "Pilot Freq" in the DS2831 parameter setting.
2. Pilot Amplitude: The DS1610-D will validate the DS2831 registration amplitude. The value should be less than the pilot amplitude transmitted from DS2831 so that the DS1610-1D can correctly accept the DS2831 registration request. The pilot signal amplitude received by the DS1610-1D should be equal to the pilot signal amplitude from the DS2831 minus (-) the estimated attenuation from the DS2831 (field location) to the DS1610-1D (HE or Hub).

Note: The pilot amplitude should be greater than the combined noise and interference signal in the network at any given US port of the DS1610-1D to avoid that the DS1610-1D mistakes random noise as a registering request from the DS2831. It is recommended to choose the port with the worse signal quality as the standard when setting up. However, Special care should be given to insure the pilot carrier level is not "too high" on clean looking nodes so as to avoid unnecessary RF energy contributions on the return path.

3. Up Freq = the frequency used by the DS2831 for communication. This narrow FSK modulated signal uses a bandwidth of less than 200 kHz. **Do not** insert these comms channels on an occupied spectrum where active signal is present. Input value range = 42 ~ 120 MHz. The value must be identical with "Up Link Freq" in the DS2831 parameter setting.

12-4.3 Settings

Amp:	Equal to the measured signal amplitude transmitted by DS2831. It must comply with network management requirements. (It is recommended to limit the transmitted signal amplitude as much as possible to avoid interference with other comms, DTV or DOCSIS signals in the network, increase overall RF power, and/or generating distortion products.) Input range: 0~60 dBmV
Time step:	Equal to the transmission delay between two adjacent frequency points. Input range: 10ms ~ 30s
Freq:	This signal is bursty and at a single frequency. Do not use occupied spectrum when setting up, this is an interfering signal carrier. Input range: 42~120 MHz

12-5 System Connection

12-5.1 Headend System Connection

1. The DS1610-1D connects with your upstream optical receiver test points (the same as your CMTS)
2. The DS1615 output signal is combined into downstream optical transmitter signal. (DC coupler connection)

Note: Before combining the signal with your downstream broadcast network, **be sure to verify** that the chosen DS frequency is unused by any other live signals.

12-5.2 DS2831 Connection

1. The DS2831 has two ports: RF and COM. The RF port is the receiver port for local position spectrum signals. Press **R-Sweep > Com > RF** to enable the RF port to receive the comms signals. The COM port is for upstream transmission being generated by the DS2831 towards the DS1610 system upstream, used in bidirectional measurements. By default, the COM port receives the FSK communication signal.
2. At terminal position, if you want to look at all the information, use a two-way splitter, one splitter's path connected to the COM port, to transmit upstream test signals and receive the DS1610 broadcast signal, another path connected to RF port to measure local position spectrum traces.

At the optical node or bidirectional amplifier, the COM port of the DS2831 should be connected to the bi-directional amplifier (or bidirectional optical node) reverse path output test port; the RF port should be connected to the output test port of a bi-directional amplifier (or bi-directional optical node).

12-6 Troubleshooting

If the DS2831 cannot register, use the spectrum analysis function of the DS2831 to verify whether the downstream signal sent by DS1615 is active & normal or not. If not, check the relevant parameter settings of the downstream communication and health of the downstream network; then run the client side of the DS1610-1D. Open the 1610-1D port connected with the DS2831, and open the maximum value display.

When the DS2831 is registering, the frame should pause for a while, and the maximum value should show that the "pilot frequency" has a signal which is over the "pilot amplitude"; if it doesn't display or the amplitude value is lower, verify the relevant parameter settings of the upstream comms channel and the status of the upstream network.

Chapter 13: Upstream Signal Generator

The upstream signal generator (USG) optional function is used to characterize the quality of a signal being transmitted in an RF upstream HFC link.

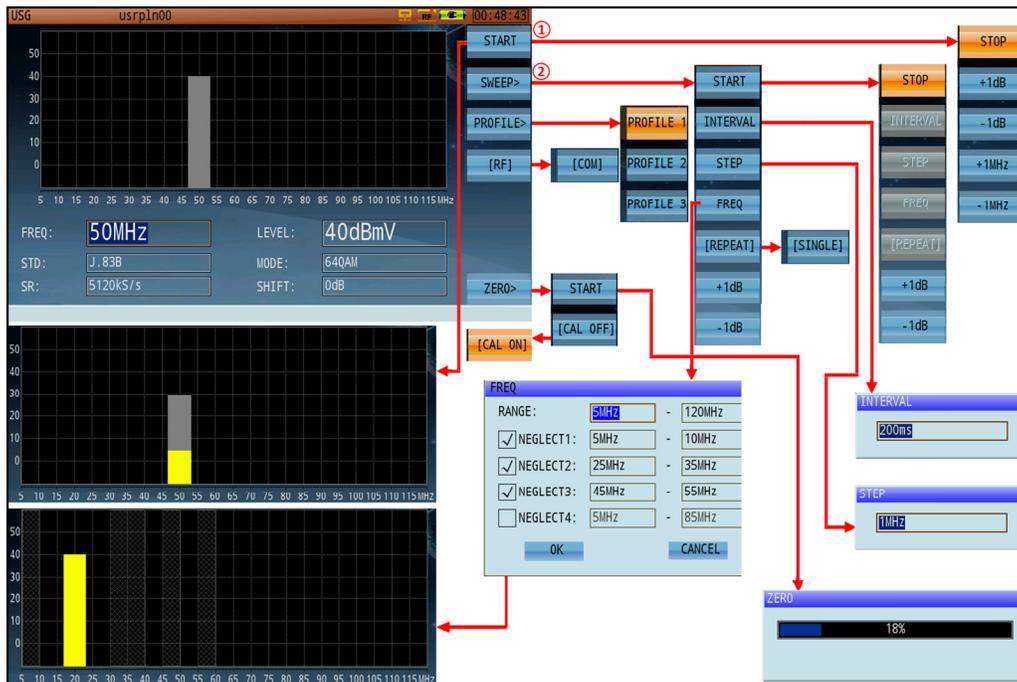
The USG generates upstream carrier signals from 5~210MHz (PRBS coding with a QAM signal is desirable if FEC coding of an upstream QAM carrier is required for Pre-Post FEC performance verification). It supports QPSK, 16QAM, 64QAM and 256QAM modulation modes, as well as J.83Annex A & J.83 Annex B FEC code modes. The symbol rate range is 1~7MS/s. MER performance >43db.

13-1 Basic Operation

From the **Home** menu, press **Upstream** (F2) and use the rotary knob to open the Upstream Signal Generator application. To adjust parameters (see below), use the rotary knob to highlight and select the desired setting. Then use the arrow keys to adjust its value. Click the rotary knob to confirm your choice. **FREQ**, **STD**, **SR** (Symbol Rate), **LEVEL**, **MODE** and **SHIFT** may be adjusted.

NOTE: Before pressing **Start**, first ensure that no active signals are present at the same frequency, as the USG signal will disrupt existing live signals on the network (e.g., DOCSIS signals).

The gray bar will fill up with yellow if USG is successful, indicating transmitting signal.



Upstream Signal Generator and function submenus

13-1.1 Settings

The following parameters can be adjusted in the USG mode.

Freq. range:	5~120MHz. This range allows network characterization over 42 MHz [NA] or 65 MHz [EU], as duplex filter field upgrades continue.
Standard:	J.83A, J.83B
Symbol Rate:	1.00 ~ 7.00MS/s
Level:	0 ~ 60dBmV
Modulation:	Annex A: CW, QPSK, 16 / 64 / 256 QAM Annex B: CW, 64 / 256 QAM
SHIFT:	-6dB~+6dB (used to compensate for the test cable length or input port insertion loss)

13-2 Sweep Function

The USG application offers a frequency stepping (sweeping) function. Follow the instructions below to activate it.

Press **Sweep>** (F2) to open the frequency sweep submenu. Here, press **Freq** (F3) to open a dialog for setting the start/stop frequencies of the sweep. You can set up to 4 guardband frequencies.

The shadowed parts on the display screen will show the currently programmed guardbands. For a CW signal sweep, the frequency steps are 1MHz, and the sweep will only jump over guardband frequencies. For modulated signals, since the bandwidth occupied by the signal is large, the guardbands are equal to half of the generated test signals, directly related to the symbol rate of the test signals selected. This may limit the symbol rate required, depending on spacing available between live (desired) signals.

Even if the instrument has started transmitting test signals, amplitude adjustments can be made by pressing the **[+1dB]** and **[-1dB]** function keys to ensure that the amplitude of the transmitted test signals is exactly as desired. The frequency and amplitude of the sweep test signals will dynamically update on the screen. This helps to prevent measurement errors; unlike levels, frequency cannot be adjusted during a measurement.

The **Interval** key allows the user to set a delay between each of the test carrier frequency steps to be generated, speeding up or slowing down the sweep motion. This delay may range from 100~1000ms. **Single/Repeat**, meanwhile, is used to control the frequency sweep to run a single cycle or on a running loop until you press the **Stop** key.

By default, the DS2831's RF port is used for test signal output. Press **RF/COM** (F4) to toggle the output port to COM instead.

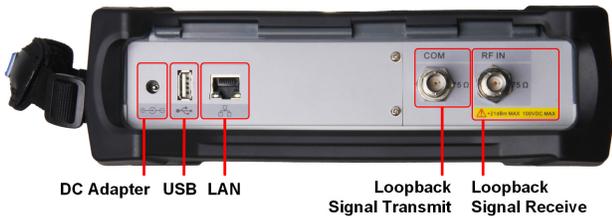
As a general safe practice, always initiate a USG test signal transmission with levels as low as possible at first and work your way up to a level quasi-equal to that of your live DOCSIS signals. This prevents introducing unnecessary additional RF power, potentially overdriving your lasers, and introducing non-linear distortions on your network.

Finally, press **Zero** (F7) to self-calibrate the USG. The cable connection of self calibration is shown as Figure 19 2 to connect RF port and COM port. At this moment, COM is USG output port, the output signals will enter RF port and are received by DS2831 itself spectrum function, then execute self calibration and generate the compensation data. If user select **【有效CAL ON】**, the application will execute self calibration and generate the compensation, but if user select **【无效 CAL OFF】**, signals emission will not use the compensation data but use signal generator itself original calibration data.

Chapter 14: Loopback Test

The Loopback Test function is a level test that only provides information on level loss in a loop. The levels measured indicate RF levels measured at the input, as it is received.

The output signal generator (indicating the output level generated), minus the received level at the RF IN port, indicates the signal loss in the loop under test.



Chapter 15: DOCSIS 3.1 Cable Modem Test

To link a PC to the instrument and use the DS2831 as a DOCSIS 3.1 32x8 or OFDM cable modem, connect a standard Ethernet cable to the LAN port in the DS2831's top panel. Set the computer network IP settings to DHCP. The computer can then access the Internet once the Cable Modem has registered with the CMTS.

The DS2831 incorporates an automatic switching Ethernet chip. The DHCP function of the instrument does not conflict with the DHCP function of an external computer, so the DHCP mode does not need to be disabled.

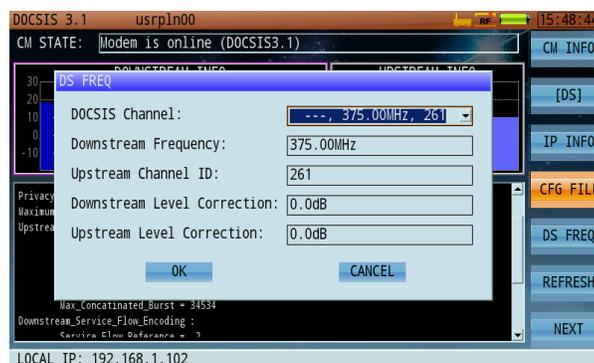
There is one exception, however. If the Cable Modem configuration files sent by CMTS include the setting **Maximum_Number_of_CPEs=1** (meaning that the Cable Modem can support only one CPE device), the DS2831's DHCP does need to be disabled. This allows the computer to automatically acquire an IP.

15-1 Basic Operation

Before starting a cable modem measurement, ensure that **DHCP** is enabled in the unit's settings.

If the downstream frequency and upstream channel ID of the bidirectional network are already known, press **DS Freq** (F4) to preset the priority downstream frequency and upstream channel ID. This helps shorten registration time dramatically, as the instrument will not have to scan for the DS DOCSIS main channel frequencies and will instead seek connection at the programmed frequency directly. (See below.)

Users may also set the "Level Correction" value to compensate for inaccuracies. The final result displayed on the screen will be the measurement result + Level Correction value.



Cable Modem Downstream Frequency Configuration



The above icons appear when the Cable Modem function is active. The color of the four dots indicates the CM status.

Red: CM is initializing.

White: CM is registering with the CMTS.

Green: CM has successfully registered with the CMTS.

Configure your channel plan before conducting the CM measurement, as shown below.

USER PLAN	STA	CH	TYPE	FREQ(MHz)
usrpln00	✓	30	DOCSIS	261.00
usrpln01	✓	31	DOCSIS	267.00
*usrpln02	✓	32	DOCSIS	273.00
usrpln03	✓	33	DOCSIS	279.00
usrpln04	✓	34	DOCSIS	285.00
usrpln05	✓	35	DOCSIS	291.00
usrpln06	✓	36	DOCSIS	297.00
usrpln07	✓	37	DOCSIS	303.00
usrpln08	✓	38	DOCSIS	309.00
usrpln09	✓	39	DOCSIS	315.00
usrpln10	✓	40	DOCSIS	321.00
usrpln11	✓	41	DOCSIS	327.00
usrpln12	✓	42	DOCSIS	333.00

PLEASE NOTE
 The CM can receive signals of -10~+20 dBmV. Signal levels outside this range will prevent connection to the CMTS. Adjust the attenuation level to place the signal within this range.

- Procedure:**
1. Set channel type to DOCSIS. Set other parameters as testing needs warrant.
 2. In the Cable Modem function, open the DOCSIS channel list and select your desired channel.
 3. Press "OK" to confirm. Note status. If connection does not succeed, re-check measurement parameters.

DS FREQ

DOCSIS Channel: 30, 261.00MHz, 0

Downstream Frequency: 261.00MHz

Upstream Channel ID: 0

Downstream Level Correction: 0.0dB

Upstream Level Correction: 0.0dB

OK CANCEL

Cable Modem ma5633 12:48:31

CM STATE: Modem is online (DOCSIS3.1)

DOWNSTREAM INFO

FREQ(MHz)	BW	P(dBμV)	MER	PRE/CORR	POST/UIC
261(256Q)	6.0	75.6	40.4	---	---
267(256Q)	6.0	76.1	40.9	---	---
273(256Q)	6.0	76.2	40.9	---	---
279(256Q)	6.0	76.2	40.9	---	---
285(256Q)	6.0	76.2	40.9	---	---
291(256Q)	6.0	76.1	40.4	---	---
297(256Q)	6.0	75.9	40.4	---	---
303(256Q)	6.0	75.8	40.9	---	---
309(256Q)	6.0	75.7	40.9	---	---
315(256Q)	6.0	75.5	40.8	---	---

UPSTREAM INFO

ID	FREQ(MHz)	P(dBμV)	BW
1	10.0(64Q)	104.5	6.4
2	17.0(64Q)	103.0	6.4
3	24.0(64Q)	103.0	6.4
4	31.0(64Q)	103.0	6.4
5	38.0(64Q)	103.0	6.4
6	45.0(64Q)	104.5	6.4
7	52.0(64Q)	105.0	6.4
8	59.0(64Q)	105.0	6.4
	66-106(2K)	106.1	39.0
	108-204(2K)	108.5	95.0

CM INFO

[DS]

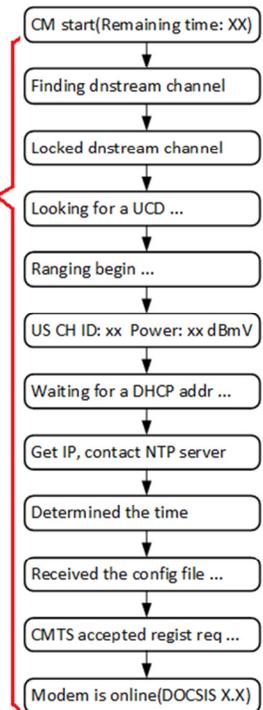
IP INFO

US ICFR>

DS FREQ

REFRESH

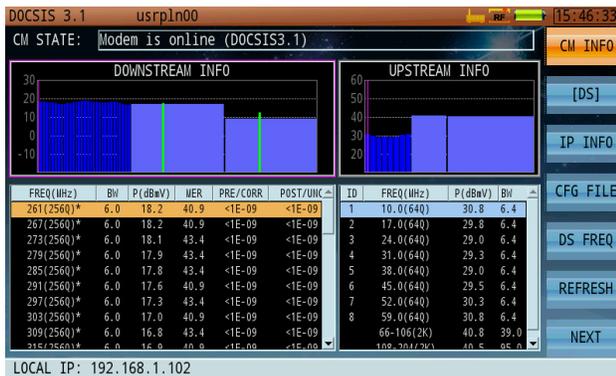
NEXT



15-2 Cable Modem Tools

15-2.1 Cable Modem Info

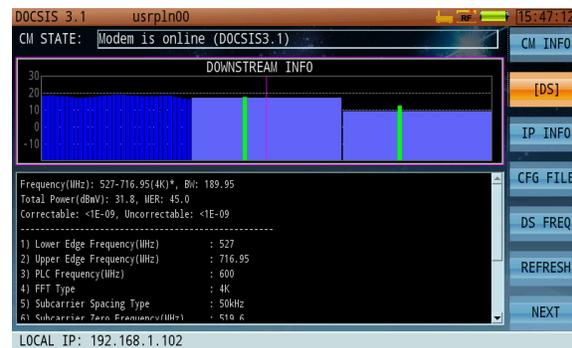
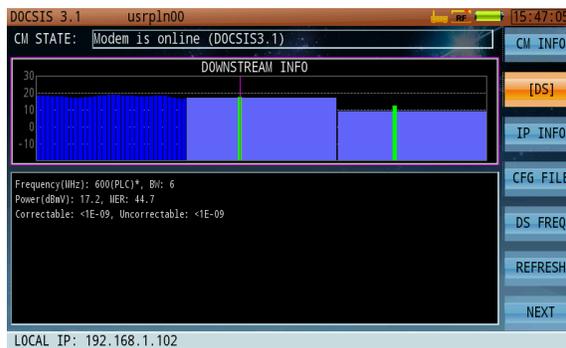
Once the CM has registered, press **CM Info** (F1) to display downstream/upstream RF signal status.



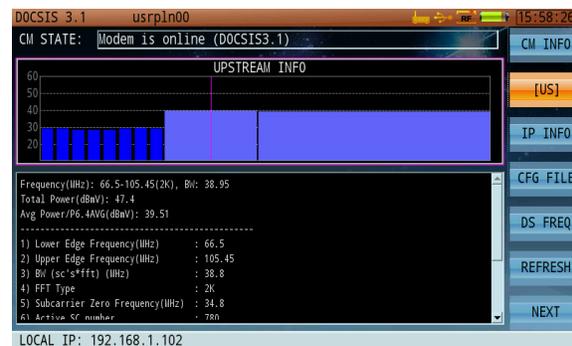
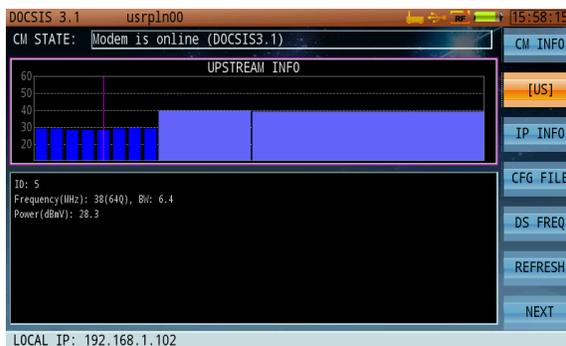
The CM registration status, signal type, and DOCSIS standard are displayed at the top of the screen. Downstream/upstream list parameters are displayed in the 2 panes at the bottom of the screen. Press **DS/US** (F2) to toggle between downstream & upstream info for QAM and OFDM modulation parameters.

Downstream details include frequency, signal level, modulation mode, S/N, symbol rate, & pre/post BER.

Upstream details include channel ID, frequency, signal level, modulation mode, and bandwidth.

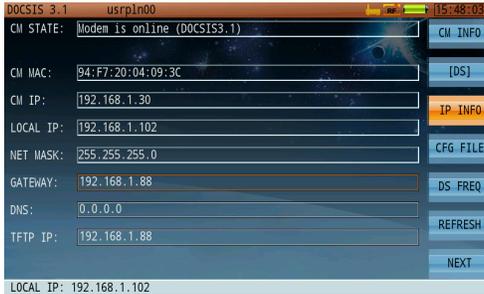


Downstream QAM (left) and OFDM (right) data



Upstream QAM (left) and OFDM (right) data

15-2.2 Cable Modem IP Details



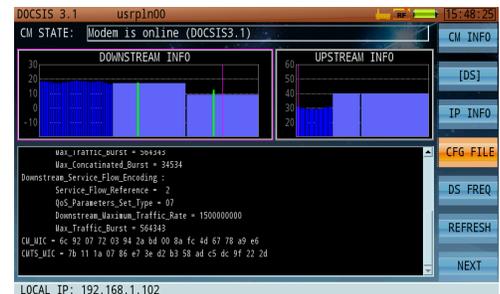
Once the CM has registered, press **IP Info (F3)** to show the following network details: MAC address, CM IP address, local IP address (DS2831's IP), subnet mask, default gateway, DNS, and TFTP server IP address.

In this interface, press the rotary knob to access the PING measurement interface and measure the connectivity of the selected IP address, as shown.

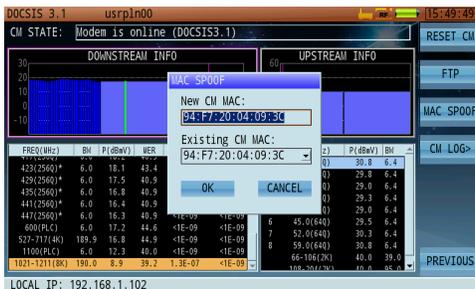
15-2.3 Cable Modem Config (Profile) Info

To confirm the configuration files sent by the CMTS, press **CFG File (F4)** once the CM is registered.

If the Cable Modem registration fails, press **Refresh (F6)** to restart the registration process.



15-2.4 MAC Spoofing



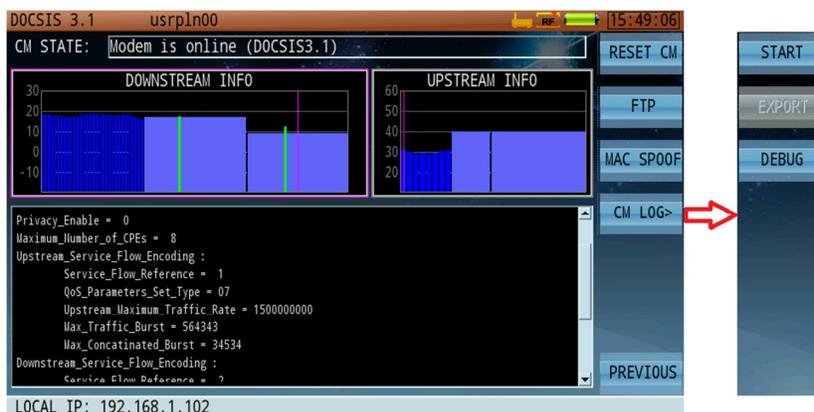
If your network does not have BPI+ enabled, you may benefit from the ability to “spoo” a customer’s MAC address during installation. Press **Next (F7)** and **MAC Spoo (F3)** to modify the MAC address.

You can copy the MAC address from the customer CM MAC that you are about to install, or that you wish to troubleshoot (left).

15-2.5 Log Recording

Technicians encounter a variety of service issues and network environments. When conducting a Cable Modem test in a new network, certain front-end device settings may cause the CM test to fail. Here, the technician may turn to the manufacturer's support engineers; but they cannot always obtain the on-site network device settings. This makes diagnosis difficult. The DS2831's Log Recording function generates a complete, detailed record of the connection process, allowing engineers to diagnose issues.

To record a log, start the cable modem and press **Next** (F7), **CM Log** (F4), **Start** (F1). The CM function will restart the connection and registration process.



Once the test concludes, the data is stored on the DS2831's hard drive. Insert a USB storage device into the instrument's top panel. In the **CM Log** submenu, press **Export** (F2) to copy the log to the inserted drive.

Deviser's support experts can help interpret the log and diagnose the connection problem – see the end of this guide for contact information.

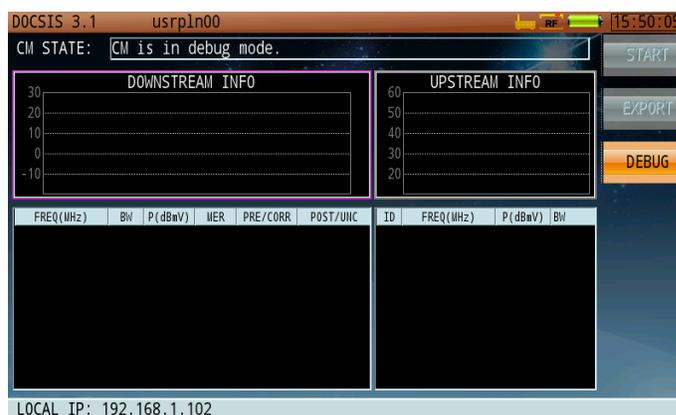
15-2.6 Online Debug

The DS2831 includes a tool for directly debugging cable modem functions. This tool can help field engineers manage and print CM output data via the network port, which may aid troubleshooting efforts.

NOTE: The debug and logging functions (see subsection 15-2.5) cannot be used at the same time.

In the **CM Log** submenu, press **Debug** (F3) to start Debug Mode as shown (right). Then, check the local IP address. Use a PC and Ethernet cable to connect to the device IP address, using a TCP debugging or Telnet tool.

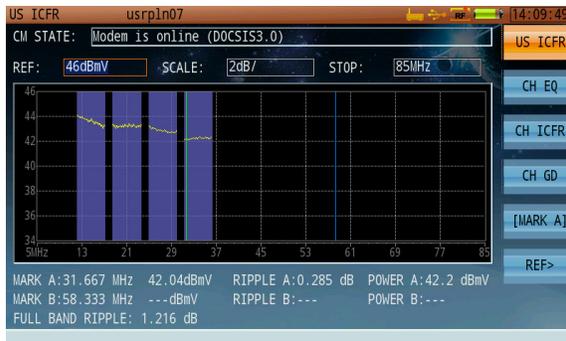
The port number is 1001.



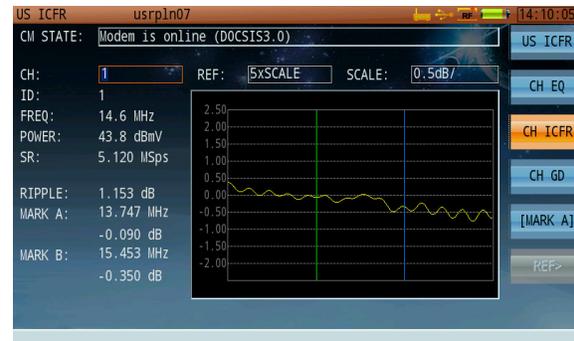
15-2.7 Upstream ICFR

Optionally, you can also measure upstream in-channel frequency response, using the Cable Modem's pre-equilibrium function. In upstream channels, CMTS can acquire channel parameters according to received Cable Modem signals. These channel parameters are transmitted to the corresponding cable modem, which will adjust the emitted upstream signal in response.

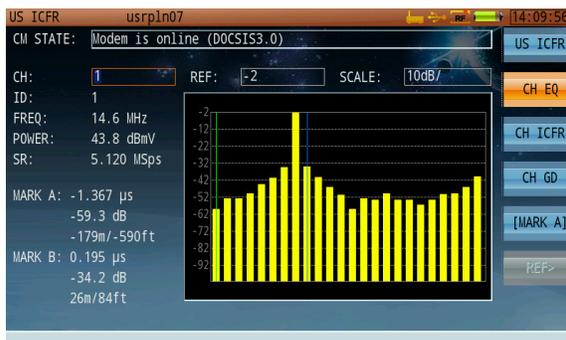
Note that the pre-distortion of these signals can offset the linear distortion of the upstream channel, improving the quality of signals reaching the CMTS port. (For more on nonlinear distortion, see Section 8-7.)



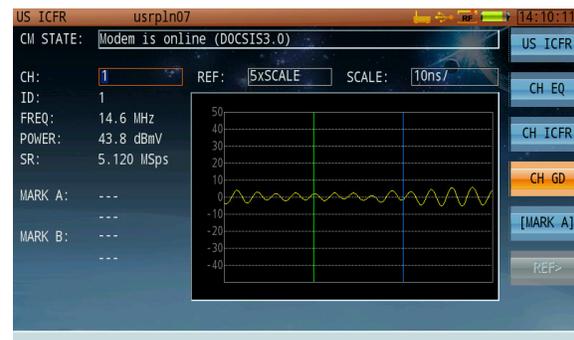
Upstream ICFR – all channels



Upstream ICFR – one channel



Equalizer – one channel



Group Delay – one channel

With the Upstream ICFR option, you can directly compare several frequency response traces in different positions. First, while conducting an ICFR test, press **Ref** (F6) and **Save Ref** (F1) to save a snapshot of the current trace. This will serve as a reference.

Next, use the touchscreen to move to another position on the signal transmission path. Perform another sweep. In the Ref> menu, press **Load Ref** (F2) to overlay the saved trace. By comparing sweep data from elsewhere on the path, you can identify problems with the upstream signal.



Saving a reference trace



Loading a reference trace

Chapter 16: Throughput Testing

The throughput test function measures the upload and download speeds of the DS2831's cable modem function. (See Chapter 15: DOCSIS 3.1 Cable Modem.) Throughput has two modes, 1G and 3G. These support maximum test speeds of 1Gbps and 3Gbps links, respectively.

This mode requires a PC and Deviser's speed test companion software, which is included with the purchase of the DS2831 Throughput option. Contact your Deviser service representative for more information.



Throughput test

To conduct a throughput test, follow the instructions below.

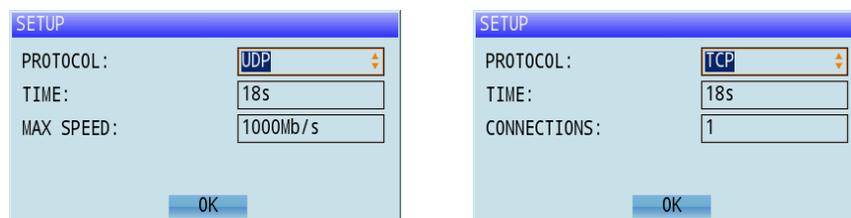
1. Ensure that the CM has successfully connected and registered under the assigned IP address. Otherwise, the throughput test cannot be performed.

NOTE: Currently, the Throughput function can only test a cable modem link.

2. Deviser offers a speed test software to assist Throughput. Using a PC installed with the software, deploy the speed test server on the CMTS side of the CM link. Configure and launch the software according to the instructions included.

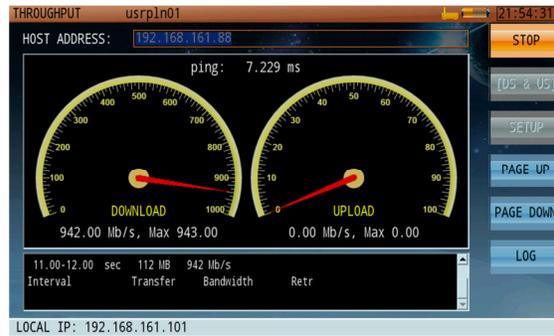
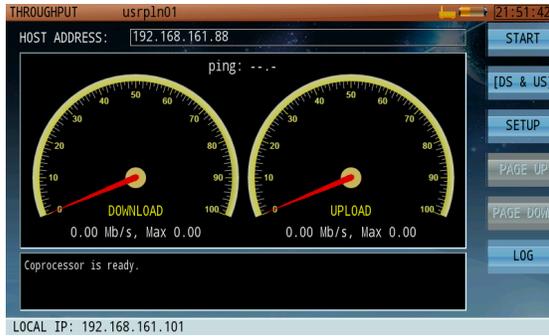
NOTE: For technical support with this software, please contact Deviser Instruments.

3. Launch the Throughput application. At the top of the screen, enter the speed test server IP address.
4. Press **Setup** (F3) to check the settings. Use the touchscreen and keypad to set the connection method (TCP / UDP), test duration (in seconds), and number of concurrent connection threads (for TCP) or maximum speed limit (for UDP). Tap **OK** to finish setup.

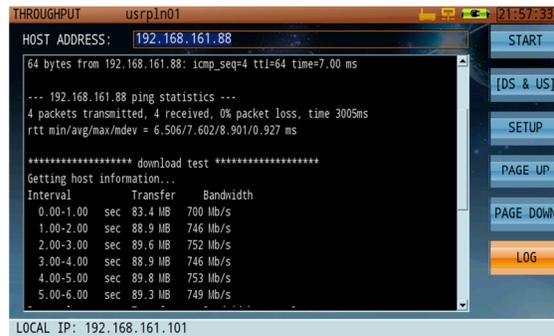


Throughput test setup

- Press F2 repeatedly to select the desired test items: upstream, downstream, or both.
- Finally, press **Start** (F1) to begin testing. During the test, you may press **Stop** (F1) at any time to interrupt the test before the scheduled time limit.



Conducting a throughput test



Completing a throughput test; viewing results

- After the test, press **Log** (F7) to view the throughput results. Use **Page Up** (F5) and **Page Down** (F6) to scroll through the test log.

Chapter 17: PPPoE

As a PPPoE client, you only need to provide a user name and password to initiate PPPoE dialing. Enter a username and password in the top two fields, using the alphanumeric keypad.

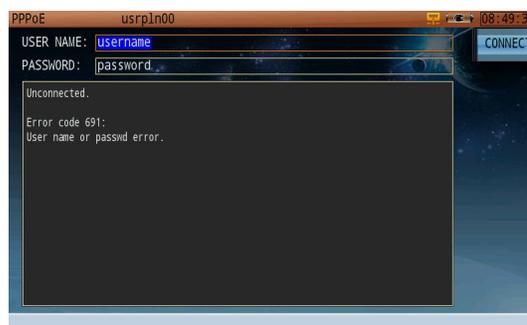
Once a login is entered, press **Connect** (F1) to initiate PPPoE dialing. Upon a successful connection; the following parameters will be acquired and displayed, as shown (below, left):

- IP address of PPP0
- Server IP address
- Subnet mask
- DNS

If the connection fails, an error code and error information will display for reference, as shown (below, right).



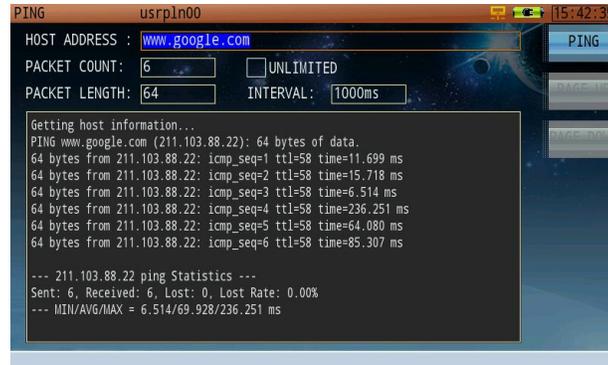
PPPoE Dialing



PPPoE Connection Error

Chapter 18: PING

PING is effective for quickly verifying your network connectivity status and speed, as shown below.



Ping Result Display

Input the network or IP address (e.g., www.google.com) to be tested in the host address box at the top, using the alphanumeric keypad. Then press **Ping** (F1) once to start the network test. You may press it again to stop the test, if necessary.

Ping results appear in real time in the window, as shown above.

Settings

Packet Count:	the number of data packets sent by the assigned PING order.
Unlimited:	If this box is checked, the PING function will fire continuously until Stop is pressed.
Packet length:	The packet length of the PING request.
Interval:	Time interval delay between ping packets, in ms.

Chapter 19: Traceroute

Traceroute is another practical network test used to verify your network route, connectivity status, & speed (as shown below). It identifies each hop <IP address> along the path between the instrument and the destination host.

```

TRACEROUTE usrp1n00
HOST ADDRESS : www.google.com
MAX HOPS: 30

Getting host information...
traceroute to 173.194.127.19, 30 hops max, 38 byte packets
[01] * * *
[02] * * *
[03] 117.131.178.97(117.131.178.97) 52.625 ms
[04] 211.103.86.241(211.103.86.241) 74.784 ms
[05] 221.183.13.45(221.183.13.45) 64.005 ms
[06] 221.183.8.158(221.183.8.158) 142.058 ms
[07] 221.183.10.90(221.183.10.90) 174.893 ms
[08] 221.176.18.114(221.176.18.114) 107.101 ms
[09] 221.176.24.234(221.176.24.234) 89.282 ms
[10] 223.118.10.2(223.118.10.2) 113.157 ms
[11] 223.119.30.86(223.119.30.86) 127.991 ms
[12] * * *
[13] 72.14.238.145(72.14.238.145) 62.529 ms
  
```

Traceroute Results

Results displayed include the IP address and name of each hop between the DS2831 and the destination host, and the time (in ms) for the data to transmit to and from the routing equipment.

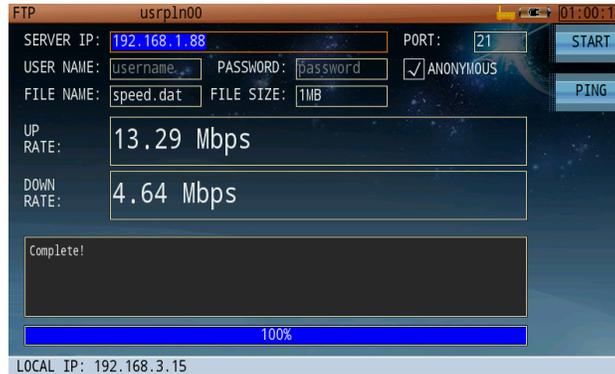
Input the desired network address to test in the host address bar, and then press **Start** (F1) to initiate the test. Press F1 again to stop the test. Results are displayed in real-time.

Max. HOPS refers to the maximum number of hops allowed for the test (user-defined).

If the list of data cannot be displayed all at once, a scroll bar appears. (See above.) Press **Page Up** (F2) and **Page Down** (F3) to scroll up and down the information window.

Chapter 20: FTP

The FTP mode is useful for testing upload/download speeds between the DS2831 and an FTP server, as shown below.



FTP Test

Measurement Settings

- Server IP: FTP server IP address
- Port: Sets the port number used by the FTP server (the default is 21)
- Username: Sets the username when connecting to a server that requires credentials.
- Password: Sets the password when connecting to a server that requires credentials.
- Anonymous login: Checked for ON, empty for OFF. (Ensure the desired server allows for anonymous login.)

When ready, press **Start** (F1) to initiate the test. The upload/download speed will display in real time. A status bar at the bottom of the screen indicates the degree of test progress. If the test encounters problems, an error message will display in the information window (shown below).



FTP Login Error

Chapter 21: Browser

From the **Home** menu, press **Upstream** (F2) and use the rotary knob to open the **Browser** application. This function equips the DS2831 with a basic web browser, able to load simple text, pictures, and hyperlinks and remember a number of website URLs.

Before opening any web page, ensure that your network setup is correct and active; the DS2831 must be connected to the Internet with an Ethernet cable, WiFi connection, or active Cable Modem session.

Note that web page Java or Flash plug-ins may not work as intended on the DS2831's browser, and may not be properly formatted for the unit's display.

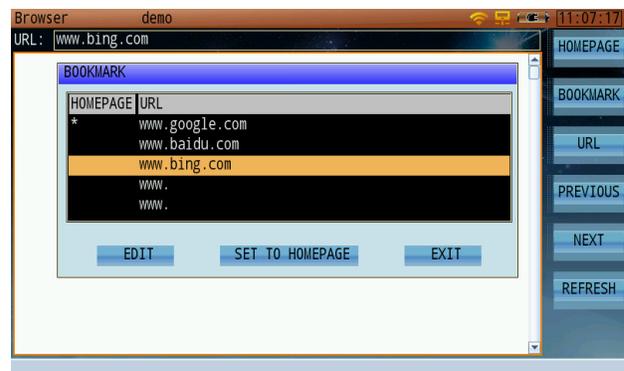
Hyperlinks are highlighted in blue (■) and may be available in the title bar of the browser. Use the arrow keys to scroll through different hyperlinks, then click the rotary knob to execute and open the related webpage. If the page is too large to fit on the DS2831's display, use the rotary knob to scroll up and down.

To skip ahead to the next page or return to the previous page, use the **Next** (F5) and **Previous** (F4) keys. Press **URL** (F3) to enter a new web site address with the alphanumeric keypad. Press the rotary knob to confirm your selection (shown below).

For frequently-accessed websites, a Bookmark menu is available for your convenience. Press **Bookmark** (F2) to open the bookmarks dialog. Use the arrow keys to highlight a URL from the list, and press the rotary knob to confirm your selection. If you want to set a particular URL as your homepage, use the rotary knob to select the **Set to Homepage** button. An asterisk (*) in the homepage column (shown below) indicates that this URL is the homepage, and will open automatically when the browser is opened.



Browser stored Website URLs



Browser Bookmark menu

NOTE: An updated browser is now available. If your DS2831 unit is unable to display images on the Internet, inquire with your local Deviser representative about upgrading your firmware to take full advantage of a better-performing Browser function.

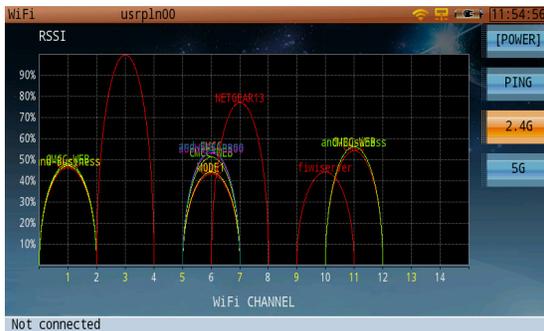
Chapter 22: WiFi Analysis

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 DS2831 location. (See the figures below for the graphical interface.)

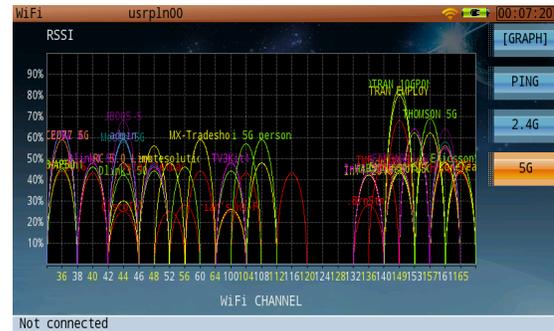
The WiFi Analysis function has two display modes: **graphical** and **list**. The list mode shows the name, status, channel, relative signal strength, MAC address, and encryption method of the SSID carriers detected.

Users can select a hotspot to connect to in the list page. If a successful WiFi connection is established, network tools such as Browser, PING and TRACEROUTE can be used.

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



2.4G WiFi Channel - Graphical Display



5G WiFi Channel - Graphical Display

NAME	STATUS	CH	LEVEL	MAC	ENC
Inf1-2016	---	136	43%	c8:f9:f9:1b:00:af	[WP]
Inf2-2016	---	136	43%	c8:f9:f9:1b:00:ac	[WP]
KillerTofu5G	---	149	43%	94:10:3e:b6:4c:80	[WP]
WAP50	---	136	43%	c8:f9:f9:1b:00:a7	[WP]
_EricssonSCTE	---	149	43%	00:0d:67:21:71:8d	[WP]
---	---	56	42%	50:60:28:7b:f9:f1	[NON]
---	---	44	42%	50:60:28:78:4f:71	[NON]
Intraway 5Ghz	---	165	42%	ac:9e:17:49:12:5c	[WP]
---	---	52	28%	50:60:28:7d:1b:f0	[NON]
Brian's Wi-Fi Netv	---	100	28%	34:36:3b:bd:b5:3d	[WP]
---	---	100	25%	50:60:28:7d:1b:d0	[NON]
---	---	48	25%	00:1b:c0:b4:b8:a5	[WP]
NETGEAR03	Not in range				

WiFi Channel - List Display

Add New WiFi Network

NAME	STATUS	CH	LEVEL	MAC	ENCRY
linkd	Connected	6	91%	00:22:3f:26:02:e2	[WPA2]
CMCC	Saved	1	65%	00:1f:64:e5:8a:ee	[ESS]
CMCC-AUTO	---	1	65%	00:1f:64:e5:8a:ee	[WPA2]
CMCC	Saved	6	64%	00:1f:64:e5:8a:f8	[ESS]
CMCC-AUTO	---	6	64%	00:1f:64:e5:8a:f8	[WPA2]
---	---	11	53%	00:50:c2:4b:80:0f	[WPA2]
---	---	11	47%	00:36:76:5c:75:24	[WPA-]
CMCC	Saved	11	47%	00:1f:64:e5:8a:ec	[ESS]
CMCC	Saved	6	46%	00:1f:64:e5:8a:f6	[ESS]
CMCC-AUTO	---	6	46%	00:1f:64:e5:8a:f6	[WPA2]
CMCC-AUTO	---	11	46%	00:1f:64:e5:8a:ec	[WPA2]
fwiwserver	---	1	43%	28:10:7b:53:f3:6a	[WPA-]

Connected linkd(00:22:3f:26:02:e2) wlan0 IP:192.168.1.11

Connected Network Status

Chapter 23: DOCSIS 3.1 OFDM DS Channel Test

New to the DS2831, this application allows you to test DOCSIS 3.1 OFDM downstream channel parameters and metrics. Before using this function, be sure to set up your channel plan with a valid DOCSIS 3.1 channel. See Chapter 4: Channel Plans for instructions.

If there are no DOCSIS 3.1 channels in your channel plan, one channel (#0, 600 MHz) will be automatically generated for you when the application is launched.



Adding a DOCSIS 3.1 channel



OFDM test four-panel interface

The OFDM test interface is divided into four panes (above, right). In general, statistical data (e.g. channel settings, power levels, and MER readings) are shown on the left, and graphical data on the right.

The OFDM test application contains three different modes. Use the function keys to configure integrated channel test (**CH>**), in-band frequency response test (**ICFR**), or spectrum analysis (**Spectrum**) settings.

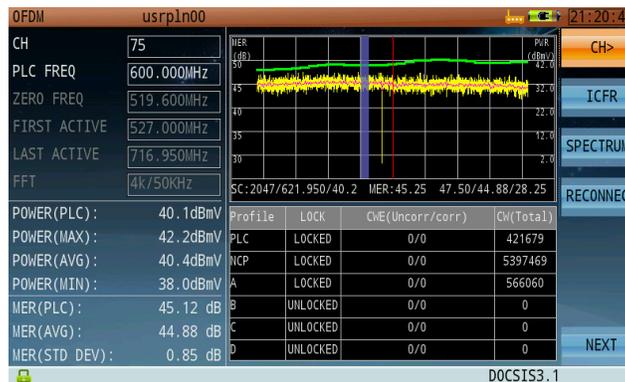
Use the submenus to alter which information is shown on the current measurement. For example:



Press **CH>** (F1), **[INFO]** (F2) (above, left) to show the full channel info pane. Then press **[VALUE]** (F2 again) (above, right) to show power and MER statistics, which overlay part of the channel info pane. You can freely toggle between these view modes at any time.

If the unit loses test connection, press **Reconnect** (F4) to try again.

23-1 OFDM Integrated Channel Test

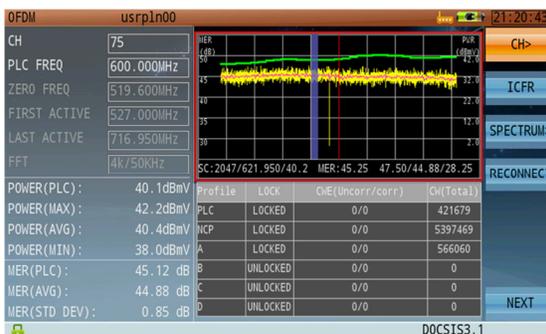


The integrated channel test contains channel power, MER, profile information, and other basic parameters. To adjust settings, press **CH>** (F1) to explore the submenu.

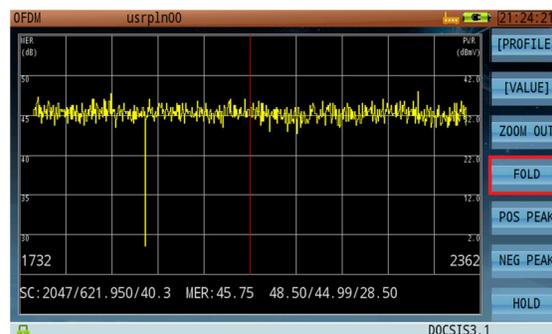
23-1.1 Settings

Button Operation

- [Profile / Graph]: Toggles Pane 4 between user profile information (displayed as a table) and OFDM sub-carrier MER graph.
- [Value / Info]: Toggles Pane 3 between channel information and power/MER readings.
- [Zoom In / Out]: Zoom in to expand Pane 2 graph display to fullscreen. Zoom out to return to normal view.
- [Fold / Unfold]: Only when zoomed in to power/MER carrier graph, When unfolded, each horizontal pixel identifies the signal level from one carrier. Use the touchscreen or arrow keys to examine different carriers. (See below.)
- POS PEAK: Moves graph cursor to the MER positive peak value.
- NEG PEAK: Moves graph cursor to the MER negative peak value.
- HOLD: Pauses the measurement for closer analysis. Zoom for best visibility.



Folded view, MER graph (zoomed out)



Unfolded view, MER graph (zoomed in)

Test Results

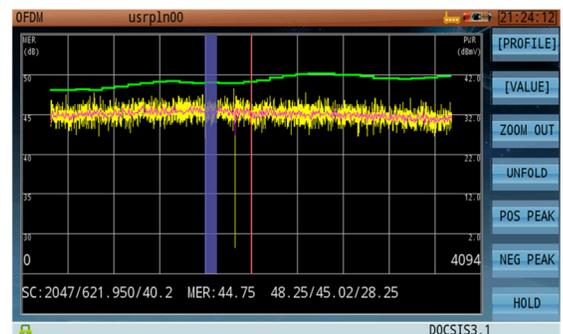
- POWER (P6):** Divides OFDM signal into segments of 6MHz bandwidth, then calculates channel power separately for each segment.
- POWER (PLC):** Channel power at location of PLC (power line communication). (6MHz)
- POWER (MAX):** Maximum readings of all POWER (P6) within OFDM frequency span.
- POWER (AVG):** Average readings of all POWER (P6) within OFDM frequency span.
- POWER (MIN):** Minimum readings of all POWER (P6) within OFDM frequency span.
- MER (PLC):** Average MER value of OFDM valid subcarriers (8 or 16) with PLC signal.
- MER (AVG):** Average MER value of all OFDM valid subcarriers.
- MER (STD DEV):** Standard deviation among all valid subcarriers' MER and average values.
- MER PCTL (2%):** Normal (Gaussian) distribution of all valid subcarriers according to the MER value. This value is a MER statistical threshold, that is, the number of carriers whose MER is lower than this threshold occupies all the active carriers 2% of the number.
- CW (TOTAL):** Total Code Word, the total number of transmission code words.
- CWE (Uncor):** Uncorrected code word error, uncorrectable error code word.
- CWE (Corr):** Corrected code word error, error-correcting error code word.

23-1.2 Interpreting the Data

The test interface includes a color-coded graph of signal levels and MER carrier statistics (shown, right). The graph illustrates two important measurements: the P6 power distribution curve, and the MER distribution curve.

Power (P6) Distribution Curve

When performing this measurement, the OFDM signal is first divided into 6MHz-bandwidths, and then the power levels of each segment are calculated and connected into a curve. This appears as the **green** trace in the graph.



For example, in a 4K OFDM scenario where the occupied bandwidth is 204.8MHz and each carrier is 50kHz, the signal can be divided into 32 frequency bands of 6MHz, each covering 120 carriers. By calculating the power levels of these 32 bands, we get 32 distinct data points to connect into a trace.

MER Distribution Curve

Here, the DS2831 reads the MER of all subcarriers and processes them according to the width of the display window. This appears as the **yellow** and **pink** traces in the graph.

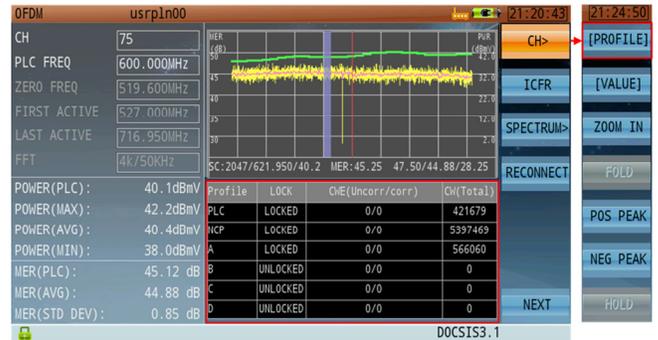
For example, in a 4K OFDM scenario where the display window is 256 pixels wide, each pixel must display the MER data of 16 carriers. By calculating the maximum, minimum, and average MER of these 16 carriers and plotting them, the user can see how they fluctuate over time.

In the graph above, the yellow trace reflects the difference between the maximum/minimum MER values of all carriers in each column, while the pink curve reflects their average MER. The blue translucent region marks the PLC frequency.

You can also move the cursor (red line), using the touchscreen or arrow keys. Check the bottom of the screen to see the subcarrier currently marked by the cursor, as well as its carrier number, frequency, power level, MER, and more. The cursor can be moved to the corresponding carrier with the positive/negative peak search tools (F5 and F6).

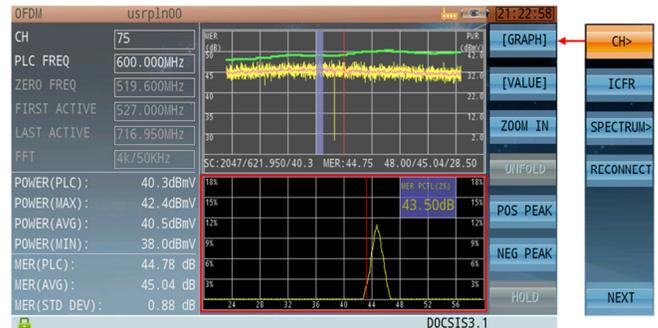
In the **CH>** (F1) menu, enter Profile view to see the profile information table (shown, right).

This table shows the status of NCP, PLC, & profiles A, B, C, and D; as well as bit error rate statistics.



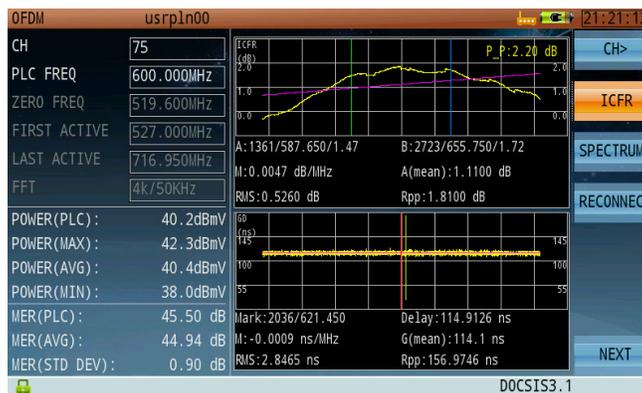
In the same menu, enter Graph view to see the carrier MER distribution graph. This graph shows the ratio of [occurrences of all MER values across all carriers] : [total number of carriers].

As shown, most carriers measure at 44~48dB MER. Among these, about 98% of carriers measure >45.25dB.



23-2 OFDM In-Band Frequency Response

From the main OFDM menu, press **ICFR** (F2) to enter ICFR mode.

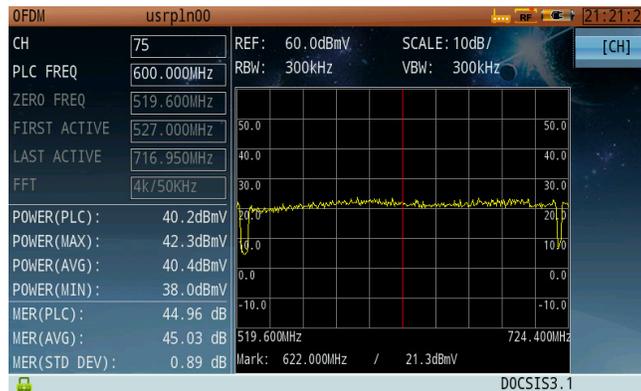


In this mode, you can view in-band frequency response curves and group time-delay curves individually, in order to determine whether the current signal transmission meets design requirements. If the ICFR values fluctuate too widely over time, there may be a problem with the cable, connectors, or other components.

23-3 OFDM Spectrum Measurement

The OFDM spectrum mode is designed to quickly analyze an OFDM channel or full-band spectrum. Press **[CH / Full BW]** (F1) to toggle between views.

Customizable parameters include REF (reference level), display scale, RBW, and VBW. The spectrum display occupies panes 2 and 4 of the OFDM interface, as shown below.



Spectrum Measurement – OFDM Channel

When measuring an OFDM channel, the start frequency corresponds to the OFDM signal's zero frequency; spectrum span is determined by the signal's occupied bandwidth. In the example above:

- Start freq. = 519.6 MHz
- Span = 204.8 MHz



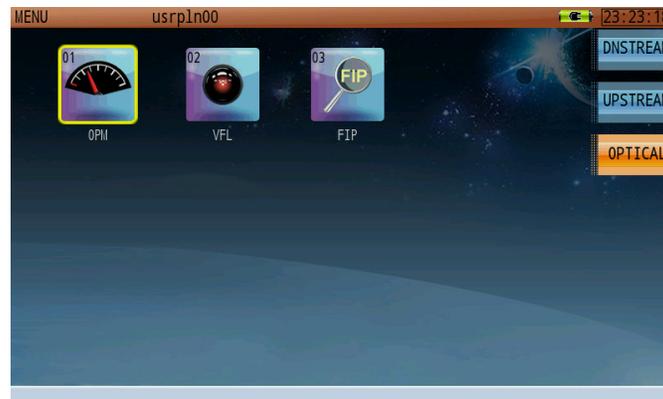
Spectrum Measurement – Full-Band Spectrum

When measuring the full-band spectrum, the frequency range is fixed at 105~1220 MHz.

Chapter 24: Optical Fiber Applications

The DS2831 is equipped with a variety of optical measurement functions and tools, for use in testing and maintenance of fiber-optic communications equipment. These include:

- Optical power meter (OPM)
- Visual fault locator (VFL)
- Fiber optical inspection scope (FIP)



Optical Measurement Screen

From the **Home** menu, press F3 to open the optical measurement menu (shown above). The optical power meter (OPM), visual fault locator (VFL) and fiber optical inspection scope (FIP) applications are available from this screen; use the rotary knob or dial the appropriate icon number to launch your desired function.

24-1 Introduction to Fiber Connectors

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.



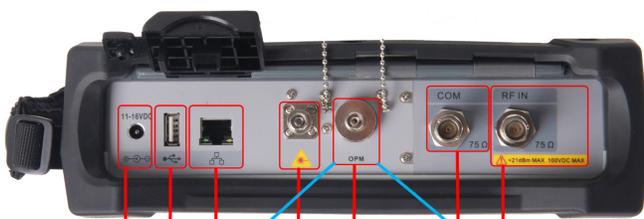
FC Connector



SC Connector



ST F Connector



DC Adapter USB LAN VFL OPM FSK RF Input USG Output
 Communication USG Output



The DS2831 uses the FC/SC/ST replaceable universal connector interface. Users may replace these with different connector interfaces, as appropriate for field applications. (See below.)

NOTE: If you purchased your DS2831 after July 1st, 2016, the default connector type for the OPM function is SC-APC. VFL is standard with ST-PC.

Replaceable FC/SC/ST universal connector interface

24-2 Optical Power Meter



Optical Power Meter Measurement Screen

Procedure:

1. Connect the optical power meter signal input port to the optical fiber for testing.
2. In the **Home** menu's optical application page, use the rotary knob to launch the optical power meter function.
3. As shown above, set the wavelength as desired. Available wavelengths include 850, 980, 1300, 1310, 1490, 1550, and 1610nm. Optical power measurement results will appear on the gauge, with numeric readings listed below.
4. Press the **Esc** button to quit power meter operation and return to the menu.

DBm and mW Conversion table

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

24-3 VFL (Visual Fault Location)

In practice, engineers often use a type of red light source to visually identify bends, faults, or breaks in a length of optical fiber. These light sources are usually termed visual fault locators.

Through the VFL port on the DS2831's top panel, it is possible to perform the same function. When active, the port emits a bright red LED beam.

SAFETY WARNING!

Take caution with high-powered light sources, or serious eye damage may occur. To avoid risk of blindness, do not look directly into the VFL port, and keep the safety cap on when this function is not in use.



Visual Fault Locator Screen

Procedure:

1. Connect the optical fiber for testing to the VFL signal output port on the DS2831's top panel.
2. In the **Home** menu's optical application page, use the rotary knob to launch the visual fault locator function.
3. Press **ON** (F1) to switch on the beam. Examine the length of the fiber for places where the beam shines through more easily; these spots may indicate weak fiber walls.
4. Press F2 repeatedly to cycle through flash modes. **Normal** causes a continuous beam. **1Hz** causes the beam to flash on and off at a rate of about 1 flash per second. **2Hz** causes the beam to flash at about 2 flashes per second.
5. When finished, turn the beam **OFF** (F1) and disconnect the fiber from the DS2831. Press the **Esc**  button to quit VFL operation and return to the menu.

24-4 Fiber Scope

A crucial part of optical fiber maintenance is ensuring that the fiber endface is free of contamination. When particles of dirt or debris become caught in the endface, signal transmission performance suffers. The DS2831's fiber inspection scope allows you to examine connector endfaces in real-time, identifying issues with automatic pass/fail testing.



Fiber Optical Inspection Scope

Procedure:

1. Connect the fiber inspection scope USB connector to the USB port in the DS2831's top panel. Then connect the optical fiber for testing to this connector.
2. In the **Home** menu's optical application page, use the rotary knob to launch the fiber inspection scope application.
3. The scope's image will appear on the DS2831 screen. Using the focus knob on the scope, adjust the image until it is clear.
4. The entry fields on the right allow you to control the scope's brightness, contrast, and sharpness. Use the rotary knob and arrow keys to tune these values, creating a clearly visible image (as above).
5. Press **Diagnosis** (F1). The DS2831 will attempt to highlight contamination. If it cannot produce a result, re-adjust the focus and image parameters and try again. If contamination is detected, it will appear in red on the screen with a FAIL notification. Otherwise, the instrument will show PASS.
6. When finished, press **Esc**  to quit the inspection scope function and return to the menu.

Part III

Background and Concepts

Unit Conversion Chart

Unit	Impedance 50Ω	Impedance 75Ω
μV	1μV=10 ⁻⁶ V	1μV=10 ⁻⁶ V
mV	1mV=1000μV	1mV=1000μV
dBμV	0dBμV=1μV	0dBμV=1μV
dBmV	0dBmV=1mV	0dBmV=1mV
dBm	0dBm=107dBμV	0dBm=108.8dBμV

Chapter 25: 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. But for broadband engineers and technicians, the key points are 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 just 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.

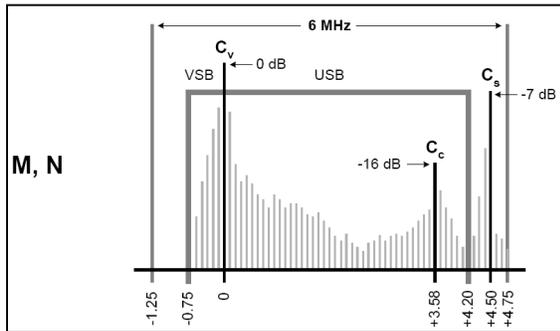
Refer to the table below for information on TV-standard/color system compatibility. Letters (e.g. B, G, M) refer to TV standards. Encoding techniques (e.g. NTSC, PAL) refer to systems.

TV Standard and Color Transmission System Relationships:

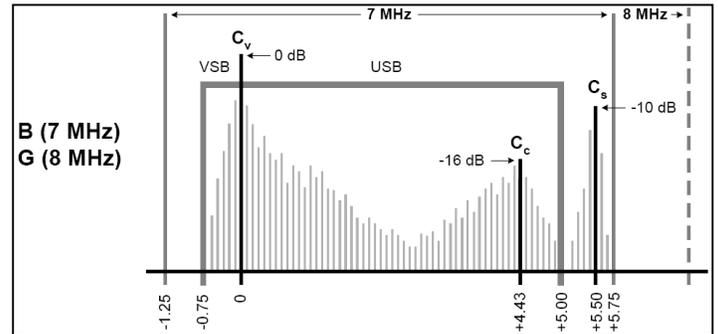
Standard	Compatible with:
B	PAL, SECAM
D	SECAM
G	PAL, SECAM
H	PAL, SECAM
I	PAL
K	SECAM
K1	SECAM
L	SECAM
M	NTSC, PAL
N	PAL

Reference for the Following Diagrams:

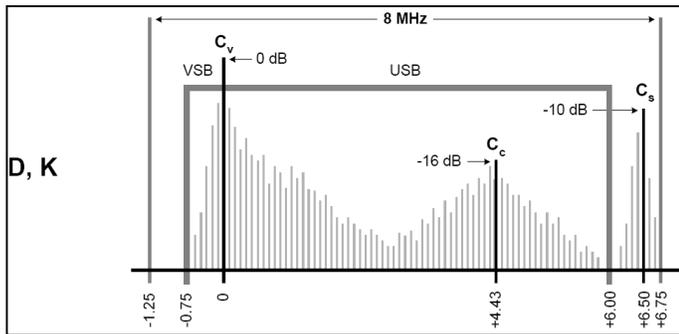
- Cs: Audio carrier
- Cv: Video carrier
- Cc: Color subcarrier
- VSB: Vestigial Sideband
- USB: Upper Sideband



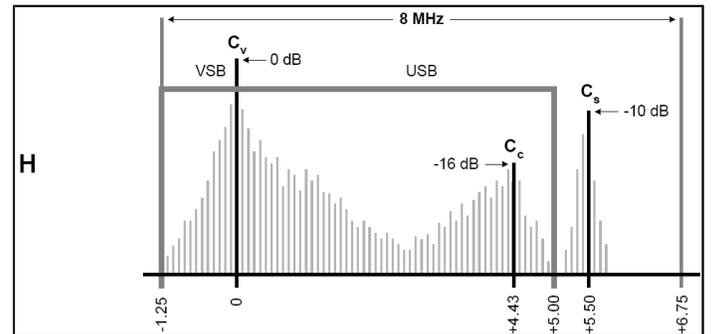
TV Standard - M, N



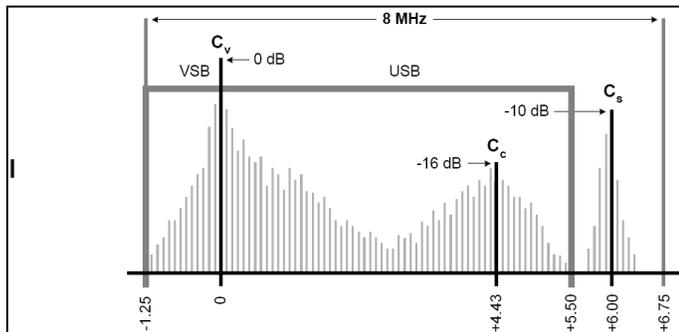
TV Standard - B, G



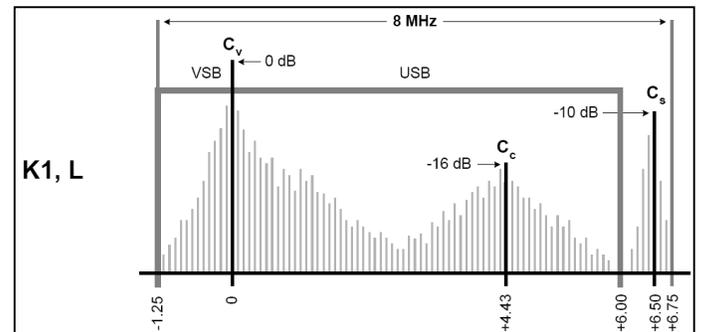
TV Standard - D, K



TV Standard - H



TV Standard - I



TV Standard - K1, L

TV standard and color system parameters setup

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

Different standard audio frequency and bandwidth

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

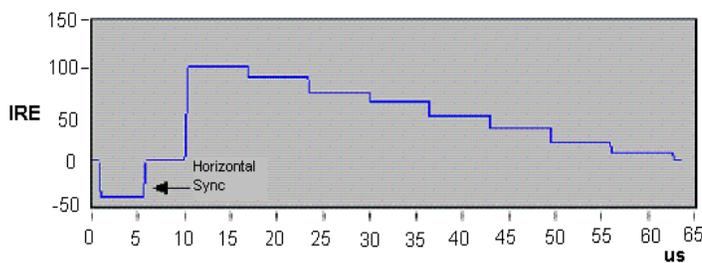
Chapter 26: Analog TV Baseband Signals

26-1 Understanding Composite Video Signal

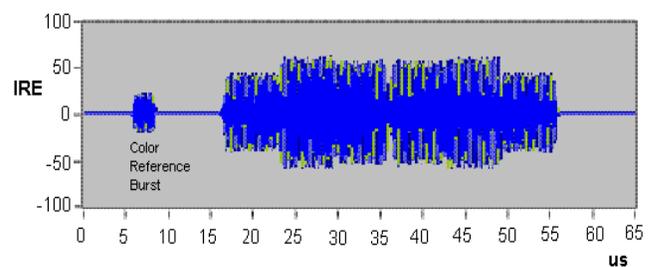
A composite video signal is a signal containing all three main components required to generate video. These components are:

- 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.

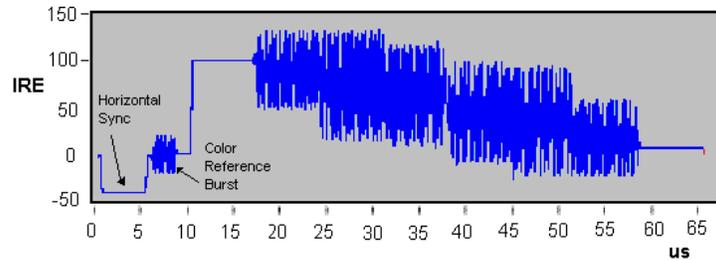
The monochrome composite signal (or “Y signal”) is constructed from two of these components: luminance and synchronization.



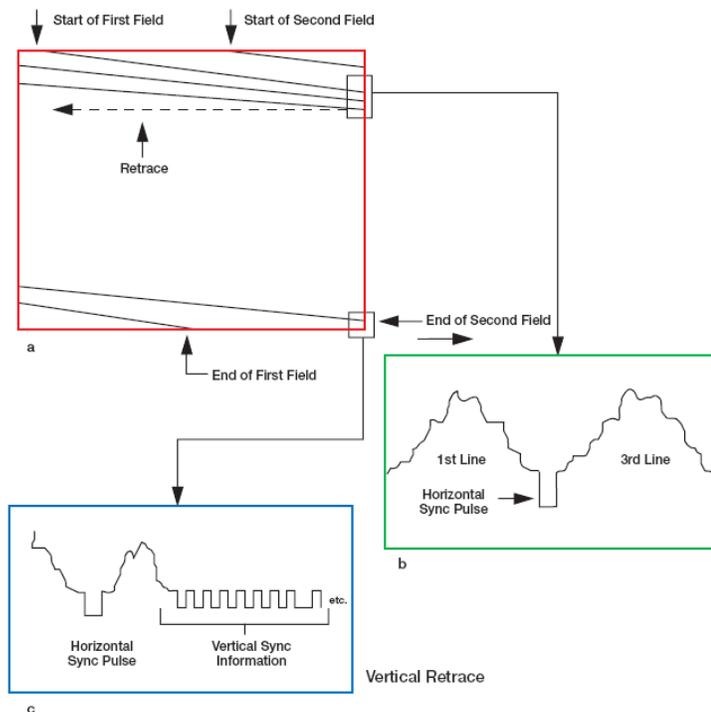
Here, the luminance steps from white to black.



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

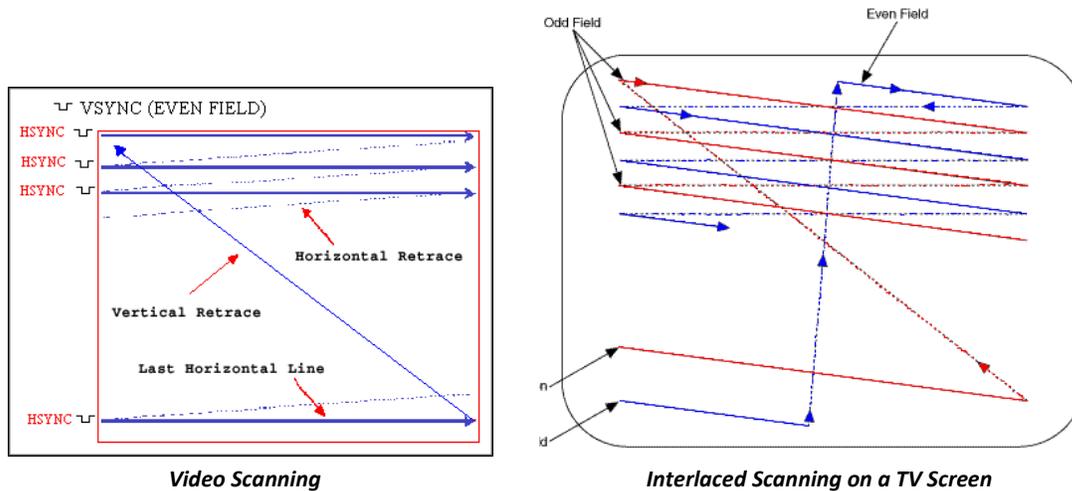
Video Format	Lines/Frame	Active Lines	Frame Rate (frames/sec)	Line Duration	Active Line Duration
NTSC	525	480/486	29.97	63.55 μ s	52.2 μ s
PAL/SECAM	625	576	25.00	64.00 μ s	52.0 μ s

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 $63.55 \mu\text{s}$, only $52.2 \mu\text{s}$ are the active line duration in NTSC. Frame rate is the scanning speed.

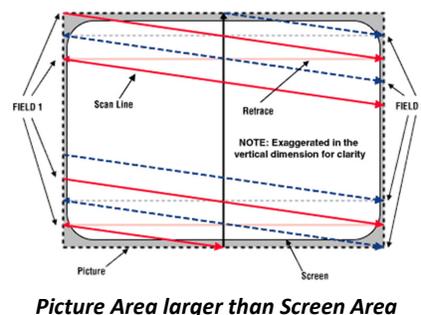
26-2 Principles of Interlaced Scanning

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.



26-3 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.

26-3.1 CCN, CSO and CTB Gated Measurements

CCN, C/CSO and C/CTB all can do gated measurement, but the C/CTB gated measurement is 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.

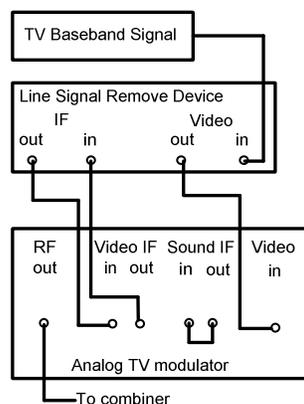
A C/CSO gated measurement also needs to measure video signal carrier peak level and second order beat on a quiet line during the vertical blanking interval, and then uses the results to calculate C/CSO.

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 DS2831 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.

26-3.2 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.

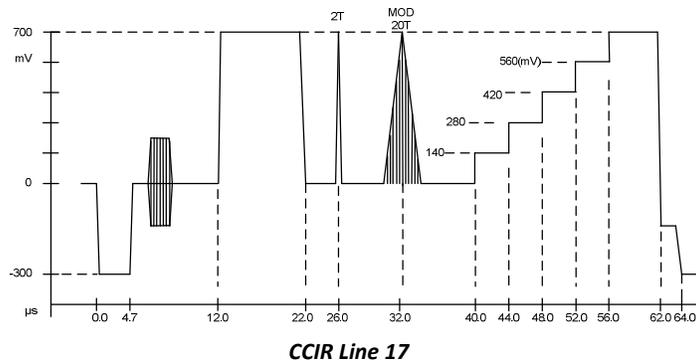
1. VITS insert position provision.

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:

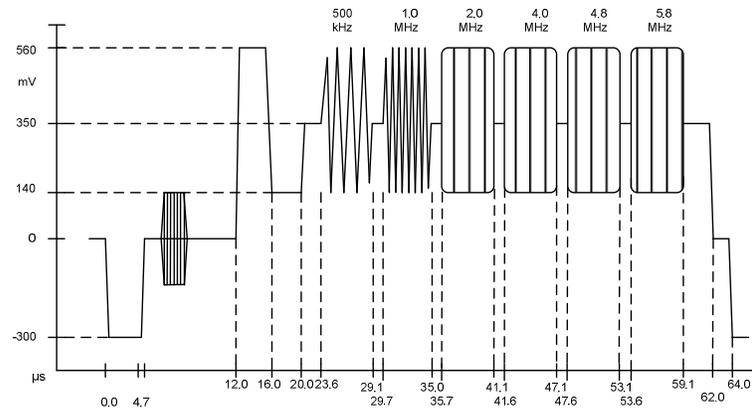
Insertion Line	Application
16 (329)	Data and communication signal
17, 18 (330, 33)	International VITS signal position, for
21 (334)	Teletext broadcast

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



CCIR17 test signal

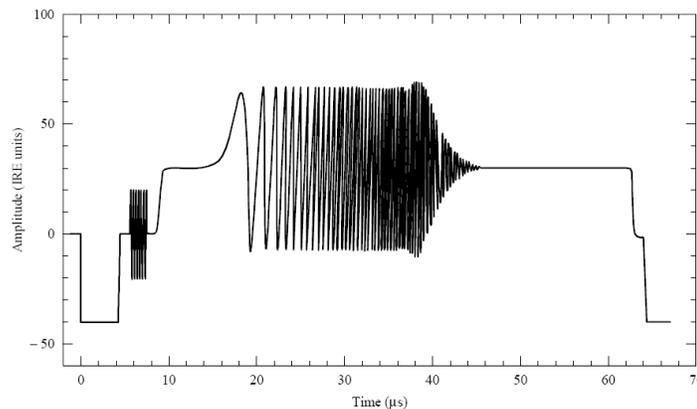
The first peak from the left is a white flag with peak amplitude of 700mV (relative to blanking level) and a width of 10µs; a zero carrier reference (base white) for measuring video signal amplitude and depth of modulation. The second from the left is 2T pulse with a half-amplitude width of 200ns, it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

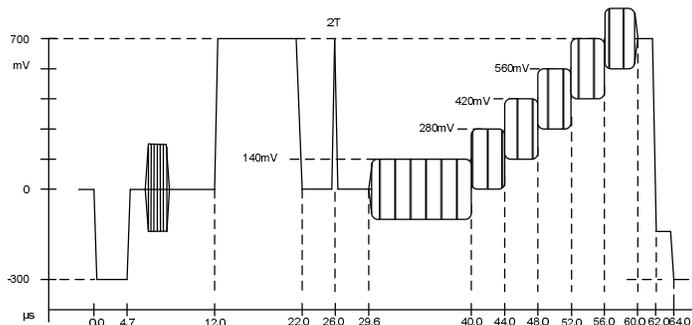
CCIR 18, also called a multiburst signal, consists of a set of single frequency sine wave signals with equal amplitude. The left side is a white flag with a peak amplitude 420mVp-p and provide amplitude standard for the following multiburst signals. Followed by six sine wave frequency packets, each frequency 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)

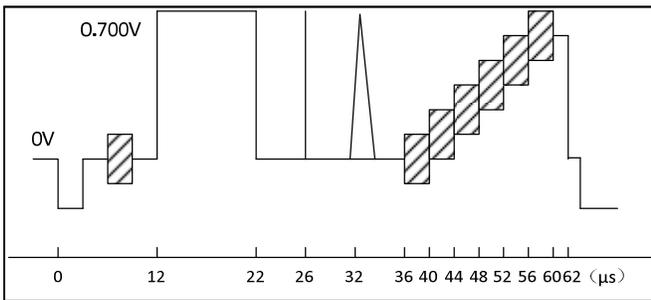
This signal is also often used to measure in-channel frequency response.



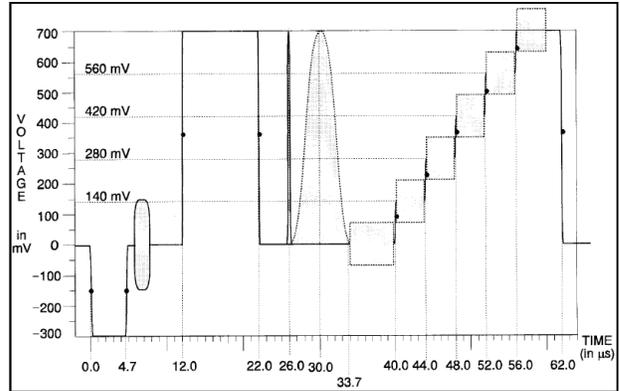
CCIR Line 330

CCIR 330 test signal

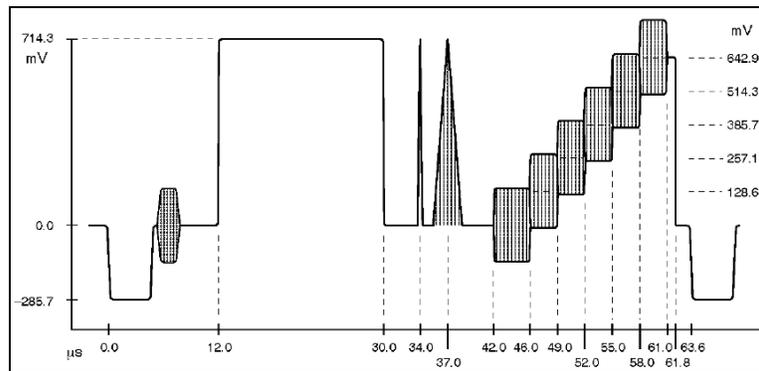
The first peak from the left is a white flag with peak amplitude of 700mV (relative to blanking level) and a width of 10µs; a zero carrier reference (base white) for measuring video signal amplitude and depth of modulation. The second from the left is 2T pulse with a half-amplitude width of 200ns, it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

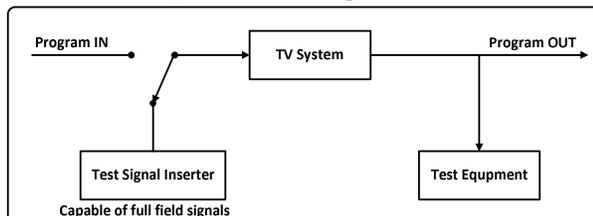
Applications of VITS Signals

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)

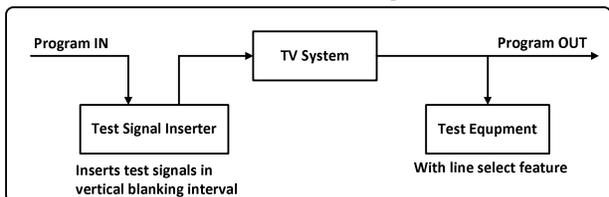
VITS test signals combine several types of test signals into one composite signal. This composite test signal is inserted in an empty or unused line of the vertical blanking interval behind the field sync pulse. The line position of these VITS signals are typically off the viewable portion of your television 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 27: Resolution and Video Bandwidth

27-1 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 DS2831 offers automatic or manual RBW selection depending on frequency/span/sweep time selection and/or what the user is looking for. The DS2831 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.

27-2 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.

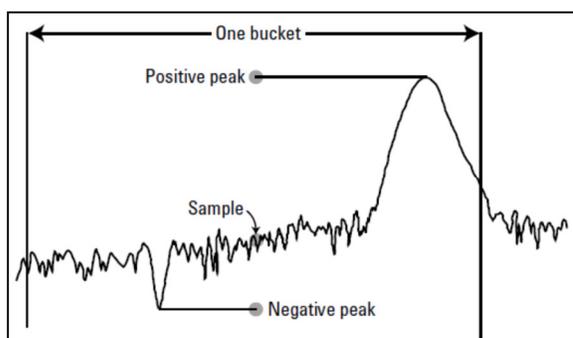
Chapter 28: Detector Mode

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).

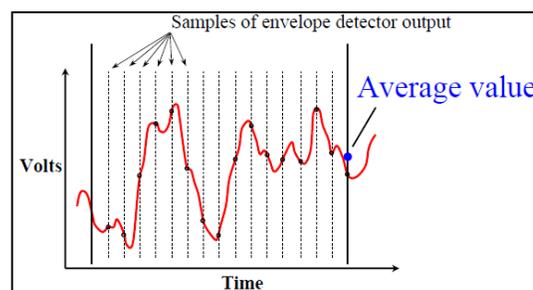
Screen size and resolution limits the amount of pixels that can be displayed on the screen, and since each pixel point can only show one value, each pixel may represent multiple measurement (or sample or acquisition) points. It is clear that not all data points can be displayed on the screen of a small 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 ≥ 3 times the RBW filter.



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



Principle of Average Detector

Chapter 29: 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

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

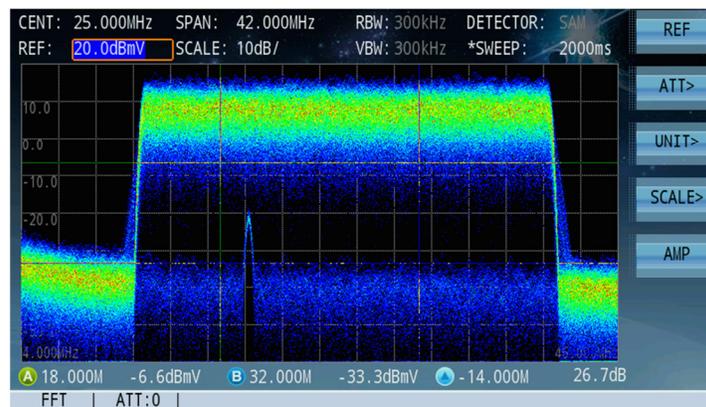
Channel Bandwidth: 8 MHz					
Video	Audio	Video	Audio	Video	Audio
8.0	14.0	296.0	302.0	584.0	590.0
16.0	22.0	304.0	310.0	592.0	598.0
24.0	30.0	312.0	318.0	600.0	606.0
32.0	38.0	320.0	326.0	608.0	614.0
40.0	46.0	328.0	334.0	616.0	622.0
48.0	54.0	336.0	342.0	624.0	630.0
56.0	62.0	344.0	350.0	632.0	638.0
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

Application Note: A Study of Digital Persistence Analysis

The DS2831 is a new-generation True Spectrum Analyzer that, among other powerful features and functions, incorporates "Spectrum Persistence" analysis. This measurement enables in-service detection of undesirable transient noise and impairments – both linear and non-linear. These impairments often hide under upstream bursty signal transmissions, like bonded DOCSIS 3 upstream channels or a fully-loaded DOCSIS 3.1 upstream bursty carrier.†

Traditional troubleshooting methods for upstream interference involve looking at a region of un-occupied upstream spectrum, placing your spectrum analyzer in peak hold mode, and hoping to capture anything of significance (or using other features, like minimum hold). But with the introduction of DOCSIS 3.0, the upstream path has become extremely crowded. This makes it difficult to distinguish interfering signals from "good" upstream transmission signals. With its easy-to-use features and color-coded display, the DS2831's spectrum persistence analysis tool greatly simplifies the task of finding linear and non-linear impairments such as CPD and impulse noise.

Spectrum Persistence testing actually captures undesirable impulse noise (in between upstream bonded bursty DOCSIS transmissions) by capturing all of the RF energy being transmitted together in a specific, customizable time period, usually 1000ms to 2000ms long. The instrument examines the RF energy as a whole, and displays it as a series of bitmap points rather than a trace. In other words, it is a graphical representation of RF energy: a bitmap where the color of each pixel indicates the amount of RF signal occupation there. Greater signal presence indicates heavier RF density over that location, translated into "hot" colors (red and yellow). "Cool" colors (blue) mark areas of lower signal presence.



The figure above represents a loaded Upstream DOCSIS 3.1 transmission. The difference in signal presence is clear. The colors assigned to bitmap points across the captures band are "hotter" as more signal presence is detected. (Up to 200 MHz can be set to capture in this mode.) Note that, in this example, the internal pre-amplifier is off, and the noise floor is at about -45dBmV (+15dBuV). Turning on the pre-amp would provide an additional 18dB of sensitivity. You can also see how easily the DS2831 will pick up a coherent distortion hiding under this large transmission.

† This chapter originally written and edited by Bernie Cadieux, North American Sales, Deviser Instruments.

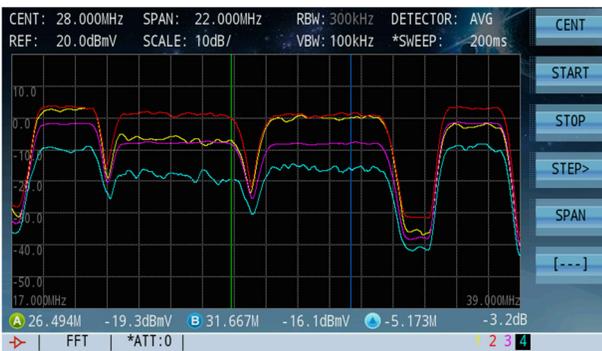
The DS2831 is a True Spectrum analyzer with 80dB of dynamic range, allowing for a much more sensitive capture and acquisition during persistence testing. The unit's sensitivity can reach -63.5dBmV (@ 300kHz RBW). This allows users to identify issues much sooner, potentially preventing impacts on customer services.

The figures below compare a typical Spectrum Analyzer screen capture, 4 simultaneous traces processed (Peak Hold, Neg Hold, Avg & normal), to the same test frequency as seen through the DPS application. The spectrum trace reveals no particular distortions at the Optical Upstream Receiver test point. (-20dB) In the righthand figure, we can clearly see 3 distinct interference signals "hiding" under US signaling. We can also confirm that the only carrier not being affected by any distortions at the moment is transmitting more data than its close bonded neighbors.

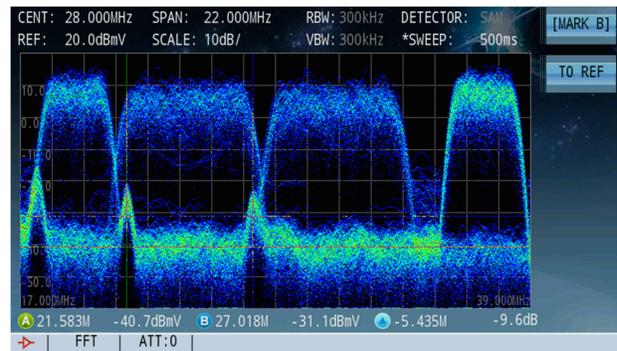
Both instances use the following settings (except where noted):

Center frequency = 28 MHz
 Span = 22 MHz (to narrow down visibility)
 Ref level = 20dBmV

Detector mode = Avg
 RBW = 300kHz
 Sweep time = 200ms (left), 500ms (right)



Trace display at the Upstream Optical receiver test point



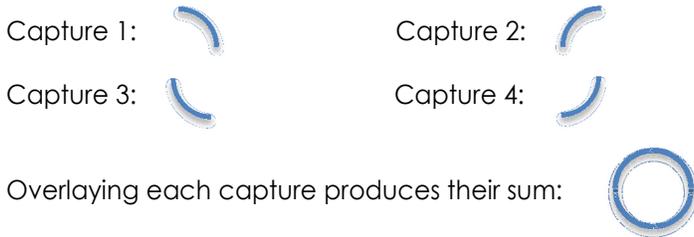
Persistence acquisition made at the same location and settings

To understand these results, we must first explore the DPS technology in greater depth. Notice that the above captures were taken in FFT (Fast Fourier Transform) mode. In this mode, the DS2831 will capture complete user-defined spans and lay each new capture over the previous ones in subsequent single acquisitions. The following table indicates how many such FFT captures the DS2831 will make, based on Span settings.

Persistence	
0-7MHz	100%POI minimum signal duration 2.5ms
4-46MHz	100%POI minimum signal duration 4.5ms
4-68MHz	100%POI minimum signal duration 4.64ms
4-88MHz	100%POI minimum signal duration 5.3ms
4-120MHz	100%POI minimum signal duration 6.3ms
4-210MHz	100%POI minimum signal duration 10.6ms

In the persistence spectrum example from before, the span was set to 22 MHz. Thus the DS2831 captured each FFT in 4.5ms. The sweep took 500ms to complete, creating the image above: an accumulation of 111.11 overlaid trace.

To better understand how the sum of all captures is not a peak hold, imagine that each acquisition is "superimposed" over the previous accumulated traces. To illustrate:



The larger the span setting, the longer the FFT capture time to ensure 100% POI (Probability Of Interception). This is because the FFT times (in the table above) have been calculated to ensure that the DS2831 will not only capture while the modems are up and transmitting data up to the CMTS, but also during those quiet times (time ticks equal to 6.25us) when the CMTS requires all modems to keep quiet so that it may listen for any new potential modems wanting to register.

The table below is extracted from page 175 of a DOCSIS white paper document, CM-SP-MULPIv3.0-I25-140729. It shows how Time Ticks are calculated based on modulation type.

Parameter	Example Value
Time tick	6.25 microseconds
Bytes per mini-slot	16 (nominal, when using QPSK modulation)
Symbols/byte	4 (assuming QPSK)
Symbols/second	2560000
Mini-slots/second	40000
Microseconds/mini-slot	25
Ticks/mini-slot	4

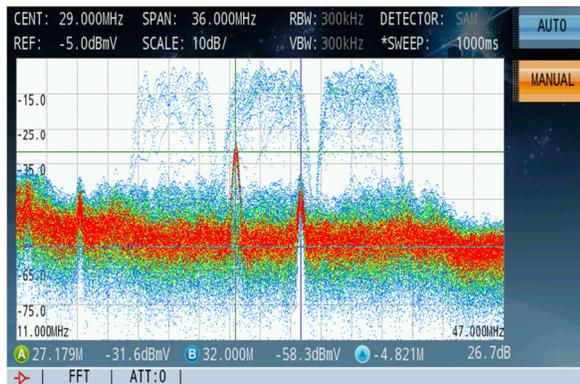
In our discussion, we have seen the technology in use; but we have not yet explored how it relates to the day-to-day task of troubleshooting ingress in the field.

Traditional techniques for locating service distortions are no longer the best approach for maintaining customer services. In most cases, a field engineer refers to their MSO monitoring platform and is notified that a particular node shows signs of issues. (For example, the HE or Hub monitoring system may detect coherent distortions in that node).

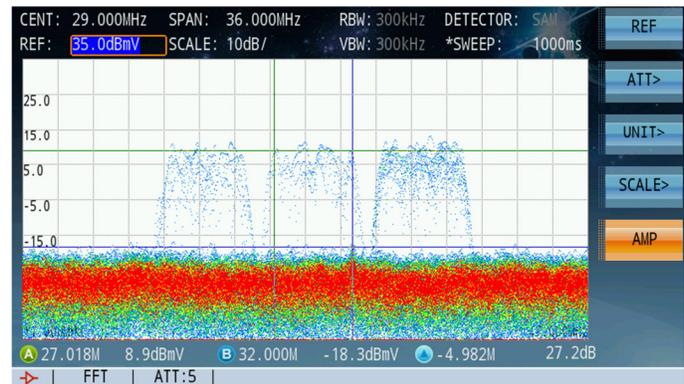
Problems occur, however, when the network engineer reaches the node. He or she must determine which of the node's 4 legs is malfunctioning. Common practice is to pull the return pads and view the Upstream RF monitoring system signature, which – in theory - should include the distortion in question) If the signature goes away after pulling the pad, the field engineer will know that the distortion comes from that leg. If not, he (she) will replace the pad and pull another until he finds the culprit.

Then, the common troubleshooting method prevails, hunting down the impairment going down a specific leg of a node. The figure below (left) shows the impairment at the node return test point, (without having pulled any return pads). Although this impairment was not customer-impacting, the engineer faces an opportunity cost in pursuing distortions at the expense of other tasks.

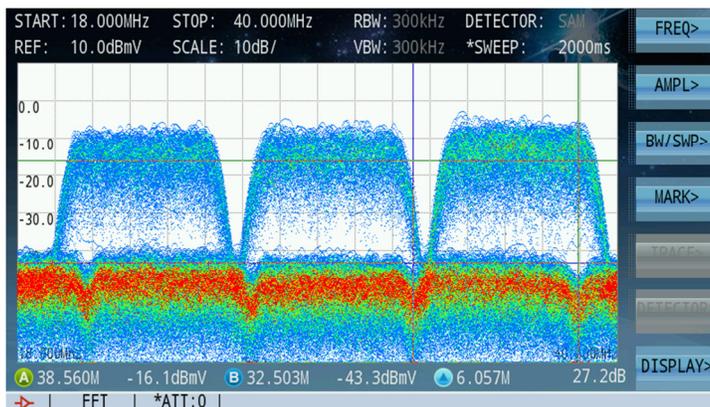
After chasing this impairment, it was found to have been injected through a multi-tap port – in fact, from a non-paying connected home. After installing a filter, the impairment almost completely disappeared, as shown (below, right).



Return path test point of an optical node



Multi-tap port of a non-paying home, passed after filter was installed



However, going 100% digital does not eliminate CPD. This capture (left) shows a rare event in the field (Input test point, 2nd active after the node). Here, there are 3 upstream DOCSIS 3.0 bursty transmissions at 6.4 MHz wide each – and a clear look at, the reflected Downstream DVB-C 6 MHz carriers sitting well below, suggesting Digital CPD. This phenomenon is difficult to see during field operation, simply because it is too low for most lower-end equipment (usually SLM-based, which offers less sensitivity than a True Spectrum Analyzer). It might also not visibly impact customer service.

Based on this scenario, the Deviser R&D team developed algorithms that provide consistent measurement results – with few metrics to control in order to provide optimal results.

You can access the Spectrum Persistence analysis from the Upstream main menu. Once in the persistence mode, you will first need to select the bandwidth of interest for your test. Depending on your location in the network, some level adjustments – like reference level, attenuation, and activating the internal pre-amplifier – may also be necessary. RF traffic conditions may also require speeding up or slowing down the sweep time to extend the accumulated capture time. A sweep time of ~1000ms is ideal for capturing transient noise under the DOCSIS carriers.

To adjust these parameters, refer to the instructions and menu map in Chapter 12: Persistence Analysis.

For further information, please contact Deviser Instruments.

Part IV

System Functions

Chapter 30: System Settings

This chapter provides instructions for DS2831 system settings and features. To access the settings menu, press the **SETUP** button along the bottom of the screen. There are three main settings tabs: **About**, **General**, and **Measure**.

30-1 About (System Information)

The About tab lists information about the DS2831 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

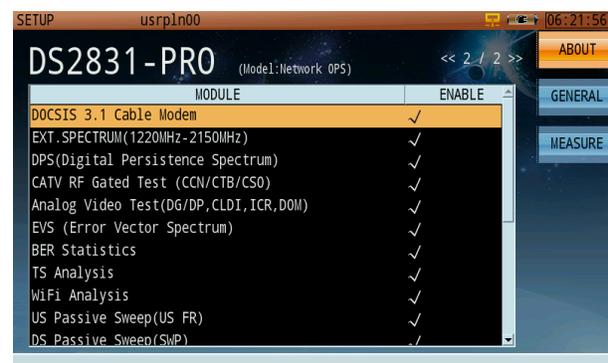
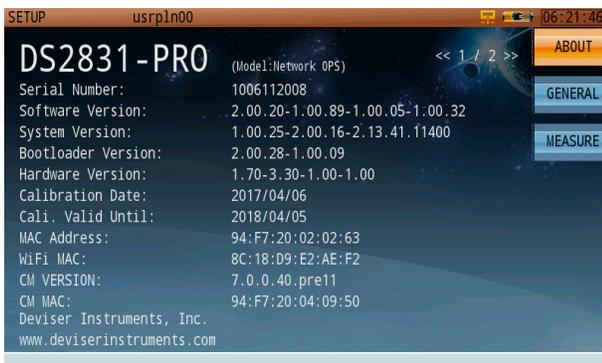
There are two pages to the About screen. Use the rotary knob to change pages.

Page 2 contains a table listing all measurement option modules available on your DS2831. 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 DS2831 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.



30-2 General Settings

The General tab contains general system settings that do not apply to particular measurement functions. This tab is divided into different categories, listed on the left-hand side of the screen; turn the rotary knob to change pages, and press the knob to select a page and begin editing settings. Press Esc to go back.

30-2.1 Network Settings

This page contains settings for allowing the DS2831 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. Highlight DHCP and press the rotary knob to activate it, or deactivate to keep the static IP settings.

To change an address, turn the rotary knob to highlight one of its bytes and enter up to 3 digits using the keypad. Continue as needed until the address is complete.

Using Wi-Fi

The Wi-Fi feature is only available if enabled on your DS2831 unit. To activate it, check the Wi-Fi Client box in the Network Settings menu. If DHCP is checked, the unit will automatically connect to the wireless network. Otherwise, you can set up a static IP configuration.

Using Ethernet

In Network Settings, when the WiFi Client box is empty, the default connection is through the Ethernet port on the top panel. Connect an Ethernet cable from an active network to the DS2831 and set up the static IP information to connect. (If DHCP is checked, the unit will auto-set a network address and configuration.)

Wi-Fi Access Point (Hotspot) Setup

The DS2831 offers a Wi-Fi AP (Access Point) function, which allows connection from a mobile device. Technicians can use this function to have the DS2831 access public networks during field operations. You can record/measure data even if no suitable networks are present. Note that this tool is currently available only on Android devices; future firmware releases will include other mobile OSs.



Select WLAN AP setup parameters to open a settings dialog (shown above). This includes:

- SSID: Service Set Identifier. User selects the correct name.
- Password: User-defined.
- IP Address: This is a fixed IP address; users cannot modify it.

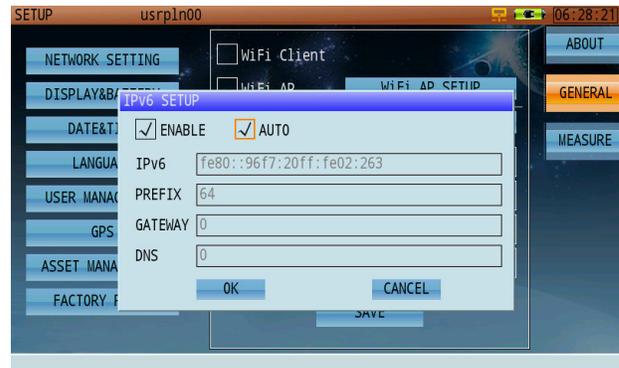
If a wi-fi connection is successful, a **yellow** wi-fi icon will appear in the status bar.

If the hotspot is set up correctly and is ready to receive connections, a **blue** wi-fi icon will appear.



IPv6 Address Setup

The DS2831 is IPv6 compatible. Select IPv6 Setup to open a dialog window. If you wish to input an address manually, check **Enable**; otherwise, check **Auto** and the system will auto-configure the IP. (You will need to enter the prefix, gateway, and DNS according to your network configuration – shown, right).



More on IPv6

Where IPv4 uses 32-bit (4-byte) source and destination addresses, IPv6 has 128 bits (16 bytes). IPv6 addresses have eight groups, with as many as four hexadecimal digits in each group (separated by colons). For example:

2001:0da8:0001:0100:0000:0000:0000:0080

Groups of digits that begin with one or more zeros don't need to be padded to four places, so you can shorten this address according to the following rules.

(1) The first zero at the beginning of each group can be omitted. So you can also write this address as:

2001:**0**da8:**0001**:**0100**:0000:0000:0000:**0080**
2001:**da8**:**1**:**100**:0000:0000:0000:**80**

(2) If a group of digits are all zeroes, a single "0" can replace them. So you can also write this address as:

2001:0da8:0001:0100:**0000**:**0000**:**0000**:0080
2001:da8:1:100:**0**:**0**:**0**:80

(3) If a group or continuous groups are all zeroes, the "::" (double colon) notation can replace them. In this way, you can abbreviate sequential groups of zeros. So you can also write this address as:

2001:da8:1:100:**0**:**0**:**0**:80
2001:da8:1:100::**80**

Note that you can only use the "::" notation *once* in an address.

For example, the IPv6 address [2001:250:f004:0000:0000:8e00:0000:ef01] can be rewritten as either of these:

2001:250:f004::**8e00**:**0**:ef01
2001:250:f004:**0**:**0**:8e00::**ef01**

IPv6 prefixes are specified similarly to IPv4. As many bits of the prefix as are significant are expressed in the standard IPv6 notation, followed by a slash and a decimal; the decimal count shows how many address prefix bits there are.

For example, the prefix of the IPv6 address [2001:250:f004:f001:e150:b95:f71e:ccb6] is 64-bit. You can rewrite the address as [2001:250:f004:f001:e150:b95:f71e:ccb6/64].

30-2.2 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. Highlight this setting with the rotary knob and use the arrow keys to select a time period, or set to **DISABLE** to disable automatic shutdown.

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. Highlight this setting with the rotary knob and use the arrow keys to select a time period, or set to **DISABLE** to disable auto-dim.

30-2.3 Date & Time

This page allows you to set the instrument's internal clock. Highlight each entry field with the rotary knob, and use the arrow keys or data keypad 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)

30-2.4 Language

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

30-2.5 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 measurement menu. You must restart the system for changes to take effect.

After making changes, press **Save** to record the current user configuration.

30-2.6 GPS

If the GPS functionality is enabled, and a USB GPS antenna is connected to the instrument's top panel, this page will display the current longitude and latitude coordinates of the device. This is useful in measurement applications like pinpointing interference. 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.

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

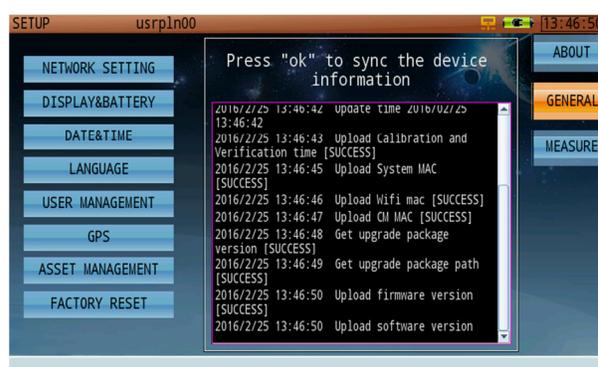
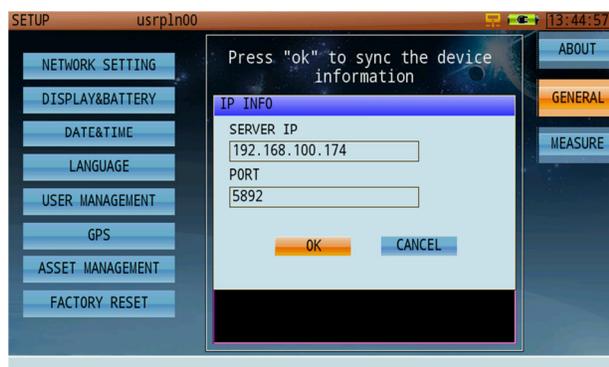


GPS coordinates are recorded at all times when a clear GPS positioning antenna has clear line of sight to the skies. The GPS coordinates are saved when a measurement is saved in "DATA" format, however, the GPS coordinates will not be displayed on a "Picture" file format.

30-2.7 Asset Management

Deviser EDGE is cloud-based and can be accessed through the URL provided by Deviser. See the EDGE user guide for complete setup instructions.

The option-enabled asset management tab allows you to synchronize your device's information (including saved data, firmware version, and system clock) with data stored on EDGE. Enter the server IP address and port number, then select **OK** to sync.



30-2.8 Factory Reset

Here, you can reset all parameters and return the instrument to initial factory settings for a fresh start. Use this feature with caution to avoid erasing a preferred configuration. **User profiles, saved measurement data, and current firmware version are not affected.**

When you highlight this page, a confirmation prompt will appear. Press the rotary knob button to confirm the factory reset process. The instrument will reboot.

30-3 Measure Settings

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

30-3.1 Level Unit

On this page, you can select the default unit in which signal magnitude measurements are displayed. Use the arrow keys or rotary knob to select one of the radio buttons: dBμV, dBmV, or dBm.

30-3.2 Test Point Compensation

Test Point compensation can be edited and applied only if **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.

DS2831 users can set up a maximum of five groups of TP compensation values. At different positions, user can active different TP compensation values.



30-3.3 Limit Edit

Limits are user-designated signal thresholds; when a measurement breaks an established limit, the DS2831 will alert the user by displaying test results in a Pass/Fail format.

From the Limit Edit menu, you can set and modify limit plans on various points of measurement data. The "Enable Limit" box must be checked for limits to take effect.

The instrument offers 9 default groups of limit settings: **Amplifier, End-of-Line, Ground-Block, Headend, High-Speed-Data, Line-Extender, Node, Set-Top** and **Tap-Check**. In addition, there are 7 customizable groups (titled UserLimit01 – 07) that can be edited to suit your test threshold needs. Default groups cannot be edited.

Users may activate or deactivate any group or any individual metric of any limit file. Threshold values of individual metrics are also customizable. Users can create new limit files with the Toolbox PC software included with each unit, and copy them to the DS2831. Note that new limit files names cannot use the same names as the 9 default groups; thus, only custom filenames can be copied to other units.



When modifying limit values, use the function keys on the right to access the following tools:

- **Reset:** reverts current limit settings to default values.
- **Ena All:** enables all individual metrics in the current limit file.
- **Dis All:** disables all individual metrics in the current limit files.
- **Edit:** Opens the highlighted metric for editing. Use the keypad, arrow keys, or rotary knob.

30-3.4 Remote Assist

The DS2831 offers a PC-based remote control networking function, allowing users to conduct measurements and check test data from any computer or tablet connected to the same network. Select the **Remote Assist** checkbox to activate it.

If properly connected to the network, the DS2831 will display the  icon in the status bar.

On a PC (or other device), open the internet browser of your choice. In the URL bar, enter the DS2831's local IP address (as found in **General > Network Settings**) and the port number 1080. Ex.: <192.168.63.23:1080>.



Browser-based Remote Control Interface: Panorama mode (left) and Lite mode (right)

In the remote assist interface, you can use a computer mouse and keyboard to navigate menus and change settings. There are two display modes: **Panorama** and **Lite**. Panorama is designed to simulate the DS2831 operation console, while Lite is designed for optimum visibility and text size. Swap modes by clicking the **LCD/Shrink** icon (depending on the current view mode) located on the bottom-right.

30-3.5 Cable Modem Diplexer

Diplexers are key components in multiplex RF communication systems. A diplexer insulates the transmitted and received signals from interference, allowing them both to send at the same time.

To ensure compatibility with the latest DOCSIS standards, the DS2831 cable modem provides two kinds of selectable power divider: **85 / 108MHz**, and **204 / 258MHz**. You can select the setting of your choice in the **CM** page. Note that this setting may affect cable modem measurement results; set as needed according to your system configuration.

A list of current major DOCSIS standards is included below.

Standard	Uplink Frequency (MHz)	Downlink Frequency (MHz)
DOCSIS 2.0	5 ~ 42	>88
EURO-DOCSIS 2.0	5 ~ 65	>108
EURO-DOCSIS 3.0	5 ~ 85	>108
DOCSIS 3.0	5 ~ 85	>108
DOCSIS 3.1	5 ~ 204	>258

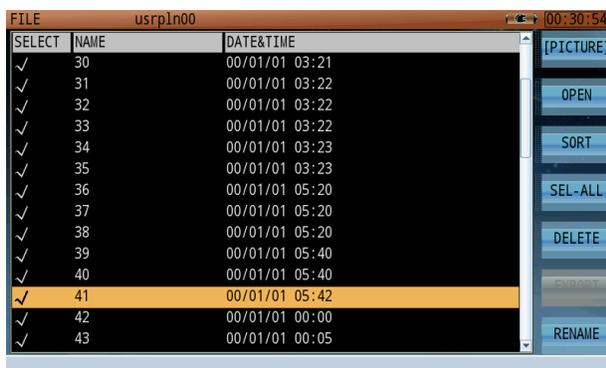
Chapter 31: File Management

The ability to save and manipulate data is a key feature of using the DS2831 Digital TV Spectrum Analyzer. From the File Management utility – accessible by pressing the **File** (**FILE**) key under the display – you can delete, view, move, and sort data files saved to the system's internal 1GB hard drive.

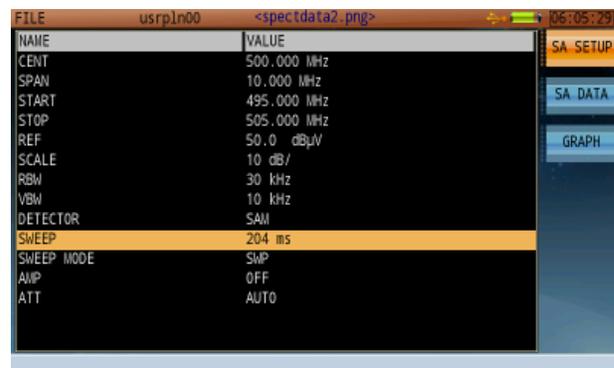
Files can also be transferred to a USB storage device. Simply connect the drive to the Type-A USB port on the DS2831's top panel, and look for the USB  icon to appear in the status bar.

31-1 File Operations

In the file management menu, you can view all readable files currently saved to the DS2831'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: Pictures



File Management Menu: Open Data

31-1.1 Open

In the above image, the top function key (F1) is labeled **[PICTURE]**. This indicates that the user is viewing a list of all picture files saved to the instrument. Press F1 to cycle through **picture**, **data**, and **work order** files.

By default, files are listed alphabetically by name in ascending order, and bear timestamps according to when the data was recorded. (See subsection 31-1.2.) Use the rotary knob or arrow keys to scroll up and down, highlighting files.

Press **Open** (F2) to view the highlighted file. This means different things for different filetypes. If available, use the function keys to shift between tabs.

- **Pictures** will be displayed on the DS2831's screen. Turn the rotary knob to cycle through other saved images.
- **Data** will display a summary of the time, GPS location, associated work order, and system serial # on which the data was taken. Press **F2** to 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.
- **Work orders** will display a list of their component projects and measurements. Work orders that have been initiated by an Auto Test setup may be exported in .csv format.

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



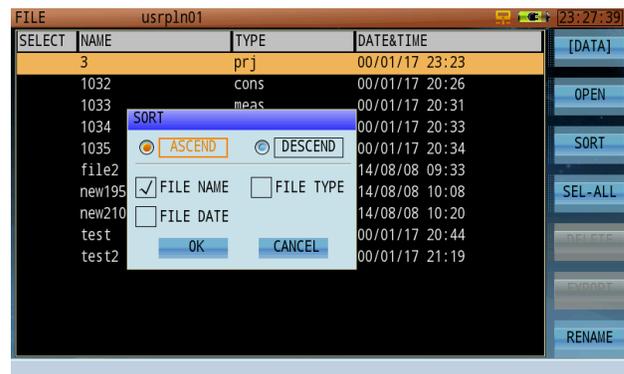
Viewing Auto Test Results: Digital Channel, Constellation, and Analog TV Channel (left to right)

31-1.2 Sort

As discussed, files are listed alphabetically by name in ascending order. This is the default setting. If you wish to list files in a different order, press **Sort** (F3) to open the Sort dialog (shown, right).

Highlight and select options with the rotary knob. 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, press **OK** to sort files as specified.



31-1.3 Rename

To rename a particular file, highlight it with the rotary knob and press **Rename** (F7). Use the alphanumeric 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 the rotary knob to confirm. Press **Esc** once to recall the previous filename, or again to cancel the operation.

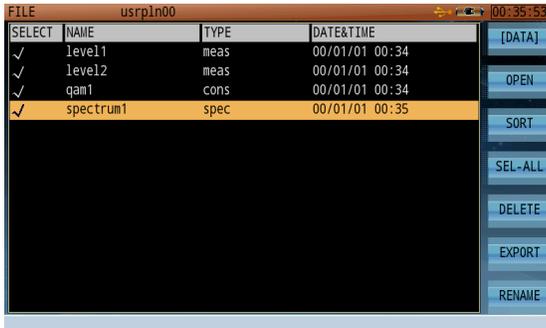
31-1.4 Delete

When you no longer need one or more files, you can erase them from the DS2831's internal hard drive. Highlight files with the rotary knob and press the knob to select them. **Delete** (F5) 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 31-2 for details.

31-2 Importing and Exporting Data

To export files to a USB storage device, first ensure the device is connected via the DS2831's top panel. The USB icon will appear in the status bar. Turn the rotary knob to highlight the desired file, press the knob to select files to export, and then press the **Export** (F6) button.



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 "DS2831_file" and screenshot / image files in "DS2831_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 DS2831 exported files.

Work order test results can only be uploaded to the asset and test data management platform **Deviser EDGE** through a network connection. They can, however, be viewed on the DS2831. (See subsection 31-1.1.)

Chapter 32: Saving Data

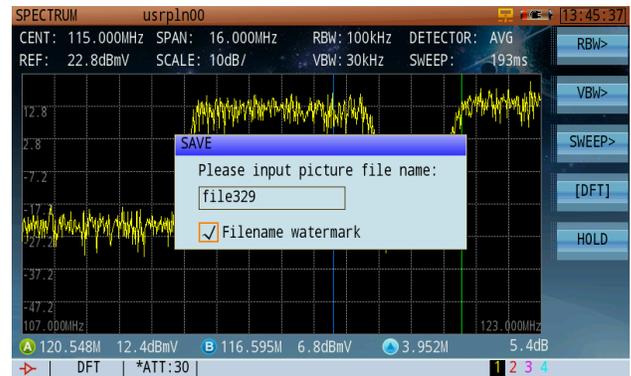
The ability to save and manipulate data is a key feature of using the DS2831 Digital TV Spectrum Analyzer. From the Save dialog— accessible by pressing the **Save** (**SAVE**) key under the display – you can create screenshots of the current display, record detailed tables of measurement data, or generate 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 30: File Management for detailed instructions.

32-1 Screenshots

You can save nearly any moment of DS2831 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, use the rotary knob to select PICTURE.

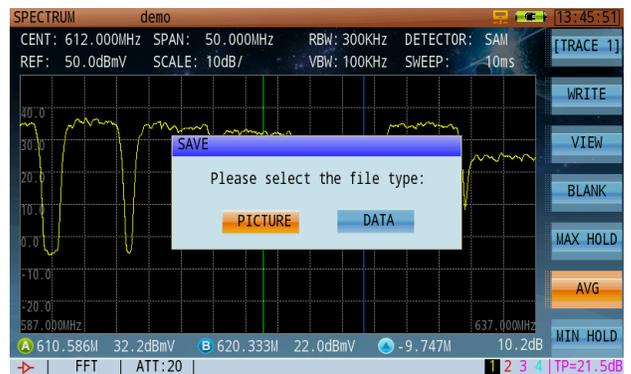
Use the alphanumeric keypad to input a filename. (See Section 2-5 for control instructions.) You may also check the **Filename Watermark** box, which imprints the captured image with its own filename, helping to easily identify the image afterward. Finally, turn the rotary knob to highlight **Save** and click the knob to confirm.



32-2 Measurement Data

Saving measurement data is much like saving an image. Just press **Save** while a DS2831 measurement application is active, then use the rotary knob to scroll from PICTURE to DATA and click to confirm.

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 29-2.3), and even individual data points.



Chapter 33: Auto Test

Press the **Auto** (**AUTO**) key below the display to enter the Auto Test menu. Auto Test allows users to design and run custom measurement plans.³ You can select the measurements to perform, as well as the channels and test settings for each one, in advance. Auto tests rely on pre-defined User Channel Plans and Limit Plans.

There are two types of auto-test: projects and work orders. Projects are tasks created with the DS2831, while work orders are tasks created by the asset and test-data management platform, Deviser EDGE. Work orders can contain multiple projects, and the content of a work order is not editable except through EDGE

NOTE: Before setting up an auto test, you must set up your active user channel plan and limit plan for testing. The channel plan determines the channels you can select for individual testing, and the limit plan adds pass/fail results to the test data depending on the limit lines you have previously specified. See Chapter 4 and subsection 29-3.3, respectively, for details on creating channel and limit plans.

33-1 Creating a Project

In the Auto Test menu, the F1 key allows you to cycle between auto test types. Cycle to **[Project]** and press **New** (F2) to open the auto test design screen (below, left).



In the **Project** and **Location** fields, you can name the auto test project and the physical test address using the alphanumeric keypad. Highlight and click the **Plan Name** and **Limit** fields to select the desired channel plan and test point location for this project. (If you plan to import the output file into a pre-configured TWC Workbook, you may choose any arbitrary test point location.)

Under the Location field are two panes. Move to a panel with the rotary knob, then use the arrow keys to scroll up and down within it. In the left panel, you can select measurement functions to perform (by clicking the rotary knob). In the right panel, you can modify the settings that each measurement will take. Press the **Item** (F2) and **Limit** (F3) keys to toggle between different available settings.

- Example: Place a check next to "Spectrum" on the left, then change "CENT" to 500 MHz on the right. The auto test will now include a spectrum analysis test centered on the 500 MHz frequency.
- Example: Place a check next to "Ch Meas" on the left, then place checks next to 101-115 on the right. The auto test will now include MER and Pre-Post BER tests for the selected channels.

When you have finished designing your auto test project, press **Save** (F1) to save the project. It will appear on the auto test main screen (above, right). Note that you must save a project if you wish to export it later.

³ Content, reference materials, and technical consultation for this chapter provided by Bernie Cadieux, Deviser Instruments. <bcadieux@deviserinstruments.com>

33-2 Managing Projects

From the auto test main screen (press **Auto**), all auto test projects and work orders saved to the DS2831 can be seen.

33-2.1 Start

Highlight a test project from the list and press **Start** (F7) to run the auto test as designed. Before the testing starts, you will be prompted to name the save data that will be collected. Use the alphanumeric keypad to enter a name, then click Save to proceed.

During an auto-test project, a progress bar (%) indicates the status of the test. The test can be aborted at any time by pressing **Stop** (F1) and confirming **OK**.

When the test concludes, you can view the data from the File Management screen (**File**). For specific instructions, see Section 31-1.

33-2.2 Edit

Highlight a test project from the list and press **Edit** (F3) to open the auto test design screen. Here, you can rename the project, re-assign its channel and limit plans, change its scheduled tests and test settings, and other operations. See Section 33-1 for details on designing an auto test project.

33-2.3 Sort

You can re-sort test plans by pressing **Sort** (F4). In the sort dialog, navigate and select with the rotary knob. Place a check next to "Project" to sort alphabetically, and "Date&Time" to sort by timestamp. Use the radio button to select Ascending or Descending order.

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

33-2.4 Delete

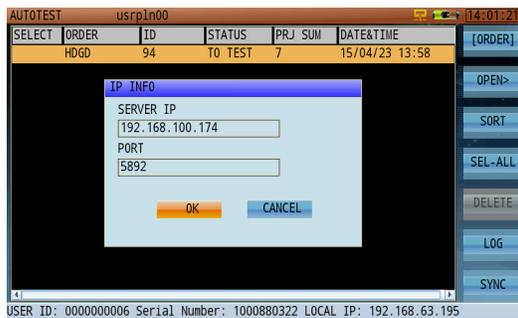
Highlight and click an auto test project with the rotary knob to select it. Select one or more test projects from the list and press **Delete** (F6) to erase it from the DS2831. You will be prompted to confirm the deletion. Click **OK** to confirm or **Cancel** to go back.

33-2.5 Export

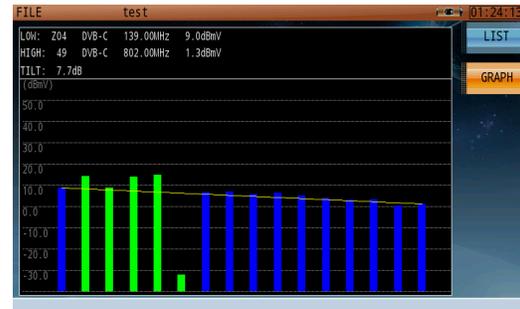
To transfer an auto test project to USB, connect a USB storage device to the DS2831's top panel. Auto test projects can be exported from the file management screen (**File**). For specific instructions, see Section 31-2.

33-3 Work Orders

A work order can include multiple projects. The attributes of each project are listed in the work order interface, which include: project name, work order ID, work order test status, the total number of projects in the work order, and the date and time when the work order was created.



Syncing work orders with EDGE



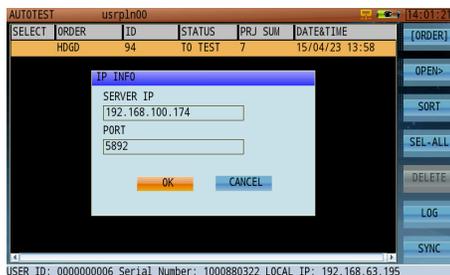
Reviewing saved project results (tilt measurement)

Work orders are created in EDGE, Deviser's asset & test data management system. For detailed instructions on customizing work orders for use with the DS2831, refer to the Deviser EDGE user guide.

33-3.1 Syncing with EDGE

Enabled by option only, the Deviser EDGE platform supports DS2831 field users with numerous data management functions, including data sync. Once the connection is established, you can sync all device information (including work orders) with the EDGE server.

Deviser EDGE is a web based cloud server application. To work with EDGE, the DS2831's Certificate and Asset Management options must be enabled. These options allow EDGE to recognize the instrument and manage data. Contact Deviser Instruments for details.



PROJECT	ID	STATUS	DATE&TIME
Home1	72	TO TEST	15/04/23 13:58
New10	16	TO TEST	15/04/23 13:58
New7	13	TO TEST	15/04/23 13:58
New5	11	TO TEST	15/04/23 13:58
New3	9	TO TEST	15/04/23 13:58
tese	6	TO TEST	15/04/23 13:58
proj_01	2	TO TEST	15/04/23 13:58

TIP: With each sync operation, the EDGE server automatically updates the DS2831's internal clock.

Specifications

Downstream Spectrum Analysis	
Frequency Range	4 ~ 1220 MHz 4 ~ 2150 MHz (by option)
Frequency Stability	±1 PPM (0 °C ~ 50 °C / 32-122 °F)
Frequency Step	1 kHz
Frequency Span	0 MHz ~ full span
Resolution Bandwidth (-3dB)	1kHz, 3kHz, 10kHz, 30kHz, 100kHz, 300kHz, 1 MHz, 3 MHz
Video Bandwidth	30 Hz, 100 Hz, 300 Hz, 1kHz, 3kHz, 10kHz, 30kHz, 100kHz, 300kHz, 1 MHz, 3 MHz
Display Scale / Range	1, 2, 5, 10, 20dB/div; 8 vertical divisions
Sweep Time	20ms ~ 25s
Input Level Range	-60 ~ +60dBmV
Dynamic Range	80dB (30kHz RBW)
Sensitivity (preamp on)	-60dBmV (100kHz RBW)
Attenuation	0 ~ 40dB in 1dB steps
Measurement Accuracy	< ±1.0dB @ 25 ±5°C (typical)
Detector Modes	Positive Peak; Negative Peak; Sample; Average; RMS
Reference Level	-80 ~ +70dBmV
Markers	2 vertical markers
Persistence	
0 ~ 7 MHz	100% POI; minimum signal duration 2.5ms
4 ~ 46 MHz	100% POI; minimum signal duration 4.5ms
4 ~ 68 MHz	100% POI; minimum signal duration 4.64ms
4 ~ 88 MHz	100% POI; minimum signal duration 5.3ms
4 ~ 120 MHz	100% POI; minimum signal duration 6.3ms
4 ~ 210 MHz	100% POI; minimum signal duration 10.6ms

Upstream Spectrum Analysis	
Frequency Range	4 ~ 210 MHz
Frequency Span	42/64/84/116/206 MHz, zero span
Resolution Bandwidth (-3dB)	300kHz fixed
Video Bandwidth	300kHz fixed
Display Scale / Range	1, 2, 5, 10, 20dB/div
Sweep Time	20ms ~ 25s
Input Level Range	-60 ~ +60dBmV
Attenuation	Auto/manual, 0 ~ 40dB
Pre-Amplifier	Manual, 18dB gain
Measurement Accuracy	< ±1.0dB @ 25 ±5°C (typical)
Detector Modes	Positive Peak; Negative Peak; Sample; Average
Markers	2 vertical markers

Analog TV Measurements		
Frequency Range	7 ~ 1220 MHz	
Standards	B/G, I, D/K, L/L', M/N	
Color Standards	NTSC, PAL, SECAM	
Frequency Steps	10kHz	
Level Measurement Range	-40 ~ +60dBmV	
Accuracy	<±1.0dB @ 25±5°C (S/N>30dB)	
Level Resolution	0.1dB	
Resolution Bandwidth	300kHz	
C/N (>53dB, 0dB attenuation)	Optim. input (preamp on/off)	32 ~ 37dBmV 12 ~ 17dBmV
	Max input (preamp on/off)	60dB ±1.0dB 65dB ±3.0dB
CTB/CSO (>53dB, 0dB attenuation)	Optim. input (preamp on/off)	22~67dBmV 2~7dBmV
	Max input (preamp on/off)	63dB @ ±1.5dB acc., 78 channels 70dB @ ±4.0dB acc., 78 channels
HUM Measurement	1~15%; ±0.5% (1~5%); ±1.0% (5~15%)	
Depth of Modulation Range	40~95%, ±1.5% (C/N>40dB)	
Tilt	Up to 16 channels	
Pre-Amplifier	Automatic, 18dB gain	
Attenuator	Automatic, 40dB	
Digital TV Measurement		
Frequency Range	7 ~ 1220 MHz	
Power Level Range	-30 ~ +50dBmV	
Accuracy	<±1.5dB @ 25±5°C (C/N>20dB)	
Level Resolution	0.1dB	
Pre-Amplifier	Automatic, 18dB gain	
Attenuator	Automatic, 40dB	
Modulation Type	16, 32, 64, 128, 256 QAM (J.83 Annex A and C); 64, 256 QAM (J.83 Annex B)	
Interleave Depth	128 x 1 ~ 128 x 4 (J.83B); 12 x 17 (J.83A/C)	
Symbol Rate	1.0 ~ 7.0 MS/s	
SNR	>47dB; Accuracy ±2.0dB	
MER	>47dB; Accuracy ±2.0dB	
EVM	>0.36%	
BER	1E-3 ~ 1E-9	
Constellation	16, 32, 64, 128, 256 QAM	

Cable Modem Measurements (Downstream)		
Supported Standards	DOCSIS 3.0; 3.1	
Frequency Range	108~1218 MHz; 258~1218 MHz	
Demodulation	DOCSIS 3.0	64 QAM, 256 QAM
	DOCSIS 3.1	OFDM 16~4096 QAM
Maximum Speed	DOCSIS 3.0	1.2 Gbps (32 DS channel bonding)
	DOCSIS 3.1	1.97 Gbps (2 OFDM 192 MHz chan.)
Channel Bonding	DOCSIS 3.0	Up to 32 SCQAM
	DOCSIS 3.1	2 OFDM, 192 MHz + 32 SCQAM
Bandwidth	DOCSIS 3.0	6 MHz / 8 MHz
	DOCSIS 3.1	OFDM 192 MHz, SCQAM 6/8 MHz
Input Signal Level	-15 ~ +15dBmV	
Cable Modem Measurements (Upstream)		
Frequency Range	5~85 MHz; 5~204 MHz	
Signal Bandwidth	TDMA	200/400/800/1600/3200/6400kHz
	S-CDMA	1600/3200/6400kHz
	OFDMA	96 MHz (3.1, BPSK~4096QAM)
Output Signal Level	TDMA	+8 ~ +54 dBmV (32, 64QAM); +8 ~ +55 dBmV (8, 16QAM)
		+8 ~ +58 dBmV (QPSK)
	S-CDMA	+8 ~ +53 dBmV (all modulations)
Channel Bonding	OFDMA	+11 ~ +65 dBmV
	DOCSIS 3.0	Up to 8 channels
Maximum Speed	DOCSIS 3.0	320 Mbps (8-channel bonding)
	DOCSIS 3.1	720 Mbps (1 OFDMA 96 MHz chan)
Advanced Upstream Signal Generator (Option)		
Signal Modulation	J.83 Annex A	CW, QPSK, 16/64/256QAM
	J.83 Annex B	CW, 64/256 QAM
FEC	J.83 Annex A	RS (204,188)
	J.83 Annex B	RS (128,122)
Symbol Rate	1.0~7.0 MS/s	
MER	>40dB; accuracy ±2.0dB	
BER	<1E-9	
Frequency Range	5~120 MHz	
Frequency Step	10kHz	
Phase Noise (CW @ 50 MHz)	100dBc@10kHz; 115dBc@100kHz	
Frequency Accuracy	2ppm	
Settling Time	2ms	
Signal Level Range	0~60dBmV	
Level Accuracy	±1.5dB (CW); ±2.0dB (QAM)	
Level Adjustable Step	0.1dB	

Transport Stream Analysis	
Real-Time Analysis	Real-time transport stream info, including service name, ID, provider info, video/audio PIDs. Audio/video details on unencrypted programs.
TR 101 290 Priority 1,2,3	TR 101 290 Priority 1, 2, 3 real-time testing & monitoring.
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.
Upstream Active Sweep	
FSK Tx Frequency	5 ~ 210MHz
FSK Tx Amplitude	10 ~ 50dBmV
FSK Rx Frequency	42 ~ 300 MHz
FSK Rx Sensitivity	-40dBmV
Pilot Frequency	5 ~ 210 MHz
Pilot Freq. Amplitude	10 ~ 50dBmV
Tx Test Amplitude	0 ~ 60dBmV
Tx Test Frequency	5 ~ 210 MHz
Tx Test Freq. Point	1 ~ 16 frequency points
Head-end Support	DS1610 supports up to 4 units
Optical Power Meter (by option only)	
Accuracy	±0.17dB (± 3%)
Detector Type	InGaAs Ø2000µm
Dynamic Range	-50dBm ~ +27dBm
Linearity	0.07db/10dB
Resolution	0.01dBm, mW, µW, nW
Wavelengths	850, 980, 1300, 1310, 1490, 1550, 1610nm
Interface	FC/SC/ST universal connector

WiFi	
Frequency	2.4G, 5G
Supported Standards	802.11 a/b/g/n
Security Mode	WPA / WPA2 / WPA-PSK / WPA2-PSK
Encryption	WEP / AES / TKIP
Test Parameters	SSID, Level, Channel
Visual Fault Locator (by option only)	
Output Wavelength	650 ± 10nm
Output Power	10mW
Safety Standard	IEC 60825-1: 2007
Interface	FC/PC
Fiber Inspection Scope (by option only)	
Resolution	0.5µm
Field of View	425µm × 320µm
Interface	USB 2.0
Focus	Manual adjust, 2mm max travel
Dimensions	175mm × Ø3500 (probe without cap)
Light Source	Blue LED
Operating Temp.	0 ~ 50°C
Storage Temp.	-20 ~ +70°C
Miscellaneous	
RF Input	75Ω F
USB	USB 2.0
Ethernet	RJ45, 10/100T Ethernet
Display	7" capacitive TFT LCD touchscreen, 800×480 pixels
AC/DC Adapter	AC 100~240 V / 50~60 Hz DC 12V / 5A
Battery	Li-ion, 7.4 V / 10Ah
Charge Time	~4 hrs.
Working Time	8 hrs.
Dimensions (WxHxL)	245mm × 155 mm × 60 mm (9.6" x 6.1" x 2.4")
Weight	~2.2kg (4.9 lbs)
Work Temperature	-10 ~ +50 °C
Storage Temperature	-20 ~ +60 °C

For a list of DS2831-compatible accessories and software-enabled measurement options available from Deviser, please see Section 1-2.



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