

# Tektronix

## 2715 Cable TV Spectrum Analyzer



The 2715 is a complete cable TV RF testing solution.

### Digital and Analog Testing for Hybrid Networks

The 2715 Cable TV Spectrum Analyzer now includes automated tests for both analog and digitally-modulated channels. When you are ready to begin installing digital transmission of video, data or voice, the 2715 is ready to help. After setting up the 2715 with the new, companion Cable TV RF Measurement Software for Windows, the analyzer automatically determines the correct measurements for each channel type – analog, digital, FM or pilot.

### Dependable, In-service Analog Carrier Measurements at an Affordable Price

Now you can make more proof of performance and other cable system measurements without disruption of service to subscribers. And you can minimize the inconvenience of making measurements at the output of set-top

converters. The 2715 provides accurate and automated measurement of carrier-to-noise, in-channel response, and coherent distortion signals as well as carrier levels, frequencies, and more...without removal of video carriers or modulation. In-service measurement of CTB requires an unoccupied channel adjacent to the test channel.

### Characterize your Digital Channels

Channel averaged power, noise and distortions on digitally modulated channels can all be measured by the 2715. It's important to understand the performance of each of the digital channels in your system as well as their interaction with your analog channels. Both broadband random noise-like distortions, and coherent distortions – plus noise – can be measured. They all can degrade the bit-error-rate behavior of your digital signals. The 2715 includes

### IN-SERVICE RF TESTING FROM TEKTRONIX

In-service Measurements Minimize Program Interruption, Reduce Cost of Acquiring Performance Data – Compatible with NTSC and PAL Systems

Digital Channel Measurements Are Ready When You Are – Characterize Averaged Power; Check Noise and Distortions that Can Worsen BER – Applicable to QAM, QPSK, QPR, VSB, and OFDM Signals

Addresses All FCC Proof of Performance Measurements

Cable TV Measurements Enhance Measurement Repeatability and Reduce Technician Training Time

Carrier Level, Carrier Frequency, Carrier-to-noise, Hum/LFD, and Other Key Measurements Execute Automatically from Easy-to-use, On-screen Menu

Unattended and Remote Measurement Modes Reduce Personnel Requirements in the Field

75  $\Omega$  Input with Quick-change F and BNC Connectors Reduce Repair Costs and Minimize Down Time

Enhanced Troubleshooting Power with Built-in Pre-amplifier, Audio and Video Demodulation – All Standard

Frequency Coverage to 2.15 GHz, with Options 50 and 75, Can View Downconverted Satellite Signals (L-Band)

Includes Windows™-compatible PC Software for Programmed Measurement Configuration, Data Collection, Measurement Results Printouts, Limits Checking, Alarming and Control of a Locally or Remotely-located 2715

High Portability, On-board Non-volatile Memory, Four Digital Displays for Spectral Display Storage and Comparison, Plus True Analog, Continuous Gray Scale Display for Detecting Low Level Beats and Spurs Amidst Noise and Active Video

digital channel averaged power, desired-to-undesired signal power ratio (D/U) and CTB/CSO measurement. You also can verify the spectral occupancy of your digital modulators with an adjacent channel leakage (ACL) measurement. The distortion and noise measurements require a brief removal of the digital signal. You get all this capability in a 23.5 lb., compact, easy-to-carry package ... at an attractive price. All of the common cable system spectral measurements are built in and menu-selectable including those needed to address field FCC proof of performance requirements. An accompanying Microsoft Windows™-compatible PC software package adds measurement configuration, data collection, measurement results printouts, limits checking, alarming and more. What used to be complicated measurement procedures, even for engineering, are now push-button simple. Technicians can easily perform extensive cable system analysis and data collection in the field, all automatically.

Measurements and data collection can also be done remotely under computer control. Or the 2715 can be left unattended to run automatic measurements and data collection initiated by the built-in real-time clock. Data collected in the field can be transferred from the 2715's memory via an RS-232 or GPIB interface to a PC. The 2715's accompanying Windows PC software package includes easy transfer of data to your choice of Windows-compatible spreadsheet or database programs for customizing analysis or reports.

#### **Quick, Repeatable, Automated Measurements**

The 2715 contains the following measurements and capabilities in its cable TV (CATV/APPL) application menu:

#### **Analog Channels:**

- Direct channel tuning and automatic positioning of visual and aural carriers
- Visual and aural carrier level and frequency measurement
- Survey of system visual and aural carrier levels and frequencies
- Depth of modulation adjustment and measurement
- Aural carrier FM deviation adjustment and measurement
- Visual carrier-to-noise measurement
- In-channel response measurement
- Hum/low-frequency disturbance measurement
- System frequency response
- View baseband modulation (field and line) and view picture
- Aural carrier demodulation (listen mode)
- Intermodulation distortion measurement (CTB and CSO)
- Cross modulation measurement

#### **Digital Channel Measurements:**

(applicable to QAM, QPSK, QPR, 8VSB and OFDM signals)

- Averaged power
- Desired-to-undesired signal power ratio (D/U)
- Adjacent channel leakage (ACL)
- CSO and CTB
- Direct channel tuning and automatic positioning of digital signal
- Survey of system digital channel levels
- System frequency response

Measurements selected from the menu are automatically executed, and the results are displayed on the CRT screen. Not only are complex measurements reduced to push-button simplicity for less-experienced spectrum analyzer users, but measurement repeatability is high.

A battery pack option makes 2715 measurements and data collection possible even where AC power isn't available.

#### **More Troubleshooting Help...**

In addition to automated measurements, the 2715 also provides analog channel video and aural carrier demodulation. Aural carrier demodulation allows you to listen to the program audio on the selected channel. Similarly, the demodulated video feature allows you to view the video on the currently selected channel (or from a down-converted satellite signal). Also, full-field or individual horizontal line waveforms can be viewed.

All of these features aid positive channel or program identification in the field. They also aid recognition of many system problems.

#### **...And Maintenance Help**

Built-in adjustment modes for audio carrier deviation and video depth of modulation assist in day-to-day maintenance of your system. These adjustment modes are conveniently accessible from within the automated FM deviation and depth of modulation measurement routines.

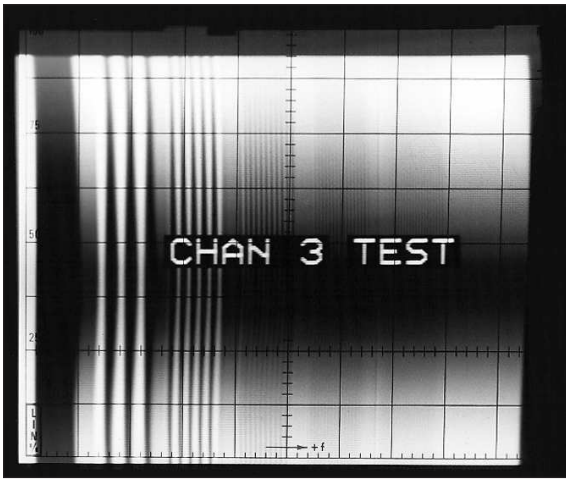
#### **Check filters, line amplifiers, cables**

The 2715's 75 Ω External Tracking Generator (Option 05) provides a convenient means of measuring frequency response on key system components. You can also sweep most two-port devices.

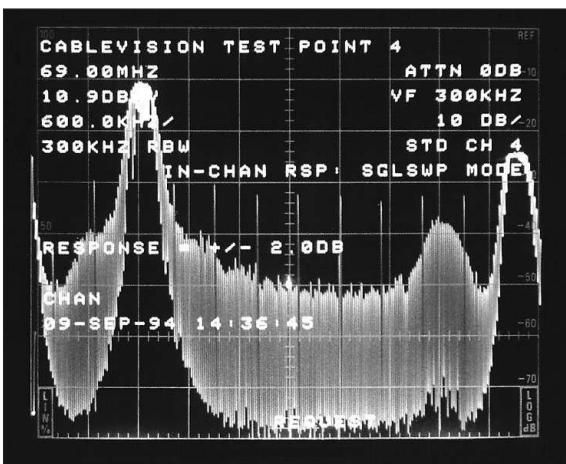
#### **The 2715 capitalizes on PC power**

The Microsoft Windows-compatible software package that accompanies the 2715 runs automated cable TV measurements via an RS-232 or GPIB interface and collects measurement history for tracking system performance.

The software package provides the following capabilities:



The demodulated video display aids channel or program identification. It also aids trouble-shooting by showing gross picture anomalies, such as the hum bars displayed here.



Measurement conditions and results are clearly displayed on-screen. Text can even be added, to describe measurement location for example.

**Channel table generator –**  
You can create your own channel tuning tables in addition to the standard tables provided. Creating

your own custom channel tuning tables is a simple matter of editing one of the standard tables or creating a completely new table by filling in a predefined, on-screen channel-setup form. Your custom tables can then be transferred to the 2715 to be used with its built-in measurement features. Result: data will be consistently taken on all of your system carriers including scrambled channels, aeronautical offsets, and non-standard frequencies.

**High-level test sequences –**  
You can configure automatic test sequences from the 2715's built-in measurements. Creating a test sequence is a simple matter of indicating the desired tests in an on-screen setup matrix. Your test sequences can then be transferred to the 2715 for later execution via front-panel selections, or run from a PC situated at another location. This capability allows less experienced technicians to easily execute high-level test sequences that have been defined and loaded into the 2715 by a cable TV system engineer or senior technician. Additionally, a time of day can be specified for automatic execution of any test sequence. You can also specify the number of times that a test is to be repeated and the interval of time between test

repetitions. This allows you to leave the 2715 unattended while it automatically performs its time initiated test procedures and stores results. For example, you can leave the 2715 at a node site overnight or over the weekend for unattended monitoring and data collection.

**Labor-saving ancillary features –** Detailed or summary current or historical measurement results can be printed directly from the 2715 PC Software or can be copied into another Microsoft Windows-compatible program for report customization.

You can execute tests from a remotely-located 2715 by using the CATV RF Measurements PC Software in conjunction with the Terminal Program that is a standard accessory of the Windows operating system software. You can place the 2715 at a node of another remote site while measurements and data collection are controlled from a centrally located PC. This configuration can significantly reduce the number of field trips necessary to monitor and diagnose system trouble spots. The RF Measurement Software also includes limits checking, alarming and 271X display transfer functions.

## 2715 Characteristics

The following specifications and features apply after a 15 minute warmup period and after all normalizations, including reference normalizations, have been performed. CATV characteristics represent typical performance and are dependent on general spectrum analyzer specifications. CATV characteristics need not be verified independently providing that all spectrum analyzer specifications are verified.

### CABLE TV MEASUREMENTS

**Channel Selection –**  
Visual and aural carriers displayed when channel number is entered or front-panel selected.  
Tune Configuration: STD, HRC, IRC, and custom; configured using 2715 PC software.  
Channel Range: 0 to 999; configured using 2715 PC software.  
Frequency Range: 1 MHz to 2.15 GHz; dependent on selected Channel Table.

**Visual Carrier Frequency –**  
Measured with internal counter to 1 Hz resolution with accuracy of  $5 \times 10^{-7} \times$  Carrier Frequency  $\pm 10$  Hz  $\pm 1$  Least Significant Digit.

**Visual-to-Aural Carrier Frequency –**  
Aural carrier measured with internal counter relative to visual carrier.  
Difference Range: 1 MHz to 10 MHz (depending on selected channel table) for an amplitude difference of  $\leq 30$  dB and aural carrier to noise  $\geq 15$  dB (300 kHz RBW).  
Resolution: 1 Hz.  
Accuracy:  $\pm 15$  Hz for visual-to-aural carrier difference  $\leq 8$  MHz.

**Visual Carrier Peak Level –**  
Absolute peak amplitude measured with preamp off.  
Amplitude Range:  $-18$  dBmV to  $+58.8$  dBmV for visual carrier to noise  $\geq 30$  dB (300 kHz RBW) and total input power  $\leq +70$  dBmV.  
Frequency Range: 15 MHz to 1015 MHz.  
Resolution: 0.1 dB.



**2715  
Characteristics  
Continued**

**Absolute Accuracy:**  $\pm 2.5$  dB for visual carrier to noise  $\geq 30$  dB (300 kHz RBW); for FM signals, carrier to noise  $\geq 33$  dB (100 kHz RBW).

**Relative Accuracy:**  $\pm 0.5$  dB relative to adjacent channel,  $\pm 1.2$  dB relative to all others.

**Visual-to-Aural Carrier Level Difference –**  
Difference Range: 0 to 30 dB for aural carrier to noise  $\geq 15$  dB (300 kHz RBW).  
Resolution: 0.1 dB.

**Accuracy:**  $\pm 0.75$  dB for aural carrier to noise  $\geq 15$  dB (300 kHz RBW).

**Digital Channel Averaged Power –**  
Averaged amplitude measured with preamp off.

**Amplitude range:**  $-30$  dBmV to  $+37$  dBmV (multi-channel) or  $-30$  dBmV to  $+52$  dBmV (preselected).  
Resolution: 0.1 dB.

**Absolute accuracy:**  $\pm 2.5$  dB.

**Carrier to Noise –**  
Default noise floor is a normalized 4 MHz bandwidth measured relative to the visual carrier peak.

**Range and Accuracy:** See Figure 1.  
Resolution: 0.3 dB.

Gated, in-service measurement is in-band; non-gated, in-service measurement is at guard band below channel boundary.

**Digital Channel Desired to Undesired Ratio –**  
Channel averaged power is divided by total noise plus distortion power in the channel.  
**Range and Accuracy:** See Figure 2.  
Resolution: 0.3 dB.

**Modulation Depth –**  
% AM measured from sync tip to lowest white level in 10 sweeps (VITS line used if defined in channel table).

**AM Range:** 50% to 95%.  
Resolution: 0.1%.  
**Accuracy:**  $\pm 2\%$  for visual carrier to noise  $\geq 40$  dB (300 kHz RBW).

**Hum/Low-Frequency Disturbance –**  
Power line frequency measured on an unmodulated visual carrier and low frequency disturbance measured on the modulated carrier.

**AM Range:** 1% to 10% peak-to-peak.  
Resolution: 0.1%.

**Accuracy:**  $\pm 1\%$  for hum  $\leq 5\%$  and visual carrier to noise  $\geq 25$  dB (300 kHz RBW);  $\pm 2\%$  for hum  $< 10\%$  and visual carrier to noise  $\geq 25$  dB (300 kHz RBW).

**Frequency Response –**  
For fixed-amplitude scrambling or no scrambling, system amplitude variations (flatness) are displayed relative to a reference trace stored during frequency-response reference setup.

**Range:** 5 dB/div.  
**Resolution:** 0.2 dB.  
**Flatness Accuracy:**  $\pm 0.75$  dB.

**In-Channel Response –**  
Expresses maximum variance in amplitude within some specified frequency range within a particular channel, given a "flat" test signal over that same specified range. The variance is referenced to the average of the highest and lowest amplitude within the frequency range.

**Range:**  $\pm 3$  dB.  
**Resolution:** 0.1 dB.  
**Accuracy:**  $\pm 0.5$  dB.  
Test signal line number must be specified for in-service measurements.

**Digital Channel Adjacent Channel Leakage –**  
Averaged power in adjacent channel(s) is divided by averaged power for the test channel.

**Range and Accuracy:** See Figure 3.  
Resolution: 0.3 dB.

**Carrier Survey –**  
Absolute peak amplitude of each visual carrier is measured and each associated aural carrier level is measured relative to the visual carrier for selected channels. Frequency counted only in ACCUR FREQ/AMPL mode. Visual Carrier (FREQ/AMPL and ACCUR AMPL modes)

**Amplitude Range:**  $-18$  dBmV to  $+58.8$  dBmV for visual carrier to noise  $\geq 30$  dB (300 kHz RBW) and total input power  $\leq +70$  dBmV.  
**Frequency Range:** 15 MHz to 1015 MHz.  
**Resolution:** 0.1 dB.

**Absolute Accuracy:**  $\pm 2.5$  dB for visual carrier to noise  $\geq 30$  dB (300 kHz RBW); for FM signals, carrier to noise  $\geq 33$  dB (100 kHz RBW).

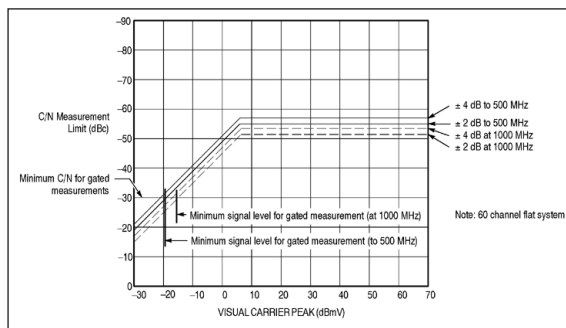
**Relative Accuracy:**  $\pm 0.5$  dB relative to adjacent channel,  $\pm 1.2$  dB relative to all others.

**Visual Carrier (FAST AMPL mode)**  
**Amplitude Range:**  $-18$  dBmV to  $+58.8$  dBmV for carrier to noise  $\geq 30$  dB (300 kHz RBW) and total input power  $\leq +70$  dBmV.

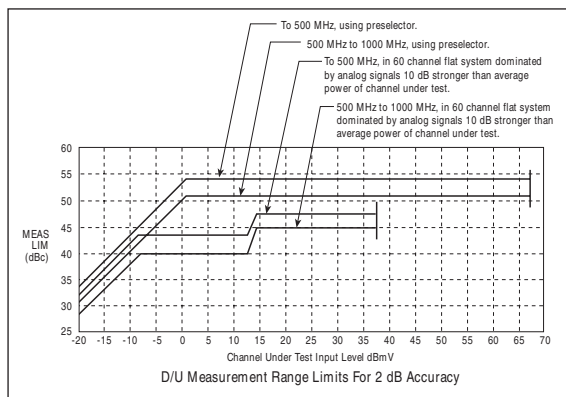
**Frequency Range:** 15 MHz to 1015 MHz.  
**Resolution:** 0.3 dB.

**Absolute Accuracy:**  $\pm 2.7$  dB for carrier to noise  $\geq 30$  dB (300 kHz RBW); for FM signals, carrier to noise  $\geq 33$  dB (100 kHz RBW).

**Relative Accuracy:**  $\pm 0.8$  dB relative to adjacent carrier;  $\pm 1.5$  dB relative to all other channels.



**Figure 1.**



**Figure 2.**

**2715  
Characteristics  
Continued**

**Aural Carrier (FREQ/AMPL and ACCUR AMPL modes)**

Difference Range: 0 dB to 30 dB for aural carrier to noise  $\geq 15$  dB (300 kHz RBW).  
Resolution: 0.1 dB.

Accuracy:  $\pm 0.75$  dB for aural carrier to noise  $\geq 15$  dB (300 kHz RBW).

**Aural Carrier (FAST AMPL mode)**

Difference Range: 0 dB to 30 dB for carrier to noise  $\geq 15$  dB (300 kHz RBW).  
Resolution: 0.3 dB.

Accuracy:  $\pm 1.1$  dB for carrier to noise  $\geq 15$  dB (300 kHz RBW).

**Analog Channel CTB and CSO –**

Measured relative to visual carrier peak according to NCTA recommendations. Range and Accuracy for INTERACTIVE and AUTO modes: See Figures 4, 5, and 6. Only  $\pm 4$  dB curve applies to SINGLE SWEEP and CONTINUOUS modes. Resolution: 0.3 dB.

**Digital Channel CTB and CSO –**

Measured relative to the averaged power of the test channel. Range and Accuracy: See Figures 7 and 8. Resolution: 0.3 dB.

**Aural (FM) Deviation –**

Peak FM deviation is measured for the selected channel. Range: 10 kHz to 50 kHz; usable to 80 kHz. Accuracy:  $\pm 4$  kHz.

**Cross Modulation –**

Peak of fundamental component of 3rd order distortion at horizontal sync frequency (AM) measured on the unmodulated visual carrier. Range: 48 dB. For cross modulation levels below  $-20$  dBc, equivalent frequency domain measurement of cross modulation results in a range of 58 dB. Resolution: 0.1 dB.

Accuracy:  $\pm 2$  dB for cross modulation  $< 36$  dB;  $\pm 3$  dB for cross modulation  $< 48$  dB.

**Listen Mode –**

Selected channel's aural carrier is FM demodulated and output fed to speaker or headphone jack; instantaneous peak FM deviation is displayed. If positive polarity video is selected, then AM audio will be demodulated.

**View Picture Mode –** Visual carrier is demodulated and displayed.

**View Modulation (Field) –** One video field of the selected channel's video is displayed.

**View Modulation (Line) –** VITS line displayed; If VITS line isn't specified in channel table, line 17 displayed. Line number user-selectable.

TV Line Selection: Via FREQ/MKRS knob. Line Format: NTSC or PAL. Line Range: 1-525 (NTSC); 1-625 (PAL). Sweep Time: 10  $\mu$ sec/div.

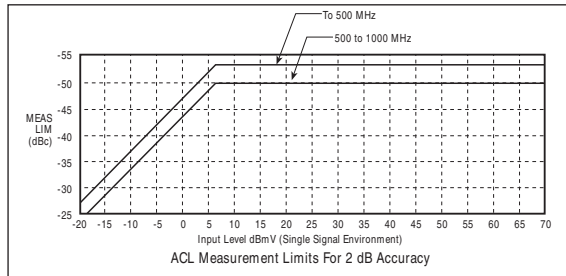


Figure 3.

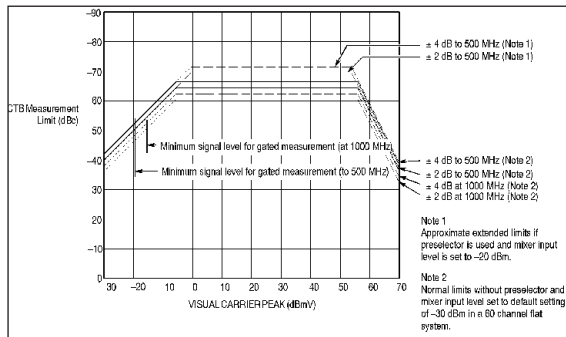


Figure 4.

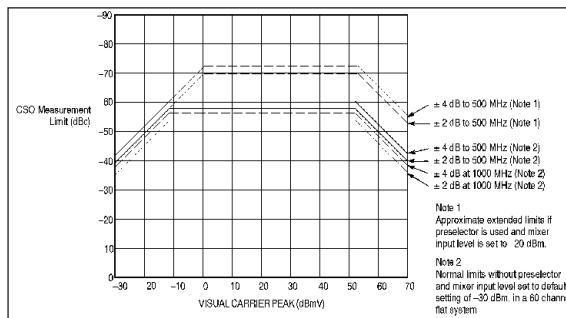


Figure 5.

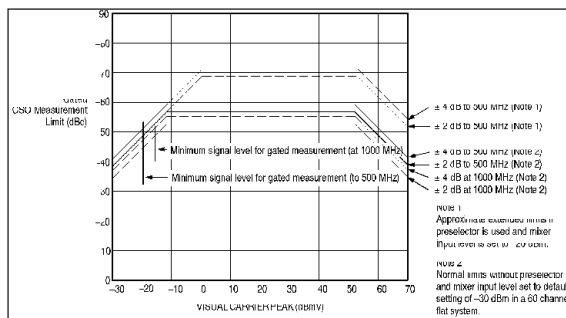


Figure 6.

**FREQUENCY RELATED**

**Frequency Range –**

9 kHz to 1800 MHz. Opt. 50 and 75: 9 kHz to 2150 MHz.

**Center Frequency Accuracy –**  $5 \times 10^{-7}$  of center frequency  $\pm 700$  Hz.

**Frequency Counter Accuracy –**  $5 \times 10^{-7}$  of center frequency  $\pm 10$  Hz  $\pm 1$  LSD (least significant digit).

**Dot Marker Frequency Accuracy –** Center frequency accuracy +3% of span, typical.

**Frequency Counter Readout Resolution –** 1 Hz or 1 kHz, selectable.

**Typical Long-Term Drift –**  $\pm 2$  ppm/year.

**Short-Term Drift –**

$\leq 400$  Hz maximum drift between correction cycles (with SPAN/DIV  $\leq 20$  kHz). Opt. 50 and 75:  $\leq 500$  Hz above 1.8 GHz.

**Residual FM –**  $\leq 100$  Hz p-p/20 msec at  $\leq 20$  kHz span/div

Opt. 50 and 75:  $\leq 120$  Hz above 1.8 GHz.  $\leq 2$  kHz p-p/20 msec at  $> 20$  kHz span/div. Opt. 50 and 75:  $\leq 2.4$  kHz above 1.8 GHz.

**Resolution Bandwidth (–6 dB) –**

5 MHz, 1 MHz, 300 kHz, 100 kHz, 30 kHz, 10 kHz, 3 kHz, 1 kHz, and 300 Hz.

**RBW Shape Factor (60 dB/6 dB) –**  $\leq 7:1$  for RBW  $\leq 1$  MHz.

**Noise Sidebands –**

$\leq -70$  dBc at 30 x RBW for RBW  $\leq 100$  kHz. Opt. 50 and 75:  $\leq 69$  dBc above 1.8 GHz.

**Video Filter –**

Auto:  $\approx 1/100$  of RBW.

Manual: 3 Hz to 300 kHz in 1-3 sequence, or WIDE.

Off:  $\approx$  RBW.

**Frequency Span/Div Range** – 100 MHz to 1 kHz selected in 1-2-5 sequence or any value from 100 MHz to 1 kHz via the keypad or UTIL menu, plus 180 MHz (MAX SPAN) and 0 Hz. Opt. 50 and 70: 215 MHz/div (MAX SPAN).

**Span Accuracy** –  $\pm 3\%$  measured over the center eight divisions.

**AMPLITUDE RELATED**

**Flatness** –

$\pm 2$  dB (relative to reference level at 100 MHz) measured with 10 dB internal RF attenuation (preamp off).

Opt. 50 and 75:  $\pm 3$  dB above 1.8 GHz.

**Vertical Display Modes** – 10, 5, 1 dB/div, Linear.

**Measurement Range** – -90 dBmV (preamp on) to +68.8 dBmV (-139 to +20 dBm).

**Display Dynamic Range** –

80 dB maximum (Log Mode); 8 divisions maximum (Linear mode).

Opt. 50 and 75: Dynamic range reduced if there is signal energy at or near 2.11 GHz. Baseline will typically rise to within 10 to 20 dB of signal applied near 2.11 GHz.

**Reference Level Range** –

Log Mode: -21.2 dBmV to +68.8 dBmV (-70 to +20 dBm); -41.2 dBmV to +48.8 dBmV with preamp on.

Linear Mode: 10.83  $\mu$ V/div to 342.33 mV/div (1.08  $\mu$ V/div to 34.23 mV/div with preamp on).

**Reference Level Steps** –

Log Mode: 1 dB or 10 dB.

Linear Mode: 10.83  $\mu$ V/div to 342.33 mV/div in 1-2-5 sequence;  $\geq 0.2$  div/increment with FINE REF LVL STEP activated.

**Display Amplitude Accuracy** –

10 dB/div:  $\pm 1.0$  dB/10 dB to a maximum cumulative error of  $\pm 2.0$  dB over the 70 dB range and a maximum cumulative error of  $\pm 4.0$  dB over the 80 dB range; accuracy and range specifications are affected by the SNR of selected RBW and are valid only for the maximum specified in the following table:

RBW dB	Down
5 MHz	40
1 MHz	40
300 kHz	50
100 kHz	50
30 kHz	60
10 kHz	60
3 kHz	80
1 kHz	80
300 Hz	80

5 dB/div:  $\pm 1.0$  dB/10 dB to a maximum cumulative error of  $\pm 2.0$  dB over the 40 dB range.

1 dB/div:  $\pm 1$  dB maximum error over the 8 dB range.

Linear Mode:  $\pm 5\%$  of full scale.

**RF Attenuation Range** – 0 to 50 dB in 2 dB steps.

**Maximum Sensitivity (at 300 Hz RBW)** –

-78 dBmV (-127 dBm); -90 dBmV (-139 dBm) with preamp on.

**SPURIOUS RESPONSE (PREAMP OFF)**

**Residual Spurious Response** –

$\leq -51$  dBmV ( $\leq -100$  dBm) with 0 dB RF attenuation, except at 1780 MHz where the spurious response is  $\leq -41$  dBmV ( $\leq -90$  dBm).

Opt. 50 and 75:  $\leq -26$  dBmV (-75 dBm) at 2.0 GHz.

**3rd Order IM Distortion** –

$\leq -70$  dBc from any two on-screen signals with any frequency span.

Opt. 50 and 75: typically  $\leq 65$  dBc at 2.15 GHz.

**2nd Harmonic Distortion** –  $\leq -66$  dBc mea-

sured with 1st mixer input level of  $\leq +9$  dBmV.

**LO Emission** –

$\leq -21$  dBmV ( $\leq -70$  dBm) with 0 dB RF attenuation.

Opt. 50 and 75:  $\leq -21$  dBmV ( $\leq -70$  dBm) (sweep above 350 MHz).

$\leq +29$  dBmV, typical (-20 dBm) (sweep below 90 MHz).

**0 Hz Spur** –  $\leq +39$  dBmV ( $\leq -10$  dBm) reference to input with 0 dB RF attenuation.

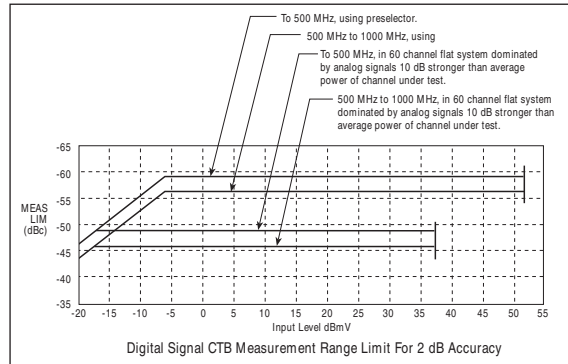


Figure 7.

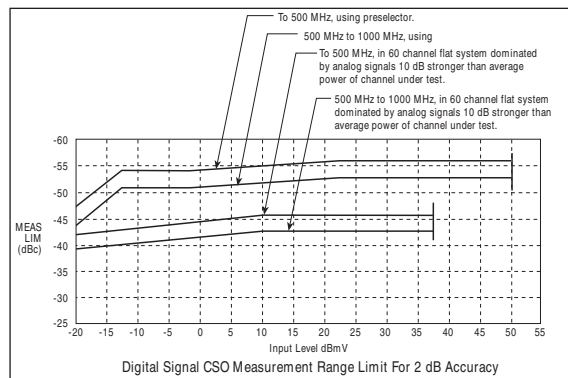


Figure 8.

**INPUT RELATED**

**RF Input** –

75  $\Omega$  BNC with quick change to 75  $\Omega$  type F connector.

Opt. 50: 50  $\Omega$  Type N connector.

**VSWR** –

With RF Attenuation  $\geq 10$  dB: 1.5:1 maximum to 1 GHz.

With 0 dB RF Attenuation: 2:1 maximum to 1 GHz.

**Maximum Safe Input** – +70 dBmV (0.1 W or 2.2 V) continuous peak with 100 VDC blocking capacitor.

**1 dB Compression Point** –  $\geq +34$  dBmV (-15 dBm) with 0 RF attenuation and 1st mixer at +19 dBmV (-30 dBm).

**SWEEP RELATED**

**Sweep Selections** – Normal, single sweep, and manual scan.

**2715  
Characteristics  
Continued**

**Sweep Times** – 1  $\mu$ sec/div to 2 sec/div in a 1-2-5 sequence.  
**Sweep Accuracy** –  $\pm 10\%$  over the center 8 divisions.  
**Trigger** – Free run, internal, external, line, TV line, and TV field.  
**Trigger Amplitude** –  
 Internal: One division or more of signal.  
 External: 100 mV peak minimum; DC coupled (15 Hz to 1 MHz).

**OTHER INPUTS/OUTPUTS**

**External Trigger** – BNC connector, 10 k $\Omega$  impedance, DC coupled, 0.1  $\mu$ sec minimum pulse width; 50 V (DC + pk AC) maximum.  
**External Video Input** – 100  $\Omega$  impedance DC coupled; 0-50 kHz BW; 0-1.6 V (200 mV/div typical) signal input for vertical deflection of CRT beam.  
**Video Output** – 0-1.6 V of video signal, inversely proportional to vertical display amplitude; 0 V is top of screen; 1 k $\Omega$  impedance.  
**Sweep Gate Out** – TTL level that is HI while CRT beam sweeps.  
**Sweep Output** – +1.3 to -1.3 V, negative-going ramp, proportional to the horizontal sweep; output impedance  $\leq 50 \Omega$ .  
**Digital Communications** – Either RS-232 or GPIB interface provided as a no-cost option.

**ENVIRONMENTAL**

**Temperature** –  
 Operating: 0° to +50°C (MIL T-28800E).  
 Nonoperating: -55° to +75°C.  
**Humidity** – Nonoperating: Five cycles (120 hrs) in accordance with MIL-Std-28800E, Class 5.  
**Vibration** – Meets MIL T-28800E, Method 514, Procedure X (modified).  
**Shock** – Operating and nonoperating: Three guillotine-type shocks of 30 g, one-half sine, 11 ms duration each direction along each major axis; total of 18 shocks.  
**Altitude** –  
 Operating: 15,000 ft.  
 Nonoperating: 50,000 ft.  
**Electromagnetic Compatibility** –  
 EC92 EMC Directive 89/336/EEC:  
 Emissions:  
 EN50081-1.  
 Radiated emissions, 30 MHz to 1 GHz:  
 EN55022 Class B (CISPR 22 B).  
 Conducted emissions, 150 kHz to 30 MHz: EN55022 Class B (CISPR 22 B).  
 Conducted emissions, power line harmonics, 0 to 2 kHz: IEC 555-213.  
 Immunity:  
 EN50082-1. Electrostatic discharge, 8 kV, IEC 801-2.  
 Radiated immunity, 27 MHz to 500 MHz, IEC 801-3.  
 No response above -90 dBm in a 3 V/meter field.  
 Fast transients, capacitive clamp, 1 kV power leads, 500 V control leads, IEC 801-4.  
 Power line surge, 1 kV differential mode, 2 kV common mode, IEC 801-5.

**GENERAL CHARACTERISTICS**

**Power Requirements** – 105 W maximum (1.4 A) at 115 V, 60 Hz; operates 48 Hz to 440 Hz, 90 to 132 VAC, or 48 Hz to 63 Hz, 90 VAC to 250 VAC; battery power option available.

Dimensions (H,W,D) with Feet, Handle, and Front-Panel Cover		
	mm	in.
	137 x 361 x 445	5.4 x 14.2 x 17.5
Weight	kg	lbs.
	<10.6	23.5

**OTHER CAPABILITIES**

**Markers** – Single marker/delta marker; next right, next left peaks; next lower, next higher peaks; (highest) peak find; marker to center frequency; select start/stop frequencies; transpose  $\Delta$  markers.  
**Measurement Modes** – Noise, carrier-to-noise, bandwidth (user-definable "dB down" points), 99% occupied bandwidth, signal search, and cable TV measurements (see Cable TV).  
**Time Delay Setup** – Uses built-in time-of-day clock to initiate measurement sequences and sequence repeat interval; START TIME, REPEAT INTERVAL, RUN N TIMES.  
**PC-Based Software Package** – Provides report generation, test data analysis, data history, channel tuning table definition, user-defined program definition, limits checking, alarming and 271X display transfer.  
**Nonvolatile Memory** –  
 Lithium battery backup, 124 K available; used to save cable TV measurement results, setup table parameters, large user-definable key routines, antenna tables, and channel tuning tables.  
 Saved Displays: 108 maximum.  
 Saved Front-Panel Setups: 36 maximum.  
**Digital Storage Display** – Selectable acquisition modes of positive peak only, positive/negative peak; SAVE A, B, C, and active D trace; up to four traces on screen; MAX HOLD A, B; MIN HOLD C; B, C minus A; TITLE MODE; digital storage off provides analog display.  
**Ensemble Averaging** – Provides weighted averaging of display, results in reduction of measured noise values and impulse signals.  
**Internal Preamp** – Preamp can be switched in/out of circuit (degrades flatness above 600 MHz, provides a maximum of 12 dB sensitivity improvement).  
**Alternate Reference Level Units** – dBm, dBmV, dBV, dB $\mu$ V, dB $\mu$ W, dB $\mu$ V/m (dBmV and dB $\mu$ V only in CATV measurement mode).  
**dB $\mu$ V/m Mode** – Automatically compensated field strength measurement with up to five user-selected antennas.  
**User-Definable Power-On Status** – Instrument powers up to user-definable state or supplied default settings.  
**Center Measure** – Signal nearest center frequency is centered with frequency and peak amplitude automatically read out (not a marker mode); the centered signal is counted.  
**Signal Track** – Drifting signal is kept at display center with correct frequency and peak amplitude displayed.  
**Direct Plot/Print** – Supports Epson FX and LQ Series compatible Printers using RS-232 interface, or HPGL compatible plotters via GPIB interface.

## 2715 Ordering Information

2715

Cable TV Spectrum Analyzer.

**Includes:** Windows-compatible PC Software, Power Cord (U.S. 115 V/60 Hz), User Manual, Programmer Manual, Reference Manual, Front Cover, 75  $\Omega$  BNC Connector, 75  $\Omega$  F Connector, and Choice of GPIB or RS-232 Interface (Opt. 03 or Opt. 08). Opt. 50 includes a 50  $\Omega$  Type N-to-BNC adapter in place of 75  $\Omega$  connectors.

### Options

- Opt. 03** – Provides an IEEE-488 General Purpose Interface Bus (GPIB) as a no-cost option (not compatible with Option 08).
- Opt. 05** – 100 kHz-1.8 GHz 75  $\Omega$  External Tracking Generator with mechanical mating kit (includes Opt. 15). Cannot be mounted to 2715 simultaneously with Option 07 Battery Pack.
- Opt. 07** – Battery Pack/Inverter.
- Opt. 08** – Provides an RS-232 port as a no-cost option (not compatible with Opt. 03).
- Opt. 15** – 1st Local Oscillator Output for a 1405 TV Sideband Analyzer or 2707 External Tracking Generator.
- Opt. 30** – Rackmount Adapter for 19 x 5.25-in. Rack Dimensions.
- Opt. 33** – Travel Line package  
**Includes:** Rain Cover, Accessory Pouch, Gray Filter, and Carrying Strap.
- Opt. 34** – Portable-to-rackmount Adapter for 19 x 7-in. Rack Dimensions.
- Opt. 50** – Frequency extension to 2.15 GHz, 50  $\Omega$  input impedance with Type N connector.
- Opt. 75** – Frequency extension to 2.15 GHz, 75  $\Omega$  BNC with quick change to 75  $\Omega$  Type F connector.

### International Power Plug Options

- Opt. A1** – Universal Euro 220 V, 50 Hz.
- Opt. A2** – UK 240 V, 50 Hz.
- Opt. A3** – Australian 240 V, 50 Hz.
- Opt. A4** – North American 240 V, 60 Hz.
- Opt. A5** – Switzerland 220 V, 50 Hz.

### Measurement Service Options

- Opt. C3** – Three years of Calibration Services.
- Opt. C5** – Five years of Calibration Services.
- Opt. D3** – Test Data (requires Opt. C3).
- Opt. D5** – Test Data (requires Opt. C5).
- Opt. R3** – Repair warranty extended to cover three years.
- Opt. R5** – Repair warranty extended to cover five years.

### Optional Accessories

- 75  $\Omega$  Coaxial Cable, BNC, 24 in.** – Order 012-1339-00.
- 75  $\Omega$  Coaxial Cable, BNC, 42 in.** – Order 12-0074-00.
- F Series Input Adapter/Connector Replacement** – Order 103-0301-00.
- BNC Input Adapter/Connector Replacement** – Order 103-0310-00.
- RS-232 Cables** –  
9-pin to 9-pin Null Modem. Order 012-1379-00.  
25-pin to 9-pin Null Modem. Order 012-1380-00.  
25-pin to 9-pin RS-232 Cable. Order 012-1214-00.
- GPIB Cables** –  
1 meter. Order 012-0991-01.  
2 meter. Order 012-0630-01.
- Rain Cover** – Order 200-2500-00.
- Accessory Pouch** – Order 016-0677-02.
- Viewing Hoods** –  
Collapsible. Order 016-0592-00.  
Polarized. Order 016-0180-00.  
Binocular. Order 016-0566-00.
- Carrying Strap** – Order 346-0199-00.
- CRT Light Filter (Gray)** – Order 337-2775-02.
- Transit Case** – Order 016-0792-02.
- Front Panel Cover** – 200-2520-00.
- Softside Carrying** – Case 016-1158-01.
- Service Manual** – 070-9096-00.
- User Manual** – 070-9115-00.

2712, 2711 Option 03 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

### For further information, contact Tektronix:

**Worldwide Web:** for the most up-to-date product information visit our web site at: [www.tektronix.com](http://www.tektronix.com)

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