

With compliments

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Section I
Introduction

SECTION I

INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This manual contains instructions for the use and operation of Spectrum Analyzers Models 630C and 640C (figures 1-1 and 1-2) manufactured by Polarad Electronics, Inc., 5 Delaware Drive, Lake Success, New York, 11042.*

1-3. SPECTRUM ANALYZER MODEL 630.

1-4. Model 630 provides coverage of signal frequencies from 3 MHz to 40 GHz and includes a broadband stripline input mixer for sensitive analysis of signals from 3 MHz to 18 GHz. Signal frequencies from 18 to 40 GHz are analyzed with optional external waveguide mixers. Frequency spans are calibrated from 500 Hz/DIV to 200 MHz/DIV (2 GHz total span). The FULL span position provides pre-set scans over the several analyzer tuning bands, which is especially useful when used with the pre-selector on the Model 640. A zero (0) span "receiver mode" is also provided to tune to any carrier frequency and display modulation waveforms. Narrow spans, 0 to 100 kHz/DIV, are displayed with the first local oscillator (LO) automatically phase-locked, providing a high degree of stability and low residual sidebands. Resolution bandwidth is normally tracked with the frequency spans in the automatic (AUTO) mode, but bandwidths are also man-

ually switchable from 300 Hz to 1 MHz.

1-5. Model 630 (figure 1-1) includes a Band 2 that covers 1.30 to 2.80 GHz. The first IF for Band 2 is 1.262 GHz instead of the 2.06 GHz used for all other bands. Thus, signal frequencies near 2.06 GHz can be analyzed on Band 2 without interfering responses caused by scans through the analyzer's first IF.

1-6. SPECTRUM ANALYZER MODEL 640.

1-7. Model 640 includes all the features of Model 630 (paragraph 1-4). In addition, Model 640 includes a low pass filter up to 1.8 GHz and a three-stage tracked YIG preselector from 1.8 to 18 GHz. The YIG preselector effectively eliminates responses to signals at image frequencies and multiple responses caused by input signals mixing with harmonics of the first local oscillator. The preselector in Model 640 greatly enhances the usefulness of the spectrum analyzer for applications involving broadband input signals up to 18 GHz and which require relatively wide frequency spans.

1-9. EQUIPMENT SPECIFICATIONS.

1-10. Table 1-1 lists the pertinent equipment specifications.

TABLE 1-1. EQUIPMENT SPECIFICATIONS, MODELS 630 AND 640.

Frequency Specifications	
Frequency Range	3 MHz to 40 GHz, pushbutton band selection: 7 bands. 3 MHz to 18.0 GHz with internal mixer. 18.0 GHz to 40 GHz with external mixer (Part No. 167032) and waveguide tapers (Part Nos. 167033 and 167034).
Tracking Preselector (Model 640 Only)	The preselector includes a low pass filter for the 3 MHz to 1.8 GHz range and a voltage-tuned bandpass filter for the 1.8 GHz to 18 GHz range. The passband of the tuned filter tracks the tuning frequency of the spectrum analyzer, reducing or eliminating unwanted responses caused by input signals outside the bandpass region of the filter.
Frequency Readout	Direct digital display of center frequency (3-1/2 digits).

* **Note** : All references to Models 630 and 640 within this manual also apply to Models 630C and 640C, respectively.

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TABLE 1-1. EQUIPMENT SPECIFICATIONS, MODELS 630 AND 640 (Continued)

Frequency Specifications (Continued)

Frequency Tuning Controls:

Center Frequency Tuning Continuous readout on LED display.

Rapid Tuning Pushbuttons for rapid tuning of center frequency in the "blue" coded frequency span positions.

Frequency Accuracy ± 5 MHz, ± 1 count, with fundamental mixing mode, up to 2.8 GHz.
 $N \times (\pm 10$ MHz), ± 1 count, up to 18 GHz.
 ± 2 counts, above 18 GHz.
 For $N > 2$, where N is the mixing mode.

Signal Identifier (SIG IDENT) When the selected frequency band corresponds to the actual signal frequency, the momentary SIG IDENT switch shifts a signal indication 2 divisions (with the 1 MHz/DIV span) and reduces its amplitude by more than 5 dB. The shift is left for N- bands (10 MHz to 10.3 GHz) and right for N+ bands (10.3 GHz to 40 GHz).

Frequency Spans per Division 17 calibrated span widths from 500 Hz/division to 200 MHz/division in a 2, 5, 10 sequence. Accuracy, $\pm 5\%$.
 The variable span (VAR SPAN) control facilitates interpolation between calibrated FREQ SPAN/DIV steps. The UNCAL light indicates the use of the VAR SPAN.

Full Span The first LO is swept over the entire range to provide spans from 2.06 to 6 GHz, 4.3 to 10.3 GHz, and 10.3 to 18 GHz. Spurious-free full spans are obtainable with the preselector on the Model 640.

Zero Span The spectrum analyzer remains tuned to the selected (center) frequency. In this mode, it is a manually-tuned, variable bandwidth receiver. Variations in signal level, such as AM or pulse modulation, are displayed versus time on the CRT.

Resolution Bandwidths:

Automatic Mode Resolution bandwidth is tracked with the FREQ SPAN/DIV switch.

Manual Mode The RESOLUTION BW switch selects the indicated resolution bandwidths.

IF Bandwidth Range 300 Hz to 1 MHz at 3 dB bandwidth. Steps of: 300 Hz, 1 kHz, 3 kHz, 10 kHz, 20 kHz, 300 kHz, and 1 MHz. Accuracy, $\pm 20\%$ (Gaussian shape).

IF Filter Characteristics

Option 6		Without Option	
IF BW (Typical)	Typ. Shape Factor 3/60 dB	IF BW (Typical)	Typ. Shape Factor 3/60 dB
1 MHz $\pm 20\%$	7:1	1 MHz $\pm 20\%$	7:1
300 kHz $\pm 20\%$	7:1	300 kHz $\pm 20\%$	7:1
10 kHz $\pm 15\%$	12:1	20 kHz $\pm 20\%$	15:1
		10 kHz $\pm 20\%$	20:1
		3 kHz $\pm 20\%$	27:1
1 kHz $\pm 15\%$	12:1	1 kHz $\pm 20\%$	30:1
0.3 kHz $\pm 15\%$	10:1	0.3 kHz $\pm 20\%$	40:1

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Frequency Specifications (Continued)	
Noise Sidebands	Average noise sideband level >70 dB below CW signal, >60 kHz from CW signal, with 1 kHz IF bandwidth, "LONG" VIDEO FILTER time constant and fundamental (1-) mixing mode.
Frequency Stabilization (Phase Lock)	Used with FREQ SPAN/DIV of 0 to 100 kHz/division. First LO is automatically phase-locked to an internal 17 MHz crystal-controlled oscillator.
First LO:	
Local Oscillator (LO)	Transistor, YIG tuned.
Frequency Range	2.06 to 4.1 GHz, plus overscan.
Residual FM	Unstabilized: < 10 kHz x N, peak-to-peak Stabilized: < 150 Hz x N, peak-to-peak. (Where, N is the mixing mode.)
Frequency Drift	(±5 kHz x N)/10 minutes, typical, in phase-lock mode after 1 hour at constant temperature. 2-minute settling time after retuning.
First IF and Image Separation	The first IF is 2.06 GHz for all bands except Band 2 (1.3 to 2.8 GHz on Model 630 and 1.75 to 2.8 GHz on Model 640). The first IF for Band 2 is 1.262 GHz. Image separation is 4.12 GHz for all bands except Band 2 on Models 630 and 640, where the image separation is 2.524 GHz.

Amplitude Specifications

Frequency Band/Sensitivity Response Flatness

Model 630 Band No.	Model 640 Band No.	Frequency (GHz) (Note 1)	LO Harmonic No. and Mixing Mode (N)	Sensitivity (dBm) (S + N = 2N)		Avg. Noise Level (dBm)		Flatness (dB Max.)	
				630 (Note 2)	640 (Note 2)	630 (Note 2)	640 (Note 2)	630 (Note 3)	640 (Note 2)
1	1	0.003 to 2.0 0.003 to 1.80	N = 1-	-110	-108	-116	-114	±1.25	±1.75
2	2	1.30 to 2.80 1.75 to 2.80	1-	-105	-99	-111	-105	±1	±2
3	3	2.1 to 6.0	2-	-104	-98	-110	-104	±2	±3
4	4	4.3 to 10.3	3	-95	-88	-101	-93	±2.5	±4
5	5	10.3 to 18.0	4+	-90	-80	-96	-86	±3	±5
6	6	18.0 to 26.0 (with Ext. Mixer)	6+	-70 (Note 5)	(Note 4)	-76 (Note 5)	(Note 4)		
7	7	26.0 to 40.0 (with Ext. Mixer)	10+	-60 (Note 5)	(Note 4)	-66 (Note 5)	(Note 4)		

Notes pertaining to this table are on the following page.

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Amplitude Specifications (Continued)

- NOTES:
1. Frequency bands are usable for frequency spans beyond their rated band edges.
 2. The Model 640 specification includes the preselector. When the preselector is bypassed, the Model 630 specification applies. Rated minimum sensitivity in band. Sensitivity is defined as: Signal Deflection (S) + Noise Deflection (N) = 2N (or, S = N + 6 dB) at 1 kHz. Resolution BW for signals up to 18 GHz. "LONG" VIDEO FILTER and 0 dB RF ATTEN. Average noise levels are 6 dB below rated sensitivity.
 3. Response flatness (uniformity) is rated with at least 10 dB RF ATTEN.
 4. Preselector range is 1.8 to 18 GHz.
 5. At 10 kHz Resolution BW.

Absolute Level Calibrations (10 MHz to 18 GHz)	Full scale LOG REF LEVEL, selectable from -59 dBm to +40 dBm, in 10 dB and 1 dB steps, and displayed on a 2-digit front panel indicator.
Reference Level	Factory set; may be reset, if required, with panel screwdriver control. The internal 100 MHz calibrator output at -30 dBm or an external source may be used as standards.
Display Calibration	CRT left-hand vertical log scale calibrated in 10 dB/division. The right-hand vertical scale is linear from 0 to 100%.
Log Scale Characteristics	1) 10 dB/division, 80 dB range. Log scale accuracy ± 0.25 dB/dB, but not more than ± 2 dB maximum error to -60 dB (measured from the LOG REF LEVEL). 2) 2 dB/division. ± 0.25 dB/dB, but not more than ± 0.5 dB maximum error to -10 dB (measured from the LOG REF LEVEL).
Linear Scale Characteristics	8 divisions: 10% to 100%. Accuracy, ± 5 FS (full scale).
RF Attenuation	0 to 50 dB in 10 dB steps, calibrated from 10 MHz to 18 GHz. Attenuator is rated for 1 watt (+30 dBm) maximum input.
Accuracy	± 1 dB or 4% of attenuator setting, whichever is greater.
Insertion Loss	$(0.4 \pm 0.07F)$ dB, where, F is in GHz.
IF Attenuation	0 to 50 dB in 10 dB steps, 0 to 9 in 1 dB steps.
Accuracy	± 1 dB overall.
IF Level Range	Continuously adjustable IF level, nominal 12 dB range. The preset calibrated (CAL) position is used for log reference level calibrations. The panel REF LEVEL dBm readout indicates UN-CAL except when the preset CAL position is in use.
Frequency and Level Calibration References:	
Calibrator Output	Frequency: 100 MHz ($\pm 0.005\%$) and harmonics.
Amplitude Accuracy	-30 dBm ± 0.5 dB at 100 MHz.

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Amplitude Specifications (Continued)	
Distortion Dynamic Range:	
Residual Responses	< -85 dBm with no input signal and 1- mixing mode.
Intermodulation Distortion (See Note)	< -65 dB residual third order intermodulation (IM) rated for two equal -40 dBm input signals to mixer, > 300 kHz apart and a 1- mixing mode (measured from the LOG REF LEVEL only).
Harmonic Distortion (See Note)	< -60 dB second harmonic (relative to the fundamental) rated at -40 dBm input to the mixer on the 1- mixing mode.
NOTE: With the preselector in Model 640, multiple responses and intermodulation responses that are outside of the preselector bandwidth are normally eliminated, providing much greater spurious-free dynamic range for measurement.	
Preselector Characteristics (Model 640 Only)	
Preselector Modes:	
Automatic	The preselector is tracked automatically with the analyzer input frequency from 1.8 GHz to 18 GHz. The low-pass filter is automatically inserted when Band 1 is in use.
Manual	The preselector filter is tuned by a dual concentric control for any desired frequency from 1.8 to 18 GHz.
Low Pass Filter	For Band 1 operation, a 1.8 GHz low-pass filter is switched in. (This filter may be omitted from the analyzer by specifying Option 3.)
Preselector Filter Characteristics:	
Type	3-stage YIG tuned.
Frequency Range	1.75 to 18 GHz.
Insertion Loss	Typically 6 dB. Measured data is supplied with each analyzer as a Frequency versus Insertion Loss plot.
Typical Filter Bandwidths (3 dB minimum)	25 MHz at 1.8 GHz 30 MHz at 9.0 GHz 50 MHz at 18.0 GHz.
Out-of-Band Attenuation	18 dB/octave, nominal.
Low-Pass Filter	Cut-off frequency 1.8 GHz; insertion loss, < 3 dB.

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Scan Characteristics	
Scan Rates and Scan Modes:	
Scan Time	2 MSEC/DIV to 2 SEC/DIV in ten calibrated steps (1:2:5 step ratio). Accuracy: $\pm 20\%$ for all steps except 2 SEC/DIV, which is nominal.
Single Scan	SINGLE scan (usually for display photography) is actuated by "momentary on" toggle switch.
Manual Scan	Analyzer tuning may be set at any frequency within the selected frequency span bandwidth. The MAN SCAN control tunes the received frequency across the CRT, in either direction.
Scan Outputs (Rear Panel BNC Connectors)	HOR OUTPUT: +0.5V to +4.5V (typical), dc coupled, 1k ohm output impedance. VERT OUTPUT: +4.5V FS (typical), dc coupled, 1k ohm output impedance, 200 kHz nominal bandwidth.
Video Filter (Noise Smoothing)	
Post-detection low-pass filter, used to average randomly varying signal displays. Three-position switch selects:	
	NORMAL time constant - 200 kHz nominal bandwidth
	SHORT time constant - 6 kHz nominal bandwidth
	LONG time constant - 100 Hz nominal bandwidth
Input Specifications (Model 630 Only)	
Input Impedance	50 ohms, nominal, for coaxial input signal, 3 MHz to 18 GHz.
Input Connector	Type N, female.
VSWR	< 1.5 to 1, with 10 dB RF ATTENUATION.
Signal Level for 1 dB Compression ..	> -10 dBm (at 0 dB RF ATTENUATION).
Maximum Safe Input	< +10 dBm (at 0 dB RF ATTENUATION).
Input Specifications for Preselectors (Model 640 Only)	
Input Impedance	50 ohms, nominal.
Input/Output Connectors	Type N, female.
VSWR	2:1, typical.
Maximum Safe Input	< +10 dBm.

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External Mixers	
Frequency Range	18 to 26 GHz (Mixer, Part No. 167032, and Adaptor, Part No. 167033). 26 to 40 GHz (Mixer, Part No. 167032, and Adaptor, Part No. 167034).
External Bias Current	Positive; front panel screwdriver adjustment.
Signal Level for 1 dB Compression	-15 dBm, typical.
Maximum Safe Input	0 dBm, maximum.
Display Specifications	
CRT Internal Graticule	P31 Phosphor (medium 0.1 sec nominal persistence).
Calibrated Graticule	Internal 8 x 10 divisions. Five subdivisions per major division on horizontal (frequency) and vertical (level) axes.
Scale Illumination	Adjustable SCALE ILLUM control.
CRT Baseline Clipper	Front panel BASELINE CLIP control adjusts blanking of CRT trace baseline. Facilitates scope photography and detailed analysis of low-repetition-rate signals.
Camera Mount	Usable with oscilloscope cameras such as Tektronix Model C-27 with No. 016-0224-00 Bezel Adaptor, or H-P Model 195A or 197A (with UV light for illumination of internal graticules) with adaptor H-P 10356A.
General Characteristics	
Power Requirements:	
Model 630	115/230 volts, $\pm 10\%$, 50 to 60 Hz, 80 watts.
Model 640	115/230 volts, $\pm 10\%$, 175 watts, 50 to 60 Hz (50 to 60 Hz, and 400 Hz available with Option 4.)
Dimensions:	
Model 630	7" (17.8 cm) H x 16-3/4" (42.5 cm) W x 15-3/4" (40.0 cm) D.
Model 640	8-3/4" (22.2 cm) H x 16-3/4" (42.5 cm) W x 15-3/4" (40.0 cm) D.
Weight:	
Model 630	45 pounds (20.5 kg).
Model 640	58 pounds (26.4 kg)

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TABLE 1-1. EQUIPMENT SPECIFICATIONS, MODELS 630 AND 640 (Continued)

General Characteristics (Continued)

Ambient Operating Temperature:

Model 630 0 to 55°C

Model 640 0 to 55°C

Furnished Accessories:

Operating Manual/
Maintenance Manual

PC Card Extender (Dual Side) . . . Part No. 165682

Fuse, 2 amp, 3 AG, slow blow . . Part No. 518110

Fuse, 1/16 amp, 3 AG, slow blow Part No. 518118

Fuse, 1 amp, 3 AG, slow blow . . . Part No. 518124
(230V)

Power Cord Part No. 160833

Cable Interconnection:

Model 630 Part No. 166829-1

Model 640 (2 cables) Part Nos. 166829-2 and 167019

Cable Assemblies (Option 2) . . . Part Nos. 166968 and 166969
(2 cables)

Optional Accessories

Waveguide Mixer Part No. 167032

Waveguide Taper (18 to 26 GHz) Part No. 167033

Waveguide Taper (26 to 40 GHz) Part No. 167034

Spare Input Mixer Module Part No. 167122

Input Limiter: 0.1 - 12.4 GHz, 75-watt peak, 1 watt avg Part No. 167343

Rack Mount Adapter with Handles:

Model 630 Part No. 166844

Model 640 Part No. 166845

Reusable Fitted Transit Case (Specify analyzer model number) . . . Part No. 166846

Carrying Case, Canvas, Foam-Lined, with carrying straps
and side pockets for accessories:

Model 630 Part No. 167084

Model 640 Part No. 167584

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Option 1 - Digital Memory		
<p>With this option, an internal digital memory (1024 x 8 BIT) provides long-term display storage, incoming signal versus split 1/2 MEMory on-screen display comparisons, and plotting of peak (maximum) level versus envelopes frequency. An input/output (I/O) memory interface is also furnished with Option 1.</p> <p>Modes of Operation:</p> <p>INF Mode Flicker-free stored displays. Each incoming scan updates memory. Any display can be retained in memory without updating by selecting SINGLE SCAN or split 1/2 MEM operation.</p> <p>Split 1/2 MEM Mode Stored displays may be presented simultaneously with incoming signal displays for precise on-screen comparisons.</p> <p>PEAK Mode Plots maximum level. On each scan, memory compares incoming versus stored levels and retains the larger signal deflection at each frequency within selected span. PEAK mode is well-suited for frequency response plots and envelopes of randomly varying and pulsed signals.</p> <p>BLANK Mode Stored displays are removed from display, but retained in memory for later recall, by unlatching the BLANK pushbutton.</p> <p>ERASE All stored data eliminated from memory.</p> <p>Battery Operation Internal battery retains memory contents for 1 hour during interruption of input ac power or transport of analyzer.</p>		
Digital Memory Input/Output Interface Capability		
<p>Option 1 includes a 37-pin rear connector for data exchange with remote accessories and systems, for later recall and comparison to incoming signals. The connector supplies regulated +5, +10, and -15 volts with limited current capacities to external devices. Memory I/O voltages use MOS IC's and are T²L compatible (0, +5V). Other voltages are 0 and +10V. The following front panel memory functions are also controllable by external bus: INFINITE and PEAK PERSISTANCE, Split 1/2 MEM, and full or split memory ERASE.</p>		
Terminals on I/O Interface and Test Connector 37-Pin, Female, D-Type Connector		
1 Data IN-OUT (Vertical) (D5)	14 Address (Horizontal) (A6)	26 +5V
2 Data IN-OUT (Vertical) (D7)	15 Split Transition	27 Memory Write/Read
3 Data IN-OUT (Vertical) (D0)	16 Peak Mode Control	28 Address (Horizontal) (A4)
4 Data IN-OUT (Vertical) (D1)	17 Clock (83 kHz)	29 Address (Horizontal) (A2)
5 +10V	18 Erase	30 Address (Horizontal) (A0)
6 Data Input Gate	19 Ground	31 Address (Horizontal) (A9)
7 Data Output Gate	20 Ground	32 Address (Horizontal) (A7)
8 Memory Enable	21 Data IN-OUT (Vertical) (D4)	33 Address Input Gate
9 Address (Horizontal) (A5)	22 Data IN-OUT (Vertical) (D6)	34 +11 to +16V (Unregulated)
10 Address (Horizontal) (A3)	23 Data IN-OUT (Vertical) (D2)	35 Split: Hi - Split; Lo - No Split
11 Address (Horizontal) (A1)	24 Data IN-OUT (Vertical) (D3)	36 Horizontal A/D Test Point
12 Select (Memory Disable)	25 -15V	37 Clock (1.5 MHz)
13 Address (Horizontal) (A8)		

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Option 2 - Tracking Generator Interface

This option provides the necessary LO (local oscillator) outputs to the Hewlett-Packard Model 8444A Tracking Generator so that its output frequency precisely tracks the spectrum analyzer tuning. The two outputs are the swept first LO (2.06 to 4.1 GHz) and a fixed frequency output of 510 MHz. The Hewlett-Packard Model 8444A provides output signals from 10 to 1300 MHz in synchronism with the tuning of the Series 600 Spectrum Analyzers in this frequency range and with output levels of -10 ± 2 dB.

Option 3 - Deletion of Low Pass Filter

This option deletes the 1.8 GHz low pass filter from the Model 640.

Option 4 - 400 Hz Fan

This option permits operation of the fan at 400 Hz input power source.

Option 5 - Variable SCAN TIME/DIV

This option provides the necessary modifications needed for the spectrum analyzer to be able to have the scan rate continuously variable.

Option 6 - Narrow IF Filter Shape Factor

This option provides the necessary modifications needed for the spectrum analyzer to decrease the shape factors for the crystal filter and thus improve its resolution capabilities. Refer to page 1-2 for specifications on the IF Filter Characteristics.

Option 7 - 10.7 MHz IF Output

This option provides a 10.7 MHz output that is linearly related to the RF input to the spectrum analyzer. The bandwidth is controlled by the analyzer RESOLUTION BW (Hz) control setting. The amplitude is controlled by the input RF ATTEN and IF LEVEL controls. The output is approximately -25 dBm for full-scale signals on the CRT. Option 7 is a rear panel BNC connector with a 50-ohm (nominal) output impedance.