MFJ-269C HF/VHF/UHF SWR Analyzer

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QST previously reviewed the MFJ-269 — an antenna analyzer that covered 1.8 – 175 MHz and 415 – 470 MHz.[1] In the years since that review appeared, MFJ has evolved this analyzer by extending the VHF frequency coverage to 230 MHz, splitting the 415 – 470 MHz range into two parts, and extending the lower frequency range to 530 kHz. The lowest range (530 kHz – 1 MHz) can be user-modified for 470 – 940 kHz to provide coverage of the new 630-meter ham band (472 – 479 kHz), already approved in some countries. Or you can purchase the MFJ-269CM, which is factory adjusted to cover this lower frequency range.

Overview

The MFJ-269C is a very wide band antenna analyzer. Two rotary band switches select low ranges (0.53 – 11 MHz) and high ranges (11 – 230 MHz). Further, a slide switch changes the two upper VHF ranges (113 – 155 MHz and 155 – 230 MHz) to cover two UHF ranges (415 – 470 MHz and 470 – 490 MHz). The TUNE control sets the measurement frequency within these ranges. Separate analog meters indicate SWR (3:1 maximum marked) and the magnitude of the impedance (400 Ω maximum marked) up to 230 MHz. The default digital display shows SWR, impedance (*Z*), resistance (*R*), and unsigned reactance (*X*). For the 415 – 490 MHz ranges, only the SWR analog meter is operational, and the default digital display shows a digital readout of SWR and a bar graph display of SWR. Figure 7 shows the display in use.

Advanced measuring screens provide additional capabilities and will be discussed later. Finally, it is worth noting that the POWER button has a raised lip around it to keep the unit from being turned on accidentally — a common complaint about earlier MFJ antenna analyzers.

Table 2 summarizes the MFJ-269C specifications and the performance measured as part of this review.

MFJ-269C Testing

The MFJ-269C output level is quite constant over the full frequency range as shown in Table 3. However, while the frequency can be set accurately, this is a touchy adjustment — especially at the higher frequencies.

Bottom Line

As it covers all ham bands from 630 meters to 70 centimeters, the MFJ-269C is a single instrument that should satisfy the RF measurement requirements needed by most hams.

Further, just touching the TUNE control shifts the frequency 1 kHz or more. And there is a noticeable frequency drift that takes about 15 minutes to stabilize when the MFJ-269C is externally powered. The drift continues when internal batteries are used. For these reasons, the MFJ-269C would probably not be a good tool for receiver testing.

Table 4 displays the unterminated SWR and impedance measured by the MFJ-269C. This gives an indication of the impedance magnitude you can measure accurately as a function of frequency.

The MFJ-269C SWR accuracy was tested by first checking it against a precision 50 Ω load, followed by tests with shorted microwave attenuators of 5 dB (1.92:1 SWR), 3 dB (3.01:1 SWR), and 2 dB (4.42:1 SWR). Additional testing was done using loads made from Caddock thick-film resistors — 7.5 Ω (theoretically 6.67:1 SWR), 200 Ω (theoretically 4:1 SWR), and 400 Ω (theoretically 8:1 SWR). Table 5 tabulates the MFJ-269C SWR measurements compared to an Array Solutions AIMuhf.[2] As you can see, the MFJ-269C SWR readings are quite accurate.

For my final tests, I built lower impedance R/C complex loads for 50, 146, and 222 MHz. I used leaded components and targeted theoretical loads of 50 –*j*36 (approximately a 2:1 SWR) on each of the three bands. Table 6 displays the MFJ-269C *R* and *X* measurements (and the calculated *Z*), compared to the Array Solutions AIMuhf. As you can see, the MFJ-269C provides good SWR correlation at the three frequencies, as well as reasonably accurate impedance measurements at 50 MHz. The impedance accuracy degrades a bit at the higher

Table 2
MFJ-269C Specifications and Measured Performance

Manufacturer's Specification	Measured Performance
Frequency range: 0.53 – 230 MHz (9 overlapping ranges), plus 415 – 470 MHz in two ranges.	As specified. See Note 1.
Display resolution: Not specified.	1 kHz below 100 MHz, 10 kHz above 100 MHz.
Frequency accuracy: Not specified.	Within the displayed frequency resolution over the full range.
RF output level: Typically +7 dBm into 50 Ω.	See Table 3.
Output RF purity: Greater than –25 dBc.	See Notes 2 and 3.
Impedance range: <500 Ω.	See Table 4.
SWR range: Not specified.	Analog meter: 3:1. Digital display: 31:1 at HF/VHF; 5:1 at 415 – 490 MHz.
SWR accuracy: Not specified.	See Table 5.

Power requirements: 10 AA alkaline or NiMH batteries (not included) or external 11 – 16 V dc. Current at 13.8 V dc: 150 mA HF/VHF; 250 mA UHF; 15 mA in sleep mode.

Size (HWD): 7.4 × 4.1 × 3.4 inches including projections; weight: 2.6 lbs. with batteries.

Price: MFJ-269C or MFJ-269CM $399.95; MFJ-1312D 12 V dc power adapter, $15.95; MFJ-731 tunable filter for attenuating off-frequency signals, $99.95.

Notes
1) The MFJ-269C low-frequency range is 530 kHz – 1 MHz. The MFJ-269CM low-frequency range is 470 – 940 kHz.
2) The third harmonic of 52 MHz is –20 dBc. The –25 dBc spec is achieved at 51 and 53 MHz.
3) There are spurious outputs at the highest frequency range of 470 – 490 MHz that are greater than –25 dBc. At 470 MHz, a spurious signal at 320 MHz is –22 dBc. At 490 MHz, a spurious signal at 327 MHz is –8 dBc.

Table 3
Output Power (dBm) vs. Frequency

Power measured with a NIST-traceable MiniCircuits PWR-6GHS+ power sensor. Specified power output is 0 dBm at HF and VHF, and –1 dBm at UHF.

Measured Power (dBm) at Frequency (MHz)								
1.8	*3.5*	*7*	*14*	*28*	*50*	*144*	*222*	*440*
+6	+6	+6.1	+6.1	+6.1	+6.2	+5.9	+5.9	+5.5

Table 4
MFJ-269C Unterminated Output Measurements

Frequency	SWR (digital)	Z (digital)
1.8 MHz	>31:1	1,500
3.5 MHz	>31:1	1,500
7 MHz	>31:1	1,500
14 MHz	>31:1	1,500
28 MHz	>31:1	1,500
50 MHz	>31:1	778
146 MHz	>31:1	278
222 MHz	>31:1	183
440 MHz	>5:1	N/A

frequencies, but is still not bad. Again, the MFJ-269C does not display the sign of the reactance.

Using the MFJ-269C

The manual is not included with the unit, and must be downloaded from the MFJ website. The manual available at the time of this review was 40 pages in length, and was quite detailed.

The MFJ-269C requires an external 11 – 16 V dc power source via a "standard" 2.1 mm jack (2.1 mm dc cable is not supplied), or 10 internal AA alkaline or NiMH batteries. When battery powered, an internal switch must be set to select either alkaline or NiMH batteries, as NiMH batteries are trickle charged by an external power source of 13.8 – 16 V dc. Battery operating time is up to 9 hours, and charging time for NiMH batteries is about 15 hours.

A blinking VOLTAGE LOW warning is displayed when voltage drops below 11 V dc. And if the MODE or TUNE controls remain inactive for three minutes, the MFJ-269C enters a 15 mA standby sleep mode and displays a blinking SLP message. The sleep mode can be turned off, but it will always default to on when the MFJ-269C is next powered on. There is no auto-off function.

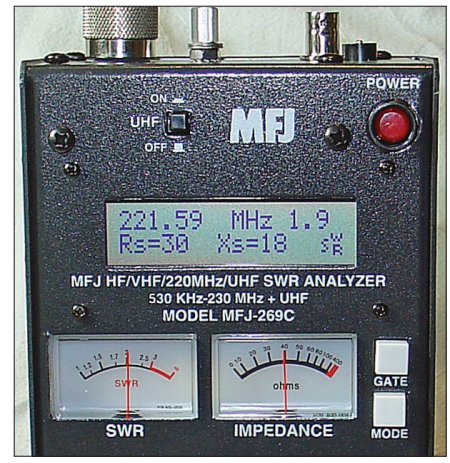

Figure 7 — The MFJ-269C measuring a complex load at 221.59 MHz.

RF measurements use a Type-N female connector (UHF/N adapter included), and the frequency counter uses a BNC female. For the typical antenna or antenna system measurement, set the band and the frequency of interest, or manually sweep the frequency to look at your antenna and antenna system characteristics. The MFJ-269C default SWR/impedance/resistance display will satisfy most requirements. However, there are numerous additional measurement features available.

In addition to the default impedance/R/X display, tapping the MODE button provides access to four additional basic measurements — coax loss, capacitance, inductance, and a frequency counter. Coax loss in decibels is measured at your frequency of interest with any length of coax cable that is unterminated, shorted, or loaded with a pure reactance. When measuring capacitors and inductors, it is assumed

Table 5
SWR Accuracy Measurements

Loads measured with the MFJ-269C compared to the AIMuhf. See text.

Freq (MHz)	1:1 SWR 269C/AIM	1.9:1 SWR 269C/AIM	3:1 SWR 269C/AIM	4.4:1 SWR 269C/AIM	7.5 Ω Load 269C/AIM	200 Ω Load 269C/AIM	400 Ω Load 269C/AIM
1.8	1.0/1.0	1.9/2.01	2.9/3.17	4.1/4.62	5.7/6.76	4.0/3.97	8.8/7.93
3.5	1.0/1.0	1.9/2.01	3.0/3.16	4.2/4.61	5.9/6.72	4.0/3.96	8.8/7.93
7	1.0/1.0	2.0/2.01	3.1/3.17	4.5/4.61	6.5/6.73	4.0/3.96	8.8/7.93
14	1.0/1.0	2.0/2.00	3.2/3.15	4.7/4.59	6.8/6.70	4.0/3.97	8.8/7.95
28	1.0/1.0	2.0/2.00	3.2/3.15	4.7/4.59	7.0/6.71	4.1/3.97	8.8/7.93
50	1.0/1.0	2.0/2.00	3.1/3.17	4.6/4.60	6.8/6.73	4.1/3.95	8.7/7.92
146	1.0/1.0	1.8/1.97	2.9/3.19	4.3/4.75	6.2/7.05	4.0/3.84	7.8/7.59
222	1.0/1.0	1.9/1.92	3.0/3.15	4.8/4.76	8.1/7.25	4.0/3.74	7.3/7.18
440	1.2/1.0	2.2/2.03	2.6/3.07	4.5/4.81	>5/8.73	3.8/3.40	>5/6.13

the component type is known, as the value is determined by the measured unsigned reactance. Also, there is no means to zero-out stray reactance (primarily affecting low-value component accuracy), so these strays must be subtracted out of the measured readings. As an example, I built a clip-lead fixture (see Figure 8) for measuring components. This fixture measured an open-circuit stray capacitance of 7 pF, and a short-circuit stray inductance of 0.1 µH.

Three advanced menus may be accessed by pressing and holding the MODE and GATE buttons simultaneously. For HF/VHF, these menus provide displays of magnitude and phase, series and parallel equivalent impedance, reflection coefficient, resonance, return loss, match efficiency, velocity factor setup, distance to fault, line length in degrees, characteristic impedance setup, and normalized SWR impedance. For UHF, the advanced features are reduced to return loss, reflection coefficient, match efficiency, velocity factor setup, and line length in degrees. A few of these functions deserve some additional comments.

The RESONANCE mode changes the analog impedance meter to a reactance meter. So when you tune the MFJ-269C for a zero reading on the analog impedance meter, the system is resonant (zero reactance).

The DISTANCE TO FAULT function is useful for finding the location of an open or short in your antenna system. The MFJ-269C does not have TDR capability, so actually making this measurement is a bit tedious. However, the manual provides detailed information on how to do it.

Table 6
Complex Load Measurements

Loads measured with the MFJ-269C compared to the AIMuhf. See text.

Frequency (MHz)	MFJ-269C SWR	MFJ-269C Impedance	MFJ-269C |Z|	AIMuhf SWR	AIMuhf Impedance	AIMuhf |Z|
50	2.0	R = 42, X = 32	53	1.95	47.5 –*j*33	58
146	1.8	R = 37, X = 23	44	1.80	45 –*j*28	53
222	1.8	R = 30, X = 19	36	1.76	42 –*j*25	49

The RETURN LOSS display is useful for measuring precision devices and filter performance. I found that return loss measurements up to 20 dB were quite accurate from HF to 230 MHz. Return loss measurements in excess of 20 dB were less accurate, as they tended to read high. I also placed a sliding short on several microwave attenuators to evaluate the return loss reading as a function of the phase of the reflected signal (ideally no variation). I found that the return loss reading versus the reflected signal phase varied by no more than 1 dB up to 230 MHz. Return loss measurements in the UHF bands were less accurate. At 440 MHz, a 20 dB return loss displayed from 15 – 35 dB, depending on the phase of the

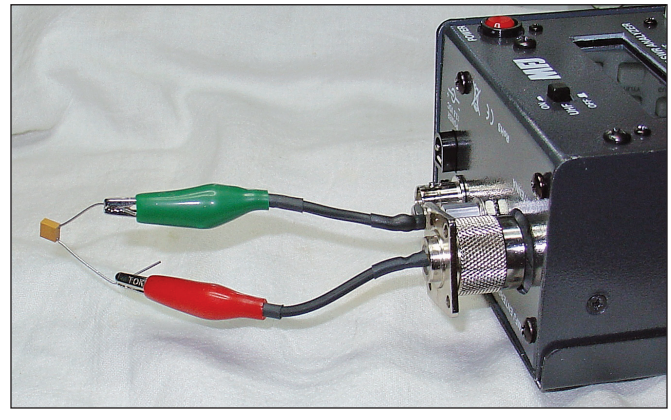

Figure 8 — Component measuring fixture.

reflected signal. A 12 dB return loss displayed from 10 – 15 dB, depending on the phase of the reflected signal.

Covering the 630-Meter Band

As mentioned earlier, the MFJ-269C low end may be adjusted to cover 630 meters. This requires removing the back cover and adjusting a variable inductor with a 2-millimeter hex tuning wand (not supplied) while watching the frequency display. Detailed information for this modification is provided in the manual. Or you can purchase the MFJ-269CM, which comes factory tuned for 470 – 940 kHz.

Conclusion

The MFJ-269C is a reasonably priced HF-through-UHF SWR analyzer. The analog meters are convenient for making antenna system adjustments, while the digital display provides additional information for more detailed analysis of antennas and components. You can investigate the MFJ-269C further by viewing the manual on the MFJ website.

Manufacturer: MFJ Enterprises, 300 Industrial Park Rd., Starkville, MS 39759; tel. 800-647-1800; **www.mfjenterprises.com**.

Notes

[1]Joel R. Hallas, W1ZR, "A Look at Some High-End Antenna Analyzers," Product Review, *QST*, May 2005, pp. 65 – 69.

[2]H.Ward Silver, NØAX, "Array Solutions AIMuhf Vector Impedance Analyzer," Product Review, *QST*, Nov. 2012, pp. 57 – 60.