MFJ-886 Pocket-size Frequency Counter

By Bob Grove, W8JHD

Frequency counters have come a long way since their original 19-inch rack-mounted arrays of nixie tubes. The hand-held MFJ-886 is an excellent example of modern, compact convenience with outstanding performance throughout the 1-3000 MHz range.

Housed in an all-metal case measuring 3.15 H x 2.7 W x 1.22 D inches, the MFJ-886 is affixed with a BNC connector to accept either its included whip or test-cable jumpers for equipment measurements.

❖ Buttons and Switches

The counter is very easy to use with a minimum of choices required of the user. When the POWER switch is activated, it will briefly display all of its icons, bargraph segments, and numeric characters as a test. Other legends briefly appear as well which aren't accessible on this instrument, suggesting that the LCD module is used on other instruments besides the MFJ-886.

The RANGE switch activates the proper frequency swath desired, 1-300 or 300-3000 MHz. A HOLD button may be pressed at any time the instrument is on and sampling, allowing a fixed display of the measurement.

The GATE button may be progressively pushed through sampling periods of 0.0625, 0.25, 1, and 4 seconds. The fastest time acquires and displays the closest kilohertz, while the slowest period allows frequency acquisition to 1 Hz for measurements below 300 MHz, and the nearest 10 Hz for measurements up to 3 GHz.

❖ Uses for the MFJ-886

Obviously, the primary use for a portable frequency counter is to determine the actual output frequency of a nearby transmitting device. Scanners with near-field detectors like Uniden's Close Call™ and GRE's Spectrum Sweeper are not frequency counters. They read out only the closest FCC-authorized channel frequency of a detected transmitter, not the actual transmitted frequency.

Citizen Band, Family Radio Service, Multi-Use Radio Service (MURS), General Mobile Radio Service (GMRS), commercial, and amateur transceivers are also often off frequency from what they should be, but hopefully within the variance allowed by FCC rules and regulations. The frequency counter will immediately let you know if that is the case.

With the ease of hiding wireless security cameras and especially wireless microphones and surreptitious listening devices, those who are

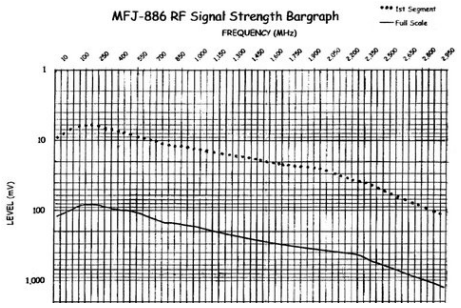
The MFJ-886 in action, showing the 10 digit frequency display and the LCD bargraph at full deflection.

vulnerable to surveillance can use a frequency counter to detect the presence of an emitting source by sweeping the room, watching the display lock its reading onto one frequency as a location is approached.

As a test-bench accessory, the 886 makes a handy piece of equipment to test oscillators in receivers, transmitters, RF remote controls, and other devices which generate or emit a radio signal as part of its normal operation.

Looking for the source of interference to reception in an office, factory, or even your home? Try approaching various electronic accessories with the frequency counter, watching for a stable signal to read out as you grow closer to the offending emitter.

And don't overlook the handy LCD signal-strength bargraph. It may not give you absolute measurements of field intensity, but it does do a credible job of allowing comparative readings



Relative response graph related to frequency, showing minimum input levels in millivolts for first segment to display, and levels to produce full deflection.

Input Sensitivity (Typical)	
Amplifier	50 ohm
Impedance	50 ohm, VSWR<2:1
Range	1 MHz - 3 GHz
Sensitivity	<0.8 mV @ 100 MHz <7 mV @ 300 MHz <6 mV @ 1 GHz <100 mV @ 2.4 GHz
Maximum Input	15 dBm

Frequency Display Resolution			
Range	Gate Time	LSD	Sample Display
300 MHz	0.0625 Sec	10 Hz	300.00000 MHz
	0.25 Sec	1 Hz	300.000000 MHz
	1 Sec	1 Hz	300.000000 MHz
	4 Sec	0.1 Hz	300.000000 MHz
3 GHz	0.0625 Sec	1000 Hz	3000.000 MHz
	0.25 Sec	100 Hz	3000.0000 MHz
	1 Sec	10 Hz	3000.00000 MHz
	4 Sec	10 Hz	3000.00000 MHz

A quick look at specifications.

for optimizing antenna adjustments, transmitter output, and homing in on unsuspected or hidden transmitting devices.

Other uses will come to mind for your own applications.

❖ Power Supply Options

The MFJ frequency counter is powered most conveniently by its internal 6 VDC NiCd battery. A top-mounted jack accommodates an external source of 9-12 VDC for recharging the NiCd or for powering the unit during extended use. An AC/DC wall adapter is included for such applications.

The 886 is capable of operating continuously for approximately 6 hours before the battery needs recharging. The battery automatically starts taking a charge when an external source of power is supplied, and it is completely recharged within 12-16 hours.

❖ Whip Antenna

The 886 comes equipped with a (nominal 50 ohm) BNC base, sturdy, telescoping whip, compressible to 5-inches in length and extensible to 23-inches. A removable pocket clip provides convenient shirt-pocket conveyance of the whip when not attached to the counter.

Adjustability of the length of the sectional whip permits optimal response for weak signals. Compressing the whip reduces strong signal overload while making critical transmitter measurements or adjustments.

The transmitter distance table accompanying this article gives a relative indication of maximum distances for making frequency measurements and taking relative signal strengths with the whip properly adjusted. Another table

Transmitter	Typ. Distance in Meters
Cordless Phone	0.3
Analog Cellular Phone	3-20
CB Radio	2-8
VHF 2-way radio	3-30
UHF 2-way radio	3-30

Typical distances from various common signal sources to produce a stable frequency readout.

shows the range of RF signal strengths which produce minimum and maximum excursions on the LCD bargraph

❖ Counter Sensitivity

A built-in 10-16 dB (depending on frequency range) preamplifier results in a sensitive frequency counter. It responds to signals in the 1-100 mV range in the 1-3000 MHz spectrum respectively. Maximum input to avoid overloading is 15 dBm.

With the whip pulled to its maximum length, the display on my review unit locked on to the carrier of a local FM broadcaster several miles away licensed on 102.7 MHz. According to my 886, however, they were actually on 102.6986062 MHz! Close enough.

Naturally, some household exploring was in order. With modern, digital cell phones constantly switching frequency, I didn't expect a steady reading, but the counter did show 832 MHz consistently. That would be expected from a cell phone transmitting in the allocated 824-849 MHz spectrum.

❖ Counter Accuracy

We were very impressed with the initial frequency accuracy right out of the box. With a signal generator adjusted to zero-beat with 15 MHz standards station WWV, the counter was within a 1- to 2-Hertz of dead-on.

For stalwart perfectionists who have zero tolerance for frequency error, an external hole provides access for razor-sharp adjustment of the time-base oscillator. In normal room temperatures, a stability of better than one part per million (1 ppm) may be expected. The calibration trimmer allows about 10 ppm adjustment range.

Naturally an invitation like that can't be ignored. I decided to see if I could improve the accuracy even further. Armed with a 10 MHz crystal test oscillator, a receiver tuned to 10 MHz WWV in the AM (not SSB) mode, and a two-port TV-style signal splitter to be used in reverse as a signal combiner, I was ready to test the accuracy of my crystal oscillator.

With a shortwave antenna attached to one splitter port and the oscillator to the other, I fed the combined signals into the receiver from the remaining single output port. Switching on the oscillator, I heard the distinct sound of flutter and a slightly altered pitch on the WWV reference tone which told me that my test oscillator was off-tuned.

A readjustment of the oscillator's trimmer gave me that familiar zero beat; switching the oscillator on and off made no difference in the WWV signal, so I now had an accurate signal source.

Attaching the now-accurate 10 MHz test oscillator to the MFJ-886, I saw that the frequency counter read 9.999982 MHz. Pretty darned close, but a touch of the calibration trimmer with a teensy jeweler's-style screwdriver put the MFJ-886 smack dab on 10.000000 MHz. Now that's accuracy!

❖ The Bottom Line

The MFJ-886 is hard to beat for compact convenience, accuracy, ease of operation, and low cost. The MFJ-886 is available for $114.95 plus shipping from Grove Enterprises (1-800-438-8155; **www.grove-ent.com**) and is available from other *MT* advertisers as well.

MFJ-266 Antenna Analyzer

In the early days of radio, tests and measurement instruments were separate. There were voltmeters, field strength meters, tube testers, ohmmeters, and myriad other dedicated testers.

As the science grew, multiple functions became more popular. Volt-ohm-milliameters (VOMs or multimeters) allowed multiple measurements, and many other combinations were offered as well to the service and repair market.

With modern solid-state electronics, compactness allows considerable sophistication to be built into small enclosures. The new MFJ-266 is one of these electronic marvels.

Housed in a 3-3/4 H x 2 W x 6 D inches metal case and weighing two pounds with batteries, it's a bit of a stretch to call it "handheld," but it certainly is portable and can be laid on one hand while making a measurement (See photo).

Powered by eight AA cells (not included), a separate front-panel jack allows connection to an optional 12 volt power supply for extended use. A type N to UHF (SO-239) adapter is included for PL-259 antenna cables, and a DC cord for connection to an external power source is provided as well.

While modestly called an "antenna analyzer," this multi-function instrument has a host of capabilities. Let's take a look at the functions and features the 266 offers.

❖ Antenna Analysis

With antennas, Voltage Standing Wave Ratio (VSWR) is always the biggest concern. Of minor consequence for receiving, it is a major consideration when transmitting, since a high reading means lossy power transfer, power reduction in transmitters, and possible circuit damage from high voltage due to impedance mismatch.

The 266 employs a stimulus-generator-driven bridge circuit which functions as a network analyzer. In this mode, the LCD displays the frequency for the measurement (MHz), the complex impedance (Z=R+JX), impedance (10-500 ohms), and the SWR (1:1 to 9.9:1).

❖ RF Measurements

A built-in frequency counter allows accurate measurements of a signal source from 1-500 MHz with resolution to 1 kHz in the fast gate mode, and 100 Hz in the slow gate mode.

The counter mode also enables a relative field-strength meter which provides a reading in millivolts (mV). This is handy for testing for local RF radiation which can interfere with accurate VSWR measurements, or even serve as a surreptitious transmitter ("bug") detector.

❖ Component Checker

The 266 can also be used to check inductances. I was able to test RF chokes in values from a fraction of a microhenry (µH) up to roughly 70 µH.

A capacitance check showed a range up to about 3000 picofarads (pF) or .003 microfarads (µF) depending on the quality of the capacitor. In both the inductance and capacitance modes, I found it best to use the lowest frequency selection (1.5 MHz).

❖ Signal Generator

Since the instrument must generate an RF signal to measure VSWR, that signal is also present at the type-N RF connector. An FM-modulated, +2 dBm output level is available throughout the 1.5-60 MHz HF range. At VHF and UHF it's no longer modulated, and the carrier it produces is quite unstable.

Frequency instability can be expected from a free-running oscillator such as this, which decreases in stability the higher the frequency, but in a pinch, it does work as an RF signal generator. And after all, the instrument is not designed to be a signal generator, so this function is just a bonus!

Depending upon factory alignment, there will be differences in actual frequency limits for band coverage. In my test unit, I was able to produce a relatively constant output (within about 2-4 dB) from 1.5-63 HF, 84-191 VHF, and 250-514 MHz UHF.

There was also a second harmonic about 24 dB lower than the fundamental signal, allowing extension of the UHF range from 500-1028 MHz.

❖ The Bottom Line

While not a laboratory-precision unit, the MFJ-266 offers a lot of analysis for the money. The frequency capability allows antenna design and testing for amateur, two-way, FM and TV broadcast, military and civilian air bands, and marine radio services in the HF, VHF and UHF services.

The MFJ-266 is available for $349.95 plus shipping from MFJ Enterprises, 300 Industrial Park Rd., Starkville, MS 39759; phone (800) 647-1800 or visit their website at **www.mfjenterprises.com**.