Contents

Input A: 1M Ohm 10Hz-50MHz
50Ohm 10MHz -1GHz

Input B: 1M Ohm 10Hz - 10MHz
50 Ohm 500MHz - 3GHz

RS-232 input

Power Input

10 Digit LCD Display

Digital Auto Capture

Digital Auto Filter

800MHz / 3GHz Range Switch

Gate LED

Input A/B Button

Power On/Off

Arm/Store and Function Button

Gate Button

Amplifier Switch 50/1M Ohm

Selection LED's

200MHz Range Switch

Pat. No. 5,471,408

Features

The 3000APlus combines the computing power of a microprocessor with the OE10 high speed counter IC to provide unparalleled counting capabilities. The 3000APlus can capture off-the-air signal frequencies completely without operator intervention - and record the result in internal memory.

The microprocessor digitally filters the RF signal measurements and reduces spurious counting. All of this is done without relying on the signal strength to exceed some arbitrary level, ensuring reliable performance in today's dense signal environments. Proprietary software monitors the incoming RF for stable coherent signals, and only when these conditions are satisfied will the count be presented to the user. Internal memory allows the 3000APlus to store the last three filtered frequencies for later examination. At any time later, the 3000APlus memories can be recalled to check the results of an extended monitoring period.

The 3000APlus has four separate input amplifiers to push sensitivity to new levels. This was done for a very simple reason: the wider the bandwidth of a counters front end, the higher its inherent noise floor and the lower the sensitivity.

This does not mean the 3000APlus sacrifices bandwidth for sensitivity. However, the input circuitry has been designed to cover the 10Hz -3GHz range in bands, chosen to optimize sensitivity for each application.

The direct 1 to 200MHz input is used primarily for setting crystal oscillators on frequency and monitoring HF through VHF communications. Here, a high gain preamplifier yields sensitivities typically below 500 microvolts.

The next higher band includes the 10 - 800+ MHZ region, chosen to include most common VHF and UHF two-way traffic. The highest frequency band covers 500MHz to 3GHz. By blocking out troublesome lower frequency signals like broadcast FM and TV, weak signals can be isolated and measured.

DIGITAL COMMUNICATIONS PORT

The 3000APlus handheld frequency counter is equipped with an RS232 interface which allows the unit to be connected directly to a personal computer for the purpose of real time data logging. The interface is accessible via a 3.5mm stereo phone jack. Connection to a serial port is required using two optional accessories, the CB232 data cable and Optolog Software. To order the CB232 and Optolog call the Optoelectronics toll free order line at 1-800-327-5912.

Specifications

	Input A		Input B	
Amplifier	1 Meg Ohm	50 Ohm	1 Meg Ohm	50 Ohm
Impedance	1 Meg Ohm, 30 pF	50 Ohm vswr <2:1	1 Meg Ohm, 30 pF	50 Ohm vswr <2:1
Range	10Hz - 50MHz	10MHz - 220MHz		500MHz - 3GHz
Sensitivity	<25mV 10Hz - 10MHz	**200MHz Range**	<25mV 10Hz - 10MHz	**3GHz Range**
	<30mV 10MHz - 50MHz	<5mV @ 10MHz	<25mV 10MHz - 50MHz	<800uV @ 400MHz
		<600uV @ 150MHz		<2mV @ 1GHz
		800MHz Range		<7mV @ 2GHz
		<800uV @ 200MHz		<60mV @ 3GHz
		<800uV @ 400MHz		
		<3mV @ 700MHz		

Time Interval Mode: "A" Start "B" Stop Minimum pulse width is 200 ns. Triggers on rising edge
Period /TI Max Resolution: Single Shot - 100ns. Averaged - .1ns. Max Display: 999 999 999.9us.
Period TI Average: Averages 10, 100, or 1000 measurements for increased resolution.
Time Base: 10MHz Stability: +/-1ppm 20-40 degrees C Aging: 1ppm/yr.
Display: 10 digit (120 segment) Liquid Crystal Display. Decimal at MHz position.
Low Battery Indicator: "LOW BATT" displayed when battery pack is no longer usable and must be recharged.
Annunciators: Frequency, Period, Interval, Ratio, Average, MHz, nS, uS, Low Batt, PRESCALE, A, B, Intervals/Periods Averaged.
Size: 5.3" high x 3.9"wide x 1.4" deep. Weight: 15oz.
Power: 9VDC, approx. 250mA using model AC90 wall plug adapter. 5+ hours operation from internal 5 cell NiCad Pack.

Range	Gate Select	Gate Time	Measurement Time	LSD Res.	Sample Display
200	1	100uS	13mS	10kHz	150.00
	2	1mS	13mS	1kHz	150.000
	3	10mS	13mS	100Hz	150.0000
	4	100mS	110mS	10Hz	150.00000
	5	1S	1S	1Hz	150.000000
	6	10S	10S	0.1Hz	150.0000000
800	1	400uS	13mS	10kHz	440.00
	2	4mS	13mS	1kHz	440.000
	3	40mS	50mS	100Hz	440.0000
	4	400mS	410mS	10Hz	440.00000
	5	4S	4S	1Hz	440.000000
3000	1	1.6mS	13mS	10kHz	3000.00
	2	16mS	25mS	1kHz	3000.000
	3	160mS	170mS	100Hz	3000.0000
	4	1.6S	1.6S	10Hz	3000.00000

Operation

Counting with an Antenna

Step 1 - Select the Amplifier

Use the 50 Ohm Amplifier for frequencies above 20MHz.

Use 1 Meg Ohm Amplifier for frequencies below 20MHz.

NOTE: The 3000A+ actually has two 1 Meg Ohm amplifiers (also called Hi Impedance amplifiers) which give you some interesting possibilities. If you select the 1M Ohm amp you can put an antenna on either input A or B and use the input A/B push-button to select which input you want to count. You could then use two antennas and select between the 1M Ohm and 50 Ohm amplifiers to achieve optimum results below 30MHz. Keep in mind that the input A/B button is not active unless you select the 1M Ohm amplifier.

Step 2 - Put the antenna on the appropriate input (BNC connector A or B)

Put the antenna on input A for frequencies below 1000MHz (most often used)

Put the antenna on input B for frequencies above 1000MHz

Step 3 - Choose the appropriate Range (Skip this step unless you selected the 50 Ohm Amp)

If you know the approximate frequency that you want to count then:

A. Between 10MHz and 250MHz slide the first range switch to the up position. It doesn't matter what position the second range switch is in.

B. Between 250MHz and 1000MHz the first range switch is in the down position and the second range switch is in the up position

C. Between 1000MHz and 3000MHz both range switches must be down.

If you are just checking what's out there and don't have a particular frequency in mind then the best strategy is to move between both range switches. You will probably only rarely find frequencies with the range switches in setting C.

Step 4 - Select a Gate or Measurement Period

Every time you push the gate button you will increase the measurement time and increase the number of digits displayed. Usually in antenna mode (unless you are attempting to calibrate a transmitter) you will want 10KHz resolution or at least two digits displayed to the right of the decimal point. Keep pressing the gate button to get back to the gate time you started with.

NOTE: The accuracy of the measurement is the sum of the time base error (+/- 1ppm) and plus or minus one count in the least significant digit. Therefore accuracy is dependent on the number of digits displayed. More digits displayed - greater the accuracy.

Using the Digital Auto Capture Feature

Digital Auto Capture (DAC) involves the use of the FILTER and CAPTURE slide switches as well as the ARM/STORE push button. If you haven't already set up the 3000APlus for antenna operation, do so as described in the previous section.

NOTE: DAC works in frequency measurement mode only. If you engage the FILTER and CAPTURE switches then the 3000APlus will automatically be in frequency mode and the function push-button will operate as ARM/STORE only.

In order to best understand how DAC operates you should have a convenient source of RF available. This could be a handheld radio, CB radio, or some other source of nearby RF.

Step 1 - Slide the FILTER switch on. The CAPTURE switch should be off.
Turn on your test source of RF and notice that the Gate LED turns on and flashes only when the display updates. Even when the display is not changing, the counter is counting and the digital filter is sampling measurements behind the scene and looking for consistent coherent measurements. The Digital Auto Filter will keep most of the random self oscillations from being displayed. Occasionally a false reading may pass through the filter but statistically not very often. Use the Gate Push Button to increase the number of digits displayed and to reduce false readings.

When a source of RF is near by you will see the Gate LED begin to flash rapidly (this will probably be accompanied by an increase in the number of segments on the Signal Strength Bargraph). The new frequency measurements will now be displayed. When the RF signal stops then the display will stop updating and the most recent measurement will be retained. If the filter passes any new measurement at this point the previous measurement will be lost. Remove the antenna to stop new signal from being received or better yet use the capture function switch as explained in step 2.

Step 2 - Turn ON both the FILTER switch and the CAPTURE switch
You are now in the full Digital Auto Capture Mode. Absolutely nothing can happen until the DAC is armed in step 3 below.

Step 3 - Arm the DAC function by pressing the ARM/STORE push button.
Notice that upon arming the DAC, the FREQUENCY annunciator in the LCD display begins to flash indicating an armed condition. Unless you see FREQUENCY flashing, the DAC is not armed.

As soon as a measurement passes the filter the flashing stops indicating that the measurement is stored. You will not lose this measurement unless you turn off the counter or go out of the DAC mode. To store a second measurement go to step 4.

Step 4 - Arm the DAC again by pressing the ARM/STORE push-button. The previously stored measurement is now rotated into the storage stack and the FREQUENCY annunciator is once again flashing. This time if a new measurement passes the filter, The 3000APlus will capture it and retain the previous measurement. You can repeat Step 4 one more time keeping two measurements in storage and one on the display. If you depress the ARM/STORE button again you will lose the first measurement that you stored.

Step 5 - Turn OFF the FILTER switch and leave the CAPTURE switch on. You are now in Recall Mode. No new measurements will be displayed. You can leave the 3000APlus in this setup and all data will be retained as long as the batteries have a charge or indefinitely from the plug transformer. To review the measurements in the stack go to step 6.

Step 6 - Depress the ARM/STORE Switch to rotate memory contents to display There are three measurements held in memory, one on the display and one in register A and one in B. Notice the A and B annunciators change in the LCD display as you depress the ARM/STORE button. If the Filter switch is turned back on then new measurements will over write the memory locations.

CONVENTIONAL MEASUREMENTS

When the High Impedance Amplifiers (1M Ohm) are selected, standard Oscilloscope Probes (Model P30) can be used to directly connect the 3000APlus to circuitry test points. In this mode you have a choice of two different inputs and amplifiers.

STEP 1 - Select the 1M Ohm Amplifier using the AMP Switch.

STEP 2 - Select the desired BNC input A or B and connect a probe.

STEP 3 - Use the INPUT Push-Button Switch to select which input to count.

STEP 4 - Depress the FUNCTION Push-Button Switch to select Function. Capture and Filter must be off.

A. Frequency - measurement units is in MHz.

B. Period - Reciprocal of Frequency, units are micro seconds or nano seconds. This function is useful for greater resolution for signals below 10kHz. The counter is really counting its own 10MHz clock between cycles of the input signal.

C. Interval - Time interval, the time between the rising edge of a pulse on input A and the rising of a pulse on input B. Units are the same as for Period. This measurement is useful for projectile velocity measurements.

D. Ratio - The ratio of two frequencies A/B is a measurement without any units. This is useful when attempting to calibrate something against a known reference. Connect the reference frequency into the B input and adjust the A input frequency until a reading of 1.00000... is obtained.

STEP 5 - Depress the Gate Push-Button to change Gate or Average.

A. In Frequency mode, the number of digits displayed increases with increasing gate or measurement period.

B. In Period mode the Gate button will average 10, 100, or 1000 cycles for greater measurement precision.

C. In Interval mode the Gate button will average 10, 100, or 1000 intervals.

D. In Ratio Mode the Gate button will increase the number of decimal places from 5, 6, 7, or 8 places.

Battery

The counter can operate several hours from fully charged internal NiCad batteries when the power switch is in the on position. The batteries are charged when the unit is powered by the AC-Charger/Adapter supplied with the 3000APlus. Full recharge will occur in 12-16 hours. The battery pack will also charge at a reduced charge rate while the counter is being operated from the adapter. The counter may be operated over prolonged periods by AC adapter operation with no harm to batteries as the charge current is regulated. The batteries should be deep cycled occasionally by allowing them to completely discharge and fully charge several times to maintain maximum battery capacity.

CAUTION

The NiCad batteries should last several years, however, it is recommended that the counter be checked inside after the first year of operation for any sign of battery leakage or corrosion. Replace the battery pack if any visible damage is observed. To inspect the NiCad battery pack it is necessary to open the cabinet. This is accomplished by removing the four machine screws on the side of the cabinet and removing the back cover. Take care not to pinch any of the battery wires. Excessive currents could flow damaging the batteries.

CAUTION

110V AC and External DC operation

A 110V AC, 60Hz 9VDC 500mA, Center-Positive, AC Charger/Adapter is specified for use and is supplied with the counter. This is a normal specification and the adapter supplied with the counter will match the counter's requirement exactly. When using external power supplies make sure that the voltage under load does not exceed 12VDC. When operating from an automotive electrical system, some means of reducing the voltage to the counter must be employed. Automotive voltages in excess of 13.8VDC are common and may damage the NiCad batteries. If the counter becomes excessively hot to the touch then remove it from the power supply immediately.

Calibration

The calibration adjustment opening in the bottom of the front panel, permits access to the trimmer capacitor which provides about a 10 parts per million adjustment range of the time base oscillator. Use the slow gate time for maximum resolution and read a stable signal of known frequency adjusting the trimmer for correct frequency display. Calibrate at 10MHz or higher. The higher the calibration frequency, the more accurately the instrument can be calibrated.

Accuracy

Frequency mode: = +/- Time Base Inaccuracy +/- 1 count

Period mode: = +/- Time Base Inaccuracy +/-1 count +/- trigger error

Trigger error: is < .3% per period for sine waves of 40dB signal to noise ratio and amplitude equal to sensitivity of counter. For any waveshape, trigger error is less than +/- .0025 microseconds divided by the signal slope in volts per microsecond for signal to noise ratio of 40 dB.

Factory Calibration Service

Optoelectronics' Service Department provides a calibration service at the factory. Counters may be shipped for this service using the Factory Service & Return policy explained later in this manual.