

MULTI-FREQUENCY CALIBRATOR MODEL 941

- **0.001% ACCURACY**
Locked to high stability crystal
- **SIX REAL-WORLD RANGES**
1 to 20000 Counts-per-Hour
0.1 to 2000.0 Counts-per-Minute
0.01 to 999.9 Hertz
0.1 to 9999.9 Hertz
0.001 to 99.999 kilohertz
0.01 to 250.00 kilohertz
- **"QUIK-CHEK® SWITCH**
Store 18 values for instant recall
Three memories for each range
- **THREE OUTPUT WAVEFORMS**
Sine Waves, Zero Crossing
Square Waves, Zero Based
Square Waves, Zero Crossing
- **SIMULATE & MEASURE DRY CONTACTS**
Add module for relay contacts



GENERAL DESCRIPTION

Calibrate your turbine meters, frequency counters, vibration systems, tachometers, vortex shedders, integrators and any other frequency devices in the shop, plant or field. Measure from 0.01 Hz to 250.00 KHz with resolution down to 0.01Hz. For your slower signals source or measure from 4.0 to 2000.0 Counts per Minute (CPM) or from 10 to 20000 Counts per Hour (CPH). Quickly indicate process signals...no more waiting around with stopwatch and calculator.

"SOURCE MODE" FUNCTION GENERATOR

Select sine wave outputs to simulate vibration pickups and variable speed drives and square waves to simulate flowmeters and magnetic pickups. Any frequency from 0.01 Hz to 250.00 KHz can be sourced in four frequency ranges to calibrate tachometers, counters, data loggers, turbine meters and frequency transmitters. For low frequency applications such as positive displacement flowmeters, Watt-hour meters, slow rate integrators and assembly line counting, the Model 941 sources signals as low as 1 CPH (0.0002777 Hz). Amplitude is adjustable from 50 millivolts to 12 Volts peak-to-peak.

Three "QUIK-CHEK" output values are remembered for each range. Turn the knob to check trip points, controller action and to control variable speed drives. The fast response 941 sets quickly without overshoot but allows slow changes at your own rate. Memory is retained for each range even when power is off.

"READ MODE" MEASURES WIDE RANGE OF FREQUENCIES AND WAVEFORMS

Use out in the field to check the signals from your flowmeter pickups, velocity and motion detectors, Frequencies can be directly measured from 0.01 Hz to 250.00 KHz in four frequency ranges.

Measure extremely slow frequencies (<1 Hz) with high resolution using CPM & CPH. Instead of displaying 1/2 Hz as 0.5 Hz (1 digit of resolution) as with most with frequency counters you can display it as 30.0 CPM (3 digits of resolution) or as 1800 CPH (4 digits of resolution). You can now measure these slow signals in seconds with the Model 941 instead of the minutes needed with a totalizer, stopwatch and calculator. Signals from 30 mV to 240 V peak-to-peak with a minimum pulse width of 2 microseconds can be measured.

Use for months without replacing the batteries. Six "AA" alkaline batteries provide more than 40 hours of continuous output or more than 80 hours of continuous frequency measurement. An optional AC adaptor can be used when the battery is low or for continuous bench and field use.

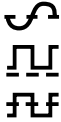
OPERATING INSTRUCTIONS

GENERAL

TURN-ON



Each time the Model 941 is turned on, the LCD will display all segments for about 1 second. It then displays the currently selected waveform (Source Mode) for approximately 3 seconds.



- 1) Move the power switch to SOURCE or READ. All segments on the LCD are turned on during self test.
- 2) (SOURCE MODE ONLY) The display will indicate the selected waveform for 3 seconds. Repeatedly press or press and hold the SCROLL/STORE pushbutton to change to the desired waveform.
- 3) (SOURCE MODE ONLY) The three QUIK-CHEK frequency outputs will be the same as previously stored. Each time a different range is selected, the three QUIK-CHEK outputs for that range will be recalled.
- 4) Move the mode switch to RANGE and repeatedly press or press and hold the SCROLL pushbutton to change to the desired frequency range.
- 5) Return the mode switch to FREQ/TRIG to source or read frequency signals.

CONNECTIONS



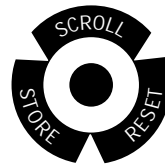
The Model 941 has built-in test leads with alligator clips for attachment to instruments or sensors with terminal blocks or flying leads. An optional BNC connector attaches to instruments or sensors equipped with BNC's for fast connections.

CHANGING BATTERY



Low battery is indicated by BAT on the LCD Display. Approximately 10 Hours of operation remain before the LCD goes blank and the Model 941 shuts itself down. Turn the 941 off, loosen the three captive screws securing the battery compartment cover. The six "AA" batteries are easily removed and replaced. Replace the battery compartment cover, tighten the screws and turn on when ready to use.

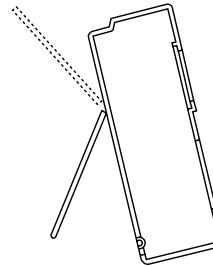
RESET



The Model 941 may be reset to the factory default setting. This will reset all the "QUIK-CHEK" memories to display 1000 and will set the output and trigger levels to 1 V p-p.

- 1) Press and hold the SCROLL/RESET pushbutton while turning the Model 941 on to SOURCE or READ
- 2) Keep pressing the STORE pushbutton for 10 seconds
- 3) All segments on the LCD will remain displayed until the Model 941 has been reset

FIELD & BENCH USE



The Model 941 comes with a carrying case and a built-in tilt stand/hanger. The 941 is held securely in the case by Velcro® even with the carrying case open. The carrying case also has a snap-on belt loop which can also be looped around a pipe or rail. The tilt stand is easily raised by pulling the stand until it locks into place. The stand can also be reversed for use as a hanger to suspend the Model 941.

OPERATING HINTS

READ MODE

In order for the Model 941 to obtain the most accurate readings you must correctly set the ATTENUATOR, TRIGGER LEVEL and RANGE. Signals from 50mV to over 240 Volts p-p, with or without DC offsets can be displayed.

SOURCE MODE

Some receivers can only detect signals that go from positive to negative (Sine Wave or Zero Crossing Square Waves) while other receivers require only positive signals (Zero Based Square Waves). The Model 941 provides a choice of these outputs.

SYMPTOM	CHECK	SOLUTION
GATE on LCD, Display shows 0.0	Connections	Make sure all power and signals are properly connected.
	Attenuator	Set at x1 for signals from 50mV to 12 Volts p-p, x10 for signals over 12 V p-p.
	Input level	Turn knob until GATE pulses and readings are displayed.
	DC Offset	Small signals with large DC offsets may require a series capacitor.
OVER/UNDER Range on LCD	Range	Move the mode switch to RANGE and press the SCROLL/RESET pushbutton until the correct range appears in the LCD.
Unstable reading	Trigger Level	Turn knob until GATE pulses and readings are displayed.

SYMPTOM	CHECK	SOLUTION
Lack of Response	Connections	Make sure all power and signals are properly connected.
	Waveform	Turn Model 941 OFF and back on to SOURCE. Repeatedly press the SCROLL/STORE pushbutton until the correct waveform is displayed.
Wrong Range	Range	Move the mode switch to RANGE and press the SCROLL/RESET pushbutton until the correct range appears in the LCD.
Lack of response or jittery signal	Peak Voltage	Move the mode switch to LEVEL and turn the knob while observing the logarithmic bar graph to match the input level of the device being calibrated. Return the mode switch to FREQ.

CPM/CPH CONVERSIONS

To Convert	From:	To:	Divide By:	To Convert	From:	To:	Multiply By:
	CPM	Hz	60		Hz	CPM	60
	CPH	Hz	3600		Hz	CPH	3600

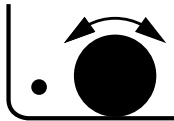
OPERATING INSTRUCTIONS

FREQUENCY OUTPUT (SOURCE MODE)

SOURCE

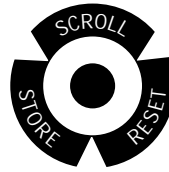


- 1) Move the POWER switch to SOURCE
- 2) Move the mode switch to RANGE and repeatedly press or press and hold the SCROLL/STORE pushbutton to change to the desired frequency range. Return the mode switch to FREQ.
- 3) Move the mode switch to LEVEL (AMPLITUDE) and turn the Digipot (Knob) until the logarithmic bargraph on the display reaches the desired level. Return the mode switch to FREQ.
- 4) Connect the Model 941 to the input terminals of the instrument or meter to be calibrated
- 5) Adjust the digital pot to the desired output value or QUIK-CHEK with previously stored frequency outputs (see below)



Whenever SOURCE mode is selected the word SOURCE will appear on the LCD display. To change the output value, turn the speed sensitive digital pot. Turning the pot slowly will cause a gradual change in the output. A faster change will occur when the pot is turned faster. This function operates in all three output positions (HI, SET & LO).

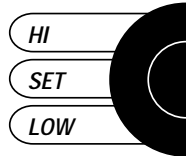
STORE



- 1) Switch to HI or LO
- 2) Turn the digital pot to desired value
- 3) Press the STORE/SCROLL pushbutton
The LCD will flash once to show that the value was saved

If a value is in the SET position and you want that value stored in HI or LO, press and hold the STORE/SCROLL pushbutton while moving the switch to HI or LO. The display will flash once to indicate the value has been stored. Then release the STORE/SCROLL button.

QUIK-CHEK



Any time you need a stored value just throw the QUIK-CHEK switch. Any value in the frequency range may be stored in HI & LO. The Model 941 remembers the HI, LO and SET values for all ranges (18 memories) for you with the power on or off. Each time a different frequency range is selected, the last three QUIK-CHEK values for that type will be recalled.

Hint: Pressing the STORE/SCROLL pushbutton will disable the Model 941's frequency generator. Releasing the pushbutton will re-enable the output. This is useful for synchronizing with displays for slow (< 1 Hz) signals.

FREQUENCY COUNTER (READ MODE)

READ

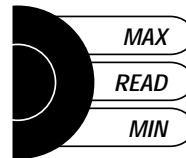


- 1) Move the POWER switch to READ
- 2) Move the mode switch to RANGE and repeatedly press or press and hold the SCROLL/RESET pushbutton to change to the desired frequency range. Return the mode switch to TRIG.
- 3) Switch the MODE switch to LEVEL (AMPLITUDE) to toggle between x1 & x10 attenuation (Use x1 for signals from 30 mV to 12 V p-p, x10 for signals from 12 V to 240V p-p). Return the mode switch to TRIG.
- 4) Connect the Model 941 to the output of the instrument or sensor to be measured.
- 5) Adjust the trigger level to obtain a stable frequency reading by turning the Digipot (knob). A bargraph on the display will show the approximate trigger level.
- 6) Use the "QUIK-CHEK" switch to display present reading, MAXimum or MINimum frequency.



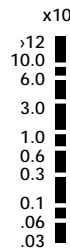
The word GATE will appear on the display whenever the Model 941 is measuring the frequency signal and will flash each time the displayed reading is updated.

MIN/MAX



To read the Maximum or Minimum frequencies since READ mode was entered, simply switch to MAX or MIN. The value will appear on the LCD along with the word MAX or MIN. The MAX/MIN values are automatically updated and may be viewed at any time without disturbing the other values. Pressing the RESET/SCROLL pushbutton will cause the 941 to stop counting frequencies and will display zeros. Upon releasing the RESET/SCROLL the Model 941 will display GATE, resume counting frequencies and update the MAX & MIN values as the measured frequency changes.

TRIGGER LEVEL



The adjustable TRIGGER LEVEL is used in measurements of noisy signals, AC signals superimposed on DC levels and to select Voltage threshold for all other signals. The bargraph on the display shows the approximate level from 0 to over 12 V positive peak with the attenuator set at x1. This bargraph should be read as 0 to over 120 V positive peak with the attenuator set at x10. For quickest readings, determine or estimate the voltage level to be detected and set the ATTENUATOR and TRIGGER LEVEL to match.

PERIOD READINGS

CPM
CPH

Select Counts-per-Minute (CPM) or Counts-per-Hour (CPH) to measure slow frequency signals. Frequencies as low as 0.1 CPM (0.001666 Hz) and 10 CPH (0.002777 Hz) can be measured (See CPM/CPH CONVERSIONS for conversion factors).

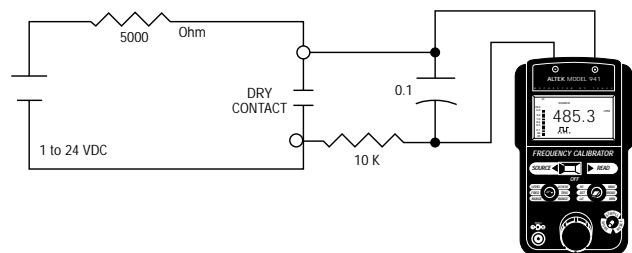
OUT OF RANGE SIGNALS

OVER
UNDER

Frequencies above or below those available for the currently selected range will be indicated by OVER and UNDER on the display (See OPERATING HINTS).

READING DRY CONTACTS

Isolated dry contact, open collector transistor or opto-isolated frequencies may be measured with the Model 941 with the optional DRY CONTACT MODULE (Model C-41) or with the circuit shown. In order to detect contact opening or closing, an external battery or power supply, in series with a 5000 Ohm resistor, may be used. Select connection polarity to provide desired signal upon contact transfer. Relay or switch contacts may require a resistor-capacitor filter in order to eliminate contact bounce errors. Typical filter values for mechanical contacts are 10 K Ohms and 0.1 microfarads.



SPECIFICATIONS

(Unless otherwise indicated, specifications are in $\pm\%$ of Reading @ 23°C)

GENERAL

FREQUENCY STABILITY: <10 PPM/Year drift
 TEMPERATURE EFFECT: $\pm 0.001\%/^{\circ}\text{C}$ based on $23^{\circ}\text{C} \pm 23^{\circ}\text{C}$
 BATTERIES: Six "AA" batteries (Alkaline supplied and recommended)
 BATTERY LIFE:
 READ MODE: Nominal >80 hours
 SOURCE MODE: Nominal >50 hours at 250 KHz at 12V p-p
 LOW BATTERY: "BAT" indication on the display at 6.5 V nominal, approximate 10 hours left. Batteries should be removed when storing unit >3 months.
 ATTENUATOR: Logarithmic for smooth input/output signal level control
 OPERATING TEMPERATURE RANGE: -5 to $+140^{\circ}\text{F}$ (-20 to $+60^{\circ}\text{C}$)
 STORAGE TEMPERATURE RANGE: -13 to $+149^{\circ}\text{F}$ (-25 to $+65^{\circ}\text{C}$)
 RELATIVE HUMIDITY: 10 to 90%, non-condensing for 24 hours
 WARM UP TIME: 5 seconds to rated accuracy
 OVERALL SIZE: $7\frac{3}{16} \times 4 \times 2\frac{7}{16}$ inches (183 x 102 x 62 mm)
 WEIGHT: 1lb, 7oz (0.650 kg)

READ MODE

ACCURACY: $\pm(0.001\%$ of reading + 1 LSD)
 SENSITIVITY: Triggers on positive peaks down to 40 mV peak, DC coupled
 MAXIMUM USABLE INPUT VOLTAGE: 240 VAC
 MINIMUM PULSE WIDTH: 2 microseconds
 INPUT IMPEDANCE: > 1 Meg Ohm + 60pF
 TRIGGER LEVEL ADJUSTMENT: x1 & x10 Attenuator plus logarithmic control
 NOTE: High signal noise and low slew rate (Volts-per-second) may affect reading uncertainty

SOURCE MODE

ACCURACY: $\pm 0.001\%$ of reading
 OUTPUT WAVEFORMS: Sine, Zero Based Square, and Zero Centered Square Waves
 OUTPUT AMPLITUDE: 50 mV to 12 V p-p, 50% $\pm 1\%$ duty cycle
 RISE TIME: <1 microsecond @ 12V peak-to-peak
 OUTPUT IMPEDANCE: 600 Ohms
 SOURCE CURRENT: 8 mA maximum
 SHORT CIRCUIT DURATION: Infinite
 VOLTAGE PROTECTION: Protected against misconnection to 240 Volts AC/DC without fuses for 30 seconds

Specifications subject to change without notice

RANGES

RANGE	SOURCE	READ	GATE TIME
KHz	0.01 TO 250.00	0.01 TO 250.00	0.2 seconds
KHz	0.001 TO 99.999	0.001 TO 99.999	1 second
Hz	0.1 TO 9999.9	0.1 TO 9999.9	1 period
Hz	0.01 TO 999.99	0.01 TO 999.99	1 period
CPM	0.1 TO 2000.0	0.1 TO 2000.0	1 period
CPH	1 TO 20000	10 TO 20000	1 period

TYPICAL APPLICATIONS

Turbine Flowmeters	Variable Speed Drives
Vortex Shedders	Telemetry Systems
Positive Displacement Flowmeters	Event Recorders
Watt-Hour Meters	Vibration Monitors
V to F and F to V Converters	Totalizers
Integrators	Data Loggers
Tachometers	Velocity Detectors
Uninterruptable Power Supplies	Magnetic Pickups
Counters	DC Contact Closures
Frequency Transmitters	

THREE YEAR WARRANTY

Our equipment is guaranteed against defective material and workmanship (excluding batteries) for a period of three years from date of shipment. Claims under guarantee can be made by returning the equipment prepaid to our factory. The equipment will be replaced, repaired or adjusted at our option. The liability of Altek is restricted to that given under our guarantee. No responsibility is accepted for damage, loss or other expense incurred through sale or use of our equipment. Under no condition shall Altek be liable for any special, incidental or consequential damage.

OTHER PRODUCTS

Altek designs and manufactures fast, accurate instruments for measurement, generation and simulation of virtually every process control signal. Consult our factory directly or contact your local stocking representative to order precise, low cost Milliamp Calibrators, Voltage Sources, Direct Thermocouple Sources, RTD Simulators and Frequency Sources. Altek also produces calibrators for custom ranges and unique applications. Additional models and ranges are frequently added to the Altek instrument family to meet all of your critical calibration requirements. Altek products are made in the USA.

TYPICAL INDUSTRIES

Chemical Plants	Textile Mills
Petroleum Refineries	Automotive Plants
Food Processing	Aerospace
Pipelines	Pharmaceutical
Utilities	Glass & Ceramics
Water & Waste Treatment	Metrology
Public Works	Beverages
Steel Mills	Plastics
Paper Mills	Machinery
	Ordinance
	Computers

ORDERING INFORMATION

	Part No.
MODEL 941 FREQUENCY CALIBRATOR	941
WITH OPTIONAL BNC CONNECTOR	941-BNC

Included with each Model 941 are:
 Carrying Case (Part No. 09-3784)
 NIST Traceable Certificate and Three Year Warranty

OPTIONAL ACCESSORIES

	Part No.
AC ADAPTOR: 120 VAC, 50/60 Hz	9V-0120
AC ADAPTOR: 240 VAC, 50/60 Hz	9V-0240
DRY CONTACT MODULE	C-41

AVAILABLE FROM: