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DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ORGANIZATIONAL, DS, GS, AND DEPOT MAINTENANCE MANUAL

DIGITAL READOUT ELECTRONIC COUNTER AN/USM-207

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HEADQUARTERS, DEPARTMENT OF THE ARMY

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SECTION 1

GENERAL INFORMATION

1-1. SCOPE.

This Technical Manual is in effect upon receipt. Extracts from this publication may be made to facilitate the preparation of other Department of Defense publications.

1-2. GENERAL DESCRIPTION.

The AN/USM-207 is a portable, solid-state electronic counter for precisely measuring and displaying on an 8-digit numerical readout the frequency and period of a cyclic electrical signal, the frequency ratio of two signals, the time interval between two points on the same or different signals, and the total number of electrical impulses (totalizing). The counter also provides the following types of output signals:

a. Standard signals from 0.1 cps to 10 mc in decade steps derived from a l-mc frequency standard, frequency dividers, and a frequency multiplier;

b. Input signals divided in frequency by factors from 10 to 10^8 by a frequency divider;

c. Digital data of the measurement in four-line binary-coded-decimal form with decimal point and control signals for operation of printers, data recorders, or control devices; and

d. A l-mc output from a frequency standard.

1-3. DESCRIPTION OF UNIT.

The AN/USM-207 consists of a major counter assembly, two plug-in assemblies which install in recesses on the front and rear panel, and a group of accessory cables and connectors stored in the detachable front cover.

a. DIGITAL READOUT ELECTRONIC COUNTER CP-814/USM-207. - The major assembly Digital Readout Electronic Counter CP-814/USM-207 contains the input amplifiers; gate control; display, reset and transfer control; frequency multipliers; time base dividers; decade and readout boards; numerical display tubes; decimal point and units indicators; power supply and regulator; and controls associated with these circuits.

b. RADIO FREQUENCY OSCILLATOR 0-1267/USM-207. - This plug-in assembly develops a 1-me signal and includes its own power supply. The oscillator includes the l-mc output receptacle which may be used as a source of that frequency when the oscillator is connected to ac power through the basic counter or when connected to the power line independently of the counter. The counter may be operated without the oscillator in totalizing, scaling the input signal, time interval with external clock, and frequency ratio measurements. For other measurements the counter does not require the oscillator when a separate external 100-kc or l-mc signal is connected. In either of those two situations the oscillator may be left in the counter or removed. The oscillator plugs into the right rear of the counter.

c. ELECTRONIC FREQUENCY CONVERTER CV-1921/USM-207. - This plug-in assembly permits measurement of frequencies up to 500 mc using the heterodyne principle. The unit consists of the broadband amplifier, mixer, multiplier, and controls and indicators associated with these circuits. When measurements other than heterodyne frequency measurement are made, the converter is not required, but need not be removed. The converter also permits the measurement of signals from 35 mc to 100 mc with a greater sensitivity than available with the basic counter. The converter plugs into the right front of the counter.

d. COUNTER COVER CW-801/USM-207. - The CW-801/USM-207 protects the front panel of the counter when not in use and provides storage space for the power cable, printed circuit board extender, two rf cables, six adapters, two tee connectors, two plug- in test cables, and the Operating Manual.

1-4. REFERENCE DATA.

The AN/SM-207 is designed for continuous operation in ambient temperatures from –28°C to +65°C with relative humidity to 95 percent, except that performance above 50°C is limited to operation with an external frequency standard. Within this range, the equipment will operate with the performance and accuracy specified below.

a. FREQUENCY MEASUREMENT.-

(1) Range (with converter): 0 cps to 500 mc.

(2) Range (without converter): 0 cps to 100 mc.

(3) Input channel: A (ac coupled), C (ac or dc coupled), or converter (ac coupled).

(4) Input amplitude.

(a) Channel A input: 0.1 to 300 volts rms from 1.0 cps to 10 mc with 6 db/octave roll-off below 10 cps; 0.1 volt rms to 100 volts rms from 10 mc to 100 mc.

(b) Channel C input: 0.1 volt rms to 425 volts rms, from 0.0 cps to 1 mc when dc coupled; ac coupled same as dc coupled except lower limit is 10 Cps.

(c) Converter input: 0.01 volt to 10 volts rms from 35 mc to 500 mc.

(5) Input impedance.

(a) Channel A input: 1 megohm +10% shunted by 30 pf maximum.

(b) Channel C input: 1 megohm +10% shunted by 30 pf maximum.

(c) Converter input: 50 ohms nominal,

(6) Readout units: In direct frequency measurement, readout is in kc and mc with automatically positioned decimal point; with frequency conversion, readout in mc is added to or subtracted from converter mixing frequency selector switch reading in mc.

(7) Gate times: 1µsec, 10 µsec, 100 µsec, 1 ms, 10 ms, 100 ms, 1 second, 10 seconds.

(8) Accuracy: ±1 count ± time-base accuracy.

b. PERIOD MEASUREMENT.-

(1) Input channel: B.

(2) Input range: Dc coupled, 0.0 cps to 1 mc for single period, and 0.0 cps to 300 kc for average of multiple periods; ac coupled, same as dc coupled, except lower limits are 10 cps.

(3) Input amplitude: 0.1 volt rms to 425 volts rms.

(4) Input impedance: 1 megohm ±10% shunted by 30 pf maximum.

(5) Number of periods averaged: 1, 10, 10^2 10^3, 10^4, and 10^5

(6) Frequency counted: 1 cps to 10 mc in decade steps for 1 period and 10 period average measurements; 100 cps to 10 mc in decade steps for 10^2 period average measurement; 1 kc to 10 mc in decade steps for 10^3 period average measurement; 10 kc to 10 mc in decade steps for 10^4 period average measurement; 100 kc to 10 mc in decade steps for 10^5 period average measurement.

(7) Readout units: Time of a single period in microseconds, milliseconds, and seconds with automatically positioned decimal point.

(8) Accuracy:

$$\pm \text{ Time-base accuracy} \pm \frac{\text{trigger error} \pm \frac{\text{frequency (unknown)}}{\text{frequency counted}}}{\text{Number of periods averaged}}.$$

c. FREQUENCY-RATIO MEASUREMENT. -

(1) Numerator input: Same as for frequency input as listed in paragraph a.

(2) Denominator (B) input: Same as for channel B as listed in paragraph b.

(3) Multipliers: 1, 10, 10^2, 10^3, 10^4, 10^5.

(4) Readout: $\frac{\text{Numerator input}}{\text{B}}$ with automatically positioned decimal point (no units).

(5) Accuracy: ±1 count ± trigger error of B.

d. TIME-INTERVAL MEASUREMENT. -

(1) Input channels: B (start) and C(stop) inputs may be switched to common signal or to separate signals to provide time interval between points on one or two waveforms, respectively.

(2) Input signals: Same characteristics as listed for period measurement in paragraph b.

(3) Range: 1 μsec to 10^8 seconds.

(4) Time-base frequency counted: 1 cps to 10 mc in decade steps.

(5) Accuracy: ± 1 count ± time-base accuracy.

(6) Readout units: Microseconds, milliseconds, or seconds with automatically positioned decimal point.

e. TIME INTERVAL MEASUREMENT, EXTERNAL CLOCK (A/B ⇒ C). -

(1) Input channels: A, B, and C. Channel C input may be switched to common signal or to separate signals to provide count of channel A signal pulses between points on one or two waveforms, respectively.

(2) Range:

$$\frac{\text{1 cps to 100 mc}}{\text{Time B} \Rightarrow \text{C} \geq \text{1 μsec}}$$

(3) Accuracy: ±1 count.

f. TOTAL COUNT. -

(1) Count range: 0 to 99,999,999.

(2) Maximum counting rate: 100 mc.

(3) Input channel: A, C, or converter.

(4) Input signal characteristics: Same as for frequency measurement as listed in paragraph a.

(5) Start and stop: Front panel control.

g. DISPLAY. -

(1) Number of digits: 8 digits with automatically positioned decimal point.

(2) Units displayed: Microseconds, mill - seconds, seconds, megacycles, kilocycles.

(3) Display tubes: In- line biquinary display tubes.

(4) Storage: Power switch selects (a) storage of a displayed count while the next count is being accumulated, and display changes only when new count changes; or (b) continuous display of counting between display periods.

(5) Display time: Adjustable from less than 0.1 second to greater than 5.0 seconds, independent of gate time. Display-time control includes an infinite-display-time position.

h. TIME BASE. -

(1) Source: l-mc internal crystal oscillator.

(2) Stability: ±1 part in 10^9 in 1000 seconds after 2-hours stabilizing time.

(3) Drift: Not more than 1 part in 10^8 per week after 48 hours stabilizing time.

(4) Coarse adjustment: Screwdriver-type control varies l-me output approximately ±5 parts in 10^7.

(5) Fine adjustment: Screwdriver-type control varies l-me output approximately ±500 parts in $1\ 0^{10}$.

i. REFERENCE FREQUENCY INPUT. -

(1) Frequency: 100 kc or 1 mc.

(2) Amplitude: 0.5 volt rms to 10 volts rms.

(3) Input impedance: 1000 ohms 10% shunted by 30 pf maximum.

j. TRIGGER ERROR. - Not greater than 0.3 percent for sine-wave signals having at least 40 decibels signal-to-noise ratio and 0.l-volt rms amplitude.

k. STANDARD l-MC OUTPUT. - Sinusoidal, l-volt peak-to-peak minimum, 50-ohm output impedance.

1. STANDARD FREQUENCY. -

(1) outputs: 0.1 cps, 1 cps, 10 cps, 100 cps, 1 kc, 10 kc, 100 kc, 1 mc, 10 mc.

(2) Output impedance: 50 ohms nominal.

(3) Minimum peak amplitude for all outputs: 1.5 volts.

(4) Waveshapes: 0.1 cps through 10 kc, positive rectangular pulses; 100 kc, positive, approximately rectangular pulses; 1 mc, positive square wave; 10 mc, sine wave.

m. SCALED OUTPUTS. -

(1) Frequency: Input signal applied to channel A, channel C, or converter, divided by any decade factor from 10 to 10^8. Input signal is as specified in paragraph a.

(2) Output impedance: 50 ohms nominal.

(3) Minimum peak amplitude for all outputs: 1.5 volts.