

OPERATING NOTES AND INSTRUCTIONS  
FOR THE  
1000 CPS FIXED FREQUENCY REFERENCE OSCILLATOR, IN-9

This document is part of an integrated file. If separated from the file it must be subjected to individual systematic review.

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## I. GENERAL DESCRIPTION

The IN-9 is a self-contained battery-operated audio oscillator providing relatively stable short duration pulses at a frequency of 1000 cycles per second. This unit was developed primarily to be used in place of the more stable tuning fork reference oscillator (IN-3) in applications where small size is more important than extreme accuracy. A socket has been provided so that the unit may be powered and/or controlled from a remote location.

## II. CHARACTERISTICS

### 2.1. Electrical

Frequency : 1000 cps

Frequency Stability: Better than plus or minus 2 per cent over the temperature range of minus 40 degrees to plus 55 degrees Centigrade and a supply voltage variation of 15 to 30 volts.

Output Waveform : Pulse

Warmup Time : None

Power Source : Self-contained 22.5 volt battery. Eveready type 412E or Burgess type U15. In a remote power setup the voltage may be between 15 and 30 volts. The current required will vary between units but should be no greater than 3 milliamperes at 22.5 volts.

Load Impedance : The load should be 1000 ohms or higher.

Output Voltage : Continuously variable. The maximum peak pulse voltage will be approximately equal to the power supply voltage.

### 2.2. Physical

Weight : 5 ounces, including battery

Dimensions: 3-5/8" x 2-1/4" x 3/4" over-all

### III. OPERATING INSTRUCTIONS

#### 3.1. Controls and Terminals (See Figure 1)

**COVER FASTENING SCREW:** This screw holds the cover in place.

**AMPLITUDE** : This control is used to vary the amplitude of the voltage appearing at the OUTPUT connector. A switch is ganged with this control and is actuated when the control is rotated fully counterclockwise. This switch disconnects the internal battery from the KEY button and prevents the battery from being discharged if the KEY button is accidentally pressed while the instrument is being carried or stored.

**OUTPUT** : The output voltage of the instrument appears at this connector.

**KEY** : This button connects the battery to the oscillator. A switch on the AMPLITUDE control must be turned on before the KEY button will function. Pressing this button causes the signal voltage to appear at the OUTPUT connector.

**REMOTE** : This connector may be used to control the instrument and/or supply power from a distant point if necessary.

### 3.2. Operation

#### 3.2.1. Local Operation

- a. Remove the cover by loosening the COVER FASTENING SCREW and sliding the cover off.
- b. Place a 22.5 volt Eveready 412E or Burgess U15 battery in the battery holder (See Figure 2). The correct battery polarity is marked on the case.
- c. Replace the cover.
- d. Rotate the AMPLITUDE control 270 degrees clockwise. This will connect the battery to the KEY button and at the same time place the maximum oscillator voltage amplitude across the OUTPUT connector when the KEY button is pressed.
- e. Connect the load to the OUTPUT connector (see paragraph 2.1.f.).
- f. Set the AMPLITUDE control for the desired voltage amplitude to the load.

#### 3.2.2. Remote Operation

- a. Pins A, B, and C of the REMOTE connector are connected in the following manner:

Pin A - negative side of battery

Pin B - positive side of battery

Pin C - chassis.

- b. If it is desired to use the internal battery but control the signal from a remote point connect a remote SPST switch to pins A and C.
- c. If it is desired to use an external battery and local KEY then connect pin A to the negative and pin B to the positive side of the remote battery.
- d. If it is desired to use both an external battery and key connect the remote switch between pins A and C and connect the positive side of the remote battery to pin B and the negative side of the remote battery to pin A.

### 3.3. Power Supply

**Type:** The self-contained power supply is a 22.5 volt Burgess type U15 or Eveready type 412E battery. A remote power supply must be capable of supplying 15 to 30 volts at a maximum current of approximately 3 ma.

**Life:** Power is required only during the time that the KEY button is pressed. Under these conditions the battery will have exceptionally long life. Because the unijunction transistor parameters vary from unit to unit the current drain will be between one and three milliamperes.

If it is assumed that the oscillator is on continuously with a current drain of three milliamperes and the battery is useful to a voltage of 15 volts the life of the battery will be about 25 hours. In any case the battery should be removed

when the terminal voltage under load drops to 15 volts.

Remove the battery if the instrument is placed in storage.

#### IV. CIRCUIT DESCRIPTION

The circuit is composed of a unijunction transistor relaxation type oscillator followed by a transistor grounded collector amplifier to isolate the load from the oscillator.

The frequency of oscillation is generally determined by the time required to charge C1 to a potential equal to the "breakdown" potential of the unijunction transistor. This capacitor is charged by the battery through the parallel paths provided by the external resistances R1, R2, and R3, and the back resistance of the P-N junction. When the potential across C1 reaches the "breakdown" value the forward resistance of the unijunction transistor junction reduces to a very low value and discharges the capacitor. The capacitor then charges again and the cycle is repeated. The oscillator stage is temperature and voltage stabilized by the setting of R3. At a given ambient temperature, and at a specific supply voltage, varying R3 will not cause a large change in frequency but the setting of R3 must not be altered since it has been set to stabilize the oscillator over the temperature and voltage range.



## V. MAINTENANCE

Since the accuracy of the oscillator depends upon the unijunction transistor and the setting of R3, the most difficult repair problem is the replacement of the unijunction transistor. Replacement of the unijunction transistor must be accompanied by a resetting of R3. This is done in the following manner:

- a. Remove the internal battery and connect a variable voltage supply to the proper terminals of the REMOTE socket (see 3.2.2.). This supply should have a continuously variable voltage range of at least 15 to 30 volts.
- b. Connect the OUTPUT to the Y-axis of an oscilloscope and an audio signal generator to the X-axis of the oscilloscope.
- c. Adjust the frequency of the audio signal generator to that of the reference oscillator.
- d. Set R3 to minimum resistance.
- e. Vary the applied voltage from 15 to 30 volts and note how much change occurs in the frequency of the reference oscillator. If the frequency changes more than one or two cycles per second R3 should be increased slightly and the voltage changed from 15 to 30 volts again. Find the value of R3 which maintains the frequency of the oscillator essentially constant with changes in supply voltage. In some cases it

may be found that the value of  $R_3$  for minimum frequency change may be zero but there should never be a case where the required resistance is greater than 500 ohms, the maximum value of the potentiometer.

The only maintenance required in the field is the periodic replacement of the battery.

## COMPONENT LIST

<u>Component</u>	<u>Value or Type</u>	<u>Manufacturer</u>	
B	Battery	22.5 volt	Eveready 412E or Burgess U15
C1	Capacitor	.01 uf silver mica, Type MS-11	Sprague
C2	"	1.2 uf, 30V DC, tantalum Type STA 170	Fansteel
R1	Resistor	*91,000 ohm, 5% $\frac{1}{2}$ watt	Allen-Bradley
R2	"	10,000 ohm, variable wire- wound, Model 300-00	Daystrom-Pacific
R3	"	500 ohm, variable wire-wound Model 300-00	Daystrom-Pacific
R4	"	Variable composition with switch, Model 1 Radiohm	Centralab
S01	Socket	Connector, coaxial	IPC 46025
S02	"	Connector, type 4-208	Continental
SW1	Switch	Push button, SPST, Series 30	Grayhill
SW2	"	SPST ganged with R4	
T1	Transformer	600 ohm to 3.2 ohm	UTC Dot 4
TR1	Transistor	Unijunction 4JX5A513 743 (ZJ14)	G.E.
TR2	"	NPN, type 2N35	Sylvania

\* This is nominal value and may vary between units.