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Bristol's

MINIATURE

# syncroverter switch


A low-power Precision Inverter for use over the excitation frequency range of 0–1800 c.p.s.

**Bristol's** Miniature Syncroverter Switch is a polarized single-pole, double-throw, non-resonant chopper which provides break-before-make action in synchronism with the current wave of the driving source. It converts low power d.c. signals into alternating voltages which can be amplified and applied to electronic, electrical, and servo systems. It can also be used as a Precision Synchronous Rectifier.

The mechanism is housed in a hermetically-sealed case (Figure 1) having glass-to-metal plug-in header and captive, locking external shield. The unit fits a skirted 7-pin socket, type B7G.

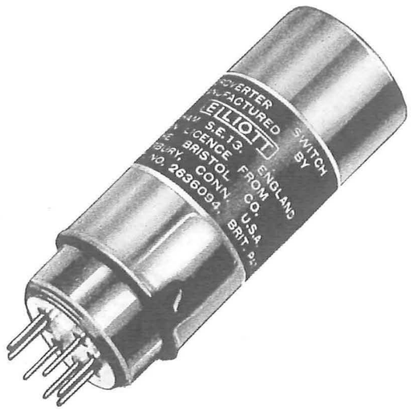


FIG. 1. *Pin-Socket Mounting Syncroverter Switch.*

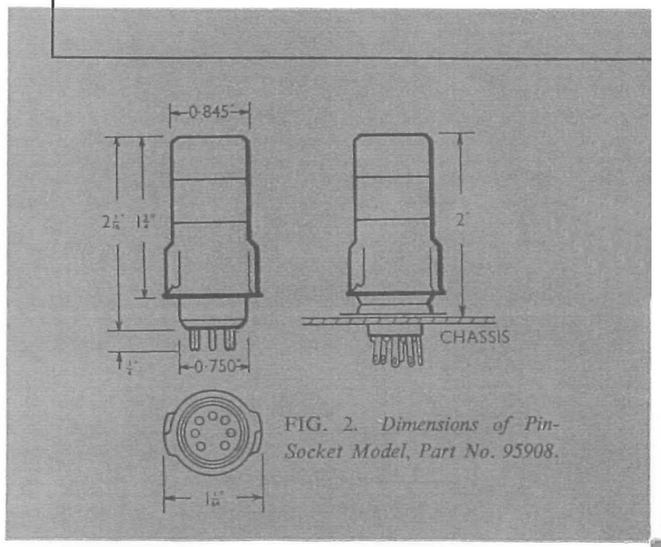


FIG. 2. *Dimensions of Pin-Socket Model, Part No. 95908.*

Contacts of the Syncroverter are of the twin or bifurcated type for improved reliability. The driving and polarizing fields act on the moving armature with a maximum force which is equivalent to more than 300*g* external acceleration. The ratio of mass to driving force is such that extreme shock or vibration has negligible effect on the switching characteristics. Phase stability is very good over a wide range of frequency, temperature, and vibration, due in part to the absence of mechanical resonances within the span of practical application.

The general design features and contact action of the switch are such as to give maximum performance ratings and reliability consistent with

A. **light weight.**

B. **small size.**

C. **insignificant change in phase lag over a long life.**

D. **negligible bounce.**

E. **excellent low-voltage performance.**

Construction features put the Syncroverter Switch in the class of high quality, precision mechanisms. Close control is maintained over production and finishing of individual parts as well as over the final assembly and operational adjustment of the units. At no time is there any compromise with the single high standard of quality for which the Syncroverter has become widely known.

## Principle of Operation

The operation of Bristol's Miniature Syncroverter Switch may be understood by referring to Figures 3 and 4. A functional schematic of the switch itself is shown in Figure 3. A driving-coil, D, powered from a suitable a.c. source, sets up an alternating magnetic flux in the iron armature, E. This latter is suitably positioned in the air-gap of a polarizing field which is maintained by permanent magnet, A.

When the driver is energized the armature, E, vibrates between the mechanical limits set by the fixed side-contacts, at a frequency which is always the same as that of the power-source connected to the driving-coil. The electrical and magnetic arrangements are such that for each time that the current through the driving-coil flows in a certain direction, the armature will move to one and always the same side-contact. When the driver-current flows in the opposite direction, the armature will always move to the other contact. The device thus works as a synchronous single-pole, double-throw switch which closes against one side-contact for every positive half-cycle of the driving-current, and against the other side-contact for every negative half-cycle.

The circuit of Figure 4 shows how the Miniature Syncroverter Switch may be used to "chop" a d.c. signal into alternating pulses which can be fed into an a.c. amplifier. The two halves of the primary winding of transformer, T, are connected to side-contacts 1 and 2 respectively. When the switch is driven, the d.c. pulses flow alternately through the two half-windings towards the centre tap. If the primary is wound continuously in one direction on the transformer iron, the d.c. pulses flowing from each side towards the centre will set up an alternating magnetic flux which will induce an alternating e.m.f. across secondary winding 3.

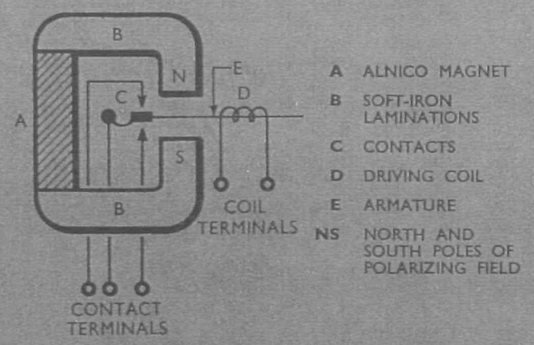


FIG. 3. *Functional Schematic Diagram of Part 95908 Syncroverter Switch.*

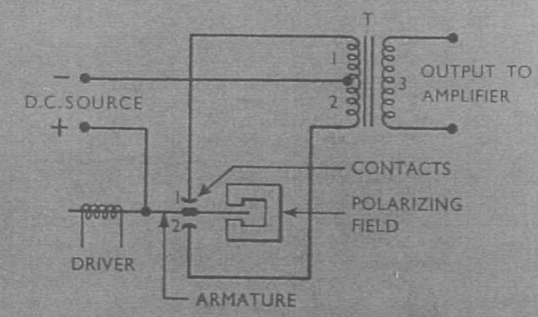


FIG. 4. *Schematic Circuit Diagram for Part 95908 Syncroverter Switch.*

## Applications

The Bristol's Miniature Syncroverter Switch is especially suited to circuits and equipment which are subject to extremes in ambient conditions of temperature, shock, and vibration, as commonly found in missile controls, aircraft computers, shipboard electronic equipment, and similar applications.

It has the advantage of requiring no special shock-mounting or protection against surrounding conditions.

The design features of the Bristol's Miniature Syncroverter Switch are such that it is frequently adaptable to performance specifications which go far beyond those listed in the normal ratings.

Syncroverter Switches are being used on such applications as missile servo-systems, aerial switching, jet-engine controls, missile-guidance systems, frequency-measuring systems, gun-sight computers, and for many other purposes.

# specifications


SCHEMATIC

## CONTACT RATING

Standard contact rating is 3 volts, 2 milliamperes, resistive load. Good results and long life are being obtained at 10 volts, 1 milliampere, resistive load, and, for some applications, much higher voltages and currents may be used on an intermittent basis. Contact action is also very reliable at low levels, i.e. in the microvolt-microampere region.

## FREQUENCY RANGE

The practicable range of driving frequencies is 0–1800 c.p.s. With special adjustment, the unit is capable of operating at frequencies up to 3000 c.p.s.

## PHASE ANGLE

Phase angle is defined as the time differential or number of degrees between centres or peaks of the driving sinusoidal voltage wave and the respective output wave. For the Syncroverter Switch, the phase angle at 400 c.p.s., 6·3 volts sine wave excitation, is 55° ± 10°. The Syncroverter Switch is strongly "overdriven", with the result that only slight variations of phase angle occur when the coil voltage is shifted by ± 25% from the nominal value of 6·3 volts. The angular change corresponding to a variation of from 4·5 volts to 8·0 volts is less than 12° total.

## SHOCK AND VIBRATION

Immunity to severe shock and vibration is one of the outstanding characteristics of the Syncroverter Switch. During vibration along any of the three major axes over the range of 5 c.p.s. to 500 c.p.s. and up to 30*g*, the effect on output waveform is negligible for most applications. Operation is within normal tolerances after five 30*g* impacts of 11 milliseconds duration in each of the six major directions. Operation during such shock is only slightly affected.

## NOISE

Quantitative values of electrical noise are always related to methods of measurement. Accepted practice in studies of chopper performance expresses the noise level in two ways: (1) Peak-to-peak amplitude; (2) R.M.S. value as determined by average-reading valve voltmeter. In addition, the measured values are dependent upon the bandwidth of the amplifier used. The noise pattern of the Syncroverter Switch has a spike of very short duration each time the contacts close. Typical noise-level values at 400 c.p.s. operation are:—

| *Load Resistance* | *Peak-to-Peak* | *R.M.S.* |
|---|---|---|
| 1 Megohm | 6 millivolts | 450 microvolts |
| 2000 ohms | 75 microvolts | 7 microvolts |

## LIFE

Rated life is 1000 hours minimum when contacts are operated at 2 milliamperes and 3 volts d.c. resistive load or 1 milliampere and 10 volts d.c. resistive load. The useful life for any particular application depends significantly on the electrical parameters of the circuit in which the Syncroverter Switch is used. If rated performance limits are not exceeded, the average service life is many times the minimum. When the circuits in which the Syncroverter Switch is to be used are not purely resistive or when operating conditions must exceed the normal specifications, tests should be made to determine performance characteristics and life expectation under the actual conditions of use.

## CHATTER OR BOUNCE

Bounce time is the total interval when electrical continuity is disrupted during mechanical dwell time. Bounce, if present, will occur within the first few per cent. of total dwell time. At 400 c.p.s. and 6·3 volts excitation, the contact bounce is within 3% of dwell time.

## TYPICAL CHARACTERISTICS FOR OPERATION AT 400 C.P.S.

| | |
|---|---|
| **Applied Voltage on Driving Coil** | **6·3 volts sine wave** |
| **Coil Current** | **55 milliamperes** |
| **Coil Resistance (d.c.)** | **85 ohms** |
| **Dissymmetry of Dwell Times** | **Less than 15° (4%)** |
| **Temperature Range** | **—55°C to +100°C** |
| **Mounting** | **Any position** |
| **Weight** | **1¾ ounces** |

*The right is reserved to vary this specification without prior notice.*

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