

Letter to the Editor

551·509 : 621·396·2 : 551·508·77

A 35 WATT TRANSISTORISED H. F. TRANSMITTER FOR USE WITH AUTOMATIC WEATHER STATION AND RADIO REPORTING RAINGAUGE SYSTEMS

1. The note describes a high frequency transistorised transmitter capable of giving an output power of 35 watts, developed in the Instruments Division, Poona and successfully field tested during the middle of 1972.

2. The transmitter (Fig. 1) is designed for operation at a frequency of 6·338 MHz and consists of a master oscillator, intermediate power amplifier, main power amplifier, aerial system and power supply. The various stages are fixed tuned to the operating frequency by means of LC tank circuits. The device employs four high frequency power transistors 2N 2890 which are locally available. The transmitter requires a DC power supply capable of delivering about 50 V at 1 amp at the time of transmission, derived from a 12 V accumulator battery through a DC-DC converter which also is made from indigenous components.

2.1. The *master oscillator of the transmitter* is crystal controlled at a frequency of 6·338 MHz for stability and narrow bandwidth of operation. The oscillator is of the tuned collector type Hartley circuit with the crystal acting as the series tuned feedback circuit from collector to base of the oscillator transistor. The oscillator output power is about 0·5 watt and is sufficient to drive the intermediate power amplifier transistor. The output of the master oscillator is transformer coupled to the intermediate power amplifier. A 50 Ω resistance is inserted in the emitter circuit of the transistor T_1 to reduce the distortion in the output sinusoidal wave-form. The morse key for operating the transmitter can be introduced in the emitter circuit as shown in the figure. The oscillator draws a current of about 50 mA when switched on.

2.2. The *intermediate power amplifier (IPA)* utilises transistor 2N 2890 in common emitter configuration with the base return path provided through L_2 . This stage is class B operated to obtain better efficiency with less collector dissipation. The output tank circuit is fixed tuned to the crystal frequency and gives about 6 watts RF power sufficient for driving the main power amplifier. The power gain of the intermediate power amplifier is more than 10 db and operates at an

efficiency of about 60 per cent. Since this stage is operated class B, the collector current of T_2 is zero when the master oscillator is switched off. Whenever the oscillator is switched on, the collector current rises to about 200 mA. The collector tank circuit is tapped at a low impedance point for matching the output of IPA to the input of the main power amplifier. The series resistance of 200 Ω (10W) introduced in the input feed line of the main power amplifier is intended to prevent over loading of the IPA by the main power amplifier input circuit. Inductance coil L_3 in this stage is about 35 turns of 20 SWG enamelled copper wire wound on a cylindrical former of 3/4" diameter over a length of about 2". The output of the IPA is capacitor coupled to the main power amplifier stage.

2.3. The *main power amplifier (MPA)* gives the final output power of about 35 watts to the aerial for transmission. This stage utilises two 2N 2890 transistors T_3 and T_4 connected in parallel as in figure, to get an increased power rating for the pair. The output of the stage operates into a common tank tuned to the crystal frequency. This stage is also class B operated giving an efficiency of about 70 per cent. The total collector current of about 700 mA flows only when the master oscillator is on. Thus during morse keying, the transmitter operates with a low duty cycle and hence the average power consumption is kept at a minimum. The power transistors are mounted on a 3/8" thick aluminium base plate which serves as the heat sink during operation. The output tank of the main power amplifier is tapped at a point where it matches the feed point impedance of about 72 Ω when coupled to a balanced centre fed dipole aerial. This tapping point has been arrived at by connecting a dummy resistive load of about 72 Ω at the output of the transmitter and adjusting for maximum transfer of power. DC power to the transmitter is applied through a 1 amp fuse as the total current drawn by the circuit is about 900 mA at the time of operation. The output of the main power amplifier is capacitor coupled to the aerial through an RF co-axial connector.

2.4. *Aerial system* — A balanced dipole aerial system made of multistrand copper wire and resonant at the frequency of operation of the transmitter has been satisfactorily used during field tests. The total length of the dipole aerial at the frequency of operation namely 6·338

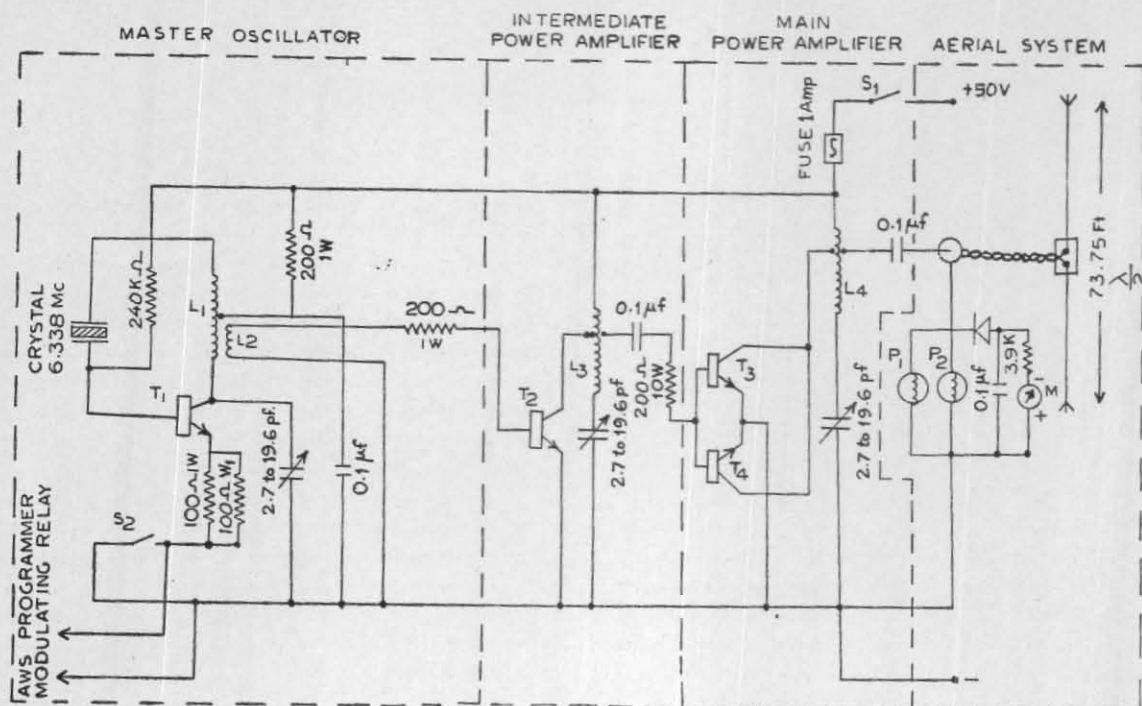


Fig 1. Solid state high frequency transmitter. L_1, L_2, L_3, L_4 —About 35 turns, 20 SWG enamelled copper wire wound on cylindrical former of diameter 19 mm over a length of 51 mm and L_2 is about 115 turns of plastic wire wound over one half of L_1

MHz works out to be 22.5 metres and is calculated from the relation L (m) = $467.4 / [\text{Frequency (MHz)} \times 3.28]$. This aerial is horizontally stretched between two vertical masts. In the field tests undertaken, the height of the masts used was 9 metres. The aerial has a feed point impedance of 72 ohm to match the output impedance of the transmitter. Energy is fed to the aerial through a pair of twisted leads, which acts as a transmission line of characteristic impedance about 72 ohm.

Two pilot lamps P_1 and P_2 connected in series with the aerial feed line serve as a visual indication of transmission, while a 0.500 μA meter (M) connected across these pilot lamps through a rectifier diode indicates the transmitted power level. Under aerial matched conditions, a meter reading of 350 μA corresponds to an output power 35 watts. This has been estimated from the dummy load measurements using the Marconi RF power meter.

2.5. *Power supply*—The power supply for the transmitter is a DC-DC converter type which provides a 50V—1 amp out put from a 12 V accumulator battery. The power supply utilises completely indigenous components and costs about Rs. 900.00

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2.6. *Field tests and results*—This transmitter was successfully field tested over ranges of more than 180 km during the monsoon months of 1972 between Poona and Bombay. The signal reception with the RG 2003 BEL communication receiver was very satisfactory in all the trials. The transmitter is made entirely from indigenous components and is in expensive costing about Rs. 600 (excluding the power, supply). The range in actual field trials was more than 180 km and the average power consumption during morse key operation is much less than 50 watts since the device is completely transistorised and all the power stages are class B operated. The device can be used for voice modulated SSB transmission with slight modification as the output wave form conforms very nearly to a sinusoidal shape. The transmitter weighs 1.5 kg and measures 254 mm \times 127 mm \times 102 mm.

Though primarily designed for use with AWS and RRRG systems, the transmitter can be used for communication over distances of the order of 200 km.

3. The author is grateful to Shri George Alexander, Director (Instruments) and Shri S.V. Datar, Meteorologist for their encouragement during the design of the transmitter.

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REFERENCE

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