

Overview of Radar Transmitter

The radar transmitter produces the short duration high-power rf pulses of energy that are radiated into space by the antenna. The radar transmitter is required to have the following technical and operating characteristics:

- The transmitter must have the ability to generate the required mean RF power and the required peak power
- The transmitter must have a suitable RF bandwidth.
- The transmitter must have a high RF stability to meet signal processing requirements
- The transmitter must be easily modulated to meet waveform design requirements.
- The transmitter must be efficient, reliable and easy to maintain and the life expectancy and cost of the output device must be acceptable.

The radar transmitter is designed around the selected output device and most of the transmitter chapter is devoted to describing output devices therefore:

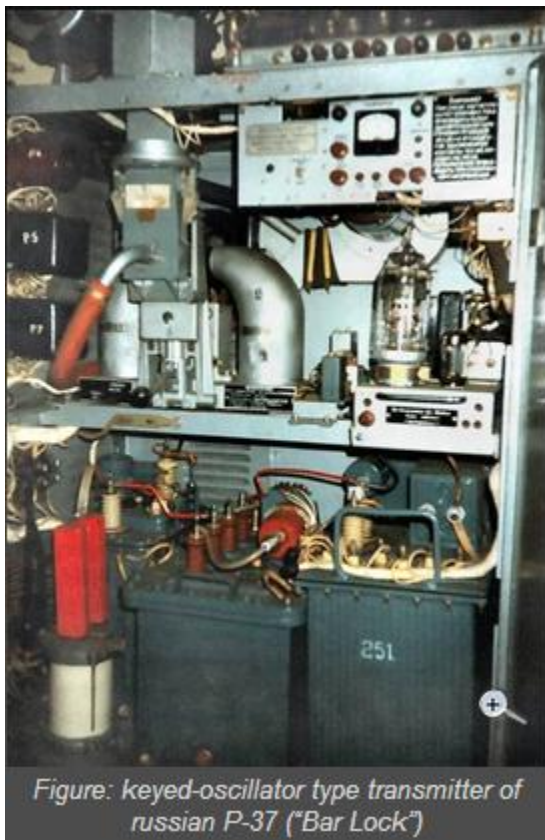


Figure: keyed-oscillator type transmitter of russian P-37 ("Bar Lock")

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- One main type of transmitters is the keyed-oscillator type. In this transmitter one stage or tube, usually a magnetron produces the rf pulse. The oscillator tube is keyed by a high-power dc pulse of energy generated by a separate unit called the modulator. This transmitting system is called POT (Power Oscillator Transmitter). Radar units fitted with a POT are either non-coherent or pseudo-coherent.
- Power-Amplifier-Transmitters (PAT) is used in many recently developed radar sets. In this system the transmitting pulse is caused with a small performance in a waveform generator. It is taken to the necessary power with an amplifier following (Amplitron, Klystron or Solid-State-Amplifier). Radar units fitted with an PAT are fully coherent in the majority of cases.
- A special case of the PAT is the active antenna.
- Even every antenna element
- or every antenna-group

is equipped with an own amplifier here.

Pictured is a keyed oscillator transmitter of the historically russian radar set P-37 (NATO-Designator: „Bar Lock“).

The picture shows the typical transmitter system that uses a magnetron oscillator and a waveguide transmission line. The magnetron at the middle of the figure is connected to the waveguide by a coaxial connector. High-power magnetrons, however, are usually coupled directly to the waveguide. Beside the magnetron with its magnetes you can see the modulator with its thyatron. The impulse-transformer and the pulse-forming network with the charging diode and the high-voltage transformer are in the lower bay of this rack.

Solid-state transmit/receive modules appear attractive for constructing phased array radar systems. However, microwave tube technology continues

to offer substantial advantages in power output over solid-state technology. Transmitter technologies are summarized in the following table.

Technology		Maximum Frequency	Peak/ Average Power	Typical Gain	Typical Bandwidth
POT	<i>Magnetron</i>	95 GHz	1 MW / 500 W) ¹	-	Fixed...10%
	<i>Impatt diode</i>	140 GHz	30 W / 10 W) ¹	-	Fixed...5%
	<i>Extended interaction oscillator (EIO)</i>	220 GHz	1 kW / 10 W) ²	-	0.2% (elec.) 4% (mech.)
PAT	<i>Helix traveling wave tube (TWT)</i>	95 GHz	4 kW / 200 W) ¹	40...60dB	Octave/ multioctave
	<i>Ring-loop TWT</i>	18 GHz	8 kW / 400 W) ¹	40...60dB	5...15%
	<i>Coupled-cavity TWT</i>	95 GHz	100 kW / 25 kW) ¹	40...60dB	5...15%
	<i>Extended interaction Klystron (EIK)</i>	280 GHz	1 kW / 10 W) ²	40...50dB	0.5...1%
	<i>Klystron</i>	35 GHz	50 kW / 5 kW) ¹	30...60dB	0.1...2% (inst.) 1...10% (mech.)
	<i>Crossed-Field amplifier (CFA)</i>	18 GHz	500 kW / 1 kW) ¹	10...20dB	5...15%
	<i>Solid state Silicon BJT</i>	5 GHz	300 W / 30 W) ³	5...10dB	10...25%
	<i>GaAs FET</i>	30 GHz	15 W / 5 W) ¹	5...10 dB	5...20%

¹ demonstrated at X-Band
² demonstrated at 95 GHz
³ demonstrated at 1 GHz

Table 1: Pulse Radar Transmitter Technology
 Source: Tracy V. Wallace, Georgia Tech Research Institute, Atlanta, Georgia.

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<http://www.radartutorial.eu/08.transmitters/Radar%20Transmitter.en.html>