

The French TR-PP-11 Jacques Feysac and Murray McCabe

Part 1

Introduction

This note was written as a result of French TR-PP-11 squad radios appearing on an Italian dealer's website. The main questions this raised were what were they, how did they work, how well did they work and where did they fit into the general development of VHF/FM military field radio? A Frenchman and a Scotsman have got together to find out and compile this note so it is international in subject and authors.

A Brief History of Early VHF/FM Squad Radios

Crudely speaking, most combat infantry deployments from the 1950s onwards used 2 types of VHF/FM portable radios. A lightweight squad or section radio to allow squads, mortars and similar, to communicate with each other and with company and a higher power company radio that could communicate with both regiment and the squads. As radios developed it became difficult to distinguish between squad radios and Personal Role Radios (PRRs). PRRs were radios intended to be carried by individual soldiers to allow a squad leader to communicate with the individual members of his team. This note discusses VHF/FM squad radios.

WS-88

As best the writers can determine, the first VHF/FM, military squad radio was the British WS-88 (Wireless Set No.88). This was a sealed, chest portaged set manufactured by ECKO. Development started during World War II (WII) as a VHF/FM replacement for the earlier HF WS-38. The WS-88 was introduced to service in 1947. It used B7G valves, had an RF output of 250 mW, a receiver IF of 3 MHz and 4 crystal controlled channels between 38.01 to 42.15 MHz. It was produced in A and B versions with different frequencies for infantry and mortars respectively. WS-88 was intended to work with WS-31, the UK version of the US SCR-300/BC-1000 backpack company set.

WS-88 was carried in 2 webbing chest pouches like British WWII ammunition pouches, the battery in one pouch and the set in the other. Early versions used discrete HT and LT batteries contained in a frame within a sealed battery box. This was later replaced with a composite HT+LT battery carried unboxed in the battery pouch. The WS-88 operator wore a headset with a boom microphone. A separate pressel switch was permanently connected to the set and could be strapped to the operators wrist. This theoretically kept his hands free for his personal weapon. Since officers, NCOs and others would use the set the operator also carried a lightweight handset for their use, (Telephone hand No.11) to which the pressel switch could be clipped.

PRC-6

The first VHF/FM handheld squad radio was the US PRC-6/RT-196 transceiver. This was a valve radio employing 'pencil' valves like the 5678 but retaining a 3B4 B7G valve in the transmitter output stage. The radio provided one crystal controlled channel in the range 47 to 55.4 MHz. It was originally designed for 200 kHz channel spacing (42 possible channels) to match and work with the WWII BC-1000/SCR-300 VHF/FM backpack transceiver. A boxed kit of 42 type CR-23 crystals was available for the PRC-6, called CK-6. The RF coils were permeability pre-tuned via individual counter dials mounted on each coil. The design intent was that the crystal frequency could be changed without returning the set to workshop. The new crystal would be fitted and the RF coil dials reset for the new frequency using a calibration chart inside the set. An ID-292 channel alignment indicator unit was also available for the set.

The RF output power of the transmitter was about 350 mW giving the set a range of around 1 mile in open country. The PRC-6 was shaped like a bulbous telephone handset, measured 381 x 127 x 114 mm and weighed 3.2 kgs with its BA-270/U battery (1.5, -4.5, 45 and 90 Volts). The set had a laminated steel tape whip antenna for normal service but could use the AT-249 or AT-340 homing antennae. PRC-6 development started pre 1945 and it entered service in 1951. During its development different mechanical formats and operational applications were evaluated before the final hand held version was released. The PRC-6 had a minimum of external attachments and could be easily handed to an officer or similar when required. However, it was hand held making it difficult to load and fire a rifle while holding a PRC-6. A strap at the back of the PRC-6 allowed it to be shoulder slung and to use an H-33/* handset.

C/PRC-26

In the early 1950s Canada produced the C/PRC-26. This was a 6 channel crystal controlled set designed to be body portaged rather than handheld. Its webbing allowed back, chest or belt portage The set operated from 47 to 54 MHz with

an RF output of about 300 mW produced again by a 3B4 valve. It had a range of 1 mile in open country on its 4 foot whip antenna, a receiver sensitivity of 2 microvolts for 20db signal plus noise-to-noise on new batteries. This increased to more than 4 microvolts as the battery discharged. The set plus battery (BA-289/U) weighed 4.5 kg. The C/PRC-26 introduced a 'Whisper' mode allowing the operator to whisper when working close to an enemy. As with the WS-88 the C/PRC-26 operator carried an 'officer's' handset but its mode of employment differed. The operator wore a single earphone headset with no microphone. The intent was that the operator use the handset on his uncovered ear, its microphone as the set microphone and that he T/R switched with the handset switch. During long periods of listening out on receive the handset could be parked on his webbing. Likewise it could be passed to an 'officer' when required and the operator would continue to monitor traffic on his earphone. Alternatively the set could be used as handset only like the standard PRC-25/77.

All but two of the C/PRC-26 receive/transmit stages were constructed in colour coded, plug-in modules. These were similar to the PRC-10 IF stages but shorter in height than them. The IF modules were not hermetically sealed and were common to the Canadian C/PRC-509 and -510 (PRC-9, -10 equivalents) and the British SR (station radio) A40, A41 and A42. Audio ancillaries and short antennae were also initially interchangeable on all these sets. The C/PRC-26 was a very creditable attempt to simplify servicing and to use common ancillaries for squad and company radios.

The C/PRC-26 was in effect an updated WS-88. It retained some WS-88 components but was extensively modernised, modularised and miniaturised using pencil valves. Its design was influenced by the RCA PRC-10 development in the US. Australia, Holland, Italy, Denmark and Britain among others used the C/PRC-26. Britain manufactured a version of it designated the SR A40. The SR A40 muddled the normal squad radio concept in that operators were issued with a 10 foot rod aerial with a ground spike base that boosted ranges to 5 km in open country.

PRC-6/6

In Europe the fact that the PRC-6 had only one channel was seen as seriously limiting its effectiveness. The Europeans wanted the option of squad-to-squad working as well as squad-to-company and to be able to move to alternative channels if the allocated channel was busy or jammed. In Europe with its higher population density than the US, the VHF spectrum was

becoming widely used for public mobile radio and similar services and this could restrict the channels available to the military.

West Germany produced a 6 channel version which they designated the PRC-6/6. This set used the same case and battery as the PRC-6 but its circuit, internal construction and crystals were different. The PRC-6 receiver was a single conversion superhet with an IF (intermediate frequency) of 4.3 MHz. The PRC-6/6 receiver was dual conversion with IFs of 11.38 and 1.71 MHz. The oscillator for the second receiver mixer was crystal controlled at 9.67 MHz. The transmitter master oscillator operated at 11.38 MHz and mixed with the receiver crystal first local oscillator to generate the transmitter output frequency.

The main external difference between the PRC-6 and -6/6 was that the PRC-6 had a BNC coaxial connector beside its whip base to connect a homing antenna, while on the PRC-6/6 this position was occupied by a 6 way rotary channel selector switch.

TR-PP-8-A

In France an externally similar 6 channel set was built for the same reasons. This was called the TR-PP-8-A or ER-39-A. The troops nicknamed it the 'banana'. The TR-PP-8-A was not the same as the PRC-6/6. It was a 12 valve set that retained much of the proven circuitry and simplicity of the PRC-6. Its receiver was a single conversion superhet with the 4.3 MHz IF of the PRC-6. The receiver local oscillator was crystal controlled. The transmitter master oscillator was LC (inductor capacitor) tuned, operated at half the channel frequency and was frequency modulated at that frequency. It then went to a frequency doubler before the 3B4 RF output stage, as in the PRC-6. The receiver remained powered in transmit. Its discriminator provided automatic frequency control for the transmitter master oscillator.

The problem of pre-set tuning over the full frequency range (47 to 54.5 MHz) was overcome by ascribing 6 different 1.4 MHz wide frequency bands to each crystal position. For example Crystal Position 1 was reserved for channel frequencies from 47 to 48.4 MHz. These bands were pre-tuned, restricting the choice of channel frequencies to one in each band.

The TR-PP-8-A had a transmitter RF output of about 250mW and a battery life of 20 hours. It could power from the normal BA-270/U battery but a French BA-491 transistor inverter pack was developed to allow it to operate from nine BA-30 (U2 or type D) dry batteries.

The French military made limited use of C/PRC-26s manufactured in Europe by Philips. The arrival of the C/PRC-26 clashed with France's own development of a body portaged VHF/FM squad radio designated TR-11-1 or ER-40-A. The ER-40-A employed 12 B7G valves and provided 4 crystal controlled channels from 37 to 40 MHz. The set, vibrator power supply and silver zinc secondary batteries were contained in a single case. [The ER-40-A was described in issue 6 – Ed.]

Transistor Designs

With the arrival of transistors design options for VHF/FM squad radios mushroomed but there was still no consensus as to how such sets should be ergonomically engineered and what reliable range should be expected from them. A few 10s of mW RF output could give 500 + meters range in open country, small set size and weight plus good battery life. However, range fell off rapidly in dense, humid jungle or heavily built-up urban environments. To maintain reliable range in these conditions greater transmitter power output was required.

The US evaluated several design approaches including:

transistorised versions of the PRC-6,

the PRC-34 a helmet mounted VHF/FM single channel crystal controlled transceiver covering 38 to 51 MHz with an RF output of 30 mW and a range of about 500 meters in open country.

the PRC-36 a belt mounted set with similar electronics to the PRC-36 but covering 47.8 to 51 MHz.

Other US development sets included the PRC-15, -30 and -35.

PRC-88

The US set of this type that saw greatest service was the composite PRC-88. It consists of separate transmitter and receiver units covering 47 to 57 MHz. The receiver (AN/PRR-9) mounted on the soldier's combat helmet. It was single channel, crystal controlled, designed for 100kHz channel spacing, with squelch and a sensitivity of about 0.5 microvolt for 20 db signal-to-noise. The transmitter (AN/PRT-4) had two crystal controlled channels and 450 mW RF output. It was held in the operator's hand like a stick microphone with a lanyard to his harness. The lanyard allowed the operator to release the transmitter to use his weapon. Latterly, 'A' versions of the PRC-88 were developed with 150 Hz tone squelch to allow it to work with the PRC-25/77 and VRC-12 derivatives.

The tone squelch was the first known use of an integrated circuit in a service squad radio. The PRC-88 was introduced about 1966 and was not replaced until the arrival of the PRC-68(*) in about 1977.

There have been arguments and inconsistencies about just what the PRC-88 was, however, a 1969 US Army publication says '...you may've heard of the 'AN/PRC-88' a 'combined' PRR-9 and PRT-4. Well the PRR-9 and PRT-4 are as combined as they are ever supposed to get, but USAECOM has taken action to standardise 'AN/PRC-88' as the nomenclature....as a means of identifying the receiver and the transmitter under one identification.'

In open country the PRC-88 achieved ranges up to 1,500 meters. These fell to about 150 meters in thick bush but, in combat, in thick bush a squad member is unlikely to be more than 150 meters from his squad leader. However, it highlighted the fact that for 'all theatre' VHF/FM operation, at these frequencies, a squad radio should have an RF output capability approaching 500 mW.

The transmitter battery was the 15 volt BA-399. The original 5 volt battery for the PRR-9 (BA-505/U) was unsatisfactory in that it had too short a continuous service life. However, battery technology was also developing allowing the BA-505/U to be replaced later by an aluminium cased magnesium battery type BA-4505/U with almost three times the continuous service life (40 hours). This was at the cost of more expensive batteries and elevated running costs.

Denmark and Holland, among, others produced transistorised sets in the C/PRC-26 format. The West Germans retained the PRC-6 'handset' format and produced transistor variants such as the PRC-6/T and the PRC-6/180 some of which did not go into service until the 1970s. They also produced handheld VHF/FM squad radios using headsets or handsets like the SEM-52 and the FSE-38/54.

Britain stuck with the C/PRC-26/SR A40 concept that the squad set should be carried on the soldier's body and in the early 1970s produced the digitally synthesised Clansman Radio UK/PRC-349. This covered 37 to 46.975 MHz, in 400 off 25 kHz channels, provided 250 mW RF (or 500 mW to option), a 20 hour battery life, tone squelch, weighed 1.5 kg, had a receiver sensitivity of at least 20 db signal-to-noise for a 1 microvolt signal and provided protection against a mismatched or shorted antenna in transmit.

TR-PP-11

The above outlines conditions and experience

before and after the TR-PP-11 was designed. By the late 1950s France had identified a need for a VHF/FM transistorised, synthesised back pack company radio like the US PRC-25/77 to replace their PRC-10 series valve sets plus a transistorised squad/section radio to replace their TR-PP-8-A, 'Banana'. It was wisely decided that a common development programme should produce both sets. The work was awarded to the organisations that became Thomson CSF. Prior to 1969 these were two separate organisations, Thomson and C.S.F., who shared military contract work.

The programme produced the TR-PP-13 VHF/FM synthesised backpack set and the TR-PP-11 squad radio. The TR-PP-11 retained the PRC-6 handset format but was about half its thickness. In part the reduction in size was restricted by the use of a standard battery. The TR-PP-11 is a 6 channel, crystal controlled, solid state transmitter receiver of modular construction. Initially, TR-PP-11 programme encountered the same problem as PRC-25 development in the USA. Suitable RF power transistors had not yet been developed. Consequently, the first batch of 100 prototype TR-PP-11s were produced with a valve in the transmitter output stage, an inverter to generate the high tension voltage for the valve and a 1.5 volt tap on the supply battery to power the valve filament.

Fortunately, during the prototype trials suitable RF power transistors became available allowing the production models of the TR-PP-11 to be released about 1966 as fully transistorised, using a standard, non tapped battery. The production model was designated the TR-PP-11-B. The prototype batch of 100 valve TR-PP-11s were reported to have been destroyed at the end of their evaluation programme. The production sets were initially manufactured at the Thomson plant at Laval and the CSF plant at Cholet.

The basic modules of the TR-PP-11 were re-packaged, provided with SQUELCH and extended to produce the 6 channel TR-VP-11 vehicle set and the 6 channel TR-AP-11 light aircraft/helicopter set. The common development programme resulted in the TR-PP-11 and the TR-PP-13 sharing some common circuit modules. These included an 8 pole IF crystal filter, an IF amplifier and an IF quartz discriminator. The TR-PP-11 IF frequency of 11.5 MHz was adopted to suit the TR-PP-13. These first generation synthesised sets covered their waveband using two equal frequency bands. The TR-PP-13 covers 26 to 72 MHz in two 23MHz bands but with one local oscillator band. In one RF band the signal frequency is local oscillator plus IF frequency and in the other local oscillator minus IF

frequency. Consequently, the 46 MHz wide RF band results in an IF of $46/4 = 11.5$ MHz.

For a set of its type and era the TR-PP-11 specification is good. Compared with the TR-PP-8-A the TR-PP-11 was about 60% of its weight and half its volume, had nearly twice the RF output, twice the battery life, more than four times greater receiver sensitivity and twice the range. Measured from its antenna base it was marginally more sensitive than the larger TR-PP-13. It appears that common spares across the range of sets allowed a better quality of circuit and component to be justified for the TR-PP-11 than would have been normal for a stand alone, hand held radio development.

The French military took a very practical view on common spares and consumables. They had poor experience with high tension battery reliability and so standardised on the 15 Volt PS.28.A battery. This was a 10 cell dry battery with a robust, reliable and cheap cell in which one sub-standard cell in 10 could be readily detected. 4 off PS.28.A batteries were used to power the PRC-10 VHF/FM backpack valve sets via the BA-511 inverter, 2 off PS.28.A powered the TR-PP-13 while the TR-PP-11 operated from a single PS.28.A. This meant that in its time one battery type serviced all French military man portable VHF/FM field sets.



The TR-PP-11

Part two of this article, which includes a detailed technical description, will be published in the next VMARS newsletter. TR-PP-11 sets are available as "untested" at www.radiosurplus.it

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Part 2 - Where to find them and technical details.

The first part of this article described how these sets fitted into the general development of VHF/FM military field radios. We continue with the technical details.

TR-PP-11s on the Surplus Market

In February 2002 the Italian website www.radiosurplus.it advertised TR-PP-11s for 20 euro, about £12 or \$18.

It is unusual for the French to release radios of the age of the TR-PP-11. Normally French army radios that reach the end of their military service go from the Army to the Gendarmerie and then to war emergency stores. French PRC-10 valve equipment was only released in recent years and there is nearly 15 years between the design dates of the PRC-10 and the TR-PP-11. However, times and practices change.

E-mail exchanges with the dealer, plus translation help from the local Italian café owner, established that the sets offered were untested and thought to be complete but not guaranteed to be so. Because of the weight breaks in European postal rates the cost of postage would be 22 euro whether one or two sets were bought.



The French 'Banana'

set. As outlined above the set was of historical and technical interest so the decision was taken to gamble. Two sets were ordered, the dealer advised despatch by e-mail and the radio parcel arrived 10 days later.

Both the pessimist and the optimist proved to be part correct. One radio was missing most of its modules but had a set of crystals. The second radio was nearly complete but its earpiece was open circuit. In the event it proved possible to build one good radio from the two but there is no

guarantee that a repeat order would have the same fortunate outcome.

Inspection of the sets explained their presence on the surplus market. They were normal TR-PP-11-Bs, manufactured about 1971 but badged by Thomson-CSF for the Portuguese Army as 'Emissor Receptor AVP-1". Both sets had been classified as defective and committed to workshops in the early 1990s. In other words the two sets purchased had not been retired from service in good order but had been hospital cases.

TR-PP-11 Description

Inspection of the radios and their circuits plus data from Refs.1 and 2 produced the following appreciation of the set.

The TR-PP-11 is basically the shape of an overgrown telephone handset, more square lined and thinner than the PRC-6. Two TR-PP-11s laid one on top of the other are about the same size and volume as the PRC-6. The TR-PP-11 is 322 x 67 x 115 mm and weighs 2 kgs including its battery.

The antenna is a 0.63 m long laminated steel tape whip that can be wrapped round the set for stowage. The antennae of both sets bought had seen better days but were recoverable. There is a subminiature BNC connector for 50 ohm external antenna equipment. A 3 way rotary switch (centre OFF) provides ON/OFF switching plus the option of operation and RT switching from an external handset or headset. These audio ancillaries can be connected via a 6 pin connector and are designed specifically for the TR-PP-11. As a throw back to the C/PRC-26, when the TR-PP-11 is switched for use with its external handset its earpiece remains live so that the set operator can monitor handset traffic. The set has a volume control but no SQUELCH.

A folded, adjustable strap at the rear of the set allows it to be carried on the shoulder when not hand held. In this mode it can be classed a body portaged set rather than a handheld.

The case is constructed from 3 rugged alloy castings. The set enclosure is sealed from the battery section of the case but the case is not desiccated. The battery cover is toggle clamped to the set case and gasket sealed. Separate bleed screws are provided for the set case and the battery compartment. The reason for the screws is unclear but it could be to prevent undesirable set-to-atmosphere differential pressures during unpressurised air transport. With the bleed screws tightened home the set will resist water immersion. External components that can be detached (battery box cover, whip and connector covers) are linked to the main set with nylon cord to prevent loss in the field.

The TR-PP-11 has a small, robust crystal turret switch. To prevent accidental change of channel the switch knob has to be lifted before it can be turned. The knob has a pointer at CHANNEL 1 to allow its setting to be determined by touch in the dark. Each switch position has a screw adjustable mechanical plunger that acts on a cam to adjust a miniature 5 gang, silver plated, variable tuning

condenser. The plungers allow the RF circuits of each channel to be pre-tuned to match the crystal in use. This permits any channel position to be tuned to any frequency in the set's 47 to 57 MHz range and so designs out the TR-PP-8-A restrictions in this area.

With its miniature tuning condenser and tuning mechanism plus the multitude of small screws holding modules and assemblies together the TR-PP-11 is something of a clockmaker's set. Some of the set modules are easily dismantled by removing securing screws and unplugging the module. Other modules require careful de-soldering to remove them. Screws with green painted heads are removed for normal strip of the set chassis assembly. In general screws with red painted should not be removed for basic dismantling.

The TR-PP-11 has a claimed set-to set range 3 to 8 km (5 miles maximum) subject to the terrain. Its 15 V battery and modest current drain make it an easy set for the enthusiast to power.

Technical Detail

Frequency Range	47 to 57 MHz/ 200 possible channels - any channel in any channel switch position
Channel Spacing	50 kHz
Number of Channels	6 individually crystal controlled channels
Number of transistors	17
Receiver	
IF Frequency	Single conversion superhet 11.5 MHz
Sensitivity	0.5 microvolt for 20 db signal-to-noise
6 db Selectivity	± 18 kHz or ± 17.5 kHz depending on the filter used
70 db Selectivity	± 50 kHz
Unwanted Response Rejection	60 db on all frequencies 74 db on IF and image frequencies
Limiter Performance	Less than 1 db output variation between 5 microV and 50mV RF input
AF Output	5mW maximum
AF Distortion	Less than 10% between 300 Hz and 3 kHz
Transmitter	
Average RF Power Output	500 mW (800 mW max.on new battery)
Minimum RF Power Output	300 mW
Modulation	± 10 kHz
Frequency Stability	± 3.5 kHz from -40 to + 55 ^o C
Unwanted Radiation Attenuation	43 db
Power Supply	
Transmitter Power Drain	French PS.28.A Dry Cell or AA-58/A NiCd battery. Nominal 15 V (16 to 10 V)
Receiver Power Drain	3 W
Battery Life (PS.28.A)	350 mW
Battery Life (AA-58/A NiCd)	48 hours on a 9:1 Receive:Transmit Regime
Operating ambient temperature	20 hours on a 9:1 Receive:Transmit Regime
Storage temperature	- 40 to + 55 ^o C
	- 40 to + 70 ^o C

Circuit Description

Most of the 17 transistors in the TR-PP-11 are mounted in plug-in bases whereas they would be soldered-in in modern equipments. This is an indication that when the set was designed transistors had not been around long enough to demonstrate their life and reliability in service. Another result of the set's design age is that the transistors are mainly germanium P-N-P devices except in stages such as the transmitter power driver and output where N-P-N silicon planar devices are used.

(Module 6) at signal minus IF frequency using an AFY47 transistor. IF selectivity is provided by an 8 pole IF crystal filter (Module 14). In some sets this is ITT type 901FMA, 11.5 MHz ± 17.5 kHz. The IF amplifier (Module 1) consists of 3 off AFY47 IF amplifiers plus one AFY47 IF limiter. The IF signal passes through a discriminator input adapter (Module 2) to an 11.5 MHz crystal discriminator (Module 3). The resultant AF output signal passes to the volume control (Module 12) and is then amplified in an AF amplifier consisting of two 2N526 transistors with a gain of about 36 db (Module 4).



Back case removed showing main chassis and crystal turret

The receiver circuit starts at the antenna where the transmitter PA (power amplifier) tuned circuit acts as the tuned RF input circuit for the receiver. A diode RF (radio frequency) R/T (receive/transmit) switch (Module 13) isolates the receiver input circuits from transmitter output in transmit. It also protects the base-emitter junction of the receiver RF amplifier transistor from voltage damage caused by high power adjacent transmitters. This protection continues to work when the set is switched OFF and does not seriously degrade the receiver noise factor. This form of protection was missing on early PRC-25s.

The diode switch is followed by a single AFY46 RF amplifier. Between the RF amplifier and the AFY46 mixer (both are part of the RF head, Module 9) is a passband circuit consisting of two capacitively coupled circuits each tuned by a separate gang of the tuning condenser. The receiver, therefore, has three RF tuned circuits.

The receiver local oscillator is a crystal oscillator

The transmitter has a two transistor microphone amplifier employing 2N526 transistors and diode clipping (Module 5). The AF output from the microphone amplifier is used to FM modulate an 11.5 MHz AFY47 LC CLAPP oscillator by a varactor diode in Module 8. Module 8 also includes an AFY47 buffer/separator and a 2N384 amplifier. The Module 8 output from the 2N384 amplifier is fed to the crystal discriminator input adapter via a diode switch and generates a frequency error signal against the discriminator crystal. This is used to control the mean frequency of the Module 8 oscillator to 11.5 MHz.

The discriminator input adapter has an external link plug secured by a short nylon cord. Unplugging this link breaks the feed to the discriminator and disables the AFC control of the 11.5 MHz oscillator. This allows the natural frequency of the LC oscillator to be pre-set to 11.5 MHz on test to centralise it in the AFC loop control range. Removal of the plug exposes a centre pin on which a rectified output of the 11.5 MHz signal is provided.

Feeding the 11.5 MHz modulated oscillator back through the discriminator also provides side tone in TRANSMIT to provide a rough check that the set is operational in TRANSMIT. To minimise noise leak in conditions close to an enemy and avoid the risk of acoustic feedback the side tone volume is limited and pre-set. In RECEIVE the 11.5 MHz oscillator is switched off and isolated by a diode switch.



The low level buffered, modulated 11.5 MHz output from Module 8 is mixed with the crystal oscillator signal in a balanced diode mixer (Module 7) to produce the transmitter frequency. Unwanted mixing products are attenuated by a filter at the mixer output. In Module 9 (the RF head) the transmitter signal is amplified in an AFY45 RF pre-amplifier stage, followed by a 2N2222A RF driver stage prior to the final 2N2951 RF PA. A variable antenna loading inductor is ganged to the 5 gang variable capacitor.

Channel Crystals

One of the sets was crystallized for 47.000, 49.000, 49.400, 50.200, 51.000 and 51.800 MHz. The second had only 5 crystals fitted. These were for 48.000, 48.200, 49.000, 49.400 and 51.200 MHz. The crystals are type CR-31/U, series resonant and, as stated above, crystal frequency is signal frequency less 11.500 MHz.

The British WS 88 and SR A40/C/PRC-26 VHF/FM squad radios both had A and B versions. Each version always had the same frequencies. It does not seem that this was the case with the Portuguese TR-PP-11s. The two sets inspected had the common frequencies of 49.000 and 49.400 MHz possibly common inter squad frequencies. The TR-PP-11 is designed so that all its 200 channels are available with the appropriate crystals so, on present evidence, it is difficult to predict what crystals will be found in a given set. One of the two radios had a label on the inside of the battery compartment cover with a hand written list of channel and crystal frequencies.

Power Supplies

There was an option to operate the TR-PP-11 from a NiCd battery, French type AA-58/A, 15 volts 0.8 AH. This battery is the same size as the PS.28.A but has about half its capacity. It includes diodes as temperature sensors for charge control.

12 off NiCd cells connected in series give a battery voltage of $12 \times 1.25 = 15$ Volt

TR-PP-11B TRANSMIT current is $3000/15 = 200$ mA
TR-PP-11B RECEIVE current is $350/15 = 23.3$ mA

The average current on a 9:1 RECEIVE:TRANSMIT regime is:

$$200/10 + (23.3 \times 9)/10 = 20 + 21 \text{ mA} = 41 \text{ mA}$$

The above battery should, therefore, give a life of just under 20 hours/charge. 0.8Ahr NiCd cells, surplus from early generation cellphones, provided a test battery for the set.

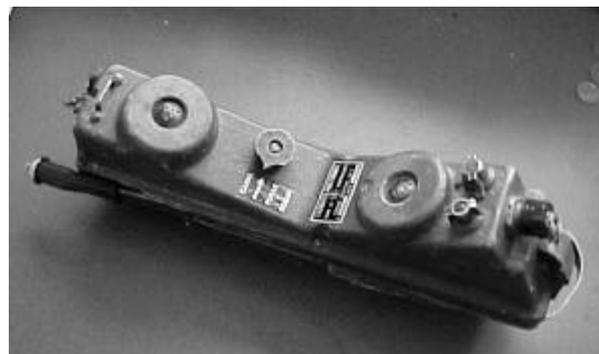
Conclusions

The TR-PP-11 is a strong, well made set. RF screening is thorough. The designers have made creative use of semiconductor diodes for T/R switching and device protection. The set is a substantial step forward compared with the TR-PP-8-A. Valve filament ageing and microphony are designed out; the operator's portage load is reduced, range and battery life are increased and battery technology is standard and cheap.

References

'TR-PP-11/TR-PP-13 et versions dérivées'
Thomson-CSF commercial publication.

MAT 6329 EX TRS 2707 'Manuel de Reparations de Poste Radio de Section TR-PP-11-B', Avril 1971



View of TR-PP11