

## 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](http://www.radiosurplus.it)