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HOW THE TATMADAW TALKS: THE BURMESE ARMY'S RADIO SYSTEMS

Desmond Ball

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Professor Ball is the author or editor of more than 40 books or monographs on technical intelligence subjects, nuclear strategy, Australian defence and security in the Asia-Pacific region. His latest publication is entitled *The Boys in Black: The Thahan Phran (Rangers), Thailand's Para-military Border Guards*. Other recent publications include *Burma's Military Secrets: Signals Intelligence (SIGINT) from the Second World War to Civil War and Cyber Warfare*; *Signals Intelligence in the Post-Cold War Era: Developments in the Asia-Pacific Region*; *Presumptive Engagement: Australia's Asia-Pacific Security Policy in the 1990s* (with Pauline Kerr); *Breaking the Codes: Australia's KGB Network, 1944-50* (with David Horner); and *Death in Balibo, Lies in Canberra* (with Hamish McDonald). He has also written articles on issues such as the strategic culture in the Asia-Pacific region and defence acquisition programs in the region.

Professor Ball was elected a Fellow of the Academy of Social Sciences of Australia (FASSA) in 1986. He served on the Council of the International Institute for Strategic Studies (IISS) in 1994-2000, and was Co-chair of the Steering Committee of the Council for Security Cooperation in the Asia-Pacific (CSCAP) in 2000-2002.

Abstract

The *tatmadaw* currently uses eight different radio systems for communications within and between the successive echelons from the Ministry of Defence (formerly called the War Office) in Rangoon to the front-line units — the 12 Regional Commands, the Military Operation Commands (MOCs), the Tactical Operation Commands (TOCs), the Light Infantry Divisions (LIDs), the Battalions, Companies and Columns. This paper describes these various radio systems and their capabilities.

How the Tatmadaw Talks: The Burmese Army's Radio Systems

Desmond Ball

Introduction

The *tatmadaw* currently uses eight different radio systems for communications within and between the successive echelons from the Ministry of Defence (formerly called the War Office) in Rangoon to the front-line units — the 12 Regional Commands, the Military Operation Commands (MOCs), the Tactical Operation Commands (TOCs), the Light Infantry Divisions (LIDs), the Battalions, Companies and Columns. These are the TRA-906, obtained from the UK in the 1960s and 1970s; the PRM-4051, acquired in the 1980s; two versions of the XD-D6M, produced by the Shaanxi Fenghou Group Company in Baoji, and supplied to the *tatmadaw* in 1993-94; the SC-120 and SC-130, which entered service around 1997, and which are mainly used for communications between Rangoon and the Regional Commands; and ICOM 2GXAT VHF walkie-talkies and IC-2100 VHF transceivers for front-line communications (including between *tatmadaw* and DKBA units). Military Intelligence (MI) units also use Kenwood FM radio sets, although in areas where service is available (eg, around Myawaddy), they are increasingly using mobile cell phones. In addition, in 1997 the *tatmadaw* introduced the LA-97 scrambler system, which has been extensively used with the PRM-4051 sets and is now being employed fairly comprehensively.

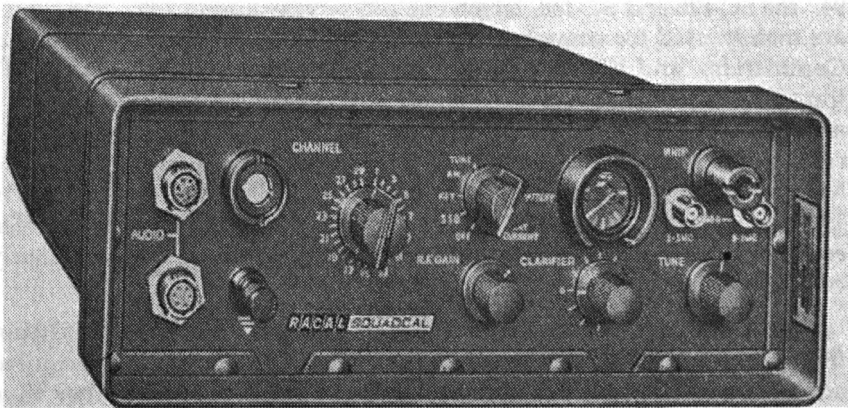
The Burmese Army acquired numerous different sorts of radio systems, from many countries, during the 1950s to the 1980s. Most were acquired according to the political and commercial opportunities rather than operational requirements, although technical and operational simplicity were common features. Most came from the UK, such as Redifon No. 53 and Redifon G251, Pye FM-8702, WS-62, HF-15B, HF-15G, TRA 309 and TRA 906 HF radio transceivers. The WS-62 was still being used at the Battalion level, and the TRA 309, together with the newer TRA 906 Squadcal, at the Company level, in the 1980s.¹ Several systems came from the US, including the AN/PRC-6, AN/PRC-9 and AN/PRC-10 transceivers, the last two of which remained in service in the 1980s.² Other transceivers were obtained from Yugoslavia, the Soviet Union, West Germany and Japan.³

The TRA 906 Squadcal HF SSB manpack transceiver

The TRA 906 Squadcal HF SSB manpack transceiver, produced by Racal-Tacticom Limited in Reading, Berkshire, in the 1960s and 1970s, is the oldest of the radio systems in service with the *tatmadaw*, and is still the basic system used at the Company level. The version produced by the Burma Army in Rangoon is called the *Thura*. It provides HF transmission and reception in the 2 to 7 MHz frequency range, with 29 crystal-controlled channels available within this range. It has an output of 5 watts, and is designed primarily for SSB (single side-band) operation. It weighs 10.7 kg and is completely sealed, dustproof and waterproof, and performs reliably 'under the most severe environmental and operational conditions'.⁴ It does not operate with a scrambler.

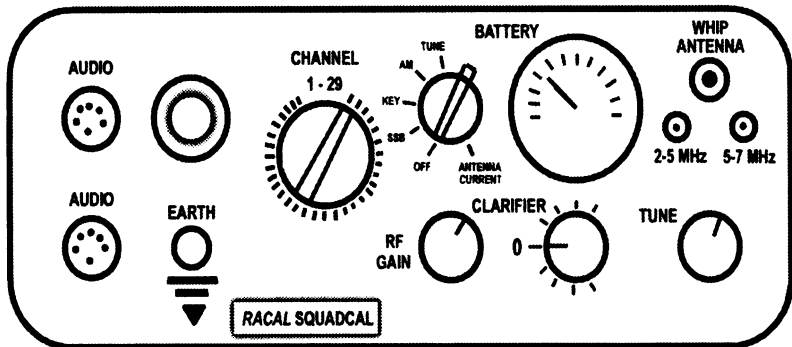
Figure 1

TRA 906 Squadcal HF SSB manpack transceiver



Source: R.J. Raggett (ed.), *Jane's Military Communications, 1979-80*, (Jane's Publishing Company, London, 1st edition, 1979), p.39.

Figure 2
Schematic of the TRA 906 Squadcal HF SSB transceiver



The TRA 906 is the primary Company-level radio, used for communication between Companies, to and from Companies and Battalions, and to and from Companies and Columns.

The operational features of the TRA 906 have been described and assessed as follows:

[The TRA-906 is a] very low end radio. Introduced in the 1960s, the Squadcal (TRA-906) would seem to have been directed towards the most inexperienced of operators. [It is] similar in concept to the Southcom SC-120, but even more basic than that radio.

[The Squadcal] units are crystal controlled, 2 to 7 MHz, AM, CW, USB on 29 channels, with a single crystal per channel. The case is injection moulded plastic, with a battery compartment for three 6-volt lantern [torch] batteries. All circuitry is on a single PC board. Construction quality is about the same as found on mid-1970s marine radios, [with] glass-epoxy PC board, [and] no plug-ins. There are no sealed modules or exotic integrated circuits. [It is] definitely a bargain-basement type of radio design, but not flimsy.

[In addition to the batteries], power can also be supplied by optional equipment from AC mains or a DC vehicle source. Features and controls include a built-in antenna tuner for use of a top-mounted whip antenna, [and] 50 ohm output connections; a Clarifier control for fine-tuning SSR or CW pitch; and an RF gain control.

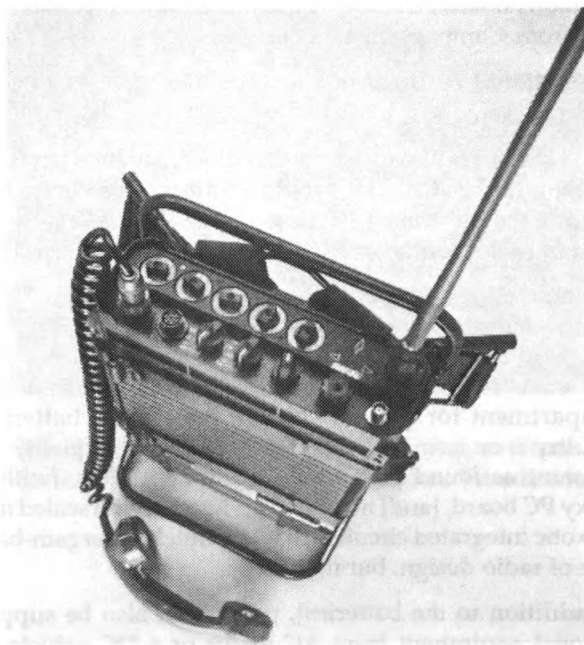
For a radio set of the 60s-70s, the Squadcal would offer some features that would appeal to the purchaser of equipment for a poor or backward country. These would include its simple operation and construction. The discrete component, single board design would allow for a minimum of logistics problems, and simple servicing, similar to a CB radio. However, a more skilled technician would be required and field servicing would be impossible.⁵

The PRM 4051 Squadcal 2 HF manpack transceiver

The PRM 4051 Squadcal 2 HF manpack transceiver was produced by Racal-Tacticom Limited in the late 1970s and the 1980s, and superseded

Figure 3

PRM 4051 Squadcal 2 HF manpack transceiver

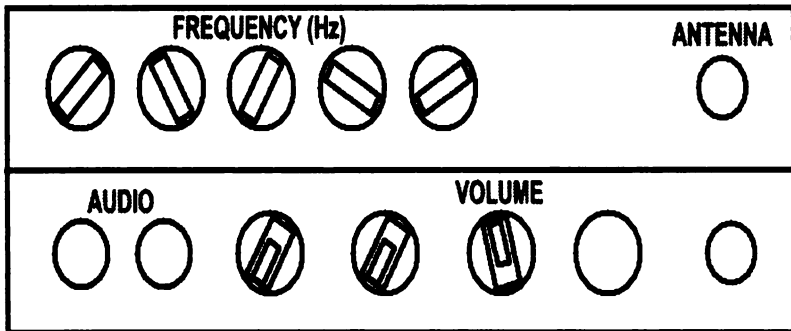


Source: R.J. Raggett (ed.), *Jane's Military Communications 1987*, (Jane's Publishing Company, London, 8th edition, 1987), p.83.

the TRA 906 design. It weighs 7.5 kg, and measures 75mm by 230mm by 253mm. It has a frequency range from 2 to 12 MHz instead of the 29 crystal-controlled channels, and a micro-electronic synthesizer which permits 100 Hz frequency steps equivalent to 100,000 channels. The operational mode has been extended from SSB to include USB, LSB and CW. The power output is 5 watts, and a collapsible whip antenna is used.⁶

The PRM 4051 is used by the *tatmadaw* at the Regional Command, LID, MOC and TOC levels, as well as to and from these to the Battalions. It is used with the LA-97 scrambler.

Figure 4
Schematic of PRM 4051 HF transceiver

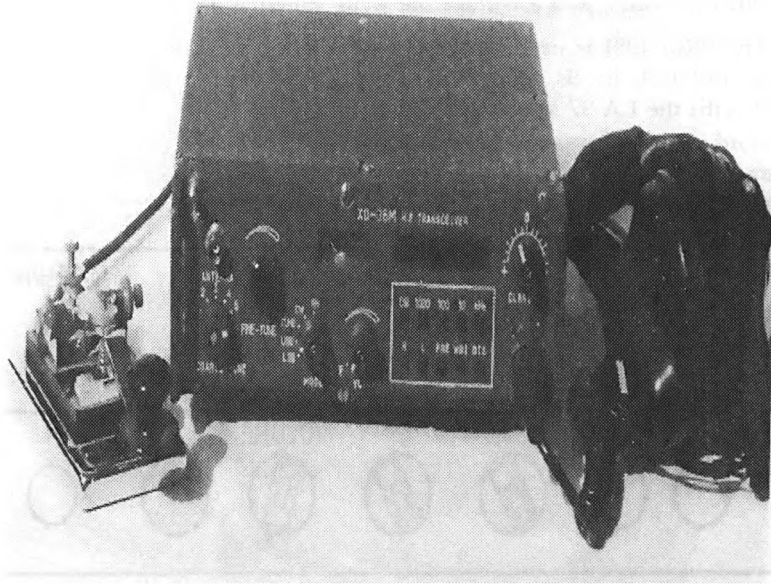


The XD-D6M and XD-D6M1 HF transceivers

The XD-D6M and XD-D6M1 HF transceivers weigh 4 kg and have a power output of 4 watts, and can operate in SSB, LSB, USB, AM (voice) and CW telegraph modes. It can use either a 2.4 metre whip antenna, a 12 metre slant antenna, a 44 metre dipole or a 2.4 metre steel-skin antenna.⁷ The XD-D6M has 24 channels in the 3 to 7.999 MHz frequency range. The XD-D6M1 has 29 channels in the 1.5 to 30 MHz band, though the *tatmadaw* uses only five channels (ie, 3, 4, 5, 6 and 7).

The XD-D6M radios were acquired by the *tatmadaw* from China in 1993-94 and first used operationally at Manerplaw in December 1994. They are used at nearly all levels, including the Defence Ministry (War Office), Divisions, Regional Commands, MOCs and TOCs, Battalions, and Companies and Columns.

Figure 5
XD-D6M HF transceiver

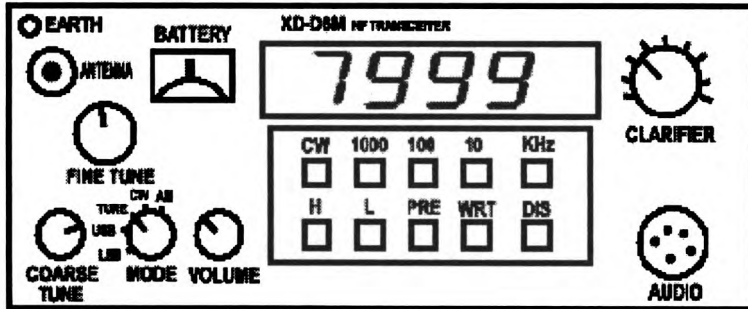


Source: John Williamson (ed.), *Jane's Military Communications*, 1996-97, (Jane's Information Group, Coulsdon, Surrey, 17th edition 1996), p.13.

The XD-D6M is used at Company level, for communications with both Columns and the Battalion HQ.

The XD-D6M1 is used for communications between the Battalions and the higher commands – the TOCs, Regional Commands and LIDs. It is used with the LA-97 scrambler. Both the Battalion commander and the deputy commander have access to these (ie, two sets per battalion).

Figure 6
Schematic of XD-D6M transceiver



The SC-120 and SC-130

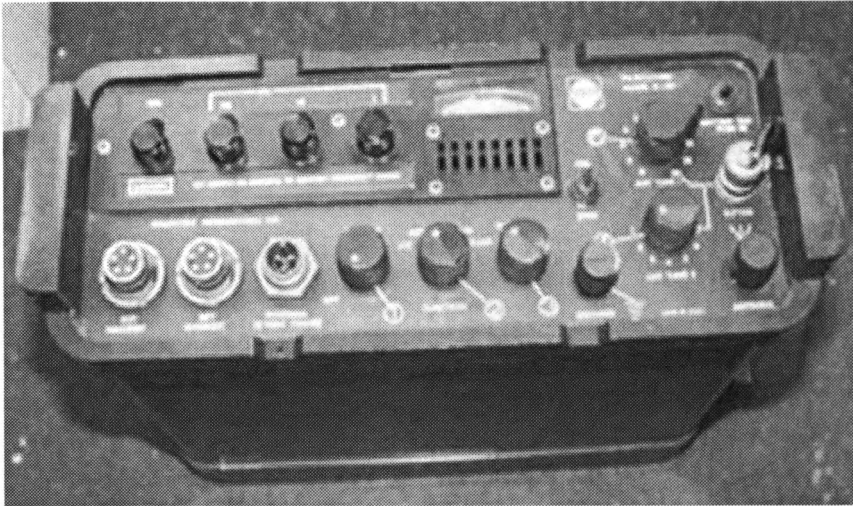
The SC-120 and SC-130 HF transceivers were acquired from Israel and entered service in about 1997. They are used for scrambled communications between the Defence Ministry in Rangoon and the HQs of the 12 Regional Commands and the Light Infantry Divisions (LIDs).

The SC-120s and SC-130s were originally produced by Southcom International in California in the 1960s and 1970s, and were extensively used by numerous defence forces, including those of South Korea, Indonesia and Israel.

The SC-120 is similar in many basic technical and operational respects to the TRA 906 Squadcal transceiver, except for incorporation of the scrambler capability. It operates on 23 channels in the 2-10 MHz range, with a power output of 10-20 watts, and operates in USB, LSB, CW and AME modes.⁸

The SC-130 system was originally produced in about 1978. It operates at 1 kHz spacings across the 2-12 MHz range, in LSB, USB, CW and AME modes, and with a power output of 5-20 watts.⁹

Figure 7
SC-130 HF transceiver



Source: 'The Southcom SC-130 and SC-200A', <http://www.home.sprintmail.com/~kcf5ijd/SC-120.SC200A.htm>.

The ICOM 2GXAT and IC-2100 VHF FM transceivers

The ICOM VHF radios are fairly commonplace, with many different models in use. They are not official *tatmadaw* issue, but are produced in China and are bought by individual battalion and company commanders through contacts in northeastern Burma. They were originally used to listen into the local communications of the resistance groups, but they are now more broadly used for field communications between battalions and their companies. They are also used for communication between small active units (eg, the Baw Bee Dohn) and their Strategic Commanders in the field. Hand-held types are used in the field, but battalion base stations also have desk-top versions with which to communicate with their companies or their assigned special small units.

Figure 8
DKBA officer with ICOM 2GXAT VHF radio, Kho Kho



Each *tatmadaw* Company and Column has at least one ICOM 2GXAT set. They are also widely used by the DKBA, both for communications with *tatmadaw* units and for communications between the DKBA units themselves. (The DKBA officer shown with the ICOM 2GXAT in Figure 8 is from the Special Security Battalion of 999 Brigade, based at Kho Kho, about 14 km northwest of Myawaddy).

The ICOM 2GXAT hand-held VHF FM transceiver is small (57mm by 125mm by 35mm), weighs only 366 grams, has a relatively high power (7 watts), and is easy to operate. It transmits and receives in the 144-148 MHz band. A call channel and 40 memory channels store all required repeater information independently. There are five DTMF [Dual-tone Multi-frequency] memory channels and a DTMF re-dial function for autopatching. (The retail price is US\$297.00).¹⁰

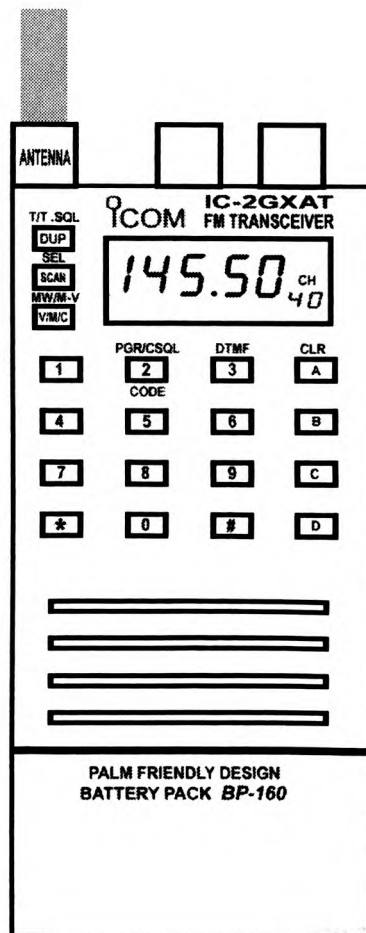
Figure 9

ICOM 2GXAT VHF radio



Figure 10

Schematic of the ICOM 2GXAT VHF radio



Some *tatmadaw* and DKBA units also use ICOM IC-2100 mobile VHF FM radio transceivers. (A DKBA soldier from Battalion 907 based at Phalu, about 15 km southeast of Myawaddy, surrendered to the KNLA with an IC-2100 set on 17 February 2004.) The IC-2100 measures 140mm by 180mm by 40mm and weighs 1.2kg, and is noted for its rugged design, easy-to-read alphanumeric display, and relatively long range (150-200 km). It transmits in the 144-148 MHz range, with three selectable power outputs (5, 10 and 55 watts), and receives in the 136-174 MHz range. It has 113 memory channels. A hand-held DTMF microphone with a full set of buttons enables easy vehicular use. (They cost around US\$140.00).¹¹ Two reported weaknesses are that it malfunctions at low voltages (below about 12.7 VDC) and when used at high power (55 watts) in high temperatures for extensive periods.¹²

Figure 11
ICOM IC-2100 VHF transceiver



Source: 'IC-2100H', at <http://www.qsl.net/sm7vhs/radio/icom/ic2100/ic2100.htm>.

Figure 12
ICOM IC-2100 VHF transceiver



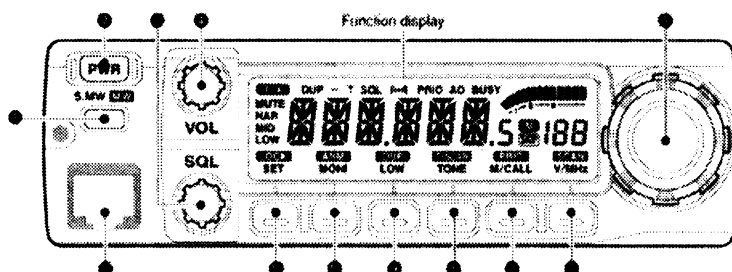
Source: 'ICOM IC-2100T', at http://www.geocities.com/joker_ykr/2100.html.

Figure 13
Microphone on ICOM IC-2100 VHF transceiver



Source: 'ICOM IC-2100T', at http://www.geocities.com/joker_ykr/2100.html.

Figure 14
Schematic of ICOM IC-2100 VHF transceiver



● **SELECT MEMORY/MEMORY WRITE SWITCH [S.MW(MW)]**

- Selects a memory channel for programming
- Programs selected memory when pushed and held

● **POWER SWITCH [PWR]**

- Turns power ON and OFF when pushed momentarily

● **SQUELCH CONTROL [SQL]**

- Varies the squelch level
- The RF attenuator activates and increases the attenuation when rotated clockwise to the center position and further

● **VOLUME CONTROL [VOL]**

- Adjusts the audio level.

● **TUNING DIAL**

- Selects the operating frequency, the memory channel, the contents of the set mode display and the scanning direction

● **VFO/MHz SWITCH [V/MHz(SCAN)]**

- Selects and toggles VFO mode and the 1 MHz/10 MHz/TS tuning display
- Starts a scan when pushed and held for 1 sec.

● **MEMORY/CALL CHANNEL SWITCH [M/CALL(PRI)]**

- Selects and toggles memory mode or the call channel
- Activates the priority watch function when pushed and held

● **TONE/TONE SCAN SWITCH [TONE(T-SCAN)]**

- Each push selects a tone function.
- Tone encoder, pocket beep, tone squelch or tone function OFF can be selected.
- Push and hold to start/stop the tone scan function.

● **OUTPUT POWER/DUPLEX SWITCH [LOW(DUP)]**

- Each push changes the output power selection.
- There are 3 output powers available: low, mid and high (the IC-2100-T Thailand and IC-2100H Taiwan versions have only 2 output powers).
- Push and hold to select a duplex setting.
- There are 3 duplex settings available: minus duplex ("DUP-" appears), plus duplex ("DUP" appears) and simplex (no indicator appears)

● **MONITOR/ALPHANUMERIC SWITCH [MON/ALPH]**

- Toggles squelch opened and closed when pushed.
- In memory and call channel mode, toggles the alphanumeric channel indication ON and OFF.

● **SET/LOCK SWITCH [SET(LOCK)]**

- Selects set mode when pushed.
- Toggles the lock function ON and OFF when pushed and held.

● **MICROPHONE CONNECTOR**

- Connects the supplied microphone

Source: Universal Radio Inc., 'Amateur Radio Transceivers: ICOM 2100H 25N Controls', at http://www.universal-radio.com/catalog/fm_txvrs/2100frt.jpg.

The LA-97 scrambler

The LA-97 (sometimes also referred to as the V-97) voice scrambler is a handset which can be used with both radio and radio-telephone systems. It is produced by the *tatmadaw*, based on the LA-54 scramblers acquired from South Africa in 1992-93, with nearly half the parts being acquired from Singapore. It weighs only 300 grams, and measures 5 inches by 5 inches by 6 inches.

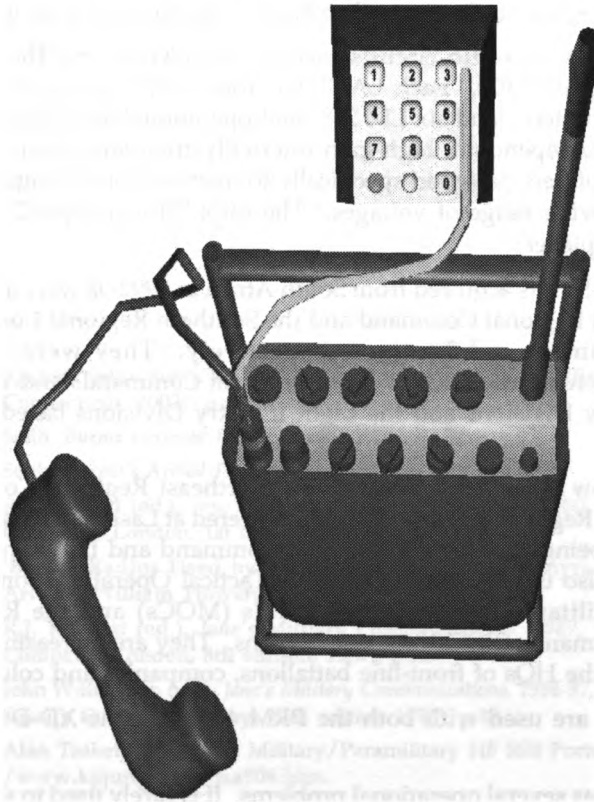
Production of the LA-97 sets began in 1997-98. The sets are made by the Engineering Corps in Rangoon; they reportedly cost about 200,000 kyats each to produce in 2000. An Army-controlled purchasing company is used to buy both the domestically-produced components and the parts acquired from Singapore. The sets are tested by the No. 2 Communications Factory in Mingaladon; this includes quality control checks on the circuit boards. They are then transferred into service through the No. 1 Communications Maintenance Company in Indaing.

The *tatmadaw* plans to acquire some 2,075 to 2,188 LA-97s, although this could take many years. Only 273 sets were produced in the first five years.

1997-1998	50
1998-1999	25
1999-2000	98
2000-2001	50
<u>2001-2002</u>	<u>50</u>
Total	<u>273</u>

According to the plans, the Ministry of Defence is to have 15 sets, including five for communications with forward and front-line units; the 12 Regional Commands are to have 925 sets; the TOC and MOC HQs are each to have six sets; the Battalion and Company HQs are each to have five sets, while each Battalion and Company 'on patrol' is to have one set; the LIDs are to have at least 461 sets (with 922 reckoned to be needed); and the Reserve forces are to have 199 sets.

Figure 15
PRM 4051 HF transceiver with LA-97 scrambler



The LA-97 sets consist of 39 parts, 21 of which are produced in Burma and 18 acquired from Singapore. The latter include the microprocessor; code/decode IC; EPROM IC; random access memory (RAM); the 74HCT 00, 74HCT 04, 74HCT 365, 74HCT 573, 74HCT 4040, 8211, 7660, 7665, LM 358, LM 741 and MC 4053 ICs; and the 8.192 MHz TCXO crystal clock.

The EPROM [Electrically Programmable Read-Only Memory] IC provides the operating system for the microprocessor. The 74HCT series of CMOS logic packages support the logic operations of the microprocessor in various respects. The 74HCT 365 IC is a hex buffer/line driver system used to control outputs from the microprocessor and the multiplexer (including the program for controlling the scrambling sequences). The 74HCT 573 IC

is an Octal D-type transparent latch circuit which provides input and output ports for the microprocessor. It consists of eight D-type input latches with 3-state outputs. The 74HCT 4040 IC is a 12-stage binary ripple counter, which probably provides the timing from the clock for the microprocessor.

The LM series of audio circuits include the LM358 and the LM741 operational amplifier ICs. Each LA-97 has four LM741 general purpose operational amplifiers; and six LM 358 dual operational amplifiers, which consist of two independent, high-gain internally frequency-compensated operational amplifiers designed specifically to operate from a single power supply over a wide range of voltages. The MC4053 is a triple 2-channel analogue multiplexer.

The first LA-54 sets acquired from South Africa in 1992-93 were allocated to the Southeast Regional Command and the Southern Regional Command, based at Moulmein and Taungoo respectively. They were used to communicate between the HQs of these Regional Commands and the HQs of their Infantry Divisions and the Light Infantry Divisions based within their Regions.

They are now also widely used in the Northeast Regional Command and the Eastern Regional Command, headquartered at Lashio and Taunggyi. In addition to being used by the Regional Command and Divisional HQs, they are now also used by the HQs of the Tactical Operation Commands (TOCs), the Military Operation Commands (MOCs) and the Regional Operation Commands (ROCs) in these Regions. They are increasingly also being used by the HQs of front-line battalions, companies and columns.

The LA-97s are used with both the PRM 4051 and the XD-D6M1 HF transceivers.

The LA-97 has several operational problems. It is rarely used to scramble telegraphy, presumably because the link with the handset has to be disconnected and connected to the telegraph plug. More importantly, it requires strong power, which requires both access to electricity generators and frequent re-charging of the batteries, which, in turn, tends to cause the sets to overheat. In practice, this has limited usage of the system to bases with diesel power generators, although solar plates are now also being used. The battery-charging and overheating problems severely limit the time schedules for transmissions – sometimes to only a few hours a day. Because relatively few front-line units have so far had access to these sets, communications security is often compromised through re-transmission of messages to these units in the clear.

Acknowledgment

The author would like to thank Michael Malloy, who produced the schematic renderings of the TRA-906, PRM-4051, XD-D6M and ICOM 2GXAT transceivers and the PRM-4051 with the LA-97 scrambler, reproduced in this paper.

Notes

- ¹ Andrew Selth, *Burma's Armed Forces: Power Without Glory*, (East Bridge, Norwalk, Connecticut, 2002), p.63.
- ² Selth, *Burma's Armed Forces: Power Without Glory*, p.63.
- ³ Selth, *Burma's Armed Forces: Power Without Glory*, p.63.
- ⁴ R.J. Raggett (ed.), *Jane's Military Communications*, 1979-80, (Jane's Publishing Company, London, 1st edition, 1979), p.39.
- ⁵ 'British Radios Used by Iraqis', at http://www.armyradio.com/publish/Articles/William_Howard_Desert_Storm/Britain.htm.
- ⁶ R.J. Raggett (ed.), *Jane's Military Communications*, 1987, (Jane's Publishing Company, London, 8th edition, 1987), p.83.
- ⁷ John Williamson (ed.), *Jane's Military Communications*, 1996-97, (Jane's Information Group, Coulsdon, Surrey, 17th edition 1996), p.13.
- ⁸ Alan Tasker, 'TRA-906: Military/Paramilitary HF SSB Portable Radios', http://www.kpjung.de/e_tra906.htm.
- ⁹ 'The Southcom SC-130 and SC-200A', <http://www.home.sprintmail.com/~kcf5ijd/SC-120.SC200A.htm>; and Alan Tasker, 'TRA-906: Military/Paramilitary HF SSB Portable Radios', http://www.kpjung.de/e_tra906.htm.
- ¹⁰ Universal Radio Inc., 'Amateur Handheld Transceivers: ICOM 2GXAT Specifications', at <http://www.universal-radio.com/catalog/ht/3536spec.html>.
- ¹¹ Universal Radio Inc., 'Amateur Mobile Transceivers: ICOM 2100H 25N Specifications', at http://www.universal-radio.com/catalog/fm_txvrs/2100.html; and 'Reviews Summary for ICOM IC-2100H', at <http://www.eham.net/reviews/detail/222>.
- ¹² Ian Johnston, KC7RYN, 'A Brief Review of the IC-2100 Mobile 2m Transceiver', at <http://222.muppetlabs.com/~reaper/ham/ic-2100h.html>.

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