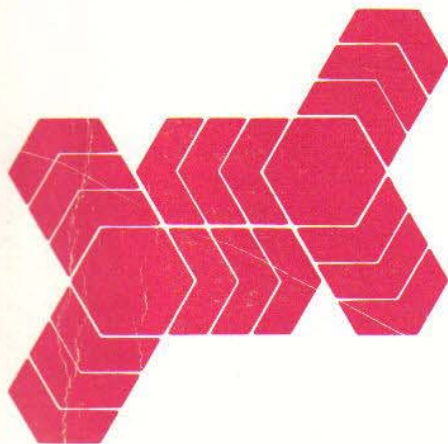




DYNA T.A.C.™
Cellular Portable Telephone
Model F09DTD8824AN



Instruction Manual

68P81046E60-O

COMMERCIAL WARRANTY (STANDARD)

Motorola radio communications products are warranted to be free from defects in material and workmanship for a period of ONE (1) YEAR, (except for crystals and channel elements which are warranted for a period of ten (10) years) from the date of shipment. Parts, including crystals and channel elements, will be replaced free of charge for the full warranty period but the labor to replace defective parts will only be provided for One Hundred-Twenty (120) days from the date of shipment. Thereafter purchaser must pay for the labor involved in repairing the product or replacing the parts at the prevailing rates together with any transportation charges to or from the place where warranty service is provided. This express warranty is extended by Motorola Communications and Electronics, Inc., 1301 E. Algonquin Road, Schaumburg, Illinois 60196, to the original purchaser only, and only to those purchasing for purpose of leasing or solely for commercial, industrial, or governmental use.

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This warranty is void if:

- a. the product is used in other than its normal and customary manner;
- b. the product has been subject to misuse, accident, neglect or damage;
- c. unauthorized alterations or repairs have been made, or unapproved parts used in the equipment.

This warranty extends only to individual products, batteries are excluded, but carry their own separate limited warranty. Because each radio system is unique, Motorola disclaims liability for range, coverage, or operation of the system as a whole under this warranty except by a separate written agreement signed by an officer of Motorola.

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In order to obtain performance of this warranty, purchaser must contact its Motorola salesperson or Motorola at the address first above shown, attention Quality Assurance Department.

This warranty applies only within the United States.

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DYNA T•A•C CELLULAR PORTABLE TELEPHONE

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 TORX is a trademark of Camcar Division of Textron, Inc.

FOREWORD

1. SCOPE OF MANUAL

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by Instruction Manual Revisions (SMR). These SMR's are added to the manuals as the engineering changes are incorporated into the equipment.

2. MODEL AND KIT IDENTIFICATION

Motorola equipments are specifically identified by an overall model number on the nameplate. In most cases, assemblies and kits which make up the equipment also have kit model numbers stamped on them. When a production or engineering change is incorporated, the applicable schematic diagrams are updated.

3. SERVICE

Motorola's National Service Organization offers one of the finest nation-wide installation and

maintenance programs available to communication equipment users. This organization includes approximately 900 authorized Motorola Service Stations (MSS) located throughout the United States, each manned by one or more trained, FCC licensed technicians.

These MSS's are independently owned and operated and were selected by Motorola to service its customers. Motorola maintenance is available on either a time and material basis or on a periodic fixed-fee type arrangement.

The administrative staff of this organization consists of national, area and district service managers and district representatives, all of whom are Motorola employees with the objective to improve the service to our customers.

Should you wish to purchase a service contract for your Motorola equipment, contact your Motorola Service Representative, or write to:

National Service Manager
Motorola Communications and Electronics, Inc.
1303 E. Algonquin Road
Schaumburg, Illinois 60196

REPLACEMENT PARTS ORDERING

ORDERING INFORMATION

Motorola maintains a number of parts offices strategically-located throughout the United States. These facilities are staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Communications Sector products.

Orders for all parts *except* crystals, active filters, channel elements, and "Vibrasender"® and "Vibrasponder"® resonant reeds should be sent to the nearest area parts center. Orders for instruction manuals should also be sent to the area parts center.

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the

chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

Orders for crystals, channel elements, active filters, and reeds should be sent to the Component Product Sales & Service address listed below. Crystal and channel element orders should specify the crystal or channel element type number, crystal and carrier frequency, and the chassis model number in which the part is used.

Orders for active filters, *Vibrasender* and *Vibrasponder* resonant reeds should specify type number and frequency, should identify the owner/operator of the communications system in which these items are to be used; and should include any serial numbers stamped on the components being replaced.

COMPONENT PRODUCT SALES & SERVICE OFFICE

All Mail Orders
Motorola, Inc.
Component Product Sales & Service
P.O. Box 66191, O'Hare International Airport
Chicago, IL 60666

Correspondence
Motorola, Inc.
Component Product Sales & Service
2553 N. Edgington Street, Franklin Park, IL 60131
Tel: 312-451-1297, TWX: 910-227-0799, Telex: 433-0067

AREA PARTS OFFICES

Western Area Parts
1170 Chess Drive, Foster City, CA 94404
Tel: 415-349-8621, TWX: 910-375-3877

Pacific-Southwestern Area Parts
P.O. Box 85036, San Diego, CA 92138
Street Address:
9980 Carroll Canyon Road, San Diego, CA 92131
Tel: 619-578-8030, TWX: 910-335-1516

Gulf States Area Parts
P.O. Box 73115, 1140 Cypress Station, Houston, TX 77090
Tel: 713-537-3636, TWX: 910-881-6392

Southwestern Area Parts
P.O. Box 34290, 3320 Belt Line Road, Dallas, TX 75234
Tel: 214-620-8511, TWX: 910-860-5505

Midwest Area Parts
1313 E. Algonquin Rd., Schaumburg, IL 60196
Tel: 312-576-7430, TWX: 910-693-0869

Southeastern Area Parts
P.O. Box 368, Decatur, GA 30031
Street Address:
5096 Panola Industrial Blvd., Decatur, GA 30032
Tel: 404-987-2232, TWX: 810-766-0876

Rocky Mountain Area Parts
20 Inverness Place East, Englewood, CO 80122
Tel: 303-790-2323, TWX: 910-935-0785

East Central Area Parts
12955 Snow Road, Parma, OH 44130
Tel: 216-433-1560, TWX: 810-427-9424

Eastern Area Parts
85 Harristown Road, Glen Rock, NJ 07452
Tel: 201-447-4000, TWX: 710-988-5614

Mid-Atlantic Area Parts
7230 Parkway Drive, Hanover, MD 21076
Tel: 301-796-8763, TWX: 710-862-1941

National Accounts
Railroad, Airlines, and Telephone Sales
1313 E. Algonquin Rd., Schaumburg, IL 60196
Tel: 312-576-6512, TWX: 910-693-0869

All Canadian Orders
Motorola, Ltd., National Parts Department
3125 Steeles, Ave. E., Willowdale, Ontario M2H 2H6
Tel: 416-499-1441, TWX: 610-491-1032,
Telex: 06-526258

National Data Services

1171 West 17th Street, Tempe, AZ 85281
Tel: 602-994-6472, TWX: 910-951-1334

All Countries Except U.S. & Canada

Motorola, Inc., International Parts Department
1313 E. Algonquin Rd., Schaumburg, IL 60196, U.S.A.
Tel: 312-576-7241, TWX: 910-693-0869
Telex: 722443, Cable: MOTOL PARTS

PERFORMANCE SPECIFICATIONS

GENERAL

Frequency Range	825.030-844.980 MHz Tx 870.030-889.980 MHz Rx
Channel Spacing	30 kHz
Channels	666
Duplex Spacing	45 MHz
Frequency Stability	Reference oscillator maintains carrier within 2100 Hz of assigned center frequency (± 2.5 ppm) from -30° to $+60^{\circ}$ C ambient ($+20^{\circ}$ C ref)
Operation	$+6.0$ to $+9$ V dc
Battery Drain at 7.5 V dc	Standby: Less than 40 mA (nominal) Transmit: Less than 850 mA (nominal) Provides for ten 3-minute call transmit and 7.5 hour standby operation.
Dimensions	19.6 cm x 4.5 cm x 8.3 cm (7.7" x 1.8" x 3.3")
Size (Volume)	580 cubic cm (35.4 cubic in.)
Weight	Approximately 0.85 kg (30 oz.); includes battery and antenna
Temperature Range	-30° C to $+60^{\circ}$ C

TRANSMITTER

RF Power Output	0.6 Watts ± 2 dB
Output Impedance	50 ohms (nominal)
Spurious and Harmonic Emissions	Complies with TITLE 47, PART 22 of the Code of Federal Regulations
Audio Distortion — Electrical	Less than 5% at 1000 Hz; ± 8.0 kHz deviation
Audio Distortion — Microphone	Less than 5% @ 97 dB SPL input
Modulation	F3: ± 12 kHz for 100% at 1000 Hz
FM Noise (C-MSG, weighted)	32 dB below ± 8 kHz deviation at 1000 Hz
Audio Response — Electrical	6 dB/octave pre-emphasis
Audio Response Microphone and Preamp	Rising 3 dB/OCT, 300 Hz to 3000 Hz
Audio Sensitivity	± 2.9 kHz deviation (nominal) @ 97 dB SPL input @ 1000 Hz

RECEIVER

Alternate Channel Selectivity (SINAD)	-65 dB at ± 60 kHz
I-F Bandwidth	28 kHz min
12 dB SINAD (C-MSG weighted)	-116 dBm
Spurious & Image Rejection	Greater than 65 dB (Except 1/2 IF = 55 dB)
Spurious Conducted Emissions	Less than or equal to -60 dBm
IM (EIA 204C)	65 dB
RF Input Impedance	50 ohms (nominal)
Audio Distortion — Electrical	Less than 5% at 1000 Hz, ± 8 kHz deviation
Audio Response	6 dB/octave de-emphasis
Audio Distortion — Earpiece	Less than 5% @ 99 dB SPL output
Audio Sensitivity	99 dB SPL (nominal) @ 1000 Hz, ± 2.9 kHz deviation, max volume

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE
FCC DESIGNATION ABZ89FT5620

CAUTION

Do not jump start vehicle or use an automotive battery charger while the vehicle adapter option and the portable radiotelephone are connected to the vehicle electrical system as this may cause serious damage to the radio. Disconnect the radio by removing the cable kit fuses.

Model Chart
For
Model F09DTD8824AN
DYNA T•A•C Cellular Portable Radiotelephone

Model	Description
TAF6100A	Antenna
TLN2616A	Interconnect Board and Keyboard in Housings
TNN6000A	Battery; 7.5 V dc @ 800 mAh
TPN6157A	AC Trickle Charger
TRN5806A	Carrying Case

TLN2616A Interconnect Board and Keyboard Model Breakdown

Model	Description
THN6522A	Housing and Hardware
TLN2617A	Keyboard Display
includes:	includes:
THN6521A	Housing and Hardware
TRN5807A	Keyboard and Display Circuit Board
TLN2618A	Interconnect Board and Modules
includes:	includes:
TFN6048A or TFN6050A	45 MHz Filter Module
TLF6591A	Power Amplifier Module
TRN5834A	Isolator Module
TRN5836A	ID Module
TRN5838A	Flex-Strip
TRN5839A	Circuit Board
TRN5840A	Mixer Duplexer Module
TRN9123A	Reference Oscillator
TRN5808A	Logic Unit Module
TRN5823A	Receive Audio Module
TRN5824A	Transmit Audio Module
TRN5825A	DC Control Module
TRN5826A	Supervisory Audio Tones (SAT) Module
TRN5827A	Voltage Controlled Oscillator (VCO) Module
TRN5828A	Phase-Locked Loop (PLL) Module
TRN5829A	Receive Multiplier Module
TRN5830A	Phase Modulator Module
TRN5831A	I-F Module
TRN5832A	RF Amplifier Module
TRN5833A	Mixer Module
TRN5835A	Automatic Output Control (AOC) Module
TRN5837A	Antenna Duplexer Module
TRN5841A	Transmit Multiplier Module
TRN5937A	Interconnect Board Hardware Kit

DYNA T•A•C Cellular Portable Radiotelephone Options Chart

Model	Description
TLN2690A	AC Fast Charger
TLN2688A	Vehicle Adapter — Front Mount
TLN2689A	Vehicle Adapter — Rear Mount



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GENERAL SAFETY INFORMATION

The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic energy safety standard which applies to the use of this equipment. Proper use of this radio will result in exposure below the OSHA limit. The following precautions are recommended:

Portable Operation:

DO NOT hold the radio such that the antenna is very close to, or touching, exposed parts of the body, especially the face or eyes, while transmitting. The radio will perform best if it is held in the same manner as you would hold a telephone handset, and with the antenna angled up and over your shoulder. Speak directly into the microphone.

DO NOT allow children to play with any radio equipment containing a transmitter.

Mobile Operation (Vehicle Adapter):

DO NOT operate the transmitter of a mobile radio when someone outside the vehicle is within two feet (0.6 meter) of the antenna.

DO NOT operate the transmitter of any radio unless all cables and connectors are secure and any open connectors are properly terminated.

In addition,

DO NOT operate a portable/mobile transmitter near electrical blasting caps or in an explosive atmosphere unless it is a type especially qualified for such use. Portable and Mobile Radio Stations are under certain conditions, capable of interfering with blasting operations. When you are in the vicinity of construction work, look for and observe signs cautioning against radio transmission. If transmission is prohibited you *must* lock your portable/mobile telephone to prevent *any* transmission. *The radiotelephone equipment will automatically transmit to acknowledge a call if it is not locked.*

All equipment must be properly grounded according to Motorola installation instructions for safe operation.

All equipment should be serviced only by a qualified technician.

Portable/Mobile Telephone Use and Driving:

For your own safety, we strongly recommend that the *driver* should not use the portable telephone while the vehicle is in motion. Stop the car in a safe location before answering or placing a call.

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technical writing services

1301 E. Algonquin Road, Schaumburg, IL 60196

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SAFETY INFORMATION FOR RADIOS INSTALLED IN VEHICLES POWERED BY LIQUEFIED PETROLEUM (LP) GAS

WARNING

It is mandatory that radio installations in vehicles fueled by liquefied petroleum gas conform to the following standard.

National Fire Protection Association standard NFPA 58 applies to radio installations in vehicles fueled by liquefied petroleum (LP) gas with the LP-gas container in the trunk or other sealed-off space within the interior of the vehicles. This standard requires that:

1. Any space containing radio equipment shall be isolated by a seal from the space in which the LP gas container and its fittings are located.
2. Remote (outside) filling connections shall be used.
3. Venting of the container space to the outside shall be provided.

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The batteries used in the operation of the portable telephone must be treated with the following precautions:

WARNING

The portable telephone battery pack may explode if disposed of in fire.

WARNING

The lithium battery used in the radio for memory retention must be treated with the following precaution:

- DO NOT short circuit the battery.
- DO NOT attempt to recharge the battery.
- DO NOT dispose of battery in fire or allow battery to get close to extreme heat.

Failure to observe these precautions could result in explosion of the battery and possible damage to equipment and/or personnel.



DYNA T•A•C CELLULAR PORTABLE TELEPHONE GENERAL DESCRIPTION

1. CELLULAR SYSTEM OVERVIEW

NOTE

The following description is intended only as a preliminary general introduction to cellular systems. This description is greatly simplified and does not illustrate the full operating capabilities, techniques, or technology involved in cell systems.

1.1 OVERALL CONCEPT

1.1.1 The cellular systems are used to provide radiotelephone service in the frequency range 825-890 MHz. A cell system provides higher call handling capacity and system availability than would be possible with conventional radiotelephone systems (those which require total system area coverage on every operating channel) by dividing the system coverage area into several adjoining sub-areas or cells.

1.1.2 Each cell contains a base station (cell site) which provides transmitting and receiving facilities on a certain set of duplex frequency pairs (channels). Since each cell is a relatively small area, both the cell site and the radiotelephone that it supports can operate at lower power levels than would be used in conventional systems. Using this technique, radiation on a given channel is virtually contained in the cell operating on that channel and, to some extent, those cells directly adjacent to that cell.

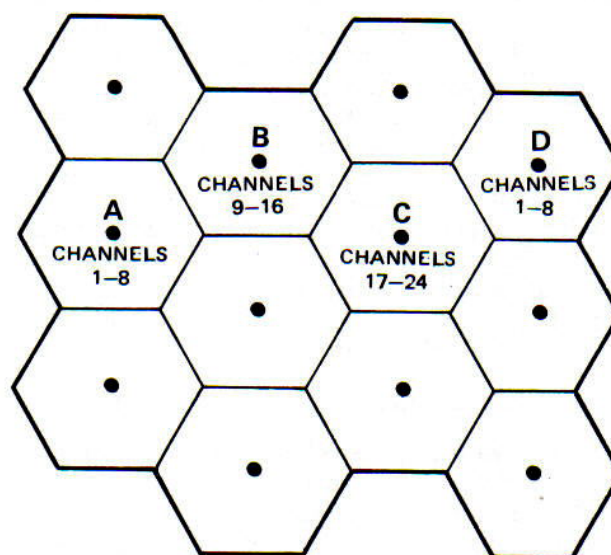
1.1.3 Since the coverage area of a cell on a given channel is limited to a small area (relative to the total system coverage area), a channel may be reused in another cell outside the coverage area of the first. By this means, several subscribers may operate within the same geographic area, without interference with each other, on a single channel.

1.2 OPERATION

1.2.1 Refer to Figure 1. In the figure, the area bounded by bold lines represents the total coverage area of a hypothetical system. This area is divided into several

cells, each containing a cell site (base station) operating on a given set of channels which interfaces radiotelephone subscribers to the telephone switching system. The radiotelephones themselves are capable of operation on any channel in the system, allowing them to operate in any cell. Due to the low power requirements for communications between radiotelephones in a particular cell and the cell site, operating channels may be repeated in cells which are outside the coverage area of each other.

TYPICAL CELL SYSTEM



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Figure 1. Hypothetical Cell System

1.2.2 For example, presume that cell A operates on channels arbitrarily numbered 1 through 8, cell B operates on channels 9 through 16, cell C operates on channels 17 through 24 and cell D operates on channels 1 through 8 (repeating the usage of those channels used by cell A). In this system, subscribers in cell A and subscribers in cell D could simultaneously operate on

channels 1 through 8 without interference, thus increasing the call-handling capability of the system without increasing the number of available channels.

1.2.3 In addition to signaling and voice communications, other telemetry such as channel selection information is passed between the cell site and radiotelephones within the cell. This telemetry enables the cell site to control the channel that an operating radiotelephone will use and also allow the radiotelephone to move from one cell to the next without an interruption in service.

1.2.4 When a radiotelephone is well within a cell, its signal strength to the cell site will be high. As the radiotelephone moves towards the edge of the cell, its signal strength decreases. Signal strength information provides an indication of the subscriber's distance. As the radiotelephone moves from cell to cell, it is informed to change channels to one of the operating channels in each new cell. This change is handled automatically by the radiotelephone and is completely transparent to the user.

1.2.5 For example, presume a radiotelephone initiates a call in cell A and then moves across the system area, through cells B and C to cell D. The call is initiated on channel 4. As the radiotelephone moves into cell B, it is instructed to change to channel 12 and then operates through the B cell site on that channel. A similar change is performed when the radiotelephone moves from cell B to cell C (e.g. from channel 12 to channel 22) and again when the radiotelephone moves from cell C to cell D (e.g. from channel 22 to channel 7). In this example, the radiotelephone has operated in four cells, through four cell sites, and on four channels without interruption in voice communications. Note that, as the radiotelephone leaves a cell, the channel on which the radiotelephone was operating is made available to another subscriber in that cell.

1.3 SERVICE AREA

1.3.1 The area within which calls can be placed and received is defined by the system operator. (Because this is a radio system, there is no exact boundary that can be drawn on a map.) If the portable is outside the radio service area, the **No Svc** (no service) message will appear and calls will be unable to be placed or received. If this happens during a conversation, the call will be lost.

1.3.2 There may also be small areas within a particular service area where communications may be lost. One area where it is very likely to lose the ability to place or receive calls would be in totally enclosed areas, such as underground parking garages, in buildings without windows and in elevators. This will be indicated either by the **No Svc** message illuminating, or by the sound of either a fast busy signal or a high-low siren signal when call placement is attempted.

1.3.3 General usage in buildings having reasonable glass area is usually quite good. However, it may be

necessary to move closer to a window to ensure reliable operation.

2. CELLULAR PORTABLE TELEPHONE DESCRIPTION

2.1 GENERAL

The *DYNA T•A•C* Cellular Portable Radiotelephone (shown in Figure 2) is a microprocessor controlled, full duplex, synthesized FM radiotelephone for use in compatible 800 MHz cellular radiotelephone systems. When operated properly, the equipment will provide the user with land-linked telephone service through individual cell site base stations, all linked to a central control office.



Figure 2. *DYNA T•A•C* Cellular Portable Telephone With Trickle Charger

2.2 PHYSICAL PACKAGING

2.2.1 The transceiver circuitry is contained in a water resistant polycarbonate plastic housing measuring (including battery pack) 19.6(H) × 4.5(W) × 8.3(D) centimeters (7.7 × 1.8 × 3.3 inches) and weighs approximately 0.8 kg (30 oz.) with battery pack and antenna attached. Internally generated heat is conducted to

the internal aluminum frame where it is distributed and dispersed around the perimeter of the radio.

2.2.2 All of the active transceiver circuits are hybrid integrated circuit modules which plug into the interconnect board having all interconnecting printed wiring. This arrangement allows the modules to be easily removed and replaced without disturbing any circuitry. All terminations of interconnecting leads on major components and printed wiring boards have connectors at one end including those connections from the interconnect board to the keyboard, antenna and battery as well as from the keyboard to the speaker, alert transducer and microphone. The interconnect board and modules are protected by an internal metal frame and an external plastic housing.

2.2.3 Access to the internal circuits is obtained by removing the battery and antenna to expose the various fasteners which hold the radio together. *There are no user serviceable components inside this radiotelephone. Service should be performed only by a qualified service technician.*

NOTE

It is possible to disassemble the radiotelephone using common tools, but it *cannot be reassembled without special equipment.*

2.2.4 The keypad, display and audio transducers provide the primary interface between the user and the **DYNA T•A•C** Portable Radiotelephone. The 21 keypad buttons are used to enter telephone numbers as well as control commands, including power on/off, volume, memory access, and electronic lock to prohibit unauthorized use. The keypad area is lighted after any button is pushed to aid readability under low light conditions. The LED numeric and message display provides keypad input feedback to the user and the four status indicators tell about operating conditions. The alert transducer, when enabled, emits a ringing tone, alerting the user of an incoming call. The microphone and speaker provide the functional means for telephone communications. The speaker also provides audible keypad feedback and a low battery warning.

2.2.5 The **DYNA T•A•C** battery pack is a 7.5 V, 800 mAh, nickel-cadmium power source which can provide up to 30 minutes of transmitting and 7-1/2 hours of standby operation before recharging. Recharging can be accomplished through desktop or in-vehicle chargers with the battery pack either attached to the portable telephone, or by itself. Physically, the battery pack is 19.7(H) × 4.1(W) × 1.7(D) centimeters (7.7 x 1.8 x 0.7 inches) and weighs 260 grams (9.2 ounces). The polycarbonate case of the battery pack provides superior impact resistance while the quick release latch holds it securely to the portable. Care should be taken not to expose the battery pack to temperatures greater than 85 °C

(185 °F) as the built-in thermal protection circuit will permanently disable the battery.

3. ELECTRICAL FEATURES AND CAPABILITIES

The following highlights detail several of the advanced design and construction techniques employed in the Motorola Cellular radiotelephone. These techniques contribute to the units' operational convenience as well as enhancing the reliability and serviceability of the unit.

• AUTOMATIC OPERATION

Several operations are handled automatically by the radio such as channel selection, transmit power output regulation, signaling, and MTX (mobile terminal exchange) registration updates.

• MICROCOMPUTER CONTROL

A single microcomputer controls major radio functions such as frequency selection and synthesis, keypad/transceiver interface, and signaling telemetry encoding/decoding.

• FULL DUPLEX OPERATION

A ceramic-resonator duplexer isolates the transmit and receive signal paths to provide full duplex operation over a single antenna.

• FULLY SYNTHESIZED

The transmit and receive injection frequencies are generated by a frequency synthesizer. The synthesizer is referenced to a temperature-compensated crystal oscillator to provide highly-stable output frequencies.

• BATTERY-PROTECTED RAM

A battery-protected RAM is used to store information such as the locked/unlocked condition of the radio and abbreviated-dialing numbers. The auxiliary battery backup allows the RAM to retain this information when the main battery pack is removed.

• ELECTRONIC LOCK

The radio can be locked electronically by the user to prohibit unauthorized use. When locked, the radio can be unlocked only by entering the electronic lock code.

• NUMBER ASSIGNMENT MODULE

The number assignment module (NAM) is an EEPROM (electrically erasable programmable read-only memory). This non-volatile memory is used to store fixed information for the radiotelephone such as the 3-digit lock code and the subscriber telephone number.

- **ADVANCED CIRCUIT DESIGN**

Extensive use has been made of MSI and LSI (medium and large-scale integration) integrated circuits to handle complex decision and control functions. This feature, as well as the use of "chip" components (ultra-small resistors and capacitors), microstrip lines, ceramic resonators, and micro-miniature construction techniques has contributed to the compact size, light weight, and high reliability of the unit.

- **CONVENIENT SERVICING**

Several features have been built into the unit to facilitate service produces. Some of these features are listed below.

- **Vehicle Adapter/Test Connector** — A 12-pin connector is provided under the battery pack. This connector provides access to several major test points without opening the radio.

- **Test Mode Operation** — A total of 39 commands can be entered via the keypad when connected to the R-2008C Test Set to manually control operation on the transceiver for testing.

- **Minimal Adjustments** — By virtue of microcomputer control and fixed-tuned circuitry, very few adjustments are required for proper alignment of the unit. Easy access to those adjustments is provided.

- **Easy Disassembly** — Connectors are provided on all lines between circuit assemblies and most modules are easily removed from the chassis for servicing.

- **Replacement/Rechargeable Battery Pack** — The rechargeable nickel-cadmium battery pack is easily removed and replaced without tools. Typical charging rates are 10 hours when using the trickle charger or one hour (or less) with the desk top charging unit.



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PORTABLE RADIOTELEPHONE OPERATING INSTRUCTIONS

1. INTRODUCTION

The following information provides an overview of the operation of the *DYNA T•A•C* Portable Telephone and some of its features. To obtain a more comprehensive understanding of its operation and features, refer to the *DYNA T•A•C* Portable Telephone User's Manual (68P81114E44). The information found in Figure 1 may be used as reference while learning the functions and features of the portable telephone.

2. TURNING THE UNIT ON

2.1 The unit is turned on by pressing the **Pwr** (power) button on the keypad. Pressing this button again will turn the unit off. Each time the portable is turned on, the power on indicator illuminates and seven "8's" and the three status messages briefly appear in the Dialed Number and Message Display. Also, a short audio tone will be heard.

2.2 If the unit is unlocked, the **No Svc** (no service) message will illuminate briefly while communication is established with the radiotelephone system. When the link is established, the **No Svc** message will extinguish and the green power on indicator will begin *blinking* to indicate that the unit is ready to place and receive calls.

NOTE

If the **No Svc** message remains on, the unit is out of range of the system and cannot operate.

2.3 If the unit is locked, the green power on indicator will illuminate *steadily* to indicate that the unit must be unlocked before it can be used. *If the unit is not unlocked, it will automatically turn itself off six seconds after the last key depression.*

3. TURNING THE UNIT OFF

There are two methods which may be used to turn the portable off. The first method is to simply depress the

Pwr button. This action turns the unit off immediately. The second method that is available is to depress the **Lock** button for 1/2 second, after which, the unit will turn itself off in six seconds (in the locked state). However, when the unit is turned on again, the specific 3-digit unlock (security) code will need to be entered.

4. ELECTRONIC LOCK

(Refer to Table 1.)

4.1 LOCKING THE UNIT

In order to prevent unauthorized calls from being placed or received on the portable telephone, the unit may be electronically locked by depressing the **Lock** button for 1/2 second (until the feedback tone is heard). The lock state is indicated by the steady illumination of the Power Indicator in the Dialed Number and Message Display while all other information in the display disappears. Once the lock state is initiated, the unit will turn itself off in six seconds.

4.2 UNLOCKING THE UNIT

The portable telephone can be unlocked by entering the specific 3-digit lock code after the unit has been turned on. This code must be entered in the proper sequence as a 3-digit group. If an error is made, the procedure can be reset by pressing the **Clr** (clear) button or by turning the unit off and back on, and then restarting the sequence.

4.3 AUTO-LOCK

The portable telephone can be programmed to always be in the locked state when power is turned on without having to operate the **Lock** button prior to every power off action. This mode may be programmed by operating the following key sequence:

Fcn + Lock + Sto

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PORTABLE RADIOTELEPHONE

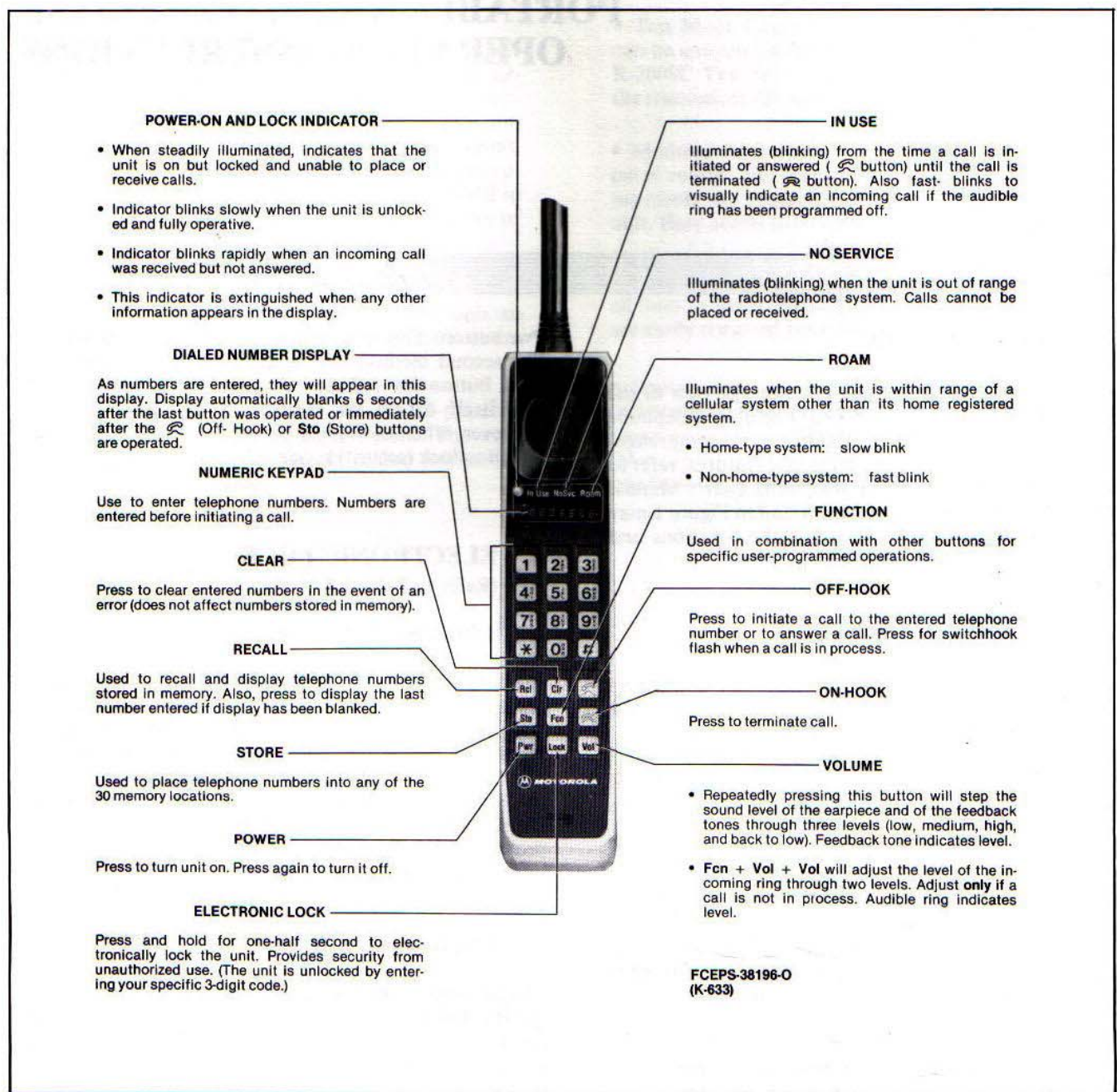


Figure 1. DYNA T•A•C Portable Operation Reference Diagram

The unit will now automatically lock every time it is turned off, until it is reprogrammed to return to the normal state by operating the following key sequence:

Fcn + Lock + Clr

Table 1. Summary of Electronic Lock Operation

Action Prior to Turning Power Off	Operational State When Power is Turned On
None	Unlocked
Press Lock Button	Locked
Fcn + Lock + Sto	Always Locked
Fcn + Lock + Clr	Determined by Lock button

5. BASIC OPERATING INSTRUCTIONS

5.1 DIALING/CALL PLACEMENT PROCEDURES

5.1.1 Placing a Call


Step 1. Turn the portable on and enter the telephone number.

Step 2. Press the **Off-Hook** button and bring the unit up to your ear. The **In Use** message will illuminate.

NOTE

Keypad illumination will go out approximately six seconds after the last button has been depressed.

Step 3. If call placement is successful, proceed with conversation.

Step 4. Press the  (On-Hook) button when conversation is completed. The **In Use** message will extinguish.

5.1.2 Reviewing Entered Telephone Numbers

Telephone numbers up to 24 digits in length may be entered from the keypad, although only the final seven digits are normally shown in the display. To review those digits not shown in the display, perform the following:

- To display the first through the seventh digit, press and hold the **Rcl** (recall) button. (The leading digits of a number which exceeds 7 digits.)
- To display the eighth through the fourteenth digit, release the **Rcl** button. (The latter 7-digits of the telephone number.)

Example —

Enter the number 1-312-397-1000. The display will contain 3971000. To review the entire eleven digit number:

Press and hold the Rcl button	<u>1312</u>
Release the Rcl button	<u>3971000</u>

5.1.3 Dialing Error

A mistake in dialing can only be corrected by depressing the **Clr** button and dialing the complete number again.

5.1.4 Unsuccessful Call Attempts

5.1.4.1 BUSY TONE RECEIVED

If a busy tone is received, press the On-Hook button. To redial (even after a wait time), press the Off-Hook to replace the call. (See Last Number Recall.)

5.1.4.2 RECORDED MESSAGES

Under certain conditions recorded messages may be received. These messages will be self explanatory and usually inform the user why a particular call cannot be completed.

5.1.4.3 REORDER (FAST BUSY) SIGNAL

If a call fails to go through, a *fast busy* signal may be received. This indicates that the telephone system did

not process the call, usually because the radiotelephone is in a poor service area. The call attempt should be terminated and tried again. (Press On-Hook, then Off-Hook.)

5.1.4.4 INTERCEPT (SIREN) SIGNAL

The reception of an alternating high and low *siren* signal indicates that *mistake has been made or that the portable telephone is in a "no service" area*. The call attempt should be terminated, check the **No Svc** indicator (should be extinguished), and the Dialed Number Display to see if the telephone number was dialed correctly.

NOTE

An intercept signal may be received if the portable telephone is restricted to placing calls to predetermined areas.

5.2 ANSWERING A CALL

5.2.1 To receive a call, the portable telephone must be turned on and unlocked, and the **No Svc** indicator must be extinguished. When the alerting signal sounds, depress the Off-Hook button and bring the unit up to your ear. The **In Use** message will illuminate.

5.2.2 If an incoming call goes unanswered, the alerting signal will stop, but, the power indicator will begin to *fast-blink*; indicating that a call to the portable was attempted.

5.3 MEMORY DIALING

5.3.1 **Last Number Recall**
(Replacing a call to the last number dialed.)

This memory feature retains the last telephone number entered into the Dialed Number Display. If a call is terminated after receiving a busy signal, or if the last number is to be re-called, just depress the Off-Hook button to re-initiate the call. To preview the telephone number before replacing the call, depressing the **Rcl** button will display the last number dialed.

5.3.2 Abbreviated Dialing

5.3.2.1 INTRODUCTION

This feature retains up to 30 frequently used telephone numbers. Each telephone number can be stored into a separate memory location (24-digits maximum) and may be recalled from that location and used to place a call. The stored telephone numbers are preserved even if the battery pack is removed from the unit. Numbers are stored in locations 01 through 30 by the user. Location 00 is used as a memory back-up for the last number dialed (stored every time the Off-Hook button is activated). However, all of the 31 memory locations may be recalled by the user.

5.3.2.2 LOADING THE ABBREVIATED DIALING MEMORY

Step 1. With the portable telephone turned on and unlocked, enter the desired telephone number.

Step 2. Momentarily depress the **Sto** (store) button.

Step 3. Enter the desired two-digit memory location (01 through 30). If there is already a number stored in a selected memory location, it will be deleted and the new number stored in its place.

NOTE

The two-digit memory location number must be entered within six seconds of pressing the **Sto** button to implement the store procedure.

Step 4. Repeat the procedure for each number to be stored.

5.3.2.3 REVIEWING STORED NUMBERS

To recall a number stored in the abbreviated dialing memory, press the **Rcl** button followed by the two-digit memory location number.

NOTE

For memory locations 00 through 09, a single digit (0 through 9) may be used instead of the two-digit entry. However, there will be a two second delay before the recalled number will appear in the display.

5.3.2.4 PLACING A CALL USING ABBREVIATED DIALING MEMORY

Step 1. With the portable telephone turned on and unlocked, depress the **Rcl** button.

Step 2. Enter the one- or two-digit memory location (00 through 30). The recalled telephone number will appear in the display.

Step 3. Press the Off-Hook button to process the call. The telephone number will disappear from the display and the green **In Use** message will illuminate.

5.3.3 Scratch Pad Memory

The scratch pad memory allows a new telephone number to be entered during a conversation. This convenience feature eliminates the need for pencil and paper when given a telephone number during a conversation with another party. To use this feature, enter the number via the keypad. The number will automatically be copied into memory thus allowing a call to be placed to that number by pressing the Off-Hook button. The number could also be stored into one of the Abbreviated Dialing memory locations if desired.

NOTE

The party at the opposite end of the call should be advised that *Touch Tone*® signaling will be heard through the earpiece as each of the numbers are placed into the scratch pad memory.

6. USER PROGRAMMING INSTRUCTIONS

6.1 EARPIECE VOLUME

Repeated pressing of the **Vol** (Volume) button will step the sound level of the earpiece audio and of the feedback tones through three levels (low, medium, high and back to low). If a call is in progress, pressing the **Fcn** button followed by repeated pressing of the **Vol** button will also reset these levels.

NOTE

The feedback tones from the **Vol** button will not be heard if a call is in progress.

6.2 RING-TONE VOLUME

The volume level of the ring-tone alerting signal can be set to one of two levels when a call is *not in progress*. By pressing the **Fcn** button, followed by repeated pressing of the **Vol** button, the ring-tone can be stepped between the two levels. A ring burst at the actual level will be heard for as long as the **Vol** button is held down.

NOTE

This feature resets after six seconds of key depression.

6.3 DISABLE RING-TONE

6.3.1 The audible ring-tone can be disabled by entering the following pushbutton sequence:

Fcn + 1 + Sto

To enable the ring-tone, enter:

Fcn + 1 + Clr

6.3.2 To compensate for the lack of an audible alert, the **In Use** message will blink fast to signal an incoming call when the audible ring-tone is programmed off.

6.4 DISABLE FEEDBACK TONE

The audible feedback tone can be disabled by entering the following pushbutton sequence:

Fcn + 2 + Sto

To enable the feedback tone, enter:

Fcn + 2 + Clr

6.5 VOICE OPERATED TRANSMISSION (VOX)

VOX operation is a battery saving feature that allows the transmitter to operate only during conversation. To actuate the VOX mode, enter the following pushbutton sequence:

Fcn + 0 + Sto

To disable the VOX mode, enter:

Fcn + 0 + Clr

7. SELECTABLE SYSTEM REGISTRATION

7.1 The selectable system registration feature of the **DYNA T•A•C** Portable Telephone allows the user to

change the roam characteristics of the unit. Normally the portable telephone will roam into the same type of system as its home system of registration. However, with the ability of being able to change this characteristic, the unit can be made to roam to a specific system other than its own.

7.2 To change the roam characteristic of the unit, enter the following sequence:

Rcl + * * * . . . + Sto

As each of the *'s are entered, a digit will be displayed corresponding to the roam state (as shown in Table 2). When the desired roam state is achieved, pressing the **Sto** button will program that state into the unit. When programming the Single System Roam (6) characteristic, the System I.D. (SID) of the specific system must be entered into the unit after the digit "6" appears in the display and must be followed by pressing the **Sto** button.

Table 2.
Roam Characteristics of the **DYNA T•A•C**
Portable Telephone

Roam State	Display	Description
Normal	1	Roams to same type of system as its home registered system.
Invert Preference	2	Automatically roams to a non-home type system. <i>SCAN H, SCAN H</i>
Home Only	3	Unit never roams.
"Scan A"	4	Roams only to RCC non-wireline systems
"Scan B"	5	Roams only to wireline operated systems.
Single System Roam	6	Selects the specific system to roam to.

MOBILE
^
STD A b or STD, bA
SCAN bA or SCAN AB
HOME
SCAN A
SCAN B
ENTER (SID)



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INSTALLATION

1. INTRODUCTION

1.1 The following information concerns the preparation of the portable telephone for initial operation, not necessarily the installation of the unit in a particular location. Because the portable telephone is intended for portable personal operation, "fixed" installation of the unit is not required. Optional accessories, however, are available for those who wish to operate the portable telephone in a vehicle operating with extended range. Vehicular installation procedures are provided in the instruction manual for these options. Contact a Motorola representative for more information on this and other options available for the portable telephone.

1.2 Preparation of the portable telephone includes the programming of the assigned telephone number and the initial charging of the nickel-cadmium battery pack. These procedures are outlined in the following paragraphs. After preparing the portable telephone, ensure that the unit is operational by making several test calls.

NOTE

Refer to the Operating Instructions section of this manual for operating procedures.

2. TELEPHONE NUMBER PROGRAMMING

The assigned portable telephone number and other data are programmed electronically by the service/installation personnel. The actual programming entails programming the NAM EEPROM (p/o the ID module) with the proper information using a Motorola Model R-1801 Digital Analyzer/Controller (includes the reader/programmer capability) equipped with applicable adapter module and application package (includes instruction manual). Refer to the manual supplied with the R-1801 for the procedure for programming the telephone number.

3. BATTERY CHARGING

The portable telephone is equipped with a rechargeable nickel-cadmium battery pack, which should be charged at the full charging rate before placing the unit into service. Complete battery care and charging information are located in section 68P81049E56 of this manual.

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MOTOROLA INC. DYNA T•A•C PORTABLE TELEPHONE Communications Sector

RECHARGEABLE BATTERY PACK

MODEL TNN6000A

1. INTRODUCTION

1.1 The TNN6000A Battery Pack, shown in Figure 1, is a 7.5V, 800 mAh, nickel-cadmium power source capable of 30 minutes of transmitting and 7.5 hours of standby operation before recharging. Recharging can be accomplished through desktop or in-vehicle chargers with the battery pack either attached to the portable telephone, or by itself.

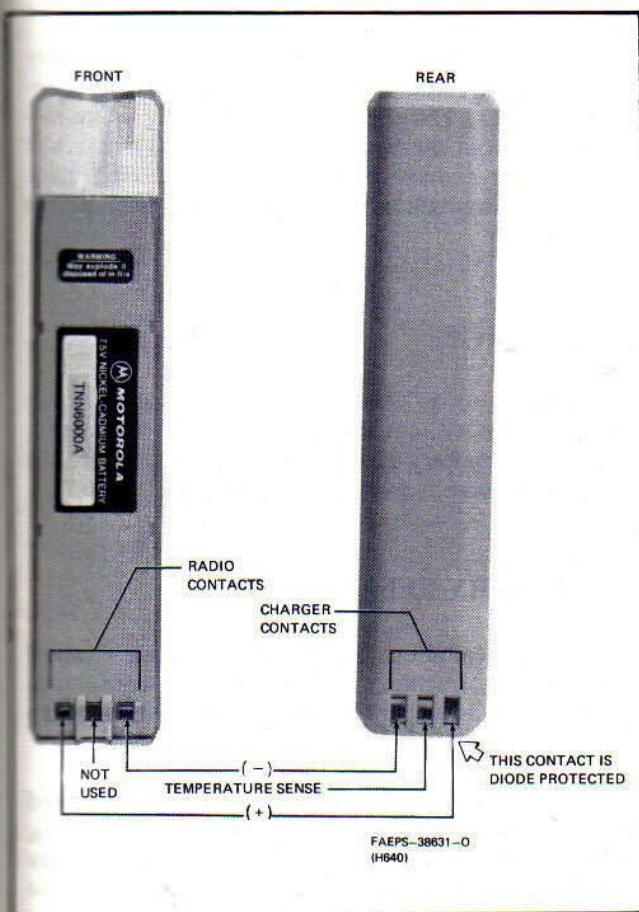


Figure 1. TNN6000A Battery Pack

1.2 Physically, the battery pack is 19.7(H) × 4.1(W) × 1.7(D) centimeters (7.7 × 1.8 × 0.7 inches) and weighs 260 grams (9.2 ounces). The polycarbonate case of the battery pack provides superior impact resistance while the quick release latch holds it securely to the portable telephone.

2. BATTERY OPERATION

The rechargeable nickel-cadmium battery pack will provide approximately 8 hours of normal operation between charges. Normal operation assumes ten 3-minute telephone calls with the unit operating standby — unit on but not engaged in telephone calls—the rest of the time. VOX operation (described in section 68P81049E49 of this manual) will approximately double the number of 3-minute calls (assuming 1-1/2 minutes talking and 1-1/2 minutes listening).

3. CHARACTERISTICS

3.1 The nickel-cadmium battery pack consists of 6 cells connected in series to provide a nominal 7.5 V dc output. A device internal to the battery pack provides thermal protection.

CAUTION

When the battery pack is removed from the portable unit *do not* allow the battery terminals to become shorted together (e.g., a paper clip placed accidentally across the battery contacts). Sustained high rate discharges permanently damages the battery, voids the battery warranty, and may create a burn or fire hazard.

3.2 The voltage of a nickel-cadmium battery remains approximately constant under load until the battery approaches the discharged condition. At this time, a marked decrease in the voltage occurs and the discharged condition (1.0 V per cell) is reached abruptly. Metering to determine the state of charge in this type of battery is difficult and is not normally performed.

DYNA TAC RECHARGEABLE BATTERY

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3.3 A general characteristic of all rechargeable batteries in storage is self discharge. If the battery is used after unknown periods of storage, it is recommended that it be charged at the full charging rate using an approved battery charger.

WARNING

Battery may explode if disposed of in fire.

4. BATTERY CHARGING

4.1 TRICKLE CHARGING

The TPN6157A AC Charger supplied with the portable telephone will recharge the battery pack in approximately 10 hours. A yellow LED indicator on the charger base is illuminated during the charging cycle. To recharge the portable telephone battery, place the entire unit or just the battery pack into the cup of the charger base (see Figure 2.).

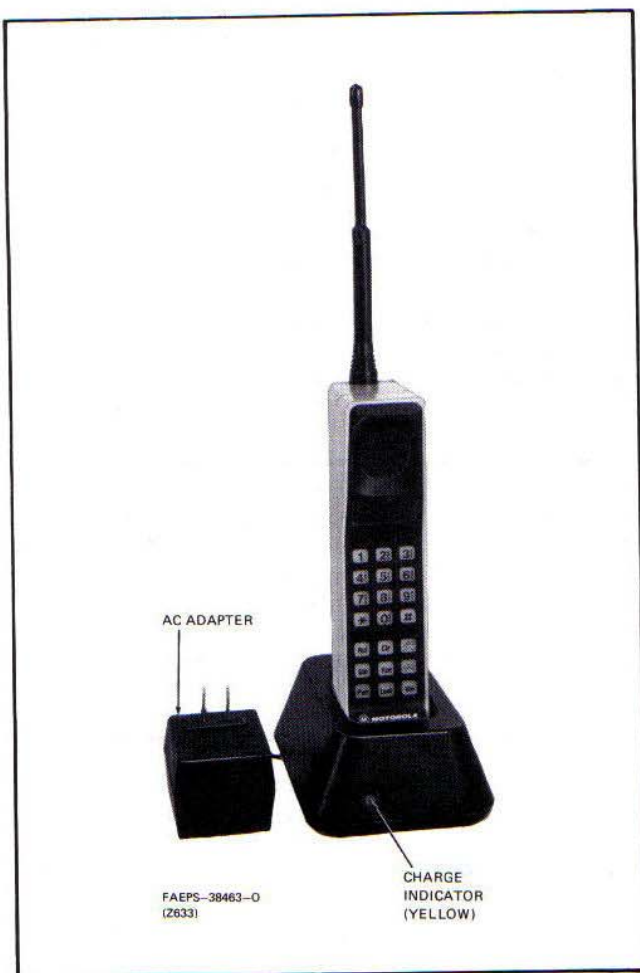


Figure 2. Portable Telephone Placed in Trickle Charger Base

4.2 ONE-HOUR CHARGING

The optional TLN2690A AC Fast Charger may be used to recharge the portable telephone battery pack in 1-hour or less. A red LED indicator illuminates during the charging cycle. A green LED indicator illuminates when the charging cycle is complete. To recharge the portable telephone battery, place the entire unit or just the battery pack into the cup of the desk top unit.

4.3 CHARGING TEMPERATURE

Battery charging should occur with the battery pack at about 77°F (room temperature) whenever possible. Charging a cold battery (below 45°F) may result in leakage of electrolyte, and ultimately, in failure of the battery. Charging a hot battery (above 95°F) results in reduced discharge capacity, affecting the performance of the portable telephone. The Motorola recommended rapid-rate battery chargers contain a temperature sensing circuit to ensure the battery is charged within these temperature limits.

5. BATTERY MAINTENANCE

The only maintenance required is recharging the battery and keeping the contacts clean. Use only a Motorola approved charger. The use of other chargers, unless approved, will void the battery guarantee and may result in permanent damage to the battery and the radio. Follow the charging instructions which accompany each charger.

6. STORAGE

Battery packs may be stored at room temperature in any state of charge without damage. As previously stated, however, the battery is subject to self discharge and should be recharged after extended storage.

7. MEMORY EFFECT

7.1 A nickel-cadmium battery may exhibit a reduced charge capacity (memory effect) caused by continuous overcharge for long periods or repetitive shallow cycling.

7.2 If the battery pack is lightly or infrequently used and is allowed to charge over a long period (30-60 days), it may develop memory effect. That is, the voltage may be sufficiently lowered on the first discharging cycle to reduce the effectiveness of radio transmission.

7.3 A more common type of memory effect is induced by uniform shallow cycling. For example, if the battery is operated so that it repeatedly delivers 50% of its full capacity, it can temporarily become inactive, and when

current demand is increased, it may show a sharp decrease in its ability to deliver proper terminal voltage.

7.4 If the battery is exhibiting memory effect, memory

can be easily eliminated by completely discharging the battery (deep discharge), and recharging again. One or two deep discharge cycles are usually sufficient to restore the battery to full capacity.