MOTOROLA

DIGITAL VOICE PROTECTION (DVP™)

Code Inserter

Models T3010BX and T3010AX

Instruction Manual

68P81060E35-C

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.

THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED WHICH ARE SPECIFICALLY EXCLUDED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL MOTOROLA BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES TO THE FULL EXTENT SUCH MAY BE DISCLAIMED BY LAW.

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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.

Non-Motorola manufactured products are excluded from this warranty, but subject to the warranty provided by their manufacturers, a copy of which will be supplied to you on specific written request.

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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MOTOROLA INC.
Communications Sector

DIGITAL VOICE PROTECTION *(DVP)* CODE INSERTER)

MODELS T3010BX
AND T3010AX

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1301 E. Algonquin Road, Schaumburg, IL 60196

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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 throug out the United States, each manned by one or mo trained, FCC licensed technicians.

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

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

Should you wish to purchase a service contract for yo Motorola equipment, contact your Motorola Servi 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., North York, 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

Power Supply	7.5 V Battery (rechargeable Nickel Cadmium)	
Number of Keys	2.36 x 10^{21} orthogonal (unique) key variables	
Key Storage	Stores up to 8 keys in volatile electronic memory	
Key Loading Method	Manual operator entry via keypad	
Key Transfer Method	Via temporary patch cord connection to *DVP* radio	
Display	8 digit, 7 segment LED display monitors operational status and provides review of manually entered keys prior to transfer into non-recallable memory	
	Size	Weight
Key Inserter only	5.76" (146.3mm)	11.5 oz. (326g)
Key Inserter with Battery		
Light Capacity	7.23" (183.6mm)	16.7 oz. (473g)
Medium Capacity	7.59" (192.8mm)	19.3 oz. (547g)
High Capacity	9.31" (236.5mm)	25.3 oz. (717g)
Ultra-High Capacity	10.21" (259.3mm)	34.0 oz. (965g)
Average No. of Key Insert Operations*		
Medium Capacity Battery	200	
High Capacity Battery	350	

Assumes one manual programming operation plus 30 seconds "on" time per key insertion.

MODEL COMPLEMENT TABLE FOR MODEL T3010AX DIGITAL VOICE PROTECTION CODE INSERTER

Item	Description
NLN8834C	Battery
TKN8209A	Portable Cable
TKN8210A	*Micor* Cable
TKN8229A	*SYNTOR* Cable
TLN2437A	*DVP* Inserter
NLN7314A	Back Cover
TRN4834A	Interface Board
TRN4835A	CPU Board
TRN4839A	Cover Front
TRN4934A	Hardware Kit
TRN4974A	Read Only Memory (ROM)
TRN6777B	Vulcan Hybrid
TLN2379A	Flex Kit and Frame
TRN4837A	Flex Kit
TRN4838A	Frame Kit
TRN5000A	Frame Hardware
TRN5300A	*DVP* Label

MODEL COMPLEMENT TABLE FOR MODEL T3010BX DIGITAL VOICE PROTECTION CODE INSERTER

Item	Description
NLN8834C	Battery
NLN7314A	Back Cover
TLN2437B	*DVP* Inserter
TRN4834A	Interface Board
TRN4835A	CPU Board
TRN4839A	Cover Front
TRN4934A	Hardware Kit
TRN4974A	Read Only Memory (ROM)
TRN6777B	Vulcan Hybrid
TLN2379A	Flex Kit and Frame
TRN4837A	Flex Kit
TRN4838A	Frame Kit
TRN5000A	Frame Hardware
TRN5300A	*DVP* Label

OPTION TABLE FOR MODEL T3010BX KEY VARIABLE LOADER CABLE KITS

Item	Description
TKN8209B	MX Cable
TKN8210B	*Micor* Cable
TKN8229B	*SYNTOR* Cable
TKN8351A	Expo Cable

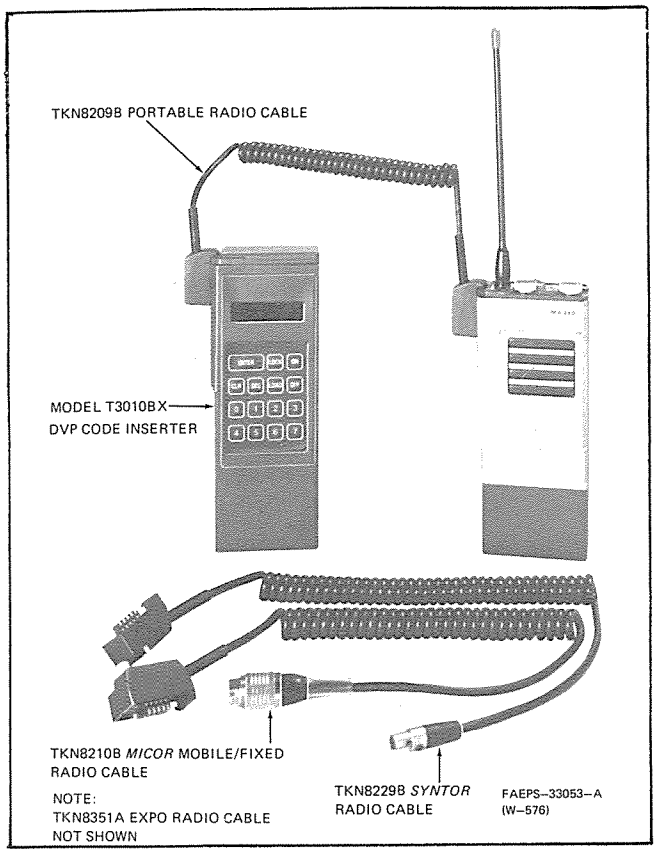


Figure 1. DVP Code Inserter Connected to Portable Radio

1. DESCRIPTION

1.1 INTRODUCTION

The Motorola Models T3010AX and T3010BX Digital Voice Protection (*DVP*) Code Inserters are hand held electronic coding devices used to encode *DVP* equipped radios. The operator manually programs the selected key into the code inserter through an 8-digit keypad on the inserter. Pressing the PUSH-TO-TRANSFER switch on the inserter causes the key to be transferred to the radio, via a cable, as shown in Figure 1.

1.2 PHYSICAL AND ELECTRICAL CHARACTERISTICS

1.2.1 The code inserter is a slim hand held unit constructed of high impact polycarbonate plastic. It is designed for field use. Its weight and size are determined by the battery selected. See performance specifications in this manual for exact size and weight. The loader uses standard *MX300* series portable batteries, chargers, and leather carrying cases. (See Figure 2.)

1.2.2 The Motorola MC6802 microprocessor based circuitry is powered by a nominal 7.5 V battery. The microprocessor contains 128 bytes of "on board" RAM for temporary variable storage during program execution; external 256 x 4 RAM is used for storage of key variables and locks. Any of the possible 2.36×10^{21} keys can be chosen by the user. The 4K x 8 ROM contains the operational program which controls the electronics of the code inserter.

1.2.3 To conserve battery power, the code inserter "times out" and shuts itself off if no usage occurs within 30 seconds in the radio coding mode and 1.5 minutes in the loader entry mode. Prior to "timing out" or powering down, the inserter emits a warning tone to alert the user. CMOS memory circuits are still provided power, and their content is not altered.

1.2.4 When exchanging batteries, the code inserter will retain all previously stored information; the memory circuits remain unchanged for at least 30 seconds.

1.3 COMPONENT PARTS

1.3.1 The Code Inserter consists of three main parts: 1) electronics unit, 2) battery pack, and 3) interface cables. The electronics unit is divided into the CPU circuit board, interface circuit board, flex circuit, frame, and case.

1.3.2 The CPU circuit board includes a Motorola MC6802 microprocessor, random access memory (RAM), read only memory (ROM), and a peripheral interface adapter (PIA). A unique inserter program is permanently stored in the ROM. The PIA interfaces the CPU circuit board to the keypad, display, encrypt hybrid, and external radio.

1.3.3 The interface circuit board contains the circuitry for the power regulator, low battery detect circuit, data output display and driver, and data entry keypad.

1.3.4 The flex circuit and frame kit contain the press-to-transfer switch and cable connector for transfer of *DVP* keys to a radio.

1.4 FUNCTION

1.4.1 The code inserter functions by accepting a selected key, storing the key, and upon command, transferring the key to program the radio. The operator chooses a key and manually enters it into the inserter through the keypad. Keys are loaded one at a time, up to a maximum of eight. The key can be reviewed before entering it into the memory circuitry. For security purposes, the key cannot be recalled once entered into memory.

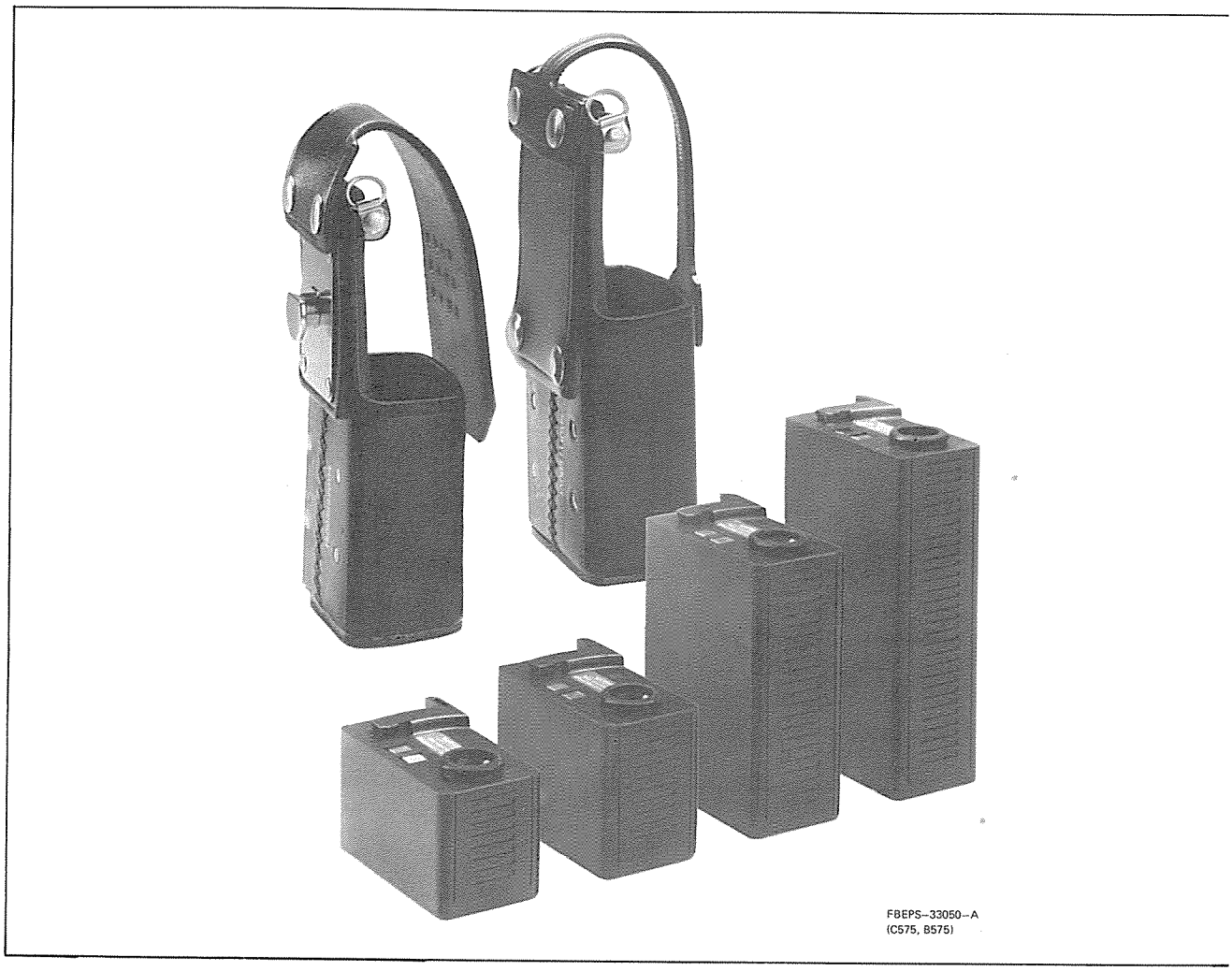


Figure 2. MX300 Series Portable Radio Batteries and Leather Carrying Cases

1.4.2 When a radio is to be programmed with a *DVP* key stored in the inserter, the operator presses a switch on the side of the inserter. The key is transferred to the radio through an interconnecting cable. An audio signal, originating from the inserter and heard through the radio's speaker, verifies that the transfer was made. When the code inserter is turned off and at a later time turned on, it will be ready to transfer the previously entered key.

1.4.3 As a feature, the keypad can be electronically locked. A combination code is loaded into memory. The keypad then becomes inoperable until the proper sequence is followed to "unlock" the keypad. See the Operating Instructions section of this manual for details.

2. OPERATING INSTRUCTIONS

The T3010AX and T3010BX *DVP* (Digital Voice Protection) Code Inserters are handheld portable units used to program *DVP* radios in the field. The *DVP* code inserter can store up to eight distinct keys. Each k consists of 24 octal digits (four sequences of characters). Keys are manually loaded, one at a tin and can then be selected and transferred to a *D* radio. Keys cannot be recalled to the inserter displ once they have been initially entered into memory.

The multiple key storage capability allows o loader to service several different user groups w operate on different keys. Because the keys cannot recalled to the display after being entered into memo one person may program the inserter, then allow oth users to enter the keys without disclosing their identity

IMPORTANT

The Motorola R1012C *DVP* Test Set can generate a test key identical to one which can be loaded with the T3010AX and T3010BX Code Inserters. Use of this key for normal system operation should be avoided to ensure communications security. The test key is 70707070707070707070 (enter the number 70 twelve times).

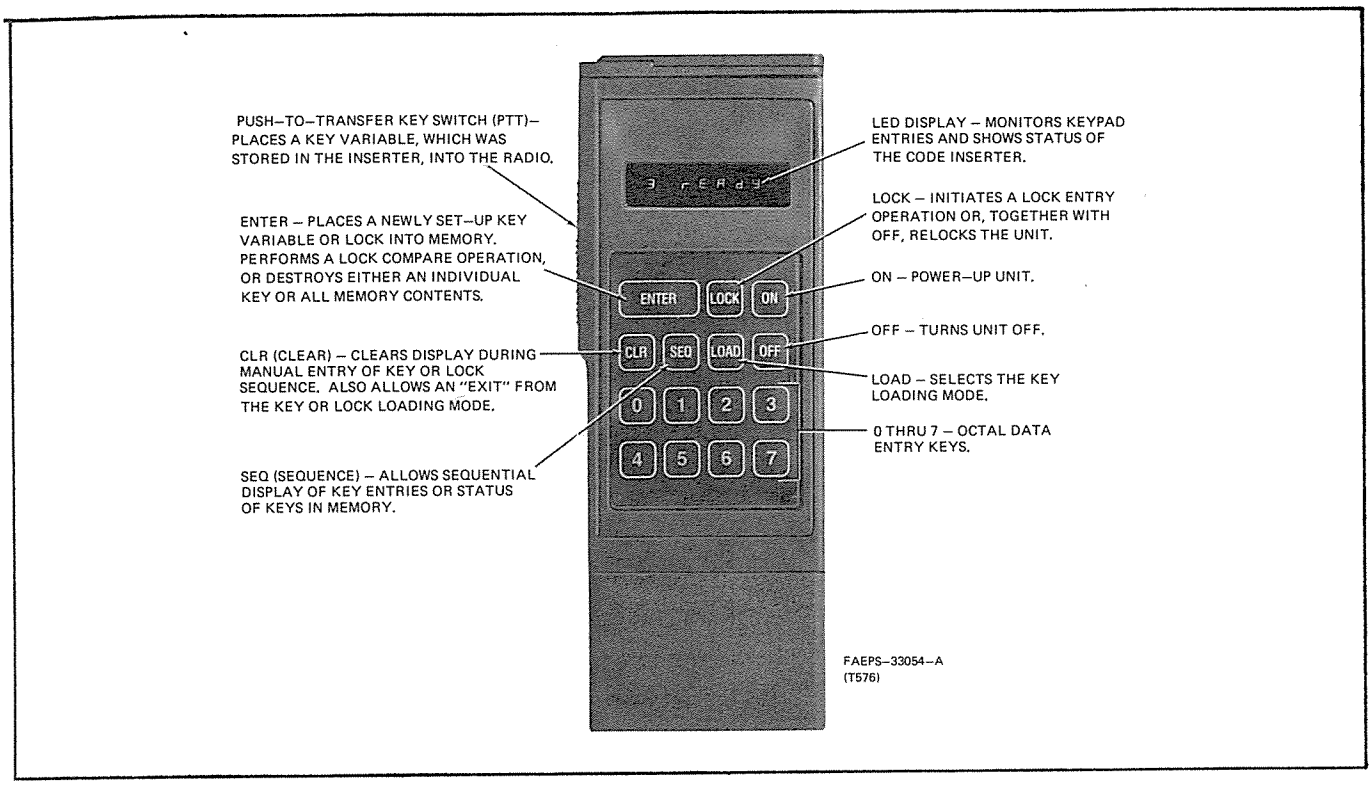
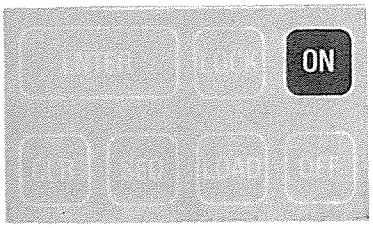


Figure 3. DVP Code Inserter Control and Indicators

TO TURN UNIT ON OR OFF



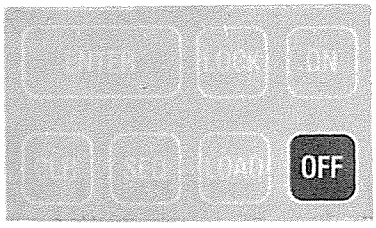
Press ON to turn unit ON.

Display indicates "READY", "ERASED", or "LO CHARGE". If LO CHARGE is displayed, turn the unit off and recharge or replace the battery.

NOTE

The last used memory location number (0-7) will also be displayed.

If the unit's internal memory has been disturbed since the last power up, the display will read "ALL ERASED".



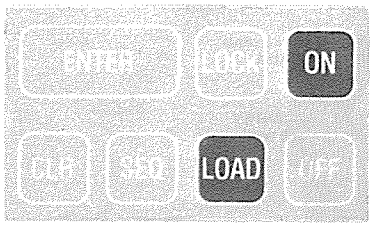
Press OFF to turn unit off.

Display goes blank.

NOTE

If no key entry is made for 30 seconds after the unit is turned on, it will automatically shut down to conserve battery power. Whenever a prompt is present on the display, the unit will remain on for 90 seconds after the last keystroke before automatic shutdown. In either case, simply press ON button to turn power back on.

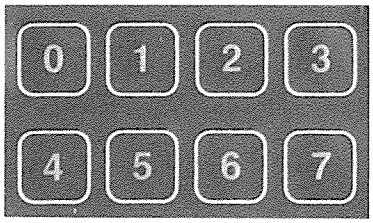
TO LOAD A KEY



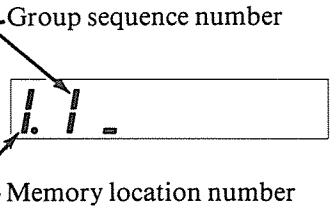
Press ON to turn unit on.

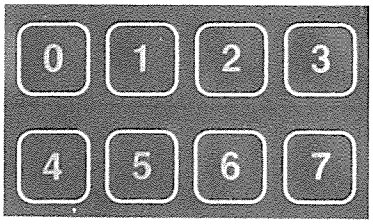
Display reads "READY" "ERASED" and indicates used memory location (0-7).

Press LOAD to begin loading. Group sequence number



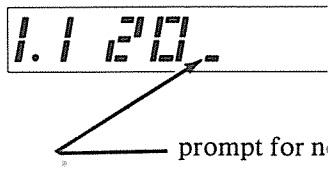
Depress any button 0-7 to select desired key memory location, or use the SEQUENCE key to select the next location. The group sequence number will be 1.

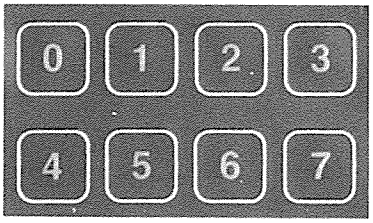




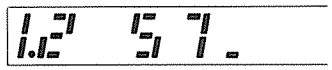
Enter first six digits of the key.

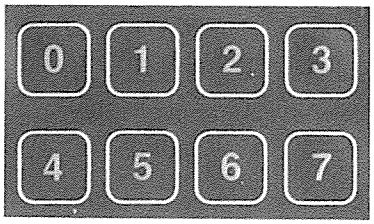
Display shows each digit as it is entered.



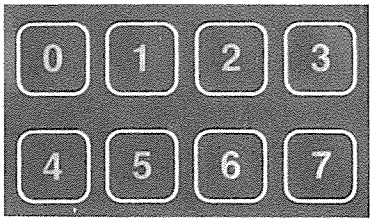


Enter next six digits of the key.

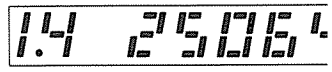




Enter next six digits of the key.

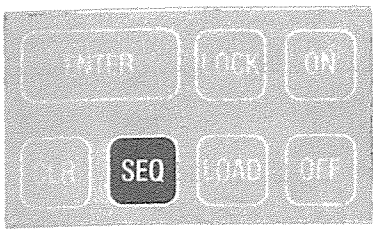


Enter last six digits of the key. The very last digit MUST be 0, 1, 2, or 3.



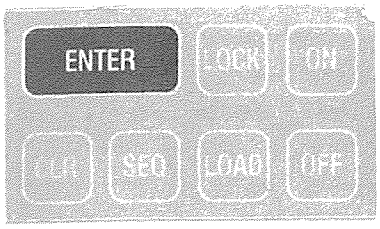
NOTE

A flashing "E" indicates an improper last digit. A period appears after a correct last digit is entered.



Verify proper entry of each group of six digits using SEQ button to step through each group. If any errors are found, make corrections using the Correcting An Error procedures before continuing.

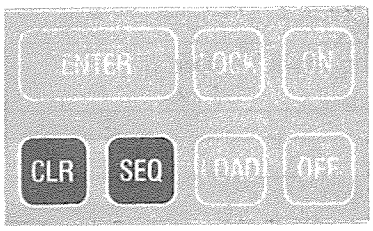
Group sequence number changes each time SEQ button is depressed. Each group of six digits appears on display, one group at a time.



Depress ENTER button to enter the key in the selected memory location. The key can NOT be displayed or corrected after this step.

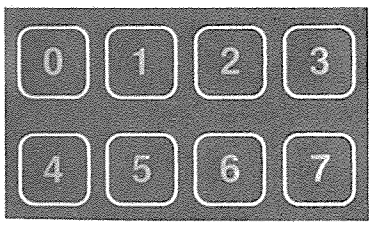
NOTE
The entire load procedure can be repeated up to 8 times using different memory locations.

CORRECTING AN ERROR (USE ONLY BEFORE PRESSING ENTER)



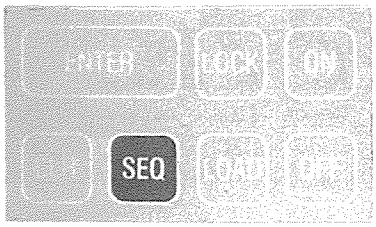
Use SEQ button to bring the desired group on the display. Depress CLR button.

The six key digits on the display are erased.



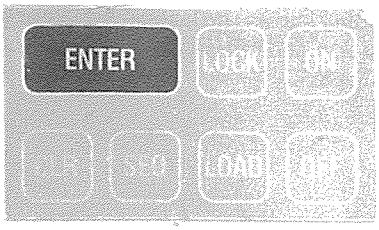
Re-enter the six key digits correcting any previous wrong entry.

Display shows each digit entered.



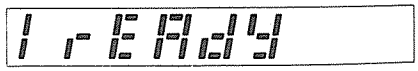
Use SEQ button to verify proper key entry for all key groups.

Each six digit key group is displayed in sequence.

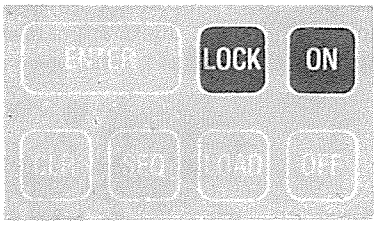


Depress ENTER button to enter the key in the selected memory location.

Display shows the selected memory location and "READY".

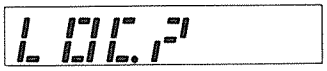


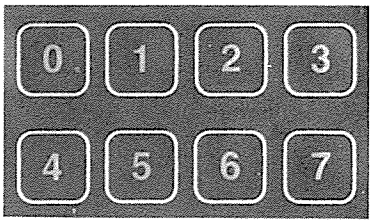
TO LOCK THE INSERTER
(No Previous Keys Or Lock May Be Present)



Press ON to turn unit on.

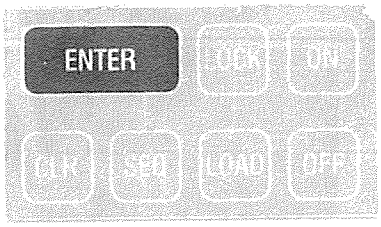
Press LOCK button.





Enter any number up to 6 digits.

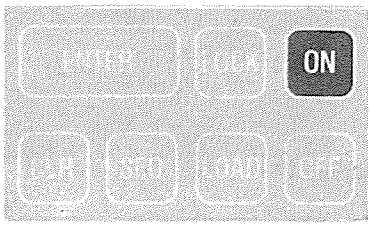
IMPORTANT
Remember the sequence and the digits entered in order to unlock the unit.



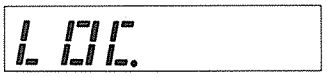
Press ENTER button.

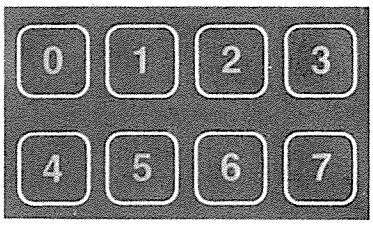
The inserter is now locked. The unit will not accept a key entry nor can it be used to transfer a key into a radio until it is unlocked.

TO UNLOCK THE INSERTER

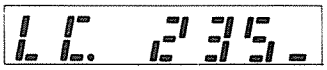


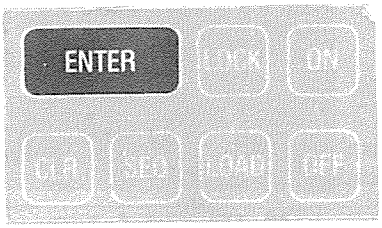
Press ON to turn the unit on.





Enter the same digits and in the same sequence used to lock the unit.





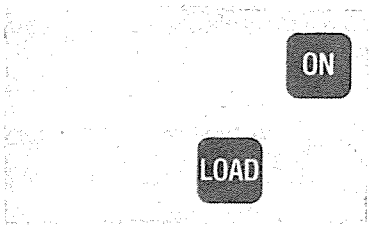
Press the ENTER button.

Display shows the last used memory location and "READY" or "ERASED".

The unit is now unlocked and will operate normally.

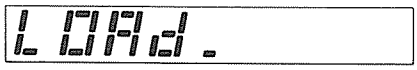
NOTE
Again depressing LOCK and then OFF will relock the inserter.

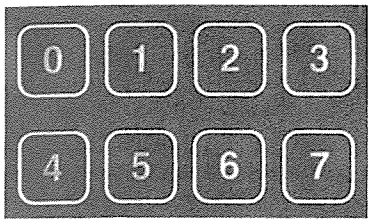
TO DESTROY AN EXISTING KEY



Press ON to turn unit on.

Press LOAD key.





Select memory location to be destroyed by entering desired location number 0-7, or use SEQ key.

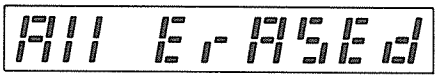
Press ENTER key.

TO DESTROY ALL EXISTING KEYS

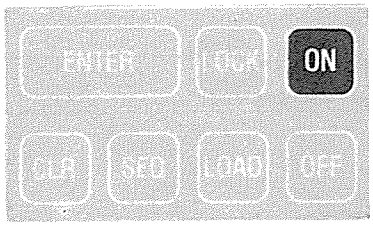
Press OFF to turn unit OFF.

Press CLR key and while holding CLR key depressed, press ON.

Press the ENTER button.

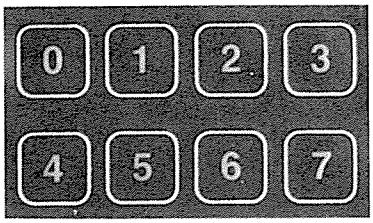


TRANSFERRING A KEY INTO A RADIO



Press ON button to turn unit on.

Display shows the last used memory location and "READY" or "ERASED".



Select desired key memory location by depressing key 0-7 or use SEQ key.

Connect appropriate cable between inserter and radio.

Press PUSH TO TRANSFER switch on left side of inserter to initiate key transfer.

If the key is transferred properly, a one second verification tone is heard in the radio speaker.

ALTERNATE METHOD OF TRANSFERRING A KEY TO A RADIO

This method is used only for transferring the previously transferred key into another radio. Connect the appropriate cable between the inserter and the radio. Then, depress the PUSH TO TRANSFER button on the left hand side of the inserter. The inserter will turn on, transfer the key, and display "BEEP?". If the key is transferred properly, a one second tone is heard in the radio speaker.

3. THEORY OF OPERATION

3.1 INTRODUCTION

(Refer to Block and Schematic Diagrams.)

This section of the instruction manual covers the theory of operation for the T3010AX and T3010BX *DVP* Code Inserters. Most of the electronic circuitry is mounted on two circuit boards: Central Processing Unit (CPU) Board and Interface Board. The Power Control/Flex circuit electronically interconnects the Interface Board to the signaling output plug and the Battery Block. A general discussion of these items is presented in the following paragraphs. Some discussions go into greater detail to familiarize the reader with unique applications.

3.2 CENTRAL PROCESSING UNIT (CPU) BOARD

The Central Processing Unit (CPU) Board contains a microcomputer. The central processing unit (U101) is a Motorola MC6802 with 128 bytes of internal random access memory (RAM) and an externa 3.84 MHz time base. The read only memory (U103) 4K x 8 and is used for program storage. The random ac cess memory (U104) is 256 x 4 and is continuousl powered to retain keystroke information. Th peripheral interface adapter (U102) provides system in put/output for the CPU board. An AND gate (U105E and amplifier (Q101) provide an audio tone output fo each keystroke, time-out warning, or the "All erase? state.

3.3 INTERFACE BOARD

3.3.1 General

The interface board contains the peripheral ci cuitry for operator interface. The data entry keypa (S202) allows the operator to enter selected data. Th data output display (DS201) show the operator what being entered, prompts the operator for entries, and i dicates results of functions being performed. K

loading information is transferred through P301. The power regulator (Q202 thru Q206) and low battery detect circuitry are also located on this board.

3.3.2 Data Entry

The data entry keypad (S202) is the means by which the operator enters selected keystroke information into memory. The keypad is scanned by 3 to 8 decoder U203. The PIA sequentially presents an octal number to the three input pins (A, B, and C) of U203. All eight possibilities are tried with the low order digit and function lines enabled (MUX U202 pins 9 and 10 logic low). The high order function line is used only to scan the model finder (S201) matrix. Model finding is performed only on power-up to determine the model and output bit rate. When a key closure of sufficient duration is detected by a low output from buffer U205C or U205B, the microprocessor causes the appropriate internal machine state and display changes to occur.

3.3.3 Data Display

The LED driver (U201) is self-scanning and is only written to by the microcomputer system when a need for updating exists. When an update occurs, the $\overline{\text{WRITE}}$ line of U201 goes to a logic low once for a control sequence and then eight times for the digit information. Display driver pins A thru G and DP are segment drivers, and pins DS0 thru DS7 are digit drivers. The LED display is common cathode type.

3.3.4 Data Output

3.3.4.1 A cable interconnects the data output plug (P301) and the radio to be encoded. The interconnect cable transfers the following signals:

- KEY — A binary data sequence which is modulo two summed with a stream of encrypted or plain text in the radio's encrypt/decrypt module to produce the desired signal.
- KEY INSERT DATA — A data stream which provides RAM addresses for the key and synchronization information for the clock and data regeneration circuitry in the radio. Encrypted verification tone and idle pattern are also sent on this line for operator verification of the correct key load. This signal is often superimposed on the discriminator line in the radio.
- $\overline{\text{WE}}$ — write enable (complement). An active low signal which enables a key load into the radio.
- KEY INSERT GROUND — Used when KEY INSERT DATA is not superimposed on the discriminator. This signal switches the source of the radio's data limiter input from the discriminator to the inserter.
- GROUND — Common line between the inserter unit and the radio.

3.3.4.2 The signaling scheme for transfer of data to an external radio is shown in Figure 4. When the push-to transfer switch (S301) is depressed, a half clock rate signal (EOM)appears on the KEY INSERT DATA line for 1000 bit clocks. This ensures clock sync in the radio. After 1000 bits, the $\overline{\text{WE}}$ line goes logic low for 137 cycles during which key bits are loaded into the encrypt module of the radio. KEY INSERT DATA provides addresses for the key bits. After the $\overline{\text{WE}}$ returns to a logic high, 600 cycles of encrypted idle pattern followed by 12000 cycles of verification tone are sent; then 1000 bits of END OF MESSAGE (EOM) are sent to squelch the radio. When the inserter is not executing a load sequence, the KEY, $\overline{\text{WE}}$, and KEY INSERT DATA lines are in a high impedance state.

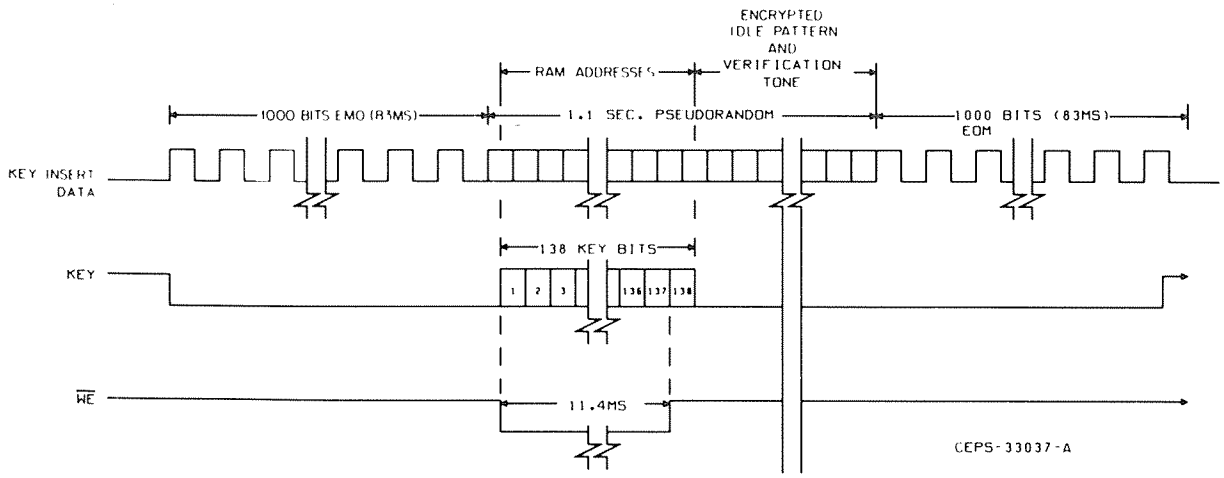


Figure 4. Signaling Scheme for Transfer of Data

3.3.5 Power Regulator

3.3.5.1 The power regulator provides the operating voltage for the CPU and interface boards. The regulator formed by Q203, Q204, and Q206 produces a VCC of 5 volts. The regulator is enabled by current injection at the base of Q204. In the "OFF" state, series pass transistor Q203 is cut off.

3.3.5.2 The power on-sequence operates as follows. Depressing either the ON or push-to-transfer (PTT) switch will saturate Q205 for approximately two time constants of the base timing circuit R224 and C206. Since POWER HOLD from PIA port CB2 is low, the collector of Q205 will be low also, providing both a CPU reset and a regulator enabling path thru power startup transistor Q202. When its base timing circuit allows the collector of Q205 to return high, the CPU begins program execution. The software module that the reset vector points to causes the POWER HOLD signal to go high. This high enables the regulator on a long term basis, but disallows any further CPU resets.

3.3.5.3 Power-down is accomplished by removing the POWER HOLD signal after the system has finished the necessary housekeeping tasks. The ALWAYS POWER voltage is provided by the power regulator when the unit is on and by the Zener network (R217 and VR201) when the unit is off. ALWAYS POWER provides supply voltage to U104 for retention of stored keys and to U202 and U205 for putting the radio programming lines in a high impedance state when off.

3.3.6 Low Battery Detect

Low charge detection is an interrupt driven event. The interrupt request signal is produced by an FET op amp (U204) and resistor bias network (R201 thru R204) whenever the battery voltage drops below approximately 6.2 volts. Software operation is such that the user may elect to clear the unit of the low power indication and load additional radios. The battery discharge characteristic is very steep in this operating region; only very limited additional operation should be attempted.

CAUTION

Continued operation with low battery charge may destroy stored key data.

3.4 BATTERY BLOCK

The battery (BT401) is a nickel-cadmium unit. Fully charged, it measures a nominal 7.5 volts. At end-of-life, the voltage will be under 6 volts. A mercury battery can also be used. Its open circuit voltage is between 10 and 11 volts.

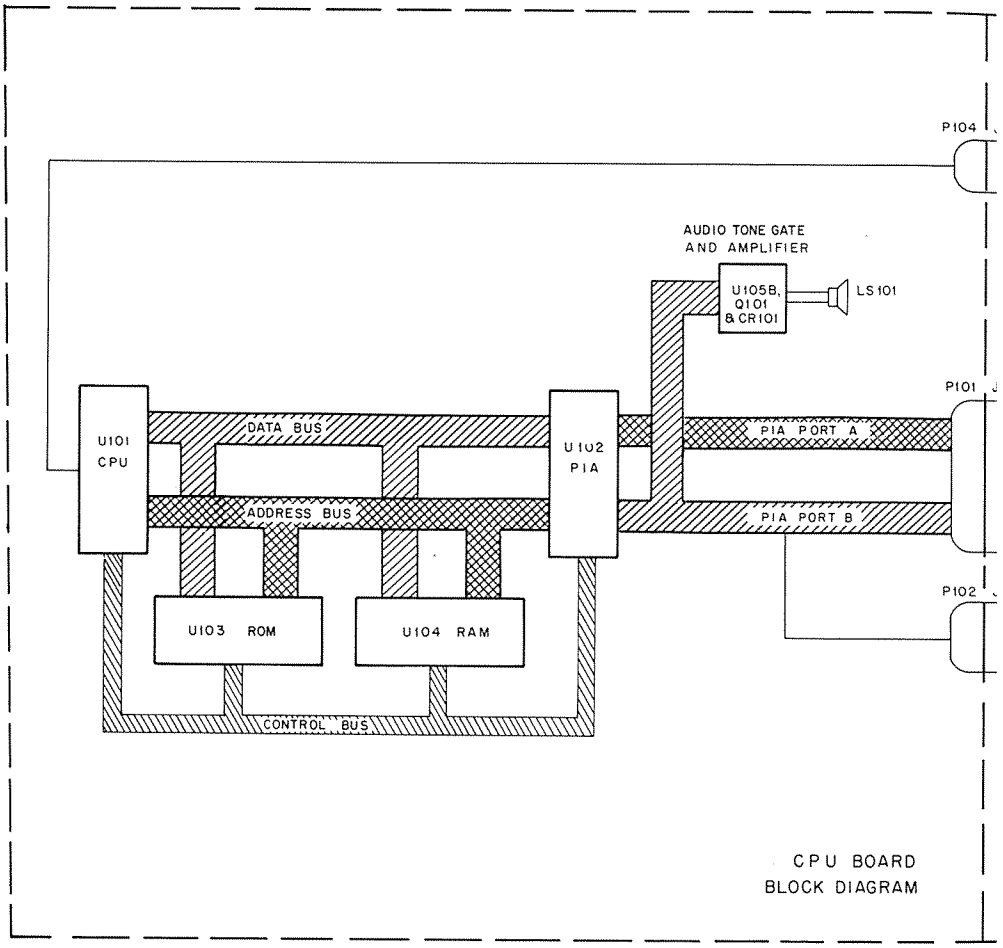


Figure 5. Block

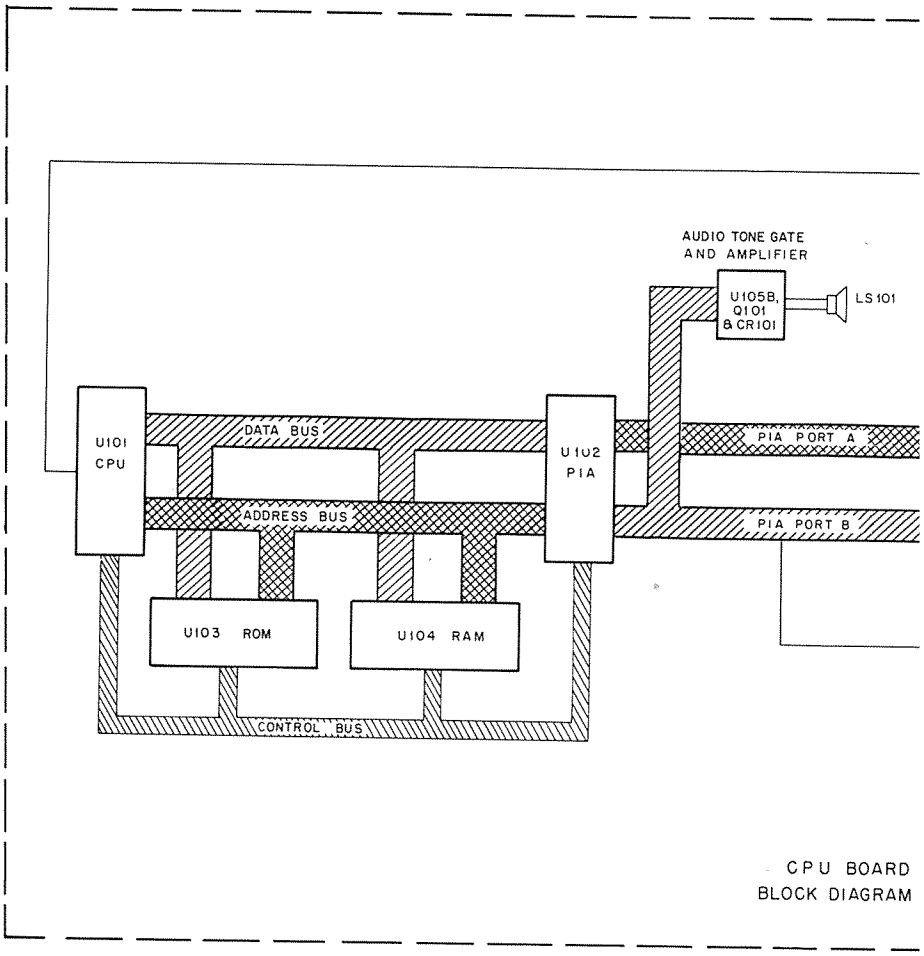
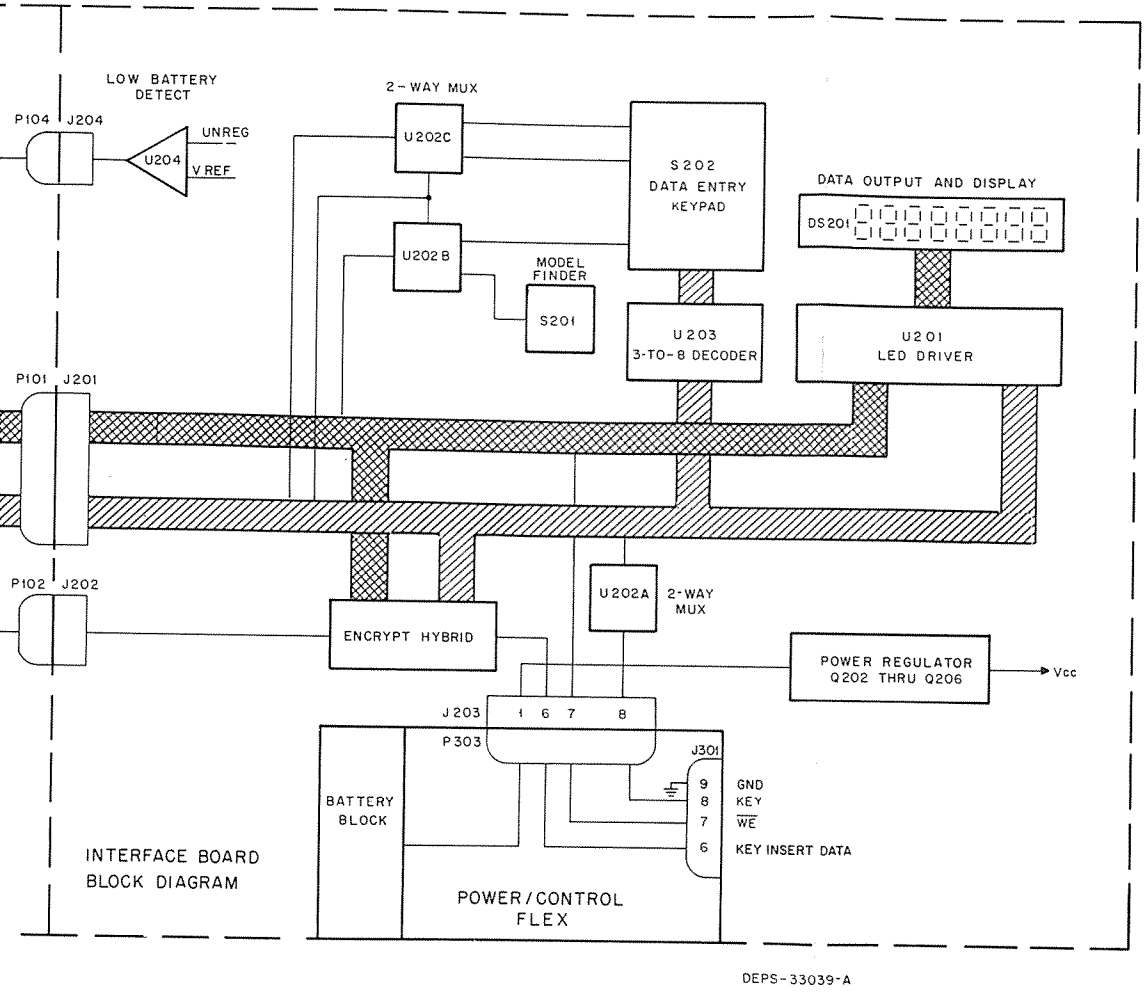

AUDIO TONE GATE
AND AMPLIFIER
U105B,
Q101
& CR101
LS101
U101
CPU
DATA BUS
U102
PIA
PIA PORT A
ADDRESS BUS
PIA PORT B
U103 ROM
U104 RAM
CONTROL BUS
CPU BOARD
BLOCK DIAGRAM

Figure 5.



Block Diagram

4. MAINTENANCE

4.1 INTRODUCTION

This section of the instruction manual assists the user with maintenance and repair. In the following sections, battery and fuse replacements are described. Also included is a troubleshooting chart to assist the user in a more detailed check. For service beyond the checks listed on the chart, it is recommended that the user return the unit to a Motorola service center. See the foreword for service center information.

4.2 BATTERY REPLACEMENT

Step 1. Turn the *DVP* code inserter off.

Step 2. Hold the *DVP* code inserter in the left hand and press the battery release with the left thumb. (See Figure 6.)

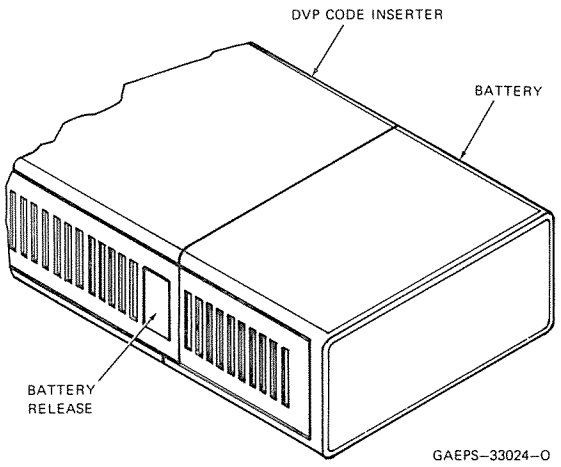


Figure 6. Battery Release

Step 3. While holding the battery release depressed, rotate the battery counterclockwise as illustrated. (See Figure 7.)

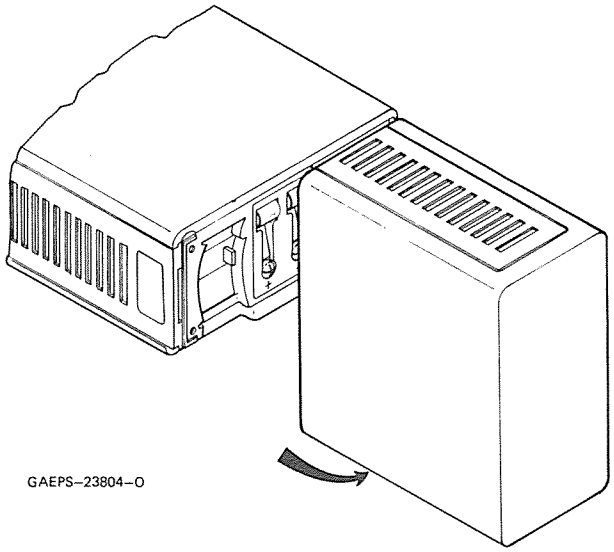


Figure 7. Battery Disengagement

Step 4. Rotate the battery about 180 degrees, until the cam lock is clear, and remove the battery from the *DVP* code inserter. (See Figure 8.)

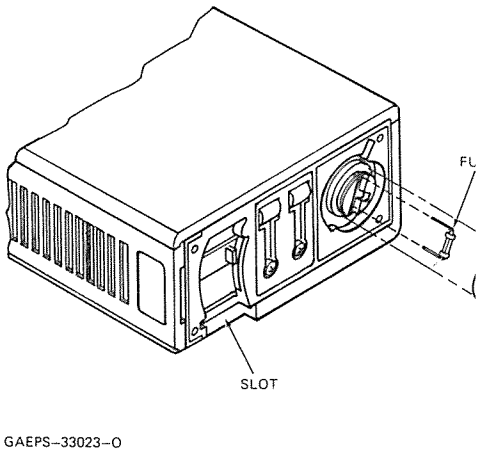


Figure 8. Battery Removal/Fu

5. To replace the battery, reverse the procedure. engage the cam lock, then rotate the battery wise until it latches in the proper position. Be sure attery engages the slot on the bottom of the *DVP* inserter.

NOTE

Memory contents will be retained if the battery is replaced in less than 30 seconds.

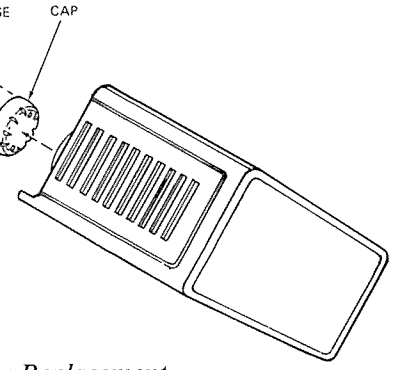
FUSE REPLACEMENT

1. Remove the battery as described in the Battery acement procedures.

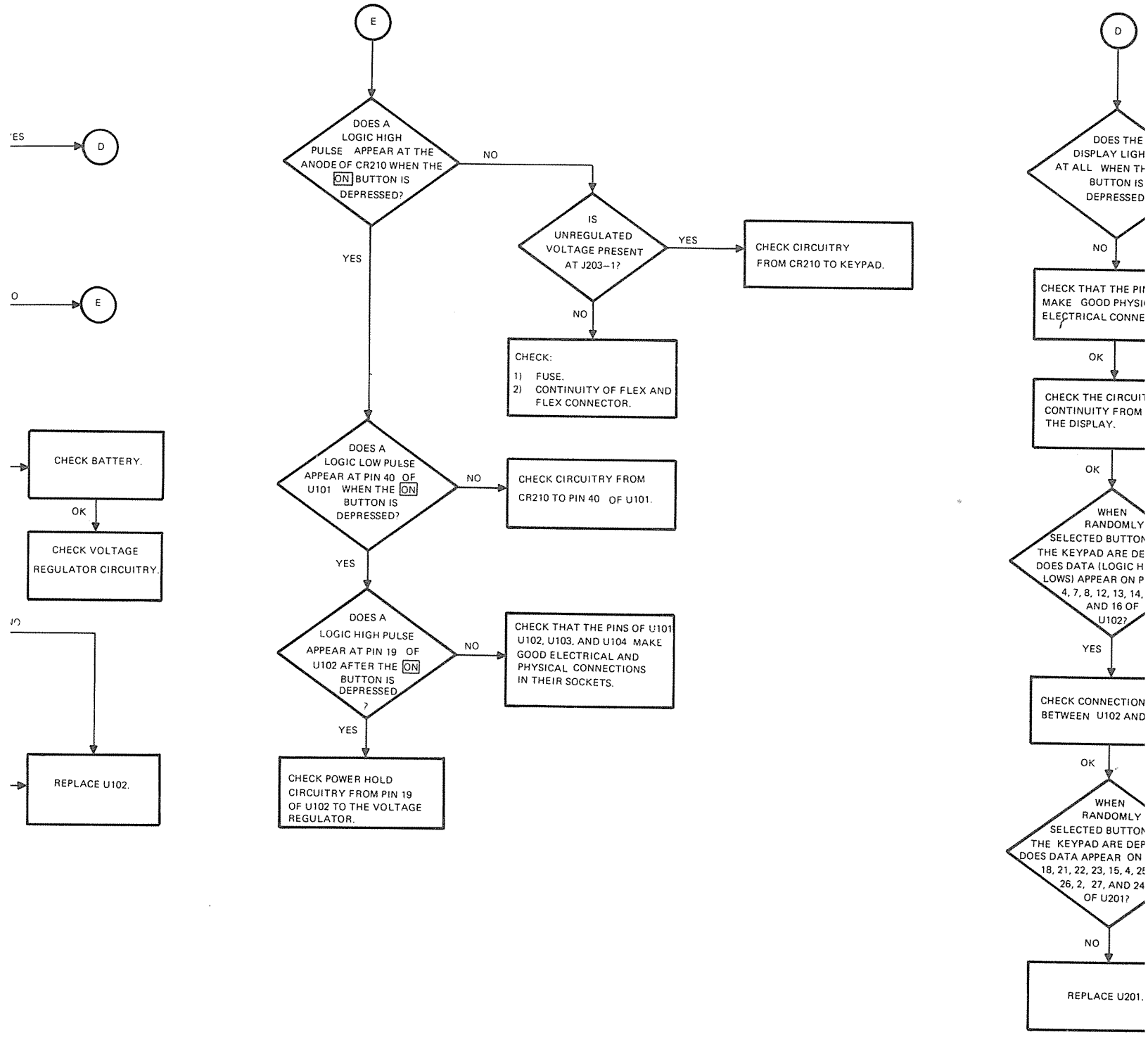
2. Unscrew the fuse cap and remove the fuse.

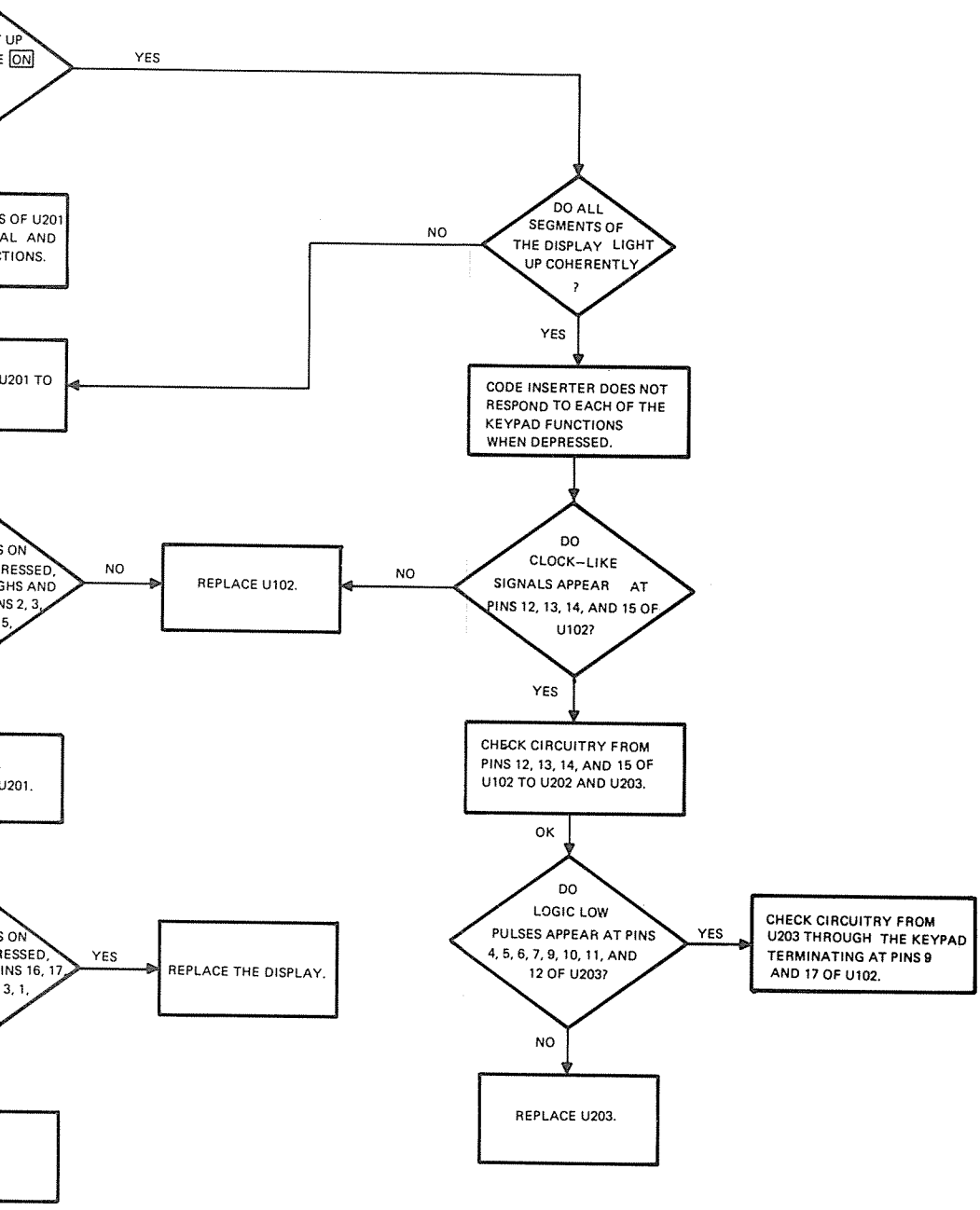
3. Replace the fuse with a new one and replace use cap making sure it is screwed on securely.

4. Reinstall the battery as described in the Bat- Replacement procedure.



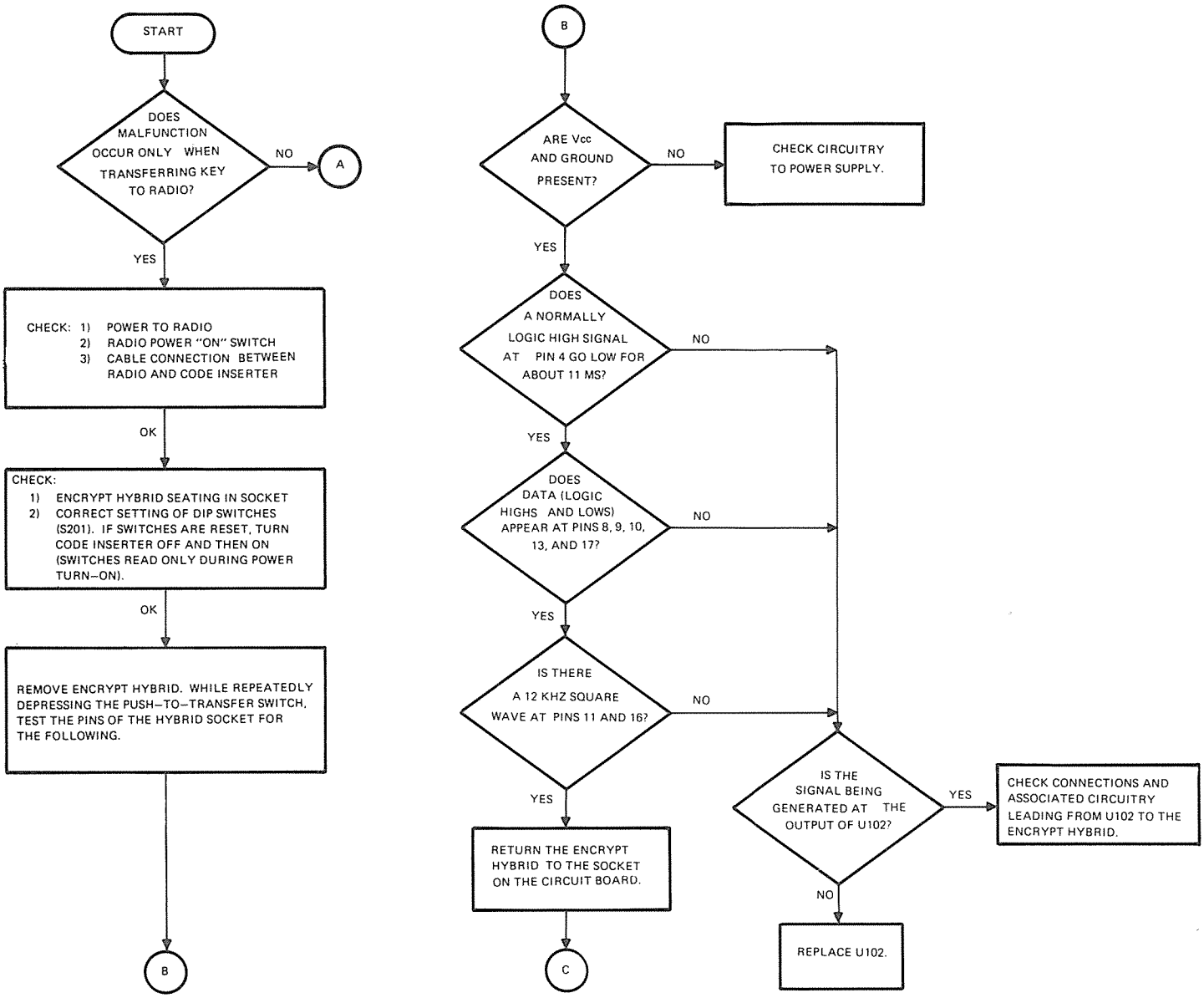
e Replacement

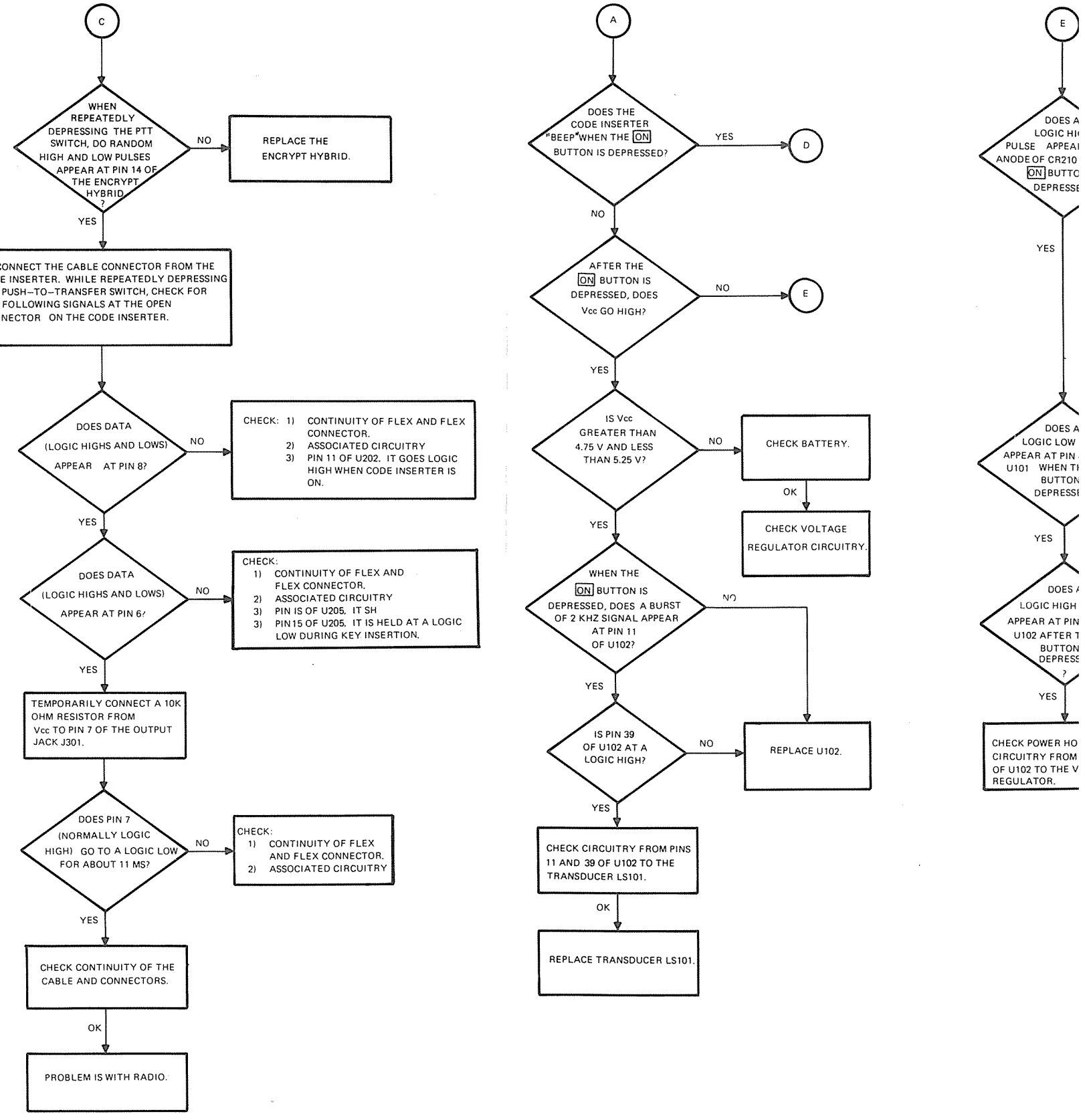

'ES
D
O
E
CHECK BATTERY.
OK
CHECK VOLTAGE REGULATOR CIRCUITRY.
JO
REPLACE U102.
E
DOES A LOGIC HIGH PULSE APPEAR AT THE ANODE OF CR210 WHEN THE ON BUTTON IS DEPRESSED?
NO
YES
IS UNREGULATED VOLTAGE PRESENT AT J203–1?
YES
CHECK CIRCUITRY FROM CR210 TO KEYPAD.
NO
CHECK:
1) FUSE.
2) CONTINUITY OF FLEX AND FLEX CONNECTOR.
DOES A LOGIC LOW PULSE APPEAR AT PIN 40 OF U101 WHEN THE ON BUTTON IS DEPRESSED?
NO
CHECK CIRCUITRY FROM CR210 TO PIN 40 OF U101.
YES
DOES A LOGIC HIGH PULSE APPEAR AT PIN 19 OF U102 AFTER THE ON BUTTON IS DEPRESSED ?
NO
CHECK THAT THE PINS OF U101 U102, U103, AND U104 MAKE GOOD ELECTRICAL AND PHYSICAL CONNECTIONS IN THEIR SOCKETS.
YES
CHECK POWER HOLD CIRCUITRY FROM PIN 19 OF U102 TO THE VOLTAGE REGULATOR.
D
DOES THE DISPLAY LIGH AT ALL WHEN TH BUTTON IS DEPRESSED
NO
CHECK THAT THE PI MAKE GOOD PHYSI ELECTRICAL CONNE
OK
CHECK THE CIRCUI CONTINUITY FROM THE DISPLAY.
OK
WHEN RANDOMLY SELECTED BUTTON THE KEYPAD ARE DE DOES DATA (LOGIC H LOWS) APPEAR ON P 4, 7, 8, 12, 13, 14, AND 16 OF U102?
YES
CHECK CONNECTION BETWEEN U102 AND
OK
WHEN RANDOMLY SELECTED BUTTON THE KEYPAD ARE DEP DOES DATA APPEAR ON 18, 21, 22, 23, 15, 4, 25 26, 2, 27, AND 24 OF U201?
NO
REPLACE U201.



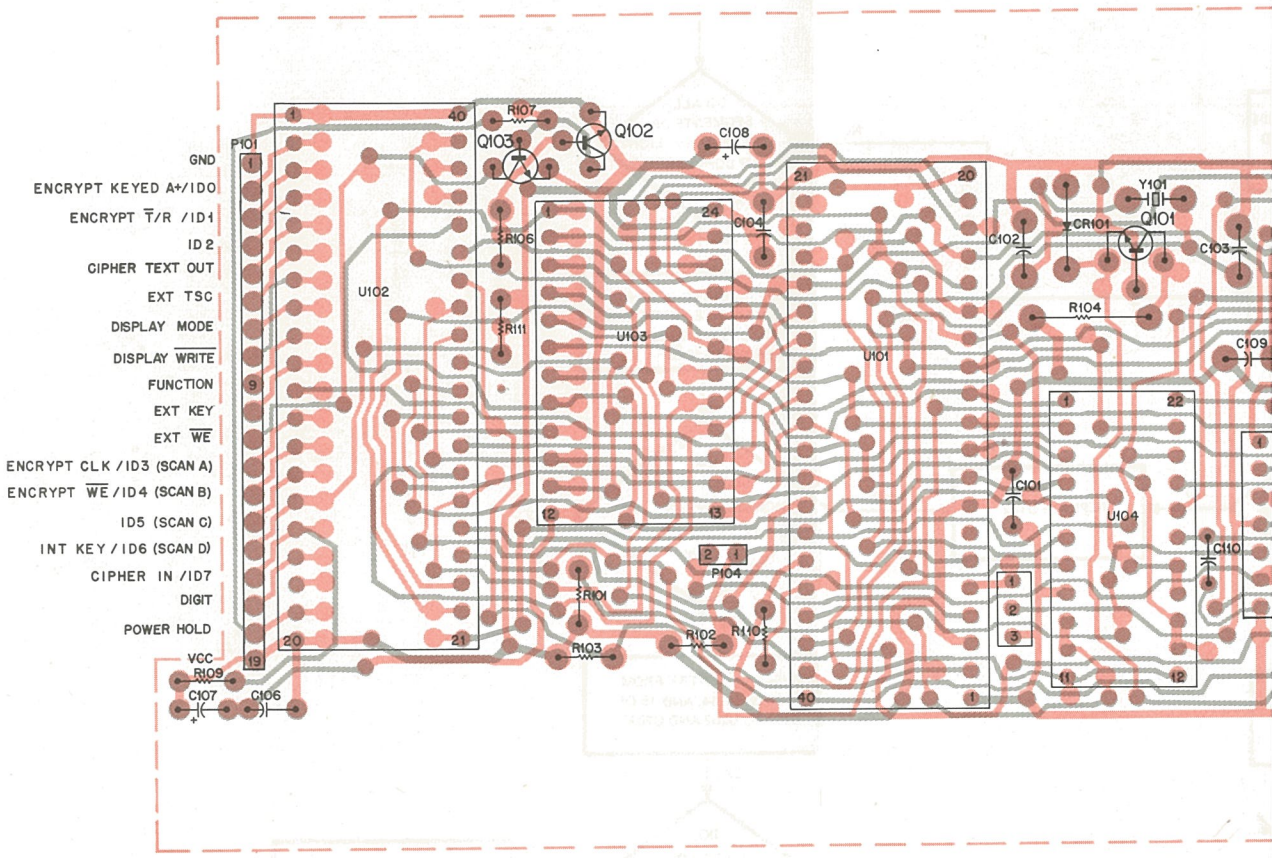
EEPS–32991–A

DVP Code Inserter
Troubleshooting Chart
*Motorola No. **EEPS-32991-A***
1/18/82- UP


START
DOES MALFUNCTION OCCUR ONLY WHEN TRANSFERRING KEY TO RADIO?
NO
A
YES
CHECK: 1) POWER TO RADIO
2) RADIO POWER "ON" SWITCH
3) CABLE CONNECTION BETWEEN RADIO AND CODE INSERTER
OK
CHECK:
1) ENCRYPT HYBRID SEATING IN SOCKET
2) CORRECT SETTING OF DIP SWITCHES (S201). IF SWITCHES ARE RESET, TURN CODE INSERTER OFF AND THEN ON (SWITCHES READ ONLY DURING POWER TURN-ON).
OK
REMOVE ENCRYPT HYBRID. WHILE REPEATEDLY DEPRESSING THE PUSH-TO-TRANSFER SWITCH, TEST THE PINS OF THE HYBRID SOCKET FOR THE FOLLOWING.
B
B
ARE Vcc AND GROUND PRESENT?
NO
CHECK CIRCUITRY TO POWER SUPPLY.
YES
DOES A NORMALLY LOGIC HIGH SIGNAL AT PIN 4 GO LOW FOR ABOUT 11 MS?
NO
YES
DOES DATA (LOGIC HIGHS AND LOWS) APPEAR AT PINS 8, 9, 10, 13, AND 17?
NO
YES
IS THERE A 12 KHZ SQUARE WAVE AT PINS 11 AND 16?
NO
YES
RETURN THE ENCRYPT HYBRID TO THE SOCKET ON THE CIRCUIT BOARD.
C
IS THE SIGNAL BEING GENERATED AT THE OUTPUT OF U102?
YES
CHECK CONNECTIONS AND ASSOCIATED CIRCUITRY LEADING FROM U102 TO THE ENCRYPT HYBRID.
NO
REPLACE U102.

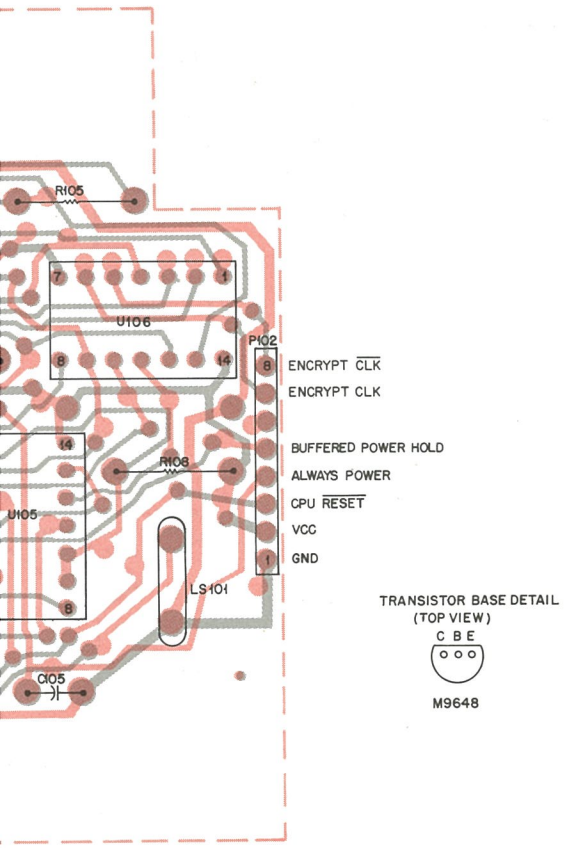

C
WHEN REPEATEDLY DEPRESSING THE PTT SWITCH, DO RANDOM HIGH AND LOW PULSES APPEAR AT PIN 14 OF THE ENCRYPT HYBRID ?
NO
REPLACE THE ENCRYPT HYBRID.
YES
CONNECT THE CABLE CONNECTOR FROM THE E INSERTER. WHILE REPEATEDLY DEPRESSING PUSH–TO–TRANSFER SWITCH, CHECK FOR FOLLOWING SIGNALS AT THE OPEN NECTOR ON THE CODE INSERTER.
DOES DATA (LOGIC HIGHS AND LOWS) APPEAR AT PIN 8?
NO
CHECK: 1) CONTINUITY OF FLEX AND FLEX CONNECTOR.
2) ASSOCIATED CIRCUITRY
3) PIN 11 OF U202. IT GOES LOGIC HIGH WHEN CODE INSERTER IS ON.
YES
DOES DATA (LOGIC HIGHS AND LOWS) APPEAR AT PIN 6?
NO
CHECK:
1) CONTINUITY OF FLEX AND FLEX CONNECTOR.
2) ASSOCIATED CIRCUITRY
3) PIN IS OF U205. IT SH
3) PIN15 OF U205. IT IS HELD AT A LOGIC LOW DURING KEY INSERTION.
YES
TEMPORARILY CONNECT A 10K OHM RESISTOR FROM Vcc TO PIN 7 OF THE OUTPUT JACK J301.
DOES PIN 7 (NORMALLY LOGIC HIGH) GO TO A LOGIC LOW FOR ABOUT 11 MS?
NO
CHECK:
1) CONTINUITY OF FLEX AND FLEX CONNECTOR.
2) ASSOCIATED CIRCUITRY
YES
CHECK CONTINUITY OF THE CABLE AND CONNECTORS.
OK
PROBLEM IS WITH RADIO.
A
DOES THE CODE INSERTER "BEEP" WHEN THE ON BUTTON IS DEPRESSED?
YES
D
NO
AFTER THE ON BUTTON IS DEPRESSED, DOES Vcc GO HIGH?
NO
E
YES
IS Vcc GREATER THAN 4.75 V AND LESS THAN 5.25 V?
NO
CHECK BATTERY.
OK
CHECK VOLTAGE REGULATOR CIRCUITRY.
YES
WHEN THE ON BUTTON IS DEPRESSED, DOES A BURST OF 2 KHZ SIGNAL APPEAR AT PIN 11 OF U102?
NO
YES
IS PIN 39 OF U102 AT A LOGIC HIGH?
NO
REPLACE U102.
YES
CHECK CIRCUITRY FROM PINS 11 AND 39 OF U102 TO THE TRANSDUCER LS101.
OK
REPLACE TRANSDUCER LS101.
E
DOES A LOGIC HI PULSE APPEA ANODE OF CR210 ON BUTTO DEPRESSE
YES
DOES A LOGIC LOW APPEAR AT PIN U101 WHEN TH BUTTON DEPRESSE
YES
DOES A LOGIC HIGH APPEAR AT PIN U102 AFTER T BUTTON DEPRESS ?
YES
CHECK POWER HO CIRCUITRY FROM OF U102 TO THE V REGULATOR.

LATER VERSION
CPU CIRCUIT BOARD



LATER VERSION

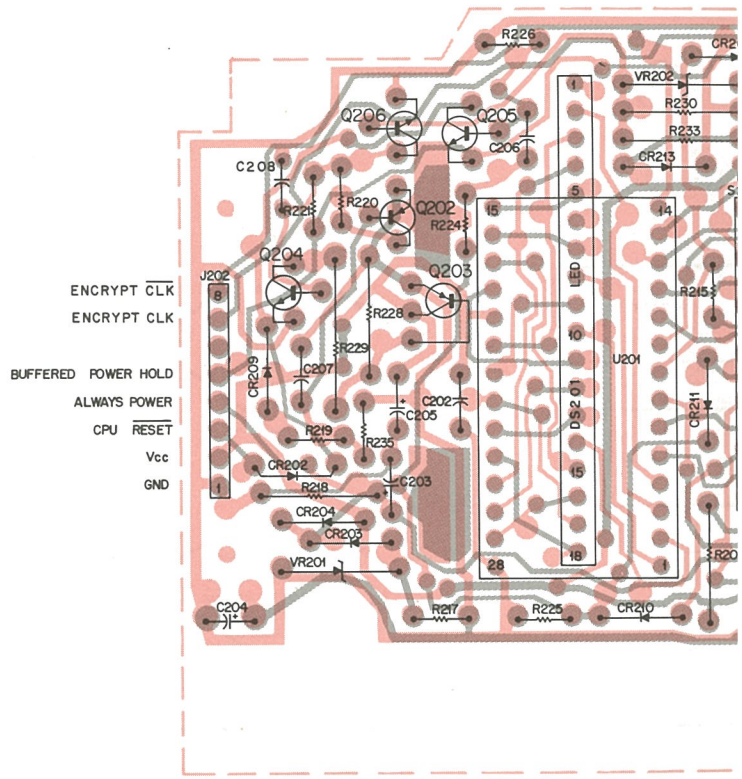
DVP Code Inserter
Schematic Diagram and Circuit Board Detail
Motorola No. ***PEPS-42693-O***
(Sheet 1 of 2)
12/5/85-



TRANSISTOR BASE DETAIL
(TOP VIEW)
C B E

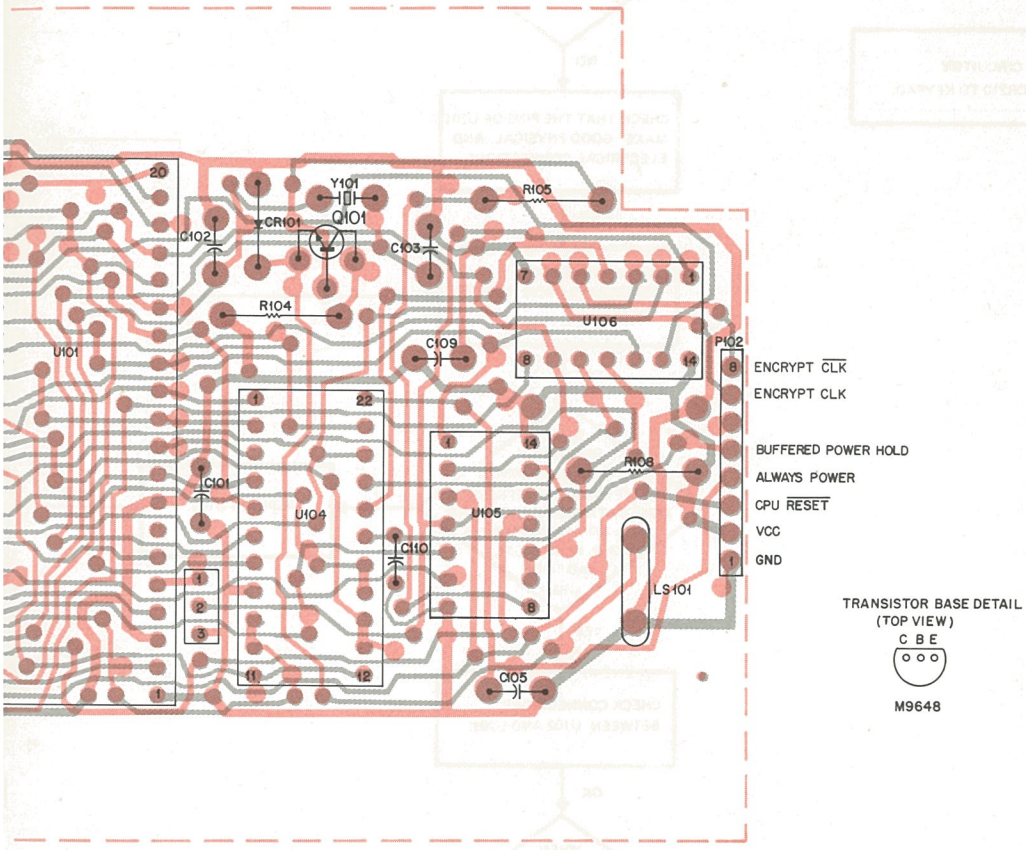
M9648

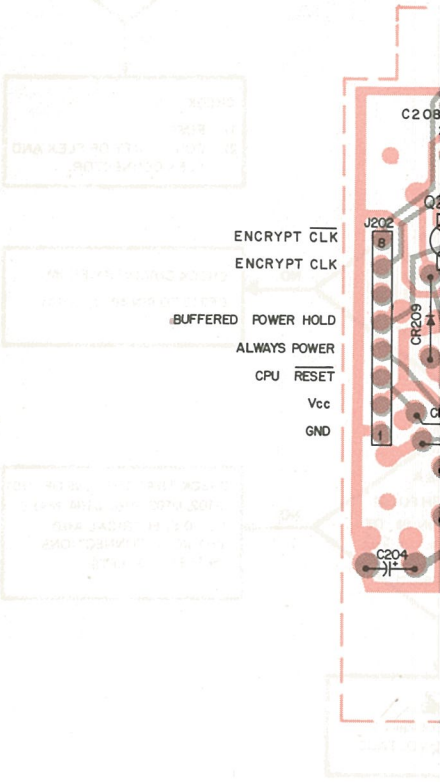
DEPS – 42686 - 0
DEPS – 42687 - 0
DEPS – 42688 - 0



SHO

VERSION
UIT BOARD

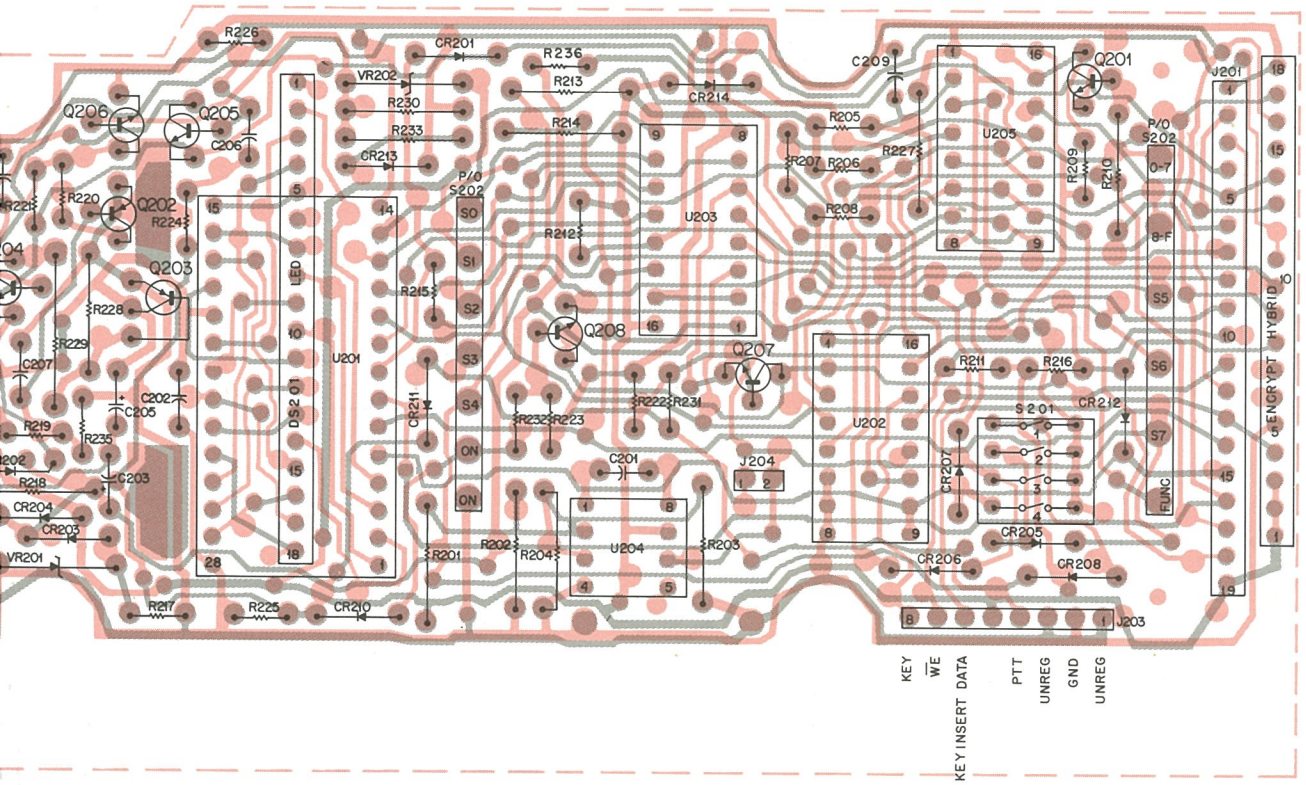




M COMPONENT SIDE

SOLDER SIDE ● BD-DEPS – 42686-0
COMPONENT SIDE ● BD-DEPS – 42687-0
OL-DEPS – 42688-0

LATER VERSION
INTERFACE CIRCUIT BOARD



SHOWN FROM COMPONENT SIDE

TRANSISTOR BASE DETAILS
(TOP SIDE)

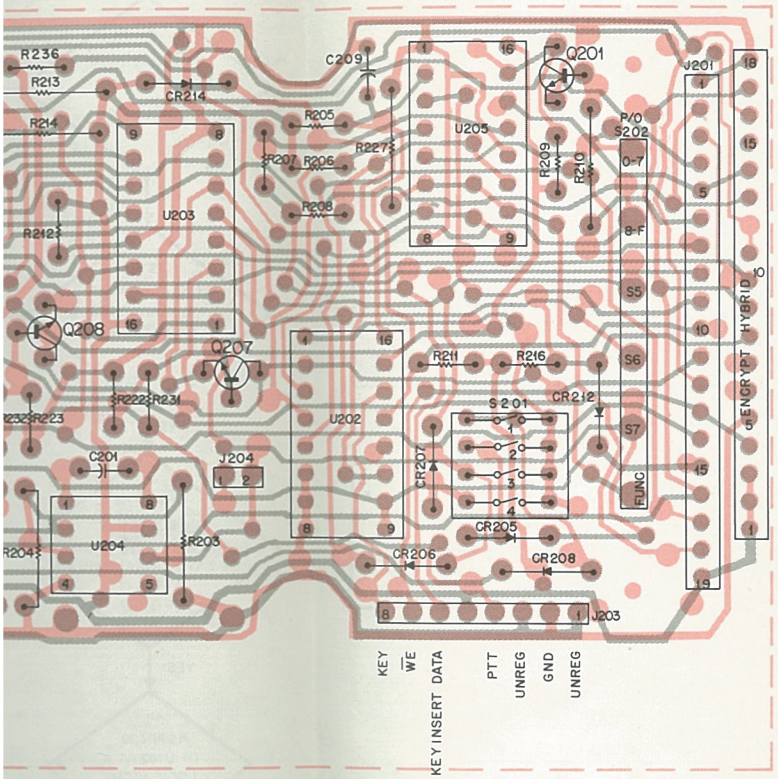
M9642
M9643

M961

SOLDER SIDE
COMPONENT SIDE

BD DEPS-42690-0
BD DEPS-42691-0
OL DEPS-42692-0

LATER VERSION
RFACE CIRCUIT BOARD



TRANSISTOR BASE DETAILS
(TOP SIDE)

M9642
M9643

M9619

BATTERY

F401
5A

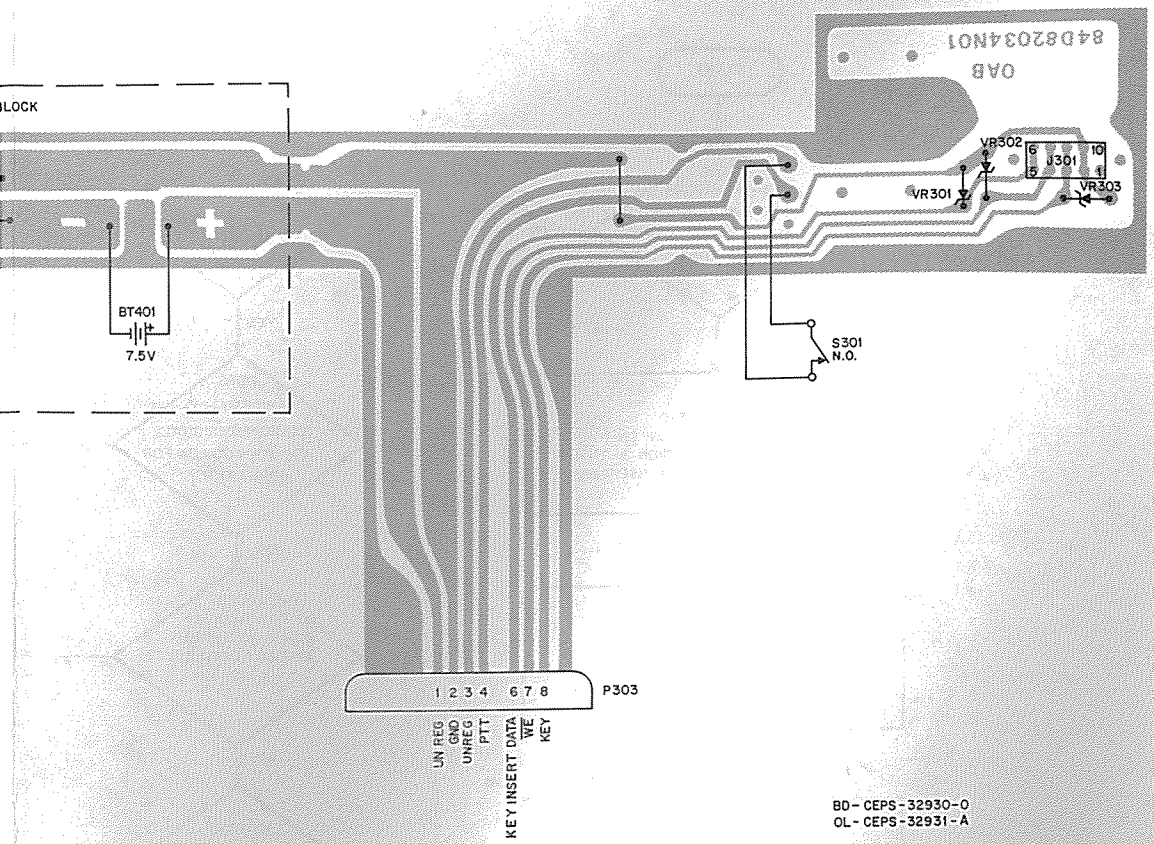
TO D
VAR
LO

TO D
VAR
LO

OM COMPONENT SIDE

SOLDER SIDE ● BD DEPS-42690-0
COMPONENT SIDE ● BD DEPS-42691-0
OL DEPS-42692-0

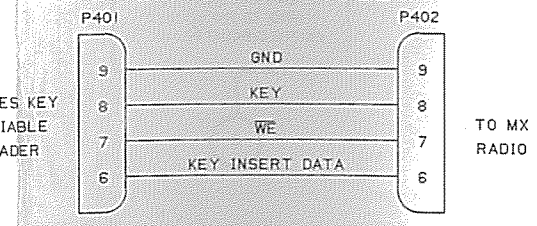
POWER CONTROL/FLEX



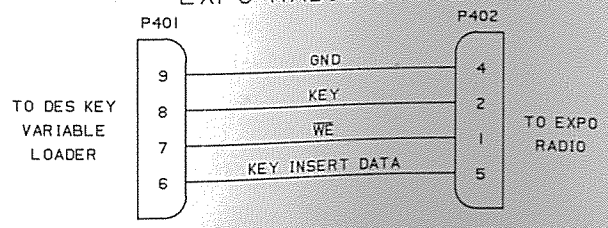
BD-CEPS-32930-O
OL-CEPS-32931-A

SHOWN FROM SOLDER SIDE

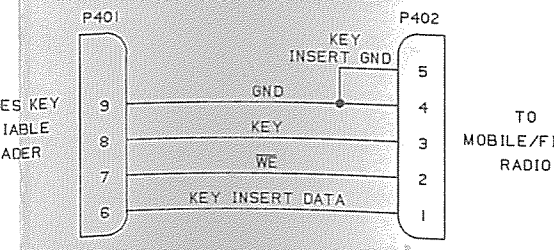
TKN8209B MX RADIO CABLE



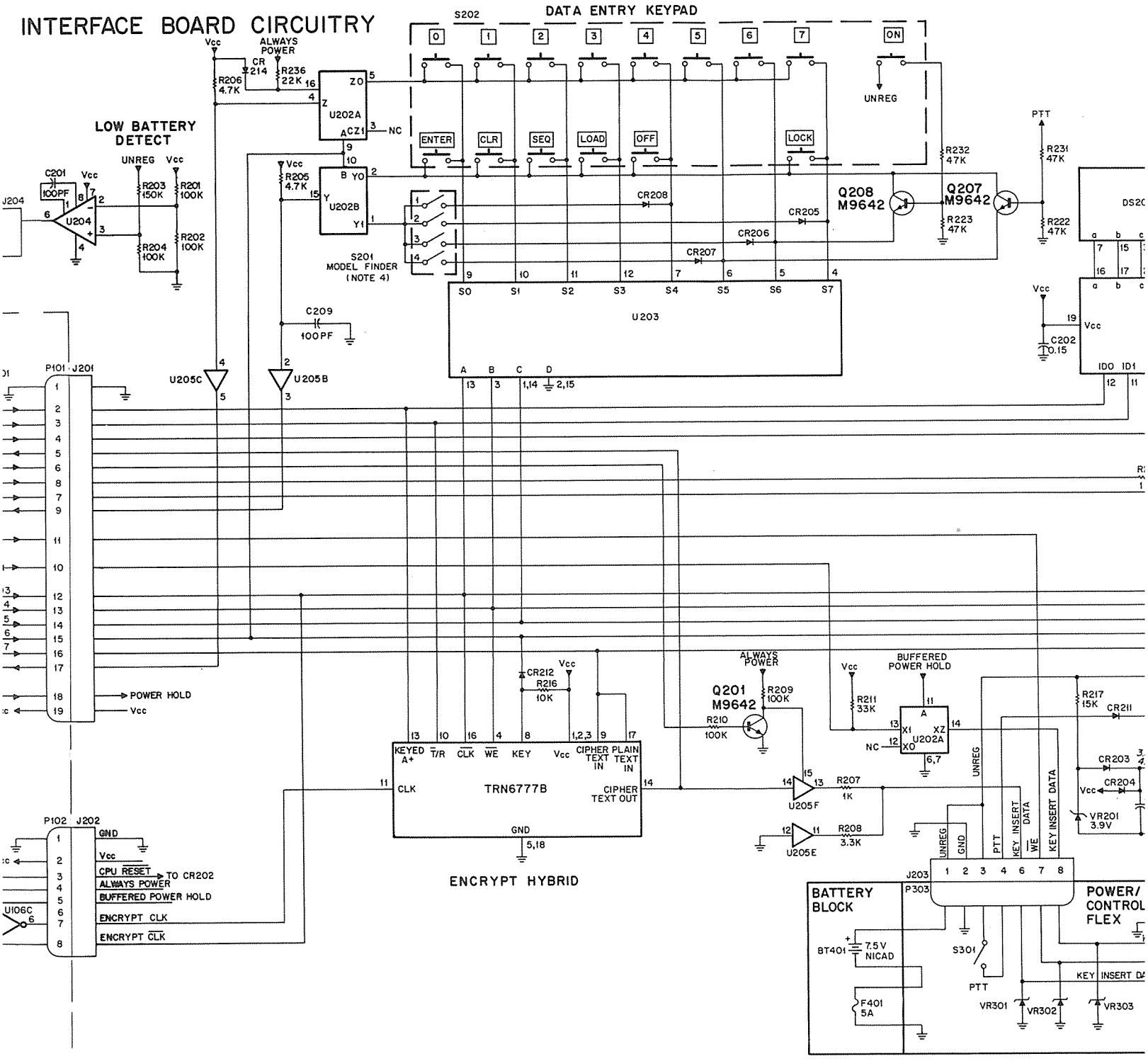
TKN8351A EXPO RADIO CABLE

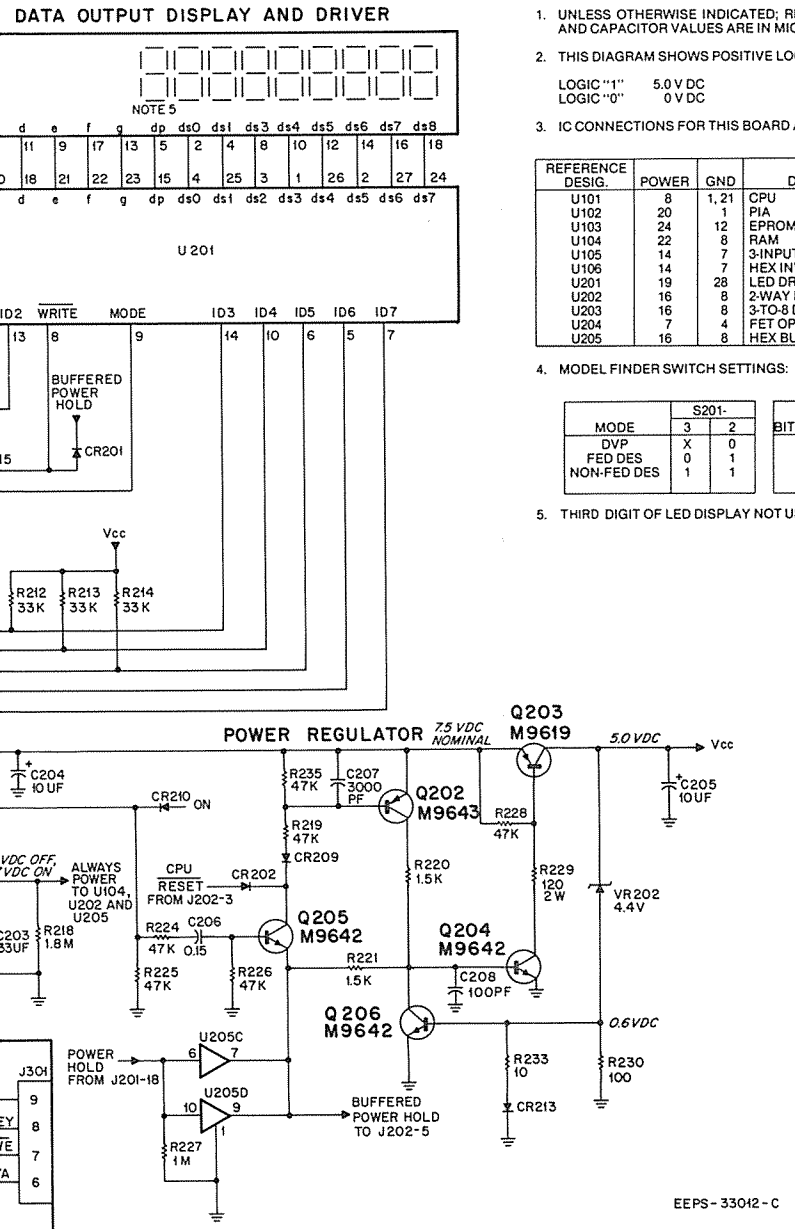


TKN8210B MICOR CABLE AND TKN8229B SYNTOR CABLE



BEPS-33011-B


INTERFACE BOARD CIRCUITRY
DATA ENTRY KEYPAD
S202
0
1
2
3
4
5
6
7
ON
UNREG
ENTER
CLR
SEQ
LOAD
OFF
LOCK
LOW BATTERY DETECT
Vcc
ALWAYS POWER
CR214
R206 4.7K
R236 22K
U202A
R205 4.7K
U202B
S201 MODEL FINDER (NOTE 4)
CR208
CR205
CR206
CR207
Q208 M9642
Q207 M9642
R232 47K
R231 47K
R222 47K
R223 47K
PTT
U203
S0 S1 S2 S3 S4 S5 S6 S7
A B C D
C209 100PF
C202 0.15
U205C
U205B
P101 J201
POWER HOLD
Vcc
CR212
R216 10K
KEYED A+
T/R
CLK
WE
KEY
CIPHER TEXT IN
PLAIN TEXT IN
CIPHER TEXT OUT
TRN6777B
GND
ENCRYPT HYBRID
Q201 M9642
R209 100K
R210 100K
R211 33K
BUFFERED POWER HOLD
U202A
U205F
U205E
R207 1K
R208 3.3K
R217 15K
CR211
CR203
CR204
VR201 3.9V
UNREG
GND
PTT
KEY INSERT DATA
WE
KEY INSERT DATA
P102 J202
GND
Vcc
CPU RESET
TO CR202
ALWAYS POWER
BUFFERED POWER HOLD
ENCRYPT CLK
ENCRYPT CLK
U106C
J203
P303
BATTERY BLOCK
BT401 7.5 V NICAD
F401 5A
S301
PTT
VR301
VR302
VR303
POWER/ CONTROL FLEX



NOTES:

1. UNLESS OTHERWISE INDICATED; RESISTOR VALUES ARE IN OHMS AND CAPACITOR VALUES ARE IN MICROFARADS.
2. THIS DIAGRAM SHOWS POSITIVE LOGIC:

   LOGIC "1" 5.0 V DC
   LOGIC "0" 0 V DC

3. IC CONNECTIONS FOR THIS BOARD ARE AS FOLLOWS:

REFERENCE DESIG.	POWER	GND	MFGR'S DESCRIPTION	TYPE
U101	8	1, 21	CPU	6802
U102	20	1	PIA	6821
U103	24	12	EPROM	2732
U104	22	8	RAM	5101
U105	14	7	3-INPUT AND	74LS11
U106	14	7	HEX INVERTER	74LS04
U201	19	28	LED DRIVER	7218B
U202	16	8	2-WAY MUX	4053
U203	16	8	3-TO-8 DECODER	74LS156
U204	7	4	FET OP AMP	3130
U205	16	8	HEX BUFFER	4503

4. MODEL FINDER SWITCH SETTINGS:

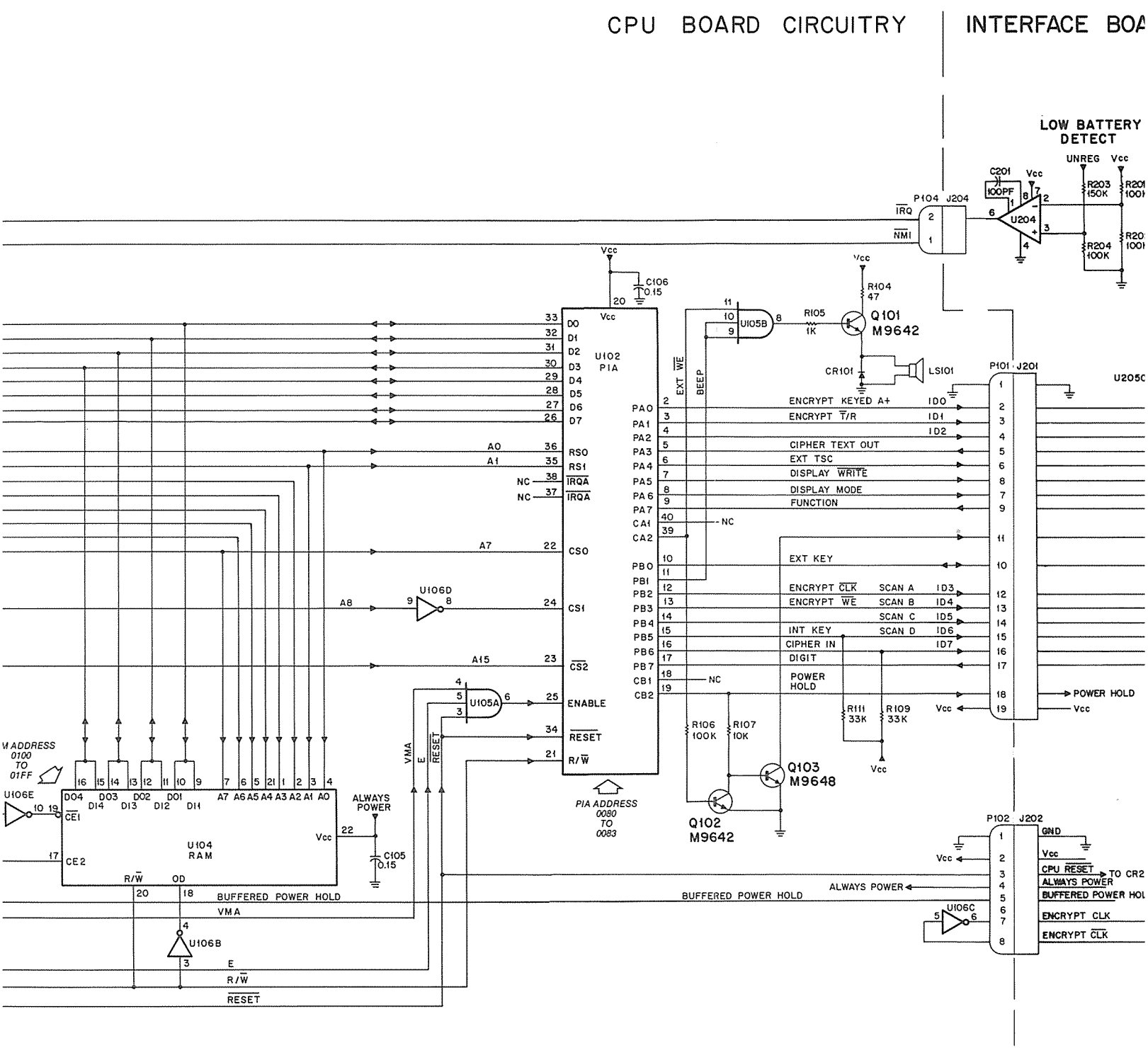
	S201-	
MODE	3	2
DVP	X	0
FED DES	0	1
NON-FED DES	1	1

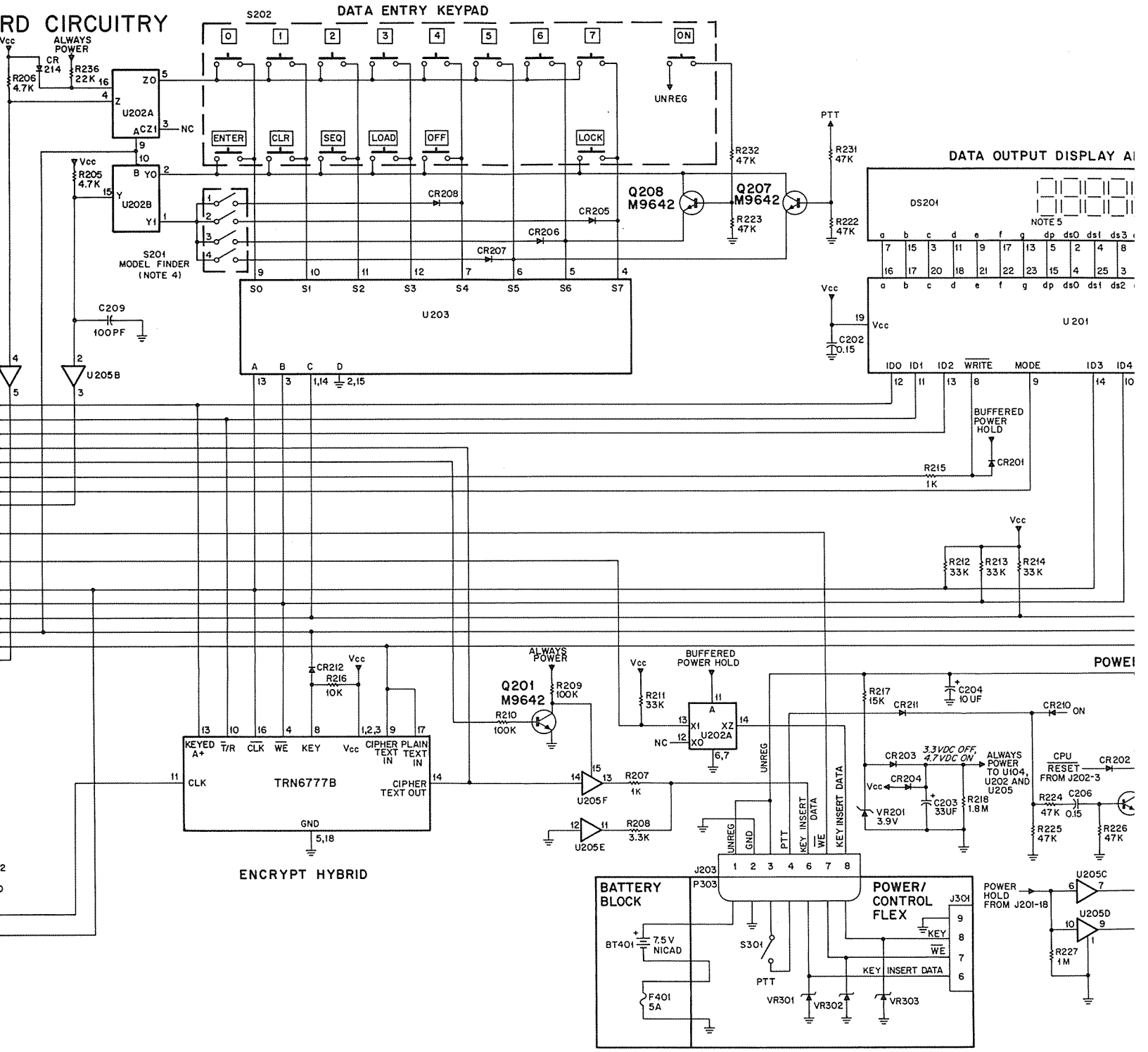
	S201-	
BIT RATE (KHZ)	4	1
9.6	1	1
12	1	0
16	0	1
24	0	0

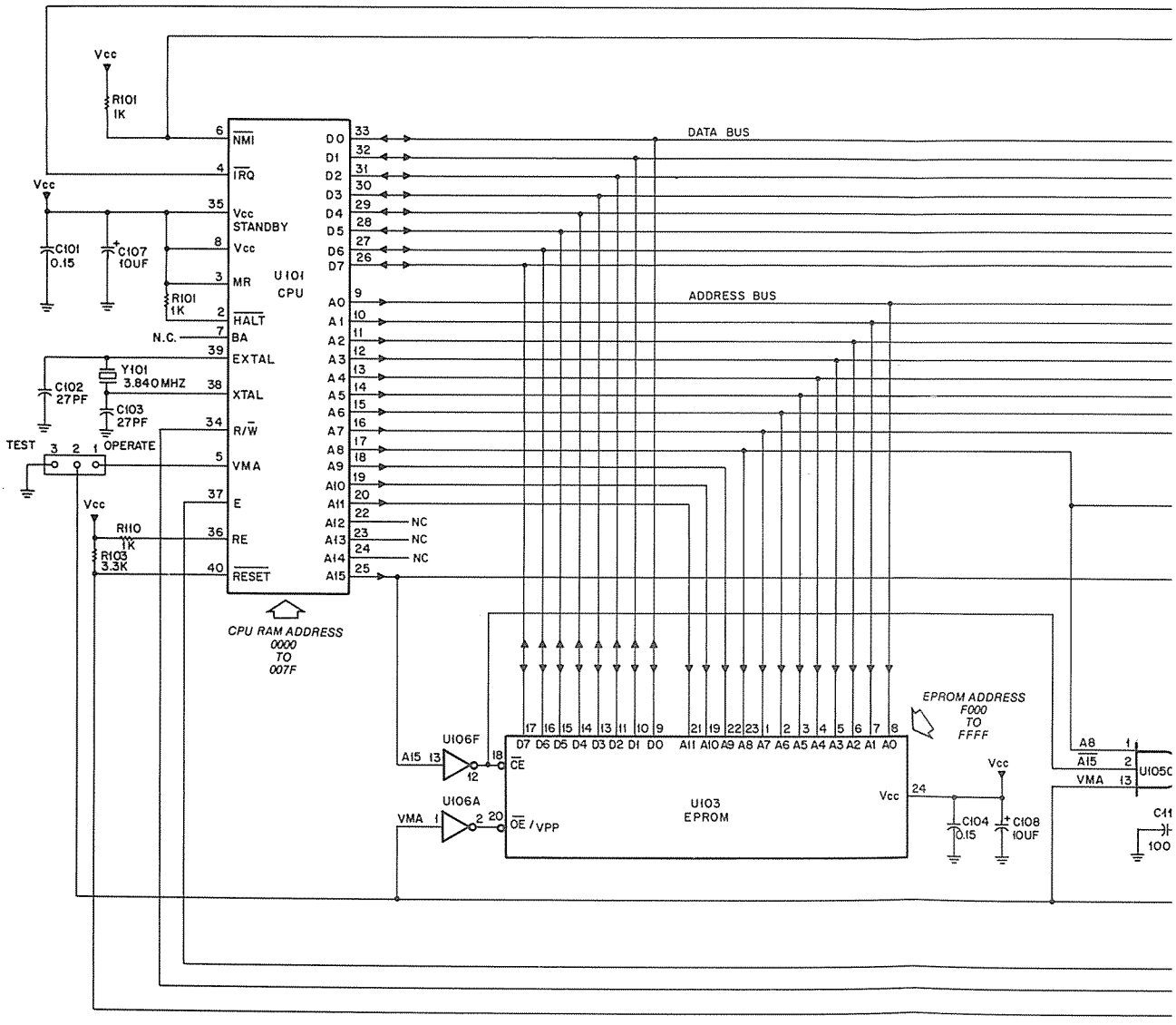
5. THIRD DIGIT OF LED DISPLAY NOT USED.

EEPS-33012-C

DVP Code Inserter
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-42693-O
(Sheet 2 of 2)
12/5/85-UP


CPU BOARD CIRCUITRY
INTERFACE BOA
LOW BATTERY DETECT
UNREG
Vcc
C201 100PF
R203 150K
R204 100K
U204
P104 J204
IRQ
NMI
U102 PIA
C106 0.15
R104 47
R105 1K
Q101 M9642
U105B
CR101
LSI01
P101 J201
EXT WE
BEEP
ENCRYPT KEYED A+
ENCRYPT T/R
CIPHER TEXT OUT
EXT TSC
DISPLAY WRITE
DISPLAY MODE
FUNCTION
EXT KEY
ENCRYPT CLK
ENCRYPT WE
INT KEY
CIPHER IN
DIGIT
POWER HOLD
SCAN A
SCAN B
SCAN C
SCAN D
ID0
ID1
ID2
ID3
ID4
ID5
ID6
ID7
R106 100K
R107 10K
R111 33K
R109 33K
Q102 M9642
Q103 M9648
PIA ADDRESS 0080 TO 0083
U106D
U105A
U106E
U104 RAM
M ADDRESS 0100 TO 01FF
ALWAYS POWER
C105 0.15
BUFFERED POWER HOLD
VMA
E
R/W
RESET
U106B
P102 J202
GND
CPU RESET
ALWAYS POWER
BUFFERED POWER HOL
ENCRYPT CLK
U106C
TO CR2


RD CIRCUITRY
DATA ENTRY KEYPAD
S202
0
1
2
3
4
5
6
7
ON
UNREG
ENTER
CLR
SEQ
LOAD
OFF
LOCK
R232 47K
PTT
R231 47K
R222 47K
R223 47K
Q208 M9642
Q207 M9642
CR208
CR205
CR206
CR207
S201 MODEL FINDER (NOTE 4)
U203
S0 S1 S2 S3 S4 S5 S6 S7
A B C D
DATA OUTPUT DISPLAY A
DS201
NOTE 5
U201
C202 0.15
C209 100PF
U205B
U202A
U202B
R206 4.7K
R205 4.7K
CR 214
R236 22K
ALWAYS POWER
Vcc
ID0 ID1 ID2 WRITE MODE ID3 ID4
BUFFERED POWER HOLD
CR201
R215 1K
R212 33K
R213 33K
R214 33K
CR212
R216 10K
Q201 M9642
R209 100K
R210 100K
R211 33K
U202A
R217 15K
CR211
C204 10 UF
CR210 ON
CR203 3.3VDC OFF, 4.7VDC ON
CR204
C203 33UF
R218 1.8M
VR201 3.9V
ALWAYS POWER TO U104, U202 AND U205
CPU RESET FROM J202-3
CR202
R224 47K
C206 0.15
R225 47K
R226 47K
KEYED A+
T/R
CLK
WE
KEY
CIPHER TEXT IN
PLAIN TEXT IN
CIPHER TEXT OUT
TRN6777B
GND
5,18
ENCRYPT HYBRID
U205F
U205E
R207 1K
R208 3.3K
UNREG
GND
PTT
KEY INSERT DATA
WE
J203
P303
BATTERY BLOCK
BT401 7.5 V NICAD
F401 5A
S301
VR301
VR302
VR303
POWER/ CONTROL FLEX
J301
KEY
WE
KEY INSERT DATA
POWER HOLD FROM J201-18
U205C
U205D
R227 1M


Vcc
R101
1K
U101
CPU
NMI
IRQ
Vcc
STANDBY
Vcc
MR
HALT
BA
EXTAL
XTAL
R/W
VMA
E
RE
RESET
N.C.
C101
0.15
C107
10UF
R101
1K
Y101
3.840MHZ
C102
27PF
C103
27PF
TEST
OPERATE
R110
1K
R103
3.3K
D0
D1
D2
D3
D4
D5
D6
D7
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
NC
NC
NC
DATA BUS
ADDRESS BUS
CPU RAM ADDRESS
0000
TO
007F
U106F
U106A
A15
VMA
CE
OE / VPP
U103
EPROM
D7 D6 D5 D4 D3 D2 D1 D0
A11 A10 A9 A8 A7 A6 A5 A4 A3 A2 A1 A0
EPROM ADDRESS
F000
TO
FFFF
Vcc
C104
0.15
C108
10UF
A8
A15
VMA
U105C
C11
100

CPU BOARD CIRCUITRY
INTERFACE E
LOW BATTI
DETECT
UNREG V
C201
100PF
Vcc
R203
150K
R204
100K
U204
P104 J204
IRQ
NMI
C106
0.15
U102
PIA
D0
D1
D2
D3
D4
D5
D6
D7
RS0
RS1
IRQA
IRQA
CS0
CS1
CS2
ENABLE
RESET
R/W
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
CA1
CA2
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
CB1
CB2
EXT WE
BEEP
U105B
R105
1K
R104
47
Q101
M9642
CR101
LS101
P101 J201
ENCRYPT KEYED A+
ENCRYPT T/R
CIPHER TEXT OUT
EXT TSC
DISPLAY WRITE
DISPLAY MODE
FUNCTION
EXT KEY
ENCRYPT CLK
ENCRYPT WE
INT KEY
CIPHER IN
DIGIT
POWER HOLD
SCAN A
SCAN B
SCAN C
SCAN D
ID0
ID1
ID2
ID3
ID4
ID5
ID6
ID7
POWER HO
R106
100K
R107
10K
R111
33K
R109
33K
Q103
M9648
Q102
M9642
PIA ADDRESS
0080
TO
0083
U105A
U106D
U106E
U106B
U106C
A0
A1
A7
A8
A15
NC
VMA
E
RESET
R/W
RAM ADDRESS
0100
TO
01FF
U104
RAM
CE1
CE2
OD
D04
D03
D02
D01
DI4
DI3
DI2
DI1
ALWAYS
POWER
C105
0.15
BUFFERED POWER HOLD
P102 J202
GND
CPU RESET
ENCRYPT CLK