MOTOROLA

Land Mobile Products Sector

T3011DX DES/DES-XL KVL (Key Variable Loader)

Instruction Manual

68P81090E20-O

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(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 applies only within the United States

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T3011DX DES/DES-*XL* KVL Key Variable Loader

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PERFORMANCE SPECIFICATIONS

GENERAL

Power Supply	7.5 V Rechargeable Nickle-Cadmium Battery
Number of Keys	7.2×10^{16} Unique and Orthogonal Key Variables
Key Variable Storage	Stores up to 16 Traffic Keys and 16 Shadow Keys in Non-Volatile Memory
Key Transfer Method	Via Temporary Patch Cord Connection to DES/DES-XL Equipment
Display	8-Digit, 7-segment LED display monitors operational status and review of manually entered keystrokes prior to transfer into non-recallable memory.
Average Number of Key Insert Operations* (w/Medium-High Capacity Battery)	200

* Assumes one manual programming operation plus 30 seconds "on" time per key load at 25° C.

PHYSICAL DIMENSIONS

	Height	Weight
Keyloader Only	5.92" (150.4 mm)	11.5 oz. (325 g)
Keyloader w/Medium-High Capacity Battery	8.62" (209.8 mm)	19.7 (560 g)

MODEL COMPLEMENT

T3011DX DES/DES-XL Key Variable Loader	
NLN9998C	Medium-High Capacity battery
TRN9859A	DES/DES-XL Label Kit
TRN7036A	DES/DES-XL Hybrid
TRN7136B	CPU Board
TRN9939A	DES/DES-XL Front Cover
TRN9876A	Hardware Kit
TRN9897B	Flex and Frame Kit
TRN9898A	Back Cover
TRN9938C	Interface Board
TVN6140A	DES/DES-XL EPROM

OPTIONS

Option	Kit	Description
		Cable Options
C540AA	TKN8209C	For MX300, MX300-R, MX300-S, STX equipment models
C541AA	TKN8210C	For Micor, Secure Test Equipment, Spectra-TAC Comparator, CIU, Portable Repeater equipment models
C542AA	TKN8229C	For SYNTOR, SYNTOR X, MCX100, MCX1000, CIU-II, DIU, PX300 S, SVX-1000 equipment models
C543AA	TKN8531B	For Expo, SYNTOR X 9000 equipment models
C544AA	TKN8506B	For SABER and ASTRO equipment models
C721	TKN8584A	RS232 interface cable for remote KVL operations
		Battery Options **
H207AB	--	Omit Battery

** The increased weight of the High Capacity and Ultra-High Capacity batteries may result in serious damage to the KVL if it is dropped.

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.

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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.
1301 E. Algonquin Road SH4
Schaumburg, Illinois 60196

REPLACEMENT PARTS ORDERING

ORDERING INFORMATION

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.

Crystal and channel element orders should specify the crystal or channel element type number, crystal and carrier frequency, and the 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.

MAIL ORDERS

Send written orders to the following addresses:

Replacement Parts/Test Equipment/
Crystal Service Items:
Motorola, Inc.
Communications Parts Division
Attention: Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

Federal Government Orders:

Motorola Inc.
Communications Parts Division
Attention: Order Processing
1701 McCormick Drive
Landover, MD 20785

International Orders:

Motorola Inc.
Communications Parts Division
Attention: International Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

TELEPHONE ORDERS

Replacement Parts/Test Equipment/Crystal Service Items:

Call: 1-800-422-4210
1-800-826-1913 (For Federal Government Orders)

TELEX/FAX ORDERS

Replacement Parts/Test Equipment/
Crystal Service Items:

Telex: 280127 (Domestic)
403305 MOTOPARTS SHBU UD (International)
FAX: 708-576-6285

Federal Government Orders:

FAX: 301-925-2473 or 301-925-2474

CUSTOMER SERVICE

Replacement Parts/Test Equipment:

Call: 1-800-537-7007

Crystals:

Call: 1-800-323-0234 (Except Illinois Residents)
1-800-537-7007 (For Illinois Residents)

Parts Identification:

Call: 708-576-7418

NATIONAL DATA SERVICES

1711 West 17th Street, Tempe, AZ 85281

Call: 602-994-6472, FAX: 602-994-6762

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SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES

Many of the integrated circuit devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open circuit impedance, CMOS ICs are vulnerable to damage from static charges. Care must be taken in handling, shipping, and servicing them and the assemblies in which they are used.

Even though protection devices are provided in CMOS IC inputs, the protection is effective only against overvoltage in the hundreds of volts range such as are encountered in an operating system. In a system, circuit elements distribute static charges and load the CMOS circuits, decreasing the chance of damage. *However, CMOS circuits can be damaged by improper handling of the modules even in a system.*

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions.

1. Prior to and while servicing a circuit module, particularly after moving within the service area, momentarily touch *both* hands to a bare metal earth grounded surface. This will discharge any static charge which may have accumulated on the person doing the servicing.

NOTE

Wearing Conductive Wrist Strap (Motorola No. RSX-4015A) will minimize static buildup during servicing.

WARNING

When wearing Conductive Wrist Strap, be careful near sources of high voltage. The good ground provided by the wrist strap will also increase the danger of lethal shock from accidentially touching high voltage sources.

2. Whenever possible, avoid touching any electrically conductive parts of the circuit module with your hands.

3. Normally, circuit modules can be inserted or removed with power applied to the unit. However, check the INSTALLATION and MAINTENANCE sections of the manual as well as the module schematic diagram to insure there are no objections to this practice.

4. When servicing a circuit module, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.

5. All electrically powered test equipment should be grounded. *Apply* the *ground lead* from the test equipment to the circuit module *before* connecting the *test probe*. Similarly, *disconnect* the *test probe prior* to removing the *ground lead*.

6. If a circuit module is removed from the system, it is desirable to lay it on a conductive surface (such as a sheet of aluminum foil) which is connected to ground through 100k of resistance.

WARNING

If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

7. When soldering, be sure the soldering iron is grounded.

8. Prior to connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary in the replacement of an integrated circuit device), be sure to discharge any static buildup as described in procedure 1. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch pins on the CMOS device and associated board wiring.

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9. When replacing a CMOS integrated circuit device, leave the device in its metal rail container or conductive foam until it is to be inserted into the printed circuit module.

10. All low impedance test equipment (such as pulse generators, etc.) should be connected to CMOS device inputs after power is applied to the CMOS circuitry. Similarly, such low impedance equipment should be disconnected before power is turned off.

11. Replacement modules shipped separately from the factory will be packaged in a conductive material. Any modules being transported from one area to another should be wrapped in a simlar material (aluminum foil may be used). NEVER USE NON-CONDUCTIVE MATERIAL for packaging these modules.

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DESCRIPTION

Model T3011DX DES/DES-XL KVL

1. INTRODUCTION

The Motorola Model T3011DX Key Variable Loader (KVL), shown in Figure 1, is a hand-held electronic encoding device used to transfer key variables to DES (Data Encryption Standard) or DES-*XL* (DES with Extended Range) equipped radio sets. The operator can manually program the selected key into the KVL via a 16-digit keypad on the keyloader, or may transfer key variables to the keyloader from other T3011 loaders (via a TKN8209B *MX300* series keyload cable). Additionally, in a Multikey/OTAR (Over-The-Air-Rekeying) System, the Key Management Controller (KMC) is capable of downloading key variable information to the KVL over the phone line using an optional dial-up modem (TDN7361, shown in Figure 2) and the Remote KVL RS232 interface cable (TKN8584). The KVL can also be connected directly to the KMC by using the RS232 interface cable with a null modem.

The operator initiates key variable transfers to equipment by pressing the Push-To-Transfer (**P-T-T**) switch on the keyloader. This causes the key to be transferred, via a cable, to the radio's memory or directly to the radio's encryption device, depending on the type of transfer selected by the operator.

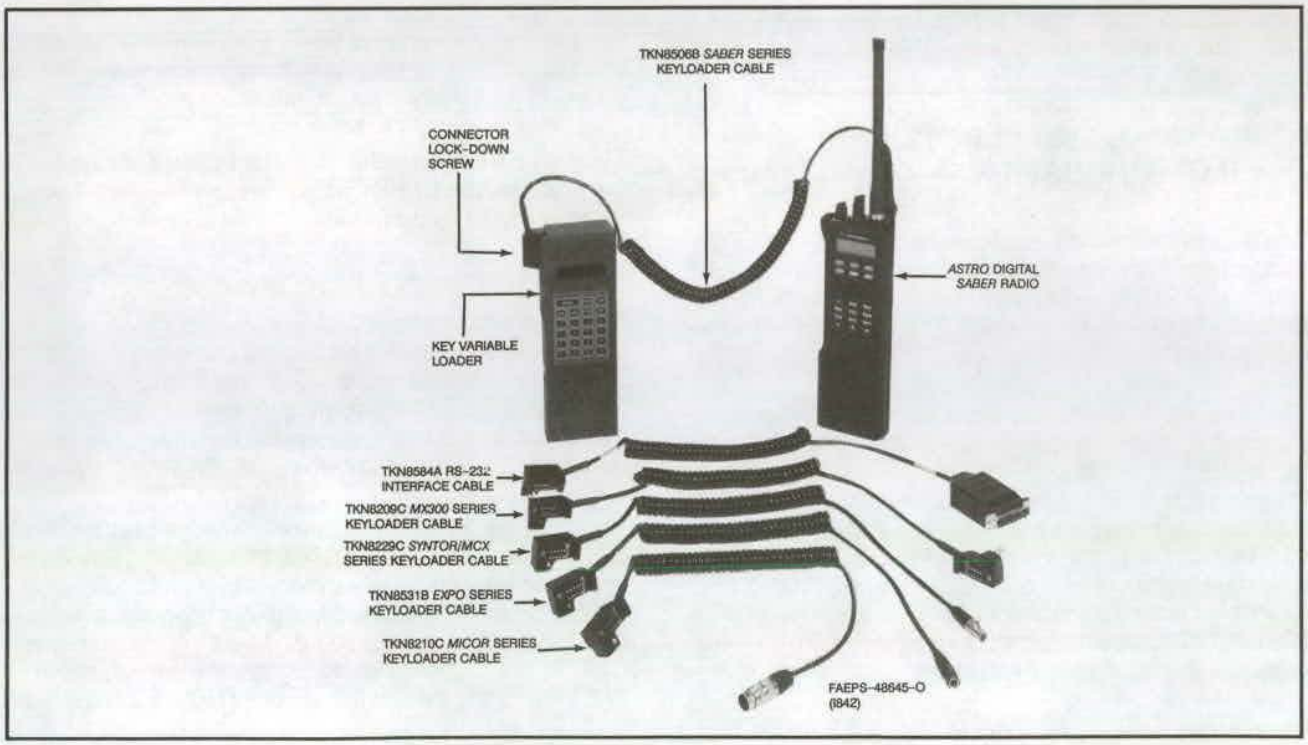

Figure 1. Model T3011DX Key Variable Loader

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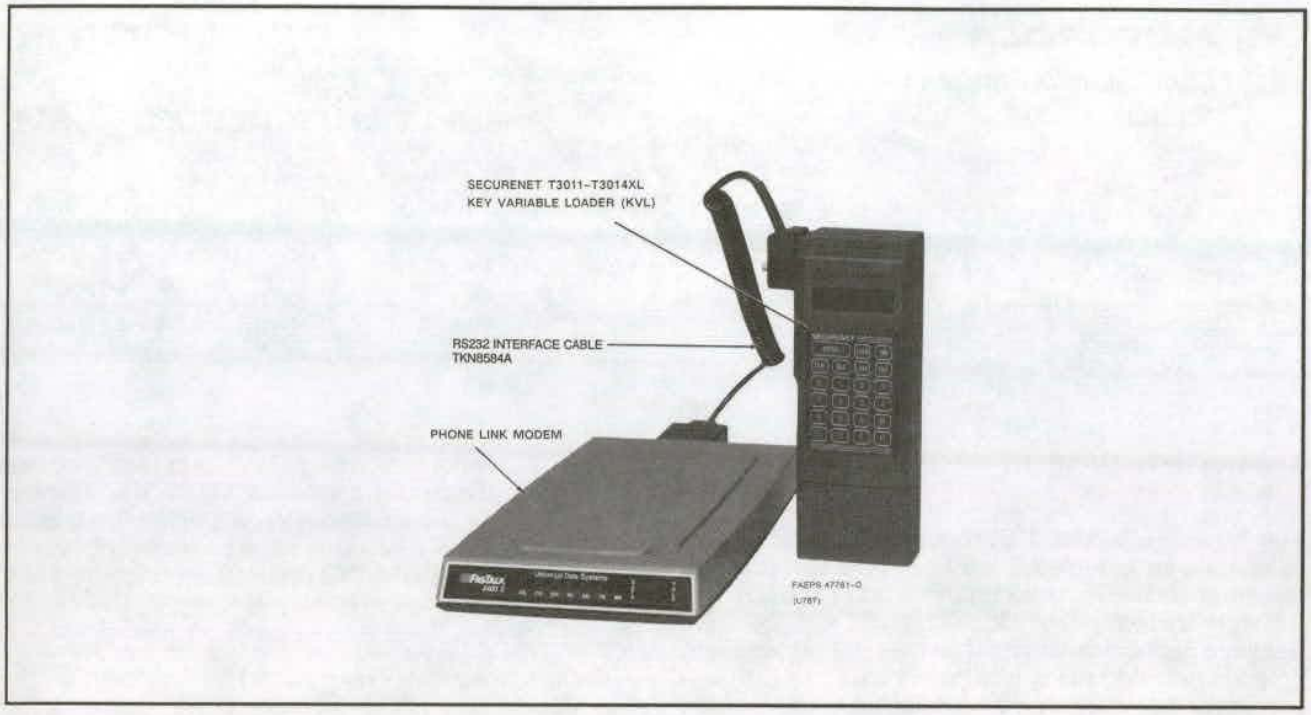

Figure 2. Key Variable Loader Connected to a Modem

NOTE

The Push-To-Transfer switch is abbreviated in this manual as "P-T-T". This is not to be confused with a Push-To-Talk switch on a radio set, normally abbreviated as "PTT".

2. PHYSICAL AND ELECTRICAL CHARACTERISTICS

The KVL is a slim hand-held unit constructed of high impact polycarbonate plastic. It is designed for the rugged demands of field use. Its weight and size are primarily determined by the battery selected. The cover of this manual shows the T3011DX Key Variable Loader.

The Motorola MC6802 microprocessor-based circuitry is powered by a re-chargeable NI-CAD™ (Nickel-CADmium) 7.5 V dc battery. The microprocessor contains 128 bytes of internal RAM for temporary lock and key variable storage during program execution. The 32k x 8 bit EPROM contains the operational program which controls the electronics of the KVL. An external 2048 x 8 bit EEPROM is used for storage of key variables, locks, and mapping information. Any of the possible 7.2×10^{16} key variables may be chosen by the user.

To conserve battery power, an automatic shutdown procedure is incorporated within the unit. The KVL "times out" and shuts itself off if no usage occurs within 45 seconds while in most of the KVL functions, and after 90 seconds if the user is in edit mode within a function. Five seconds before automatic shutdown, the loader emits a warning tone to alert the user that a shutdown is about to occur. To abort a shutdown, the user must press any button within five seconds of hearing this warning tone. If no buttons are pressed the unit will preserve any key or lock variables previously entered and shuts itself off.

Since all critical variables (keys, locks, etc.) are stored in the non-volatile EEPROM, the battery may be removed without loss of information.

3. COMPONENT PARTS

The key variable loader consists of three main parts: 1) electronics unit, 2) battery pack, and 3) interface cables. The electronics unit is internally divided into the CPU circuit board, interface circuit board, flex circuit, frame, and covers.

The CPU circuit board includes a Motorola MC6802 microprocessor, an EPROM, a EEPROM, a peripheral interface adapter (PIA), a watchdog timer and a low battery charge detector. A unique keyloader program is permanently stored in the EPROM. The PIA interfaces the CPU to the keypad, display, encryption hybrid, the EEPROM and the external equipment to be loaded.

The interface circuit board contains the circuitry for the power regulator, light emitting diode (LED) display and driver, encryption hybrid, and the keypad.

The flex circuit and frame kit contains the Push-To-Transfer (P-T-T) switch and cable connector for transfer of DES keys to DES/DES-*XL* equipment and other KVLs.

4. FUNCTIONS

4.1 KEY VARIABLE ENTRY AND STORAGE

The Key Variable Loader (KVL) functions by accepting a selected key variable, storing the key variable, and (upon command) transferring the key variable to load another KVL or to program DES/DES-*XL* equipment. The operator may load key variables into the KVL manually via keypad entries, electronically utilizing another KVL connected by the keyload cable, or in an OTAR system, by establishing an electronic link with the Key Management Controller.

The operator who decides to enter key variables manually, must choose a 16-digit key variable and manually enter it into the keyloader through the keypad. The key variable can be reviewed in the KVL display prior to entering it into the memory circuitry. For security purposes, once the operator presses the **ENTER** button, causing the variable to be entered into the EEPROM memory, the key variable cannot be recalled to the display. The KVL can store up to 16 distinct traffic keys, and 16 shadow keys. Traffic keys are used for encrypting voice traffic between encryption equipped radios. Shadow keys, on the other hand, are used in an OTAR (Over-The-Air-Rekeying) system. Shadow keys can only be used in OTAR systems.

The KVL has the capability to store a logical ID for each key variable entered. A logical ID is a 16 bit key variable identifier that can be used in systems that support preamble or embedded signalling. The logical ID tells the receiver which key to use to decrypt a message. A logical ID can only be entered immediately following entry of a key variable.

By using the Group Mapping feature, the operator may transfer a group of 16 traffic keys and one shadow key in a single transfer. Default maps are set up to transfer key 0 in the KVL to slot 0 in the radio, key 1 to slot 1, etc. "Personalized" maps can be set up by editing the default maps.

The T3011DX DES/DES-*XL* KVL also transfers key variables and group maps to other DES/DES-*XL* KVLs. To perform this operation, the operator first connects the two units together via the appropriate keyload cable. Next, the operator chooses the desired features from the share options menu. The Push-To-Transfer (P-T-T) switch is depressed to send the desired data. There is no mechanism provided for viewing the key variables before, during, or after the transfer in either unit to ensure security of the key and lock variable data.

In addition to loading keys directly from the keypad and receiving key variables from another KVL, the KVL can also receive keys and mapping information from the Key Management Controller (KMC). The KVL operator can 'call' the KMC by attaching the KVL through the specially designed RS232 interface cable (TKN8584) to a modem (TDN7361) and receive key variables and mapping information over the phone. If the KMC is at the same site, the KVL can be hooked directly to the KMC through the same RS232 interface cable with a null modem adaptor attached, between the KVL's interface cable and the RS232 connector on the KMC.

4.2 TRANSFER OF KEY VARIABLES AND MAPPING INFORMATION

To load Motorola equipment with DES/DES-*XL* key variables, the KVL is connected to the equipment with the appropriate keyload cable. The key variable or group map is selected for transfer and the transfer is activated by pressing the Push-To-Transfer (P-T-T) button on the side of the KVL. As part of the transfer function, the KVL is able to automatically determine the type of equipment that is connected so the appropriate data can be transferred with the appropriate protocol. When loading ASN radios the KVL operator may transfer a single key to a specific memory location in the radio, or may transfer the key only to the radio's encryption device. Additionally, the KVL is capable of sending up to 16 traffic keys and 1 shadow key in a single transfer to memory locations in a multikey radio specified by the KVL operator (this is known as "transferring a group map"). If the transfer is successful, the KVL sends an encrypted verification tone to the equipment where it is decrypted. Most Motorola equipment will send the decrypted data to a local speaker to give an audible indication that the transfer was successful. In addition,the display on the KVL indicates "X PASSed", where "X" is a key variable memory location label or group map number.

4.3 LOCK MODE

As a feature, the KVL can be electronically locked to prevent use by unauthorized persons. To use this feature, the operator enters a lock variable of any length from one to sixteen digits long while the unit is unlocked. If the lock function is activated, the user is prompted to enter the correct lock variable whenever the KVL is turned on. Until the lock variable is correctly entered, the operator is not allowed to use any of the functions of the KVL.

If the operator forgets the lock digits, the electronic lock can be manually overridden by erasing all key and lock variables via a keypad sequence. The unit then becomes unlocked and is fully functional, however, all data must be re-entered.

4.4 CALIBRATION MODE

The KVL can also be used to assist in setting the output level of Motorola equipment that utilize DES-*XL* encryption modules. DES-*XL* modules within the equipment can be internally placed in a special calibration mode. When in this mode, the module outputs a constant

1 kHz square wave on its CTO pin whenever the equipment is placed in private transmit operation. This can be very helpful for setting the FM deviation in radios, line levels on wireline phone connections, etc.

To place the DES–*XL* equipment in the calibration mode, the operator connects the KVL to the equipment via the appropriate keyload cable. Then, via a keypad sequence, the KVL places the equipment in the calibration mode. After the equipment levels have been adjusted, the KVL can return the equipment to the normal mode of operation. Note that key variables must then be loaded into the equipment, because the calibration mode forces a key erasure in the radio's encryption device.

OPERATION

Model T3011DX DES/DES–XL KVL

1. THE KVL OPERATING SYSTEM

The KVL consists of 5 top level menus which are accessed by repeated pressing of the **SEQ** button (see Figure 1). Pressing the **ENTER** button at any one of the top level menus takes the user into the selected function. The following is a list of the five top level menus with a brief description of the function provided.

LOAd? Allows the operator to enter key variables and Logical ID's or to transfer a single key to a radio.

G LOAd? Allows the operator to transfer a group of 16 traffic keys and one shadow key in a single transfer. Default maps are set up to transfer key 0 in the KVL to slot 0 in the radio, key 1 to slot 1, etc. "Personalized" maps can be set up by editing the default maps.

SHArE? Allows the operator to select what is to be shared with other KVLs.

ASN? Allows the operator to receive key variables and mapping information from the KMC.

CAL? When selected, this function allows the operator to place the connected radio in the calibration mode.

The operator may return to the top level menu at any time by repeatedly pressing the **ENTER** button until the top level menu for the function is displayed.

Each press of the **ENTER** button advances the menu to the next higher level in the menu "tree" until the top level menu is reached. At the top level menu, the **ENTER** button is then used to select a function. The **LOAD** button is used to enter into the sub–menus for each function.

2. TURNING THE UNIT ON

Refer to Figure 2, Locations of Controls, for abbreviations, definitions, and locations of the various operator controls on the Key Variable Loader (KVL).

2.1 METHOD 1

When the unit is powered up by pressing the **ON** button, the message "bUSy" will appear temporarily. The display will then show the top–level menu of the functional group the KVL was in when the unit was turned off. If the unit was turned off in one of the menus used to load key variables or mapping information, (x rEAdy, x ErASEd, GrouPx) the unit will power up at the last selected key or group specified by x.

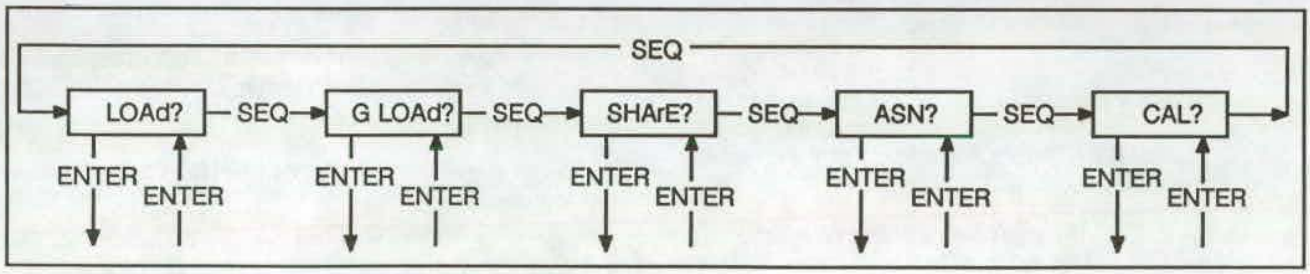

Figure 1. Display Looping Sequence.

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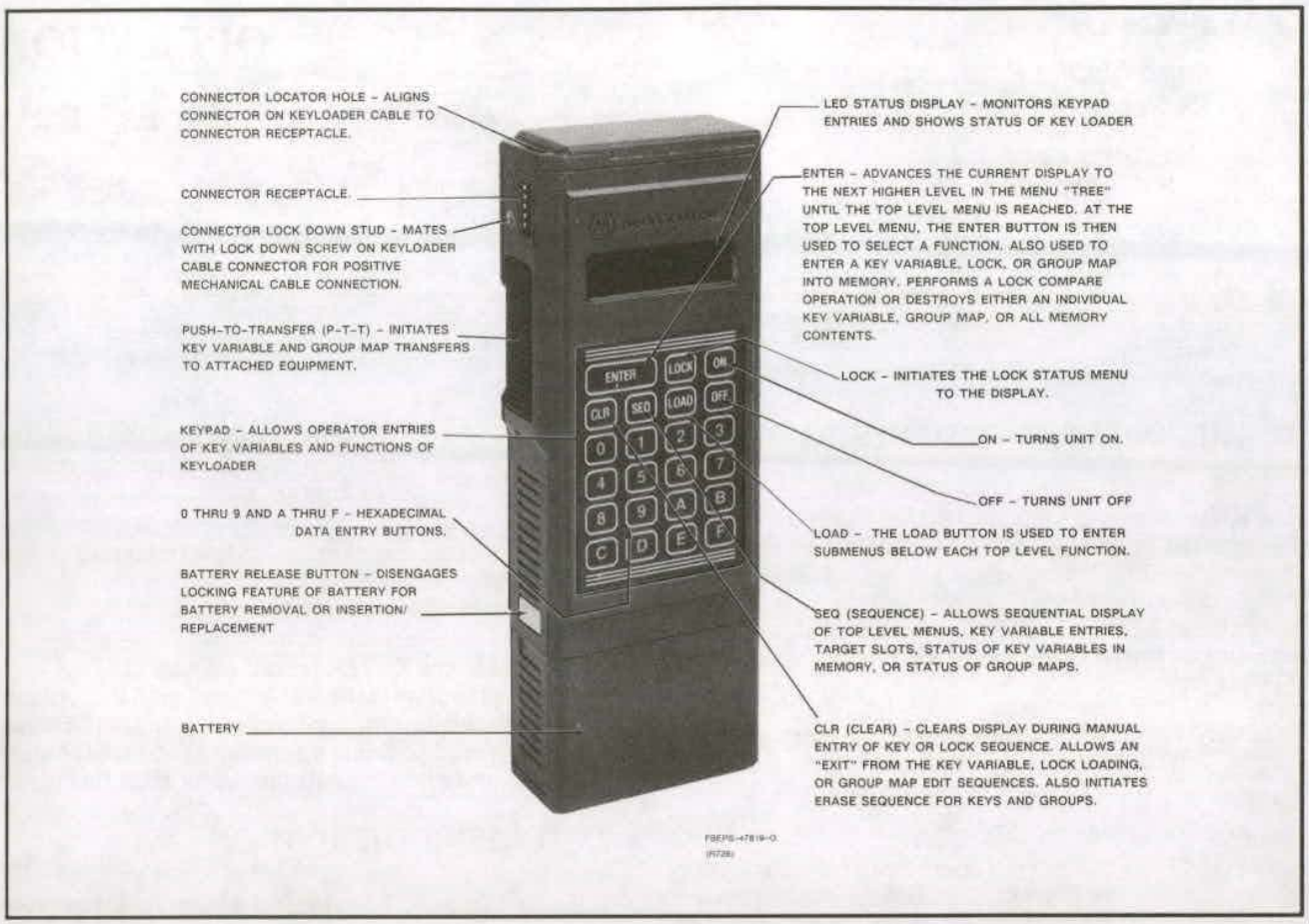

Figure 2. Locations of Controls.

2.2 METHOD 2

If the unit is powered up by pressing the Push To Transfer (P-T-T) button on the side of the unit, the message "bUSy" will appear temporarily. If the unit was turned off at "x rEAdy" or "GrouPx", the unit will display "bUSy" momentarily and go directly to the key variable transfer routines.

The following is a list of the status alarms and their meanings that may appear when the unit is turned on:

- "LO CHArGE" — the internal circuitry has detected a low battery voltage condition. The unit may appear to function correctly, however, it is not recommended to operate the KVL in this condition. Turn the unit off and replace or recharge the battery.
- "All ErASEd" — there are no valid key variables in the unit (i.e., all 32 key variables and the lock variable are erased).
- "LOC?" — this indicates that the unit is electronically locked and will not allow further use until the lock digits have been correctly entered, or until all the key variables are erased. Refer to the lock entry paragraphs or key variable erase paragraphs.

3. SELECTING A TOP-LEVEL FUNCTION

Press **ON** to turn the unit on.

Display shows "LOAd?", "G LOAd?", "SHArE?", "CAL?", "x rEAdy", "x ErASEd", "ASN?", or "GrouPx", where "x" is a key variable memory location or group number.

If display shows "x rEAdy" or "x ErASEd", press **ENTER** to get back to the top level menus.

Display shows "LOAd?".

If display shows "GrouPx", press **ENTER** to get back to the top level menus.

Display shows "G LOAd?"

Sequence through the top level functions by depressing the **SEQ** button.

Display will loop in the following sequence (as shown in Figure 1):

"LOAd?"
"G LOAd?"
"SHArE?"
"ASN?"
"CAL?"

When the display is showing the desired function, press the **ENTER** button to select the function.

4. LOAD FUNCTION

Pressing the **ENTER** button at the "LOAd?" menu allows the operator to view the status of the 16 traffic keys and the 16 shadow keys. This menu also allows the operator to load a new key variable into any of the key storage locations or to transfer a single key variable to ASN as well as non-ASN equipment.

4.1 LOADING A KEY VARIABLE INTO THE KVL VIA THE KEYPAD

Select "LOAd?" from the main menu.

Display shows "LOAd?".

Press **ENTER** (as shown in Figure 3) to select the LOAD function.

Display shows "x rEAdy", "x ErASEd", "Sx rEAdy" or "Sx ErASEd".

Select the desired key variable memory location, as shown in Figure 4, by pressing a digit (**0–9**, **A–F**) on the keypad, or use the **SEQ** button.

To select a shadow key when the status of a traffic key is being shown, press the **SEQ** button until the status of the first shadow key is displayed (denoted by the "S" in the leftmost position of the display) or press "**F**" on the keypad followed by the **SEQ** button.

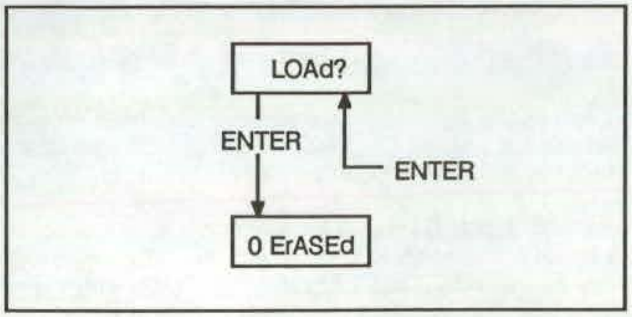

Figure 3. Load Function Selection

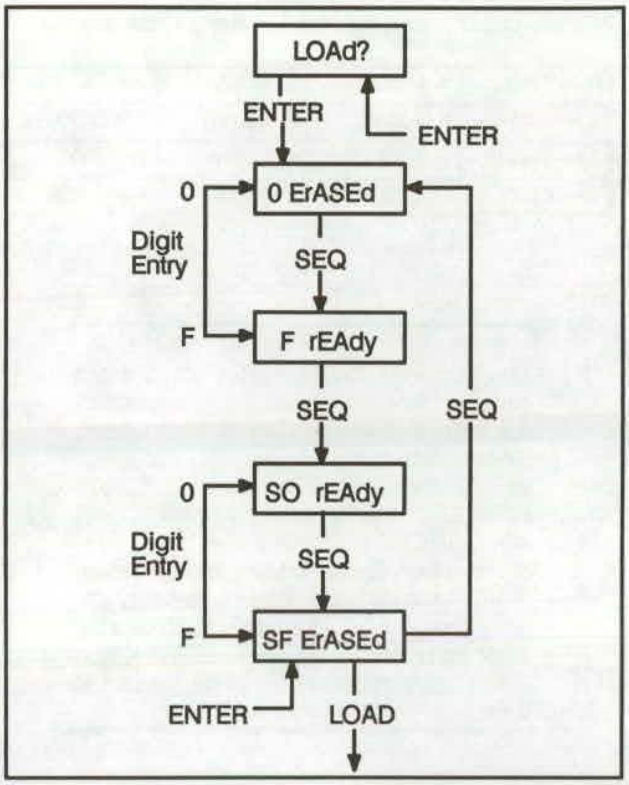

Figure 4. Selecting Key Variable Memory Locations

When the status of a shadow key is being displayed, pressing a digit (**0–9**, **A–F**) from the keypad selects shadow keys 0–9, A–F respectively.

Similarly, to select traffic keys when the status of a shadow key is being shown, as in Figure 4, press the **SEQ** button until the status of the first traffic key is displayed (the "S" in the leftmost position of the display is turned off) or press "**F**" on the keypad followed by the **SEQ** button.

Once the status of the desired key location to be loaded is displayed, the user may begin entry of a key variable into memory by pressing the **LOAD** button.

After the user has entered four valid digits, window 0 is full. When the fifth digit is entered, the window number changes from "0" to "1". Entry proceeds in this manner until all 16 digits are entered, filling all 4 windows with four digits each. When the last window is filled, the cursor changes from a blinking dash to a steady dot.

During entry, the KVL checks that the entered digit pairs have correct (odd) parity. During an attempt to enter a digit which does not meet this requirement, the KVL beeps several times and then blinks the digit until a new digit is entered. Table 1, Keypad Number Parity Definitions, shows the parity of each hexadecimal digit on the keypad.

Table 1. Keypad Number Parity Definitions

0 = EVEN	1 = ODD	2 = ODD	3 = EVEN
4 = ODD	5 = EVEN	6 = EVEN	7 = ODD
8 = ODD	9 = EVEN	A= EVEN	B = ODD
C = EVEN	D = ODD	E = ODD	F = EVEN

NOTE

The Motorola R1032A DES Test Set can generate test keys identical to two which can be loaded with the key variable loader. Communication analyzers also use a test key. The three test keys are: 70707070 70707070, 8F8F8F8F8F8F8F8F and AD6D6D6D6D6D6D6E respectively. Use of these keys for normal system operation should be avoided to ensure communications security. In addition, when entering a key variable into the keyloader, it is best if the operator uses randomly selected keys.

The KVL also has some built–in editing functions to assist in key variable entry. If a mistake is made during entry, pressing the **CLR** button erases all the digits in the window currently selected. The four digits can then be re–entered for that window. In addition, the **SEQ** button can be pressed at any time to view the currently filled windows. Changes can be made to any window by pressing **CLR** to erase the four digits and re–entering the desired digits.

While entering (and editing) a key variable, the digits are stored in the internal RAM of the microprocessor.

If the **ENTER** or **LOAD** button is pressed prior to entering all 16 digits of the variable, the KVL exits the key entry mode and erases any key variable currently stored at the selected memory position of the variable in the EEPROM. This provides a quick way to erase an individual key variable and is discussed in a later sub–paragraph, "Erasing Key Variables".

Once all the digits of the key variable have been properly entered, a period will light adjacent to the last digit entered, as shown in Figure 5. Press either the **ENTER** button or the **LOAD** button to proceed to the Logical ID entry screen, as shown in Figure 6. At this point, the key variable can no longer be displayed, or in any way reviewed or edited by the operator. A Logical ID must be entered before the key just entered will be encrypted and saved to EEPROM.

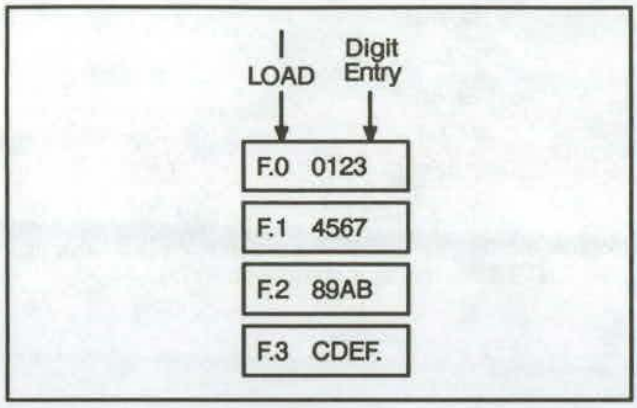

Figure 5. Window Display During Key Variable Entry

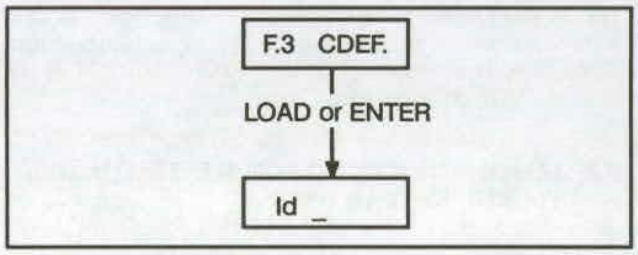

Figure 6. Accessing the Logical ID Entry Screen.

4.2 LOGICAL ID'S

A Logical ID is a 16 bit (4 hex digit) key identifier, as shown in Figure 7, that is used to identify the key to be used for decryption of messages. Logical ID's can be used in systems that support preamble signalling or in systems that support embedded signalling. In systems that utilize embedded signalling, such as the Motorola ASTRO line of digital radios, Logical ID's are required for proper operation. Consequently, the Logical ID is required to be entered after a key variable is entered.

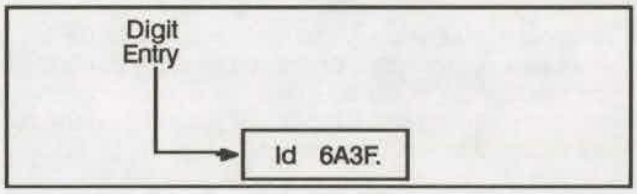

Figure 7. Typical 16–Bit Logical ID Key Identifier.

4.2.1 Entering a Logical ID

Once all the digits of the key variable have been properly selected, a Logical ID (as shown in Figure 6) can be entered by pressing the **ENTER** or **LOAD** button.

Since a Logical ID identifies or names a key variable, the Logical ID, in general, must be unique. The only exception to this rule is the Logical ID of '0000', which is reserved for key variables that are channel (mode)–slaved. Management of Logical ID's will be explained in detail in Paragraph 4.2.3.

The Logical ID is selected by pressing hex digits **0 – F** on the keypad. Each Logical ID must contain 4 digits. Pressing the **CLR** button will erase the last digit entered.

Once all four digits of the Logical ID have been properly entered, press the **ENTER** button to save the Logical ID, as shown in Figure 8. Pressing the **ENTER** button also causes the key variable to be encrypted and stored to EEPROM. Later, when the key variable is being transferred to DES/DES–*XL* encryption equipment, the KVL decrypts the EEPROM contents, reconstructs the key variable, and transfers the key variable along with the Logical ID of that key variable.

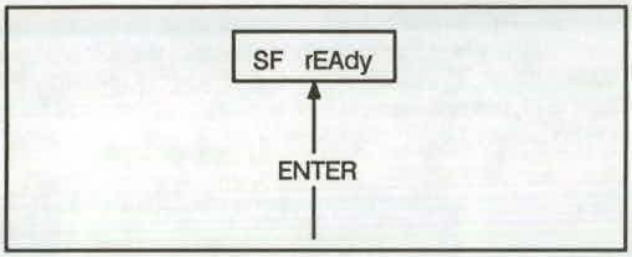

Figure 8. ENTER Pressed After Logical ID Entry.

If all four digits of the Logical ID have not been entered, an alarm will sound prompting the KVL operator to finish entering the ID. The alarm will also sound if the Logical ID just entered matches an existing Logical ID in the KVL. The only exception to this is the Logical ID of '0000'.

4.2.2 Viewing the Logical ID of a Key Variable

A new feature of the DX series KVL is the Logical ID viewing feature. This feature permits the viewing of Logical ID's of key variables in the KVL and makes Logical ID management easier. In addition, the DX series KVL do not allow duplicate Logical ID's to be entered from the keypad of the KVL.

To view the Logical ID of a key variable, press and hold down the button that corresponds to the key number for that key, as shown in Figure 9. The Logical ID will be displayed on the screen until the button is released.

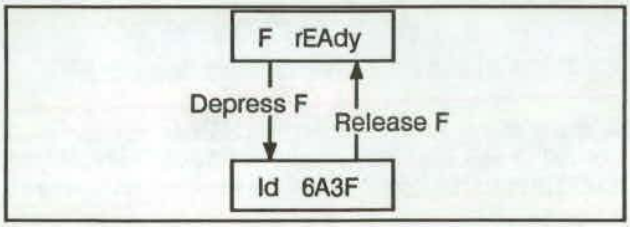

Figure 9. Viewing the Logical ID of a Key Variable

4.2.3 Managing Logical ID's

It is important that Logical ID's be correctly managed in order to ensure proper system operation. Improper management of Logical ID's could result in the occurrence of duplicate Logical ID's. This could result in a radio using the wrong key variable to decrypt received messages and lose the information. A duplicate Logical ID situation occurs when the same Logical ID is used for two different key variables.

When there are two or more KVL's in a system, care must be taken to ensure that the same Logical ID for two different keys is not entered into two different KVL's. Similarly, all KVL operators must be careful not to use the same Logical ID for two different key variables.

When a Logical ID is entered via the T3011DX KVL keypad, the KVL will check to see if it already contains the Logical ID just entered. If so, an alarm will sound, and the Logical ID must be re–entered. This prevents duplicate Logical ID's from entering the T3011DX KVL from the keypad.

However, if two KVL's having the same Logical ID for two different keys share key information (sharing is explained in Paragraph 6.), it is possible that the sharing of key information could result in a KVL having the same Logical ID for two different keys.

IMPORTANT NOTE

A Logical ID should always be unique and represent only one key variable in a system. This includes multiple algorithm systems.

There are three main ways of preventing duplicate Logical ID's from entering a system.

Method 1. *Limiting Logical ID's to KVL's.* This method works **only** if all the KVL's in a system are of the DX series or have been upgraded to have DX or limited DX features. In this method, each KVL is assigned a valid range of Logical ID values that can be entered from the keypad. For example, KVL #1 might have Logical ID's entered from the keypad to be limited to those that begin with '1'. KVL #2 might have Logical ID's entered from the keypad to be limited to those that begin with '2'.

Since the DX series KVL prevents duplicate Logical ID entry from the keypad, no person or persons may enter duplicate Logical ID's as long as the restrictions are followed by the KVL operators. Sharing between T3011DX KVL's will not compromise the Logical

ID's because each T3011DX KVL was restricted to its own range of Logical ID values.

Method 2. *Limiting Logical ID's to KVL operators.* In this method, each KVL operator is assigned a valid range of Logical ID values that **only** he or she may use. For example, KVL operator #1 might be restricted to using Logical ID's from '0001' to '0FFF'. KVL operator #2 might be restricted to using Logical ID's from '1000' to '1FFF'. As long as each KVL operator remains within his or her assigned range of Logical ID's and does not duplicate any, duplicate Logical ID's should not occur in the system.

Method 3. *Limiting Logical ID entries to one master KVL.* In this method, all key variables and their associated Logical ID's are entered only via the keypad of the master KVL. The remaining KVL's in the system initially receive keys by sharing from the master KVL. Once these KVL's receive keys from the master KVL, they can share among themselves if desired. This way, key variables and Logical ID's can be present on more than one KVL without having to type in the information on each KVL.

The best way to prevent duplicate Logical ID's from occurring is to use a combination of Methods 2 and 3. Each KVL operator is assigned a range of Logical ID's, and there is only one master KVL on which key variables and Logical ID's can be entered. The remaining KVL's receive their keys by sharing from the master KVL.

The T3011DX KVL can hold up to 16 traffic keys and 16 shadow keys, along with the Logical ID's for each of those keys. If there are more than 16 traffic keys or more than 16 shadow keys in a system, then, as needed, additional KVL's should be designated as master KVL's to hold the additional traffic or shadow keys.

IMPORTANT NOTE

Sharing should never occur among master KVL's. This way, if a key variable or Logical ID is changed, there is no chance that another master KVL might still contain old information.

4.3 ERASING A KEY VARIABLE

There are three ways to erase key variables in the KVL:

- via an all-erase sequence at power-up,
- via an individual key erase sequence on the keypad, or
- via transfer of erased key variables from another KVL.

4.3.1 All-Erase at Power-Up

The KVL EEPROM can be wiped clean at power-up by pressing and holding the **CLR** button down while turning the unit on. To execute this function, turn the unit off, and then while holding the **CLR** button down, press either the **ON** button or the Push-To-Transfer (**P-T-T**) switch on the side of the KVL. This causes the display to read "All ErASE?" with the question mark blinking. Press **ENTER** and all key and lock variables are erased in the KVL EEPROM and the display reads "All ErASEd". Note that this operation reinitializes all the group maps to the default settings. At this point there is no electrical or mechanical trace of the variables previous contents in the KVL. If the **CLR** button is pressed while the display is reading "All ErASE?", the erase action is prevented and a normal power-up occurs.

4.3.2 Individual Key Erase Via Keypad Sequence

To erase a single key variable, the operator need only to start the entry of this variable and prior to entering all 16 digits of the variable, press **ENTER**. This aborts the key entry mode and erases the key variable in the KVL memory. Typically, the shortest keystroke sequence to erase a key variable in this manner would require 3 keystrokes. Key stroke 1 would be to get the KVL to display the status of the key variable to be erased. This keystroke may not be necessary if the status of the variable is currently being displayed. Keystroke 2 would be the **LOAD** button to start entry of a new key variable. Keystroke 3 would be the **ENTER** button to erase the key variable currently at this position. Again, after a key erasure, no electrical or mechanical trace of the selected key variable is left in the KVL.

Another way to erase a single key is to press the **CLR** button while viewing the key that is to be erased.

The operator may abort the key erase operation by pressing the **CLR** button again, as shown in Figure 10.

Press the **ENTER** button to complete the zeroization process.

Note, that erasing a key variable also erases the Logical ID associated with the key.

4.3.3 Key Erasure Via Transfer from Another KVL

Transfer of key variables from one KVL to another is not limited to variables that are status "rEAdy" only. If a key variable is status "ErASEd" in the sending KVL, the receiving KVL key variable also assumes that same status. This provides a means for erasing selected key variables in the receiving KVL.

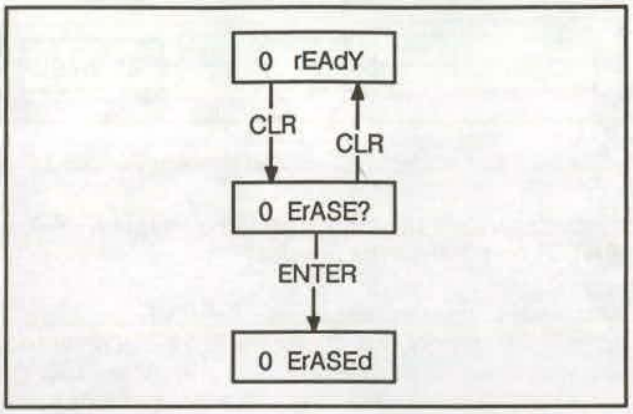

Figure 10. Zeroization Process to Delete a Key Variable.

To erase all the keys in a KVL via sharing, first erase the key variables in the sending unit (Paragraphs 4.3.1 or 4.3.2). Next, transfer all of the key variables from the sending unit to the KVL in which the key variables are to be erased. This erases the key variables in the receiving unit. For individual erasure of keys, use the single key transfer function. Again, key variables erased in this manner leave no electrical or mechanical trace in the KVL. For a more detailed description on transferring key variables from one KVL to another, refer to Paragraph 6.

4.4 TRANSFERRING A SINGLE KEY VARIABLE TO DES/DES-*XL* ENCRYPTION EQUIPMENT

Connect the keyloader to the equipment via the appropriate keyloader cable. Set the keyloader so that the status of the key variable desired to transfer is currently being displayed, as explained in Paragraph 4.1. Note that the status of the selected key must be "rEAdy" to proceed with the key variable transfer.

Press the Push-To-Transfer (**P-T-T**) switch on the side of the KVL to initiate the transfer.

4.4.1 Transferring a Key Variable to Single-Key Equipment

After pressing the **P-T-T** button to initiate a transfer to a single-key radio, "bUSy" will be displayed while the key is being transferred. At the end of the transfer, a successful transfer will be indicated by the message "PASSEd" in the KVL's display and will be accompanied by a verification tone in the radio. An unsuccessful transfer will be indicated by the message "x FAIL" and will be accompanied by a failure tone in the KVL.

Refer to paragraph 4.4.3 "Displaying Transfer Status Information" for an explanation on how to display the transfer status codes when a transfer has been completed.

4.4.2 Transferring a Key Variable to Multikey Equipment

After pressing the **P-T-T** button to initiate a transfer to a multikey radio, as shown in Figure 11, the operator will be prompted for a target location to which the key variable is to be sent and stored in the radio.

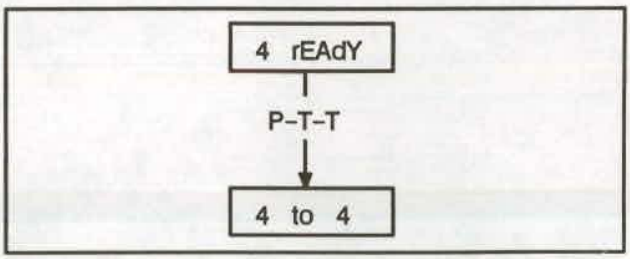

Figure 11. Initiating Single Key Variable Transfer.

To change the target location of the key variable, press the digit keys **0-9** and **A-F**, as shown in Figure 12. To correct an error, simply press the correct digit desired. Press **P-T-T** or **ENTER**, as shown in Figure 12, to transfer the key variable to the radio's memory.

The KVL will not allow key transfers to locations outside the key storage capabilities of the radio. If a storage location is selected that is out of the radio's range, an alarm will sound when the **ENTER** or **P-T-T** button is pressed.

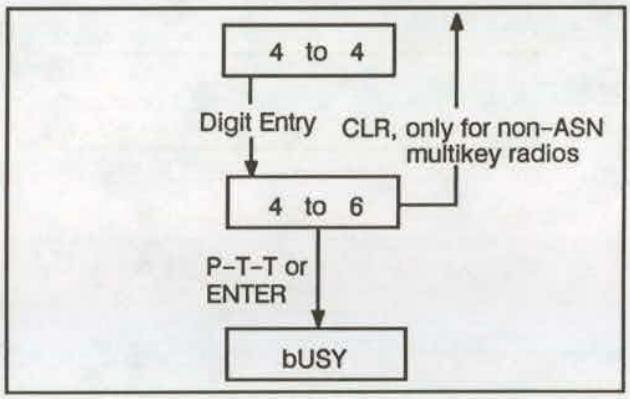

Figure 12. Transfer Key Variable to Memory.

In ASN radios, the key variable may optionally be transferred to the radio's encryption device instead of memory. Pressing the **CLR** key as shown in Figure 13 will specify the radio's encryption device as the destination of the key variable. Pressing the **CLR** key again will abort the key transfer sequence. For non-ASN multikey radios, a single press of the **CLR** key will abort the key transfer sequence.

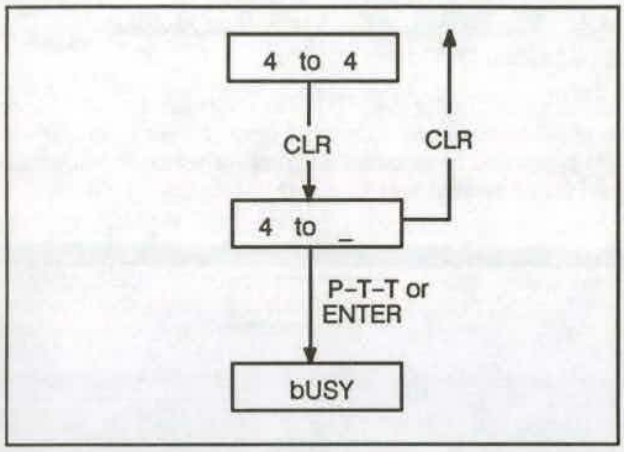

Figure 13. Selecting the Encryption Device as the Target Location for the Key Variable.

IMPORTANT NOTE

See APPENDIX A for a description of the relationship between memory locations in the KVL and key variable memory locations in the radio.

If the operator selects a shadow key to be transferred to a DES/DES–*XL* equipped radio, the operator will be prompted to select either the unique or the common shadow key slot in the radio's memory (denoted as "SU" and "SC" respectively, see Figure 14).

NOTE

Shadow keys can be transferred only to OTAR capable radios.

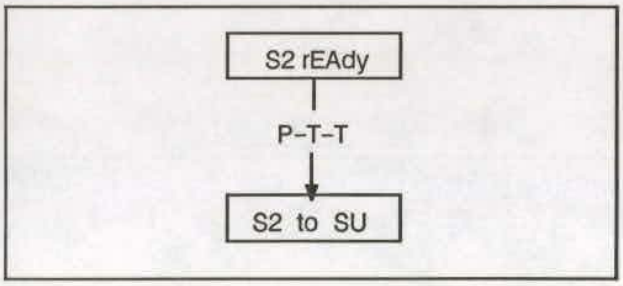

Figure 14. Selecting Unique/Common Shadow Key Slot

While digit entry is not allowed when selecting a shadow key slot, the **SEQ** button can be used to alternate between "SU" and "SC", as shown in Figure 15.

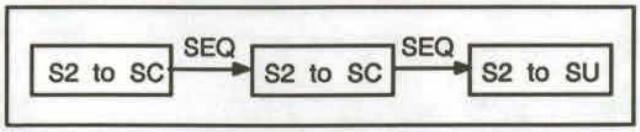

Figure 15. Alternating Selection Between SU and SC

Once the desired slot is displayed, press either **P–T–T** or **ENTER** to complete the transfer.

During the transfer sequence, the KVL performs a lengthy sequence of security checks on the equipment being loaded, and then transfers the key variable. If all the security tests pass and the key variable is properly transferred to the equipment, the KVL completes the sequence by sending an encrypted tone to the equipment. Motorola encryption equipment then decrypts this tone and in most models the tone is heard in a local speaker. After the tone is sent by the KVL, the KVL displays the message "x PASSed" (where "x" is a key variable memory location label).

If any of the security tests fail or the KVL detects that the data did not properly transfer, the KVL terminates the transfer, gives a short beeping alarm, and displays the message "x FAIL" (where "x" is a key variable memory location label).

4.4.3 Displaying Transfer Status Information

If desired, the operator can determine whether the KVL is loading a key variable to DES or DES–*XL* equipment. After the transfer has completed (pass or fail) press and hold down the **ON** button. One of the following messages will be displayed as long as the **ON** button is held down.

- "CFb 00" is displayed if the key was successfully transferred only to the encryption device (not to the radio's memory). This means that the attached radio is equipped with the DES encryption.
- "8db 00" is displayed if the key was successfully transferred to a DES–*XL* equipped radio.
- " 1.0 " indicates that transfer of a single traffic key to a radio was successful.
- " 0.1 " indicates that transfer of a single shadow key to a radio was successful.
- "CFb xx" (where xx is a non–zero value) is displayed if the key transfer failed when attempting to load a DES equipped radio.
- "8db xx" (where xx is a non–zero value) is displayed if the key transfer failed when attempting to load a DES–*XL* equipped radio.
- "ASN xx" (where xx is a non–zero value) indicates that the transfer failed when attempting to load the key variable into a memory location in a radio.

If the transfer fails, refer to the Troubleshooting section in this manual for additional information.

5. G LOAD FUNCTION

Pressing the **ENTER** button at the "G LOAd?" menu allows the operator to select a group map to transfer multiple keys to a radio. Initially, 4 default group maps have been programmed into the KVL such that traffic key variable 0 will be transferred to memory location (slot) 0 in the radio, traffic key 1 in the KVL will be sent to memory location 1, etc., through traffic key F. In addition, Shadow Key 0 (S0) in the KVL will be mapped to the Common Shadow Key slot in the radio by default. If the default maps are used for multiple key transfers, the appropriate key variables should be entered into the KVL (as described in "To Load a Key") in the same memory location (slot number) in the KVL that the radio will use to store the key variable. Note that by using the default map, any key variable location that is "ErASEd" in the KVL will cause the corresponding memory location in the radio to be erased after a multiple key transfer. Skip to Paragraph 5.5 if the default map is to be used for multiple key transfers.

If the user desires to create a 'personalized' map, the maps can be edited as explained in Paragraph 5.1.

5.1 EDITING THE MAPPING INFORMATION

Select "G LOAd?" from the main menu.

Display shows "G LOAd?"as shown in Figure 16.

Press **ENTER** to select the G LOAD function.

Display shows "GrouPx", where "x" is a group number.

Select the desired group number by pressing a digit (**0–3**) on the keypad, or use the **SEQ** button, as shown in Figure 17.

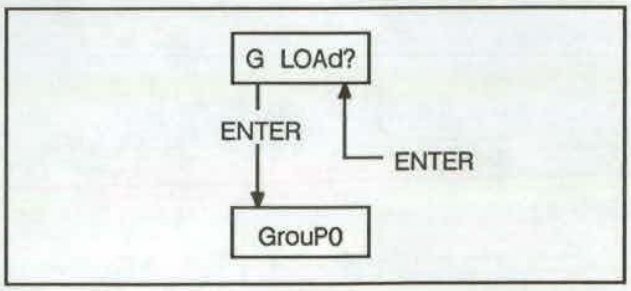

Figure 16. Entering Mapping Information.

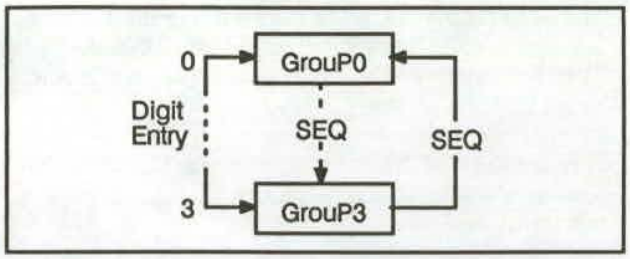

Figure 17. Selection of Desired Group Number.

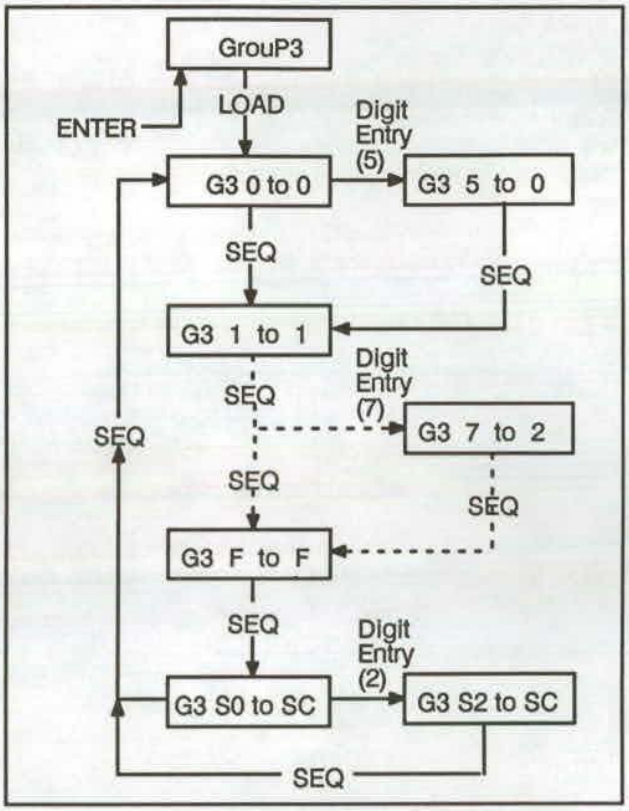

Figure 18. Editing the Mapping Information

Press the **LOAD** button to drop down into the edit menus for the mapping information.

The KVL will display "x to y" where "x" specifies the key location stored in the KVL and "y" specifies the target location in the radio's memory where the key is to be stored.

Note – SC specifies the common shadow key locations.

Pressing **0–9, A–F**, as shown in Figure 18, will map any one of the key locations in the KVL to the subscriber target location specified by the rightmost digit in the display.

NOTE

There is no way to map a shadow key to a traffic location or vice versa.

The **SEQ** button is used to step through the target locations in the radio. Pressing a hexadecimal (**0–9, A–F**) digit while holding down the **SEQ** button will directly select a target location for one of the traffic keys.

Pressing the **CLR** button will cause the KVL location to become blank and the target location in the subscriber to remain unchanged.

If the KVL key number is not specified (display shows " _ " in the KVL "x" field), then the target location in the radio will not be modified when the group map is transferred to the radio.

A target location in the radio may be zeroized by specifying an erased key ("x ErASEd") or by entering the special zeroization character (designated by " ≡ ") by pressing the **0** button while holding down the **CLR** button.

To correct an error, reenter the desired memory location by pressing the keys **0–9, A–F**.

Press the **ENTER** button to store the changes.

IMPORTANT NOTE

See APPENDIX A for a description of the relationship between memory locations and keys in the radio.

Pressing **LOAD** from any mapping window ("x to y") will allow the user to view and edit the offset value, as shown in Figure 19.

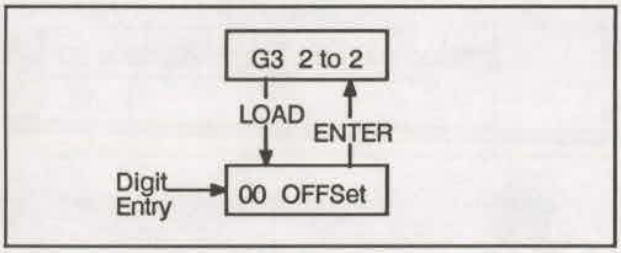

Figure 19. View and Edit Offset Value.

5.2 ENTERING AN OFFSET

In addition to the mapping information, a 2-digit offset can be entered in a sub-menu for accessing all 1024 key slots in the T5007BX Console Interface Unit (CIU), as well as all 512 key slots in the the F2040 Digital Interface Unit (DIU). This value is sent during a multikey transfer of either a single key or a group of keys to a radio. Currently, the portable and mobile radios ignore this information. The offset value is only important when transferring keys to a CIU or DIU.

Enter the offset by pressing the digits **0–9, A–F**. Pressing **CLR** will set the offset to 00.

Press **ENTER** to return to the mapping windows.

5.3 ABORTING AN EDIT SESSION

To exit without changing the mapping information:

Press the **CLR** button twice, as shown in Figure 20. The first press of the **CLR** button will clear the KVL storage location ("_" will be displayed in the KVL, "x" field). The second press will cause the KVL to display the "no CHAng?" message.

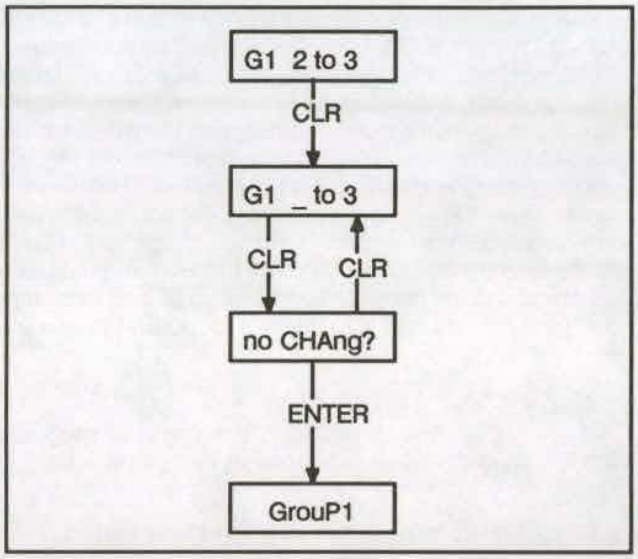

Figure 20. Exit Without Changing Mapping Information

The operator may return to the group mapping edit operations by pressing the **CLR** button again.

Pressing the **ENTER** button will abort any changes made to the group map and return the operator to the "GrouPx" menu .

5.4 REINITIALIZING A GROUP MAPPING

To return a group map to the original default setting, select the desired group number, as shown in Figure 21, by pressing a digit (**0–3**) on the keypad, or use the **SEQ** button.

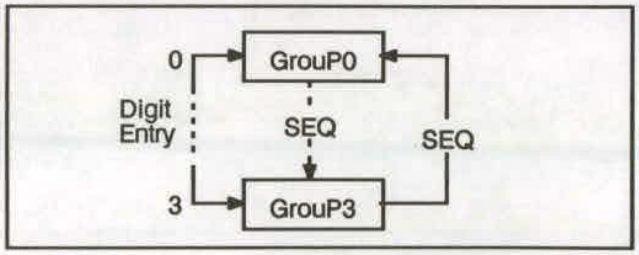

Figure 21. Selection of Desired Group Number.

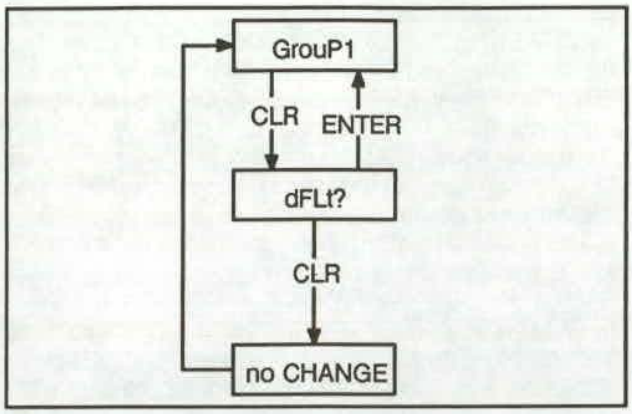

Figure 22. Reinitializing a Group Mapping

Press the **CLR** button to begin the reinitialization sequence on the group mapping specified, as shown in Figure 22.

The operator may abort the reinitialization sequence by pressing the **CLR** button again.

Pressing the **ENTER** button will complete the reinitialization sequence on the mapping information for the specified group.

NOTE

This sequence also initializes the offset value for the current group to zero.

5.5 GROUP TRANSFERS TO RADIOS

NOTE

Group transfers **CANNOT** take place with pre–ASN radios. Group transfers can only take place with ASN and post–ASN radios.

Connect the KVL to the radio via the appropriate keyload cable. Select the desired group number by pressing a digit (**0–3**) on the keypad, or use the **SEQ** button, as shown in Figure 21.

While the "GrouPx" menu is displayed, press the **P–T–T** button on the side of the KVL to transfer the keys to the slots specified in the mapping menus, as shown in Figure 23.

A successful transfer will result in an audible verification tone and the message "GX PASSED" in the display.

NOTE

If the receiving radio is a single–key radio, then only the key variable mapped to slot 0 in the radio will be transferred. If the key variable that is mapped to slot 0 in the radio is erased, then the key in the radio will be erased.

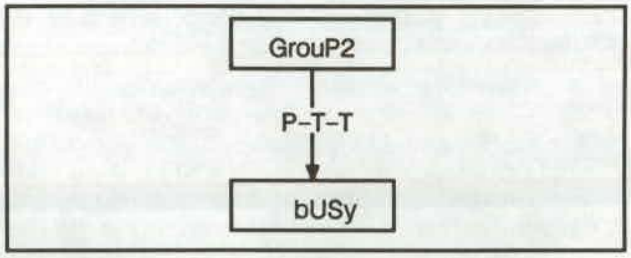

Figure 23. Transferring Keys to Specified Slots.

6. SHARE FUNCTION

NOTE

Key transfer routines between two KVLs are only possible between units of the same model series. Key transfers between other model series will not work.

To transfer keys from one KVL to another, connect the two keyloaders with the TKN8209B MX300 series keyload cable, choose the desired features from the key transfer menu, and then press the **P–T–T** switch on the side of the KVL to initiate the transfer. (Refer to the following discussions concerning single key, single group map, or all data transfers.) To connect the cable, engage the top tab on the connector end of the cable with the slot on top of the KVL. Using the tab and slot as a pivot point, engage the connector into the receptacle on the KVL. Screw down the connector lock–down screw hand tight to ensure a good connection. Repeat this procedure with the other KVL (Refer to Figure 2 for details for this connection.).

To activate the key transfer feature, turn both units on and make sure they are unlocked. Sequence to the top–level "SHArE?" function. This is the key transfer menu prompt asking the user if it is desired to use the KVL–to –KVL data transfer features. If user so desires, **ENTER** is pressed.

NOTE

If a KVL–to–KVL transfer of any kind is attempted with nothing selected from the transfer status menu, pressing the **P–T–T** switch will revert the KVL to the transfer status menu. Transfer will not occur until some function is selected from the menu.

6.1 SELECTING THE TRANSFER TYPE

After **ENTER** is pushed to select the key transfer feature, the display should read "SH A 1 L?". This is a prompt to the user asking if it is desired to "SHare" all data ("A"), one key or group map ("1"), and/or the lock ("L"). The decimal point lit next to the symbol indicates that this feature is activated.

The following describes the selective features of the KVL-to-KVL data transfer mode:

- "A" — is a prompt to the user, asking whether or not the sending unit should transfer all of its key variables and group maps to the receiving KVL. If the user desires this transfer action, the **A** button is pressed once and the decimal point will light; next to the "A" (i.e., "A."). To turn this feature off, push the **A** button again and the decimal point will go off ("A ").

- "1" — is a prompt to the user, asking whether or not the sending unit should transfer a single key variable or group map to the receiving KVL. If this is the desired transfer action, press the **1** button once and the decimal point will light next to the "1.". To turn this feature off push the **1** button again and the decimal point goes off.

> **NOTE**
> The "A" and "1" features are mutually exclusive. If "A" is activated and then the **1** button is pushed to select single key or group map transfer, the period next to "A" will automatically be turned off. Conversely, if "1" is activated and then the **A** button is pushed to select all data to be transferred, the period next to "1" will automatically turn off.

- "L" — is a prompt to the user, to determine whether or not the sending unit should transfer its lock to the receiving KVL. If the user desires this transfer action, the **LOCK** button is pressed once and the decimal point next to the "L" should light (i.e., "L."). To turn this feature off, push the **LOCK** button again to turn the decimal point off. If the lock transfer feature is activated, the lock variable will also be sent along with any keys or group maps selected to be transferred.

6.2 SINGLE KEY OR GROUP MAP TRANSFER (S H A 1.L)

Once the share options in the key transfer menu have been selected, the user should press **ENTER**. Then press the **P-T-T** button on the side of the sending KVL to initiate the transfer. Again, when "1" is the selected share option, the last selected key variable or group map will be sent to the attached KVL, depending on which menu is displayed when the transfer is initiated. For example, if the display shows "SHArE", "LOAd", "Sx rEAdy", or "x rEAdy", the key variable in the display, or the last selected key under "LOAd?" will be sent to the receiving KVL. If the display shows "G LOAd?" or "GrouPx', the last selected group map will be sent to the receiving KVL. During the transfer, the key number or group map number will be displayed temporarily in both units as "x SHARE" as it is being sent.

In addition to sharing keys and group maps with other T3011CX/DX DES/DES-XL KVLs and with T3011AX/BX DES/DES-XL KVLs retrofitted for sharing operation, traffic keys and lock variables can also be shared with T3011AX/BX (non-retrofitted) DES/DES-*XL* KVLs. Note that while the T3011AX/BX (non-retrofitted) DES/DES-XL KVLs will accept traffic keys and lock variables, the transfer will fail if the operator attempts to transfer a shadow key or group map to a non-retrofitted KVL. If the transfer is successful, "SH PASS" will be displayed in both units temporarily. If an error occurs during the transfer, an alarm will sound in both KVLs and the displays will read "SH FAIL".

> **NOTE**
> If the sending KVL is a T3011AX/BX (non-retrofitted) model DES/DES-XL KVL, the receiving DX will default the Logical ID to '0000'.

6.3 ALL KEY TRANSFER (S H A.1 L)

If the 'all' transfer option is set ("A."), all keys and group maps will be transferred to the receiving KVL, regardless of the menu from which the transfer is initiated. As above, the transfer is initiated by pressing the **P-T-T** button on the sending KVL after the appropriate cable has been attached between the two units. During the transfer, the key number or group map number will be displayed as "x SHArE" in both units as it is being transferred from one unit to the other. As above, if the transfer is successful, "SH PASS" will be displayed in both units temporarily. If an error occurs during the transfer, an alarm will sound in both KVLs and the displays will read "SH FAIL".

If the receiving KVL is a T3011AX/BX (non-retrofitted) DES/DES-*XL* KVL, the sending DX KVL will send only the traffic keys to the receiving KVL. Similarly, if the sending KVL is a T3011AX/BX (non-retrofitted) KVL, the DX KVL will only receive traffic keys if an 'all' transfer is initiated from the non-retrofitted T3011AX/BX KVL.

> **NOTE**
> If the sending KVL is a T3011AX/BX (non-retrofitted) model DES/DES-XL KVL, the receiving DX KVL will default the Logical ID to '0000'.

6.4 "ErASEd" KEY TRANSFER (S H A 1.L) or (S H A.1 L)

Transfer of key variables from one KVL to another is not limited to variables that are status "rEAdY" only. If a key variable is status "ErASEd" in the sending KVL, the receiving KVL will also assume the same status for its corresponding key variable. For example, if the 'All' option is selected, the key locations that are "ErASEd" in the sending unit will also be "ErASEd" in the same locations in the receiving unit when the transfer is complete. This convention also applies when sending a single "ErASEd" key; i.e., the same key number in the receiving KVL will also be "ErASEd" upon successful completion of the transfer.

6.5 LOCK VARIABLE TRANSFER (S H A 1 L.)

NOTE

Transfer of the lock variable from one KVL to another will cause the lock of the receiving keyloader to be turned off. This condition will occur even if the lock of the sending keyloader lock was set 'on' before the transfer. Refer to Paragraph 9 of this section for more information about the LOCK feature.

The lock variable transfer is independent of any key transfers and is performed in the same manner as the single ('1') and all ('A') key transfers. If single or all key transfers are not selected, but the lock is selected, only the lock variable will be transferred. Note that during transfer of the lock variable, both KVLs will display "L SHARE".

7. "REMOTE KVL" FEATURES

The functions incorporated under "ASN?" allow the user to select whether the KVL will communicate with the KMC via a phone or by direct connection to the KMC.

IMPORTANT NOTE

Before initiating any communications with the KMC, it is required that the KVL have the same unique shadow key that the KMC uses to encrypt the data. In addition, the KVL must have a recognizable MDC ID for the KMC to respond with any key variable data. Refer to Paragraph 8.2 for a discussion of how to configure the KVL with these parameters before proceeding.

7.1 CALLING THE KMC WITH "PHONE?"

Turn the KVL 'on', and sequence to the "ASN?" menu as described in "Selecting a Top-Level Function", Paragraph 3.

Press **ENTER** at the "ASN?" menu., as shown in Figure 24, "PHONE?" will be displayed.

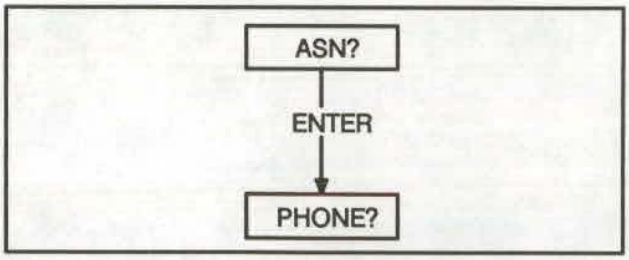

Figure 24. Selecting PHONE to Call KMC

Pressing the **SEQ** button causes the display to alternate between "PHONE?" and "dirECt" (See Figure 25).

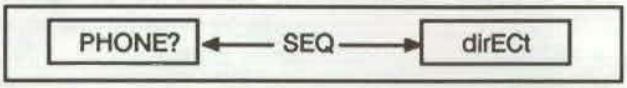

Figure 25. Enable dirECt *Access to KMC*

The "PHONE?" function allows the user to enter a phone number with which to call up the KMC through a 2400 baud modem.

First, connect the KVL to the RS232 interface cable, TKN8584A. Connect the DB-25 connector side of the cable to its mate on the back of the modem.

Turn the modem on.

Press the **LOAD** button at the "PHONE?" prompt to view the dialing 'scratch pad'.

If a phone number has been previously entered into the KVL's memory, the last number dialed will be scrolled across the rightmost seven digits of the display. The last seven digits of the phone number will now be displayed (See Figure 26).

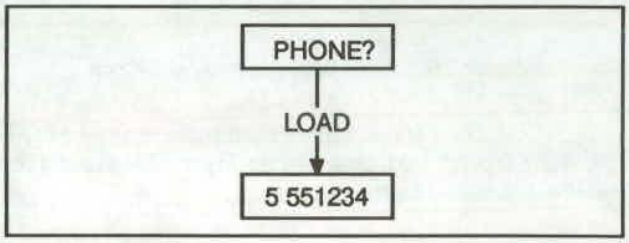

Figure 26. Display of Previously Entered Phone Number

If the dial function has never been used or the KVL's memory has been recently erased by the **CLR-ON** sequence, a single cursor will be displayed in the rightmost field (as shown in Figure 27) indicating that there was no previous number.

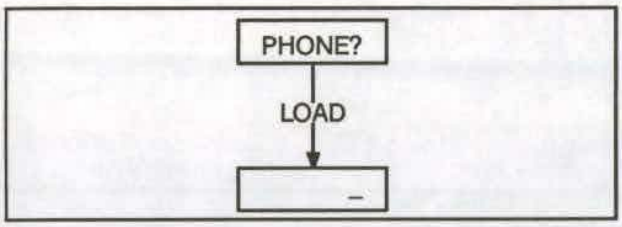

Figure 27. No Number in KVL Memory

The user may choose a new number by using the digits, **0** through **9**, on the front keypad. The new digits will overwrite the display, as shown in Figure 28, and will also scroll to the left to show only the last seven digits entered. The phone number should be entered in the same order in which it would be dialed using a standard telephone keypad or rotary dial (i.e., a long distance phone number would be entered in the following order: 1 - 312 - 555 - 1234). A maximum of 20 digits is allowed.

If a mistake is made, the user may delete the digit just entered by pressing the **CLR** button once, as shown in Figure 28.

Figure 28. Delete Last Character Entered

If the operator chooses to exit phone number entry without sending the dial command, press **ENTER** to go back to the "PHONE?" menu, as shown in Figure 29. Any changes made to the scratch pad will be saved.

Figure 29. Save Changes to Scratch Pad

Once the desired phone number is displayed, press **LOAD** from the scratch pad, as shown in Figure 30, to send the dialing command to the modem.

During the dialing sequence, the KVL will display "bUSy".

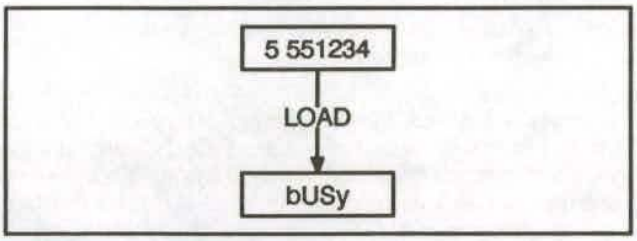

Figure 30. Press LOAD, Send Dial Command to Modem

If an error occurs in attempting to access the phone line, an alarm will sound and the KVL will terminate the call and hang up the line. In addition, if the receiving modem does not respond, the operator can press the **SEQ** button to terminate the call and hang up the line. Refer to Figure 31 for both conditions.

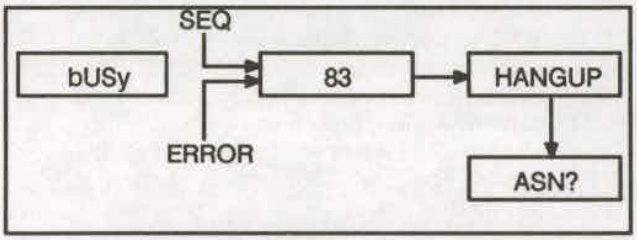

Figure 31. Terminating Pending Call

When the error occurs (or the transfer is aborted manually by the operator) during communications with the KMC an alarm will sound and an error code will be displayed temporarily, as shown in Figure 31. Table 2 lists the possible error codes, their probable cause, and the corrective action that should be taken (if any can be determined).

After a connection with the receiving modem has been established, the word "ConECt" will appear momentarily in the display followed once again by "bUSy", as shown in Figure 32.

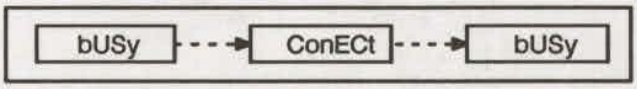

Figure 32. Display Confirmation of Connection

Once connected, the KVL will proceed to communicate with the KMC by sending and receiving data through the modem. The KMC operator will decide which key variables and group maps need to be sent to the KVL. Due to the slower speed of the information transfer between the KMC and KVL (compared to a key variable transfer from a KVL to a radio), this process may take a few minutes, depending on the amount of information sent by the KMC. If an error occurs in the data transfer, an alarm will sound and the KVL will terminate the call and hang up the line.

Table 2. Keypad Number Parity Definitions

ER-ROR CODE	PROBABLE CAUSE	CORRECTIVE ACTION
00	Phone cord not connected to modem or phone outlet is not in service.	Check modem connections. Make sure phone outlet is in service.
01	KVL does not have a unique shadow key.	Turn the KVL off. Enter configuration mode (Paragraph 8) and enter the unique shadow key.
82	Timeout occurred. KMC is heavily loaded with tasks.	Try again at a less busy time.
83	Operator initiated abort of transfer.	
84	Factory test code.	
85	Factory test code.	
86	MDC ID is not recognized by KMC, or unique shadow key is not the same as that used by KMC.	Consult KMC operator for correct parameters.
87	Factory test code.	
88	Factory test code.	

When the transfer has completed successfully, "donE" will be displayed momentarily followed by the "ASN?" display, as shown in Figure 33.

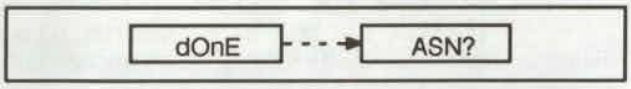

Figure 33. Confirmation of KVL Data Transfer

7.2 CALLING THE KMC FROM A TELEPHONE USING A TDN7361 MODEM

In addition to dialing up the KMC using using the "PHONE?" menu on KVL, a call may be originated from a telephone using a TDN7361 modem.

Make sure that the modem and phone are connected as shown in Figure 2-3 on Page 2-5 of the TDN7361 FasTalk modem manual. A standard telephone cable with mini-modular connectors at each end should connect the telephone to the RJ11 jack labeled "PHONE" on the rear of the modem. Similarly, a cable should connect the modem from the jack labeled "WALL" to the RJ11 wall jack provided by the phone company for telephone service. Be sure that power is connected to the modem via the modem's power cord and make sure the modem is turned on. Using the TKN8584 RS-232 Interface Cable, connect the KVL to the RS-232 jack labeled "COMPUTER" on the rear of the modem. Place the TALK/DATA switch on the modem front panel in the TALK position. Make sure that the KVL is still turned off at this point.

Pick up the phone handset and dial the remote number to connect with the KMC modem.

Put the modem TALK/DATA switch in the DATA position and hang up the phone handset.

When the CD light on the modem front panel comes on, a connection has been established with the KMC's modem. Wait approximately 3 seconds after the CD light has come on before proceeding.

Turn the KVL on and sequence to the "ASN?" menu. Press **ENTER** at the "ASN?" menu. "PHONE?" will be displayed. Since a connection has already been established between the two modems, the user may sequence to the "dirECt" prompt to begin the transfer.

At this point, the KVL will proceed to communicate with the KMC. If an error occurs during transfer, or if the transfer is aborted by the user, an alarm will sound and an error code will be displayed. Refer to Table 2 for an explanation of the possible error codes. To terminate the connection between the modems, put the TALK/DATA switch on the modem front panel in the TALK position.

When the transfer is complete, "donE" will be displayed momentarily followed by the "ASN?" display. At this point, the connection between the modems must be terminated by placing the modem TALK/DATA switch in the TALK position.

7.3 COMMUNICATING WITH KMC DIRECTLY

When the KMC and KVL are at the same site, it is possible to transfer data to the KVL without using the telephone modem. This can be accomplished by using the RS232 interface cable, TKN8584A, with a null modem adaptor connected to the KMC.

Turn the KVL on. Sequence to the "ASN?" menu as described in "Selecting a top-level function". Press **ENTER** at the "ASN?" menu. "PHONE?" will be displayed, as shown in Figure 34. Press **SEQ** to display the "dirECt" menu.

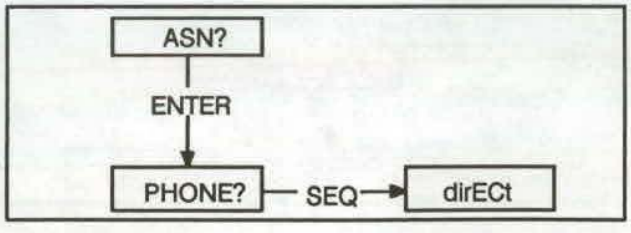

Figure 34. Prepare to Receive Data Directly from KMC

Connect the KVL to the RS232 interface cable. Connect the DB-25 connector side of the cable to its mate on the null modem adaptor, and the other side of the adaptor to the appropriate serial port on the KMC.

Press the **LOAD** button at the "dirECt" prompt to begin the transfer, as shown in Figure 35. At this point, the KVL will proceed to communicate with the KMC as described above. If an error occurs during the data transfer an alarm will sound and the connection will be terminated.

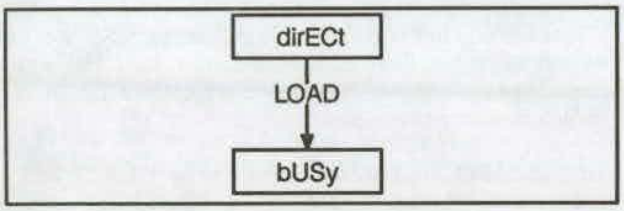

Figure 35. Initiate RS232 Transfer Activity

Again, if an error occurs during the transfer, the alarm will sound and an error code will be displayed temporarily. Refer to Table 2 for an explanation of the possible error codes.

The operator can also abort the transfer by pressing the **SEQ** button, as shown in Figure 31.

When the transfer is complete, "donE" will be displayed momentarily followed by the "ASN?" display, as shown in Figure 33.

8. CONFIGURATION MODE

If the KVL is turned on by pressing the **C** and **ON** buttons simultaneously, the configuration mode will be entered.

This will be designated by the word "CONFIG" in the display, as shown in Figure 36. After pressing **ENTER**, the user will be able to use the **SEQ** button to sequence between the different configurable features provided in the KVL. The features which may be entered at this time include the KVL's unique shadow key, which is used to decrypt data received from the KMC, and the KVL's MDC ID which uniquely identifies the KVL to the KMC.

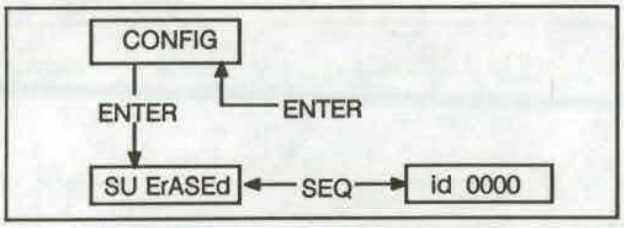

Figure 36. Accessing Configuration Mode

NOTE

It is important that the unique shadow key and MDC ID be selected and entered properly. The KMC operator should be contacted whenever these parameters are initially entered or changed in every KVL.

8.1 UNIQUE SHADOW KEY

The KVL's unique shadow key can be entered, as shown in Figure 37, using the same editing procedures for entering any key variable, as described in Paragraph 4.1, "Loading a Key Variable into the KVL Via the Keypad". The unique shadow key is used for decrypting encrypted data sent to the KVL during KMC to KVL data transfers. The default state of the key is "ErASEd". The same editing features are available for deleting the Unique Shadow Key.

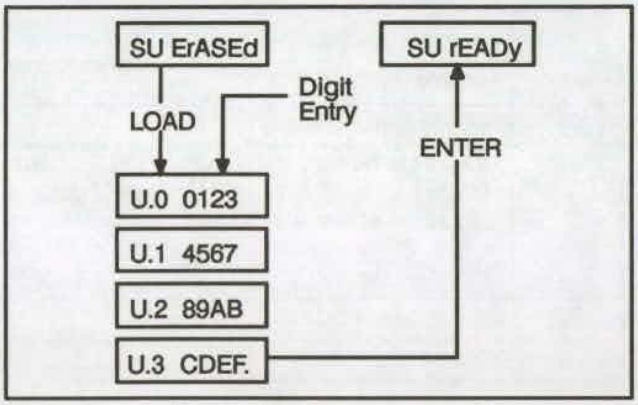

Figure 37. Entering the KVL's Unique Shadow Key

8.2 MDC ID

Press **SEQ** when viewing the status of the unique shadow key to view the MDC ID of the KVL. The MDC ID is a unique address that identifies the KVL when communicating with the KMC. Figure 38 illustrates how an MDC ID can be changed. If the KVL's ID is changed without notifying the KMC operator/manager of the change, the KVL will not be able to receive information from the KMC.

Figure 38. Accessing and Changing MDC ID

The unique MDC ID of the KVL can be entered simply by selecting 4 consecutive digits on the keypad. The first digit pressed will clear the display and show the selected digit in the most significant position of the ID. Each digit of the ID will be displayed as entered in their corresponding positions. The following rules must be adhered to when entering the KVL's MDC ID:

1) No digit in the MDC ID can be an "F".

2) The most significant digit of the MDC ID cannot be an "E" (i.e., $Exxx is not allowed).

3) The $ value $0000 is not allowed to be used as a valid MDC ID.

If any of the above rules are broken during digit entry, a short alarm will sound and the operator will be required to re-enter the digit.

The first press of the **CLR** button erases the last key digit entered. The ID will not be stored until all 4 digits have been entered. Thus, if the **SEQ** or **ENTER** button is pressed before all 4 digits have been entered, an alarm will sound to prompt the operator to finish the ID entry. The default ID is $0001.

Once the ID has been entered, press **SEQ** again to view the status of the Unique Shadow Key.

Press **ENTER** to return to the "CONFIG" menu. Press the **OFF** button to exit the configuration mode.

9. LOCK FEATURE

9.1 GENERAL

When the operator utilizes the lock feature of the KVL, he gains two benefits. The first benefit is additional encryption security in the software routines that encrypt the entered key variables prior to storage in the EEPROM. While the key variables are always encrypted prior to storage in the EEPROM, if a new lock variable is not entered, the KVL uses an internal default lock variable to encrypt the key variables. A determined adversary would find reversal of the encryption process much easier when the default lock is used, as opposed to a user selection of digits. The second benefit is the additional security provided when a non-authorized person is not able to to use the KVL to transfer your key variables into their equipment. This benefit is gained by locking the unit when it is not in use.

NOTE

The length of the user's lock variable is selective from one to sixteen digits. The above two benefits can be maximized by entering a full length lock variable (i.e., sixteen digits).

9.2 CONTROL OF THE LOCK

To turn the lock on or off, the user first presses the **LOCK** button. The KVL then displays the lock status menu. This menu is of the form "LC on? o.F.F.", where the question mark is blinking and the periods next to either the letters in the word "on" or "oFF" are lit.The words "on" and "oFF" refer to whether the KVL is locked or not, respectively, when it is shut off. Whichever word has the periods lit is the current user selection. This selection may be changed by pressing the **ON** and **OFF** keypad buttons, causing the periods to move from one word to the other. When satisfied with the lock state, depress **ENTER** to store the lock variable and exit the lock menu.

The lock status display also indicates whether or not the KVL is using the default lock, or an operator entered lock variable. This is indicated by the period next to the "C." in the display. If the period is lit, the KVL has a user entered lock variable which is used to encrypt the key variables regardless if the lock feature is on or off. If the period is not lit, the KVL is using the default lock variable to encrypt the key variables.

To enter or change a lock variable press the **LOAD** button while the lock status menu is displayed. Pressing the **LOAD** button causes the KVL to enter the lock variable entry routines. These routines are very similar to the routines for key variable entry and the reader's attention is directed to Paragraph 4.1 for a full explanation of the entry and edit sequences of the KVL. Only exceptions to these paragraphs are explained below.

As opposed to key variable length, the lock variable length is user selective. From one to sixteen digits may be entered where each pair of consecutive digits must have odd parity. The KVL also has some built in editing functions to assist in lock entry. If a mistake is made during entry, pressing the **CLR** button erases all the digits in the window currently selected. The correct digits can be re-entered. In addition, the **SEQ** button can be pressed at any time to view the currently filled windows. Again, pressing **CLR** erases the digits in the selected window and the correct digits can be reentered. Once the operator has entered the lock variable, pressing the **ENTER** button causes the KVL to revert to the lock status display. At this time the period next to the "C." should be lit, indicating that the operator has entered a lock variable.

Lock variable erasure is similar to key variable erasure, via a keypad sequence. From the lock status display, press **LOAD** followed by **ENTER**. The current lock variable is erased and the KVL reverts to using the default lock variable.

It should be noted that if the operator selects the lock "on" feature, the lock function is activated *whenever* the unit is shut off. This includes times when the KVL automatically shuts off due to inactivity, as well as when the operator manually shuts the unit off. An exception to this occurs when the operator has not entered a lock variable, and is using the default lock to encrypt the key variables. If the lock "LC o.n.? o f f" (lock ON) feature is activated when the KVL does not have a user selected lock variable, the unit is not locked when it is shut off.

If the operator forgets the lock combination, a means is provided to override the lock, but all stored keys are destroyed. To override the lock, turn the unit off and then

press and hold the **CLR** button while pressing the **ON** button. The KVL displays "bUSy" for two seconds followed by "All ErASE?". Next, press **ENTER** and the KVL displays "bUSy" for two seconds followed by "All ErASEd". The lock and all key variables are now erased and all group maps have been reinitialized to their default settings. Enter the new lock and key variables as desired.

To exit the lock status display, press the **ENTER** button.

9.3 UNLOCKING A LOCKED KVL

If the lock status display option "on" is selected, then whenever the unit is shut off it will be locked. Correct lock digit entry upon power-up is required in order for the KVL to be usable with the current key variables.

When a locked unit is turned on, the display reads "LOC?" with the question mark blinking. If the operator then presses any button except digit buttons or **OFF**, the KVL responds by beeping a short alarm, and then resumes waiting for digits. The operator must respond with digits as the first entry.

Once the operator starts entering digits, the full editing capabilities offered during lock definition are available. When satisfied with the lock variable entry, the operator then presses **ENTER**. The KVL determines if the operator has entered the correct lock variable. If the variable is incorrect, the KVL responds by beeping a short alarm, displaying the "LOC?" prompt and then waiting for the operator to enter digits again. If the variable entered by the operator is correct, the KVL will display the top level menu of the function in which it was turned off. At this point, all KVL functions are available to the operator.

10. ACTIVATING/DEACTIVATING THE CALIBRATION MODE OF THE DES-*XL* EQUIPMENT

Motorola equipment utilizing DES-*XL* encryption may be placed in a special calibration mode. In this mode the equipment outputs a constant 1 kHz square wave on the CTO output whenever the equipment is placed in private transmit operation. This can be very helpful for setting the FM deviation in radios, line level on wireline phone connections, etc.

To place Motorola DES-*XL* equipment in the CALibration mode, first connect the KVL to the equipment via the appropriate keyloading cable for that equipment. Turn the KVL on and make sure it is unlocked (Paragraph 9.3). Sequence to the top level "CAL?" menu. This is a prompt asking if the operator wants to use the calibration feature of the KVL. Press **ENTER** to use the calibration mode.

Once the operator presses **ENTER** from the "CAL?" display, the display reads "CA o.n.? o F F" (Similar to the lock status display discussed previously). The periods being lit next to the letters of the word "on" inform the operator of the current operation of the calibration mode. When the periods are lit in the word "on", this indicates that if the KVL is connected to a piece of Motorola DES-*XL* equipment, and the Push-To-Transfer (**P-T-T**) switch on the KVL is pressed ***while*** the display shows the "CA o.n.? o F F" menu, the KVL places that equipment in its calibration mode. Similarly, when the periods are lit in the word "oFF", the KVL returns that equipment to the normal mode of operation. The periods can be toggled between the words "on" and "oFF" by pressing **ON** and **OFF** buttons on the keypad, respectively.

NOTE

To turn the calibration mode on or off at the equipment, the KVL ***must*** be connected to the equipment and have the calibration menu displayed. Simply disconnecting the KVL does ***NOT*** return the equipment to normal operation.

After calibration has been performed, the operator must take the piece of equipment out of the calibration mode to return to the normal mode of operation. The procedure is the same for entering the calibration mode except that the periods should be lit in the word "oFF". This indicates that if the KVL is connected to Motorola DES-*XL* equipment, and the Push-To-Transfer switch on the KVL is pressed *while* the display shows the "CA o n ? o.f.f" menu, the KVL takes that equipment out of the calibration mode.

NOTE

When Motorola DES-*XL* equipment is placed in the calibration mode, the key variable in the equipment is erased. This requires that the key variable be reloaded after the equipment is placed back in the normal mode of operation.

To exit the calibration mode, press **ENTER**.

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THEORY OF OPERATION

Models T3010DX thru T3014DX

1. CENTRAL PROCESSING UNIT (CPU) BOARD

1.1 GENERAL

The TRN7136B Central Processing Unit (CPU) Board contains a Motorola MC6802 microcomputer (U101) with 128 bytes of internal random access memory (RAM) and an external 3.84 MHz crystal controlled time base. The EPROM (U103) is arranged as 32k x 8 bits and is used for program storage. The 2048 x 8 bit EEPROM (U104) is used for storage of key variables, lock variable, and group maps. The peripheral interface adapter (PIA U102), provides system input/output for the CPU board. An AND gate (U105B) and amplifier (Q101) provide an audio output indication for each keystroke, time out alert, warnings for the "All ErASE?" state, and keypad entry errors. The low battery detect circuitry is also located on this board.

1.2 LOW BATTERY DETECT CIRCUIT

Low charge detection is an interrupt driven event to the CPU. The interrupt request signal is produced by a comparator (U107A) and resistor bias network (R113 thru R116) whenever the battery voltage drops below approximately 6.25 volts. Software operation is such that the user may elect to clear the unit of the low power indication by pressing any button. The low battery discharge characteristic is very steep in this operating region therefore limited additional operation should be attempted.

2. INTERFACE BOARD

2.1 GENERAL

The TRN9938C Interface Board contains the peripheral circuitry for operator interface. The data entry keypad (S202) allows the operator to enter selected data. The data output display (DS201) shows the operator what is being entered, prompts the operator for entries, and indicates results of functions being performed. Key loading information is transferred through connector J203 to/from the Power Control/Flex circuit board. The voltage regulation circuitry (Q202, Q203, Q204, and Q206) is also located on this board.

2.2 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), then the high order digit line is scanned. When a key closure of sufficient duration is detected by a low output from buffer U204A or U204B, the microprocessor causes the appropriate internal machine state and display changes to occur.

2.3 DATA DISPLAY

The LED driver (U201) is self-scanning and continuously updated. 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 drivers A thru G and DP are segment drivers, and pins DS0 thru DS8 are digit drivers. The segment driver and digit driver pins in turn drive the common cathode display. (The third digit on the display is not used.)

2.4 DATA OUTPUT DURING KEY TRANSFER

(Refer to Figure 1, Keyloader Connector Detail and Table 1, Voltage Specifications at Keyload Connector.)

The key variable loader is connected to a radio by a coiled patch cord containing four interface lines. Transitions on the $\overline{\text{WE}}$ line are used to indicate the beginning and end of a key transfer as well as to signal the start of various test procedures. The KEY INSERT DATA line (KID) carries a pseudo-random bit stream which is used to synchronize clock systems and provides necessary test information to the radio. The KEY line is bidirectional; it carries the key bits and a failure control signal to the radio, and reads the failure status sent from the radio. The GND line provides a common ground between the two pieces of equipment. V_{CC} is available at pin 1 of the keyloader connector and is used to supply power to the RS232 interface cable when it is attached.

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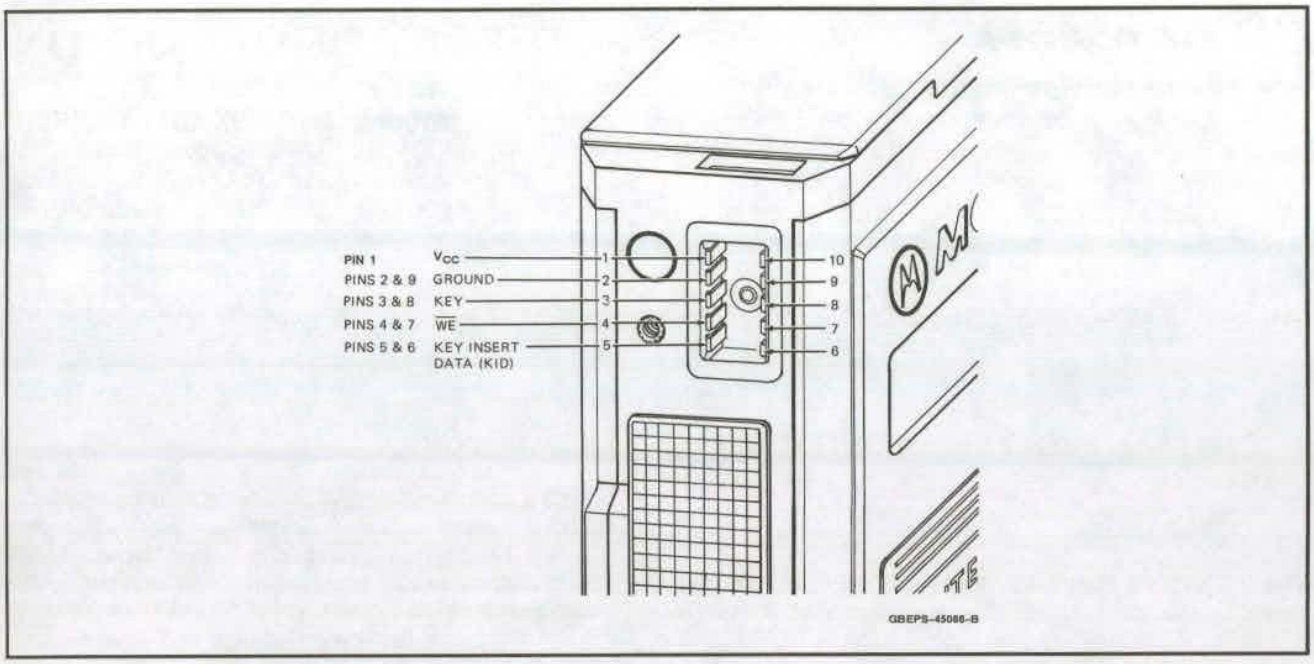

Figure 1. Keyloader Connector Detail

Table 1. Voltage Specifications at Keyload Connector

Signal Name	Voltage Level *
$\overline{WE}$	Logic High 4.9 V min. Logic Low 0.4 V max.
KID	Logic High 3.7 V min. Logic Low 0.8 V max.
KEY	Logic High 3.5 V min. Logic Low 1.0 V max.
V_{CC}	+5.0 V

* Assumes a load resistance of 10k ohms +/- 1% connected to +5.0 V

In order to ensure that the KVL and the radio or other encryption equipment being loaded are functioning properly, a series of tests are performed during each key loading sequence. If an error is indicated, the key loading sequence is aborted, an error message is displayed, and the alert tone is sounded.

2.5 POWER REGULATOR

The power regulator produces the operating voltage for the CPU and Interface Boards. The circuitry formed by start-up transistor Q202 and regulation transistors Q203, Q204, and Q206 produce a V_{cc} of 5 volts. The regulator is enabled by current injection at the base of Q204. In the off state, series pass transistor Q203 is in cutoff to eliminate any battery drain.

The power-on sequence operates as follows. Depressing either the **ON** or Push-To-Transfer (**P-T-T**) switch will saturate Q210 for approximately two time constants of the base timing circuit comprised of R237 and C216. This provides an enabling path for the regulator through power start-up transistor Q202. CPU reset is accomplished through the timing circuit comprised of R224 and C206. Since the time duration of the CPU reset is shorter than the time duration of WATCHDOG RESET POWER HOLD (WRPH) (at Q210), the CPU comes out of reset and begins program execution before Q210 times out. 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 further CPU resets.

Power-down is accomplished by removing the POWER HOLD signal after the system has finished the necessary housekeeping tasks. Software from the CPU changes the state (logic low) of the POWER HOLD line at the PIA upon either manual entry of the **OFF** button or when automatic shutdown occurs. 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

MAINTENANCE

Models T3010DX thru T3014DX

1. INTRODUCTION

The following paragraphs assist the user with general maintenance limited to battery and fuse replacement. Areas concerning other keyload transfer problems are detailed more fully in the Troubleshooting section in this manual.

2. BATTERY REPLACEMENT

Step 1. Turn the key variable loader off.

Step 2. Hold the unit in the right hand and press and hold the battery release button with the right thumb (See Figure 1).

Step 3. Rotate the battery counterclockwise as illustrated, while keeping the battery release button depressed (See Figure 2).

Step 4. Rotate the battery about 180 degrees until the cam lock is clear, and remove the battery from the unit (See Figure 2 and Figure 3).

Step 5. To replace the battery, reverse the procedure. First engage the cam lock, then rotate the battery clockwise until it latches in the proper position. Be sure the battery engages the slot on the bottom of the unit, otherwise the electrical contacts do not mate properly. (A click is heard when the battery engages.)

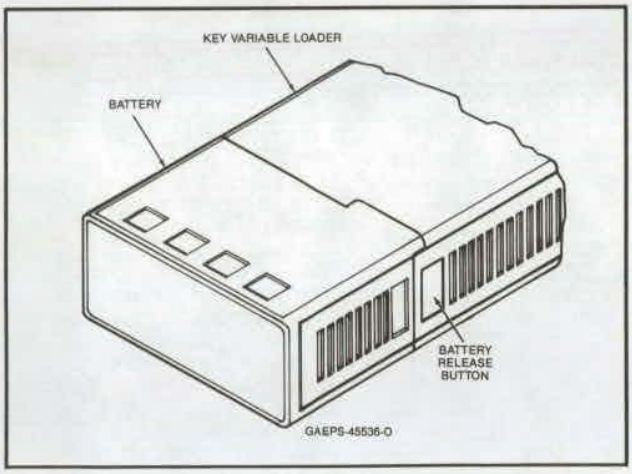

Figure 1. Battery Release

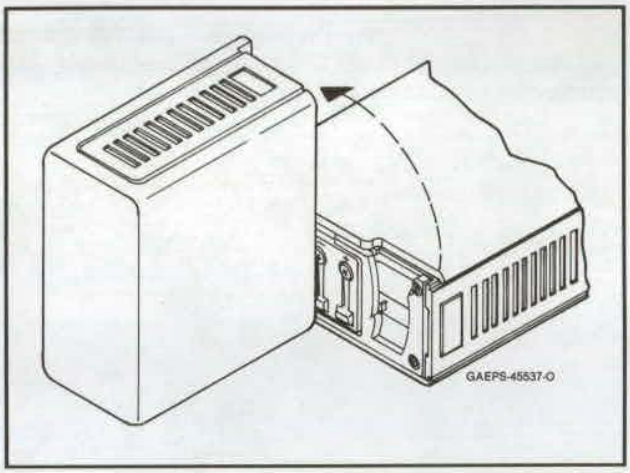

Figure 2. Battery Disengagement

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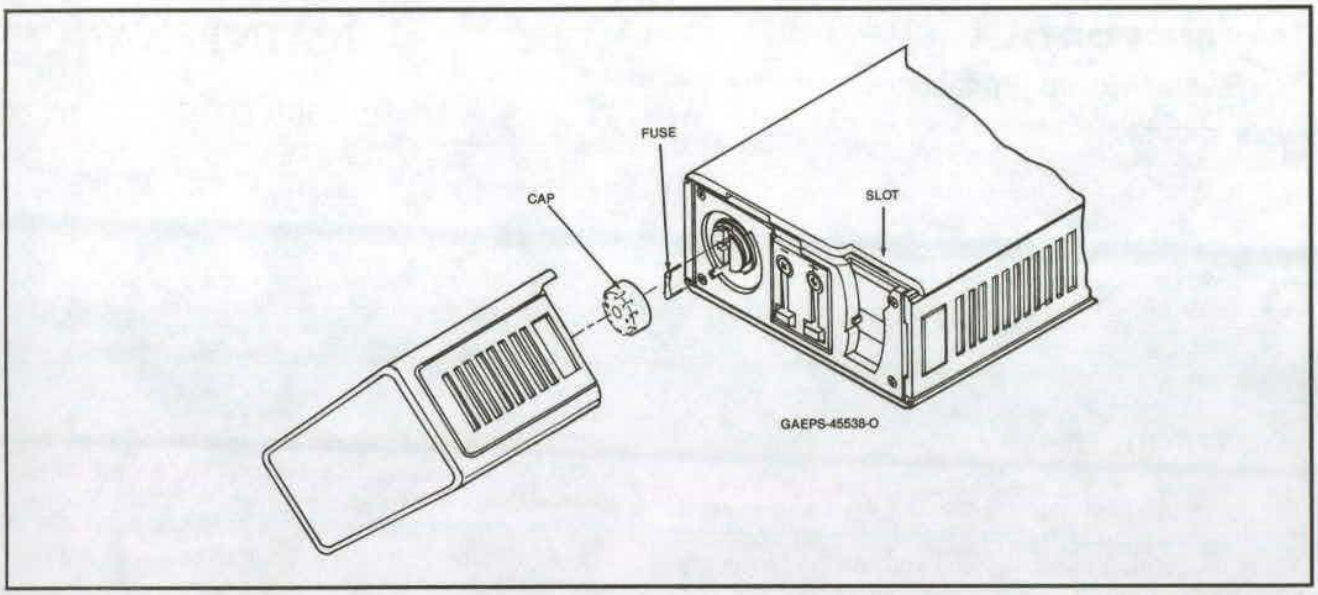

Figure 3. Battery Removal/Fuse Replacement

3. FUSE REPLACEMENT

Step 1. Remove the battery as described in the battery replacement procedures.

Step 2. Unscrew the fuse cap and remove the fuse. (See Figure 3.) If the cap is difficult to remove, insert the point ends of a long-nosed pliers into the two tightening holes on the cap. Use the pliers to loosen the cap, turning in a counterclockwise direction.

Step 3. Replace the fuse with a new one and replace the fuse cap making sure it is screwed on securely. Tighten the fuse cap hand-tight only. Over-tightening may cause the cap threads to strip, or make it impossible to remove the cap.

Step 4. Re-install the battery as described in the Battery Replacement procedure.

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TROUBLESHOOTING

Model T3011DX DES/DES–XL KVL

1. INTRODUCTION

This section describes additional service procedures for general fault detection. Internal troubleshooting is limited to diagnostic displays on the KVL display, keyed to 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. Contact your Motorola service representative or refer to the Foreword in this manual for service center and parts ordering information.

2. ERROR MESSAGES

The Key Variable Loader contains built–in diagnostics to check the EPROM, EEPROM, and the encryption hybrid at every power–on sequence. If a failure is detected, a message is displayed indicating the device that failed. (Refer to Table 1, Diagnostic Displays.)

After failing a normal transfer of key variables or mapping information to a radio, the operator can view an error code by pressing and holding down the **ON** button. One of the following messages will be displayed:

- CFb xx
- 8db xx
- ASN xx
- SH xx

The first three messages indicate that an error occurred during transfer of key variable information. The fourth message will be displayed if an error occurs during a KVL–to–KVL transfer.

The "xx" are two error code numbers that indicate how far the transfer routines got before a failure occurred. If the failure occurs when transferring a key variable to a radio, refer to Table 1 for the display screen. The error code "xx" in "CFB xx" and "8db xx" has the same meaning as the error code in "ASN 0x" if the first digit is a 0. For further troubleshooting information, refer to the System Correlation Troubleshooting Chart on the troubleshooting flow chart.

3. CONNECTOR SIGNAL NAMES

Table 2 through Table 5 are lists of signal names at all the connectors within the KVL. Refer to the circuit board details and the schematic diagram for the location and routing of signals for these connectors.

Table 1. Diagnostic Displays

Message Display	Failed Device or Condition
"U3 FAILEd"	EPROM check has failed, go to troubleshooting chart section A
"U4 FAILEd"	EEPROM check has failed, go to troubleshooting chart section B
"U9 FAILEd"	HYBRID check has failed, go to troubleshooting chart section C
"CFb xx" or "8db xx" (Error Codes)	Where "xx" is **not** "00" go to troubleshooting chart section E
"ASN 0x"	Go to troubleshooting chart section E.

4. KVL MENUS

Figure 1 illustrates the KVL menu interfaces. Other function menus are shown in Figure 2 through Figure 7 and should be used as quick references to the functions discussed in this manual.

A single key transfer to an encryption device is shown in Figure 2. A single key transfer to memory is shown in Figure 3; single key zeroization is shown in Figure 4; group mapping zeroization is shown in Figure 5; abort group mapping change is shown in Figure 6; and group transfer is shown in Figure 7.

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Table 2. Connectors P101/J201 Signals

Pin Number	U102 Desig.	Signal Name
1	GND	GROUND
2	ID0	ENCRYPT KEYED A+
3	ID1	ENCRYPT T/R
4	ID2	
5		CIPHER TEXT OUT
6		EXT TSC
7		DISPLAY MODE
8		DISPLAY WRITE
9		FUNCTION
10		EXT KEY
11		$\overline{WE}$
12	ID3	ENCRYPT CLOCK/SCAN A
13	ID4	ENCRYPT WE/SCAN B
14	ID5	SCAN C
15	ID6	INT KEY/SCAN D
16	ID7	CIPHER IN
17		DIGIT
18		POWER HOLD
19	GND	GROUND

Table 3. Connectors P102/J202 Signals

Pin Number	Signal Name
1	NOT USED
2	+5 V
3	$\overline{RESET}$
4	UNREG +7.5 V
5	NOT USED
6	NOT USED
7	NOT USED
8	WATCHDOG RESET POWER HOLD (WRPH)

Table 4. Connectors P303/J203 Signals

Pin Number	Signal Name
1	UNREG +7.5 V
2	GND
3	UNREG +7.5 V
4	P-T-T (PUSH-TO-TRANSFER)
5	V_{CC} +5 V
6	KID (KEY INSERT DATA)
7	$\overline{WE}$
8	KEY

Table 5. Connector J301 Signals

Pin Number	Signal Name
1	NOT USED
2	GND
3	NOT USED
4	NOT USED
5	NOT USED
6	KID (KEY INSERT DATA)
7	$\overline{WE}$
8	KEY
9	GND
10	NOT USED

5. MEMORY LOCATION DEFINITION

Appendix A has been provided to explain the relationship between memory locations (slots), as specified in the KVL, and Key Names in a multikey radio.

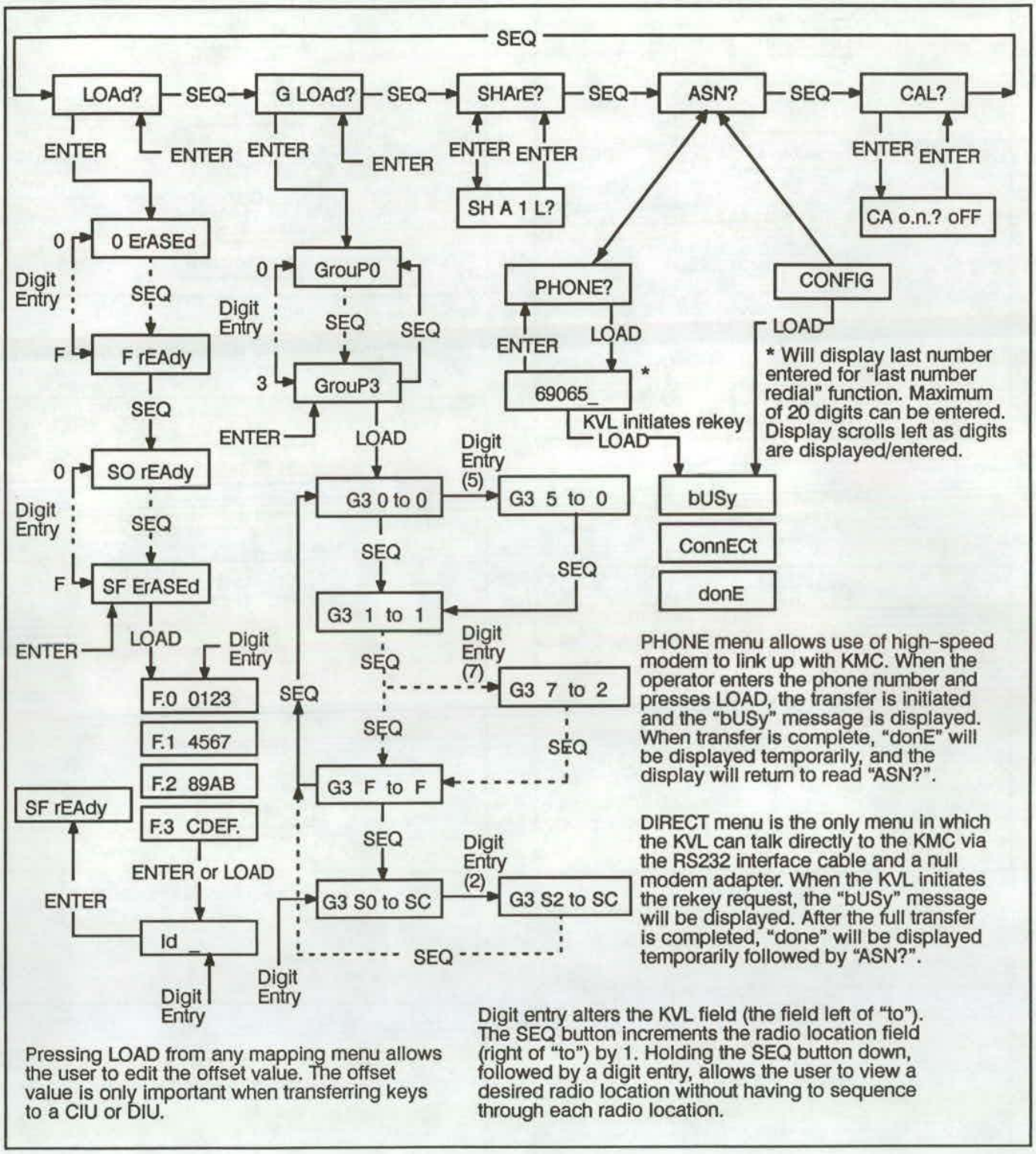


Figure 1. KVL Menus

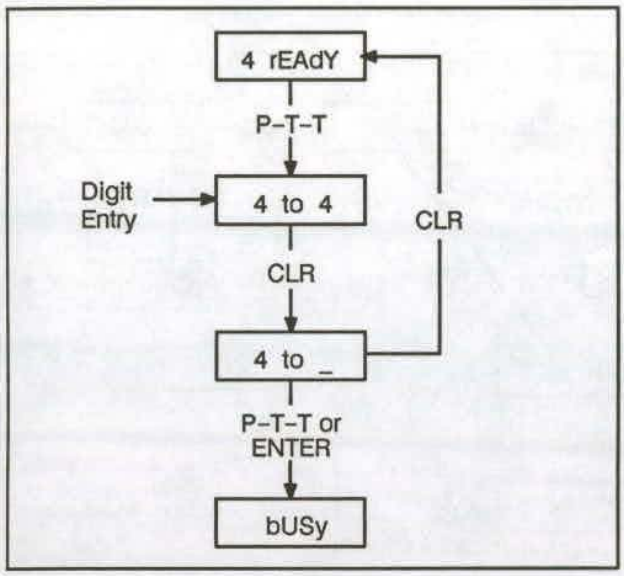


Figure 2. Single Key Transfer to Encryption Device in an ASN Multikey Radio.

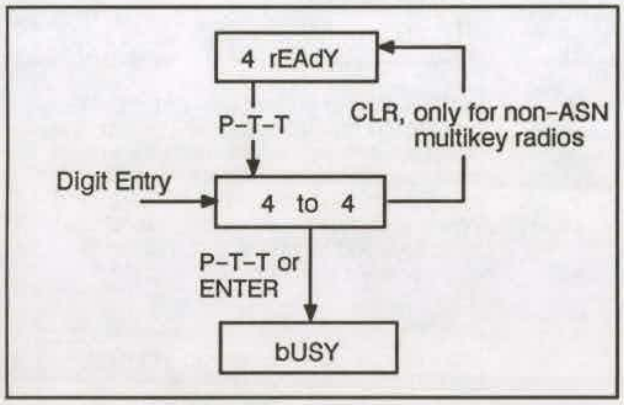


Figure 3. Single Key Transfer to Memory in a Multikey Radio.

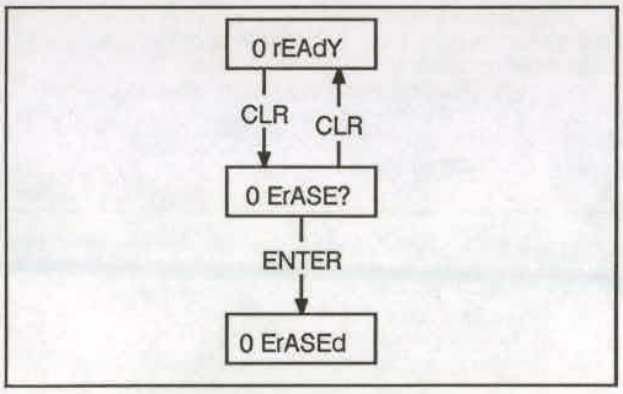


Figure 4. Single Key Reinitialization/Zeroization.

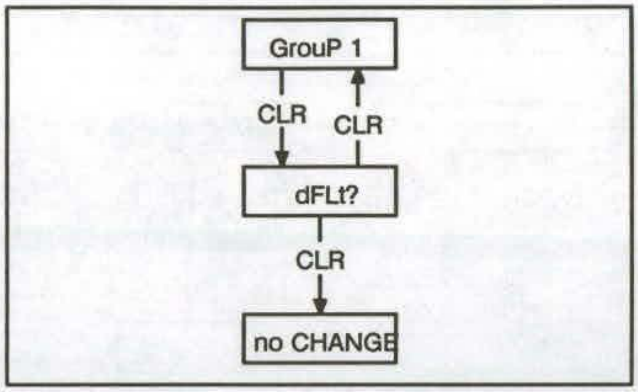


Figure 5. Group Mapping Reinitialization/Zeroization.

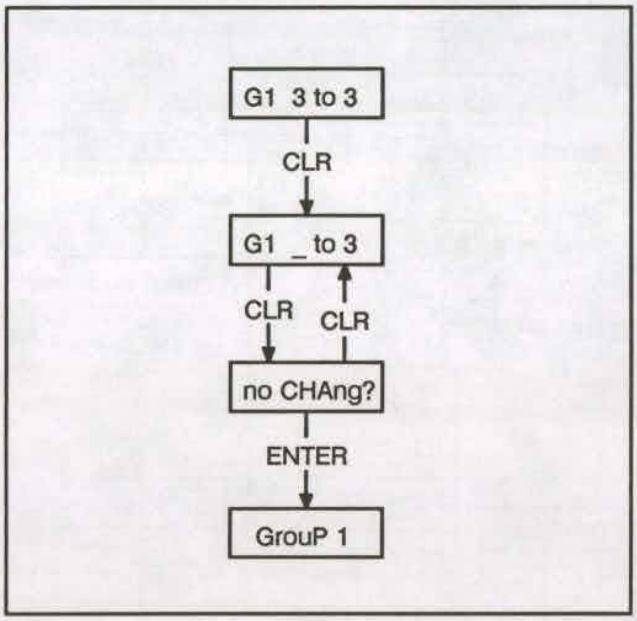


Figure 6. Aborting Group Mapping Change.

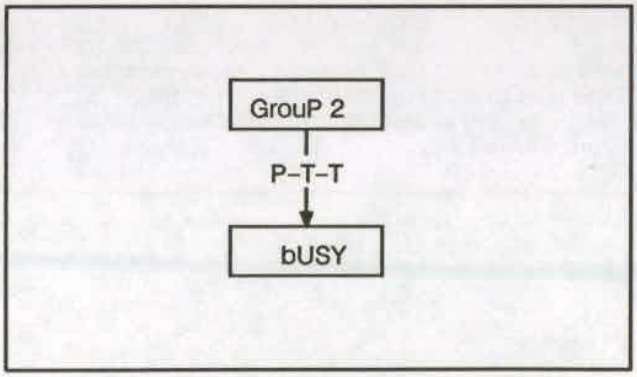


Figure 7. Group Transfer.

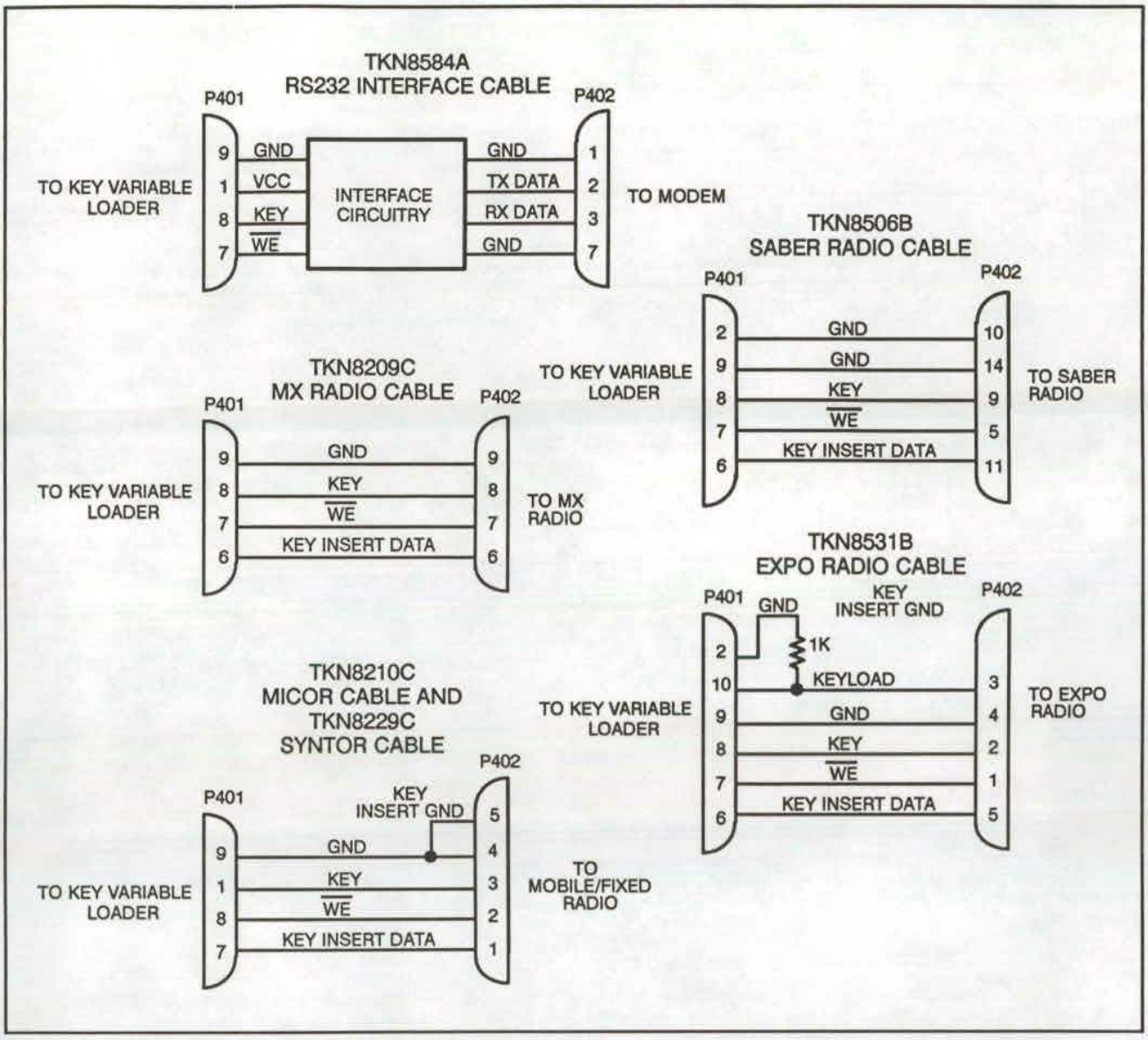


Figure 8. KVL Interconnect Cable Details

KEY VARIABLE LOADER
TROUBLESHOOTING FLOW CHART

SYSTEM TROUBLESHOOTING CHART CORRELATION TABLE

SYSTEM	USE CHART
DISPLAY SHOWS "U3 FAILED"	A
DISPLAY SHOWS "U4 FAILED"	B
DISPLAY SHOWS "U9 FAILED"	C
MALFUNCTION OCCURS WITHOUT TRANSFER OF KEY VARIABLE TO OTHER EQUIPMENT	D
MALFUNCTION OCCURS WITH TRANSFER OF KEY VARIABLE TO OTHER EQUIPMENT. DISPLAY INDICATES "FAIL".	E
MALFUNCTION OCCURS WITH TRANSFER OF KEY VARIABLE TO OTHER EQUIPMENT. DISPLAY INDICATES "PASS".	REFER TO RADIO SET TROUBLESHOOTING

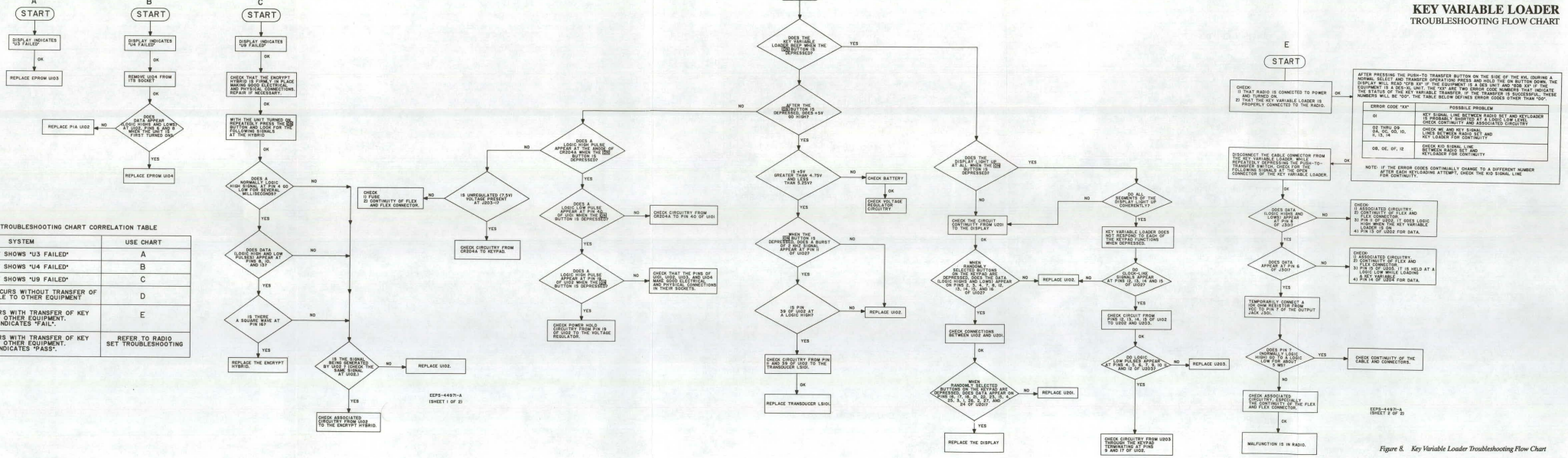
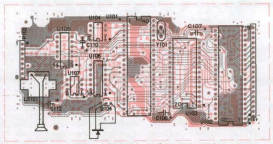


Figure 8. Key Variable Loader Troubleshooting Flow Chart

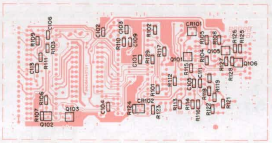
KEY VARIABLE LOADER
CIRCUIT BOARD DETAILS

TRN7136A CPU BOARD



COMPONENT SIDE ⊕ 80-BEPS-48216-0
SOLDER SIDE ⊖ 80-BEPS-48219-0
OL-BEPS-48220-0

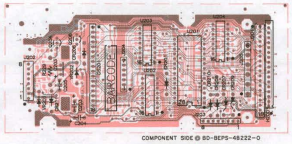
SHOWN FROM COMPONENT SIDE



SOLDER SIDE ⊖ 80-BEPS-48219-0(REV)
OL-BEPS-48221-0

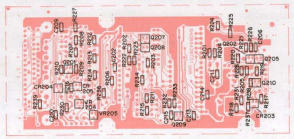
SHOWN FROM SOLDER SIDE

TRN9938B INTERFACE BOARD



COMPONENT SIDE ⊕ 80-BEPS-48222-0
SOLDER SIDE ⊖ 80-BEPS-48223-0
OVERLAY OL-BEPS-48224-0

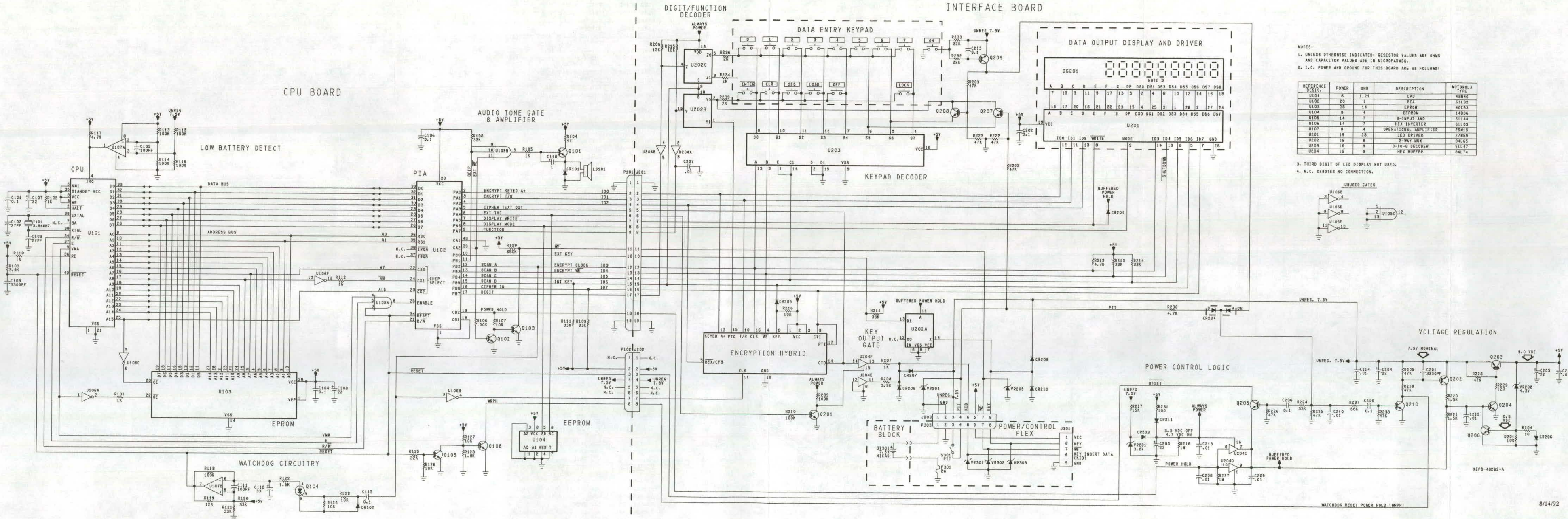
SHOWN FROM COMPONENT SIDE



SOLDER SIDE ⊖ 80-BEPS-48223-0 (REVERSED)
OL-BEPS-48225-0

SHOWN FROM SOLDER SIDE

KEY VARIABLE LOADER
SCHEMATIC DIAGRAM



NOTES:

1. UNLESS OTHERWISE INDICATED: RESISTOR VALUES ARE OHMS AND CAPACITOR VALUES ARE IN MICROFARADS.
2. I.C. POWER AND GROUND FOR THIS BOARD ARE AS FOLLOWS:

REFERENCE DESIG.	POWER	GND	DESCRIPTION	MOTOROLA TYPE
U101	8	1,21	CPU	48W46
U102	20	1	PIA	61L32
U103	28	14	EPROM	40C63
U104	8	4	EEPROM	14B06
U105	14	7	3-INPUT AND	61L44
U106	14	7	HEX INVERTER	61L03
U107	8	4	OPERATIONAL AMPLIFIER	29W15
U201	19	28	LED DRIVER	27W69
U202	16	8	2-WAY MUX	84L65
U203	16	8	3-TO-8 DECODER	61L47
U204	16	8	HEX BUFFER	84L74

3. THIRD DIGIT OF LED DISPLAY NOT USED.
4. N.C. DENOTES NO CONNECTION.

UNUSED GATES

U106B
U106D
U106E
U105C

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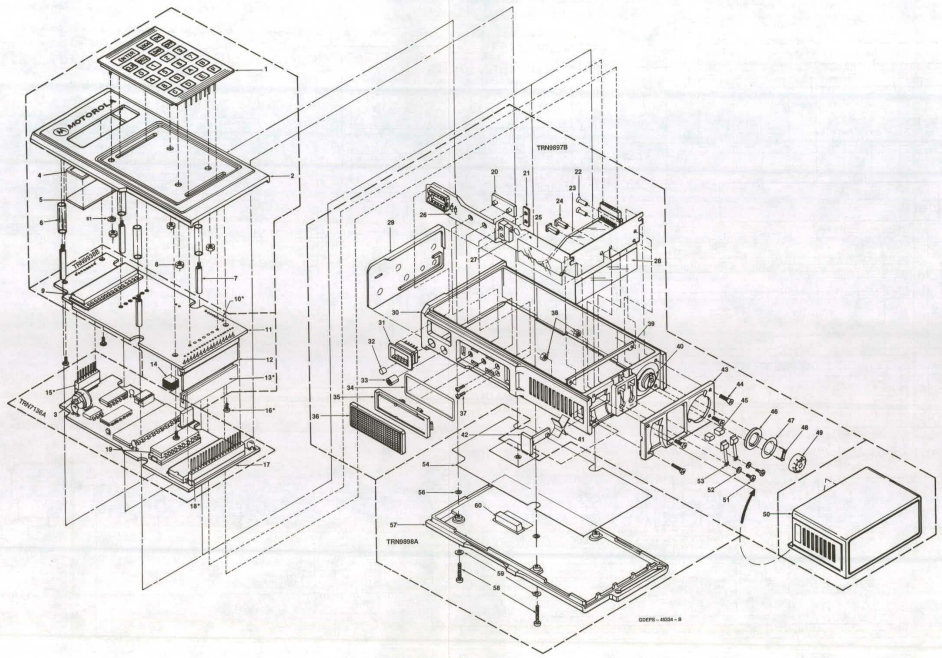
KEY VARIABLE LOADER
EXPLODED VIEW DETAIL



T3011DX DES/DES-XL KVL Exploded View

REF. SYMBOL	PART NO.	DESCRIPTION
1	4084670R01	SWITCH KEYPAD 23 POSTN
2	1582157N02	COVER FRONT
3	4284868R01	CLIP TRANSDUCER RETAINER
4	3283573N02	GSKT
5	8182212N01	WINDOW
6	3700132026	TBG HS POLYOL 3/16 CLR (4 used)
7	4382073N01	SPACER (4 used)
8	0200009627	NUT 4-40X3/16X3/32 HEX STL CAD (4 used)
9	4884736K06	DIODE LE 36K06
10	4382075N01	SPACER
11	TRN9938C	KVL INTERFACE BD
12	TRN7036A	HYBRID DES/DES-XL
13	7583984B03	PAD URET FOAM DBL ADHES
14	7582863N02	PAD
15	4382074N01	SPACER
16	0300131490	SCR MCH 4-40X3/16 PHLRND STL (4 used)
17	TRN7136B	KVL CPU BD
18	4382074N02	SPACER
19	TV98140A	T3011DX KVL FIRWARE
20	4205506C01	CLP STRAIN RELIEF FLEX CKT
21	6405883F01	PLT NUT
22	0905604C07	SKT SPR (2 used)
23	1482284N01	INS
24	4605481C01	BATTERY CONTACT (2 used)
25	1184521R01	ACRYLIC TAPE
26	0182448T02	FLEX CKT
27	4082159D01	PTT SWITCH
28	1482294N01	INS
29	1582059N01	COV
30	0783388R02	FRAME ECDR PC PLAS GRA
31	1505673C01	HSNG
32	2882164N01	PLUG COAXIAL
33	4605458C01	STUD THREADED REM MIC FIN
34	3283573N01	GSKT
35	4805509C03	SLIDE PTT PADDLE
36	3205427C04	BOOT PTT
37	0305685F01	SCRMCH SPCL (2 used)
38	0200007041	NUT 2-56X3/16X1/16 HEX STL CAD (2 used)
39	0784447N02	BRKT FRM
40	4205383F01	RETNR FUSE
41	4105395F01	SPR LATCH SULFUWATE NKL PLTD
42	5505417C01	LATCH BAT PLTD
43	0705295K05	PLT BASE PLATED
44	0305714J01	SCRMCH PHL 2-56 X .238 (4 used)
45	0705830C02	SPRT BAT CONT (2 used)
46	0405342C04	WSHR THRUST
47	0405342C05	WSHR THRUST
48	8500139678	FUSE 2A 125V
49	3805881D01	CAP FUSE
50	NLN9998C	BATTERY
51	0300138651	SCR MCH 2-56X1/8 PHLPAN SST (2 used)
52	0400002625	WSHRLCK 2 INT SST PAS (2 used)
53	3905421C05	CONT BAT GLD PLTD (2 used)
54	6484606R01	INSULATOR
55		NOT USED
56	0405818D01	WSHRFLT .180 .096 .010 SST PAS (4 used)
57	1584467R01	COVER BACK POLYC SHADOW BRZ
58	0382210E16	SCR CAPTIVE FIN (4 used)
59	0405485C01	WSHR .112X.245X.012 (4 used)
60	7505897J03	PAD SHOCK
61	0400009777	WASHER, lock: No. 4 med split

PARTS LISTS

TRN7036A HYBRID DES-XL

REF. SYMBOL	PART NO.	DESCRIPTION
		capacitor, fixed:
C1	2113741B61	0.047 uF, ±5%; 50V
C3	2113740B57	220 pF, ±5%; 50V
C5	2113740B65	470 pF, ±5%; 50V
		inductor:
L1 thru 20	2984209P02	TERM CHAIN FORM PHBRZ
		integrated circuit: (see note)
U1	5183977M69	IC 77M69 DES 400 LEADLESS CAR
U2	5105479G34	IC ENCRYPTION REX

TRN7136B KVL CPU BD

REF. SYMBOL	PART NO.	DESCRIPTION
		capacitor, fixed:
C101	2113741B69	0.1 uF, ±5%; 50V
C102,103	2113740B35	27 pF, ±5%; 50V
C104	2113741B69	0.1 uF, ±5%; 50V
C105	2113740B49	100 pF, ±5%; 50V
C106	2113741B69	0.1 uF, ±5%; 50V
C107,108	2311054E10	22 uF, ±20%; 15V
C109	2113741B33	3300 pF, ±5%; 50V
C110	2311054K06	1 uF, ±20%; 50V
C111	2113740B49	100 pF, ±5%; 50V
C112	2311054E12	33 uF, ±20%; 15V
C113	2113741B69	0.1 uF, ±5%; 50V
		diode: (see note)
CR101,102	4813833C10	0.1A, 70V
		speaker:
LS101	5005800L01	TRANSDUCER
		connector:
P101	2884125T03	CONNECTOR DBL HDR 19 CON
P102	2884125T02	CONNECTOR DBL HDR 8 CON
		transistor: (see note)
Q101 thru 103	4811056A09	NPN
Q104	4811043C50	TRST 48R00869563 A/I
Q105,106	4811056A09	NPN
		resistor, fixed:
R101,102	0611077A74	1K, ±5%; 1/8W
R103	0611077A88	3.9K, ±5%; 1/8W
R104	0611077A42	47 ohms, ±5%; 1/8W
R105	0611077A74	1K, ±5%; 1/8W
R106	0611077B23	100K, ±5%; 1/8W
R107	0611077A98	10K, ±5%; 1/8W
R108,109	0611077B11	33K, ±5%; 1/8W
R110	0611077A74	1K, ±5%; 1/8W
R111	0611077B11	33K, ±5%; 1/8W
R112	0611077A74	1K, ±5%; 1/8W
R113,114	0611077G88	100K, ±1%; 1/8W
R115	0611077H06	150K, ±1%; 1/8W
R116	0611077G88	100K, ±1%; 1/8W
R117	0611077A90	4.7K, ±5%; 1/8W
R118	0611077B23	100K, ±5%; 1/8W
R119	0611077B01	12K, ±5%; 1/8W
R120,121	0611077B11	33K, ±5%; 1/8W
R122	0611077A78	1.5K, ±5%; 1/8W
R123,124	0611077A98	10K, ±5%; 1/8W
R125	0611077B07	22K, ±5%; 1/8W

R126,127	0611077A98	10K, ±5%; 1/8W
R128	0611077A80	1.8K, ±5%; 1/8W
R129	0611077B43	680K, ±5%; 1/8W
		integrated circuit: (see note)
U101	5182848M46	IC 48M46 MC6802CP
U102	5182807K03	IC NMOS DGTL __6821__
U103	0982808R10	SOCKET, IC: 28-contact
U104	0982808R02	SOCKET, IC: 8-contact
U105	5184118K40	IC TRP 3-INP AND _4LS11_
U106	5184118K05	Hex Inverter
U107	5113820D01	IC DL COMPARTOR LM2903N
		crystal: (see note)
Y101	4882611M32	XTAL QUARTZ
	non-referenced items:	
	0180732E04	COMP PREP CPU BD
	0180732E05	CA CHIPS CPU BD
	0180732E06	CA A/I CPU BD
	4284866R01	CLIP TRANSDUCER RETAINER (used with LS101)
	5483865R01	LABEL, bar code: 1/4" wide, white
	5484960T01	LABEL, bar code: 6.3 x 12.7MM, white

TRN9859A DES XL LABEL

REF. SYMBOL	PART NO.	DESCRIPTION
	non-referenced items:	
	3384204R01	NAMEPLATE DIGITAL VOICE PROT

TRN9876A HARDWARE

REF. SYMBOL	PART NO.	DESCRIPTION
	non-referenced items:	
	0300131490	SCR MCH 4-40X3/16 PHLRND STL (4 used)
	4382074N01	SPACER
	4382074N02	SPACER
	4382075N01	SPACER
	7583984R03	PAD URET FOAM DBL ADHES

TRN9897B KVL FLEX AND FRAME

REF. SYMBOL	PART NO.	DESCRIPTION
	non-referenced items:	
	0182448T02	FLEX CKT
	0200007041	NUT 2-56X3/16X1/16 HEX STL CAD (2 used)
	0300138651	SCR MCH 2-56X1/8 PHLPAN SST (2 used)
	0305685F01	SCRMCH SPCL (2 used)
	0305714J01	SCRMCH PHL 2-56 X .238 (4 used)
	0400002625	WSHRLCK 2 INT SST PAS (2 used)
	0405342C04	WSHR THRUST
	0405342C05	WSHR THRUST
	0705295K05	PLT BASE PLATED
	0705830C02	SPRT BAT CONT (2 used)
	0783368R01	FRM ECDR PC PLAS GRA
	0783368R02	FRAME ECDR PC PLAS GRA
	0784447N02	BRKT FRM
	0905604C07	SKT SPR (2 used)
	1482294N01	INS
	1505673C01	HSNG
	1582050N01	COV
	2882164N01	PLUG COAXIAL
	3205427C04	BOOT PTT
	3283573N01	GSKT
	3805881D01	CAP FUSE
	3905421C05	CONT BAT GLD PLTD (2 used)
	4105395P01	SPR LATCH SULFUMATE NKL PLTD
	4205383F01	RETNR FUSE
	4205506C01	CLP STRAIN RELIEF FLEX CKT
	4505509C03	SLIDE PTT PADDLE
	4605458C01	STUD THREADED REM MIC FIN
	5505417C01	LATCH BAT PLTD
	6405683F01	PLT NUT
	6500139676	FUSE 2A 125V

TRN9898A COVER BACK METALLIZED

REF. SYMBOL	PART NO.	DESCRIPTION
	non-referenced items:	
	0382210E15	SCR CAPTIVE FIN (4 used)
	0405465C01	WSHR .112X.245X.012 (4 used)
	0405818D01	WSHRFLT .180 .096 .010 SST PAS (4 used)
	1505223L02	COV BACK
	1584467R01	COVER BACK POLYC SHADOW BRZ
	5482184N01	LABEL, FCC
	6484606R01	INSULATOR
	7505897J03	PAD SHOCK

TRN9938C KVL INTERFACE BD

REF. SYMBOL	PART NO.	DESCRIPTION
		capacitor, fixed:
C201	2113741B33	3300 pF, ±5%; 50V
C202	2113741B69	0.1 uF, ±5%; 50V
C203 thru 205	2311054E10	22 uF, ±20%; 15V
C206	2113741B69	0.1 uF, ±5%; 50V
C207 thru 214	2113741B45	0.01 uF, ±5%; 50V
C215,216	2113741B69	0.1 uF, ±5%; 50V

		diode: (see note)
CR201	4884616A09	Schottky type
CR203	4813833C10	0.1A, 70V
CR204	4813833C02	DIODE DUAL 70V '5B' COMM CATH
CR205	4813833C10	0.1A, 70V
CR206	4884616A01	hot carrier
CR207 thru 210	4883654H01	silicon
CR211	4884616A09	Schottky type
		light emitting diode: (see note)
DS201	4884738K06	DIODE LE 38K06
		unknown:
H200	0985125U01	SOCKET MULTI CONT
		connector:
J201	0982295N01	RECP 19 CONT
J202	0982295N02	RECP 8 CONT
J203	2884125T01	CONNECTOR DBL HDR 8 CON
J204	0984865R02	HEADER FEMALE TCB 7 CONT
J205	0984865R03	HEADER FEMALE TCB 6 CONT
		transistor: (see note)
Q201	4811056A09	NPN
Q202	4811056A08	PNP
Q203	4800869619	TSTR M9619
Q204	4800869642	NPN
Q205	4811056A09	NPN
Q206	4800869642	NPN
Q207,208	4811056A09	NPN
Q209	4811056A08	PNP
Q210	4811056A09	NPN
		resistor, fixed:
R201	0611077A50	100 ohms, ±5%; 1/8W
R202,203	0611077B15	47K, ±5%; 1/8W
R204	0611077A26	10 ohms, ±5%; 1/8W
R205	0611077B15	47K, ±5%; 1/8W
R206	0611077B01	12K, ±5%; 1/8W
R207	0611077A74	1K, ±5%; 1/8W
R208	0611077A88	3.9K, ±5%; 1/8W
R209,210	0611077B23	100K, ±5%; 1/8W
R211	0611077B11	33K, ±5%; 1/8W
R212	0611077A90	4.7K, ±5%; 1/8W
R213,214	0611077B11	33K, ±5%; 1/8W
R215	0611077B01	12K, ±5%; 1/8W
R216	0611077A98	10K, ±5%; 1/8W
R217	0611077B03	15K, ±5%; 1/8W
R218	0611077B47	1 meg, ±5%; 1/8W
R219	0611077B15	47K, ±5%; 1/8W
R220,221	0611077A78	1.5K, ±5%; 1/8W
R222,223	0611077B15	47K, ±5%; 1/8W
R224	0611077B11	33K, ±5%; 1/8W
R225,226	0611077B15	47K, ±5%; 1/8W
R227	0611077B47	1 meg, ±5%; 1/8W
R228	0611077B15	47K, ±5%; 1/8W
R229	0611045A27	120 ohms, ±5%; 1/2W
R230	0611077A90	4.7K, ±5%; 1/8W
R231	0611077A50	100 ohms, ±5%; 1/8W
R232,233	0611077B07	22K, ±5%; 1/8W
R234	0611077A81	2K, ±5%; 1/8W
R236	0611077A81	2K, ±5%; 1/8W
R237	0611077B19	68K, ±5%; 1/8W
R238	0611077B15	47K, ±5%; 1/8W
R239	0611077A81	2K, ±5%; 1/8W

		integrated circuit: (see note)
U201	5183627M69	IC BI
U202	5184887K60	Triple 2-Channel Analog Mux/ Demux
U203	5184118K42	IC DL 1-OF-4 DCDR _4LS156_
U204	5184887K71	Hex 3-State Buffer
		voltage regulator: (see note)
VR201	4882372L05	DIODE ZENER 72L05 3.8V
VR202	4882372L06	DIODE ZENER 72L06 4.3V
VR204,205	4811058B09	DIODE 48S11058A09 A/I
	non-referenced items:	
	0180732E07	CA COMP PREP INTFC BD
	0180732E08	CA CHIPS INTFC BD
	0180732E09	CA A/I INTFC BD
	0200131435	NUT, hex: 4-40x1/4x3/32" (used with Q203)
	0300400106	SCR MCH 4-40X3/8 PHLBIN STL (used with Q203)
	0984865R01	HEADER FEMALE TCB 18CONT (used with DS201)
	1482294N01	INS (used with DS201)
	1483820M05	INSULATOR HEAT CONDUCTIVE (used with Q203)
	2682300N01	HT SINK (used with Q203)
	5483865R01	LABEL, bar code: 1/4" wide, white
	5484960T01	LABEL, bar code: 6.3 x 12.7MM, white

TRN9939A DES/DES XL FRONT COVER

REF. SYMBOL	PART NO.	DESCRIPTION
	non-referenced items:	
	0200009627	NUT 4-40X3/16X3/32 HEX STL CAD (4 used)
	0400009777	WASHER, lock: No. 4 med split
	1582157N01	COV FRONT
	1582157N02	COVER FRONT
	3283573N02	GSKT
	3700132026	TBG HS POLYOL 3/16 CLR (3.12 used)
	4084470R01	SWITCH KEYPAD 23 POSTN
	4382073N01	SPACER (4 used)
	6182212N01	WINDOW

TVN6140A T3011DX KVL FIRMWARE

REF. SYMBOL	PART NO.	DESCRIPTION
	non-referenced items:	
	5191006H89	IC PRGMD EPROM _06H89
	5191015A01	IC CMOS EEPROM 2KX8 SER _24C16

NOTE: For optimum performance, integrated circuits must be ordered by Motorola part number.

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APPENDIX A
MEMORY LOCATION MAPPING

Models T3010DX thru T3014DX

1. GENERAL

Appendix A has been provided to explain the relationship between memory locations (slots), as specified in the KVL, and Key Names in a multikey radio.

2. SELECTING A TARGET KEY VARIABLE LOCATION

This section has been provided to explain in detail the relationship between key variable storage locations (slots) in the KVL's memory and the key variable storage locations (slots) that are available in a multikey radio. A short discussion follows which explains how to use a KVL when loading key variables into multikey radios that have "indexed" keys.

To select a target memory location for a key variable in a multikey radio, you need to understand how the fixed memory slots in a radio are assigned; therefore, in this discussion it is crucial that you understand the concept of "indexing" a key. "Indexing" is a key management feature which allows the radio operators to use one set of key variables while another set is available for keyloading. At a predetermined time, the radio operators can simultaneously make a 'clean' switch to the alternate index, and immediately use the set of newly loaded keys. This allows a clean transition in changing keys since the operator can be using one set of keys while the other set is being loaded. To use a key in this fashion, the key must be indexed via the field programmer. The field programmer is also used to program the key names and index names that will be displayed by the radio. For example, if Key 0 were programmed as the 'Police key', "Police" would be displayed whenever Key 0 was being referred to. The default key and index names correspond to the actual key or index number that they represent (i.e., "Key 1", "Key 2", "Index 1", etc.).

An indexed key has two index names associated with it (usually "Index 1" and "Index 2"). Note that the same key name ("Key 1", "Key 2", etc.) is associated with both index names. One index is associated with the key currently in use, the other is associated with the key to be used when the radio receives the command to change to the next index. From the radio operator's perspective, both key variables are "Key 1" in his radio and the selected index determines which is used.

In any radio, the number of memory slots available for key variable storage is fixed. If any key, x, is indexed, it uses two memory slots: one slot for key x index 1, and a second slot for key x index 2. (Note that x is hereby referred to as the key number.) For a more detailed description of indexing consult the system planner or your salesperson.

To avoid unnecessary confusion it is suggested that if the Key Indexing feature is selected in the field programmer, it should be used for all the keys in a radio. In the short description that follows, it is assumed that all the keys in a radio are indexed. For those who prefer to index only certain keys, consult the next section entitled "Individual Key Indexing".

If all the key numbers in a radio are indexed, the number of key numbers available for use is cut in half. For example, in a 16 Key Syntor–X 9000 mobile radio there are 16 memory locations (slots) available for key variable storage. While the actual key variables all take one slot, a key number will consume 2 slots if it is indexed. Thus, if all the keys are indexed, only 8 key numbers will be available to the user since each indexed key number requires two memory slots.

Similarly, in a Saber portable radio that has 8 memory slots available for key storage, the user will be able to access a maximum of 8 non–indexed key numbers. If all the key numbers are indexed, only 4 key numbers will be accessible.

The first key slot in the radio is specified by the KVL as slot 0 (this is the number that appears to the right of "to" when the KVL prompts the operator to select a target slot in the radio when transferring a key.). Up to 16 individual slots may be targeted in the KVL by specifying any slot number 0 – F. With all the key numbers indexed, even slot numbers (0, 2, 4, 6, 8, A, C, E) correspond to Index 1 key numbers, and odd slot numbers (1, 3, 5, 7, 9, B, D, F) correspond to Index 2 key numbers.

The attached tables summarize the relationship between slot numbers, key numbers, key names, and the use of in-

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8/14/92– UP

dexed keys. Note that Table 1 and Table 2 have assumed a one–to–one correspondence between slot numbers in the KVL and slot numbers in a multikey radio. In other words, all the key variables have been entered into the KVL (via the keypad) in the same KVL memory slots as they will reside in the radio. Table 1 shows the relationship between slot numbers in the KVL and slot numbers in the radio with various indexing schemes. Table 2 is an example of how a system of keys may be set up in which all the key numbers in the radio are indexed. Table 3 is an example of a system that is set up with individual key indexing (see the next section on Individual Key indexing) and key variable storage locations that have been entered into the KVL without regard to the corresponding target locations in the radio. These example worksheets have been provided to better understand how a system of keys may be set up and maintained in a KVL and the radios for a specific system. Also, a blank worksheet has been provided to facilitate the set up and management of a 'personalized' system of keys.

3. INDIVIDUAL KEY INDEXING

If a system is to be set up in which only certain key numbers are indexed, the following discussion is applicable.

As explained above, while the actual key variables all take one slot, a key number will consume 2 key variable slots if it is indexed. If a single key number is indexed (in a 16 slot Syntor–X 9000) the user will be able to access only 15 total key numbers, since the single indexed key number takes up two key variable slots. Similarly, if 2 key numbers are indexed the user will be able to access only 14 key numbers.

The slots in the radio that are used for a particular key number will vary depending upon which keys are indexed. For example, if 'Key 1' is not indexed, slot 0 corresponds to 'Key 1' in the radio, and slot 1 would be used by Key 2. If Key 1 is indexed, slot 0 corresponds to "Key 1 index 1"; slot 1 would correspond to "Key 1 index 2", and slot 2 would be used by Key 2.

Table 3 summarizes how to set up a system in which only selected key numbers in a radio are indexed. Also note that in Table 3, a unique mapping of KVL key slots to radio key slots has been used. Table 1 and Table 2 have assumed a one–to–one correspondence between slot numbers in the KVL and slot numbers in a radio. Table 1 shows the relationship between slot numbers in the KVL and slot numbers in the radio with various indexing schemes. Table 2 is an example of how a system of keys may be set up in which all the key numbers in the radio are indexed. These example worksheets have been provided to better understand how a system of keys may be set up and maintained in a KVL and the radios for a specific system. A blank worksheet, similar to Table 3, has been provided as Table 4 to facilitate set up and management of a 'personalized' system of keys.

Table 1 Relationship Between Slot Numbers in a KVL and a Multikey Radio

RELATIONSHIP BETWEEN SLOT NUMBERS IN THE KVL AND SLOT NUMBERS IN THE RADIO			
FIXED MEMORY SLOTS	KEY NUMBER WITH NO KEYS INDEXED	KEY NUMBER WITH ALL KEYS INDEXED	KEY NUMBER WITH CERTAIN KEYS INDEXED
0	KEY 1	KEY 1 (INDEX 1)	KEY 1 (NOT INDEXED)
1	KEY 2	KEY 1 (INDEX 2)	KEY 2 (INDEX 1)
2	KEY 3	KEY 2 (INDEX 1)	KEY 2 (INDEX 2)
3	KEY 4	KEY 2 (INDEX 2)	KEY 3 (INDEX 1)
4	KEY 5	KEY 3 (INDEX 1)	KEY 3 (INDEX 2)
5	KEY 6	KEY 3 (INDEX 2)	KEY 4 (NOT INDEXED)
6	KEY 7	KEY 4 (INDEX 1)	KEY 5 (NOT INDEXED)
7	KEY 8	KEY 4 (INDEX 2)	KEY 6 (NOT INDEXED)
8	KEY 9	KEY 5 (INDEX 1)	KEY 7 (INDEX 1)
9	KEY 10	KEY 5 (INDEX 2)	KEY 7 (INDEX 2)
A	KEY 11	KEY 6 (INDEX 1)	KEY 8 (NOT INDEXED)
B	KEY 12	KEY 6 (INDEX 2)	KEY 9 (INDEX 1)
C	KEY 13	KEY 7 (INDEX 1)	KEY 9 (INDEX 2)
D	KEY 14	KEY 7 (INDEX 2)	KEY 10 (NOT INDEXED)
E	KEY 15	KEY 8 (INDEX 1)	KEY 11 (INDEX 1)
F	KEY 16	KEY 8 (INDEX 2)	KEY 11 (INDEX 2)

NOTE: - No indexing allows the use of 16 different keys.
- Full indexing allows only 8 different keys.
- Indexing of keys can be used in any combination to allow the use of 8 to 16 keys.

Table 2 Example of Unique Mapping of KVL Key Slots to a Multikey Radio

EXAMPLE WORKSHEET					
USER KEY NAME	KEY NUMBER IN KVL (0 - F)	SLOT NUMBER IN RADIO (SPECIFIED BY KVL)	KEY NUMBER	INDEXED? (Y / N)	INDEX NUMBER
POLICE	0 1	0 1	KEY 1	Y	1 2
FIRE	2 3	2 3	KEY 2	Y	1 2
MAYOR	4 5	4 5	KEY 3	Y	1 2
P. CHIEF	6 7	6 7	KEY 4	Y	1 2
F. CHIEF	8 9	8 9	KEY 5	Y	1 2
HOSPITAL	A B	A B	KEY 6	Y	1 2
COUNCIL	C D	C D	KEY 7	Y	1 2
GAS CO.	E F	E F	KEY 8	Y	1 2

Table 3 Example of Indexing of All Key Numbers

EXAMPLE WORKSHEET					
USER KEY NAME	KEY NUMBER IN KVL (0 – F)	SLOT NUMBER IN RADIO (SPECIFIED BY KVL)	KEY NUMBER	INDEX? (Y / N)	INDEX NUMBER
POLICE	7	0	KEY 1	N	N/A*
FIRE	A 3	1 2	KEY 2	Y	1 2
MAYOR	B 2	3 4	KEY 3	Y	1 2
P. CHIEF	1	5	KEY 4	N	N/A
F. CHIEF	F	6	KEY 5	N	N/A
HOSPITAL	0	7	KEY 6	N	N/A
COUNCIL	C D	8 9	KEY 7	Y	1 2
GAS CO.	4	A	KEY 8	N	N/A
ELECTRIC CO.	9 5	B C	KEY 9	Y	1 2
TRANSIT	8	D	KEY 10	N	N/A
WATER CO.	6 E	E F	KEY 11	Y	1 2

NOTE: – The key number in KVL is the user selected memory location of the desired key in the KVL.
* N/A = Not Applicable.

Table 4 Blank Worksheet for User Development

CUSTOMER WORKSHEET					
USER KEY NAME	KEY NUMBER IN KVL (0 – F)	SLOT NUMBER IN RADIO (SPECIFIED BY KVL)	KEY NUMBER DISPLAYED BY RADIO	INDEX? (Y / N)	INDEX NUMBER

NOTE: – The key number in KVL is the user selected memory location of the desired key in the KVL.

MOTOROLA

User Questionnaire

To the User of this Instruction Manual:

Motorola is engaged in a continuing program of improving its instruction literature. We believe that you can aid us in this program, so that we in turn can better help you operate and service our equipment. Please help us by answering the following questions. Whenever possible, please give complete model number of equipment and part number of diagram, parts list, and/or instruction section. ***This information is important!***

SCHEMATIC DIAGRAMS (Depot manuals only), CABLING DIAGRAMS AND FLOW CHARTS

- ❑ Are accurate and easy to follow
- ❑ Contain minor errors
- ❑ Contain major errors
- ❑ Are difficult to follow

If you have checked any box except the first, please tell us what diagram(s) (or portions thereof) were at fault, or enter other comments.

_____

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TEXT

- ❑ Easy to follow – helps to operate and/or service equipment
- ❑ Would like more information on –

_____

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- ❑ Some instruction sections are too long or superfluous such as –

_____

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- ❑ Other comments

_____

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(continued on reverse side)

68P81086E92-O

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AVAILABLE BACKGROUND REFERENCE PUBLICATIONS

Seven reference publications are available to provide background information needed to service some of the newer Motorola products more effectively. The information in these publications is not duplicated in our instruction manuals. To obtain your free copy, check the ones you want and return this self-mailer to us.

Check item desired:

☐ **Basic Logic Circuit Guide** 68P81105E88
Describes the basic logic circuits used in Motorola Communications digital equipment and the logic notational scheme used in our instruction manuals.

☐ **"Digital Private-Line" Binary-Coded Squelch** 68P81106E83
Contains fundamentals of "Digital Private-Line" system operation, circuit operation and servicing techniques.

☐ **Safe Handling of CMOS Integrated Circuit Devices** 68P81106E84
Describes special handling techniques needed to prevent irrepairable damage from static charges encountered with normal handling of CMOS devices.

☐ **Reducing Noise Interference in Mobile Two-Way Radio Installations** 68P81109E33
Defines the major sources of noise encountered in a mobile radio installation and suggests methods of remedying them.

☐ **Anti-Skid Braking Precautions** 68P81109E34
Provides installation suggestions and a detailed checkout procedure for installation of mobile radios in vehicles with anti-skid braking systems.

☐ **Removal and Replacement of Chip Components on Circuit Boards** 68P81113E77
Contains general information and repair procedures relative to chip-type (leadless) components.

☐ **Lightning Protection Recommendations** 68P81111E17
Provides general information concerning lightning protection for equipment sites. Also, provides a quick reference of available lightning protection kits.

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instruction manual revision

GENERAL:

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81090E20–O	Key Variable Loader DES/DES–XL KVL Model T3011DX
68P81090E25–O	Key Variable Loader *DVI–XL* Operator KVL Model T3013DX
68P81090E30–O	Key Variable Loader *DVP* KVL Model T3010DX
68P81090E35–O	Key Variable Loader *DVP–XL* KVL Model T3014DX
68P81090E40–O	Key Variable Loader *DVI–XL* Supervisor KVL Model T3012DX

REVISION DETAILS:

1. The Key Variable Loader (KVL) models listed above are in compliance with Generic Emissions Standards EN50081–1 and EN50082–1. Therefore, in accordance with the EU (European Union) EMC Directive 89/336/EEC, the EM compliance mark shown below is added to the above listed instruction manuals. A compliance label (Motorola part number 5483430X03) is also affixed to the housing of the compliant KVLs.

CE

MOTOROLA

instruction manual revision

GENERAL:

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81090E30–O	Model	T3010DX DVP KVL (Key Variable Loader)
68P81090E20–O	Model	T3011DX DES/DES–XL KVL (Key Variable Loader)
68P81090E40–O	Model	T3012DX DVI–XL SUPERVISOR KVL (Key Variable Loader)
68P81090E25–O	Model	T3013DX DVI–XL OPERATOR KVL (Key Variable Loader)
68P81090E35–O	Model	T3014DX DVP–XL KVL (Key Variable Loader)
68P81090E60–O	Key Variable Loader	T3010 thru T3014 Retrofit From a CX KVL to a DX KVL
68P81090E55–O	Key Variable Loader	T3010 thru T3014 Retrofit From a AX/BX KVL to a DX KVL

REVISION DETAILS:

Add this information to the Logical ID section of your instruction manual

1. DUPLICATE LOGICAL ID WARNINGS

On some products equipped with displays, the user will be warned when a duplicate Logical ID (LID) has been entered into the equipment.

If duplicate LIDs are detected immediately after a keyload, the equipment will generate a long duplicate LID key chirp and display one of the following messages for approximately two seconds:

"ID DUPLICATE" on equipment with 14 Character Displays
"LID DUPLCAT" on equipment with 11 Character Displays
"LID DPLC" on equipment with 8 Character Displays

Next, a warning message will appear that can be used to determine which keyload locations in the equipment contain the duplicate LIDs.

On some products, this warning message will remain on the display until the user initiates another keyload or removes the KVL from the radio. On other products, this warning message will only be displayed for approximately three seconds before the product reverts to the home display.

The warning message will be displayed in hexadecimal format which represents the locations that contain duplicate LIDs. It will consist of three parts as shown below:

"x / yyyy / zzzz "

char x = 1 hex digit, indicates OTAR Shadow key locations: Unique/Common
chars yyyy = 4 hex digits, traffic key locations 0–15, up to 16 encryption keys per radio
chars zzzz = 4 hex digits, not used

Note: on products with 8 character displays, the entire warning message cannot be displayed at once. Thus, the "x / yyyy" will be displayed first for approximately three seconds followed by the "/ zzzz" being displayed for approximately three seconds. The equipment will then revert to the home display.

The user will then have to convert the hex digits into binary digits using the conversions given in Table 1.

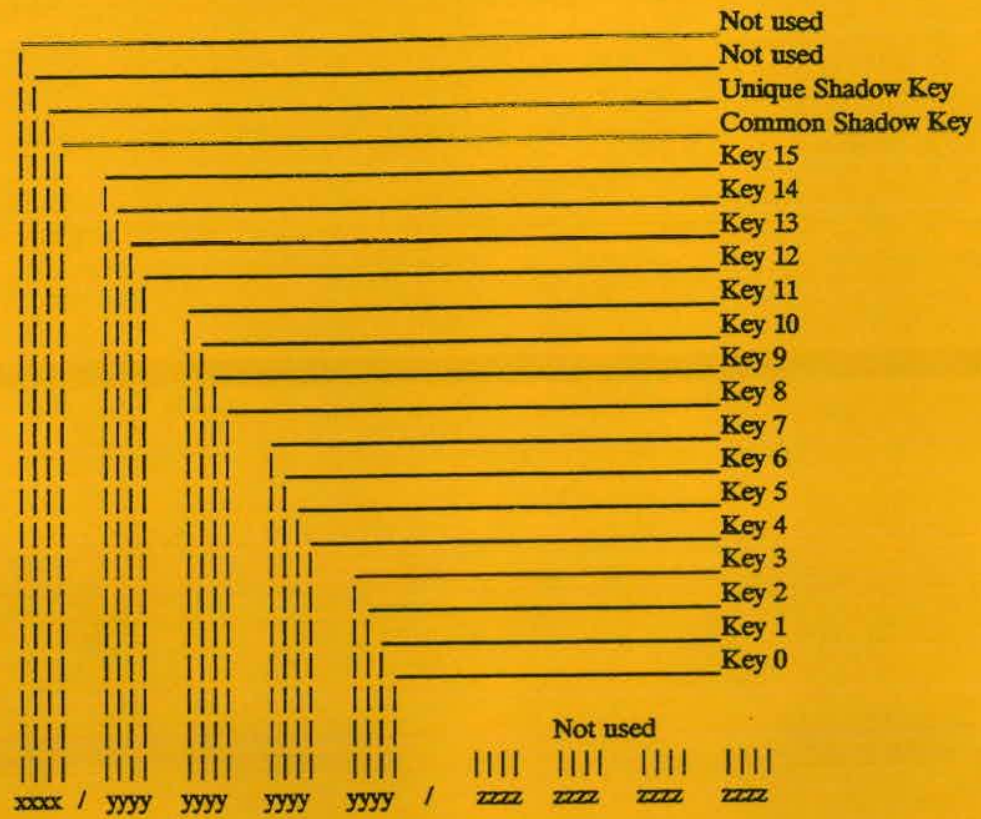
Table 1. Hex to Binary Conversion

HEX	BINARY	HEX	BINARY
0	0000	8	1000
1	0001	9	1001
2	0010	A	1010
3	0011	B	1011
4	0100	C	1100
5	0101	D	1101
6	0110	E	1110
7	0111	F	1111

For Shadow Keys, the two right most bits represent the two shadow keys (Unique and Common). Since a radio can only have two Shadow keys, the two left most digits are not used and are always "0" (Table 2). All digits with a "1" represents a key location containing a duplicate LID.

For traffic keys, after converting to binary format the right most digit will represent key location 0 and the left most digit will represent key location 15 (Table 2). All digits with a "1" represents a key location containing a duplicate LID.

Table 2. Shadow Key/Traffic Key LID location Determination



Examples (Refer to Table 2)

Each hex digit converts to a four-bit binary number. For example:

- 2/0014/0000 Converts to -> 0010 / 0000-0000-0001-0100 / 0000-0000-0000-0000
  (Hex 2 / 0 0 1 4 / 0 0 0 0)
  Indicates key locations 2 , 4, and the unique shadow key have duplicate LIDs.
- 1/F020/0000 Converts to -> 0001 / 1111-0000-0010-0000 / 0000-0000-0000-0000
  (Hex 1 / F 0 2 0 / 0 0 0 0)
  Indicates key locations 15, 14, 13, 12, 5 and the common shadow key have duplicate LIDs
- 3/0000/0000 Converts to -> 0011 / 0000-0000-0000-0000 / 0000-0000-0000-0000
  (Hex 3 / 0 0 0 0 / 0 0 0 0)
  Indicates that the common and unique shadow keys have duplicate LIDs. After the KVL is detached, the radio will resume normal radio operations.

2. TRUNKING LOGICAL ID SELECTION

In trunking systems a Logical ID of "0000" should never be used. Using a logical ID of "0000" may cause a loss of clear audio in low signal conditions.

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 crystal devices 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 within the original shipped products plus travel costs for work on non-movable installed equipment will only be provided for One Hundred Twenty (120) days from the date of shipment. After said 120 days, Buyer must pay for the labor involved in repairing the product or replacing the parts at the prevailing rates together with any travel or 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 buyer 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 OR 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.

In the event of a defect, malfunction or failure to conform to specifications established by Seller, or if appropriate, to specifications accepted by Seller in writing, during the applicable periods stated above, Seller, at its option, will either repair or replace the product or refund the purchase price thereof, and such action on the part of Seller shall be the full extent of Seller's liability hereunder, and Buyer's exclusive remedy. This warranty shall automatically terminate 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. improper alterations or repairs have been made, or if nonconforming parts are used in the product unless done by a service facility authorized by Seller to perform warranty service.

This warranty extends only to individual products; frequency sensitive components, towers, vidicon tubes, test equipment, and batteries are excluded but carry their own separate limited warranty. Because each radio system is unique, Seller 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 Seller.

Non-Motorola manufactured products are excluded from this warranty (unless bearing a Motorola Part Number in the form of an "alpha-numeric number"; i.e. TDE6030B) but such products are subject to the warranty provided by their manufacturers, a copy of which will be supplied to Buyer on specific written request.

Any claim for breach of this warranty shall be waived unless Buyer notifies Seller's salesperson or Seller at the above address, Attention: Quality Assurance Department, within the applicable warranty period.

This warranty applies only within the 50 United States.

MOTOROLA
Communications and Electronics Inc.

Revised date: 5/1/81
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