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KVL 3000 *PLUS*™

KEY VARIABLE LOADER

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SERVICE MANUAL
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FEBRUARY 2004

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ABOUT THIS MANUAL

SCOPE

This manual is intended for use by experienced technicians familiar with similar types of equipment. This manual contains detailed servicing information (including schematics, circuit board details, and parts lists) sufficient to allow service personnel to make component-level repairs. Technicians should understand encryption concepts and be familiar with other types of Motorola encryption equipment.

The information in this manual is current as of the printing date. Changes which occur after the printing date are incorporated by Instruction Manual Revisions (SMR). These SMRs are added to the manuals as the engineering changes are incorporated into the equipment.

HOW THE MANUAL IS ORGANIZED

This manual is a combination of descriptive information and procedural instructions describing tasks associated with troubleshooting and repairing the device. The manual includes troubleshooting information, schematic diagrams, component location diagrams, instructions on replacing major subassemblies, and replacement parts information.

RELATED MANUALS

The following manuals may be required to supplement the information contained in this guide:

- *Dimetra KVL 3000 Plus™ User's Guide* — 6881131E52
- *ASTRO® 25 KVL 3000 Plus™ User's Guide* — 6881132E29

ERROR AND CONCERNS REPORTING

Any errors or concerns about this manual or its contents should be addressed to *KVL 3000 Plus Brand Manager* and faxed to 1-847-435-9067. Include your name and phone number so we can follow up with you.

HOW TO ORDER PARTS

For complete information on ordering replacement modules, contact the appropriate Motorola Accessories and Aftermarket Division facility listed below.

UNITED STATES AND CANADA

Mail Motorola, Inc.
Accessories and Aftermarket Division
1309 East Algonquin Road
Schaumburg, IL 60196

Phone (800) 422-4210
(847) 538-8023 (Outside the U.S.)

FAX (800) 622-6210
(847) 576-3023 (Outside the U.S.)

UNITED STATES FEDERAL GOVERNMENT

Mail Motorola, Inc.
Accessories and Aftermarket Division
1309 East Algonquin Road
Schaumburg, IL 60196

Phone (800) 826-1913
FAX (410) 712-6033

EUROPE, MIDDLE EAST, AND AFRICA

Mail Euro Repair And Service Centre
Motorola GmbH,
Customer Care
Am Borsigturm 130
13507 Berlin
Germany
Phone +49 30 6686 1555

LATIN AMERICA AND SOUTH AMERICA

Mail LACR Parts Division
Motorola, Inc.
Attn.: Octavio Cadena
789 International Parkway
Sunrise, FL 33325
Phone (954) 723-6531
FAX (954) 723-8560

HOW TO RETURN PARTS FOR REPAIR

For instructions on returning faulty modules for repair, contact the System Support Center at:

Motorola System Support Center
1311 E. Algonquin Road
Schaumburg, IL 60196

1-800-221-7144
1-847-576-7300 (outside the U.S.)
1-847-576-2172 (FAX)

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CHAPTER 1

SPECIFICATIONS

SERVICE AND REPLACEMENT MODULES

The field replaceable units (FRUs) available for the KVL 3000 *Plus* Key Variable Loader are listed in Table 1-1.

TABLE 1-1 KVL 3000 *PLUS* FRUS

Item	Description
DLN1193	KVL 3000 *Plus* Display Board
CLN1385	KVL 3000 *Plus* PCMCIA Board
CLN1386	KVL 3000 *Plus* Power Board
DLN1194	KVL 3000 *Plus* Housing Kit
DLN1222	KVL 3000 *Plus* Main Board

The model numbers for replacement parts available for the KVL 3000 *Plus* Key Variable Loader are listed in Table 1-2.

TABLE 1-2 MODEL COMPLEMENT FOR T6717A KVL 3000 *PLUS*

Item	Description
CLN7493	KVL 3000 *Plus* Main Circuit Board
CLN7722	KVL 3000 *Plus* Bitmapped Display
CLN7064	Chassis Assembly
CLN7724	Housing Assembly
CLN6985	Hardware

TABLE 1-2 MODEL COMPLEMENT FOR T6717A KVL 3000 *PLUS (CONTINUED)*

Item	Description
CLN7135	Nameplate
CNN6002	Coin Cell Battery
NTN7395	High Capacity NiCad Battery
CBN6134	Packing
CLN7751	KVL 3000 *Plus* Bracket Stand
6881132E29	*ASTRO® 25 KVL 3000 Plus™ User's Guide*
6881131E52	*Dimetra KVL 3000 Plus™ User's Guide*

ACCESSORIES

TABLE 1-3 BATTERY ACCESSORIES

Item	Description
NTN1402	120 Volt Rapid Rate Dual Unit Charger
NTN7621	120 Volt Rapid Rate Multi Unit Charger
NTN1403	220 Volt Rapid Rate Multi Unit Charger
NTN1404	240 Volt Rapid Rate Multi Unit Charger
NTN7395	High Capacity Nickel Cadmium Battery

TABLE 1-4 INTERFACE CABLES AND ACCESSORIES

Kit	Option	Description
CKN6766	N/A	KVL *Dimetra* Adapter Use with CKN6767A for *TETRA* Site Controller, Base Radio Controller, Mobile Subscriber
CKN6767	N/A	KVL *Dimetra* Serial Cable Use for Authentication Centre, Provisioning Centre, Zone Controller
TDN9390	C724AA	MTS 2000™, XTS 3000™, MTS2500, MTS5000, XTS5000
TKN8209	C540AA	MTX300S and STX Series

TABLE 1-4 INTERFACE CABLES AND ACCESSORIES (CONTINUED)

Kit	Option	Description
TKN8210	C541AA	MICOR™ mobile and base, portable repeater
TKN8229	C542AA	Series II CIU, SYNTOR™, SYNTOR X™, MCX 1000™, PX300-S™, KMC
TKN8506	C544AA	Saber™, ASTRO Saber™
TKN8531	C543AA	MSF 5000, DIU, DIU 3000, Expo, SYNTOR X 9000™ Series, RNC, SPECTRA™, ASTRO SPECTRA™ (requires TRN7414), Motorola Gold Elite Gateway (MGEG), XTL 5000
TKN9152	C551AA	MCS 2000™
TRN7414	N/A	Cable Adapter for SPECTRA, ASTRO SPECTRA, and XTL 5000
CKN6324	N/A	KVL 3000 *Plus* DB-9/Modem Cable
N/A	C954AB	Cables for SPECTRA and ASTRO SPECTRA (includes cable and adapter)

PERFORMANCE SPECIFICATIONS

TABLE 1-5 PHYSICAL SPECIFICATIONS

Item	Specification
Dimensions	226 mm L (includes Connector Boot) 89 mm W 48 mm Thick (High Capacity Battery Included)
Weight	714 g (High Capacity Battery Included)

TABLE 1-6 GENERAL SPECIFICATIONS

Item	Specification
Motorola 68332 Processor:	16.78 MHz (32.768 kHz Oscillator)
Code Space	2M x 8 Flash Memory
Key and Key Data Storage	128K x 8 EEPROM

TABLE 1-6 GENERAL SPECIFICATIONS (CONTINUED)

Item	Specification
Operating Memory	512K x 8 RAM
Tamper Protection	
Tone Generator	
Real Time Clock	
Power Regulation	Continuous Power Regulation Switched Power Regulation
Low Voltage Detection	Low Battery Detection (<6.68V) Minimum Voltage to Upgrade KVL (7.24V) 5 V Detection
Backup Power	3 Volt Coin Cell Battery for Real Time Clock Backup
PCMCIA Support	Interface support for Type I or Type II PCMCIA Cards
Serial Communications	RS232 Port

TABLE 1-7 ENCRYPTION SPECIFICATIONS

Item	Specification
Supported Encryption Applications:	• DES-CFB • DES-XL • DES-OFB • DVP-XL • DVI-XL • AES • ADP
Supported Encryption Protocols:	• 12 kbps SECURENET • 9.6 kbps Secure ASTRO (VSELP Vocoder) • 9.6 kbps Secure APCO Project 25 (IMBE Vocoder)
Encryption Keys:	1,024 Total Traffic and Shadow Keys
Standards:	• FIPS 46-2 • FIPS 81 • FIPS 140-2 (pending certification)

USER INTERFACE

- Bitmapped LCD Display
- LCD Annunciator Line
- 4x4 Numeric Keypad (0 - 9 and A - F keys)
- Two General purpose softkeys
- Scroll Left/Increment Key
- Scroll Right/Decrement Key
- Power On/Off (**PWR**) **DELETE/SHIFT**, **ENTER**, **Esc** Keys
- DB-9 Connector (RS232)
- Type II PCMCIA Slot
- Keyload Port

REGULATORY COMPLIANCE AND APPROVALS

Safety: EN 6095

ELECTROMAGNETIC COMPATIBILITY

- CISPR 22 Class A
- European EMC Directive 89/336 EEC
- EN 50022 Class A
- EN 55024
- IEC 801.2, IEC 801.3, IEC 801.4, IEC 61000-4.2, IEC 61000-4.3
- FCC Part 15*

* This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

ENVIRONMENTAL TESTING

TABLE 1-8 ENVIRONMENTAL TESTING STANDARDS AND COMPLIANCE

Standard	Method	Procedure	Test	Performance
MIL-STD 810E	516.4	I	Thermal Shock	Meets or exceeds published specs following shock testing.
MIL-STD 810E	516.4	I	Vibration	Meets or exceeds published specs following vibration testing.
MIL-STD 810E	505.3	I	Solar Radiation	Meets or exceeds published specs following solar radiation testing.
MIL-STD 810E	510.3	I	Blowing Dust	Meets or exceeds published specs following blowing dust testing.
Operating Temperature				-30° to +60° Celsius except PCMCIA Card (which is 0° to +60° Celsius)
Storage Temperature				-55° to +85° Celsius

CHAPTER 2

BLOCK DIAGRAM THEORY

This chapter describes the KVL 3000 *Plus* circuitry at a block diagram level. See Figure 2-1 for the block diagram. The service diagrams provided in Chapter 5 are also referenced throughout the theory.

POWER BLOCK

OVERVIEW

The power block (see Figure 5-6) consists of all the circuitry used to control the power into the KVL 3000 *Plus*. Main board power is provided by the main battery through the power circuit board and the power flex cable. Backup battery power for the Real Time Clock is provided by the 3.0 Volt coin cell battery.

The applied voltage from the main battery is fed initially into 3 voltage detectors (Low Upgrade, Low Battery, and Low Voltage) and 2 regulators (5V Continuous Regulator and 5V Switched Regulator). The output from 5V Continuous Regulator is fed into a 3.3V Continuous Regulator. The output from the 5V Switched Regulator is fed into a 3.3V Switched Regulator and a 2.8V Switched Regulator.

VOLTAGE DETECTORS

All detectors on the KVL board are 2.3V detectors. Prior to reaching the detector, the input voltage is passed through a resistor network to drop the voltage into a range suitable for the detector. To disable the functionality of the voltage detectors when the KVL is powered off, the input voltage is also passed through a switching logic circuit before going through the resistor network. To reduce current consumption when the KVL is powered off, the switching logic circuit prevents the KVL from checking the battery level when the unit is powered off.

- **Low Upgrade Voltage Detector**

  The output from low voltage detector U508 (PROG_VOLT_LOW*) is fed into one of the TPU channels on the processor (TPU7). If the input voltage drops below a certain set level (~7.24V), the processor reads a low signal from TPU7 and the processor uses this information to prohibit a KVL upgrade from being executed.

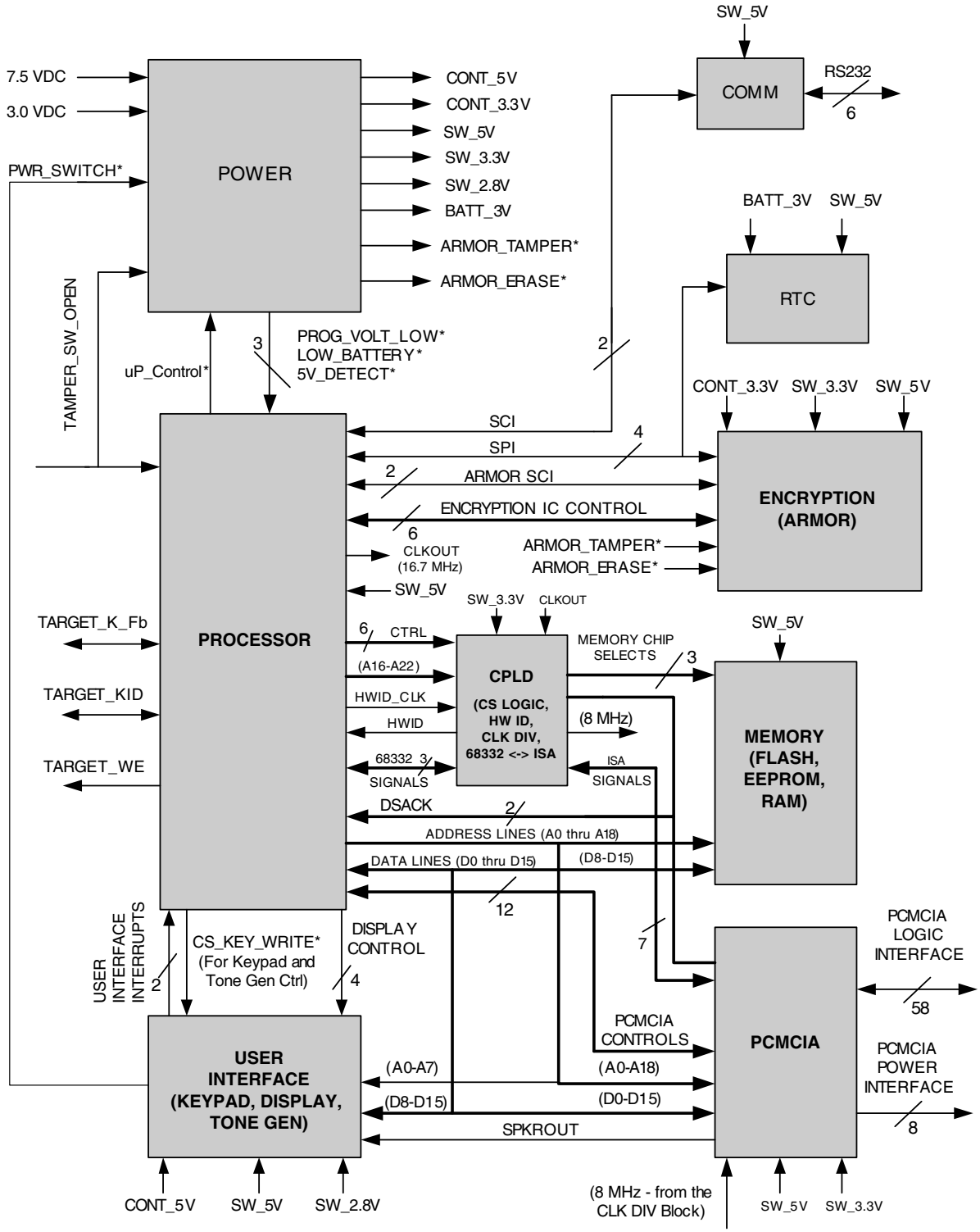

FIGURE 2-1 OVERALL BLOCK DIAGRAM

- **Low Battery Detector**

  The output of low battery detector U507 (LOW_BATTERY*) is fed directly to the processor and is used to interrupt the processor when the input voltage drops below a set level (~6.68V). The processor uses this information to notify the user of a low battery condition.

- **Low Voltage Detector**

  The output (5V_DETECT*) from voltage detector U506 is used to detect a critical drop in the supply voltage. If the supply voltage drops to ~5.4V, this detector interrupts the processor to notify it to prepare for shutdown. In general, if the supply voltage reaches 5.4V, the battery is either extremely low or has been removed.

VOLTAGE REGULATORS

There are five regulators on the KVL 3000 *Plus*. Two regulators (5V Continuous and 3.3V Continuous) provide continuous regulated outputs as long as there is a valid voltage source attached. The others (5V Switched, 3.3V Switched, and 2.8V Switched) can be switched on and off. The continuous regulators are used to power circuitry which should not be shut off, and the switched regulators are used for the remaining circuitry.

- **5V Continuous Regulator**

  The output of continuous 5V regulator U504 is used for two primary purposes:

  - to provide power to the circuitry used to turn the KVL on/off
  - to enable the tamper detection and response mechanisms to operate even if the KVL is switched off (certain security requirements require the erasure of key data if tampering of the KVL is detected).

  The output of the regulator is also fed into a 3.3V Continuous Regulator.

- **3.3V Continuous Regulator**

  The output of continuous 3.3V regulator U502 is used to supply power for the battery backed registers in the Armor encryption chip (U906). Battery backed registers hold the KPK (Key Protection Key) used for encrypting key data that is stored in the EEPROM. In order to retain the KPK during power cycle, a continuous voltage must be applied to U900. The output of U501 is also fed into two large filter capacitors to ensure that the KVL retains the KPK when users replace the battery. The output of this regulator is also fed into an ARMOR_TAMPER* detector (U901) which erases the KPK if the regulated supply voltage drops below ~2.7V (the voltage will drop when the main battery is removed for a long period of time). The output of the tamper protection circuitry is also connected to the output of the 2.8V detector; therefore the KPK is also erased if the KVL is tampered with.

- **5V Switched Regulator**

  The output of switched regulator U503 is used to provide power to the circuitry that should be switched off when not in use. This regulator is switched to the ON state when the user presses the **PWR** key on the keypad. This regulator is switched to the OFF state by the microprocessor either through the detection of the pressing of the **PWR** key or some other criteria noted by the processor (for example, a time-out occurs or the supply voltage drops below a certain level). The output of U506 is also fed into a 3.3V Switched Regulator and a 2.8V Switched Regulator.

- **3.3V Switched Regulator**

  The output of switched regulator U501 is used to provide power to the encryption circuitry (Armor Encryption IC and its flash memory), the programmable CPLD, and the power core of the PCMCIA Controller IC. One large47 uF filter capacitor is connected to the output of this regulator to maintain its power level for a few minutes after the KVL is switched off so that the Armor chip can perform necessary cleanup.

- **2.8V Switched Regulator**

  The output of switched regulator U505 is used primary for supplying power to the bitmapped display.

PROCESSOR BLOCK

OVERVIEW

The processor block (Figure 5-4) consists of the processor and the circuitry needed to support it. It also includes the target interface circuitry which consists of simple gate devices to support bidirectional signals and buffers to isolate the processor.

PROCESSOR

The processor (U300, a Motorola 68332 processor) controls the majority of the circuitry in the KVL 3000 *Plus*. Circuitry not under control of the processor consists primarily of power circuitry or tamper/low-voltage circuitry.

The processor consists of five basic sections:

- **CPU32 (Central Processing Unit)** — the main processing engine for the processor.
- **QSM (Queued Serial Module)** — capable of performing serial communication through its SCI (Serial Communications Interface) and SPI (Serial Peripheral Interface) port.
- **RAM (Random Access Memory)** — the 68332 processor contains 2 kilobytes of internal RAM.
- **SIM (System Integration Module)** — used to integrate both the internal modules as well as external devices to the CPU32 through the address bus, data bus, and control signals.
- **TPU (Time Processor Unit)** — composed of 16 independent I/O channels, each of which can be individually configured to generate or detect various signal conditions.

32.768 KHZ OSCILLATOR (Y300)

The clock source for the processor is a 32.768 kHZ oscillator circuit. The processor uses this signal as a reference to create an internal 16.768 MHz clock. The output of the 32.768 kHz oscillator is also buffered by U803, and the buffered signal is fed to Real Time Clock IC U700.

TARGET INTERFACE

The target interface signals are derived from TPU channels on the processor. For bidirectional signals, two TPU channels are used (one input and one output).

MEMORY BLOCK

The memory block (Figure 5-3) consists of three memory devices. The first is FLASH memory U202 which is used to hold the operational software of the KVL 3000 *Plus*. The second is EEPROM U201which is used to store encrypted key data. The third is the RAM (U204), which is used by the processor during operation. All of the memory operations are controlled by the processor and the chip select logic that is implemented inside the programmable CPLD (U1000). The chip select logic decodes the address and generates the chip select signals for the Flash, EEPROM, and RAM. All memory devices are controlled via the address bus lines with data transferred over the data bus lines.

CHIP SELECT LOGIC

There is a section in the programmable CPLD chip (U1000) that implements the memory's chip select logic. The Clock, Reset, Address Strobe, Data Strobe, Read/Write*, and six most significant bits of the address (A22 through A17) from the microprocessor are fed into programmable CPLD U1000. Based on these inputs, the CPLD generates the chip select signals for the Flash, EEPROM, and RAM. The CPLD also generates data and size acknowledge (DSACK) signals that are fed back into the microprocessor. During a write cycle, the DSACK signals indicate that an external memory device has successfully stored data, therefore the cycle can be terminated. During a read cycle, the DSACK signals indicate that the microprocessor has latched the data being read from an external device.

USER INTERFACE BLOCK

The user interface block (Figure 5-5) is made up of the following: a 16 key hex keypad circuit, an 8 key control keypad circuit, display control circuitry, and a tone generator circuit. All of these circuits are controlled by or interface to the processor. The keypads are controlled via the data bus with chip select signals controlling the keypad latches. The tone generator and display backlight circuitry are also controlled through the keypad latches. The display circuitry is controlled by the processor through the data bus as well as other control lines.

NUMERIC KEYPAD

The 16-key hex numeric keypad (0 - F hex) is configured as four rows of four keys each. A keypress of one of the keys generates an interrupt to the processor. The processor then performs a decoding function which determines the location of the key pressed.

CONTROL KEYPAD

The eight-key control keypad is made up of the following: a **PWR** key, **DEL/SHIFT** key, an **ESC** key, an **ENTER** key, a left arrow key ◄, a right arrow key ► , and two soft keys.

- **PWR key —** Toggles power on and off. If the power is OFF and the key is pressed, a latch is activated which turns the switching regulator ON. If power is ON and the key is pressed, the microprocessor is interrupted. After cleaning up any currently running processes, the processor then resets the latch which turns the switching regulator OFF.
- **DEL/SHIFT key —** Depending on the current function being performed by the processor, this key acts as either a delete key or as the shift key as part of a double key press operation.
- **ESC key —** In general, this key allows a user to exit the current function being executed and return to a higher level menu
- **Arrow keys —** The function performed is menu dependent. These keys provide the following two functions:
  - Scrolling through menus
  - Incrementing/decrementing through a list
- **Soft keys —** These keys do not have a permanent definition. The function performed by the pressing of either of these keys is dependent upon the mode of operation of the KVL and the menu option displayed on the screen directly above the key.

DISPLAY CONTROL CIRCUITRY

The display control circuitry consists of a few gates which are controlled by the processor. These gates are necessary for developing the proper interface signals to the display

The Tone Generator circuitry can be activated/deactivated by either the processor or the PCMCIA circuitry. However, the hardware provides a means for the processor to inhibit PCMCIA sound generation.

PCMCIA BLOCK

The PCMCIA block (Figure 5-7) consists of an ISA/PCMCIA interface chip and a 68000/ISA converter logic chip implemented in the programmable CPLD (U1000, shown in Figure 5-9) to convert certain ISA signals to 68000 format (and vice versa), a power-switching network IC for card power control, and several logic gates as support devices.

- **ISA/PCMCIA Interface IC**

  This IC (U600) is the PCMCIA socket controller. It provides a means for the processor to communicate with the PCMCIA cards.

- **Power-Switching Network**

  This power-switching network IC U601 controls power to the PCMCIA socket. Two power inputs (5V and 3.3V) are fed into the power-switching network IC, and the PCMCIA Interface IC (U600) controls which power is supplied to the PC Card that is inserted into the PCMCIA socket.

- **ISA/68000 Signal Converter**

  The ISA/68000 signal converter is implemented inside the programmable CPLD (U1000, shown in Figure 5-9) to alter the waveforms of 68000 signals to appear as ISA signals and vice-versa. In addition to the ISA/68000 signal converter logic, the CPLD also implements the clock divider to reduce the 16.78 MHz clock that is generated by the 68332 microprocessor to an 8.39 MHz clock supported by the PCMCIA standard.

REAL TIME CLOCK BLOCK

This block (shown on Figure 5-6) contains the Real Time Clock (RTC U700) which gets the 38.768 kHz clock from the same oscillator circuit (Y300) that provides a reference clock to the microprocessor. The Real Time Clock interfaces to the processor through the SPI port with the processor being the Master and the RTC being the slave device. It maintains the date and time of day. The 3V coin cell battery maintains the date and time when the KVL is powered off.

COMMUNICATIONS BLOCK

This block (shown on Figure 5-6) contains a serial interface which consists of level-shifting IC (U801), which converts TTL levels to RS232 levels for transmitting data and RS232 levels to TTL levels when receiving data. The source and destination of data within the KVL is the Serial Communications Interface (SCI) on the 68332 processor.

ENCRYPTION BLOCK

The KVL 3000 *Plus* supports the FIPS 140-2 (pending certification) (Federal Information Protection Standards) encryption security standard.

The encryption block (Figure 5-8) consists of an Armor Encryption IC (U906) with its 7.948 MHz crystal (Y900), and a Flash (U907). The Armor Encryption IC has a DES engine inside it, and it is capable of performing the Secure Hash Algorithm (SHA-1) that is fully compliant with the FIPS 180-1 secure hash standard. The Flash is used for storing the boot code and main code of the UCM (Universal Crypto Module). This Flash also stores all algorithms that are supported by KVL 3000 *Plus*. This encryption block supports both Motorola proprietary encryption algorithms as well as other standard or custom encryption algorithms.

In general, the KVL uses a unique key protection key (KPK) to encrypt the keys in the KVL's database of keys. By doing so, the security of the KPK becomes the primary element by which the other keys are protected. When a KVL 3000 *Plus* is configured for FIPS mode (user-selectable via the Menu System), the KPK is stored in the battery-backed register inside the Armor Encryption IC. The battery-backed register is a volatile register controlled directly by both the tamper switch and the low-power detection circuitry. Upon removal of the KVL's main battery for a long period of time or by detection of a tamper condition, this register is automatically cleared and the KPK will be lost. Because the KPK is lost, there are no means of decrypting the keys stored in the EEPROM.

The KVL 3000 *Plus* also contains circuitry designed to hold a sufficient charge without the main battery in place. This allows the user a minimum of 30 seconds to replace the battery without destroying the KPK.

CHAPTER 3

MAJOR SIGNAL DESCRIPTIONS

This chapter describes each of the major signals, buses, and control lines in the KVL 3000 *Plus* circuitry.

BUS/PROCESSOR CONTROL LINES

ADDRESS BUS

Address bus lines A0 through A22 are the address lines for the processor and the other bus components. The higher address line (A23) is programmed ECLK.

DATA BUS

Data bus lines D0 through D15 are the data lines over which data is passed in transferring information between components in the KVL 3000 *Plus*. Upon startup, the state of the data lines determines certain processor parameters. Pull-up resistors and various other gating circuits are used to ensure the proper power-up state of these lines.

RESET* / RESET

This is the reset line for the processor. Upon startup, the processor holds this line low until the oscillator stabilizes. When the clock has stabilized, the signal is released. In the KVL 3000 *Plus*, the processor has total control over this line (the processor may activate this line and therefore put itself into reset if it encounters certain error conditions).

RW*

This is the bus read/write signal used during data transfers.

ECLK

This is a clock signal used during synchronous bus cycles.

SIZ0

This line specifies the number of bytes remaining to be transferred during an operand cycle.

AS*

This is the address strobe line used to indicate the validity of an address on the address bus.

DS*

This signal is used to indicate when data is valid on the data bus or when a device should place its data on the data bus.

DSACK0* / DSACK1*

These signals are used to indicate to the processor the width of the data that a peripheral device is placing on the bus.

CHIP SELECTS/SLAVE SELECTS

- Memory Block—All memory chip selects (CS_FLASH*, CS_EEPROM*, and CS_RAM*) are generated by an external CPLD (U1000).
- Real Time Clock (RTC) Block—The RTC is connected to the processor via the SPI interface. Its RTC_SS (slave select) line is derived from PCS3 of the QSM.
- User Interface Block
  - Display Chip Select (CS_DISPLAY*)—The chip select for the display originates from CS2 of the processor's SIM module.
  - Tone Generator Chip Select (CS_KEY_WRITE*)—Selection of the tone generator is made via the same chip select as the one used for writing to the keypad circuitry (CS1 of the SIM).
  - Keypad Chip Selects (CS_KEY_WRITE* and CS_KEY_READ*)—There are two chip selects for the keypad circuits: one for writing and one for reading. They originate at CS1 and CS0, respectively.
- Encryption Block—The Armor Encryption IC is connected to the processor via a SPI interface bus. Its slave select (ARMOR_SS*) line is derived from PCS1 of the QSM.
- Communications Block—The RS232 Serial port portion of the Communications block does not use chip select circuitry.
- PCMCIA Block
  - PCMCIA Memory Chip Select (CS_MEM*)—This chip select is derived from processor pin CS4.
  - PCMCIA I/O Chip Select (CS_IO*)—This chip select is derived from processor pin CS3.
  - PCMCIA Register Chip Select (CS_REG*)—This chip select is derived from processor pin CS5.

PROCESSOR INTERRUPT SIGNALS

- Low Battery Interrupt (LOW_BATTERY*)—The source of this interrupt (IRQ2) is the low battery detection circuit. When this interrupt occurs, the processor provides an indication to the user that the battery's charge is low.

- PCMCIA Interrupts (PCMCIA_INT_1* and PCMCIA_INT_2*)—These interrupts originate from within the PCMCIA block and interrupt the processor on IRQ3 and IRQ4.
- Keypad Interrupts (NUM_KEY_INT* and CTL_KEY_INT*)—One interrupt originates in the numeric keypad circuitry and interrupts the processor on IRQ5. The other originates in the control keypad circuitry and interrupts on IRQ6.
- Tamper Interrupt / 5V Interrupt (TAMPER_INT*)—The tamper detection signal and the 5V detection signal are multiplexed to interrupt the processor on IRQ7. The tamper detection signal is also routed to the RMC pin on the processor (although labeled RMC, it is configured as a general purpose input pin in the KVL 3000 *Plus*). The first step of the IRQ7 interrupt routine is to read the state of the RMC line to determine which signal caused the interrupt.

SERIAL PERIPHERAL INTERFACE (SPI)

The SPI interface is a master/slave type. In the KVL 3000 *Plus*, the processor is always the master. The operation of the interface is that of a circular shift register with 8 bits residing in the master and the other 8 residing in the slave. The master initiates the transfer by selecting (via a slave select signal) the slave to which it needs to communicate, clocking out its 8 bits on the Master_Out_Slave_In (MOSI) line (synchronously with the SPI_CLK signal), and simultaneously clocking in the slave's data on the Master_In_Slave_Out (MISO) line.

In the KVL 3000 *Plus*, the MOSI line originates at the processor and ends at the Armor Encryption IC and at the Real Time Clock. The MISO line originates at the Armor Encryption IC and RTC with the processor as the destination. The SPI_CLK and the slave select signals for both the RTC and the Armor Encryption IC originate at the processor.

SERIAL COMMUNICATION INTERFACE (SCI)

The SCI interface consists of the SCI_TXD line and the SCI_RXD line. These lines are linked between the processor's Queued Serial Module and the RS232/TTL converter IC. The SCI port provides serial communication capabilities such as those found on standard serial interfaces.

TARGET INTERFACE SIGNALS

TARGET_K_FB (TARGET KEY/FAIL B)

This signal is a bidirectional signal which is connected between the processor and the target connector on the back of the KVL 3000 *Plus*. It actually connects to the processor through two ports on the Time Processor Module (TPU) of the processor. TPU Channel 15 is used to output information while channel 14 is used for input.

TARGET_KID (TARGET KEY INSERT DATA)

This signal is similar to the Target_K_Fb signal except that it uses TPU channels 12 and 13.

TARGET_WE* (TARGET WRITE ENABLE B)

This signal utilizes TPU channel 11 only and is designed as an output channel only. It is converted to an open collector signal prior to its routing to the external target connector. This is necessary to prevent sharing KVL 3000 *Plus's* from shorting each other's WE* line to ground.

ENCRYPTION INTERFACE SIGNALS

ARMOR_KF* (ARMOR KEY/FAIL B)

This signal is connected between the processor's TPU channels (0 and 1) and the Armor encryption IC. The two channels are combined through an open collector transistor. KVL 3000 *Plus* software does not utilize this signal.

ARMOR_TAMPER* (ARMOR TAMPER)

The KVL 3000 *Plus* accepts encryption keys and keeps them secure by storing the keys in encrypted form. The only piece of “RED” (unencrypted) information is the key with which all of the other keys are encrypted. To keep this key secure, the KVL 3000 *Plus* has a tamper detection device which, when activated, will destroy the RED key. This detection device is only active when there is power available (i.e. there is a sufficiently charged battery installed).

The state of the ARMOR_TAMPER line is dually controlled by the tamper detection mechanism and the Cont_3.3V regulator output. Either the detection of tampering or the drop in Cont_3.3V power will activate the ARMOR_TAMPER line. Activation of this line clears the KPK in the battery-backed registers.

ARMOR_ERASE

This signal originates from the Switched_5V voltage detector. Soon after the KVL 3000 *Plus* is turned off, the ARMOR_ERASE* line goes low and resets the Armor Encryption IC. When the Armor IC is reset, the Armor does not clear the KPK. However, when the Armor is tampered with, the Armor clears the KPK and the Armor is reset.

ARMOR_BOOT

This signal originates from the TPU channel 2 of the processor and ends at the BOOT* of the Armor IC. This signal tells the Armor to go into either bootstrap mode or production mode. To put the Armor IC into bootstrap mode, TPU channel 2 pulls this signal low (active) at reset. To put the Armor IC into production mode, TPU channel 2 pulls this signal high (inactive) at reset.

ARMOR_WAKEUP

This signal is originated from TPU channel 3 of the processor. This signal is used to wake up the Armor IC if the Armor IC is in sleep mode (low current consumption mode).

ARMOR_RST_DIRECT (ARMOR RESET DIRECT)

This signal is combined with the RESET line to reset the Armor. This signal originates from TPU channel 4 of the processor and ends at the Armor's RESET. Therefore there are three ways to reset the Armor Encryption IC: Hardware reset, software reset, and set TPU channel 4 output to high.

SPI_CLK (SPI CLOCK)

This is a SPI Clock Input for the SPI communication interface between the processor (master) and the Armor (slave).

ARMOR_SS* (ARMOR SLAVE SELECT)

This signal is originated from the PCS1 of the processor and is used to enable the SPI communication between the processor and the Armor.

SPI_MOSI (SPI MASTER OUT SLAVE IN)

The data from the processor (master) to the Armor (slave) is transferred through this line.

SPI_MISO (SPI MASTER IN SLAVE OUT)

The data from the Armor (slave) to the processor (master) is transferred through this line.

UCM_REQUEST_5V

When the ARMOR Encryption Module (UCM) wants to communicate with the processor, it interrupts the processor on IRQ1.

ARMOR_SCI_RXD (ARMOR SCI RECEIVE)

This signal originates from TPU channel 5 of the processor and ends at the SCI_IN of the Armor. This signal is used for communication between the Armor and the processor through the SCI interface.

ARMOR_SCI_TXD_5 (ARMOR SCI TRANSMIT)

This signal originates from SCI_OUT of the Armor and goes through a 3.3V/5V buffer translation before it ends at the TPU channel 6 of the processor. This signal is used for communication between the Armor and the processor through the SCI interface.

MISCELLANEOUS SIGNALS

CLKOUT

This signal is a 16.78 MHz square wave clock used by the Chip Select Logic and the PCMCIA circuitry for synchronization purposes. For the PCMCIA circuitry, this signal is fed into an external CPLD (U1000) in order to divide the frequency by two (resulting in an 8 MHz clock signal).

uP_CONTROL* (MICROPROCESSOR CONTROL)

The processor uses this signal to power down the KVL's circuitry. When the KVL 3000 *Plus* is off, pressing the **PWR** key directly activates a latch which turns on the SW_5V regulator (and turns on the KVL circuitry). When the user presses the **PWR** key to turn the KVL off, the processor is notified via an interrupt. The processor then "cleans up" its current process and deactivates the SW_5V regulator latch through this signal.

BATT_3V

This signal is the backup voltage for the Real Time Clock (RTC). Its source is the 3V battery. This voltage supply is needed to maintain the time in the KVL whenever the KVL is switched off.

PWR_SWITCH

The **PWR** key is different than the other keys on the keypad because it is powered by the Cont_5V supply rather than the SW_5V supply. This is necessary to allow the user to turn the KVL power on (pressing other keys while in the OFF state will have no effect). The PWR_SWITCH* signal is basically the output of the **PWR** key press. From the power off condition, toggling this line activates the latch which turns on the SW_5V supply. Activation of this line from the ON state yields no immediate result (turning the SW_5V supply OFF is the responsibility of the microprocessor through the resetting of the latch).

CHAPTER 4

DISASSEMBLY INSTRUCTIONS

This section provides disassembly instructions for replacing the main circuit board in the KVL 3000 *Plus*.

PROCEDURE 4-1 DISASSEMBLING/REASSEMBLING THE KVL

1	Remove the Main Battery.
2	Using a coin, unscrew and remove the backup battery cover.
3	Using the ribbon, remove the backup battery.
4	Open the rubber boot at the top of the unit.
5	Using a long #10 Torx® driver, remove the 2 back cover screws and lift the back cover away from the chassis.
6	Carefully disconnect the Target/PCMCIA flex cable from the connector on the back cover by using a small screwdriver to pry the connector components apart. At this point the back cover should be removed; set it aside.
7	Carefully remove the Target/PCMCIA flex cable from the PCMCIA circuit board 80-pin connector (a small screwdriver may be used to separate the mating connector components).  **NOTE** Do not pull on the Flex Cable to separate the mating connector components.
8	Using a #6 Torx driver, remove the screws (4) which secure the PCMCIA circuit board and rails to the chassis.
9	Remove the PCMCIA circuit board and rails.
10	Using a #15 Torx driver, remove the center screw that secures the chassis to the front cover.
11	Tabs located at both ends of the chassis are used to snap into slots in the front housing (2 at each end). Using a small, flat screwdriver, release the narrow end of the chassis from the front housing by prying the housing away from the narrow end of the chassis and pulling up on the chassis. When the narrow end has been released from the housing, release the wide end by pulling the chassis slightly toward the narrow end.

PROCEDURE 4-1 DISASSEMBLING/REASSEMBLING THE KVL (CONTINUED)

12	With the chassis free of the front housing, lift the wide end of the chassis, pulling the flex cable through the center slot until the chassis is free of the flex cable.
13	Fold the chassis away from the front housing using the narrow end as the hinge end.
14	Separate the Target/PCMCIA flex from the mating connectors on the main circuit board; set the flex cable aside.
15	Release the Power flex cable at the narrow end of the chassis by pulling out on the friction mechanism of the main board connector and then pulling out on the flex cable; the chassis, Power flex, and Power circuit board may now be set aside.
16	With the front portion of the unit face down, locate the 2 main board tabs in the narrow end of the unit. Pull back on the tabs and pull up on the main board until it is free of the tabs; at this point, the main board should separate from the front housing.
17	Disconnect the Display and Display flex from the front side of the main board by releasing the friction/snap mechanisms holding them to the board.
18	Reverse the disassembly sequence to reassemble the unit.

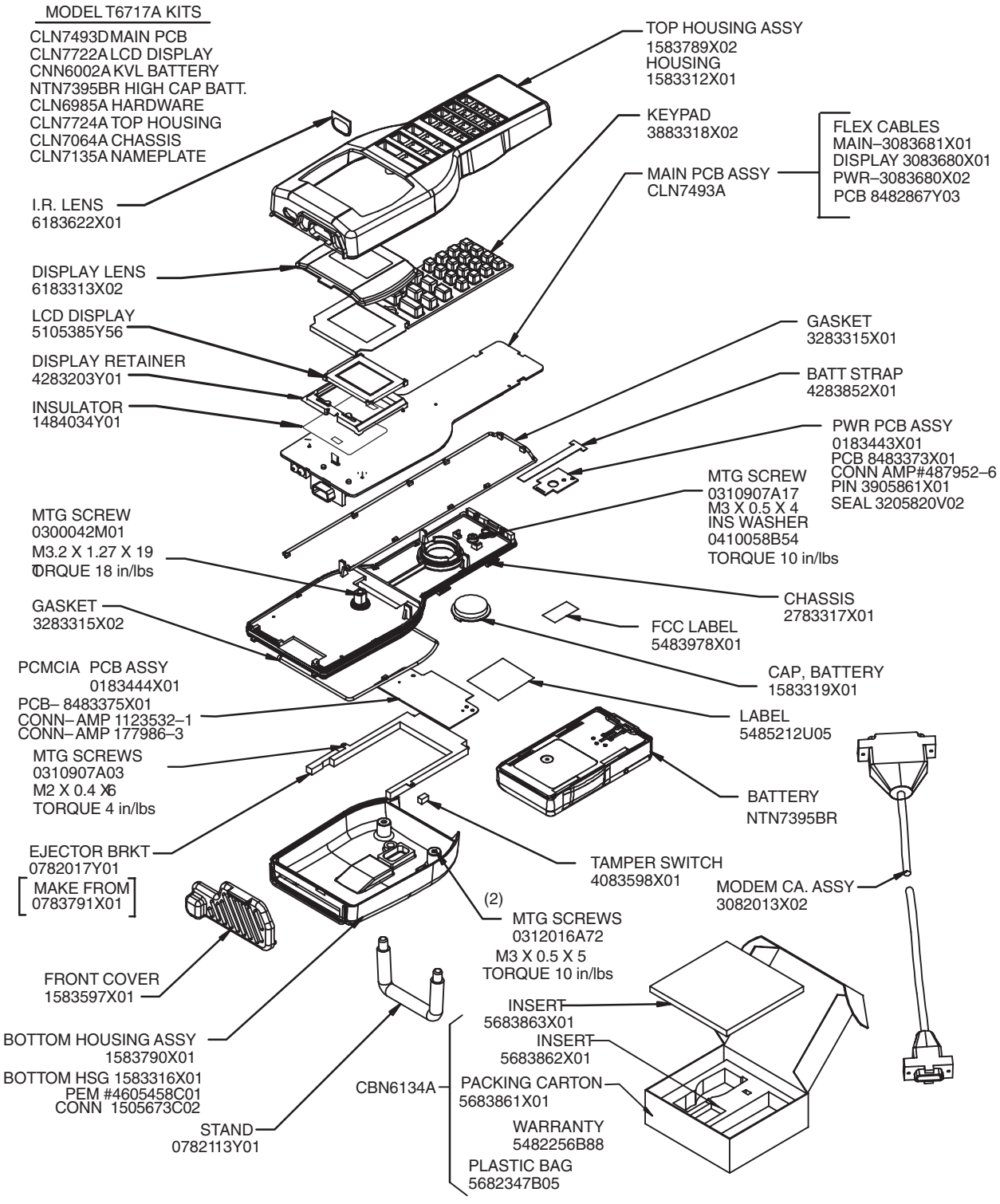

FIGURE 4-1 KVL 3000 PLUS EXPLODED VIEW

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CHAPTER 5

TROUBLESHOOTING

INTRODUCTION

The KVL 3000 *Plus* can be partitioned into three conceptual components: the processing section, the peripheral section, and the external interface section. The processing section and the peripheral sections reside on the main circuit board. The external interface section consists of all of the components (cables and circuit boards) necessary to connect the main board to the external world. The processing section consists of the processor, the Flash (code) memory, the RAM, the EEPROM (for key and configuration storage), and the PCMCIA controller circuitry. The peripheral circuitry consists of the RS232-TTL level converter, the power circuitry, the tone generator, the encryption IC, the display, the tamper register, the real time clock (RTC), and other components that bring information to or take information from the processor section.

Use this conceptual partitioning to isolate the source of a problem within the KVL 3000 *Plus*. For example, if the non-working operation is an interface operation, first determine if the connections are complete. If yes, then move to the processing or peripheral area (depending on the specific problem).

Repair of the KVL 3000 *Plus* is limited primarily to kit replacements. However, limited replacement of components on the main circuit board is possible. This applies primarily to the replacement of components in the peripheral sections where component lead counts and pitches allow.

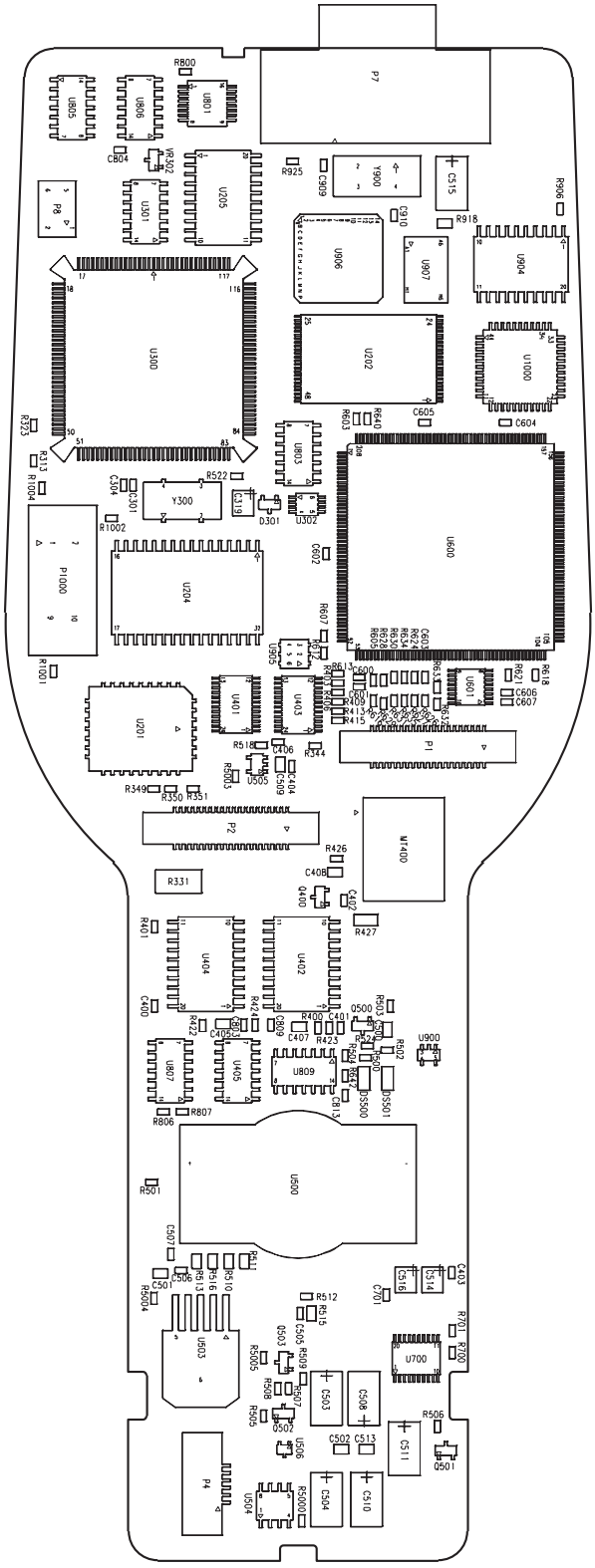
See Chapter 6 for the top and bottom circuit board overlay diagrams, the parts list, and the schematic diagram for the KVL circuit board.

TROUBLESHOOTING PROCEDURES

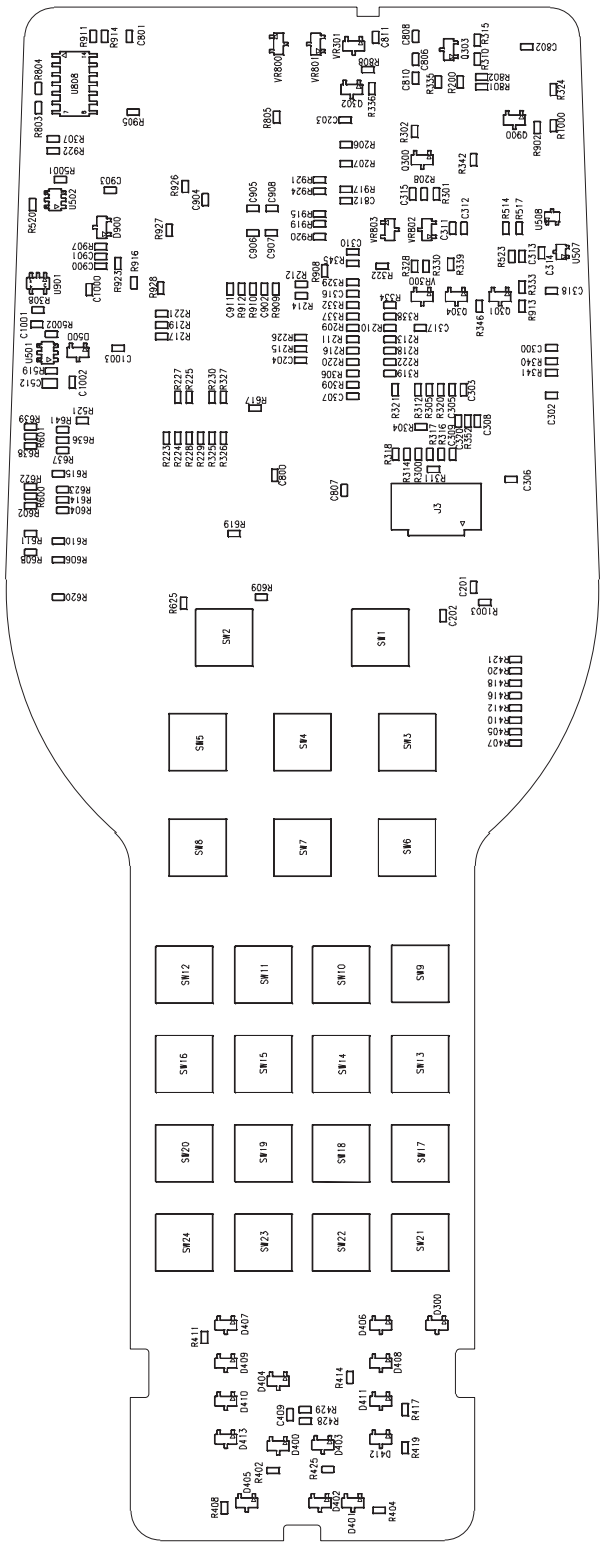
This section provides troubleshooting symptoms and solutions for the KVL 3000 *Plus* circuitry.

TABLE 5-1 TROUBLESHOOTING PROCEDURE

Component	Symptom	Solution
Power	No display when **PWR** key is pressed	• Ensure the main battery is charged. • Ensure the tamper switch/back cover is closed. If problem persists, check the following: • Check cable connections between battery and main board. • The battery voltage should appear on pin 4 of U503. Pin 2 should be approximately 0V to turn on the regulator. Pin 5 should put out the regulated 5V. • If no LED is lit, check the display flex cable. • Check CLKOUT signal on pin 13 of U1000. It should be ~8.39 MHz. • RESET should be high (check pin 5 on U803).
Real Time Clock	Does not keep time and date	• Check that the backup lithium battery measures 2.4V to 3.3 V. If not, replace battery. Ensure the battery is installed tightly and that it makes contact on the bottom as well as on the side. • Check under the **CONFIG/TIME** menu to see that the time display increments every second. If not, it is a board-level issue.
Audio	No audio	• Check audio menu under **CONFIG** for audio **ON**. • Press keys and check for audio waveform on MT400. Check pin 3 on U806. Check pin 14 on U402.
Keyloading	Keyload failure	• Ensure radio encryption type matches selected encryption. • Check keyload cable for connectivity. Waveforms should appear on the signal contacts. • Check target flex connectivity between the target connector and the board connectors.
PCMCIA	General failure	Check PCMCIA flex connectivity between the PCMCIA board connector and the main board connectors.
RS-232	Unable to communicate	• Check that cables are connected tightly. • Ensure baud rate is set correctly under **CONFIG**. • Check for high/low transitions on pins 2 (Receive) and 3 (Transmit) of the DB9 connector.



TOP VIEW



BOTTOM VIEW

FIGURE 5-1 MAIN BOARD

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PARTS LIST, CLN7493D KVL 3000 *PLUS* MAIN BOARD

Reference	Part Number	Description
		capacitor, fixed:
C201 – 204	2113743E20	CAP CHIP .10 UF 10%
C300 – 305	2113743E20	CAP CHIP .10 UF 10%
C306	2113741F49	CAP CHIP CL2 X7R REEL 10000
C307 – 318	2113743E20	CAP CHIP .10 UF 10%
C319	2311049A13	CAP TANT CHIP 4.7 1010 A/P
C320	2113741F49	CAP CHIP CL2 X7R REEL 10000
C400 – 404	2113743E20	CAP CHIP .10 UF 10%
C405	2113743A31	CAP CHIP 1.0 UF 10% X7R
C406	2113743E20	CAP CHIP .10 UF 10%
C407, 408	2113743A31	CAP CHIP 1.0 UF 10% X7R
C409	2113743E20	CAP CHIP .10 UF 10%
C500 – 502	2113743A31	CAP CHIP 1.0 UF 10% X7R
C503	2311049A21	CAP TANT CHIP 22 10 20 A/P
C504	2311049C04	CAP TANT CHIP 220 UF 10V 20%
C505 – 507	2113743E20	CAP CHIP .10 UF 10%
C509	2113743A31	CAP CHIP 1.0 UF 10% X7R
C511	2311049C04	CAP TANT CHIP 220 UF 10V 20%
C512, 513	2113743A31	CAP CHIP 1.0 UF 10% X7R
C514	2311049A13	CAP TANT CHIP 4.7 1010 A/P
C515	2311049A23	CAP TANT CHIP 47 1010
C516	2311049A13	CAP TANT CHIP 4.7 1010 A/P
C600 – 607	2113743E20	CAP CHIP .10 UF 10%
C701	2113743E20	CAP CHIP .10 UF 10%
C800 – 804	2113743E20	CAP CHIP .10 UF 10%
C806 – 813	2113743E20	CAP CHIP .10 UF 10%
C900, 901	2113743E20	CAP CHIP .10 UF 10%
C902	2113740F59	CAP CHIP REEL CL1 +/-30 220
C903 – 908	2113743E20	CAP CHIP .10 UF 10%
C909, 910	2113740F33	CAP CHIP REEL CL1 +/-30 18
C911	2113743E20	CAP CHIP .10 UF 10%
C1000 – 1003	2113743E20	CAP CHIP .10 UF 10%
		diode (see note 1):
D300	4813833C03	DIODE DUAL 70V 'A1X' BAW56LT1
D301	4813825A05	DIODE 30V HOT CARRIER MMBD301L
D400 – 413	4813833C03	DIODE DUAL 70V 'A1X' BAW56LT1
D500	4813825A05	DIODE 30V HOT CARRIER MMBD301L
D900	4813833C03	DIODE DUAL 70V 'A1X' BAW56LT1
DS0501	4883288Y05	LED, RED, SMT
		connector:
J3	0982882Y01	CONNECTOR,SMT/Z1F
P1, P2	2883784X01	PLUG, BD TO BD 40 PIN, SM
P4	2883351X01	FPC CONNECTOR
P7	0984524T14	DB9 CONNECTOR, HIGH TEMP
P8	2880001S03	CON PCB HDR 1 GOLD DR ST 6 POS

Reference	Part Number	Description
		integrated circuit (see note 1):
U201	5191080A01	IC EEPROM 128KX8 28C010
U202	5182969Y01	IC FLASH ZMX8 5V 75NS 48TSOP
U204	5182970Y01	SRAM 512KX8 70NS 32 SOIC 0-70
U205	5113805A54	IC OCT BFR LINE DRV/RCVR HC244
U300	5113802A28	IC 32BIT MCU W/Q'ED SPI/SCI
U301	5113805A26	IC QUAD BFR 3ST NON INV HC125
U302	5113815A56	IC VOLTAGE DETECTOR 5V
U401	5113839M19	IC DL VOLT (3/5) OCTTRANSCVR
U402	5113808A63	IC FLIP-FLOP, OCT D 3-ST
U403	5113839M19	IC DL VOLT (3/5) OCTTRANSCVR
U404	5113805A72	IC OCT 3ST N/INV TRANS LAT
U405	5182550Y07	NAND DUAL 4-IN 14 SOIC T+R
U500	0983295X01	SOCKET COIN CELL BATTERY
U501, 502	5184075Y01	IC, 3.3V LDO REG I OUT 200MA
U503	5164216A02	IC ADJ LOW DROPOUT VLTG REG
U504	5182923X01	IC LO DRPOUT P-CH REG -883-
U505	5185355C12	IC 2.8V ULTRA-LOW DROPOUT REG
U506 – 508	5183257Y01	VOLTAGE DETECTOR 2.3V SC70-3
U600	5184238Y01	VG469ISA PCMCIA CONTROLLER
U601	5184234Y01	1 SLOT PCMCIA POWER NETWORK
U700	5183340X01	IC, RTC DS1305
U801	5185778L02	MAX3221 RS232 XCVR W/ESD PROT
U803	5113805A98	IC INVTR HEX
U805	5182550Y02	ANO TRIPLE 3-IN 14 SOIC T+R
U806	5113805A22	IC QUAD 2 INPUT EXOR
U807	5113805A01	IC QUAD 2INP NAND 74HC00AD
U808	5113805A02	IC QUAD 2INP NOR 74HC02AD
U809	5113805A18	IC DUAL D FF W/SET RST 74HC74
U900	5185368C92	IC 4.5 VOLT DETECTOR
U901	5185368C91	IC 2.7 VOLT DETECTOR
U904	5113805A55	LN DR/RCVR TTLIN OCT N-INV BFR
U905	5180674R01	IC SILICON SERIAL NUMBER
U906	5185963A91	IC ARMOR
U907	5185963A32	IC 8 MB FLASH BGO/FBGA
U1000	5184233Y01	PLD EPM7032AE 36-I/O 44PTQFP

Reference	Part Number	Description
		resistor, fixed:
R200 – 214	0662057P10	RES CHIP 10.0K 1% 30X60
R215	0662057P95	RES CHIP 100.0K 1% 30X60
R216 – 222	0662057P10	RES CHIP 10.0K 1% 30X60
R223 – 230	0662057A37	CHIP RES 330 OHMS 5%
R300	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R301	0662057P10	RES CHIP 10.0K 1% 30X60
R302	0662057T68	RES CHIP 1.0K 1% 30*60
R304, 305	0662057P95	RES CHIP 100.0K 1% 30X60
R306	0662057T68	RES CHIP 1.0K 1% 30*60
R307 – 312	0662057P95	RES CHIP 100.0K 1% 30X60
R313	0662057P10	RES CHIP 10.0K 1% 30X60
R314	0662057P95	RES CHIP 100.0K 1% 30X60
R315, 316	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R317, 318	0662057P10	RES CHIP 10.0K 1% 30X60
R319	0662057T68	RES CHIP 1.0K 1% 30*60
R320 – 322	0662057P95	RES CHIP 100.0K 1% 30X60
R323	0662057P10	RES CHIP 10.0K 1% 30X60
R324	0662057A65	CHIP RES 4700 OHMS 5%
R325 – 330	0662057P10	RES CHIP 10.0K 1% 30X60
R331	0683962T33	RES CHIP 22 5-1
R332	0662057P10	RES CHIP 10.0K 1% 30X60
R333	0662057T68	RES CHIP 1.0K 1% 30*60
R334	0662057P10	RES CHIP 10.0K 1% 30X60
R335, 336	0662057T68	RES CHIP 1.0K 1% 30*60
R337, 338	0662057P10	RES CHIP 10.0K 1% 30X60
R339	0662057T68	RES CHIP 1.0K 1% 30*60
R340, 341	0662057P95	RES CHIP 100.0K 1% 30X60
R342	0662057A65	CHIP RES 4700 OHMS 5%
R344 – 346	0662057P10	RES CHIP 10.0K 1% 30X60
R349 – 351	0662057T48	CHIP RES 150 OHMS 1%
R352	0662057A79	CHIP RES 18K OHMS 5%
R400 – 421	0662057P95	RES CHIP 100.0K 1% 30X60
R422	0662057A69	CHIP RES 6800 OHMS 5%
R423	0662057P95	RES CHIP 100.0K 1% 30X60
R424	0662057A69	CHIP RES 6800 OHMS 5%
R425	0662057P95	RES CHIP 100.0K 1% 30X60
R426	0662057T68	RES CHIP 1.0K 1% 30*60
R427	0611077A44	RES CHIP 56 5 1/8W
R428	0662057P95	RES CHIP 100.0K 1% 30X60
R429	0662057T68	RES CHIP 1.0K 1% 30*60
R500	0662057P10	RES CHIP 10.0K 1% 30X60
R501	0662057T68	RES CHIP 1.0K 1% 30*60
R502	0662057P10	RES CHIP 10.0K 1% 30X60
R503	0662057T68	RES CHIP 1.0K 1% 30*60
R504	0662057P95	RES CHIP 100.0K 1% 30X60
R505	0662057T68	RES CHIP 1.0K 1% 30*60
R506	0662057P95	RES CHIP 100.0K 1% 30X60
R507	0662057P10	RES CHIP 10.0K 1% 30X60
R508, 509	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R510	0611079F01	RES CHIP 1.00K 1/10W 1% 0805
R511	0611079F48	RES CHIP 3.09K 1/10W 1% 0805
R512	0662057T29	RES CHIP 402K
R513	0611079E26	RES CHIP 182.0K 1/10W 1%
R514	0662057T65	CHIP RES 475K OHMS 1%
R515	0611079E42	RES CHIP 267.0K 1/10W 1%
R516	0611079E01	RES CHIP 100.0K 1/10W 1%
R517	0662057Y04	RES CHIP 237 K 1% 0603
R518 – 523	0662057P95	RES CHIP 100.0K 1% 30X60
R524	0662057T46	CHIP RES 100 OHMS 1%
R600 – 619	0662057P95	RES CHIP 100.0K 1% 30X60
R620, 621	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R622 – 624	0662057P95	RES CHIP 100.0K 1% 30X60
R626	0662057P95	RES CHIP 100.0K 1% 30X60
R629	0662057P95	RES CHIP 100.0K 1% 30X60
R631	0662057P95	RES CHIP 100.0K 1% 30X60
R632	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R634	0662057P95	RES CHIP 100.0K 1% 30X60
R636 – 638	0662057P10	RES CHIP 10.0K 1% 30X60
R639	0662057P95	RES CHIP 100.0K 1% 30X60
R640, 641	0662057P10	RES CHIP 10.0K 1% 30X60
R642	0662057B46	CHIP RES 10.0 MEG OHMS 5%
R700	0662057P95	RES CHIP 100.0K 1% 30X60
R701	0662057P10	RES CHIP 10.0K 1% 30X60
R800 –804	0662057P10	RES CHIP 10.0K 1% 30X60
R805	0662057P95	RES CHIP 100.0K 1% 30X60
R806 – 808	0662057P10	RES CHIP 10.0K 1% 30X60
R902	0662057T68	RES CHIP 1.0K 1% 30*60
R905	0662057P10	RES CHIP 10.0K 1% 30X60
R906, 907	0662057P95	RES CHIP 100.0K 1% 30X60
R908 – 910	0662057P10	RES CHIP 10.0K 1% 30X60
R911	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R912 – 917	0662057P10	RES CHIP 10.0K 1% 30X60
R918	0611079A91	RES FIXED CHIP 5100 5 1/10 A/P
R919	0662057P10	RES CHIP 10.0K 1% 30X60
R920, 920	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R922 – 924	0662057P10	RES CHIP 10.0K 1% 30X60
R925	0662057B46	CHIP RES 10.0 MEG OHMS 5%
R926, 927	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R928	0662057P10	RES CHIP 10.0K 1% 30X60
R1000	0662057P10	RES CHIP 10.0K 1% 30X60
R1001, 1002	0662057T68	RES CHIP 1.0K 1% 30*60
R1003	0662057P10	RES CHIP 10.0K 1% 30X60
R1004	0662057T68	RES CHIP 1.0K 1% 30*60
R5000 – 5005	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
		transducer:
MT400	5083354X01	TRANDSUCER, SMT
		transistor (see note 1):
Q300 – 304	4813824A10	TSTR NPN 40V .2A GEN PURP
Q400	4813824A10	TSTR NPN 40V .2A GEN PURP
Q500 – 502	4813823A07	XSTR N-CH TMOS FET 2N7002LT1
Q503	4813823A12	TSTR P-CH HDTMOS
Q900	4813823A07	XSTR N-CH TMOS FET 2N7002LT1
		zener diode (see note 1):
VR300 – 302	4813830A15	Diode 5.6V5% 225MW MMBZ5232B_
VR800 – 803	4813830A28	Diode 15V 5% 225MW MMBZ5245B_
		crystal (see note 1):
Y300	4885766C02	OSCILLATOR, CRYSTAL 32.768MHZ
Y900	4805574W03	XTAL PRL RESONANCE 7.9488MHZ
		non-referenced items:
	8482867Y03	PCB KVL 3000 PLUS
	5482006W02	RIBBON THERMAL XFER
	5482006W03	BARCODE LABEL

NOTE 1: For optimum performance, crystals, diodes, transistors, and integrated circuits must be ordered by Motorola part number.

NOTE 2: U202 and U907 are flash memory chips. Contact Motorola System Support Center (1-800-448-3245) for information on software for these chips.

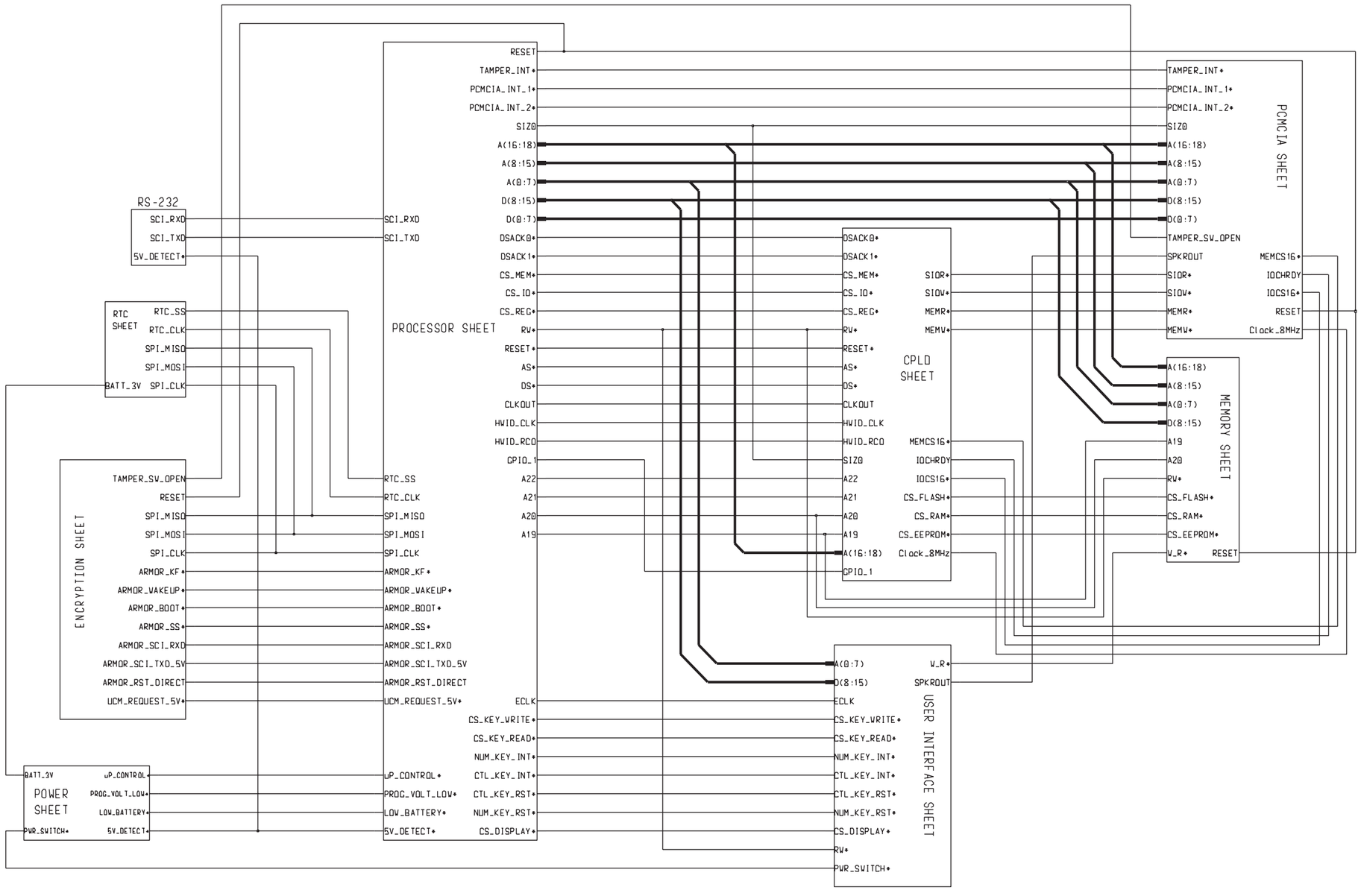


FIGURE 5-2 FUNCTIONAL BLOCK DIAGRAM

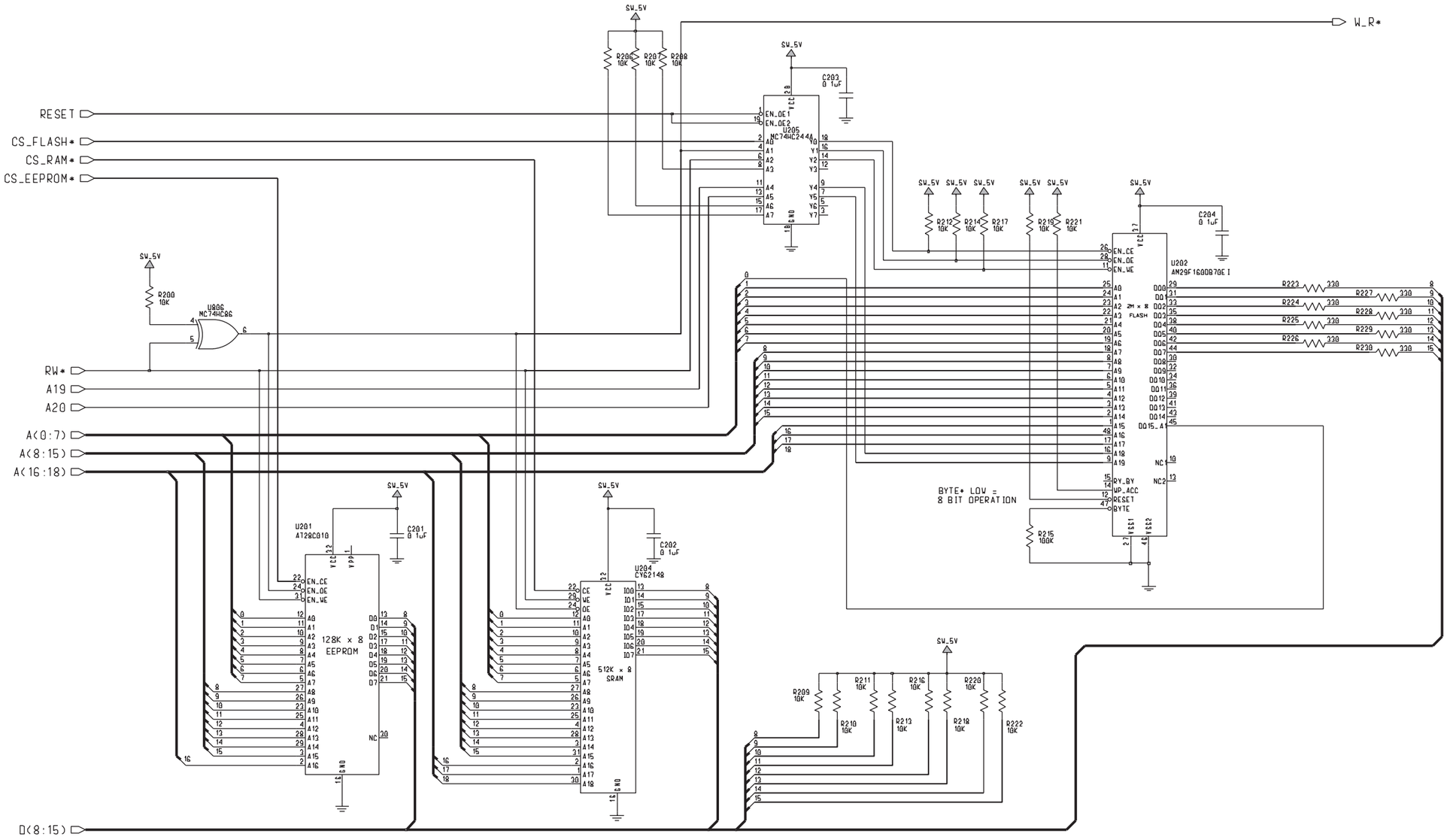


FIGURE 5-3 SCHEMATIC DIAGRAM, MEMORY BLOCK

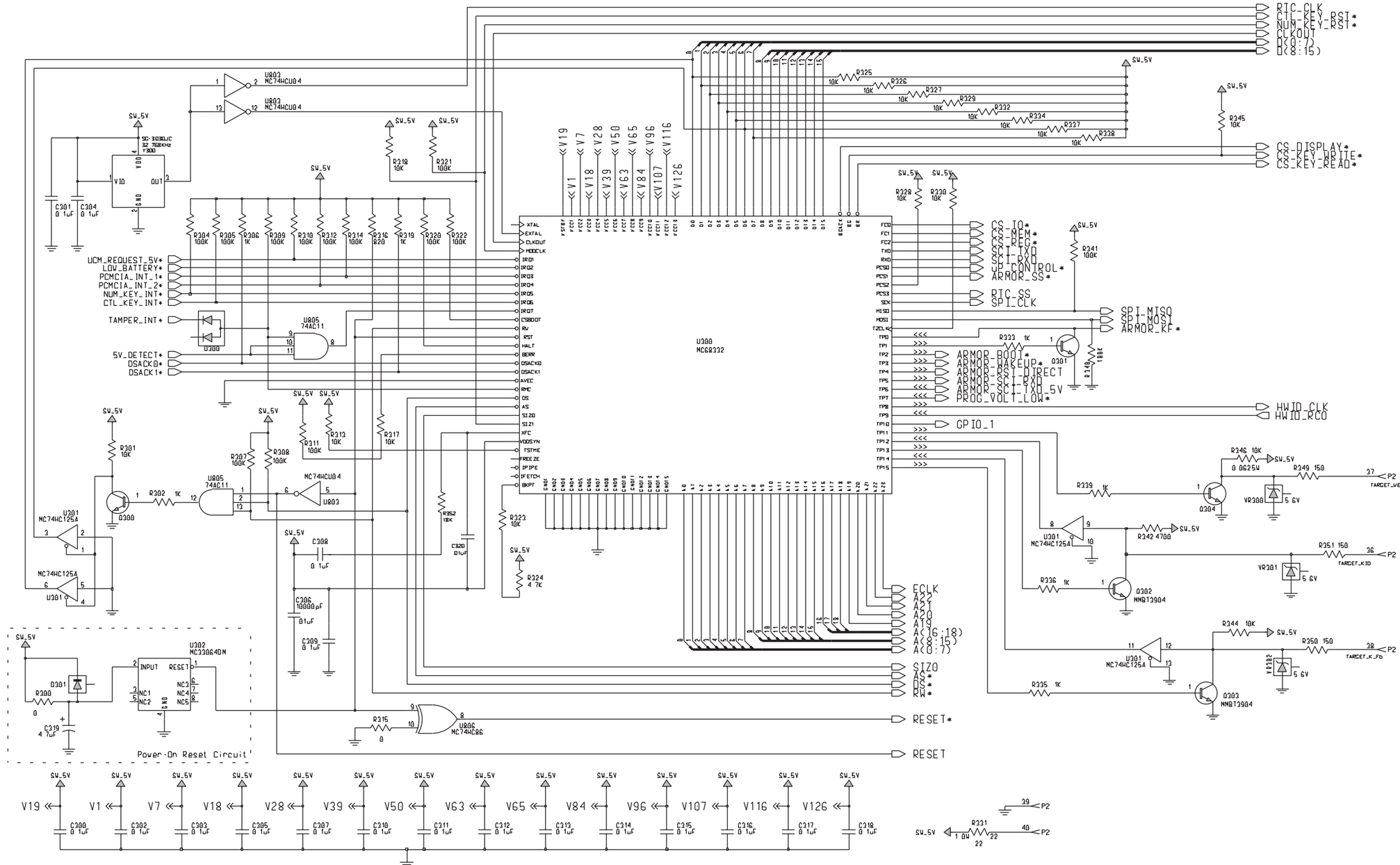


FIGURE 5-4 SCHEMATIC DIAGRAM, PROCESSOR CIRCUITRY

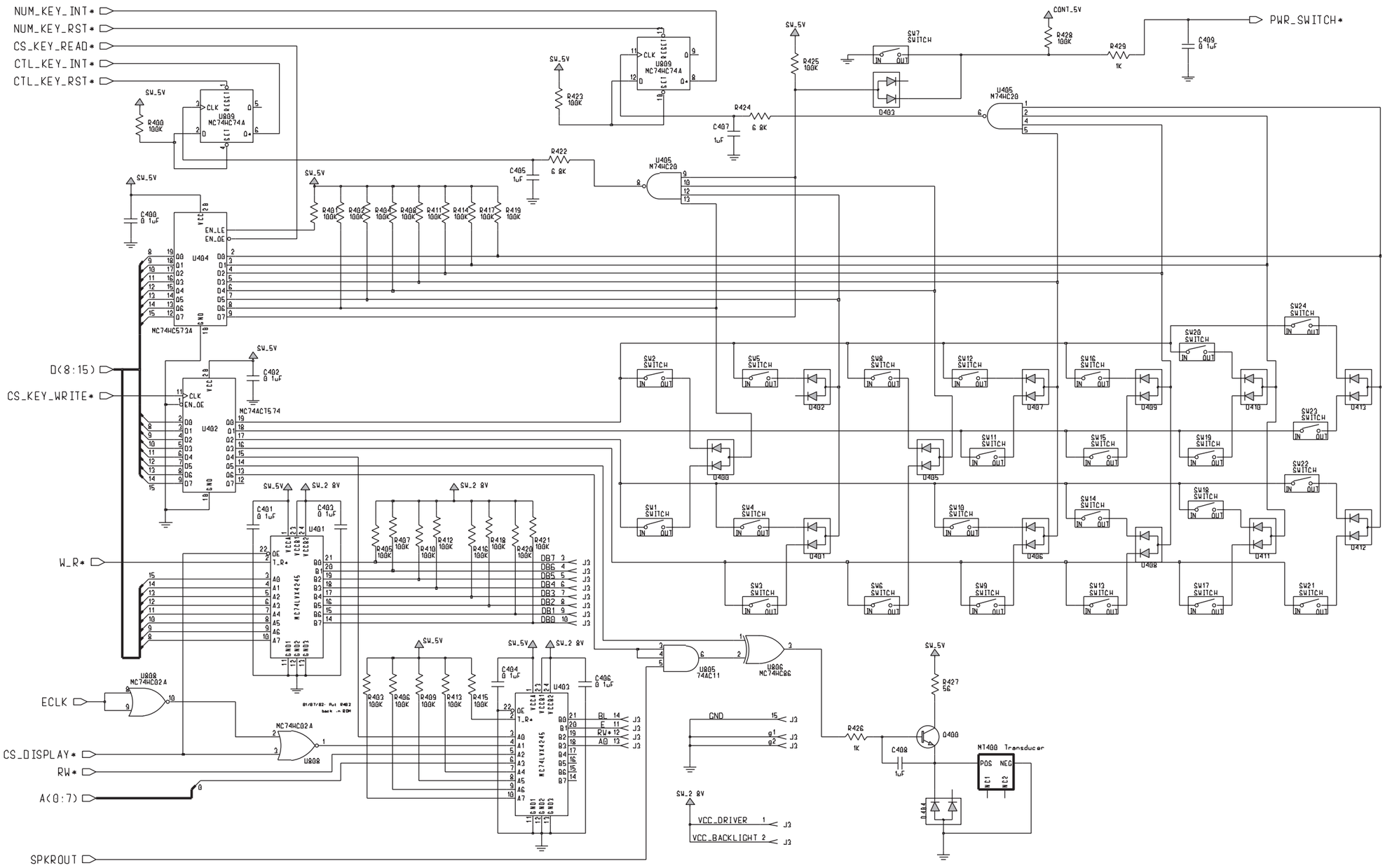
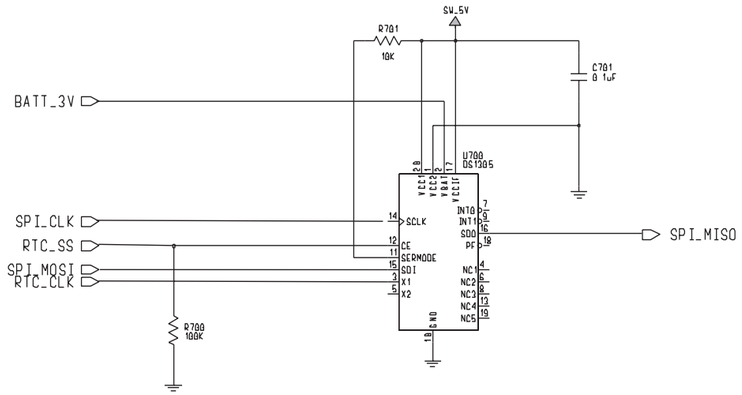
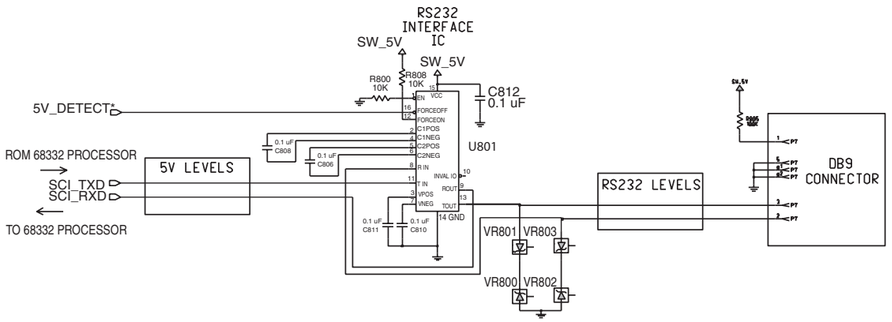


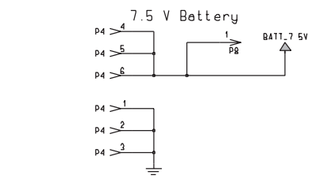
FIGURE 5-5 SCHEMATIC DIAGRAM, USER INTERFACE CIRCUITRY

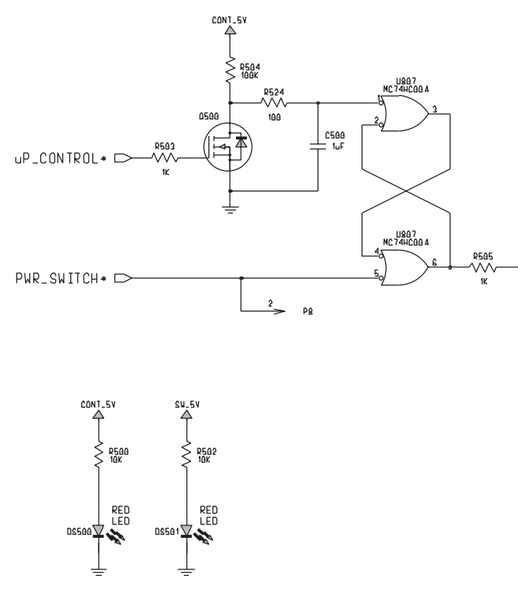


REAL TIME CLOCK CIRCUITRY



INPUT/OUTPUT CIRCUITRY





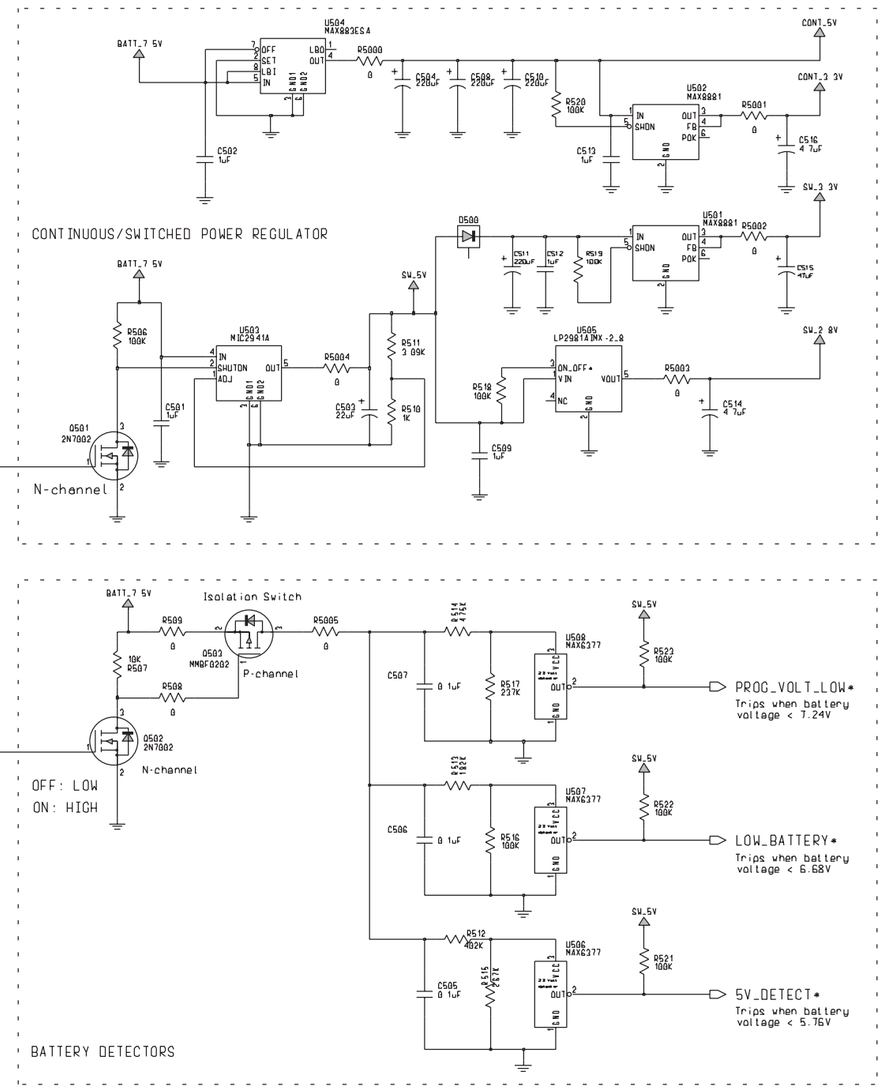


FIGURE 5-6 SCHEMATIC DIAGRAMS, INPUT/OUTPUT, POWER, AND REAL TIME CLOCK CIRCUITRY

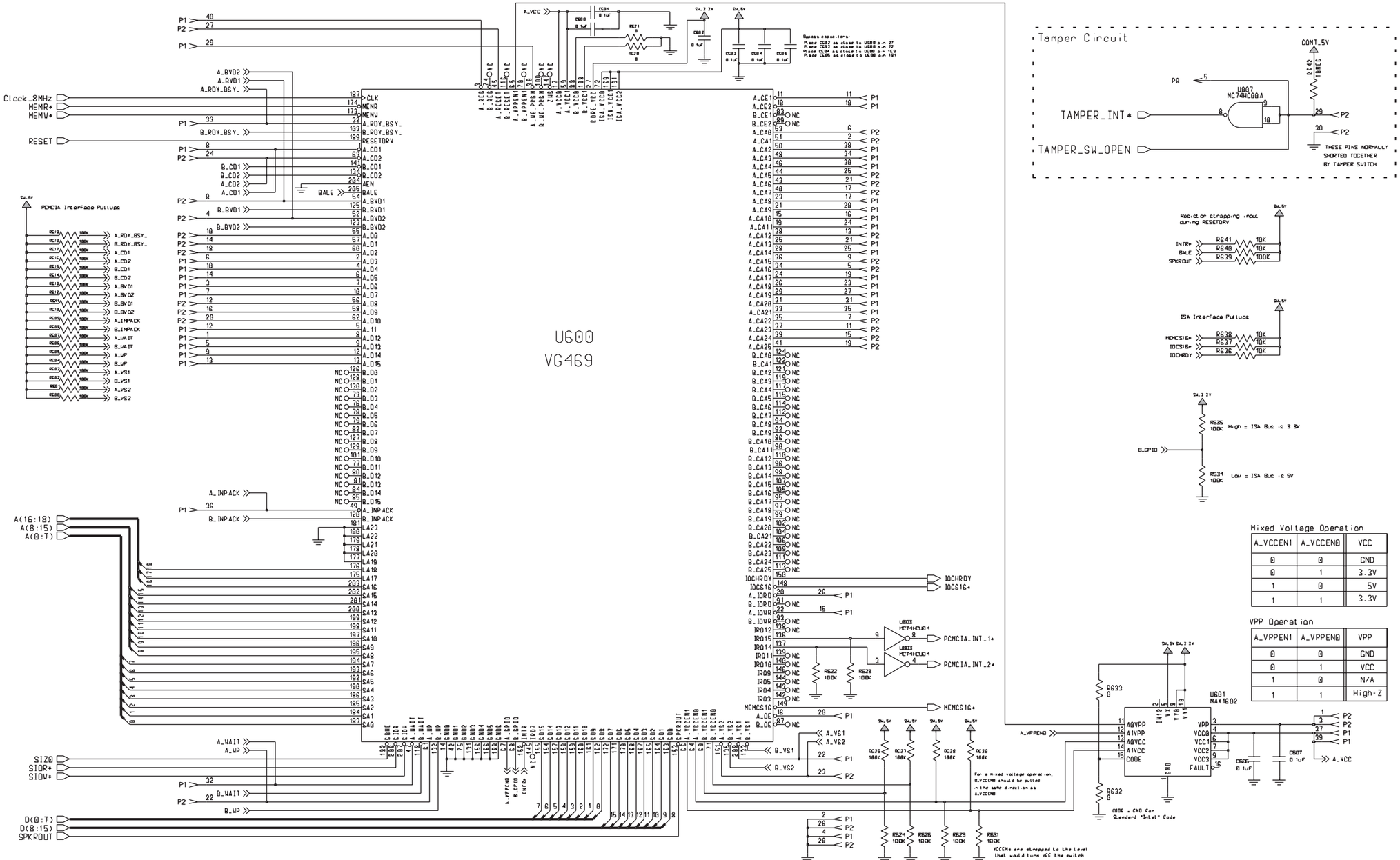


FIGURE 5-7 SCHEMATIC DIAGRAM, PCMCIA CIRCUITRY

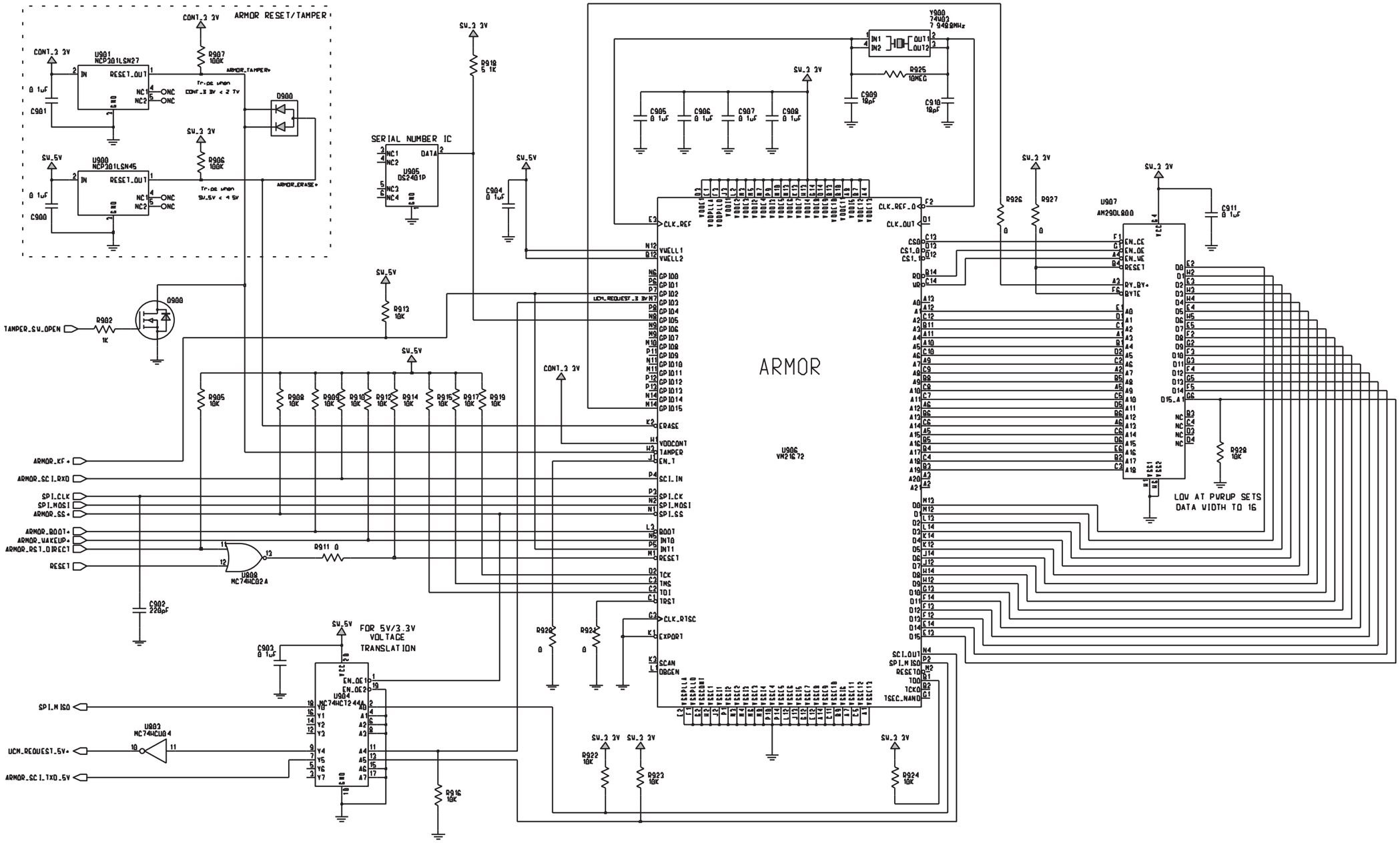


FIGURE 5-8 SCHEMATIC DIAGRAM, ENCRYPTION (ARMOR) CIRCUITRY

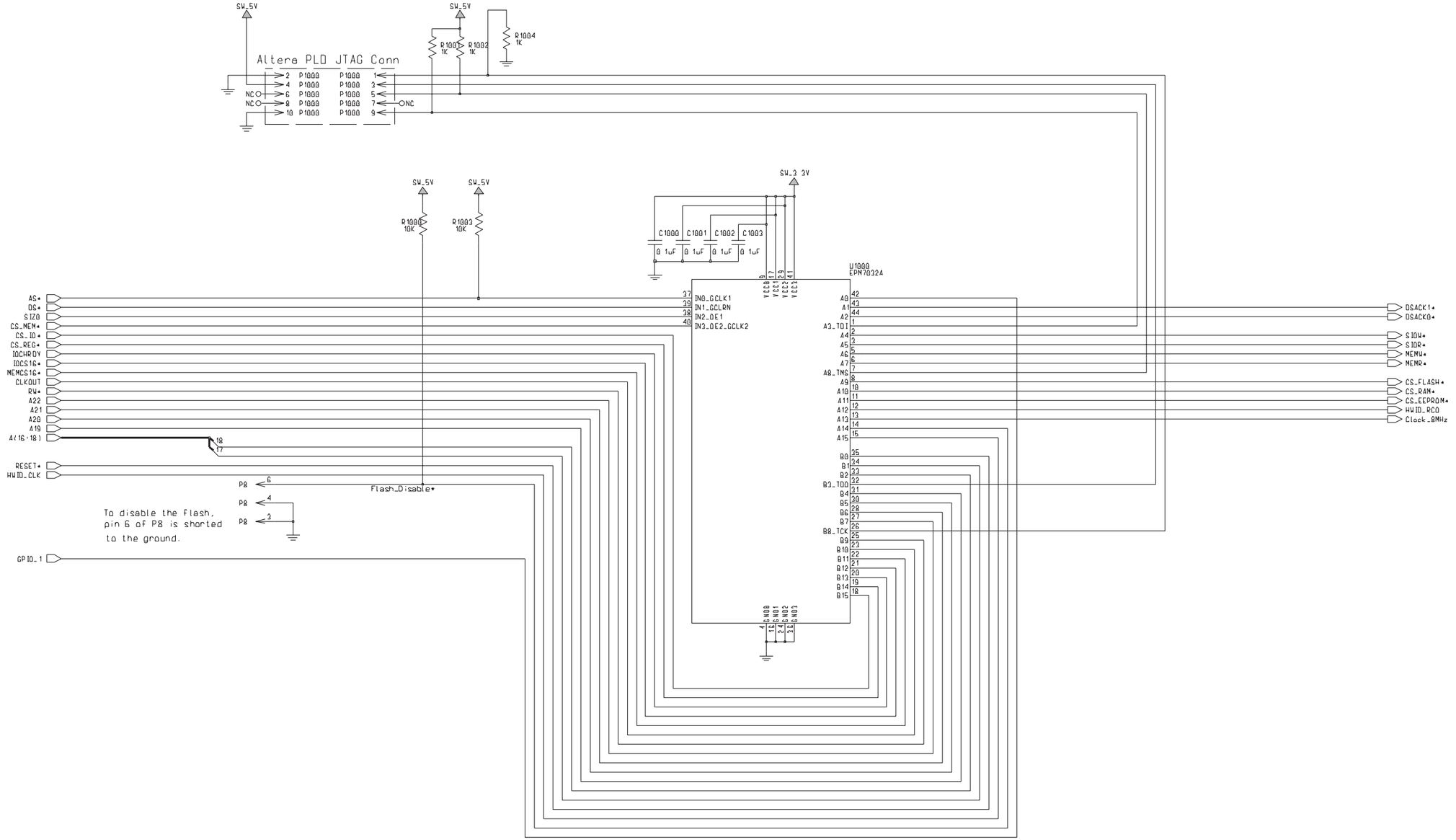


FIGURE 5-9 SCHEMATIC DIAGRAM, CPLD CIRCUITRY

APPENDIX
A

ERROR MESSAGES

For all error messages other than those shown in this table, check the KVL 3000 *Plus* cable connection and try the operation again. If it still fails, the KVL 3000 *Plus* must be returned to the service center for troubleshooting and repair.

TABLE A-1 ERROR MESSAGES

Error Message	Display Method	Probable Cause	Remedy
ALL ZERO LFSR DID NOT FAIL DEVICE	Press/hold **Del/Shift** key, then press **E** key.	Defective REX of target hybrid	Return target device to service center for troubleshooting and repair of hybrid.
ALL ZERO LFSR FAIL DID NOT CLEAR	Press/hold **Del/Shift** key, then press **E** key.	Defective REX of target hybrid	Return target device to service center for troubleshooting and repair of hybrid.
BAD ACK RCV'D AFTER SECURITY TEST	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection	Ensure proper keyload cable connections at each end; try known good keyload cable.
BAD CRC FAILURE DID NOT CLEAR.	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
BAD CTO DATA ACK RECEIVED FROM RADIO	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
BAD DISCONNECT ACK RECEIVED FROM RADIO	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
BAD GROUP MAP CRC	Displayed during KVL 3000 *Plus* operation.	Group map data corrupted Defective EEPROM	Re-enter the Group Map. Return target device to service center for troubleshooting and repair of EEPROM.

TABLE A-1 ERROR MESSAGES (CONTINUED)

Error Message	Display Method	Probable Cause	Remedy
BAD INDEX NAME ACK RECEIVED FROM RADIO	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
BAD INVALID ACKNOWLEDGE RECEIVED FROM RADIO	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
BAD IV ACK RECEIVED FROM RADIO	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
BAD KEY PACKET ACK RECEIVED FROM RADIO	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
BAD OFFSET ACK RECEIVED FROM RADIO	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
BAD SYSTEM KEY ACK RECEIVED FROM RADIO	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
BAD ZERO ACK RECEIVED FROM RADIO	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
CANT CLEAR INITIAL KEYFAIL	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
COULD NOT PERFORM AN ENCRYPTION SERVICE	Displayed during KVL 3000 *Plus* operation.	Defective encryption IC in target device Defective EEPROM in KVL Defective flash memory in KVL	Return KVL to service center for troubleshooting and repair of encryption IC. Return KVL to service center for troubleshooting and repair of EEPROM. Return KVL to service center for troubleshooting and repair of flash memory.
COULD NOT SET LID	Displayed during KVL 3000 *Plus* operation.	Defective EEPROM in KVL	Return KVL to service center for troubleshooting and repair of EEPROM.

TABLE A-1 ERROR MESSAGES (CONTINUED)

Error Message	Display Method	Probable Cause	Remedy
CRC OF A KEY FAILED	Displayed during KVL 3000 *Plus* operation.	Defective encryption IC in target device Defective EEPROM in KVL Defective flash memory in KVL	Return KVL to service center for troubleshooting and repair of encryption IC. Return KVL to service center for troubleshooting and repair of EEPROM. Return KVL to service center for troubleshooting and repair of flash memory.
CRC OF THE KVLS USK FAILED	Displayed during KVL 3000 *Plus* operation.	Corrupted data in EEPROM in KVL	Re-enter the USK. If error persists, return the KVL to service center for troubleshooting and repair of EEPROM.
CRC OF THE SYSTEM KEY FAILED	Displayed during KVL 3000 *Plus* operation.	Corrupted data in EEPROM in KVL	Re-enter the System Key. If error persists, return the KVL to service center for troubleshooting and repair of EEPROM.
DES KEY TRANSFER FAILURE	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
ENCRYPTION SERVICE IS MISSING DATA	Displayed during KVL 3000 *Plus* operation.	Corrupted data in EEPROM in KVL	Perform a hard reset of the KVL. If error persists, return the KVL to service center for troubleshooting and repair of EEPROM.
ENCRYPTION SERVICE IS MISSING DATA	Displayed during KVL 3000 *Plus* operation.	USK has been zeroized.	Re-enter the USK. If error persists, return the KVL to service center for troubleshooting and repair of EEPROM.
GOOD KEY FAILURE AFTER SBOX TEST	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
KEY WITH BAD PARITY DID NOT CLEAR	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
NO INITIAL RESPONSE FROM RADIO	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
NO RESPONSE FROM RADIO AFTER SECUR_TEST	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Incompatible target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Ensure target device is compatible with KVL.

TABLE A-1 ERROR MESSAGES (CONTINUED)

Error Message	Display Method	Probable Cause	Remedy
NO SECURITY TEST ACK RECEIVED FROM RADIO	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Incompatible algorithm	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
RADIO DID NOT RESPOND TO CTO DATA OPCODE	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
RADIO DID NOT RESPOND TO DISCONNECT OPCODE	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
RADIO DID NOT RESPOND TO INDEX NAME OPCODE	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
RADIO DID NOT RESPOND TO IV OPCODE	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
RADIO DID NOT RESPOND TO KEYPACKET OPCODE	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
RADIO DID NOT RESPOND TO OFFSET OPCOD	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
RADIO DID NOT RESPOND TO SYSTEMKEY OPCODE	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
RADIO DID NOT RESPOND TO ZEROIZE OPCODE	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
REX IV FAILURE	Press/hold **Del/Shift** key, then press **E** key.	Defective REX of target hybrid	Return target device to service center for troubleshooting and repair of hybrid.
REX KEYSTREAM FAIL DID NOT CLEAR	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.

TABLE A-1 ERROR MESSAGES (CONTINUED)

Error Message	Display Method	Probable Cause	Remedy
SBOX FAIL FAILURE DID NOT CLEAR	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
SBOX FAIL FAILURE DID NOT OCCUR	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
SBOX KEYLOAD FAILURE	Press/hold **Del/Shift** key, then press **E** key.	Defective encryption IC in target device	Return target device to service center for troubleshooting and repair of encryption IC.
SBOX TEST FAILURE	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
SHORT REX WEB DID FAIL NOT DEVICE	Press/hold **Del/Shift** key, then press **E** key.	Defective encryption IC in target device	Return target device to service center for troubleshooting and repair of encryption IC.
SHORT REX WEB FAIL DID NOT CLEAR	Press/hold **Del/Shift** key, then press **E** key.	Defective encryption IC in target device	Return target device to service center for troubleshooting and repair of encryption IC.
SOV KEY TRANSFER FAILURE	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.
UNKOWN ENCRYPTION ABORT KEYLOAD	Press/hold **Del/Shift** key, then press **E** key.	Defective EEPROM in KVL	Return KVL to service center for troubleshooting and repair of EEPROM.
VALID SYSKEY CRC TRANSFER FAILURE	Press/hold **Del/Shift** key, then press **E** key.	Faulty Keyload Cable or connection Defective encryption IC in target device	Ensure proper keyload cable connections at each end; try known good keyload cable. Return target device to service center for troubleshooting and repair of encryption IC.

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