MOTOROLA

KVL3000™
Key Variable Loader

Service Manual

68P80800B85-O

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MOTOROLA
Commercial Government and Industrial Solutions Sector

KVL 3000 ™ Key Variable Loader

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Commercial Government and Industrial Solutions Sector
1301 E. Algonquin Road, Schaumburg, IL 60196

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12/31/98–PHI

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FOREWORD

Scope of Manual

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.

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.

Service and Replacement Modules

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)

For complete information on ordering FRU replacement modules, or instructions on how to return faulty modules for repair, contact the System Support Center (see sidebar).

The following FRU replacement modules are available:

KVL 3000 Display Board	CLN1384A
KVL 3000 Main Board (DES–CFB/XL/OFB)	T5882A
KVL 3000 Main Board (DES/DVP)	T6228A
KVL 3000 Main Board (DES/DVP–XL)	T6229A
KVL 3000 Main Board (DVI–XL)	T5883A
KVL 3000 Main Board (DVP)	T5884A
KVL 3000 Main Board (DVP–XL)	T5885A
KVL 3000 PCMCIA Board	CLN1385A
KVL 3000 Power Board	CLN1386A

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Service and Replacement Modules (continued)

For replacement parts ordering, contact the appropriate Motorola facility as shown below:

United States and Canada

Call: (800) 422-4210
FAX: (847) 538-8198
Mail: Motorola, Inc.
Americas Parts Division Order Processing
1313 East Algonquin Road
Schaumburg, IL 60196

United States Federal Government

Call: (800) 826-1913
FAX: (410) 712-6033
Mail: Motorola, Inc.
Americas Parts Division Order Processing
1313 East Algonquin Road
Schaumburg, IL 60196

Europe, Middle East, and Africa

Call: +49 6128 702134
FAX: +49 6128 73538

Latin America and South America

Call: (847) 538-8037
FAX: (847) 576-3023
Mail: Motorola, Inc.
International Order Processing
1313 East Algonquin Road
Schaumburg, IL 60196 U.S.A.

Model Complement for T5795A *KVL 3000*

Item	Description
CLN6738B	*KVL 3000* Main Circuit Board
CLN7051A	4 x 12 LCD Display
CLN7064A	Chassis
CLN7063A	Housing Assembly
CLN6985A	Hardware
CLN7135A	Nameplate
CNN6002A	Battery
NTN7395AR	High Capacity Ni-Cad Battery
CBN6134A	Packing
0782113Y01	KVL Bracket Stand
68P81130E08	*KVL 3000* User's Guide

Battery Accessories

Item	Description
NTN1308A	120 Volt Rapid Rate Dual Unit Charger
NTN7621C	120 Volt Rapid Rate Multi Unit Charger
NTN1403A	220 Volt Rapid Rate Multi Unit Charger
NTN1404A	240 Volt Rapid Rate Multi Unit Charger
NTN7395AR	High Capacity Nickel Cadmium Battery

Interface Cables

Kit	Option	Description
TDN9390D	C724AA	MTS 2000™, XTS 3000™
TKN8209C	C540AA	MTX300S and STX Series
TKN8210C	C541AA	MICOR™ mobile and base, portable repeater
TKN8229C	C542AA	Series II CIU, SYNTOR™, SYNTOR X™, MCX 1000™, PX300–S™, KMC
TKN8506B	C544AA	Saber™, ASTRO Saber™
TKN8531B	C543AA	MSF 5000, DIU, DIU 3000, Expo, SYNTOR X 9000™ Series, RNC, SPECTRA™, ASTRO SPECTRA™ (requires TRN7414)
TKN9152A	C551AA	MCS 2000™
TRN7414A	n/a	Cable Adapter for SPECTRA™ and ASTRO SPECTRA™
CKN6324A	n/a	*KVL 3000* DB-9/Modem Cable
n/a	C954AB	Cables for SPECTRA™ and ASTRO SPECTRA™ (includes cable and adapter

PERFORMANCE SPECIFICATIONS

General

Motorola 68332 Processor — 16.78 MHz (32.768 KHZ Crystal)
Code Space — 512K x 8 Flash Memory
Key and Key Data Storage — 128K x 8 EEPROM
Operating Memory — 128K x 8 RAM
Tamper Register — 64 Bit Register
Numeric Data Entry — 16 Key Keypad (Interrupt Driven)
Control Data Entry — 8 Key Keypad (incl. 2 Soft Keys) (Interrupt Driven)
LCD — 4 x 12 Character Display with Backlight
Tone Generator
Real Time Clock
Power Indicator — LED (switched power only)
Power Regulation Continuous Power Regulation Switched Power Regulation
Low Voltage Detection 4.7 Volt Detection 3.0 Volt Detection Low Battery Detection (unregulated power)
Backup Power — 3 Volt CoinCell Battery for Real Time Clock Backup
PCMCIA Support — Interface support for Type I or Type II PCMCIA Cards
Encryption Capabilities — DES (in software) and second algorithm (in hardware IC)
Serial Communications — RS232 Port

Physical

Dimensions	226 mm Long (includes Connector Boot) 89 mm Wide 48 mm Thick (High Capacity Battery Included)
Weight	714 g (High Capacity Battery Included)

Encryption

Supported Encryption Applications	DES–CFB DES–XL DES–OFB DVP DVP–XL DVI–XL
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 140-1

User Interface

Four Line, 12 Character (4x12) LCD Display
LCD Annunciator Line
4x4 Numeric Key Pad (0–9 and A–F Keys)
Two General Purpose Softkeys
Scroll Left/Increment Key
Scroll Right/Decrement Key
Power On/Off, Delete/Shift, Enter, Esc Keys
DB–9 Connector (RS232)
Type II PCMCIA slot
Infrared Transceiver
Keyload Port

Regulatory Compliance and Approvals

Safety	EN 60950

Electromagnetic Compatibility

CISPR 22 Class B
European EMC Directive 89/336 EEC
EN 50081–1 Class B
EN 50082–2
EN 55022 Class B
IEC 801.2, IEC 801.3, IEC 801.4
FCC Part 15 Subpart B* * This device is verified to comply with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interfer ence, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Environmental Testing

Standard	Method	Procedure	Test	Performance
MIL–STD 810E	510.3	I	Blowing Dust	Meets or exceeds published specs following blowing dust testing.
MIL–STD 810E	509.3	I	Salt Fog	Meets or exceeds published specs following salt fog testing.
MIL–STD 810E	516.4	I	Shock	Meets or exceeds published specs following shock testing.
MIL–STD 810E	505.3	I	Solar Radiation	Meets or exceeds published specs following solar radiation testing.
MIL–STD 810E	514.4	I	Vibration	Meets or exceeds published specs following vibration testing.
Operating Temperature				–30° to +60° Celsius except PCMCIA Card (which is 0° to +60° Celsius)
Storage Temperature				–55° to +85° Celsius

Chapter 1 ▶ Block Diagram Theory

chapter contents

1 BLOCK DIAGRAM THEORY

This section describes the *KVL 3000* circuitry at a block diagram level. Refer also to the service diagrams provided in Chapter 3.

Power Block

Overview

The power block consists of all the circuitry used to control the power into the *KVL 3000*. 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.

Low Battery Detector (U502)

The applied voltage from the main battery is fed initially into 2 regulators and a 4.7 volt low voltage detector. This low voltage detector output (LOW_BATTERY*) is fed directly to the processor and is used to interrupt the processor when the input voltage drops below a set level (~6.5 volts). The processor uses this information to notify the user of a low battery condition. Prior to reaching the detector, the input signal is passed through a resistor network to drop the voltage into a range suitable for the detector.

Voltage Regulators

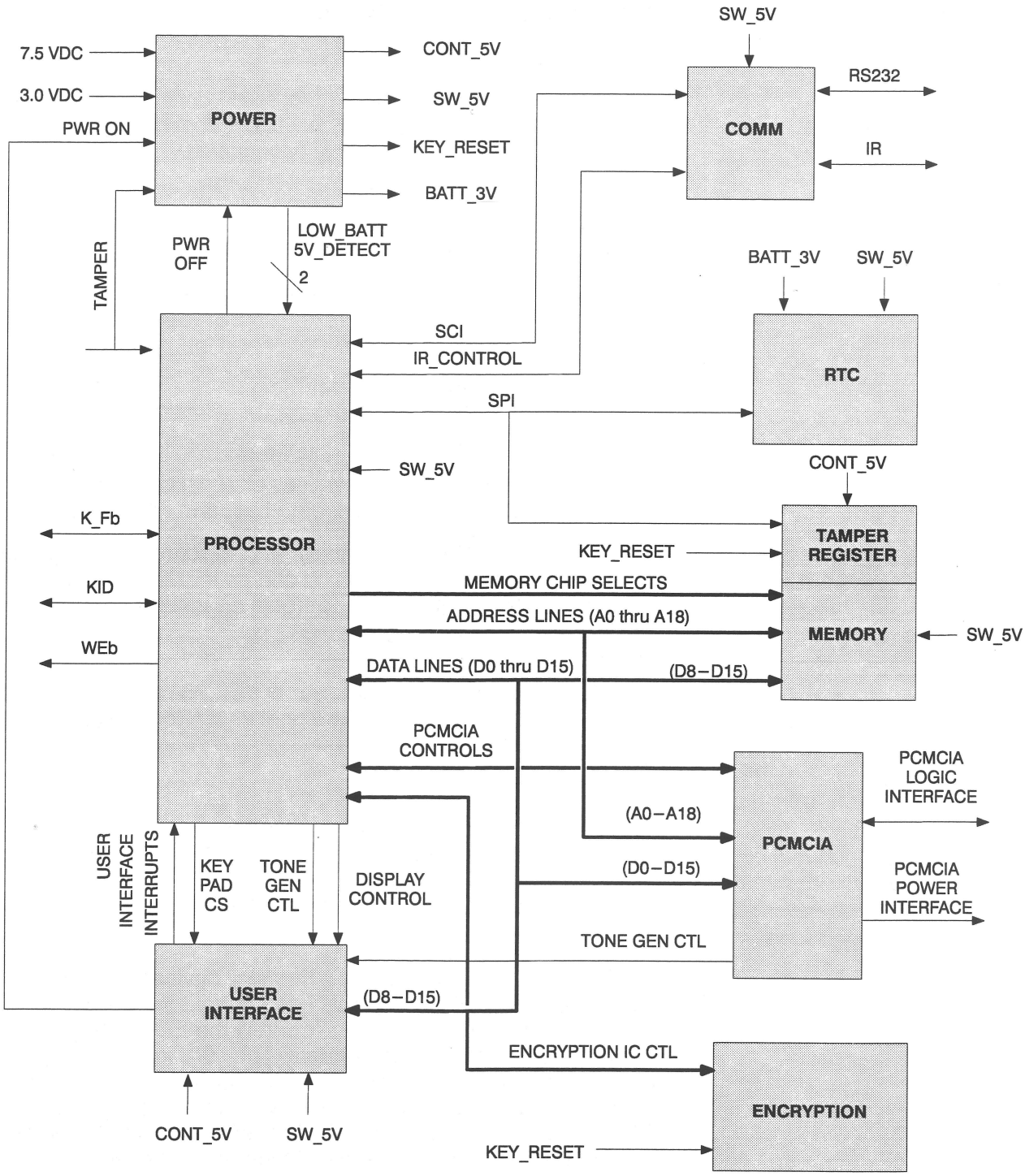
Of the 2 regulators receiving the main battery power, both provide 5 volt regulated outputs. One regulator provides a continuous regulated output. The other one can be switched on and off. The continuous 5 volt signal is used to power portions of circuitry which should not be shut off (as long as there is a valid voltage source attached) and the switched regulator is used for the remaining circuitry.

Continuous Regulator (U503) — The output of the continuous 5 volt regulator is used for 2 primary purposes: to provide power to the circuitry used to turn the KVL on/off and 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 fed into a 3.0 volt detector (U506) whose purpose is to clear the information in the tamper register if the regulated supply voltage drops below 3.0 volts (activation of the tamper switch will clear the tamper register if the voltage level is above 3.0 volts).

Switched Regulator (U504) — The output of the switched regulator is used to provide power to the circuitry which should be switched off when not in use. The switching of this regulator to the ON state is performed by the user via the PWR key on the keypad. The switching of this regulator to the OFF state is performed by the microprocessor either through detection of the pressing of the PWR switch or some other criteria noted by the processor (for example, a timeout occurs or the supply voltage drops below a certain level).

Low Voltage Detector (U507) — A second 4.7 Volt Detector is used to detect a critical drop in the supply voltage. If the supply voltage drops to ~5.4 volts (5.4v – diode drop of ~.7v = ~4.7 volts), this detector will interrupt the processor to notify it to prepare for shutdown. In general, if the supply voltage reaches 5.4 volts, the battery is either extremely low or has been removed.

KVL 3000 Overall Block Diagram



Processor Block

Overview

The processor block consists of the processor and the circuitry needed to support it such as its reset circuitry and the crystal. It also includes the target interface circuitry which consists of simple gate devices to support bi–directional signals and buffers to isolate the processor from the outside world.

Processor (U300)

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

The processor consists of 5 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) ports
- **RAM (Random Access Memory)** — the 68332 processor contains 2 kbytes 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

Crystal (Y300)

The clock source for the processor is a 32.768 kHz crystal oscillator circuit. The processor uses this signal as a reference to create an internal 16.78 MHz clock.

Target Interface

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

Memory Block

The memory block consists of 4 memory devices. The first is the FLASH memory (U202) which is used to hold the operational software of the *KVL 3000*. The second is the EEPROM (U201) which is used to store encrypted key data. The third is the RAM (U204) which is used by the processor during operation. The fourth is the tamper register (U203) which is used to store unencrypted key data. All of the memory operations are controlled by the processor. The FLASH, the EEPROM, and the RAM are all controlled via the address bus lines with data transferred over the data bus lines. The tamper register interfaces to the processor through the Serial Peripheral Interface (SPI) lines.

User Interface Block

The user interface block 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 4 rows of 4 keys each. User entry 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 8 key control keypad is made up of the following: a PWR key, a 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. These keys provide 2 separate functions: **1)** scrolling through a menu, or **2)** incrementing/decrementing through a list. The function performed is menu dependent.

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.

Tone Generator — This circuitry can be activated/deactivated by either the processor or the PCMCIA circuitry. However, the *KVL 3000* hardware provides a means for the processor to inhibit PCMCIA sound generation.

PCMCIA Block

Overview

The PCMCIA block consists of an ISA/PCMCIA interface IC, a PAL which converts certain ISA signals to 68000 format (and vice versa), power switches for card power control, and several logic gates as support devices.

PAL (U602)

The PAL IC is designed to alter the waveforms of 68000 signals to appear as ISA signals and vice–versa. In addition to the PAL, a flip–flop is used to reduce the 16.78 MHz clock of the processor to a 8.39 MHz clock supported by the PCMCIA standard.

ISA/PCMCIA Interface IC (U607)

This IC is the PCMCIA socket controller. It provides a means for the KVL 3000 processor to communicate with PCMCIA cards.

Power Switches (U604, U606)

These MOSFET switches control power to the PCMCIA socket.

Real Time Clock Block

This block contains the Real Time Clock (U700) and its own 32.768 kHz crystal oscillator circuit. 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 keeps the date and time of day.

Communications Block

Overview

This block consists of the circuitry for two separate interfaces. One interface is the RS232 serial interface and the other is the infrared (IR) interface.

Serial Interface

The serial interface consists of a level–shifting IC (U804) 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.

Infrared (IR) Interface

The IR circuitry consists of an IR transceiver (U800) and its associated support circuitry. The transceiver is responsible for translating TTL data into IR and vice–versa. The source and destination of data within the KVL is the processor. The processor transmits data from a discrete I/O line and utilizes a TPU channel for receiving data. The signal waveforms use 3/16 encoding. For transmitting a 1 for example, the signal is held low for one bit time; to transmit a 0, the signal is held low for 7/16ths of a bit time, held high for 3/16ths and the held low for the remaining 6/16ths.

Tamper Register

The *KVL 3000* supports the FIPS 140-1 Level 1 (Federal Information Protection Standards) encryption security standard. The Tamper Register in the *KVL 3000* provides a means of adhering to the standard.

In general, the *KVL 3000* uses a unique encryption key to encrypt the keys in the KVL's database of keys. By doing so, the security of the unique key becomes the primary element by which the other keys are protected. When a *KVL 3000* is configured for FIPS (user-selectable via the Menu System), the unique key is stored in the Tamper Register. the Tamper Register is a shift register capable of holding a 64-bit value. the reset pin of the IC is controlled directly by both the tamper switch and the low-power detection circuitry. Upon removal of the KVL's main battery (and the eventual loss of power) or by detection of a tamper condition, the shift register will automatically be reset and the unique key will be lost. Since the unique key is lost, there are no means of decrypting the keys stored in the EEPROM.

The *KVL 3000* also contains circuitry designed to hold a sufficient charge without the main battery in place. This is to allow the user a minimum of 10 minutes to replace the battery without destroying the unique key.

Encryption Block

This block consists of an encryption IC and reset circuitry for clearing any residual key information. As with the Tamper Register, this device is reset by both the detection of tamper and the loss of power.

The encryption IC is used to support Motorola proprietary encryption algorithms, such as DVI-XL and DVP-XL.

Chapter 2 ▶ Major Signal Descriptions

chapter contents

1 MAJOR SIGNAL DESCRIPTIONS

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

Bus/Processor Control Lines

Address Bus (A0 thru A18)

These are the address lines for the processor and the other bus components. The higher address lines (A19:A25) are programmed as chip selects.

Data Bus (D0 thru D15)

These are the data lines over which data is passed in transferring information between components in the *KVL 3000*. 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*, 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.

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Bus/Processor Control Lines (continued)

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

- ***Flash Chip Select*** — The Flash memory's chip select is the CSBOOT line from the processor. Because this memory device contains the *KVL 3000*'s operating code, it is the device from which the *KVL 3000* is "booted."
- ***EEPROM Chip Select*** — The EEPROM memory device is selected via CS7 of the SIM.
- ***RAM Chip Select*** — The RAM memory device is selected via CS6 of the SIM.
- ***Tamper Register Slave Select*** — The SS (slave select) signal for the tamper register is generated from the peripheral chip select lines (PCS2) of the Queued Serial Module (QSM) of the processor. This register is controlled via the SPI interface, not the main processor bus.

Real Time Clock (RTC) Block

The RTC is connected to the processor via the SPI interface. Its SS (slave select) line is derived from PCS3 of the QSM.

User Interface Block

- ***Display Chip Select*** — The chip select for the display originates from CS2 of the processor's SIM module.
- ***Tone Generator Chip Select*** — Selection of the tone generator is made via the same chip select as the one used for writing to the keypad circuitry, i.e. CS8 of the SIM.
- ***Keypad Chip Selects*** — There are two chip selects for the keypad circuits; one for writing and one for reading. They originate at CS8 and CS9, respectively.

Encryption Block

The chip select for the encryption IC is not one of the SIM modules pre–defined chip select signals. Since the encryption IC interface is a custom interface, the chip select for it was created using a discrete I/O pin.

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Bus/Processor Control Lines (continued)

Communications Block

Neither the Infrared (IR) portion nor the RS232 Serial port portion of the Communications block uses chip select circuitry.

PCMCIA Block

- ***PCMCIA Memory Chip Select*** — This chip select is derived from the processor's CS4 pin.
- ***PCMCIA I/O Chip Select*** — This chip select is derived from the processor's CS3 pin.
- ***PCMCIA Register Chip Select*** — This chip select is derived from the processor's CS5 pin.

Processor Interrupt Signals

Low Battery Interrupt

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

These interrupts originate from within the PCMCIA block and interrupt the processor on IRQ3 and IRQ4.

Keypad Interrupts

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

The tamper detection signal and the 5V (actually 4.7V) 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 labelled RMC, it is configured as a general purpose input pin in the *KVL 3000*). 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 of interface. In the *KVL 3000*, 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*, the MOSI line originates at the processor and ends at the Tamper Register and at the Real Time Clock. The MISO line originates at the Tamper Register and RTC with the processor as the destination. The SPI_CLK and the slave select signals for both the RTC and the Tamper Register originate at the processor.

Serial Communications Interface (SCI)

The SCI interface consists of 2 lines: 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 is designed to provide 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 bi–directional signal which is connected between the processor and the target connector on the back of the *KVL 3000*. It actually connects to the processor through 2 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 Enableb)*

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*s from shorting each other's WE* line to ground.

Encryption Interface Signals

KG_K_F* *(KG Key/Fail b)*

This signal is connected between the processor's TPU channels (0 and 1) and the encryption IC. The two channels are combined through open collector circuitry. Keys are loaded into the encryption IC through this line.

ENC_CLK *(Clock)*

This signal is an output from the processor TPU channel 2 and ends at the encryption IC. This signal is used when clocking data through the encryption IC.

ENC_WE* *(Write Enable b)*

This signal originates from TPU channel 3 of the processor and ends at the encryption IC.

PTI_CTI *(Plain Text In / Cipher Text In)*

This signal originates from TPU channel 4 of the processor and ends at the encryption IC. This signal is used to pass data to the encryption IC.

ENC_PTO *(Plain Text Out)*

This signal originates from the encryption IC and ends at TPU channel 5 of the processor. This signal transfers plain text data to the processor.

ENC_CTO *(Cipher Text Out)*

This signal originates from the encryption IC and ends at TPU channel 6 of the processor This signal passes ciphertext data to the processor.

ENC_TR* *(Transmit / Receive*)*

This signal originates from TPU channel 7 of the processor and ends at the encryption IC. This signal determines the mode of operation of the encryption IC.

BUSY_DONE* *(Busy / Done*)*

This signal originates from the encryption IC and ends at TPU channel 8 of the processor This signal tells the processor the status of the encryption IC.

ENC_VPP *(Programming Voltage In)*

This signal originates at pin 1 of the 4 pin header on the board and ends at the encryption IC. This signal is used to provide the programming voltage necessary for flavorizing the encryption IC in the factory.

IR Signals

IR_TXD *(Infrared TX)*

This signal originates at the processor's SIZ1 pin and ends at the IR transceiver. The SIZ1 pin of the processor is internally configured to operate as a general purpose I/O pin.

IR_RXD *(Infrared RX)*

This signal originates at the IR transceiver and terminates on TPU channel 10 of the processor.

Miscellaneous Signals

CLKOUT

This signal is a 16.78 MHz square wave clock. It is used by the PCMCIA circuitry for synchronization purposes.

uP_CONTROL *(Microprocessor Control)*

The processor uses this signal to power down the KVL's circuitry. When the *KVL 3000* is OFF, pressing of 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 switch 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.

KEY_RESET *(Key Reset)*

The *KVL 3000* is designed to accept encryption keys and to keep them secure. To keep the keys secure, the KVL stores the keys in encrypted form. The only piece of "RED" (unencrypted) information then is the key with which all of the other keys are encrypted. To keep this key secure, the *KVL 3000* has been designed with 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 attached).

The state of the KEY_RESET line is dually controlled by the tamper detection mechanism and the Cont_5V regulator output. Either the detection of tampering or the drop in Cont_5V power will activate the KEY_RESET line. Activation of this line will clear the Tamper Register as well as clear any key loaded in the encryption IC.

— continued on next page —

Miscellaneous Signals (continued)

A_B*_SEL *(A/B Input Select)*

The tamper register is a serial–in, serial–out shift register device. It is designed to allow data to be input from one of two sources, selectable by the logic level on the A_B*_SEL line. Control of the A_B*_SEL line is from the processor via a general purpose I/O line. When entry of an encryption key into the tamper register is performed, the processor enters the key through the A input using the Serial Peripheral Interface (SPI). When reading the key from the register, the output of the register is returned to the B input to re–establish the key in the register (when data is read from a serial shift register, the contents of the register are altered; to restore this value, the correct data must be re–inserted).

BATT_3V

This signal is the backup voltage for the Real Time Clock (RTC). Its source is the 3 Volt battery. This voltage supply is needed to maintain the time in the *KVL 3000* whenever the *KVL 3000* is switched OFF.

PWR_SWITCH*

The PWR key on the keypad of the *KVL 3000* is different than other keys on the keypad in that 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 3000* 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 *KVL 3000* OFF condition, toggling this line activates the latch which is responsible for turning ON the SW_5V supply. Activation of this line from the *KVL 3000* 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 3 ▶ Disassembly Instructions

chapter contents

1 DISASSEMBLY INSTRUCTIONS

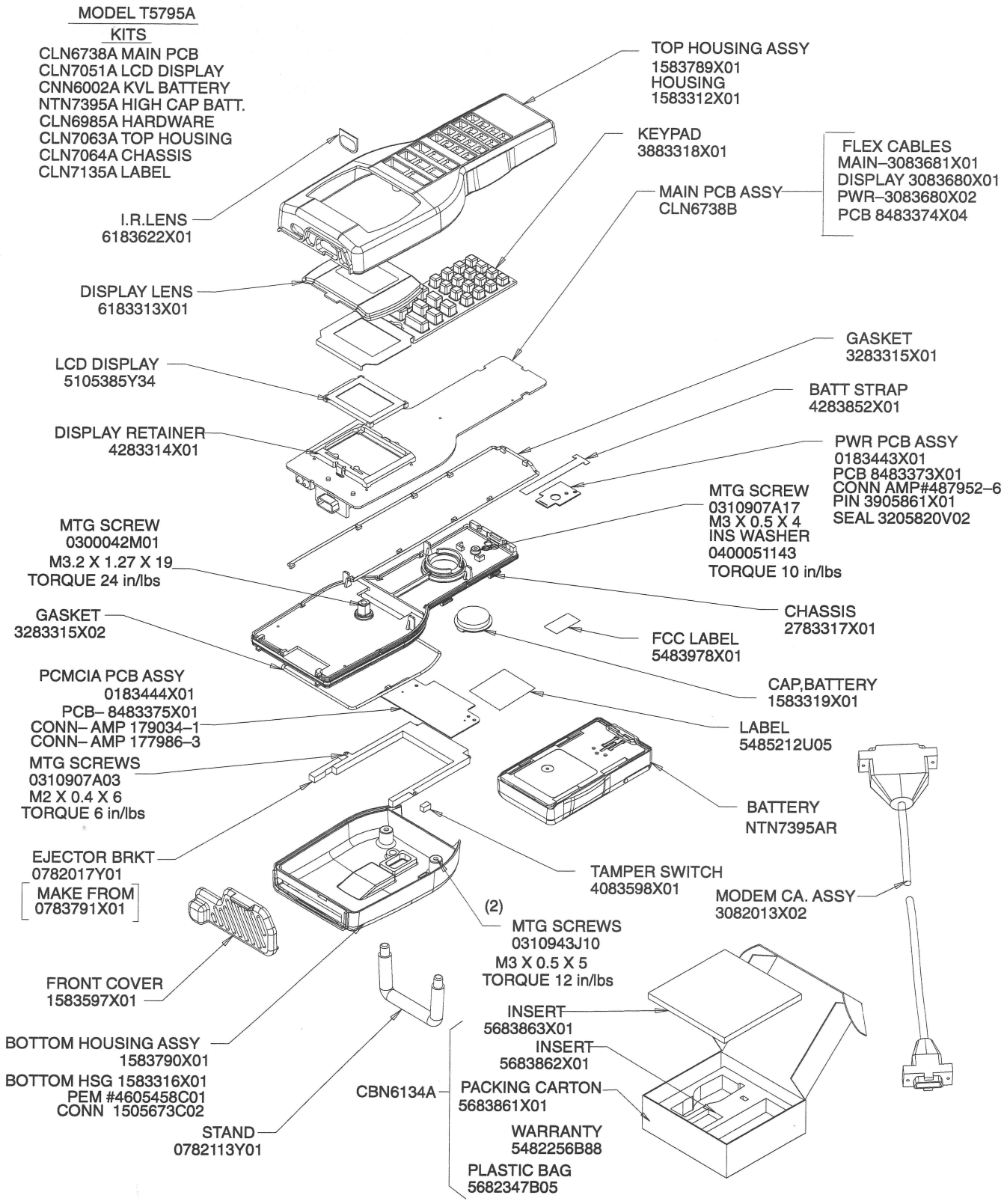
This section provides disassembly instructions for replacing the main circuit board in the *KVL 3000*.

Disassembly Procedure

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 (using a small screwdriver to pry the connector components apart).
7. At this point the back cover should be totally disconnected; set it aside.
8. 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.*
9. Using a #6 Torx driver, remove the screws (4) which secure the PCMCIA circuit board and rails to the chassis.
10. Remove the PCMCIA circuit board and rails.
11. Using a #15 Torx driver, remove the center screw that secures the chassis to the front cover.
12. 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. Once the narrow end has been released from the housing, release the wide end by pulling the chassis slightly towards the narrow end.
13. 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.
14. Fold the chassis away from the front housing using the narrow end as the hinge end.
15. Separate the Target/PCMCIA flex from the mating connectors on the Main circuit board; set the flex cable aside.

— continued on page 3–4 —

KVL 3000 Exploded View



Disassembly Procedure (continued)

16. 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.
17. 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 2 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.
18. 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.
19. At this point, the Main board can be replaced; reverse the disassembly sequence to reassemble the unit.

Chapter 4 ▶ Troubleshooting

chapter contents

1 INTRODUCTION

The *KVL 3000* can be partitioned into 3 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.

In troubleshooting the *KVL 3000*, one should use this conceptual partitioning to isolate the source of a problem within the *KVL 3000*. 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* 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.

2 TROUBLESHOOTING PROCEDURES

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

Power

Symptom

No display when **Pwr** key is pressed

Solution

- Make sure the main battery is charged.
- Make sure the tamper switch/back cover is closed.

If problem persists, check the following:

- The red LED, DS501, should be lit, indicating switched 5 volt power.
- If not, check cable connections between the battery and main board.
- The battery voltage should appear on pin 4 of U504. Pin 2 should be around zero volts to turn on the regulator. Pin 5 should put out the regulated 5 volts.
- If LED is lit, check the display flex cable.
- Check CLKOUT signal on pin 2 of U602. It should be ~ 8.39 MHz.
- RESET should be high (check pin 5 on U803.)

Real Time Clock

Symptom

Does not keep time and date

Solution

- Check that the backup lithium battery measures 2.4 to 3.3 volts. If not, replace battery. Make sure the battery is in tight and makes contact on the bottom as well as on the side.
- Check under CONFIG/TIME menu to see that the time display increments every second. If not, it is a board level issue.

Audio

Symptom

No audio

Solution

- 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

Symptom

Keyload failure

Solution

- Make sure 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

Symptom

General failure

Solution

- Check PCMCIA flex connectivity between the PCMCIA board connector and the main board connectors.

RS-232

Symptom

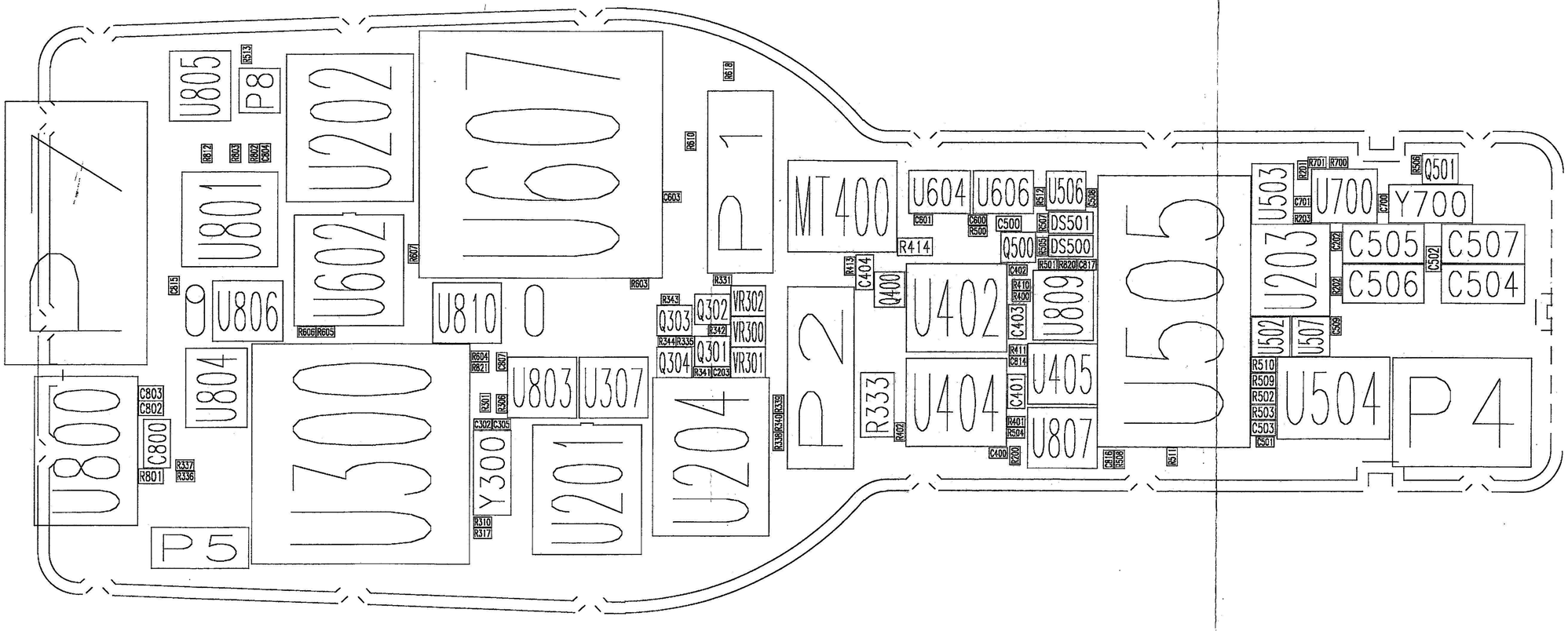
Unable to communicate

Solution

- Check that cables are connected tightly.
- Make sure baud rate is set correctly under CONFIG.
- Check for high/low transitions on pins 2 (Receive) and 3 (Transmit) of the DB9 connector.

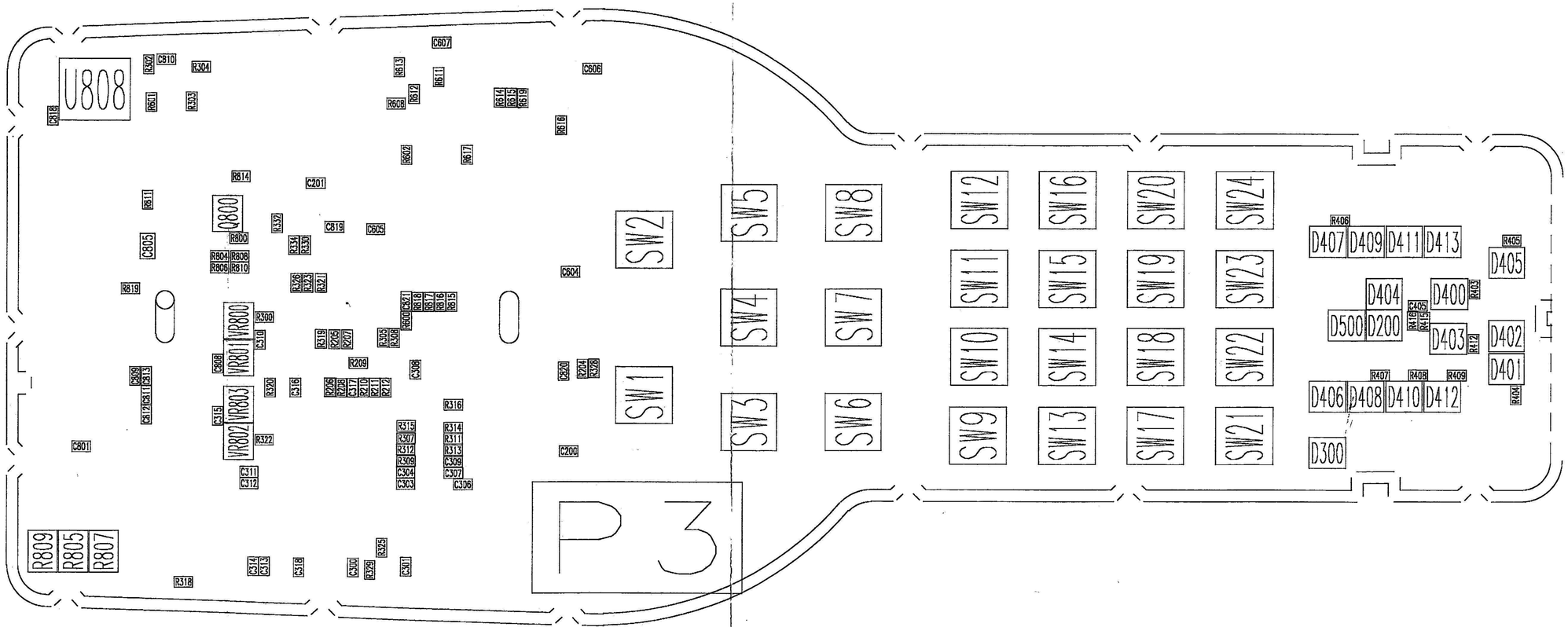
Circiut Board Details

TOP VIEW



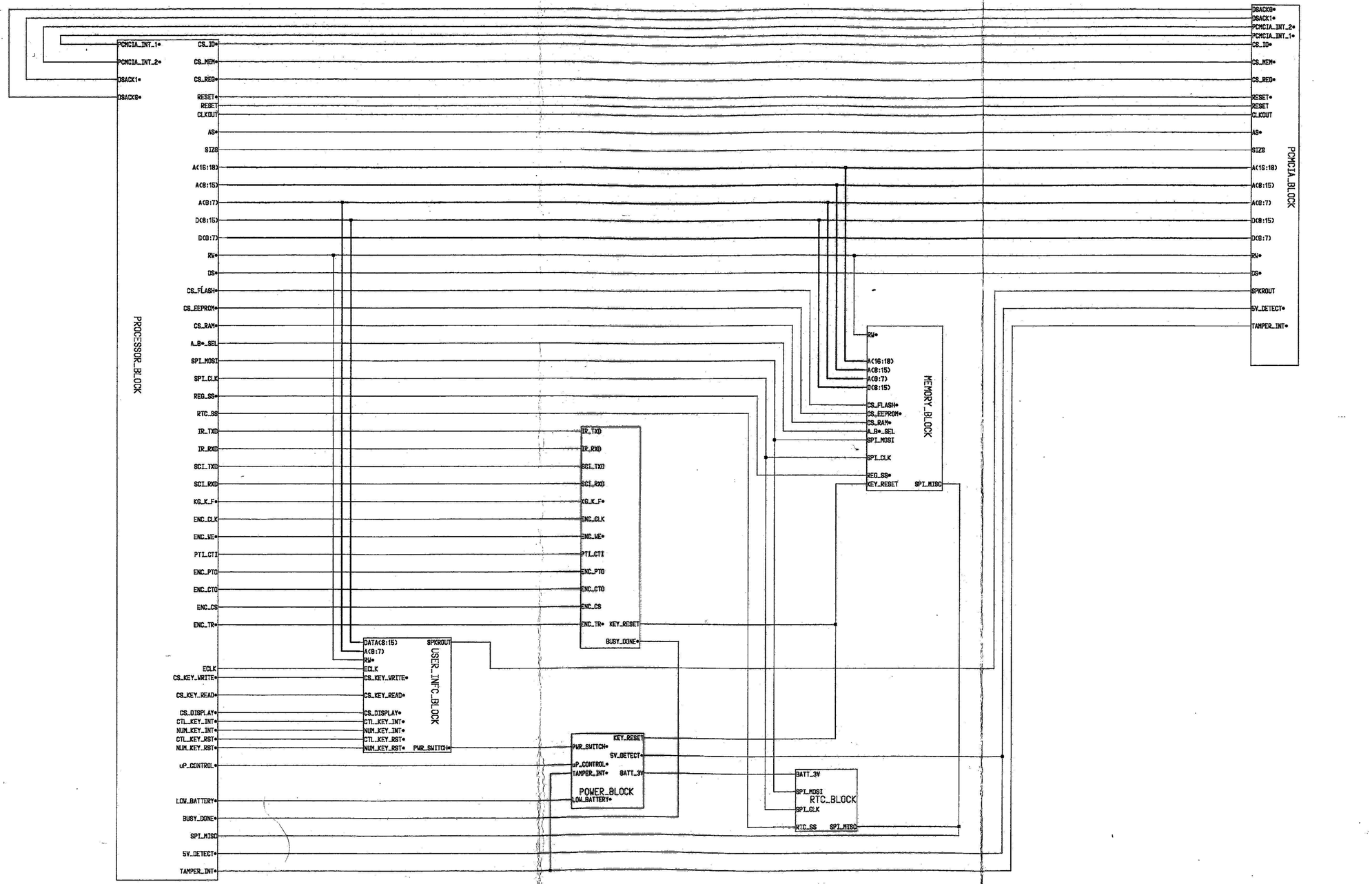
Circiut Board Details

BOTTOM VIEW

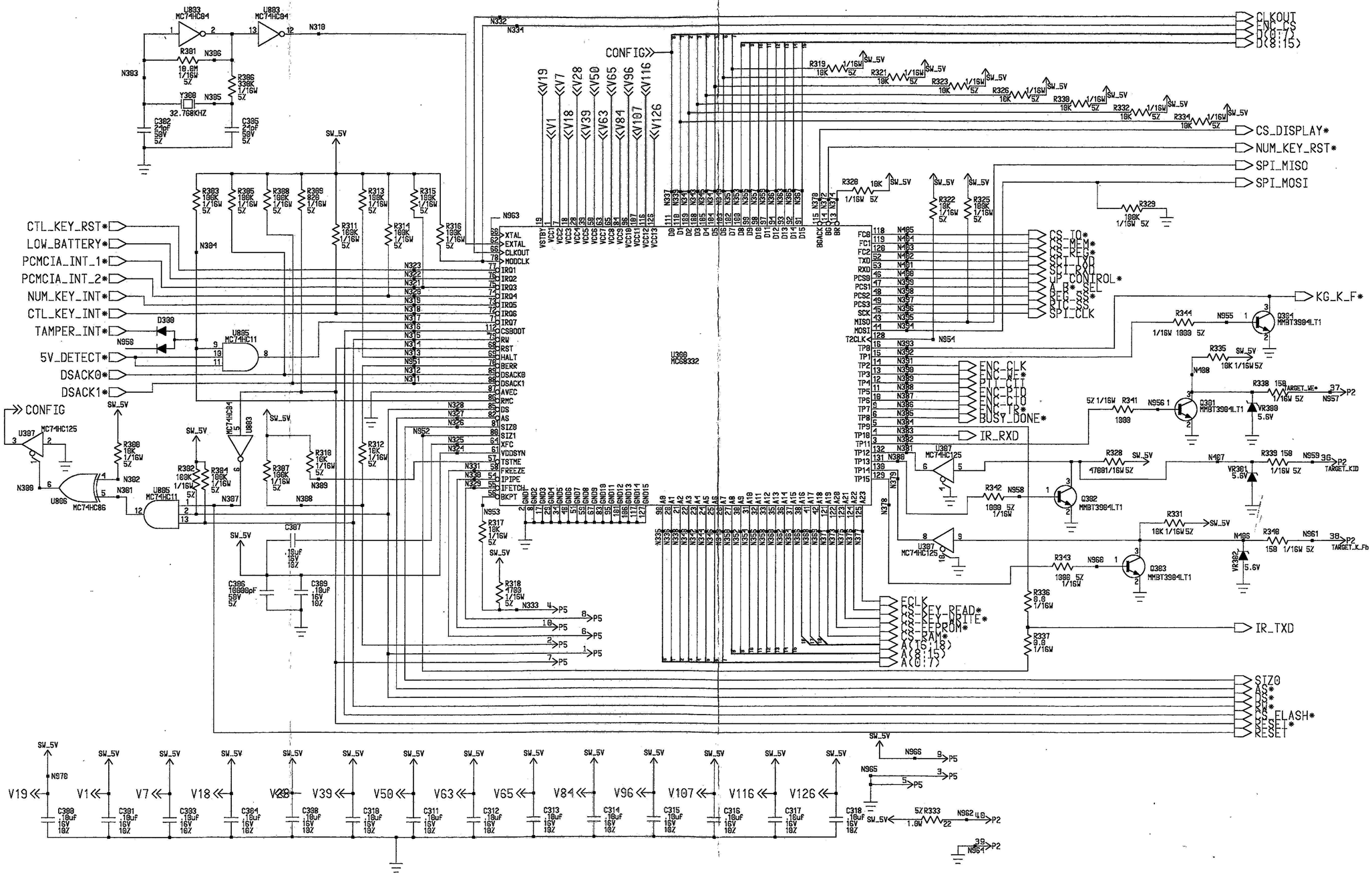


68P80800B85–A
12/31/98

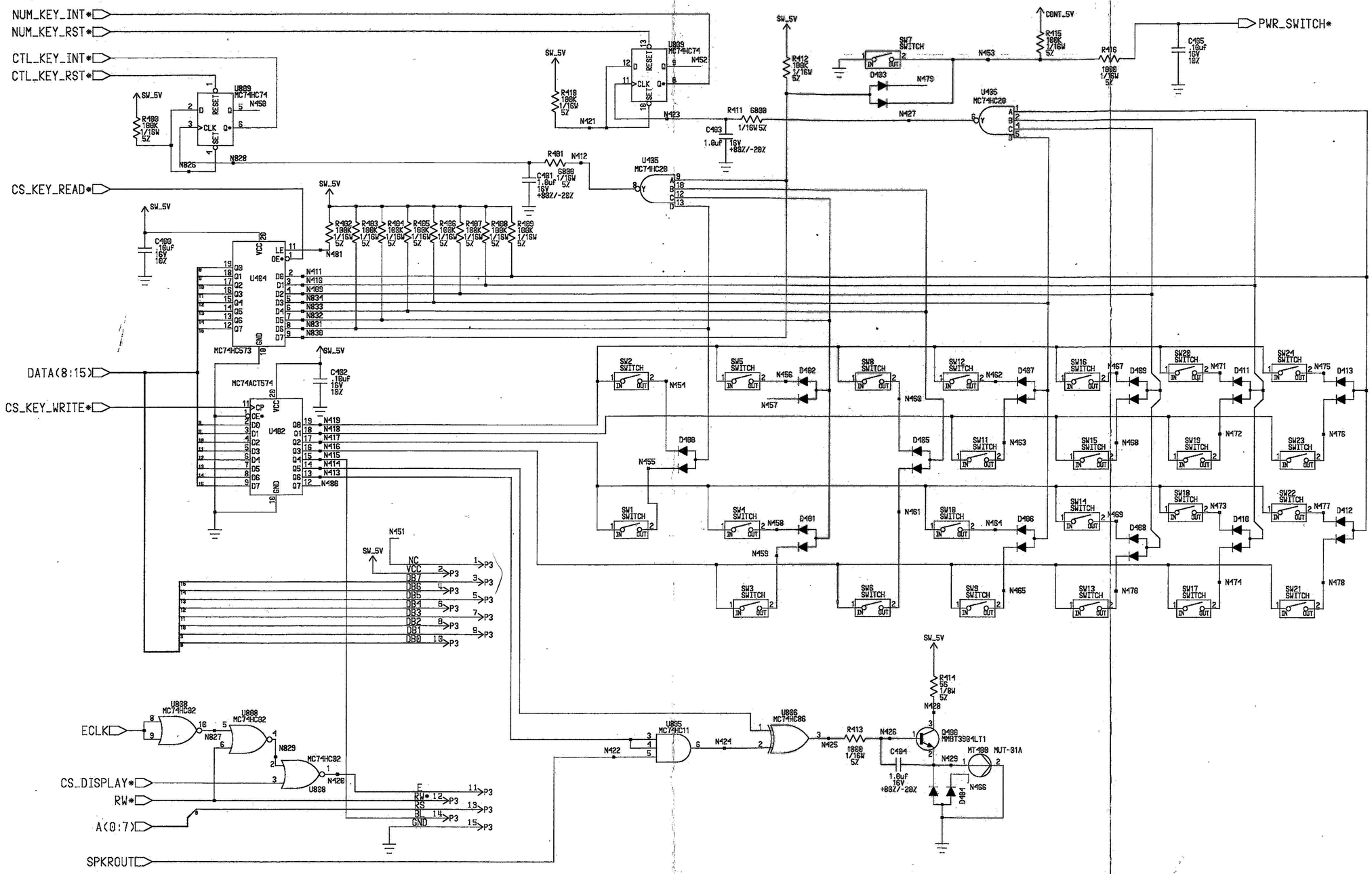
Functional Block Diagram



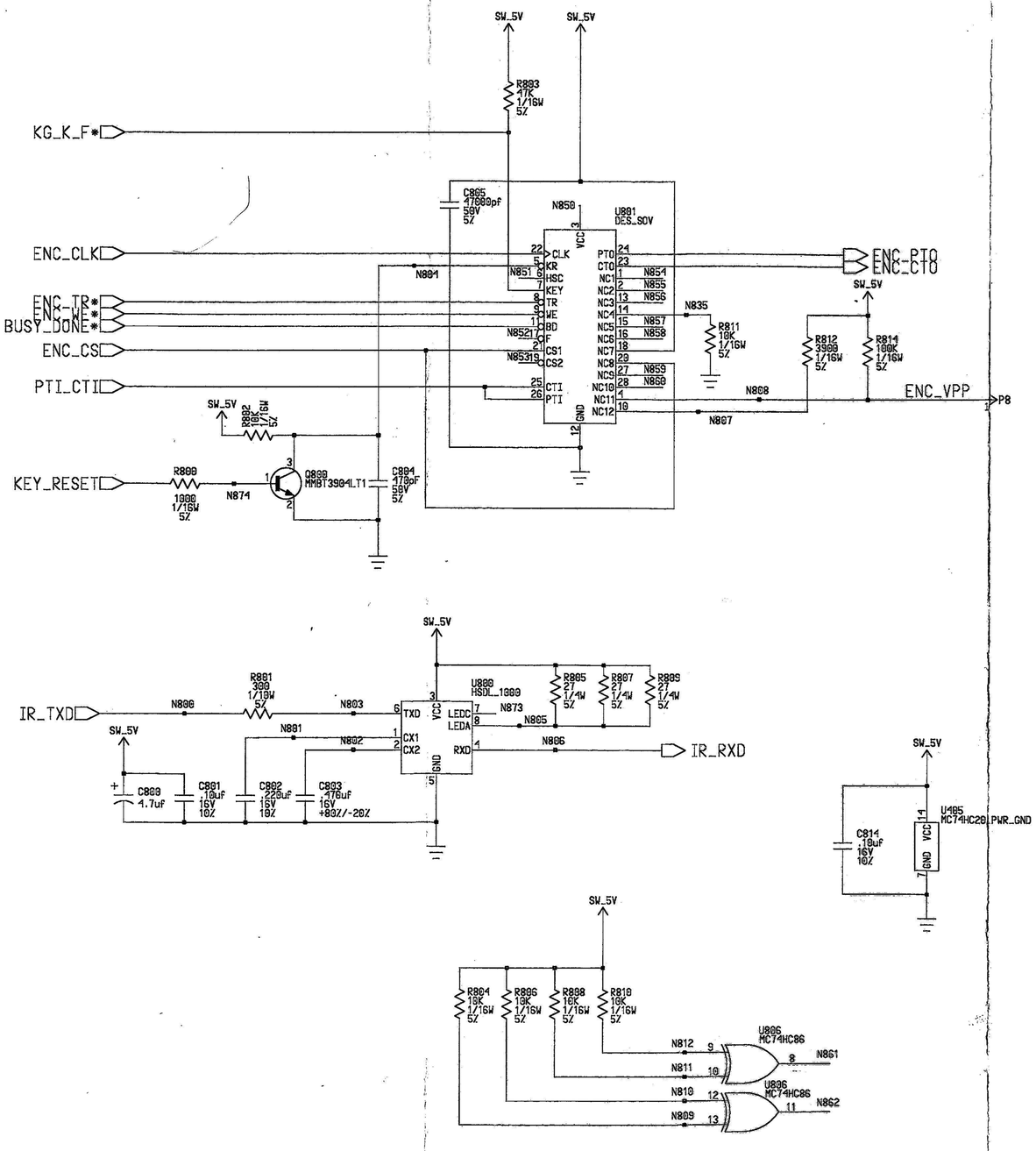
Processor Circuitry



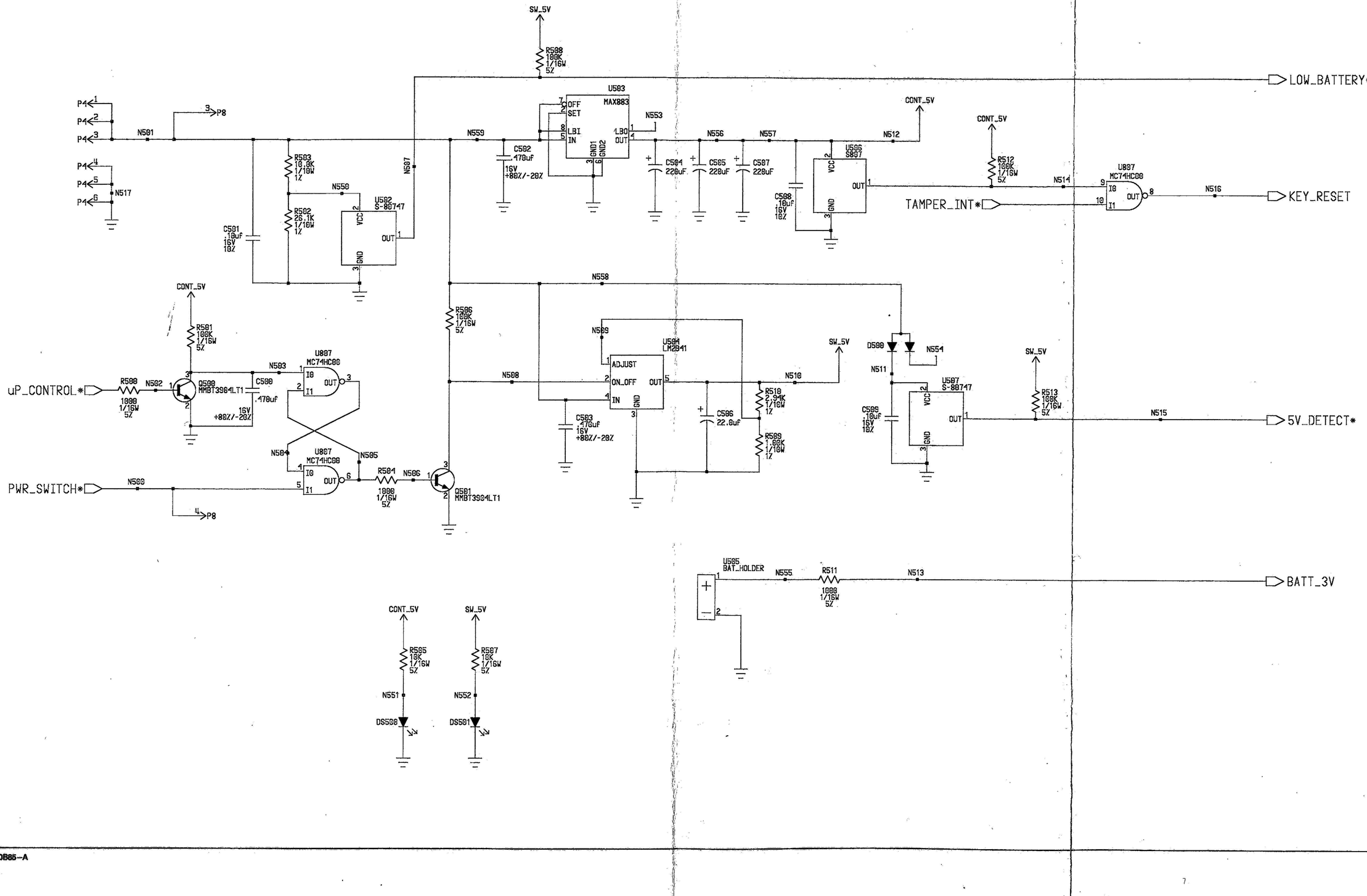
User Interface Circuitry



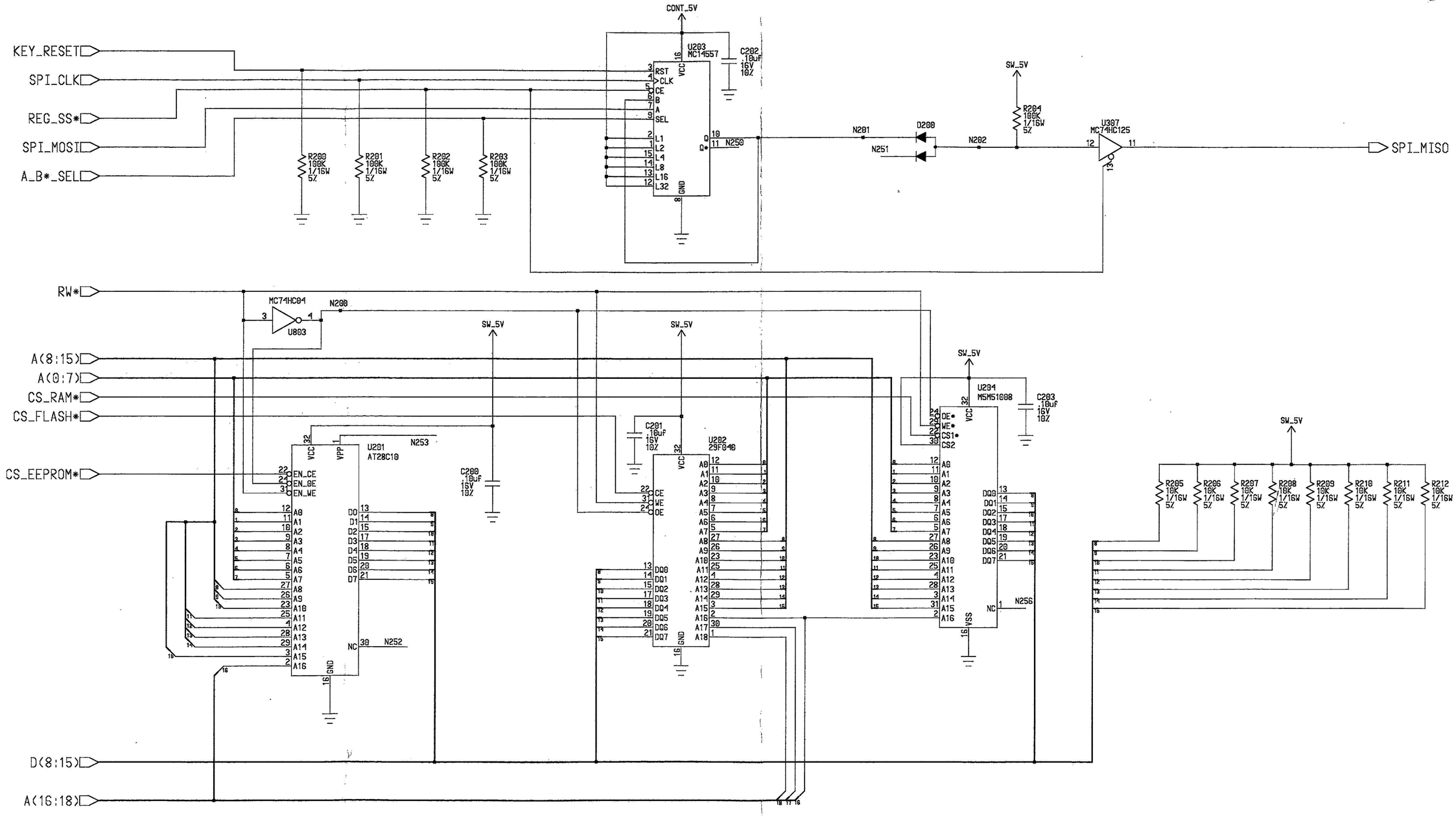
Input/Output Circuitry



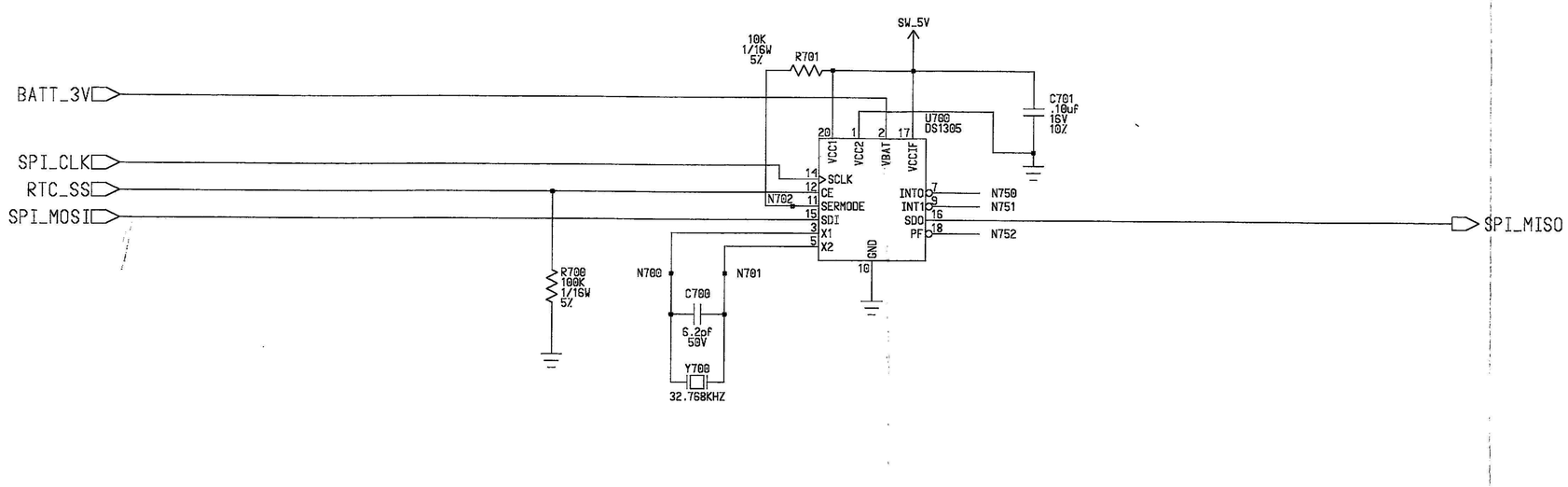
Power Circuitry



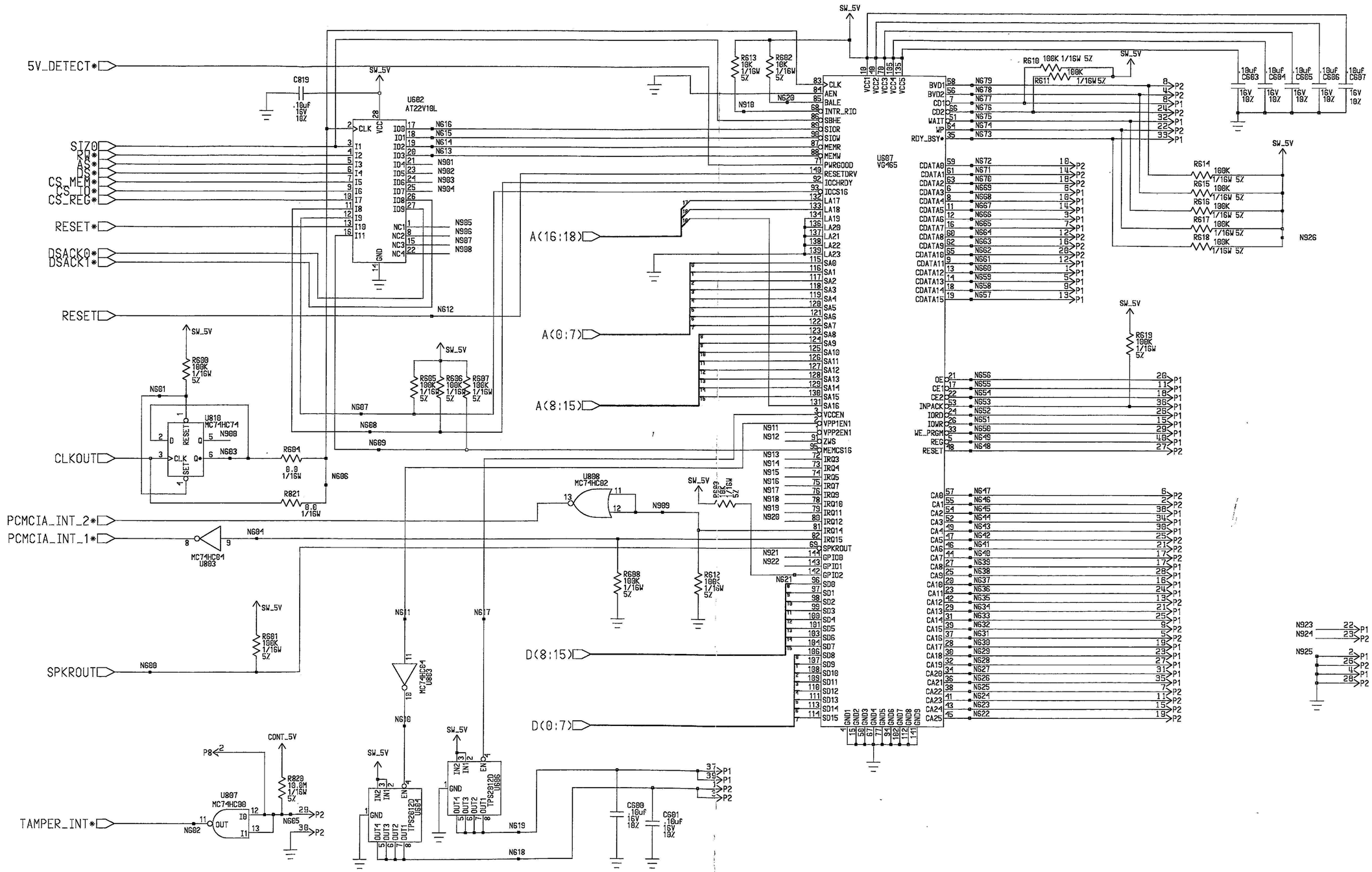
Memory Circuitry



Real Time Clock Circuitry



PCMCIA Circuitry



Parts List

parts list

CLN6738B KVL 3000 Main Board **PL–13166–O**

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C200 thru 203	2113743E20	CAP CHIP .10 UF 10%
C300,301	2113743E20	CAP CHIP .10 UF 10%
C302	2113740F36	24 pF, ±5%; 50V
C303,304	2113743E20	CAP CHIP .10 UF 10%
C305	2113740F36	24 pF, ±5%; 50V
C306	2113741F49	0.01 uF, ±5%; 50V
C307 thru 318	2113743E20	CAP CHIP .10 UF 10%
C400	2113743E20	CAP CHIP .10 UF 10%
C401	2113743G21	1 uF, +80%/–20%; 16V
C402	2113743E20	CAP CHIP .10 UF 10%
C403,404	2113743G21	1 uF, +80%/–20%; 16V
C405	2113743E20	CAP CHIP .10 UF 10%
C500	2113743F14	CAP CHIP .470UF +80 –20% Y5V
C501	2113743E20	CAP CHIP .10 UF 10%
C502,503	2113743F14	CAP CHIP .470UF +80 –20% Y5V
C504,505	2311049C04	CAP TANT CHIP 220 UF 10V 20%
C506	2311049A21	22 uF, ±10%; 20 V
C507	2311049C04	CAP TANT CHIP 220 UF 10V 20%
C508,509	2113743E20	CAP CHIP .10 UF 10%
C600,601	2113743E20	CAP CHIP .10 UF 10%
C603 thru 607	2113743E20	CAP CHIP .10 UF 10%
C700	2113740F22	6.2 pF, ±0.25 pF; 50V
C701	2113743E20	CAP CHIP .10 UF 10%
C800	2311049A13	4.7 uF, ±10%; 10V
C801	2113743E20	CAP CHIP .10 UF 10%
C802	2113743A23	CAP CHIP .220 UF 10% X7R
C803	2113743F14	CAP CHIP .470UF +80 –20% Y5V
C804	2113741F17	470 pF, ±5%; 50V
C805	2113741A61	0.047 uF, ±5%; 50 V
C807 thru 821	2113743E20	CAP CHIP .10 UF 10%
		diode (see note):
D200	4813833C03	dual 70V
D300	4813833C03	dual 70V
D400 thru 413	4813833C03	dual 70V
D500	4813833C03	dual 70V
		light emitting diode (see note):
DS501	4882198T01	red
		transducer:
MT400	5083354X01	TRANDSUCER, SMT
		connector:
P1,2	2883784X01	PLUG, BD TO BD 40 PIN, SM
P3	2883351X03	FPC CONNECTOR
P4	2883351X01	FPC CONNECTOR
P5	2880001S05	plug: 10–contact
P7	0984524T11	D–SUB HIGH TEMP PC MI RTANG
P8	2880001S02	CON PCB HDR 1 GOLD DR ST 4 POS
		transistor (see note):
Q301 thru 304	4813824A10	NPN
Q400	4813824A10	NPN
Q500,501	4813824A10	NPN
Q800	4813824A10	NPN
		resistor, fixed:
R200 thru 204	0662057A97	CHIP RES 100K OHMS 5%
R205 thru 212	0662057A73	CHIP RES 10K OHMS 5%
R300	0662057A73	CHIP RES 10K OHMS 5%
R301	0662057B46	CHIP RES 10.0 MEG OHMS 5%
R302 thru 305	0662057A97	CHIP RES 100K OHMS 5%
R306	0662057B10	CHIP RES 330K OHMS 5%
R307,308	0662057A97	CHIP RES 100K OHMS 5%
R309	0662057A47	CHIP RES 820 OHMS 5%
R310	0662057A73	CHIP RES 10K OHMS 5%
R311	0662057A97	CHIP RES 100K OHMS 5%
R312	0662057A73	CHIP RES 10K OHMS 5%
R313 thru 316	0662057A97	CHIP RES 100K OHMS 5%
R317	0662057A73	CHIP RES 10K OHMS 5%
R318	0662057A65	CHIP RES 4700 OHMS 5%
R319 thru 323	0662057A73	CHIP RES 10K OHMS 5%
R325	0662057A97	CHIP RES 100K OHMS 5%
R326	0662057A73	CHIP RES 10K OHMS 5%
R328	0662057A65	CHIP RES 4700 OHMS 5%
R329	0662057A97	CHIP RES 100K OHMS 5%
R330 thru 332	0662057A73	CHIP RES 10K OHMS 5%
R333	0683962T33	22 ohms, ±5%; 1W
R334,335	0662057A73	CHIP RES 10K OHMS 5%
R337	0662057B47	CHIP RES 0 OHMS +–.050 OHMS
R338 thru 340	0662057A29	CHIP RES 150 OHMS 5%
R341 thru 344	0662057A49	CHIP RES 1000 OHMS 5%
R400	0662057A97	CHIP RES 100K OHMS 5%
R401	0662057A69	CHIP RES 6800 OHMS 5%
R402 thru 410	0662057A97	CHIP RES 100K OHMS 5%
R411	0662057A69	CHIP RES 6800 OHMS 5%
R412	0662057A97	CHIP RES 100K OHMS 5%
R413	0662057A49	CHIP RES 1000 OHMS 5%
R414	0611077A44	56 ohms, ±5%; 1/8 W
R415	0662057A97	CHIP RES 100K OHMS 5%
R416	0662057A49	CHIP RES 1000 OHMS 5%
R500	0662057A49	CHIP RES 1000 OHMS 5%
R501	0662057A97	CHIP RES 100K OHMS 5%
R502	0611079G41	RES CHIP 26.1K 1/10W 1% 0805
R503	0611079G01	10k, ±1%; 1/10 W
R504	0662057A49	CHIP RES 1000 OHMS 5%
R506	0662057A97	CHIP RES 100K OHMS 5%
R507	0662057A73	CHIP RES 10K OHMS 5%
R508	0662057A97	CHIP RES 100K OHMS 5%
R509	0611079F01	1.00K, 1/10 W
R510	0611079F46	RES CHIP 2.94K 1/10W 1% 0805
R511	0662057A49	CHIP RES 1000 OHMS 5%
R512,513	0662057A97	CHIP RES 100K OHMS 5%
R600,601	0662057A97	CHIP RES 100K OHMS 5%
R602,603	0662057A73	CHIP RES 10K OHMS 5%
R604	0662057B47	CHIP RES 0 OHMS +–.050 OHMS
R605 thru 608	0662057A97	CHIP RES 100K OHMS 5%
R610 thru 612	0662057A97	CHIP RES 100K OHMS 5%
R613	0662057A73	CHIP RES 10K OHMS 5%
R614 thru 619	0662057A97	CHIP RES 100K OHMS 5%
R700	0662057A97	CHIP RES 100K OHMS 5%
R701	0662057A73	CHIP RES 10K OHMS 5%
R800	0662057A49	CHIP RES 1000 OHMS 5%
R801	0611079A61	RES FIXED CHIP 300 5 1/10W A/P
R802	0662057A73	CHIP RES 10K OHMS 5%
R803	0662057A89	CHIP RES 47K OHMS 5%
R804	0662057A73	CHIP RES 10K OHMS 5%
R805	0611072A11	27 ohms, ±5%; 1/4W
R806	0662057A73	CHIP RES 10K OHMS 5%
R807	0611072A11	27 ohms, ±5%; 1/4W
R808	0662057A73	CHIP RES 10K OHMS 5%
R809	0611072A11	27 ohms, ±5%; 1/4W
R810,811	0662057A73	CHIP RES 10K OHMS 5%
R812	0662057A63	CHIP RES 3900 OHMS 5%
R814	0662057A97	CHIP RES 100K OHMS 5%
R815 thru 818	0662057A73	CHIP RES 10K OHMS 5%
R819	0662057A97	CHIP RES 100K OHMS 5%
R820	0662057B46	CHIP RES 10.0 MEG OHMS 5%
		integrated circuit (see note):
U201	5191080A01	IC EEPROM 128KX8 28C010
U202	0913900A13	Socket, 32–position
U203	5113806A55	IC 64-BIT TAMPER SHFT REG
U204	5184830T02	Static RAM 128KX8
U300	5113802A28	IC 32BIT MCU W/Q'ED SPI/SCI
U307	5113805A26	IC QUAD BFR 3ST NON INV HC125
U402	5113808A63	IC FLIP–FLOP, OCT D 3–ST
U404	5113805A72	Octal 3–State Non–Inverter Transmit Latch
U405	5113805A10	Dual 4–Input NAND Gate
U502	5183341X01	IC,VOLT DET,4.7 S–80747
U503	5182923X01	IC LO DRPOUT P–CH RGLR –883–
U504	5183308X01	IC, LM2941, TO DRPOUT RGTR
U505	0983295X01	SOCKET COIN CELL BATTERY
U506	5105625U94	IC UNDER VOLTAGE DETECTOR 3.1V
U507	5183341X01	IC,VOLT DET,4.7 S–80747
U602	5191061C01	IC PRGMD PCMCIA2, J1
U604	5191063A01	IC, PWR DIST SW, TPS2012
U606	5191063A01	IC, PWR DIST SW, TPS2012
U607	5183368X01	IC,PCMCIA HST ADPTR,VG465
U700	5183340X01	IC, RTC DS1305
U800	5191062A01	IC, INFARED TRAN HSDL–1000
U801	5105479G37	IC ENCRYPTION SOV 13" REEL
U803	5113805A98	IC INVTR HEX
U804	5183221X01	IC,RS232 TRANSCEIVER202
U805	5113805A08	Triple 3–Input AND Gate
U806	5113805A22	Quad 2–Input Exclusive OR Gate
U807	5113805A01	Quad 2–Input NAND Gate
U808	5113805A02	Quad 2–Input NOR Gate
U809,810	5113805A18	Dual D–Type Flip–Flop with Set/Reset
		zener diode (see note):
VR300 thru 302	4813830A15	Zener, 5.6 V
VR800 thru 803	4813830A28	Zener 15 V
		crystal:
Y300	4802582S02	OSC. XTAL 32.768KHZ SMD PKG
Y700	4802582S02	OSC. XTAL 32.768KHZ SMD PKG
		non–referenced items:
	5484960T02	LABEL BLANK BARCODE
	8483374X04	CIRCUIT BOARD

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

Appendix A — Error Messages

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

Error Message	Display Method	Probable Cause and Remedy
ALL ZERO LFSR DID NOT FAIL DEVICE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Defective REX of target hybrid **Remedy(s):** 1) Return target device to service center for troubleshooting and repair of hybrid
ALL ZERO LFSR FAIL DID NOT CLEAR	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Defective REX of target hybrid **Remedy(s):** 1) Return target device to service center for troubleshooting and repair of hybrid
BAD ACK RCV'D AFTER SECURITY TEST	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable
BAD CRC FAILURE DID NOT CLEAR	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
BAD CTO DATA ACK RECEIVED FROM RADIO	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
BAD DISCONNECT ACK RECEIVED FROM RADIO	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
BAD GROUP MAP CRC	Displayed during *KVL 3000* operation	**Probable Cause(s):** 1) Group map data corrupted 2) Defective EEPROM in *KVL 3000* **Remedy(s):** 1) Re-enter the Group Map 2) Return *KVL 3000* to service center for troubleshooting and repair of EEPROM
BAD INDEX NAME ACK RECEIVED FROM RADIO	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC

Error Message	Display Method	Probable Cause and Remedy
BAD/ INVALID ACKNOWLEDGE RECEIVED FROM RADIO	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
BAD IV ACK RECEIVED FROM RADIO	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
BAD KEY PACKET ACK RECEIVED FROM RADIO	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
BAD OFFSET ACK RECEIVED FROM RADIO	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
BAD SYSTEM KEY ACK RECEIVED FROM RADIO	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
BAD ZERO ACK RECEIVED FROM RADIO	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
CANT CLEAR INITIAL KEYFAIL	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC

Error Message	Display Method	Probable Cause and Remedy
COULD NOT PERFORM AN ENCRYPTION SERVICE	Displayed during *KVL 3000* operation	**Probable Cause(s):** 1) Defective encryption IC in target device 2) Defective EEPROM in *KVL 3000* 3) Defective FLASH memory in *KVL 3000* **Remedy(s):** 1) Return *KVL 3000* to service center for troubleshooting and repair of encryption IC 2) Return *KVL 3000* to service center for troubleshooting and repair of EEPROM 3) Return *KVL 3000* to service center for troubleshooting and repair of FLASH memory
COULD NOT SET LID	Displayed during *KVL 3000* operation	**Probable Cause(s):** 1) Defective EEPROM in *KVL 3000* **Remedy(s):** 1) Return *KVL 3000* to service center for troubleshooting and repair of EEPROM
CRC OF A KEY FAILED	Displayed during *KVL 3000* operation	**Probable Cause(s):** 1) Defective encryption IC in target device 2) Defective EEPROM in *KVL 3000* 3) Defective FLASH memory in *KVL 3000* **Remedy(s):** 1) Return target device to service center for troubleshooting and repair of encryption IC 2) Return *KVL 3000* to service center for troubleshooting and repair of EEPROM 3) Return *KVL 3000* to service center for troubleshooting and repair of FLASH memory
CRC OF THE KVL'S USK FAILED	Displayed during *KVL 3000* operation	**Probable Cause(s):** 1) Corrupted data in EEPROM in *KVL 3000* **Remedy(s):** 1) Re-enter the USK. If error persists, return *KVL 3000* to service center for troubleshooting and repair of EEPROM
CRC OF THE SYSTEM KEY FAILED	Displayed during *KVL 3000* operation	**Probable Cause(s):** 1) Corrupted data in EEPROM in *KVL 3000* **Remedy(s):** 1) Re-enter the System Key. If error persists, return *KVL 3000* to service center for troubleshooting and repair of EEPROM
DES KEY TRANSFER FAILURE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
DES SECURITY TEST FAILED	Displayed during *KVL 3000* operation	**Probable Cause(s):** 1) KVL 3000 EEPROM has bit set to enable DES, but non-DES software has been loaded **Remedy(s):** 1) Check the customer order to determine if DES was ordered. If DES was ordered, return KVL 3000 to service center to have DES software installed. If DES was not ordered, return to service center to have the DES bit in the EEPROM turned off.
ENCRYPTION SERVICE IS MISSING DATA	Displayed during *KVL 3000* operation	**Probable Cause(s):** 1) Corrupted data in EEPROM in *KVL 3000* **Remedy(s):** 1) Perform a hard reset of *KVL 3000*. If error persists, return *KVL 3000* to service center for troubleshooting and repair of EEPROM

Error Message	Display Method	Probable Cause and Remedy
ENCRYPTION SERVICE IS MISSING USK	Displayed during *KVL 3000* operation	**Probable Cause(s):** 1) USK has been zeroized **Remedy(s):** 1) Re-enter USK. If error persists, return *KVL 3000* to service center for troubleshooting and repair of EEPROM
GOOD KEY FAILURE AFTER SBOX TEST	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
INTERNAL KVL HW ALGO DEVICE ERROR	Displayed during *KVL 3000* operation	**Probable Cause(s):** 1) Encryption device in *KVL 3000* not functioning properly **Remedy(s):** 1) Return *KVL 3000* to service center for troubleshooting and repair
INTERNAL KVL KEYLOAD ERROR	Displayed during *KVL 3000* operation	**Probable Cause(s):** 1) Encryption device in *KVL 3000* not functioning properly **Remedy(s):** 1) Return *KVL 3000* to service center for troubleshooting and repair
KEY WITH BAD PARITY DID NOT CLEAR	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
NO INITIAL RESPONSE FROM RADIO	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
NO RESPONSE FROM RADIO AFTER SECUR_TEST	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Incompatible target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Make sure target device is compatible with *KVL 3000*
NO SECURITY TEST ACK RECEIVED FROM RADIO	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Incompatible algorithm **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Make sure algorithm for key is supported by target device

Error Message	Display Method	Probable Cause and Remedy
RADIO DID NOT RESPOND TO CTO DATA OPCODE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
RADIO DID NOT RESPOND TO DSCONNECT OPCODE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
RADIO DID NOT RESPOND TO INDEX NAME OPCODE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
RADIO DID NOT RESPOND TO IV OPCODE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
RADIO DID NOT RESPOND TO KEYPACKET OPCODE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
RADIO DID NOT RESPOND TO OFFSET OPCOD	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
RADIO DID NOT RESPOND TO SYSTEMKEY OPCODE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
RADIO DID NOT RESPOND TO ZEROIZE OPCODE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC

Error Message	Display Method	Probable Cause and Remedy
REX IV FAILURE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Defective REX of target hybrid **Remedy(s):** 1) Return target device to service center for troubleshooting and repair of hybrid
REX KEYSTREAM FAIL DID NOT CLEAR	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
SBOX FAIL FAILURE DID NOT CLEAR	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
SBOX FAIL FAILURE DID NOT OCCUR	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
SBOX KEYLOAD FAILURE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Defective encryption IC in target device **Remedy(s):** 1) Return target device to service center for troubleshooting and repair of encryption IC
SBOX TEST FAILURE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC
SHORT REX WEB DID FAIL NOT DEVICE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Defective encryption IC in target device **Remedy(s):** 1) Return target device to service center for troubleshooting and repair of encryption IC
SHORT REX WEB FAIL DID NOT CLEAR	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Defective encryption IC in target device **Remedy(s):** 1) Return target device to service center for troubleshooting and repair of encryption IC
SOV KEY TRANSFER FAILURE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC

Error Message	Display Method	Probable Cause and Remedy
UNKNOWN ENCRYPTION ABORT KEYLOAD	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Defective EEPROM in *KVL 3000* **Remedy(s):** 1) Return *KVL 3000* to service center for troubleshooting and repair of EEPROM
VALID SYSKEY CRC TRANSFER FAILURE	Displayed by pressing/ holding **Del/Shift** key, then pressing **E** key	**Probable Cause(s):** 1) Faulty Keyload Cable or connection 2) Defective encryption IC in target device **Remedy(s):** 1) Ensure proper keyload cable connections at each end; try known good keyload cable 2) Return target device to service center for troubleshooting and repair of encryption IC