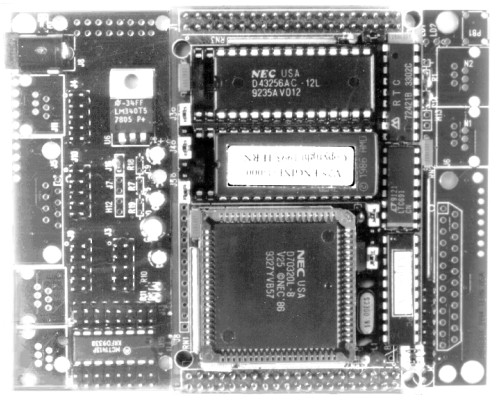
# *BirdBox* ™

A Universal Communication Unit
for
C/C++ programmers

# *Technical Manual*

**BirdBox™**



**BirdBox board + V25-Engine™**

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Temperature readings for controllers are based on the results of limited sample tests; they are provided for design reference use only.

# Table of Contents

# Chapter 1
# Introduction

## 1. Functional Description

The BirdBox™ is a low cost universal communication unit driven by a V25-Engine™ or a C-Engine™. It has four serial ports: two RS-232C ports and one RS-485/RS-232 UART on the V25-Engine™, plus one RS-232 UART on the BirdBox board. The BirdBox has 12 digital outputs and 5 digital inputs, connecting to a DB25 connector that can be used as a PC- compatible parallel printer port. There are seven channels of comparator inputs with software-programmable threshold voltages. These comparator inputs can be used as 4-bit ADC inputs, or as digital inputs. The BirdBox™ also features seven channels of solenoid drivers, two PDC ports, a 16x2 character LCD, an interrupt-driven 3x4 keypad, a reset pushbutton, red and green LEDs, a beeper, and DC power jack, all packaged in a 4.8" x 3.7" x 1.5" enclosure.

Users may connect the BirdBox™ to computers, control systems, and external MODEMs via the RS-232C serial ports, and may connect a printer via the BirdBox™ parallel port. The BirdBox™ may be used to convert protocols into different formats, to check passwords and PIN codes entry, and to translate messages for communication among different systems or machines. The Birdbox™ also can be used for control applications with the ADC, high voltage drivers, and digital I/Os. Up to 32 BirdBoxes may be networked together via a RS-485 multi-drop system with twisted pair wires. The BirdBox™ can read/write external serial EEPROMs via the PDC ports.

You program the BirdBox from your PC via serial link. With the TERN EV-P/DV-P, you can use Paradigm C/C++ to edit, compile, download, and then remote debug via the serial link, at 115,000 baud rate. TERN provides I/O libraries, sample programs, target EPROM, and all the hardware necessary for you to quickly develop your application software. For more details please see the data sheet and Technical Manual for the V25-Engine™.

The BirdBox™ can be connected to computers, systems, external MODEMs via RS232C serial ports, or the parallel port. The BirdBox™ may be used to convert different protocols into different formats, check passwords, and translate messages for user communication among different systems or machines. Up to 255 units can be net-worked in a RS485 network system with twist pair wires. The Birdbox™ can be used as a PDC (Portable Data Carrier) reader or/and writer. The PDC (up to 64K bits) from TERN is a 0.4 x 0.3 x 0.05 (inches) data chip, which can be used to conveniently store and retrieve information. The PDCs are low cost, small, rugged, and easy to use. They can be shaped into keys, tags, tokens, bracelets, or cards. PDCs are designed to carry important information for medical, consumer, industrial, government, and military applications. The BirdBox™ also has 7 channels of high voltage/current drivers and 8 channels of comparator inputs. Users can program the BirdBox™ with Paradigm C/C++. TERN provides C libraries that allow users to access all the BirdBox™ hardware facilities. A functional block diagram is shown in Fig. 1.1.

## 1.2 Features:

- Driven by a V25-Engine™ or a C-Engine™.
- Power consumption: 130 mA normal, including VE/CE
- Low power version: 65 mA full speed, 35 mA standby
- Four RS-232 ports: two for V25 UART, two for SCC2691
- One RS-485 channel for the SCC2691 UART(on CE/VE) networking
- 12 digital outputs and 5 digital inputs at a DB25 printer port.
- Seven channels of high voltage/current drivers
- Two PDC (Portable Data Carrier) ports
- 16 characters x 2 lines LCD display
- Interrupt driven 4 x 3 keypad, beeper, LEDs
- 4.8 x 3.72 x 1.5 inch enclosure

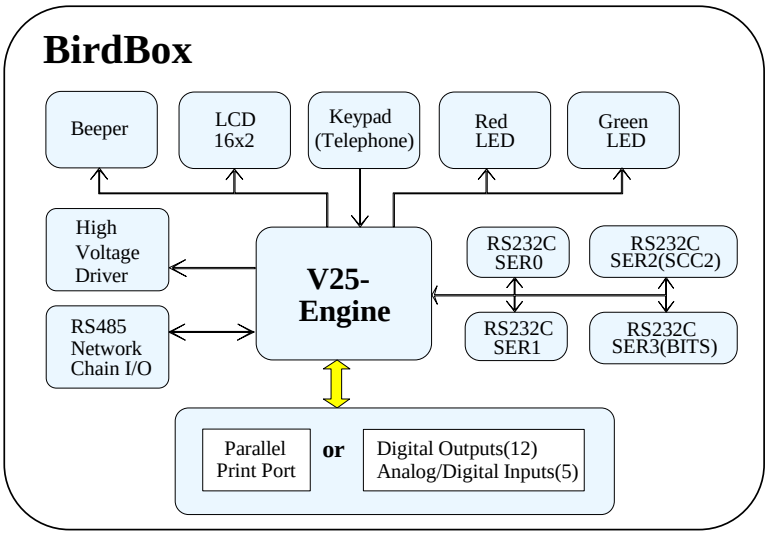



Fig. 1.1. Functional block diagram of BirdBox

## 1.3 Physical Description

Fig. 1.2 shows the physical layout of the BirdBox™. The dotted components are those at the other side of the BirdBox™ board. Table 1.1 is a summary of all the main components used in the BirdBox™. The BirdBox™ is used as an expansion board for the V5-Engine™.

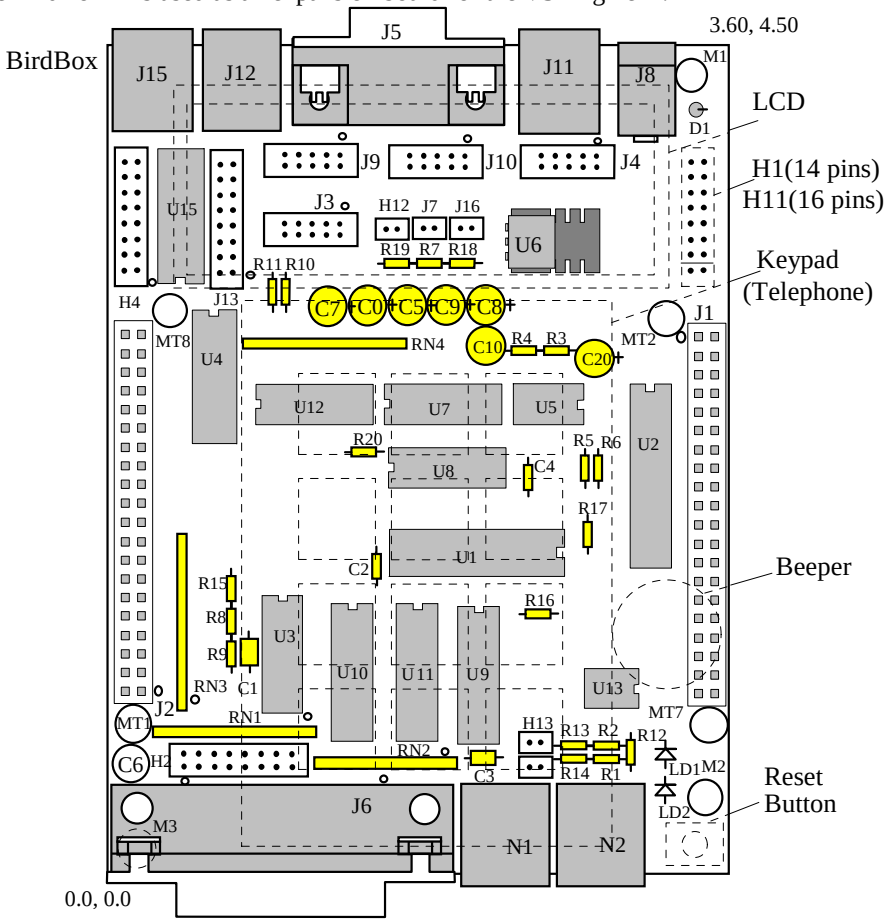



Fig. 1.2. Physical layout of BirdBox™, with dotted components at the solder side.

Table 1.1 Main Components used in BirdBox™

| Name | Description |
|---|---|
| U1 | PAL16V8 |
| U2 | SCC2691 |
| U3 | 74HC05 |
| U4 | 1489 |
| U5 | ICL7660 |
| U6 | LM7805 |
| U7 | 1488 |
| U8 | 1488 |
| U9 | 74HC259 |
| U10 | 74HC259 |
| U11 | 74HC259 |
| U12 | 1489 |
| U13 | LTC485 |
| U15 | ULN2003 |

## 1.4 Minimum Requirements

### 1.4.1 Minimum Hardware Requirements

- A BirdBox, including a V25-Engine™ with TERN EPROM (VE_0_115);
- A PC-V25™ serial cable with a DB9 connector and an IDC10 connector;
- A center negative wall transformer (+9 V, 500 mA); and
- A PC or PC compatible computer.

# Chapter 2
# Installation

## 2.1 Software Installation

Insert your TERN EV-P or DV-P CD-ROM into your CD_ROM drive. Setup will start automatically. For first time users, allow setup to use all default settings for BAUD rate and COM port selection, etc. Follow all steps to finish setup.

If Paradigm C/C++ does not launch automatically, launch it. With a properly installed EV-P or DV-P, you should see the “led.ide “ project in the project window of Paradigm C/C++ . Assuming you have all hardware installed correctly, you are now ready to download a sample program. Right mouse click on the “led.axe” node and do “build all”. Then, double-clicking on the “led.axe” node will download to a properly connected controller.

## 2.2 Hardware Installation

1. Connect the V25-Engine to the BirdBox by plugging the J2 male connector on the V25-Engine to the J2 female connector on the BirdBox, and the J1 male connector on the V25-Engine to the J1 female connector on the BirdBox. Figs. 2.1.a and 2.1.b show situations before and after plugging V25-Engine on BirdBox.

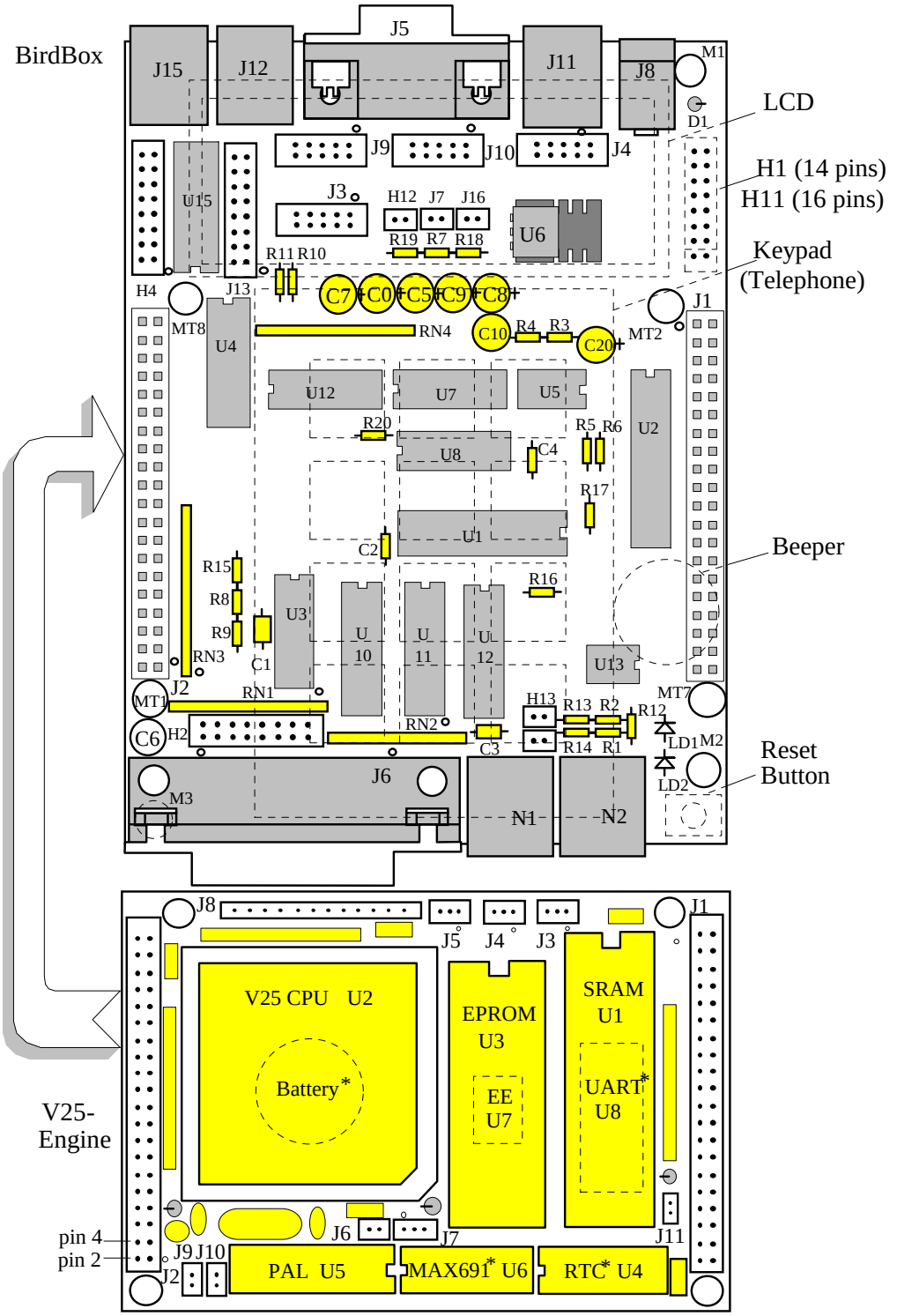



Fig. 2.1.a. Before plugging V25-Engine on BirdBox

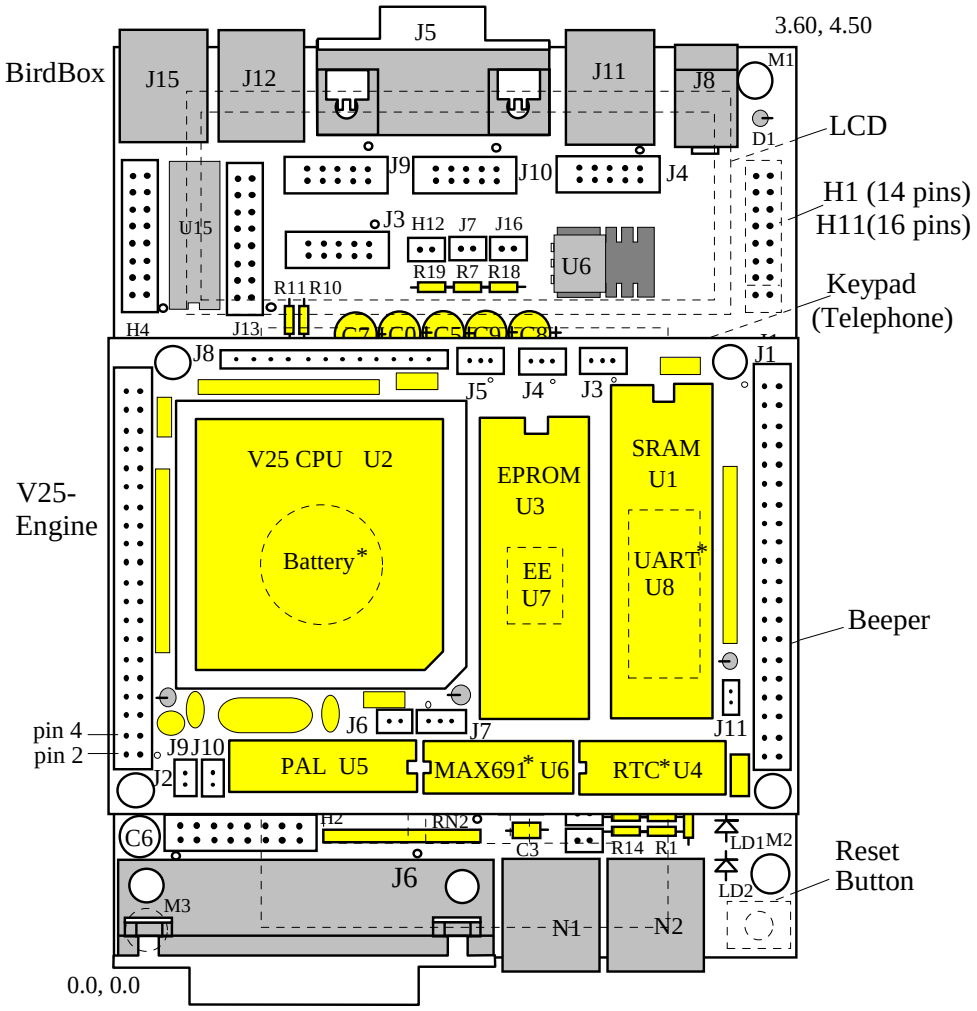



Fig. 2.1.b. After plugging V25-Engine on BirdBox

2. Plug the IDC 10-pin connector of the serial cable in J3 of BirdBox, making sure that the red side of the cable corresponds to pin 1 of J3, and connect the DB9 connector of the cable to PC serial port COM1 or COM2 (whichever COM you selected when installing TERN's EV-P or DV-P, with defalt being COM1) (Fig. 2.2).

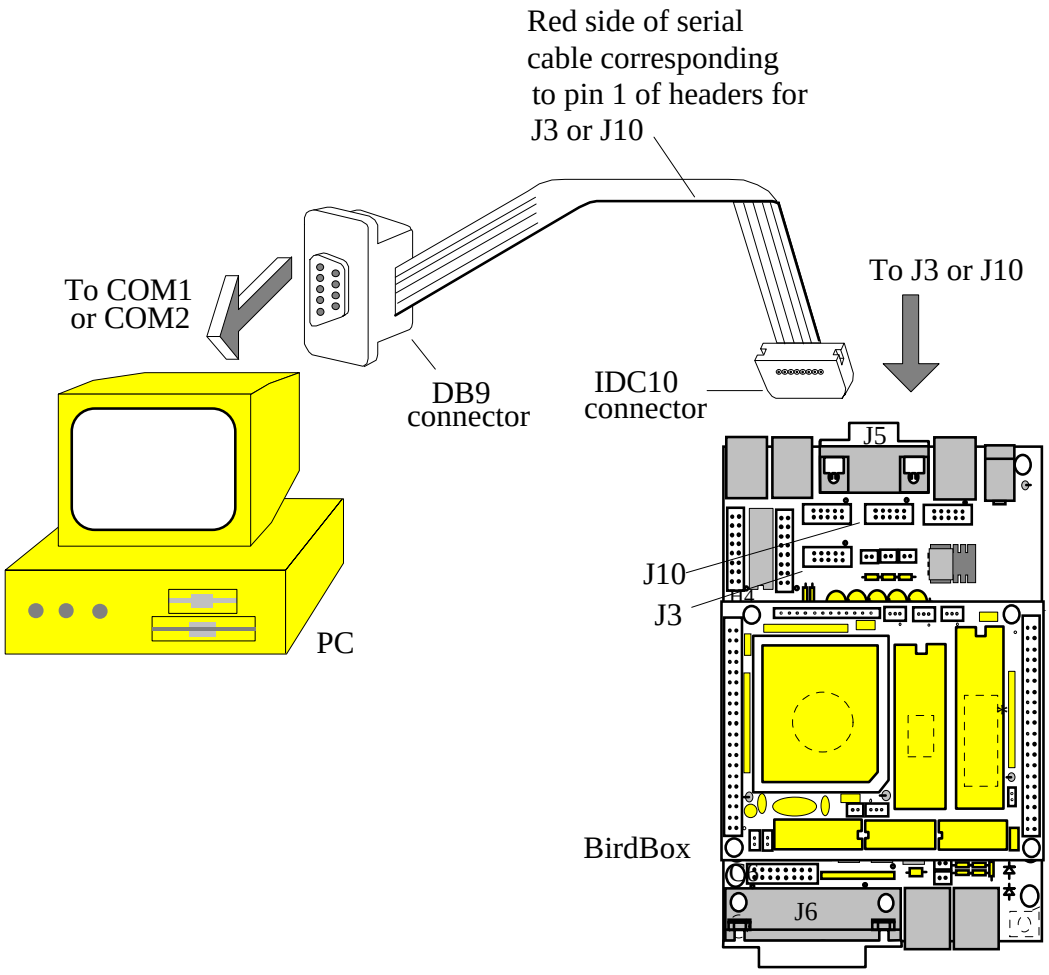



Fig. 2.2. Connection of BirdBox with the PC

3. Connect the output of the center negative wall transformer (+9V DC) to the BirdBox DC power jack J8 (Fig. 2.3).

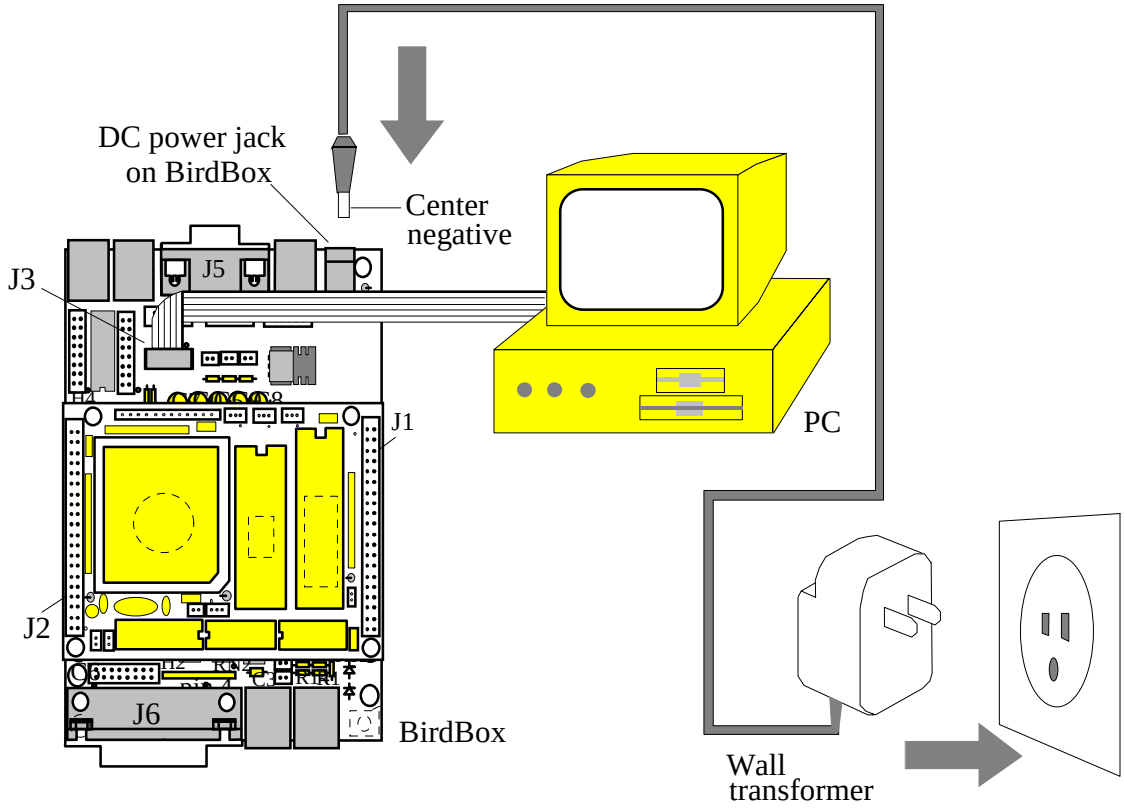



Fig. 2.3. Connection of center negative wall transformer to BirdBox

# Chapter 3
# Hardware

## 3.1 The V25-Engine

The V25-Engine is a microprocessor core module used in the BirdBox, therefore, all functions pertaining to the V25-Engine are inclueded in the BirdBox. Please refer to the V25-Engine Technical Manual for more information.

## 3.2 V25 I/O mapping

The I/O and Port T pins of V25, a CPU used in the V25-Engine, are assigned for special usage in the V25-Engine are listed below:

Table 3.1

| | | |
|---|---|---|
| P00 | OUTPUT | V25-Engine EEPROM (U7) clock SCL |
| P01 | I/O | V25-Engine EEPROM (U7) data SDA |
| P02 | INPUT | V25-Engine J2 pin4. If low, V25 runs code starting at 8000:0000 |
| P03 | OUTPUT | HWD (Hit Watch Dog) |
| P04 | INPUT | WDO (Read watchdog output), if low, watchdog time-out reset. |
| P05 | OUTPUT | V25-Engine on board LED control |
| P06 | INPUT | Keypad ROW 2 |
| P07 | OUTPUT | CLKOUT, 8 MHz, V25-Engine J1 pin4 |
| P10 | NMI | Connected to PFO (Power Failure Output) of MAX691, if J10 jumper is on. |
| P11 | INTP0 | External Interrupt Input0, falling edge effective, V25-Engine J2 pin8. |
| P12 | INTP1 | External Interrupt Input1, falling edge effective, V25-Engine J2 pin6. |
| P13 | INTP2 | External Interrupt Input2, falling edge effective, V25-Engine J2 pin33. |
| P14 | OUTPUT | RTS1 for SER1, (HV1), BirdBox |
| P15 | INPUT | CTS3 input, BB H12 on (output to HV2 H4, or TOUT on H12.1) |
| P16 | OUTPUT | RTS0 for SER0, (HV3), BirdBox |
| P17 | RDY | V25-Engine ready signal, used for more wait states |
| P20 | DR0 | V25-Engine DMA channel 0 request, active high, J2 pin30 |
| P21 | DA0 | V25-Engine DMA channel 0 Ack, active low, J9 jumper on |
| P22 | INPUT | V25-ENgine J2 pin38. If low, V25 runs code starting at 4000:0000 |
| P23 | OUTPUT | EN485 for SCC RS485 driver, if low, receiving |
| P24 | INPUT | RxD3 (or output HV4, need cut U12 pin3) |
| P25 | INPUT | Keypad ROW 3(or output HV5) |
| P26 | INPUT | Keypad ROW 1 |
| P27 | INPUT | Keypad ROW 4 |

| | | |
|---|---|---|
| PT0 | INPUT | ERR=DB25 pin 15, if jumper on H2 1-3. |
| PT1 | INPUT | SLCI=DB25 pin13, if jumper on H2 3-4. |
| PT2 | INPUT | PE = DB25 pin 12, if jumper on H2 5-6. |
| PT3 | INPUT | BSY=DB25 pin 11, if jumper on H2 7-8 |
| PT4 | INPUT | ACK=DB25 pin10, if jumper on H2 9-10 |
| PT5 | INPUT | SDA, External EEPROM data line |
| PT6 | INPUT | SDA1, External EEPROM 1 data line |
| PT7 | INPUT | V25-Engine PFI (Power Failure Input, if PFI<1.3V, reset) |

## 3.3 BirdBox I/O Map

### Table 3.2 Write External I/O Registers

| Address | Data bits | Symbol | Function |
|---|---|---|---|
| 0x20 | D0 | HI1 | Write D0 to the keypad H1=COL1 line. If D0=0, H1 is an open collector output pin, it can be pulled high or low by other device. If D0=1, H1 is low.<br>Power on or reset low. |
| 0x21 | D0 | HI2 | Write D0 to the keypad H2=COL2 line. If D0=0, H2 is an open collector output pin, it can be pulled high or low by other device. If D0=1, H2 is low.<br>Power on or reset low. |
| 0x22 | D0 | HI3 | Write D0 to the keypad H3=COL3 line. If D0=0, H3 is an open collector output pin, it can be pulled high or low by other device. If D0=1, H3 is low.<br>Power on or reset low. |
| 0x23 | D0 | BPL | Write D0 to the Beeper control line. Toggle D0 will sound the beeper.<br>If D0=0, both beeper's pin high, less power consumption.<br>Power on or reset low. |
| 0x24 | D0 | SDAB1 | Write D0 to the external EEPROM1 data line SDA1. If D0=0, SDA1is an open collector output pin, it can be pulled high or low. If D0=1, SDA1is low.<br>Power on or reset low. |
| 0x25 | D0 | SCL1 | Write D0 to the external EEPROM1 clock line SCL1.<br>If D0=0, SCL1 is low. If D0=1, SCL1 is high. Power on or reset low. |
| 0x26 | D0 | SDAB | Write D0 to the external EEPROM data line SDA. If D0=0, SDA is an open collector output pin, it can be pulled high or low. If D0=1, SDA is low.<br>Power on or reset low. |

(Table 3.2 continued)

| Address | Data bits | Symbol | Function |
|---|---|---|---|
| 0x40 | D0 | LED | Write D0 to Red LED control line. If D0=0, LED on. If D0=1, LED off.<br>Power on or reset low, LED on. |
| | | | |
| 0x41 | D0 | LED1 | Write D0 to Green LED1 control line. If D0=0, LED1 on. If D0=1, LED1 off.<br>Power on or reset low. LED1 on. |
| 0x42 | D0 | DTR1 | Write D0 to SER1 DTR1line. If D0=0, DTR1 is low. If D0=1, DTR1 is high.<br>Power on or reset low. |
| 0x43 | D0 | TxD3 | If D0=0, TxD3 is low. If D0=1, TxD3 is high. TxD3 may be used as a slow serial port data line. Power on or reset low. |
| 0x44 | D0 | SLCT | If D0=0, SLCT is low. If D0=1, SLCT is high.<br>SLCT is on printer port DB25 pin17. Power on or reset low. |
| 0x45 | D0 | INIT | If D0=0, INIT is low. If D0=1, INIT is high.<br>INIT is on the printer port DB25 pin 16. Power on or reset low. |
| 0x46 | D0 | AF | If D0=0, AF is low. If D0=1, AF is high.<br>AF is on the printer port DB25 pin 14. Power on or reset low. |
| 0x47 | D0 | STB | If D0=0, STB is low. If D0=1, STB is high.<br>STB is on the printer port DB25 pin 1. Power on or reset low. |
| 0x60 | D0 | P7 | If D0=0, P7 is low. If D0=1, P7 is high. P7 is the printer port data line DB25 pin 9. Power on or reset low. |
| 0x61 | D0 | P6 | If D0=0, P6 is low. If D0=1, P6 is high. P6 is the printer port data line DB25 pin 8. Power on or reset low. |
| 0x62 | D0 | P5 | If D0=0, P5 is low. If D0=1, P5 is high. P5 is the printer port data line DB25 pin 7. Power on or reset low. |
| 0x63 | D0 | P4 | If D0=0, P4 is low. If D0=1, P4 is high. P4 is the printer port data line DB25 pin 6. Power on or reset low. |
| 0x64 | D0 | P3 | If D0=0, P3 is low. If D0=1, P3 is high. P3 is the printer port data line DB25 pin 5. Power on or reset low. |
| 0x65 | D0 | P2 | If D0=0, P2 is low. If D0=1, P2 is high. P2 is the printer port data line DB25 pin 4. Power on or reset low. |
| 0x66 | D0 | P1 | If D0=0, P1 is low. If D0=1, P1 is high. P1 is the printer port data line DB25 pin 3. Power on or reset low. |
| 0x67 | D0 | P0 | If D0=0, P0 is low. If D0=1, P0 is high. P0 is the printer port data line DB25 pin 2. Power on or reset low. |

(Table 3.2 continued)

| Address | Data bits | Symbol | Function |
|---|---|---|---|
| 0x81 | D0-D7 | LCD1 | Write D0-D7 to H1 and H5 with A0 high, IOWR low, and LCD1 active high 500 ns. |
| 0xA0 | D0-D7 | LCD2 | Write D0-D7 to H1 and H5 with A0 low, IOWR low, and LCD2 active high 500 ns. |
| 0xA1 | D0-D7 | LCD2 | Write D0-D7 to H1 and H5 with A0 high, IOWR low, and LCD2 active high 500 ns. |
| 0xc0-0xc7 | D0-D7 | SCC2 | Write D0-D7 to SCC2691 (U2) registers. |

**Table 3.3 Read External I/O Registers**

| Address | Data bits | Symbol | Function |
|---|---|---|---|
| 0x80 | D0-D7 | LCD1 | Read D0-D7 from H1 and H5 with A0 low, IOWR low, and LCD1 active high 500 ns. |
| 0x81 | D0-D7 | LCD1 | Read D0-D7 from H1 and H5 with A0 high, IOWR low, and LCD1 active high 500 ns. |
| 0xA0 | D0-D7 | LCD2 | Read D0-D7 from H1 and H5 with A0 low, IOWR low, and LCD2 active high 500 ns. |
| 0xA1 | D0-D7 | LCD2 | Read D0-D7 from H1 and H5 with A0 high, IOWR low, and LCD2 active high 500 ns. |
| 0xc0-0xc7 | D0-D7 | SCC2 | Read D0-D7 from SCC2691 (U2) registers. |

## 3.4 Serial Ports

There are four RS232C serial channels and an RS485 serial channel in the BirdBox (Fig. 3.1). Two of these serial channels are SER0 and SER1, the internal UARTs in the V25 CPU. They are configured as RS232 channels. By default, SER0 will be used by Paradigm C/C++ when programming BirdBox from PC. It can talk to an external MODEM.

The third serial port is the SCC2691 UART (U8) on the V25-Engine (refer to Fig. 1.1 in V25-Engine technical manual and Fig. 3.1), with I/O address = 0xc000. This SCC is designed for the RS485 networking.

There is an additional SCC2691 UART (U2), SCC2, on BirdBox, with I/O address = 0x00c0. SCC2 is configured as an RS232 channel.

A bit stream serial communication RS232 channel is made by using P24 as RxD3 and I/O address 0x43 as TxD3. This channel exists because an extra RS232 driver is available on the BirdBox. This channel is a slow UART, and not driven by interrupts. A functional diagram of all the serial ports is shown in Fig. 3.1.

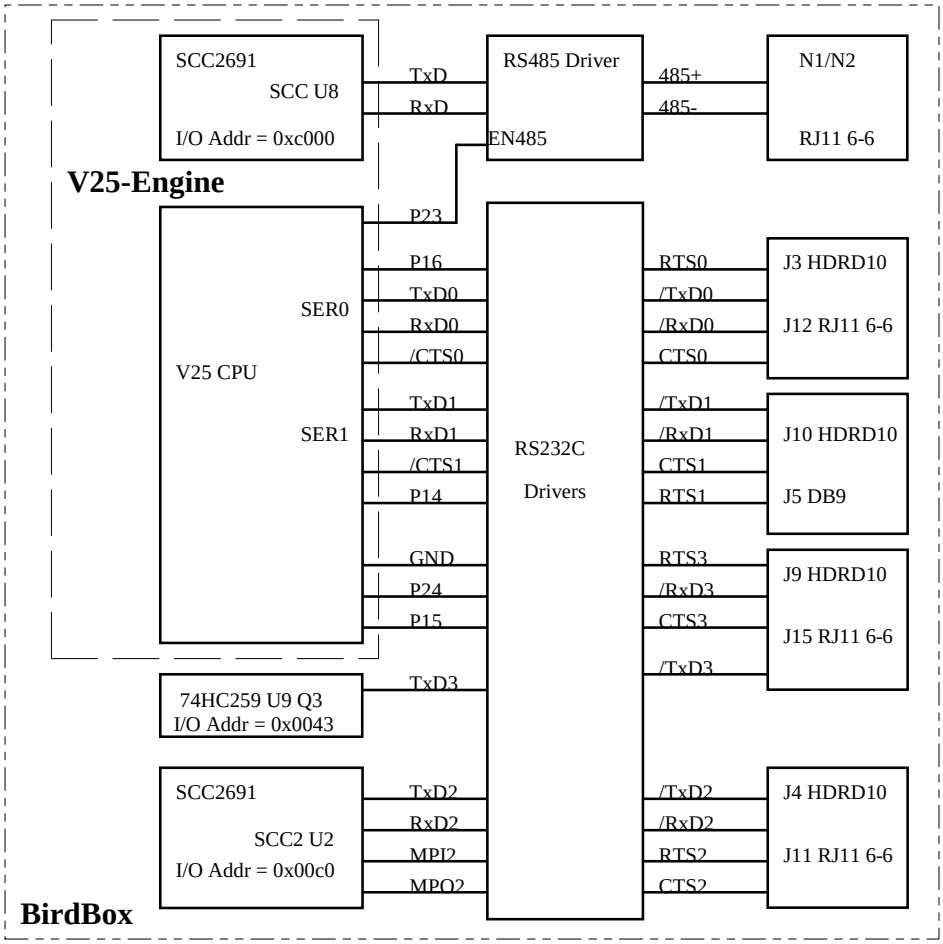



Fig. 3.1. Functional diagram of serial ports in BirdBox

### 3.5 Parallel Port

A DB25 PC-compatible parallel printer port J6 is configured by general purpose I/O pins. P0-P7 (I/O addr = 0x67-0x60), SLCT, INIT, AF, SCL are output pins. ERR, SLCI, PE, BSY, ACK are inputs to V25 PORTT 0-4. The I/O addresses are listed in the BirdBox I/O map (Tables 3.2 and 3.3).

A printer driver is available in TERN's BB.LIB. User can also use DB25 as a general purpose I/O port. All output pins are individually controllable via software. All input pins can be either analog signal inputs or digital signal inputs to the V25 PORTT. PORTT is a comparator input port which can operate as a low resolution ADC port.

### 3.6 Interrupt Driven Keypad

A telephone keypad (3 x 4) is provided for user inputs. The user first sets all the column lines H1, H2, and H3 (open collector output pins) to low, and then sets all the row lines ROW1(P26), ROW2 (P06), ROW3 (P25), and ROW4 (P27) to the input mode. These row lines are pulled high by 10K resisters. If INTP2, a V25 external interrupt, is enabled, any key being pressed will generate an interrupt. The interrupt handler is intp2_interrupt_isr. The user can call bb_kb_scan() to find out which key has been pressed down, then take the corresponding action. The keypad matrix is shown in Fig. 3.2.

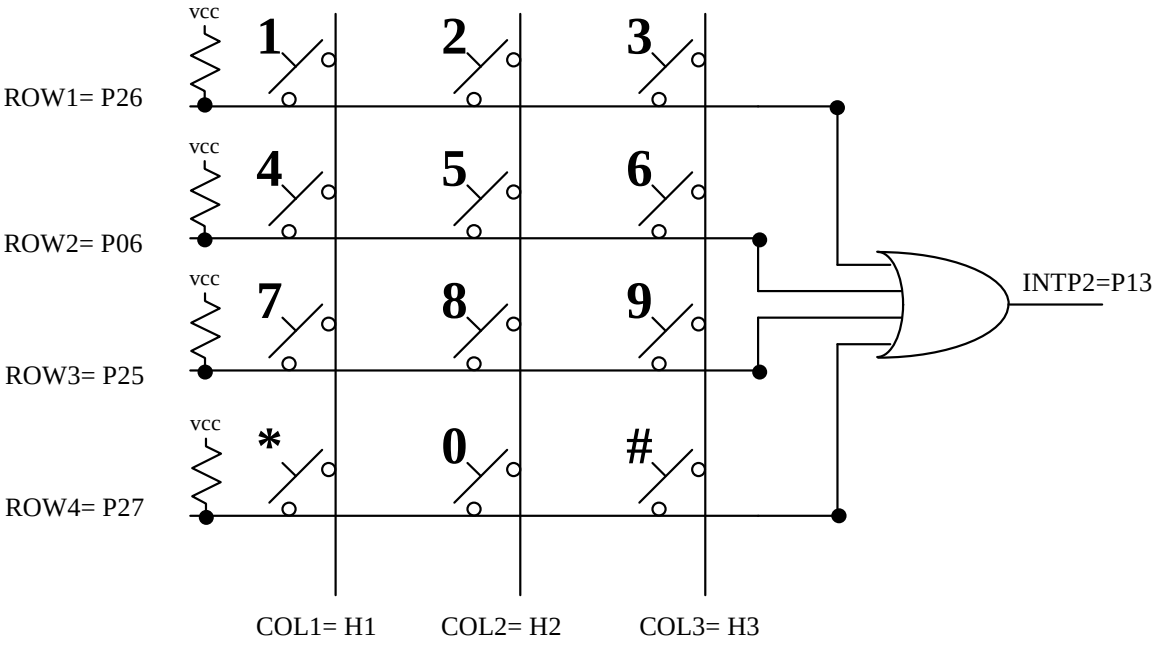



Fig. 3.2. Keypad matrix

### 3.7 LCD display

A Seiko M1632 16x2 LCD character module is directly mounted in H1 (14 pins, on the LCD side of BirdBox, Fig. 2.1) and it fits the current enclosure. A Seiko L2014 20x4 LCD character module may be used with H5 (a header perpendicular with H1). A Seiko M4024 40x4 LCD character module may be used with H11 (16 pins, shared the

space with H1, Fig. 2.1), but needs a bigger enclosure. VLC, the voltage driving LCD, is provided by a resistor divider (R3 and R4) in the range of -12V to GND.

### 3.8 RS485 Networking

N1 and N2 are phone jack connectors (6x6), the same pin out RJ11. They are designed for using SCC RS485 networking. N1 is used as network cable chain in, and N2 the chain out. In addition to 485+ and 485- signals, the RS485 network cable also has +12V, GND, and /RST signals.

SCC2691 is a single-chip UART (Universal Asynchronous Receiver/Transmitter, Philips Semiconductors). SCC2691 is mapped in I/O address of 0xc000. A special mode of SCC2691 is using Address or Data bit in additional to the normal data frame. The V25-Engine uses the special mode of this SCC2691 for networking, which provides automatic wake-up of the receiver through address frame recognition for multi-processor communications.

Only the master V25-Engine sends out a destination address byte. All slaves only respond to the address byte, not data byte, even the receiver is disabled. If the node address of the destination node matches the address byte, this node will be waked up and will communicate with the master.

The default message length = 128 bytes. The mail box inbox [0-127], and outbox [0-127] must be initialized before network operation. The node address is in EEPROM byte 0. Node 0 is the master.

A network module is included in BB.LIB. The master processor V25-Engine may use the following functions:

```
master_nt_init(char* in_buf, int isize, char* out_buf, int osize,COM *c);

unsigned char master_mail
(unsigned char* inbox, unsigned char* outbox, unsigned char node, char mdir, COM *c);
```

The slave nodes of the other V25-Engines may use:

```
slave_nt_init(char* in_buf, int isize, char* out_buf, int osize,  COM *c); and

unsigned char slave_mail
(unsigned char* inbox, unsigned char* outbox, unsigned char node, COM *c).
```

## 3.9 ADC

V25 PORTT is an 8-bit comparator input port whose threshold voltage can be changed in 16 steps by software. VTH has been pulled up with a 10 K resistor on the V25-Engine. VTH is also connected through a resistor to the GND inside the V25 chip. Approximately 3.6V is on the VTH pin. User can set the VTH1, a pin on H2 of BirdBox which connects to VTH of PORTT by a jumper on H2 pin 15-16, to a fixed voltage level by using the resistor divider of R8 and R9. If the user provides a variable voltage on VTH1. Higher resolution can be obtained for measuring the analog input voltage at PT0-PT7. PT7 is used by the V25-Engine for monitoring the PFI (Power Failure Input) voltage level. PT0-4 can be accessed via the DB25 connector. PT5 and PT6 can be accessed via SDA and SDA1 pin at J12 and J15. PT5 and PT6 can be used by external PDCs (Personal Data Carriers). PT0-4 are shared with the DB25 printer port.

## 3.10 High Voltage/Current Driver

The ULN2003, (U15) on the BirdBox, is a high voltage/current Darlinton transistor array. It can handle 50-100V, 300 mA each pin. User must be aware that the input pins of the high voltage driver are shared with other functions. When using the high voltage driver, those functions should not be used. The following are functions that share with the high voltage driver:

Table 3.4 Functions Shared with the High Voltage Driver

| Pin Name | High Voltage Driver | Other Functions |
|---|---|---|
| P14 | HV1 | RTS1 for SER1 |
| P15 | HV2 | CTS3 for RS232C (BITS) |
| P16 | HV3 | RTS0 for SER0 |
| P24 | HV4 | RxD3 for RS232C (BITS) |
| P25 | HV5 | ROW3 on keypad |
| U9 Q2 | HV6 | DTR1 |
| U9 Q3 | HV7 | TxD3 |

The high voltage driver output pins HV1-HV7 are available at H4. The K pin of the high voltage driver (ULN2003) must be connected to the highest voltage level in the system in order to protect voltage surge for inductive load.

## 3.11 Portable Data Carrier Interface

Two PDCs (Portable Data Carriers, or portable EEPROMs, up to 8K bytes each) can be accomodated by the BirdBox. PDC1 uses phone jack J12, when jumpers are on

for J13 pins 1-2, 3-4, 5-6, and 7-8. PDC2 uses phone jack J15, when jumpers are on for J13 pins 9-10, 11-12, 13-14, and 15-16. If the jumpers are off from J13, and on for J3, J12 can be used as a connector for SER0.

### 3.12 LED indicator

Three LED indicators are used on BirdBox. One of them is on V25-Engine, indicating system resetting, and the other two are on the LCD side of BirdBox, green and red, respectively.

### 3.13 Reset Push-Button and DC Power Supply

A reset push-button is mounted on the LCD side of BirdBox. DC power supply (+9V, 500 mA)is using certer negative cord.

### 3.14 Enclosure

The BirdBox enclosure (optional) is shown below (Figs. 3.3-3.8). Material used is anodized sheet aluminum, with maximum sheet thickness = 0.05 inch.

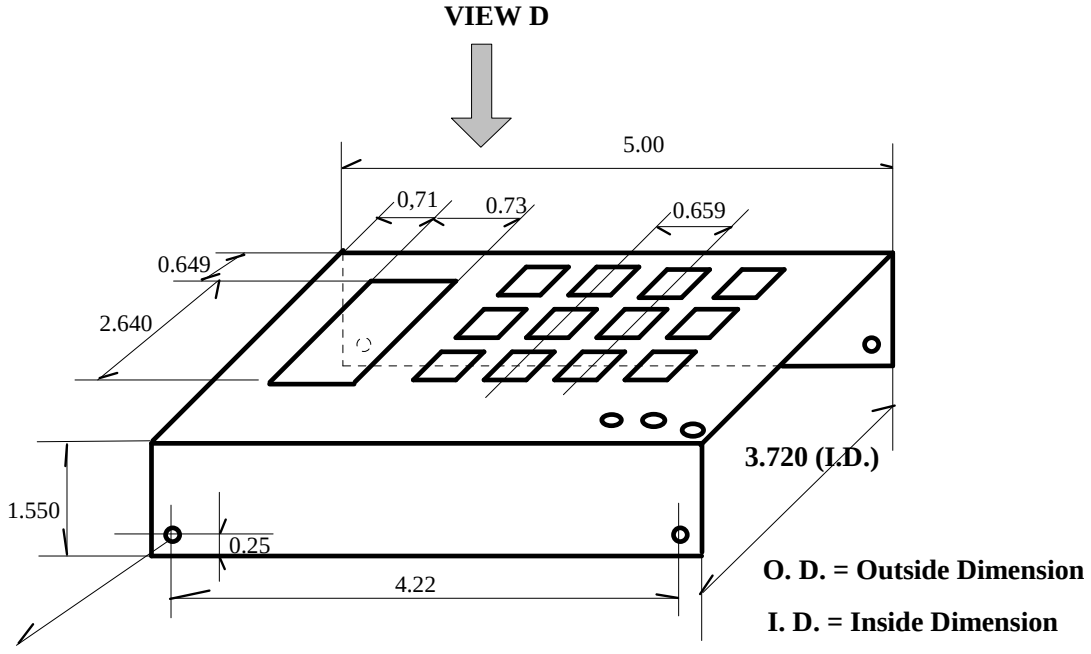



Fig. 3.3. Upper half of the enclosure

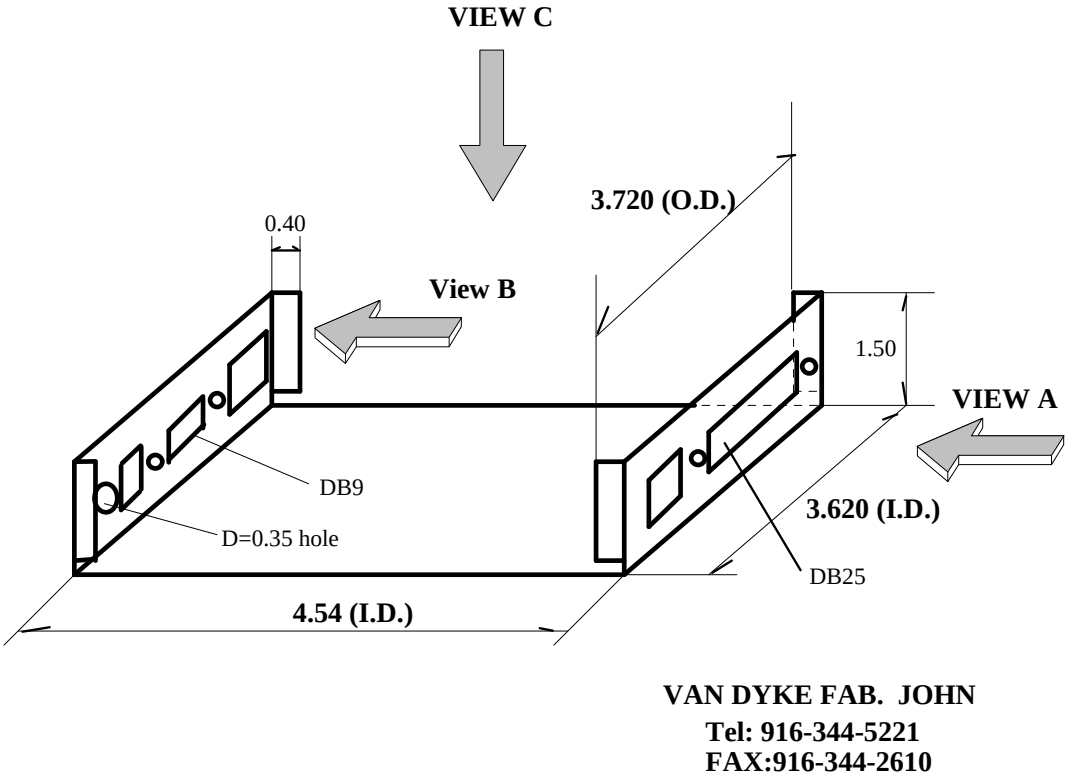



Fig. 3.4. Lower half of the enclosure

View D dimension:

**VIEW D**

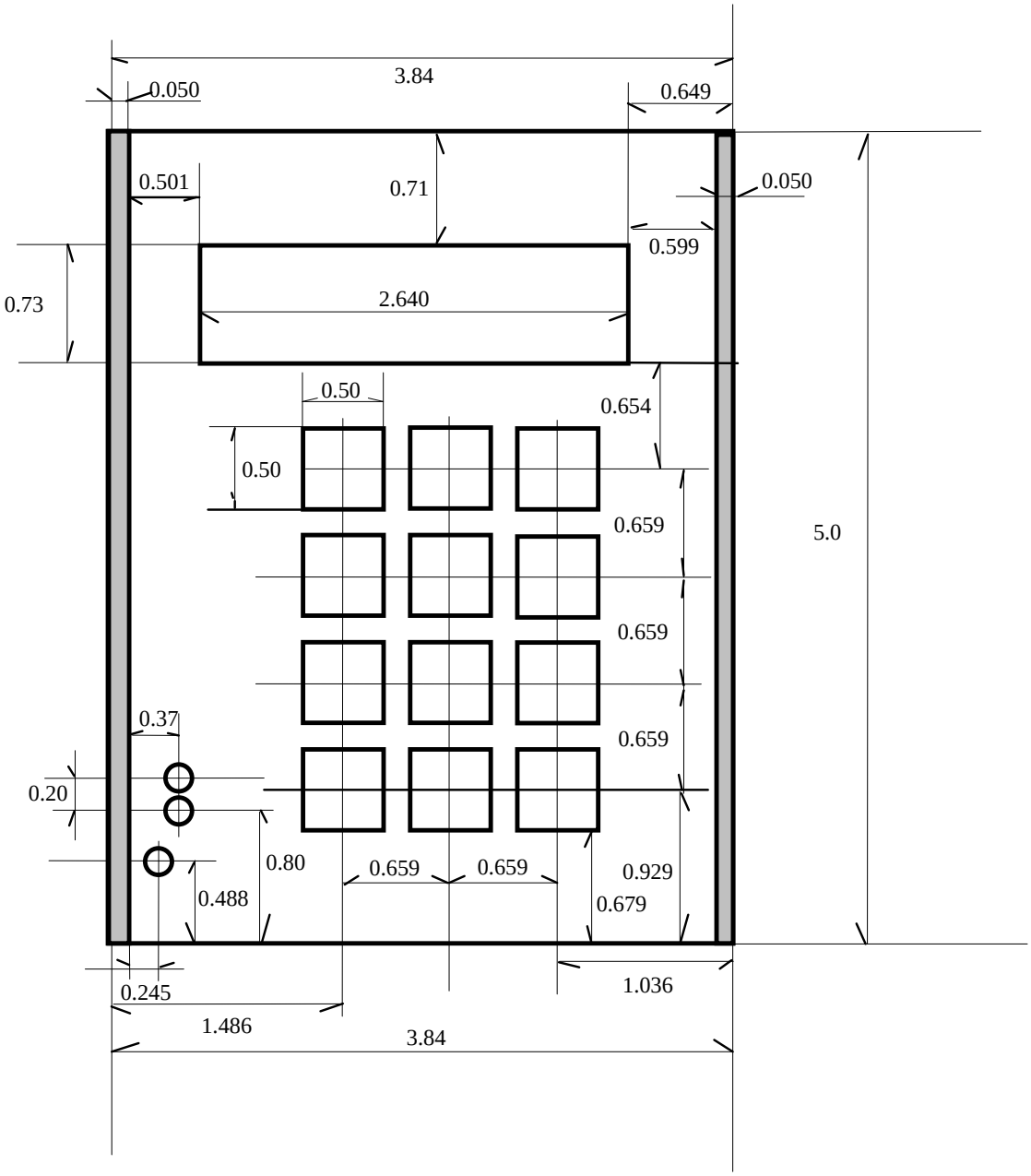



Fig. 3.5. View D of the enclosure

View C dimension:

**VIEW C**

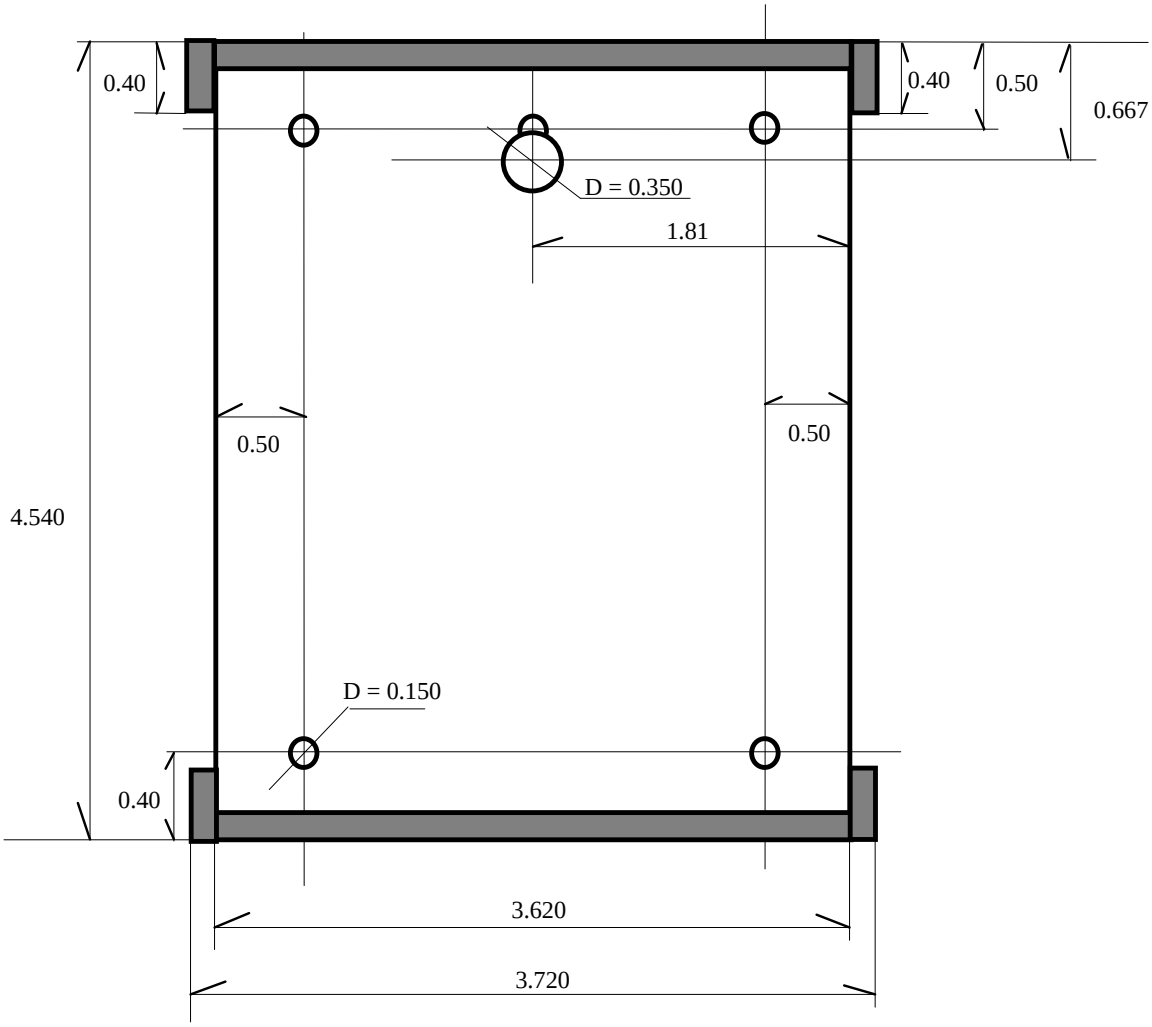



Fig. 3.6. View C of the enclosure

Side view A dimension:

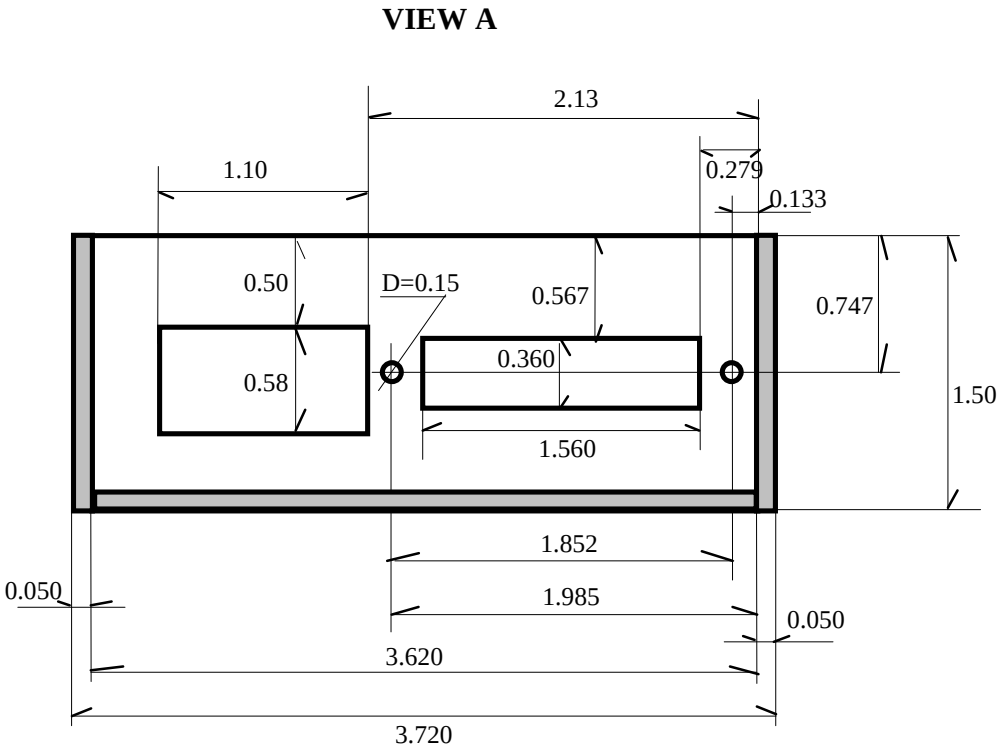



Fig. 3.7. Side view A of the enclosure

Side view B dimension:

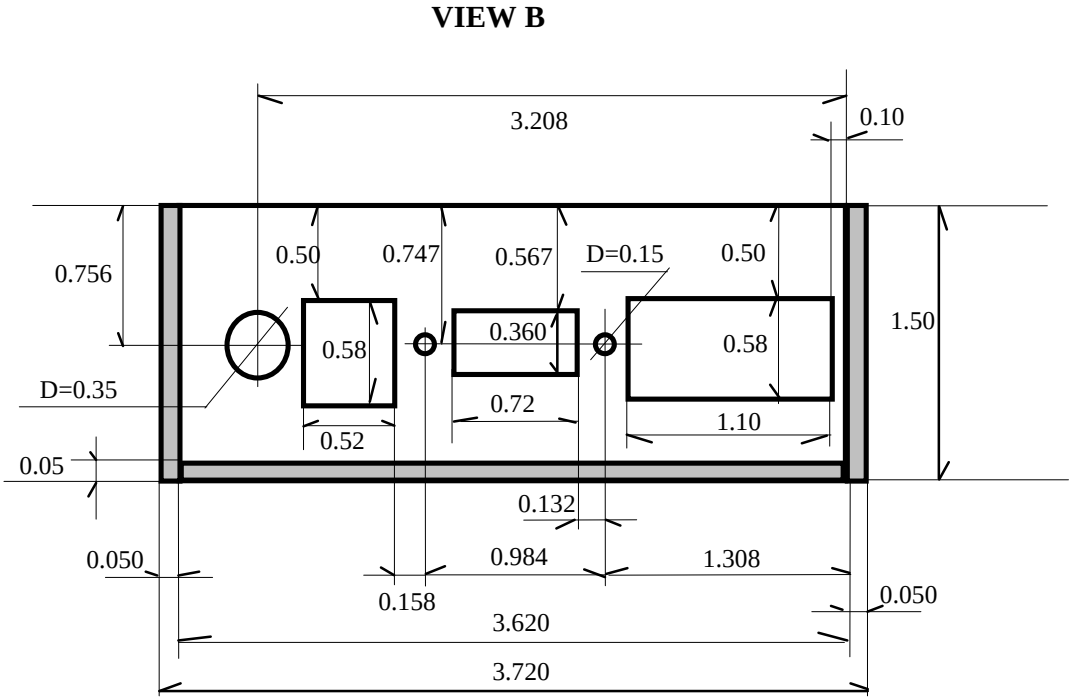



Fig. 3.8. Side view B of the enclosure

## 3.15 Jumpers and Headers

**Table 3.5 Jumpers and Headers Used in the Birdbox**

| | | |
|---|---|---|
| J1, J2 | 20x2 | V25-Engine |
| J3 | 5x2 | SER0 or PDC1(Key1, SDA1) |
| J4 | 5x2 | SCC2 |
| J5 | DB9 | SER1 |
| J6 | DB25 | Parallel printer port |
| J7 | 2x1 | Power Battery |
| J8 | DJ005 | +9V DC power jack |
| J9 | 5x2 | SER3 or PDC(Key, SDA) |
| J10 | 5x2 | SER1 |
| J11 | RJ11 6-6 | SCC2 |
| J12 | RJ11 6-6 | SER0 or PDC1 |
| J13 | 8x2 | PDC1 to J12, if 1-2, 3-4, 5-6, 7-8 connected<br>PDC to J15, if 9-10, 11-12, 13-14, 15-16 connected |
| J14 | | |
| J15 | RJ11 6-6 | SER3 or PDC |
| J16 | 2x1 | +12V to +V |
| | | |
| H1+H1 1 | 8x2 | LCD1 and LCD2 for M1632 16x2 CH /M4024 40x4 |
| H2 | 8x2 | PORTT input |
| H4 | 8x2 | High voltage driver output |
| H5 | 14x1 | LCD1 for L2014 20x4 CH |
| H12 | 2x1 | CTS3 to P15, if jumper on |
| H13 | 2x2 | 1-2 network power input +VI=+12VI<br>3-4 network remote reset /RT=/RST |
| N1 | RJ11 6-6 | RS485 Network Chain IN |
| N2 | RJ11 6-6 | RS485 Network Chain OUT |

## 3.16 MODEM Interface

The SER1 serial channel of the BirdBox has two connectors, one is J10, and the other, J5, a DB9 connector, is configured as a DTE device. This connector is compatible with a PC-AT DB9 serial port. A cable connecting the DB9 of BirdBox and a DB25 connector of an external MODEM (RS232C) can be constructed as shown in Fig. 3.9:

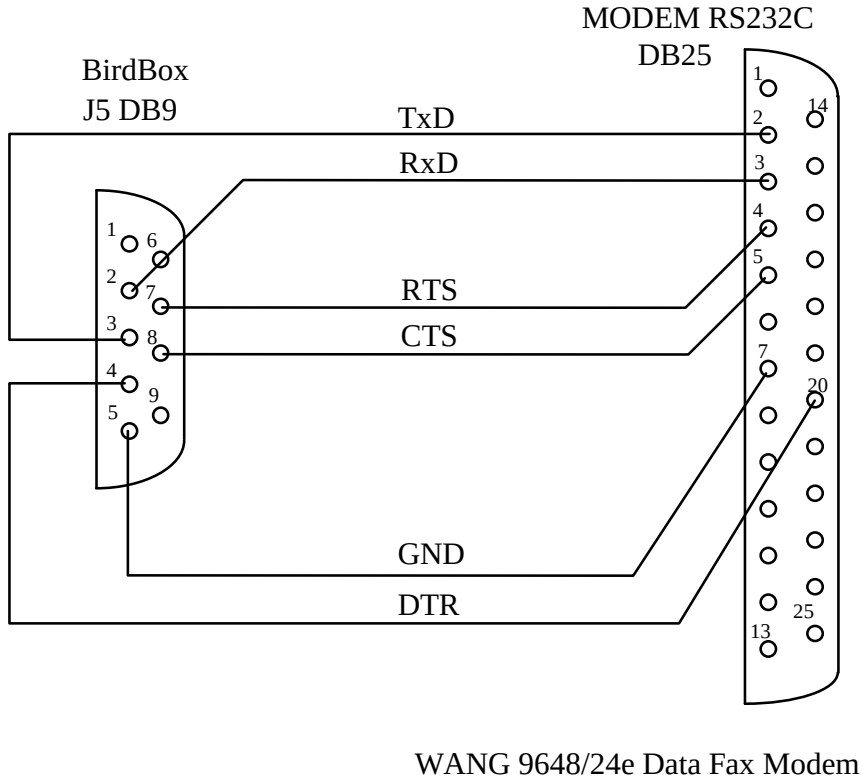



Fig. 3.9. Connection between BirdBox J5 DB9 and MODEM RS232C DB25

# Chapter 4
# Software

**4.1 Programming the BirdBox™ with C/C++**

Since the BirdBox™ is only an I/O expansion board driven by a V25-Engine™ or a C-Engine™. Please refer to the V25-Engine Technical Manual for more details.

**4.2 Modules in the BB.LIB Library**

TERN provides BB.LIB, in addition to the libraries with the V25-Engine™. The BB.LIB has two modules, BB.OBJ and SCC22.OBJ:

| Module Name | Include-File Name | Description |
|---|---|---|
| BB.OBJ | dos.h, stdio.h, string.h, ve.h, bb.h | module including functions regarding keypad, PDCs, high voltage/current drivers, printer port, beeper, LEDs |
| SCC22.OBJ | dos.h, stdio.h, string.h, ve.h, scc22.h | module including functions regarding UART SCC22 on the BirdBox™ |

LCD functions are listed in the V25-Engine™ Technical Manual

**4.3 Functions in BB.OBJ Module**

| Name | Description |
|---|---|
| int bb_kb_scan(void); | scan keypad to identify which key is pressed |

**4.3.2 PDC Functions**

| | |
|---|---|
| int bb_ee_wr(int addr, unsigned char i); | random write a character to an address of EEPROM, PDC0 |
| unsigned char bb_ee_rd(int); | random read a character from an address of EEPROM, PDC0 |
| int bb_ee1_wr(int addr, unsigned char i); | random write a character to an address of EEPROM, PDC1 |
| unsigned char bb_ee1_rd(int); | random read a character from an address of EEPROM, PDC1 |

**4.3.3 LED Function**

| | |
|---|---|
| void bb_led(char n, char i ); | turn on red LED if n = 0, i = 1<br>turn off if n = 0, i = 0<br>turn on green LED if n = 1, i = 1<br>turn off if n = 1, i = 0 |

**4.3.4 Beeper Function**

| | |
|---|---|
| void bb_beep(int t, int delay); | beep the beeper for time length = t<br>with frequency = 1/(2*delay*unit) |

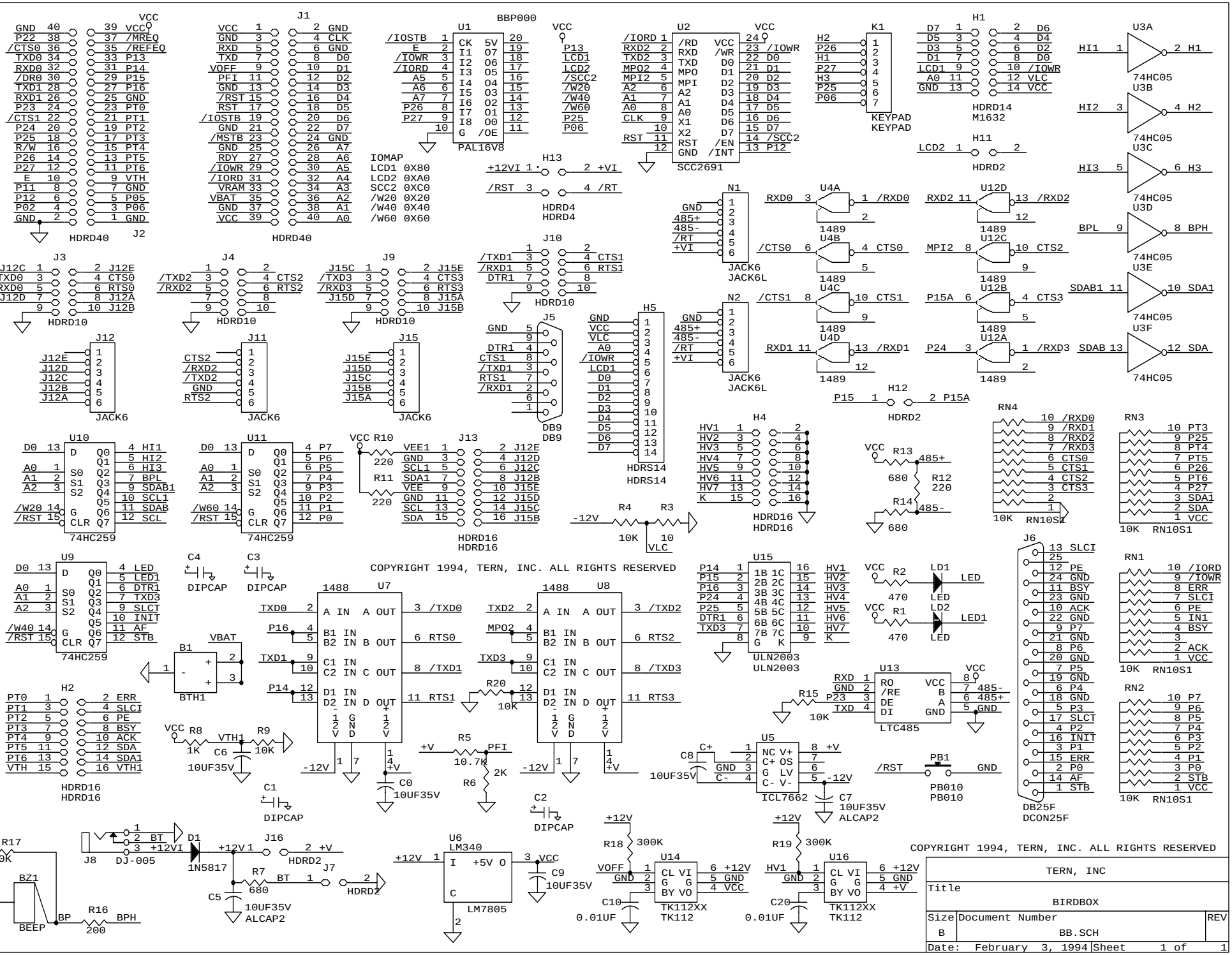
**4.4 SCC2.OBJ**

void **scc2_init**(char m, char b, char* ibuf, int isiz, char* obuf, int osiz, COM *c);

initialize SCC2 serial port, where: m = mode, b = Baud rate
ibuf = pointer to input buffer
isiz = size of input data buffer

obuf = pointer to output buffer
osiz = size of output data buffer
c = serial data structure, COM
baud - baud rate expressed in units of 1200 baud. (8 == 9600 baud )
baud: 1=1200,2=2400,4=4800,8=9600,16=19200,104=125000,208=250000
mode - 8 bit, 1 stop, no parity, Special mode for Networking, see SCC2691 data sheet

void **scc2_close**(COM *c); Close serial port SCC2
void **clean_ser_scc2**(COM *c); Flush input buffer of SCC2
unsigned char **getser_scc2**(COM *c); get a character from input buffer of SCC2
int **getsers_scc2**(COM *c, int len, unsigned char *str);
get a string from input buffer, where: c = serial data structure, COM, see ve.h
len = max length of input buffer
str = pointer to a buffer for storing the string
return number of characters read or -1 if abort
int **putser_scc2**(unsigned char outch, COM *c);
put a character to the output buffer, return 1, if character output. return 0, if output buffer full
int **putsers_scc2**( unsigned char *str, COM *c);
output a string to output buffer, where str = pointer to the string being output
c = serial data structure, COM
return 1, if character output, return 0, if output buffer full
unsigned char **scc2_rch**void); Receive a character from SCC2 port
void **scc2_sch**(unsigned char dat); Send a character out of SCC2 port
int **serhit_scc2**(COM *c); Check if SCC2 has received anything, return 1, if any, return 0, if nothing
void **scc2_send_e**(void); Enable transmit interrupt for SCC2
void **scc2_rec_e**(void); Enable receive interrupt for SCC2
void **scc2_addr**(unsigned char ad, COM *c); Set SCC2 in the special wakeup mode. where
if ad = 1, set address-byte mode if ad = 0, set data-byte mode
void interrupt far **scc2_s_isr**(void); Interrupt service routine for sending a character to the network
void interrupt far **scc2_r_isr**(void); Interrupt service routine for receiving a character from the network
void interrupt far **scc2_err_isr**(void); Interrupt service routine for error processing


J2
HDRD40
J1
HDRD40
IOMAP
LCD1 0X80
LCD2 0XA0
SCC2 0XC0
/W20 0X20
/W40 0X40
/W60 0X60
U1
BBP000
PAL16V8
U2
SCC2691
K1
KEYPAD
KEYPAD
H1
HDRD14
M1632
H11
HDRD2
U3A
U3B
U3C
U3D
U3E
U3F
74HC05
H13
HDRD4
HDRD4
J10
HDRD10
N1
JACK6
JACK6L
U4A
U4B
U4C
U4D
U12A
U12B
U12C
U12D
1489
J3
HDRD10
J4
HDRD10
J9
HDRD10
J12
JACK6
J11
JACK6
J15
JACK6
J5
DB9
DB9
H5
HDRS14
HDRS14
N2
JACK6
JACK6L
H12
HDRD2
H4
HDRD16
HDRD16
U10
74HC259
U11
74HC259
R10
R11
J13
HDRD16
HDRD16
R4
R3
10K
VLC
RN4
10K RN10S1
RN3
10K RN10S1
U9
74HC259
C4
DIPCAP
C3
DIPCAP
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U7
1488
U8
1488
B1
BTH1
VBAT
U15
ULN2003
ULN2003
R2
R1
LD1
LD2
LED
470
J6
DB25F
DCON25F
RN1
10K RN10S1
RN2
10K RN10S1
H2
HDRD16
HDRD16
R8
VTH1
R9
1K
C6
10K
10UF35V
C1
DIPCAP
C0
10UF35V
R5
10.7K
PFI
R6
2K
C2
DIPCAP
R20
10K
U13
LTC485
R15
10K
U5
ICL7662
C8
10UF35V
C7
10UF35V
ALCAP2
/RST
PB1
PB010
PB010
R17
20K
BZ1
BEEP
R16
200
J8
DJ-005
D1
1N5817
J16
HDRD2
R7
680
C5
10UF35V
ALCAP2
J7
HDRD2
U6
LM340
LM7805
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10UF35V
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R19
300K
U14
TK112XX
TK112
U16
TK112XX
TK112
C10
0.01UF
C20
0.01UF
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