Intellicom

Models OP6600 and OP6700

User's Manual

019–0078 • 020331–C

Intellicom User's Manual

Part Number 019-0078 • 020331–C • Printed in U.S.A.

Trademarks

Rabbit 2000 is a trademark of Rabbit Semiconductor.

Dynamic C is a registered trademark of Z-World Inc.

Z-World, Inc.

2900 Spafford Street
Davis, California 95616-6800
USA

Telephone: (530) 757-3737
Fax: (530) 753-5141

www.zworld.com

TABLE OF CONTENTS

1. INTRODUCTION

The Intellicom intelligent terminal interface is a high-performance, C-programmable terminal that offers built-in I/O and Ethernet connectivity. A Rabbit 2000 microprocessor operating at 18.5 MHz provides fast data processing.

1.1 Features

- C-programmable to create a custom user interface
- 4 protected logic-level digital inputs
- 4 protected sinking digital outputs
- High-visibility backlit 4 × 20 LCD
- 10BaseT Ethernet interface
- TCP/IP capability
- RS-232 and RS-485 serial ports
- 128K SRAM and 256K–512K flash EPROM
- Self-healing lens is scratch, impact, and abrasion-resistant
- Real-time clock
- Watchdog supervisor
- Voltage regulator
- Backup battery
- Can be programmed to emulate a serial terminal
- Water-resistant when panel-mounted using the supplied gasket
- Can be wall-mounted or panel-mounted

Appendix A provides detailed specifications for the Intellicom.

Two versions of the Intellicom are available. Their standard features are summarized in Table 1.

Table 1. Intellicom Series Features

Model	Features
OP6600	Standard terminal *without* Ethernet interface and only 256K flash EPROM.
OP6700	Full-featured terminal *with* Ethernet interface and 512K flash EPROM.

Both models are available with a vacuum fluorescent display instead of the LCD.

1.2 Development and Evaluation Tools

1.2.1 Tool Kit

The Tool Kit has the essentials that you need to understand and program your own Rabbit-based display unit.

The items in the Tool Kit and their use are as follows:

- ***Intellicom User's Manual*** with schematics.
- Demonstration Board. The Demonstration Board includes pushbutton switches and LEDs, and can be connected to the Intellicom board. Programs that run on the Demonstration Board can be used to flash the LEDs and otherwise demonstrate the capabilities of the Intellicom terminal.
- Programming cable. The programming cable is used to connect your PC serial port to the Intellicom to write and debug C programs that run on the Intellicom board.
- Wire assembly to connect Intellicom board to Demonstration Board.
- Screwdriver.
- AC adapter. The AC adapter is used to power the Intellicom board. The wall transformer is supplied only for Development Kits sold in the North American market. A power supply of 12 V at up to 500 mA is recommended. The Intellicom can also be powered from any DC voltage source between 9.0 V and 40 V.

1.2.2 Software

The Intellicom terminal is programmed using Z-World's Dynamic C Premier, an integrated development environment that includes an editor, a C compiler, and a debugger. Library functions provide an easy-to-use interface for the Intellicom board. Software drivers for TCP/IP, I/O, keypad, LCD, speaker, and serial communication are included with Dynamic C Premier.

The programming cable has a level converter board in the middle of the cable since the Intellicom programming port supports CMOS logic levels, and not the higher voltage RS-232 levels that are used by PC serial ports. When the programming cable is connected,

Dynamic C running on the PC can hard-reset the Intellicom board and cold-boot it. The cold boot includes compiling and downloading a BIOS program that stays resident while you work. If you crash the target, Dynamic C will automatically reboot and recompile the BIOS if it senses that a target communication error occurred or that the BIOS source code has changed.

You have a choice of doing your software development in the flash memory or in the static RAM included on the Intellicom board. The advantage of working in RAM is to save wear on the flash, which is limited to about 100,000 writes.

> **NOTE:** Note that an application can be developed in RAM, but cannot run standalone from RAM after the programming cable is disconnected. All standalone applications can only run from flash.

The disadvantage of using flash is that interrupts must be disabled for approximately 5 ms whenever a break point is set in the program. This can crash fast interrupt routines that are running while you stop at a break point or single-step the program. Flash or RAM is selected on the **Options** > **Compiler** menu.

Dynamic C Premier provides a number of debugging features. You can single-step your program, either in C, statement by statement, or in assembly language, instruction by instruction. You can set break points, where the program will stop, on any statement. You can evaluate watch expressions. A watch expression is any C expression that can be evaluated in the context of the program. If the program is at a break point, a watch expression can view any expression using local or external variables. If the program is running and a call to the debugger is included in the user's code (`runwatch();`), it is possible to evaluate watch expressions using global variables only while the target program continues to run, slowed down only by the need to refresh a display in response to a **<Ctrl-U>** command.

2. GETTING STARTED

Chapter 2 explains how to connect the power supply to the Intellicom board and how to connect the programming cable from the Intellicom board to your PC. Once you run a sample program to demonstrate that you have connected everything correctly, you will be ready to go on and finish developing your system.

2.1 Power Supply Connections

1. Remove and set aside outer casing and rubber gasket.

Before proceeding, remove and set aside the outer casing, rubber gasket, screws, and panel-mount brackets included with your Intellicom unit, shown in Figure 1. The outer casing and rubber gasket are not attached to the front panel when the Intellicom is shipped. Take care not to damage the rubber gasket.

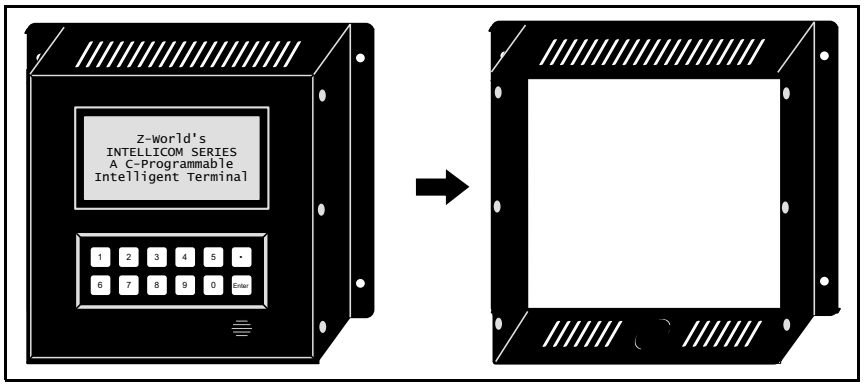


Figure 1. Remove and Set Aside Outer Casing and Accessory Parts

2. Position Intellicom board.

The Intellicom board is attached to the back of the front panel. Turn the front panel assembly over so that the Intellicom board is facing up as shown in Figure 2.

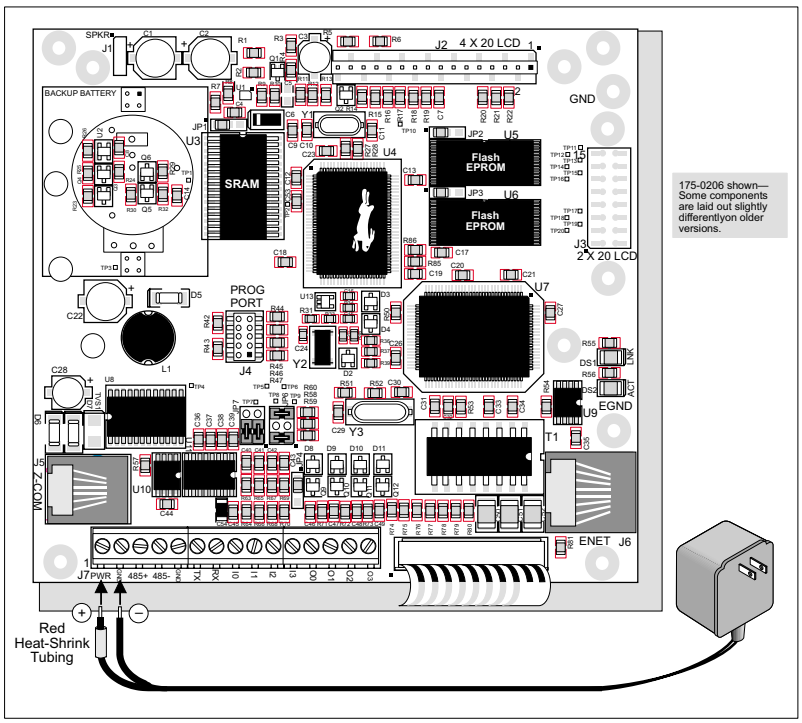


Figure 2. Power Supply Connections

3. Connect Power Supply to the Intellicom Board.

Connect the positive lead (indicated with red heat-shrink tubing on the AC adapter included with the Tool Kit) to the PWR connector on header J7 on the Intellicom Board and connect the negative lead to GND on header J7 as shown in Figure 2 and Figure 3.

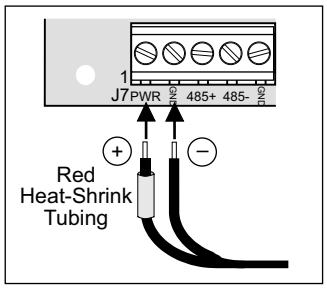


Figure 3. Power Supply Connections—Detailed View

NOTE: Be careful to hook up the positive and negative power leads ***exactly*** as described. Otherwise, the Intellicom board will not function.

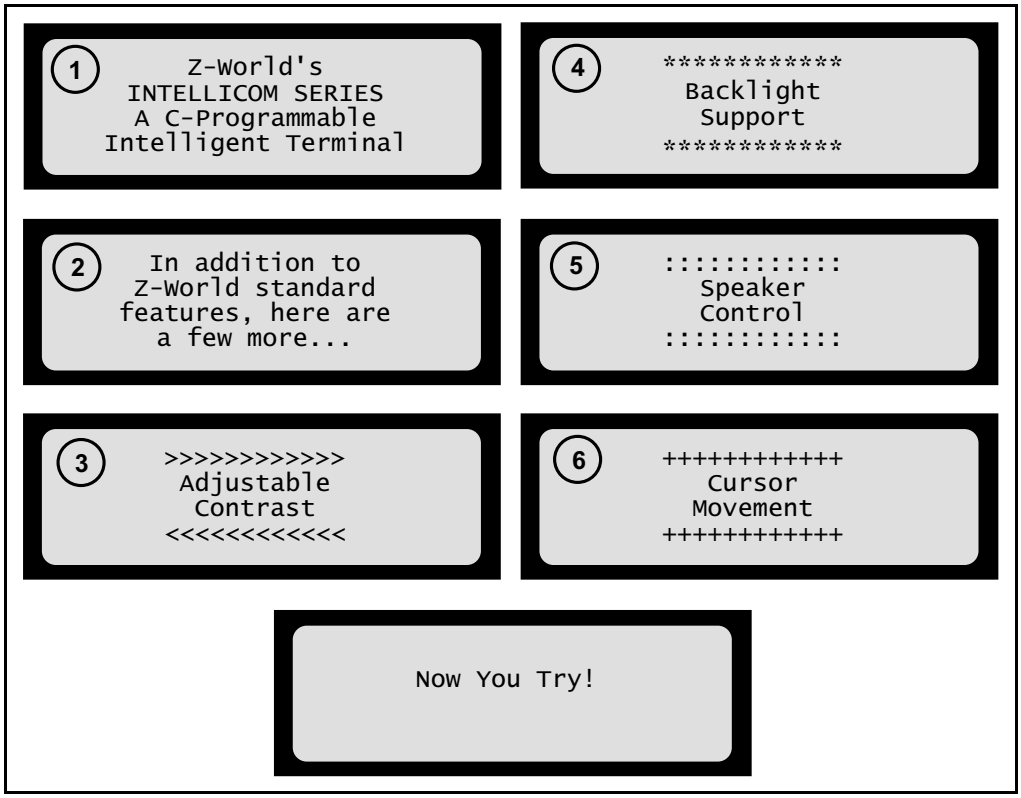
4. Apply power.

Plug in the AC adapter. The Intellicom board is now ready to be used.

NOTE: A hardware RESET is accomplished by unplugging the AC adapter, then plugging it back in.

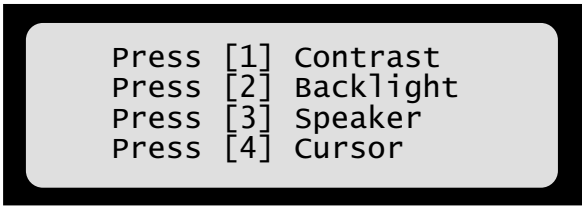
2.2 Demonstration Program on Power-Up

The following sequence of messages will be displayed on the LCD when power is first applied to the Intellicom board. Note that the programming cable must ***not*** be connected.

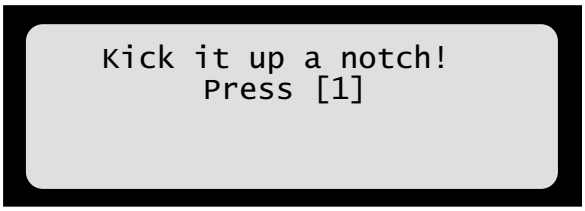


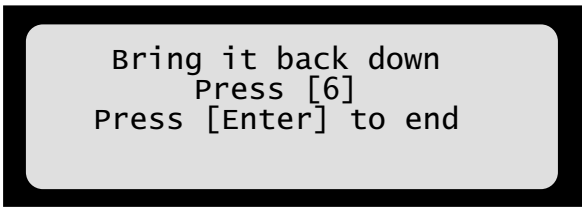
The contrast, backlight, speaker volume, and cursor positions will change automatically through the demonstration. Then there is an opportunity for you to vary these settings by responding to prompts on the LCD.

1. Choose which feature (LCD contrast, backlight on/off, speaker, or cursor) you wish to change.

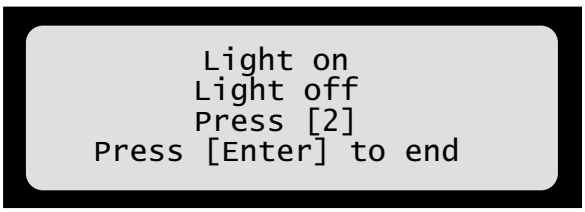


2. Press [**1**] to select the contrast adjustment demonstration.
3. Press [**1**] to increase contrast, press [**6**] to decrease contrast, or press [**Enter**] to get to choose another feature.

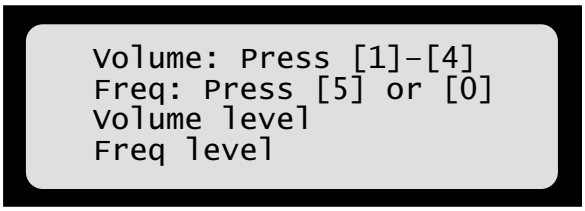




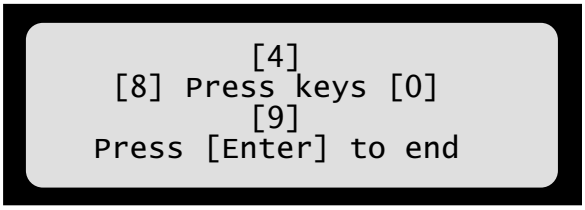
4. Press [**2**] to select the backlight demonstration. Press [**2**] to toggle backlight on or off, or press [**Enter**] to get to choose another feature.



5. Press [**3**] to select the speaker demonstration. Press [**1**]–[**4**] to set the desired speaker volume ([**1**] is min, [**4**] is max), press [**5**] or [**0**] to increase or decrease frequency, or press [**Enter**] to get to choose another feature. The volume and frequency are displayed.



6. Press [**4**] to select the cursor demonstration. Press keys as shown to move cursor, or press [**Enter**] to get to choose another feature.



This demonstration will be replaced by a new program when the programming cable is attached and the new program is compiled and run. The demonstration is available for future reference in the Dynamic C Premier **SAMPLES** directory as **ICOMDEMO.C**.

2.3 Programming Cable Connections

1. Connect the programming cable to the Intellicom board.

Connect the 10-pin **PROG** connector of the programming cable to header J4 on the Intellicom board as shown in Figure 4. Be sure to orient the red edge of the cable towards pin 1 of the connector. (Do not use the **DIAG** connector, which is used for a normal serial connection.)

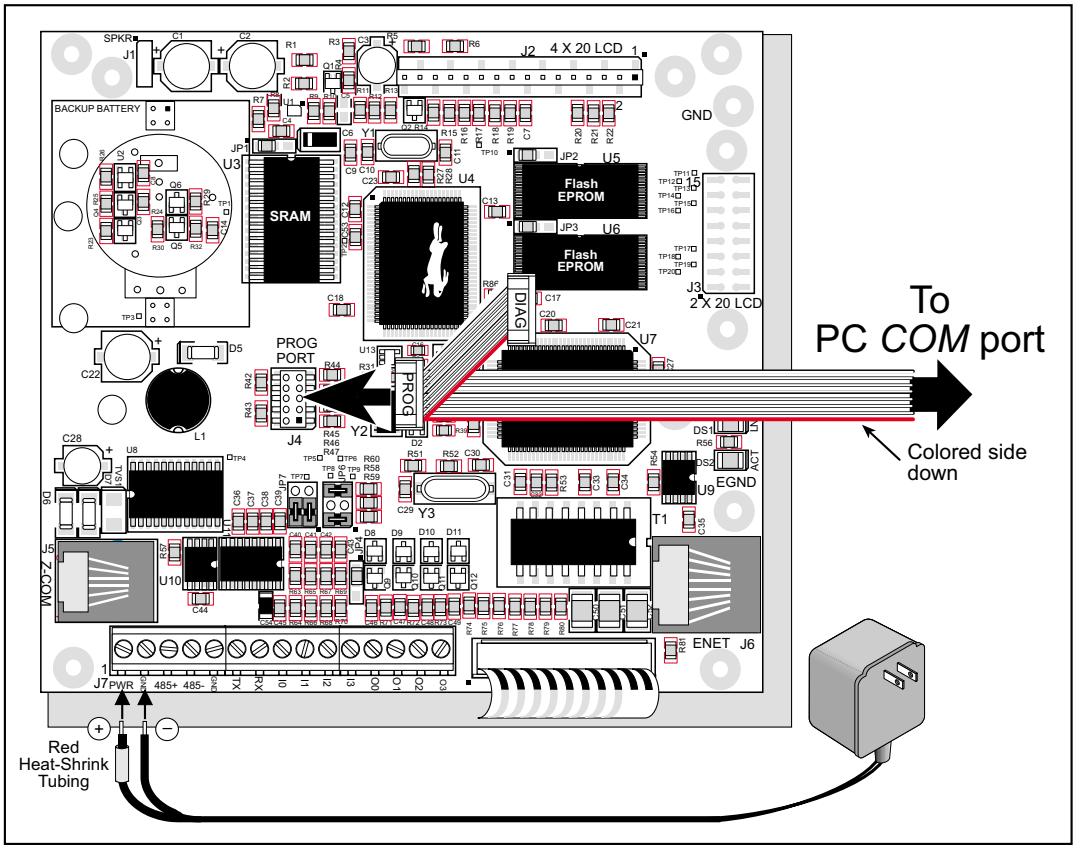


Figure 4. Programming Cable Connections

2. Apply power.

Reset the Intellicom by unplugging the AC adapter, then plugging it back in. The Intellicom board is now ready to be used.

> **NOTE:** A hardware RESET is accomplished by unplugging the AC adapter, then plugging it back in.

2.4 Installing Dynamic C

If you have not yet installed Dynamic C, you may do so by inserting the Dynamic C Premier CD in your PC's CD-ROM drive. The CD will auto-install unless you have disabled auto-install on your PC.

If the CD does not auto-install, click **Start > Run** from the Windows **Start** button and browse for the **setup.exe** file on your CD drive. Click **OK** to begin the installation once you have selected the **setup.exe** file.

The ***Dynamic C Premier User's Manual*** provides detailed instructions for the installation of Dynamic C and any future upgrades.

2.5 Starting Dynamic C

Once the Intellicom board is connected as described above, start Dynamic C by double-clicking on the Dynamic C icon or by double-clicking on the **.exe** file associated with **DcRab** in the Dynamic C directory.

Dynamic C assumes, by default, that you are using serial port COM1 on your PC. If you ***are*** using COM1, then Dynamic C should detect the Intellicom board and go through a sequence of steps to cold-boot the Intellicom board and to compile the BIOS. If the error message "Rabbit Processor Not Detected" appears, you have probably connected to a different PC serial port such as COM2, COM3, or COM4. You can change the serial port used by Dynamic C with the **OPTIONS** menu, then try to get Dynamic C to recognize the Intellicom board by selecting **Recompile BIOS** on the **Compile** menu. Try the different COM ports in the **OPTIONS** menu until you find the one you are connected to. If you still can't get Dynamic C to recognize the target on any port, then the hookup may be wrong or the COM port is not working on your PC.

If you receive the "BIOS successfully compiled …" message after pressing **<Ctrl-Y>** or starting Dynamic C, and this message is followed by "Target not responding," it is possible that your PC cannot handle the 115,200 bps baud rate. Try changing the baud rate to 57,600 bps as follows.

- Locate the **Serial Options** dialog in the Dynamic C **Options > Communications** menu. Change the baud rate to 57,600 bps.

If you are using Dynamic C version 7.04 or earlier, modify the BIOS source code as follows. Skip these three steps if you are using Dynamic C version 7.05 or later.

1. Open the BIOS source code file named **RABBITBIOS.C**, which can be found in the **BIOS** directory.
2. Change the line

   ```
   #define USE115KBAUD 1   // set to 0 to use 57600 baud
   ```

   to read as follows.

   ```
   #define USE115KBAUD 0   // set to 0 to use 57600 baud
   ```

3. Save the changes using **File > Save**.

Now press **<Ctrl-Y>**. You should receive the "BIOS successfully compiled …" message indicating that the target is now ready to compile a program.

2.6 PONG.C

You are now ready to test your set-up by running a sample program.

Find the file **PONG.C**, which is in the Dynamic C **SAMPLES** folder. To run the program, open it with the **File** menu (if it is not still open), compile it using the **Compile** menu, and then run it by selecting **Run** in the **Run** menu. The **STDIO** window will open and will display a small square bouncing around in a box.

This program does not test the serial ports, the I/O, or the TCP/IP part of the board, but does ensure that the board is basically functional. The sample program in Section 5.9, "Run the PINGME.C Demo," tests the TCP/IP portion of the board.

2.7 Where Do I Go From Here?

NOTE: If you purchased your OP6800 through a distributor or Z-World partner, contact the distributor or Z-World partner first for technical support.

If there are any problems at this point:

- Check the Z-World Technical Bulletin Board at www.zworld.com/support/bb/.
- Use the Technical Support e-mail form at www.zworld.com/support/support_submit.html.
- Call Z-World Technical Support at (530)757-3737.

If the sample program ran fine, you are now ready to go on to explore other Intellicom features and develop your own applications.

Chapter 3, "Subsystems," provides a description of the Intellicom board's features, Chapter 4, "Software," describes the Dynamic C software libraries and introduces some sample programs, and Chapter 5, "Using the TCP/IP Features," explains the TCP/IP features.

3. SUBSYSTEMS

Chapter 3 describes the principal subsystems for the Intellicom.

- Switching Between Program Mode and Run Mode
- Intellicom Subsystems
- Serial Communication
- Memory
- Speaker

3.1 Switching Between Program Mode and Run Mode

The Intellicom is automatically in Program Mode when the programming cable is attached, and is automatically in Run Mode when no programming cable is attached. See Figure 5.

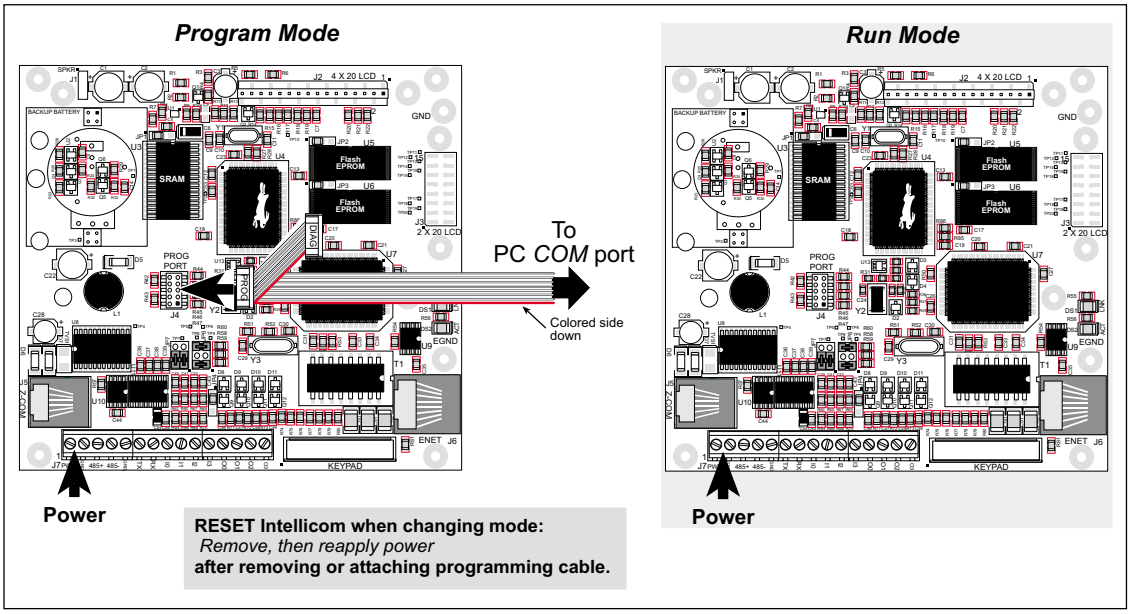


Figure 5. Intellicom Program Mode and Run Mode Set-Up

3.1.1 Detailed Instructions: Changing from Program Mode to Run Mode

1. Disconnect the programming cable from header J4 of the Intellicom board.
2. Reset the Intellicom by unplugging the AC adapter, then plugging it back in.

The Intellicom is now ready to operate in the Run Mode.

3.1.2 Detailed Instructions: Changing from Run Mode to Program Mode

1. Attach the programming cable to header J4 of the Intellicom board.
2. Reset the Intellicom by unplugging the AC adapter, then plugging it back in.

The Intellicom is now ready to operate in the Program Mode.

3.2 Intellicom Subsystems

Figure 6 shows the Rabbit-based subsystems designed into the Intellicom.

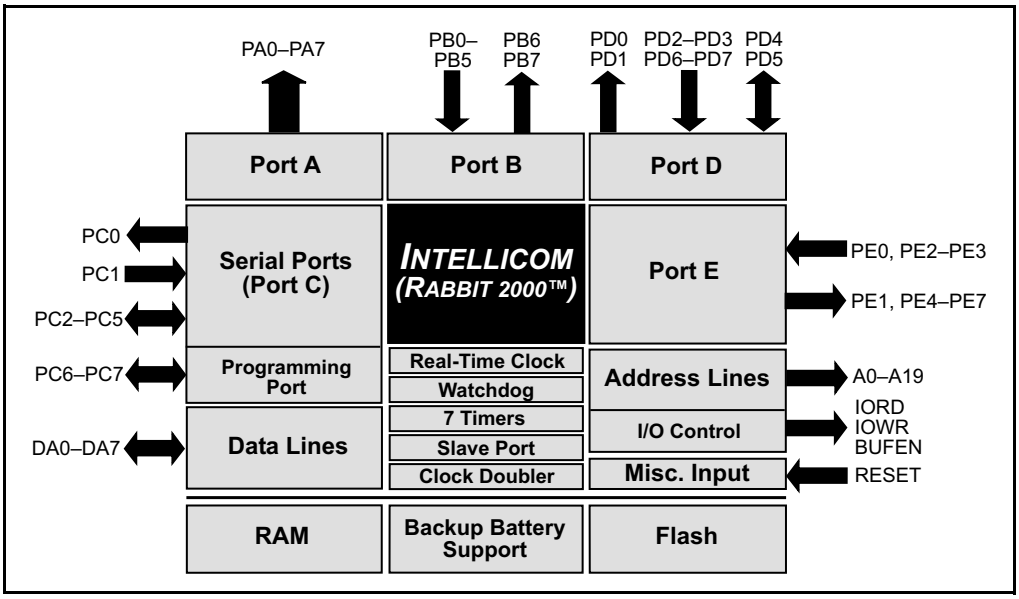


Figure 6. Intellicom Rabbit-Based Subsystems

The Intellicom board has 15 pins on header J7, one RJ-12 jack for RS-232 or RS-485 serial communication, and one Ethernet jack (OP6700 only). The pinouts are shown in Figure 7.

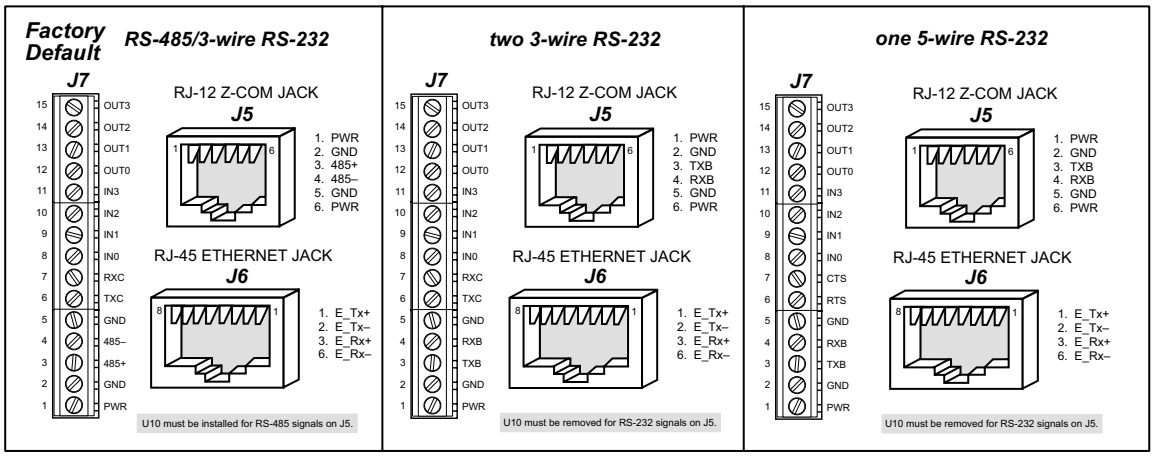


Figure 7. Intellicom I/O Pinout

RJ-45 pinouts are sometimes numbered opposite to the way shown in Figure 7. Regardless of the numbering convention followed, the pin positions relative to the spring tab position (located at the bottom of the RJ-45 jack in Figure 7) are always absolute, and the RJ-45 connector will work properly with off-the-shelf Ethernet cables.

3.2.1 Digital Inputs

Pins 8–11 on header J7 have the four digital inputs IN0–IN3. Each of the four digital 0 V to 5 V inputs is protected over a range of –36 V to +36 V. The Intellicom is factory-configured for the digital inputs to be pulled up to +5 V, but the digital inputs can also be pulled down by moving the surface-mounted jumper at JP4. The jumper settings and the location of JP4 are shown in Figure 8.

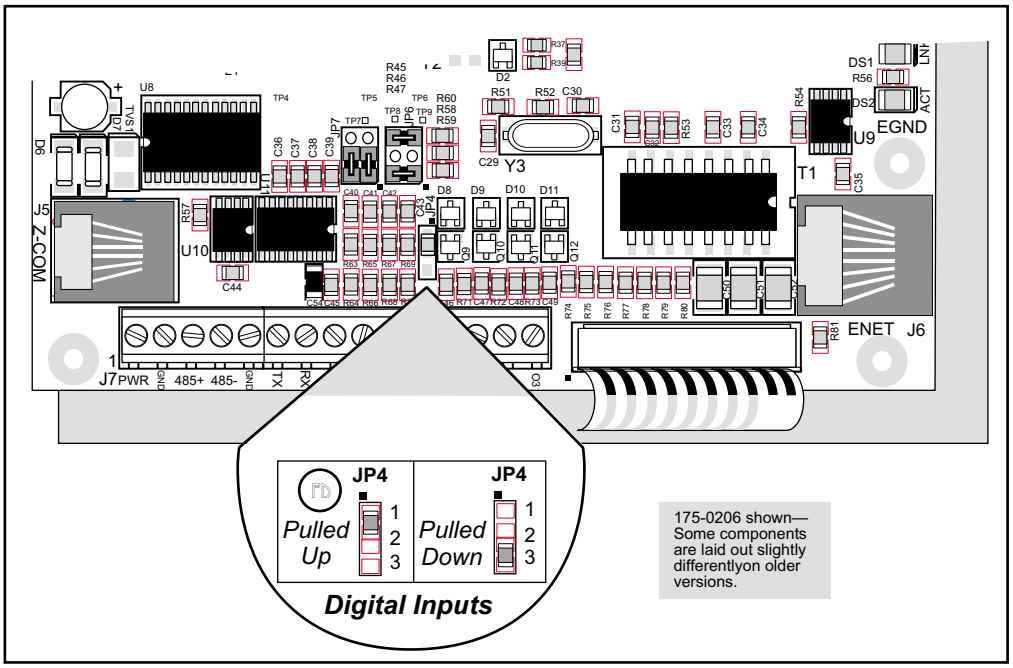


Figure 8. Surface-Mounted Jumper Configurations for Selecting Pullup/Pulldown on the Digital Inputs

3.2.2 Digital Outputs

Pins 12–15 on header J7 have the four digital outputs OUT0–OUT3. Each of the four open-collector digital outputs can sink up to 200 mA at 40 VDC.

3.3 Serial Communication

In the factory-default configuration, the Intellicom has one RS-232 (3-wire) serial channel, one RS-485 serial channel, and one synchronous CMOS serial channel. The Intellicom may be configured for 5-wire RS-232 or two 3-wire RS-232 channels. The exact configuration instructions depend on the version of Intellicom board you have. This information is etched on the bottom side of the printed circuit board, or you can readily determine your version by examining the diagrams below to find the one that matches your board.

Version 175-0188 Rev. A & B

The RS-232 transceiver may be used as a 5-wire RS-232 channel or as two 3-wire RS-232 channels at the expense of the RS-485 channel by adding 0 Ω surface-mounted resistors at R61 and R62 as shown in Figure 9(a). The RS-485 chip (U10) and the associated bias and termination resistors (R58, R59, and R60) shown in Figure 9(a) must be removed when configuring the Intellicom for either one 5-wire RS-232 or two 3-wire RS-232.

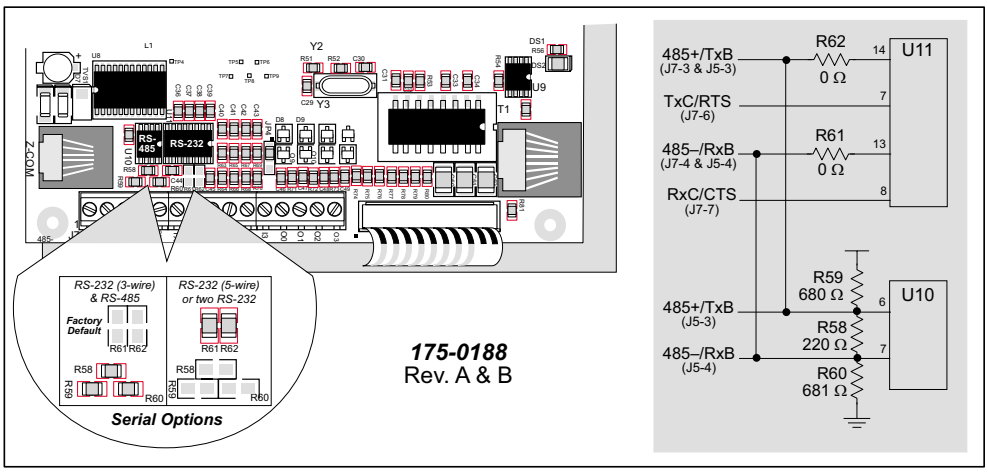


Figure 9(a). Intellicom RS-232/RS-485 Serial Communication Options

Table 2(a) summarizes the options. Note that the parameters in the **`serMode`** software function call must also be set to match the hardware configuration being used.

Table 2(a). Serial Communication Configurations (Version 175-0188 Rev. A & B)

Item	FD One 3-wire RS-232 & RS-485	Two 3-wire RS-232	One 5-wire RS-232
R58–R60	In	Out	Out
R61–R62	Out	In	In
U10	In	Out	Out
J7-3 & J5-3	RS-485+	TxB	TxB
J7-4 & J5-4	RS-485–	RxB	RxB
J7-6	TxC	TxC	RTS
J7-7	RxC	RxC	CTS

Version 175-0188 Rev. C

The RS-232 transceiver may be used as a 5-wire RS-232 channel or as two 3-wire RS-232 channels at the expense of the RS-485 channel, which is connected through 0 Ω surface-mounted resistors at R82 and R83 as shown in Figure 9(b). R82 and R83, shown in Figure 9(b), must be removed when configuring the Intellicom for either one 5-wire RS-232 or two 3-wire RS-232. U10 and the associated bias and termination resistors (R58, R59, and R60) must also be removed, but R82 and R83 are left installed, if you wish the TxB and RxB RS-232 signals to be available on header J5.

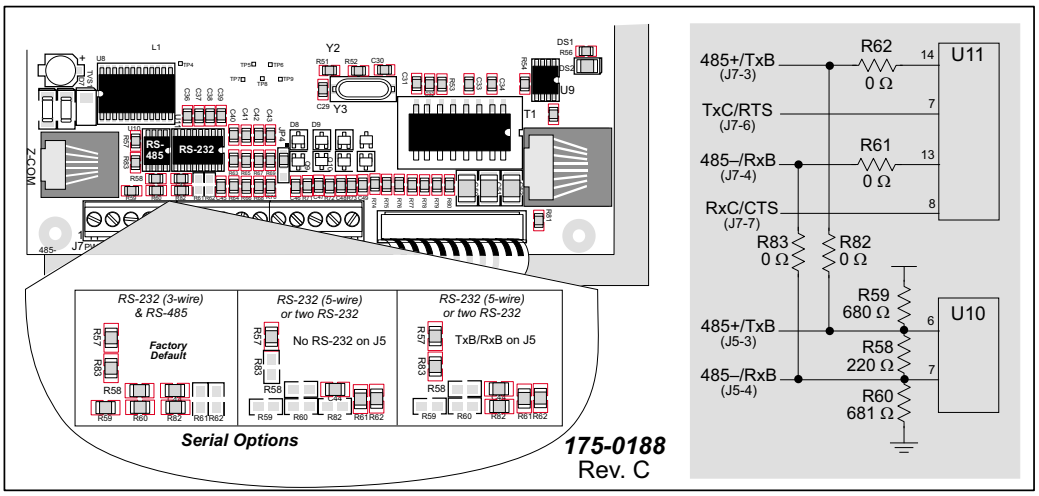


Figure 9(b). Intellicom RS-232/RS-485 Serial Communication Options

Table 2(b) summarizes the options. Note that the parameters in the **`serMode`** software function call must also be set to match the hardware configuration being used.

Table 2(b). Serial Communication Configurations (Version 175-0188 Rev. C)

Item	FD One 3-wire RS-232 & RS-485	Two 3-wire RS-232	One 5-wire RS-232	RS-232 on J5
R58–R60	In	—	—	Out
R61–R62	Out	In	In	In
R82–R83	In	Out	Out	In
U10	In	In	In	Out
J7-3	RS-485+	TxB	TxB	TxB
J7-4	RS-485–	RxB	RxB	RxB
J7-6	TxC	TxC	RTS	TxC or RTS
J7-7	RxC	RxC	CTS	RxC or CTS
J5-3	RS-485+	—	—	TxB
J5-4	RS-485–	—	—	RxB

Version 175-0206

The RS-232 transceiver may be used as a 5-wire RS-232 channel or as two 3-wire RS-232 channels at the expense of the RS-485 channel, which is connected through jumpers across header JP7 as shown in Figure 9(c). The jumper configurations are shown in Figure 9(c).

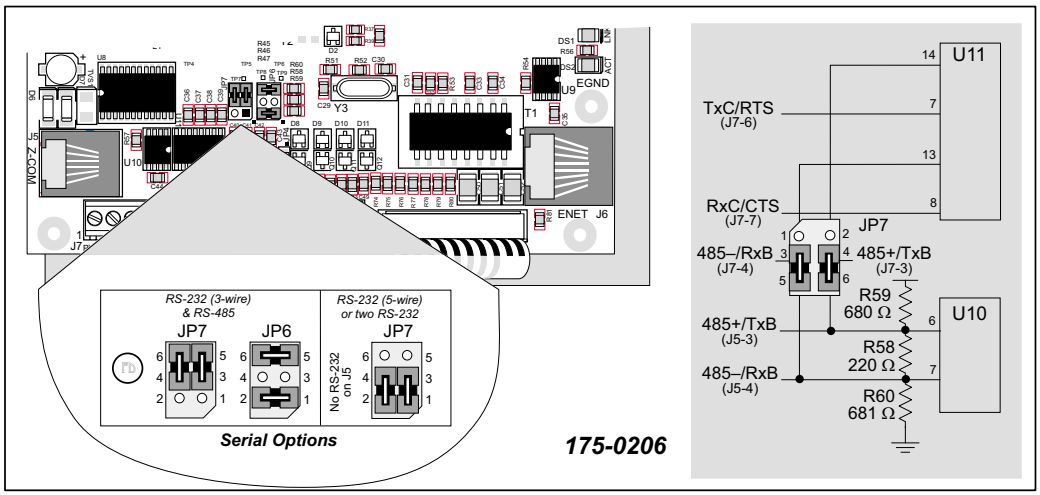


Figure 9(c). Intellicom RS-232/RS-485 Serial Communication Options

Table 2(c) summarizes the options. Note that the parameters in the **`serMode`** software function call must also be set to match the hardware configuration being used.

Table 2(c). Serial Communication Configurations (Version 175-0206)

Item	One 3-wire RS-232 & RS-485	Two 3-wire RS-232	One 5-wire RS-232	RS-232 on J5
Header JP7	3–5 4–6	1–3 2–4	1–3 2–4	1–5 2–6
Header JP6	1–2 5–6	—	—	No jumpers installed
U10	In	In	In	Out
J7-3	RS-485+	TxB	TxB	—
J7-4	RS-485–	RxB	RxB	—
J7-6	TxC	TxC	RTS	TxC or RTS
J7-7	RxC	RxC	CTS	RxC or CTS
J5-3	RS-485+	—	—	TxB
J5-4	RS-485–	—	—	RxB

3.3.1 RS-232

The Intellicom's RS-232 serial channel is connected to an RS-232 transceiver, U11. U11 provides the voltage output, slew rate, and input voltage immunity required to meet the RS-232 serial communication protocol. Basically, the chip translates the Rabbit 2000's 0 V to +Vcc signals to RS-232 signal levels. Note that the polarity is reversed in an RS-232 circuit so that +5 V is output as approximately -10 V and 0 V is output as approximately +10 V. U11 also provides the proper line loading for reliable communication.

The maximum baud rate is 115,200 bps. RS-232 can be used effectively at this baud rate for distances up to 15 m.

3.3.2 RS-485

The Intellicom has one RS-485 serial channel, which is connected to the Rabbit 2000 serial port B through U10, an RS-485 transceiver. The chip's slew rate limiters provide for a maximum baud rate of 250,000 bps, which allows for a network of up to 1200 m (or 4000 ft). The half-duplex communication uses the Rabbit 2000's PC0 pin to control the data enable on the communication line.

The RS-485 signals are available on pins 3 and 4 of header J7, and on J5, the RJ-12 jack.

The Intellicom can be used in an RS-485 multidrop network. Connect the 485+ to 485+ and 485– to 485– using single twisted-pair wires (nonstranded, tinned) as shown in Figure 10.

Alternatively, the RS-485 multidrop network may be hooked up using cables with RJ-12 plugs. Note that the RJ-12 jack has +RAW_485 and GND, which means that only ***one*** Intellicom needs to be connected to an external power source via an AC adapter. When doing so, ensure that the AC adapter has sufficient capacity for the network — each Intellicom unit nominally draws 100 mA at 24 VDC.

NOTE: If you plan to connect a power supply to more than one Intellicom unit in an RS-485 network using the RJ-12 jacks, rework the RS-485 cables so they do not connect +RAW_RS485 through the RJ-12 jack to the boards in the network.

NOTE: The RS-485 port is available only in the factory default configuration. The RS-485 port will not be available when you select the configuration option for both 3-wire RS-232 ports or one 5-wire RS-232 port.

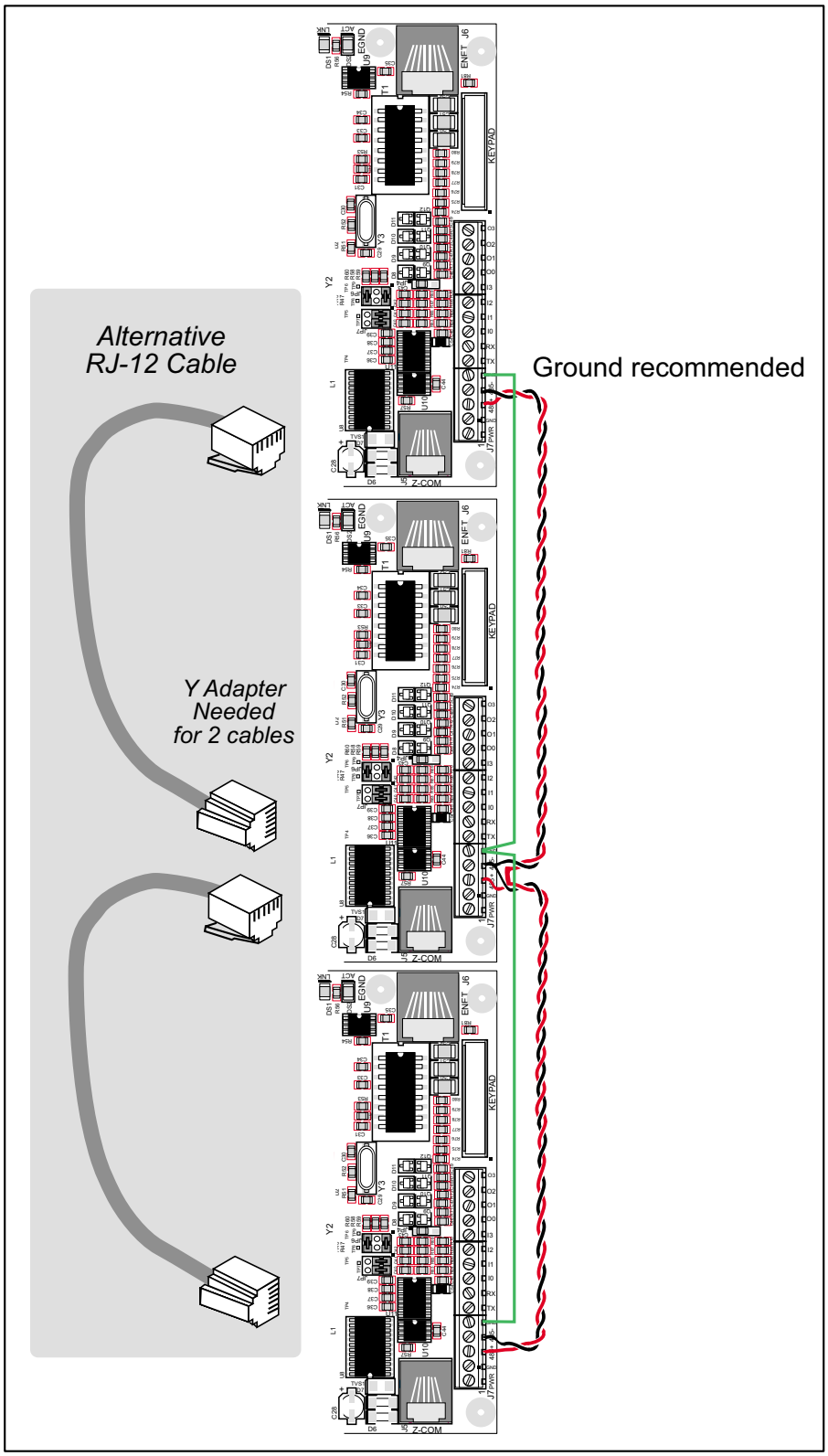


Figure 10. Multidrop Intellicom Network

The Intellicom comes with a 220 Ω termination resistor and two 680 Ω bias resistors installed and enabled with jumpers across pins 1–2 and 5–6 on header JP6, as shown in Figure 11.

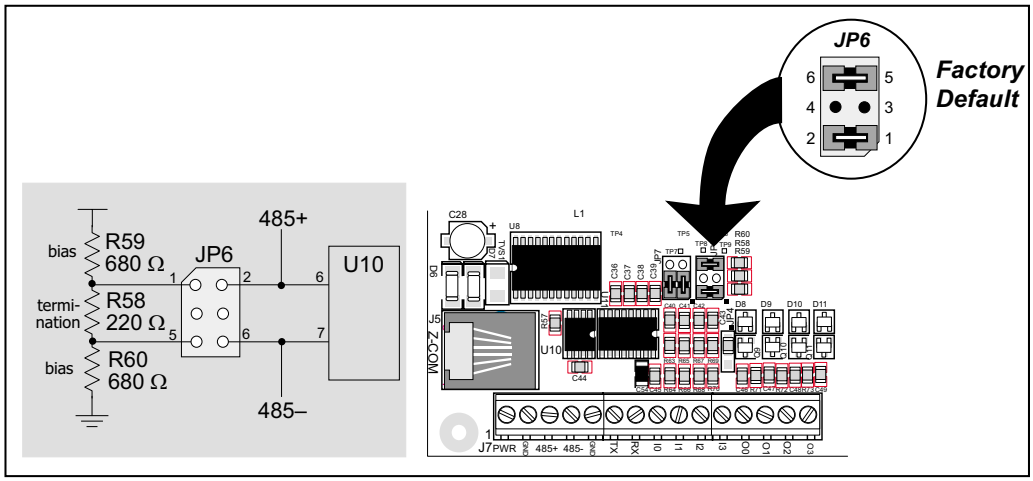


Figure 11. RS-485 Termination and Bias Resistors

The bias and termination resistors in a multidrop network should only be enabled on both end nodes of the network. Disable the termination and bias resistors on the intervening Intellicom units in the network by removing both jumpers from header JP6. Note that older versions of the Intellicom do not have this jumper feature, and the surface-mounted bias and termination resistors shown in Figure 11 have to be removed in networks containing more than 10 Intellicom units.

3.3.3 Programming Port

The Intellicom has a 10-pin programming header labeled J4. The programming port uses the Rabbit 2000's serial port A for communication. The Rabbit 2000 startup-mode pins (SMODE0, SMODE1) are presented to the programming port so that an externally connected device can force the Intellicom to start up in an external bootstrap mode.

> **NOTE:** Refer to the ***Rabbit 2000 Microprocessor User's Manual*** for more information related to the bootstrap mode.

The programming port is used to start the Intellicom in a mode where the Intellicom will download a program from the port and then execute the program. The programming port transmits information to and from a PC while a program is being debugged.

The Intellicom can be reset from the programming port.

The Rabbit 2000 status pin is also presented to the programming port. The status pin is an output that can be used to send a general digital signal.

The clock line for serial port A is presented to the programming port, which makes fast serial communication possible.

3.4 Memory

3.4.1 SRAM

The Intellicom is designed to accept 32K to 512K of SRAM packaged in an SOIC case.

The standard models come with 128K of SRAM. Figure 12 shows the locations and the jumper settings for the jumpers at JP1 used to set the SRAM size. The "jumpers" are 0 Ω surface-mounted resistors.

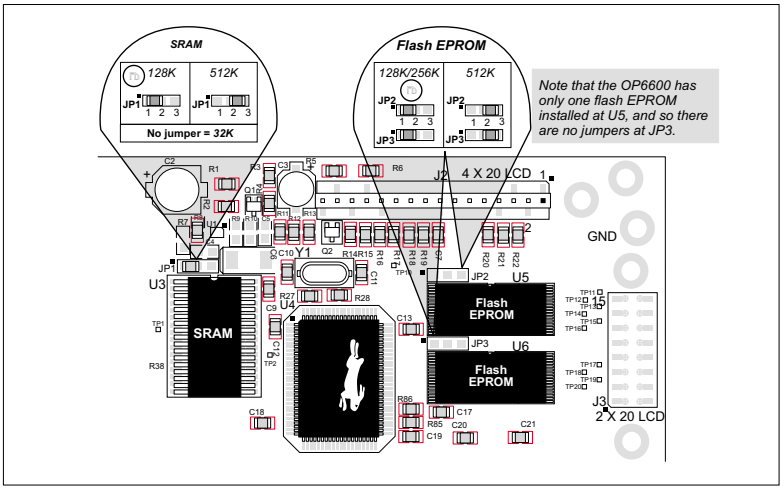


Figure 12. Intellicom Jumper Settings for SRAM and Flash EPROM Size

3.4.2 Flash Memory

The Intellicom is also designed to accept 128K to 512K of flash memory packaged in a TSOP case.

The Intellicom OP6700 comes with two 256K flash memory chips, and the Intellicom OP6600 comes with one 256K flash memory. Figure 12 shows the locations and the jumper settings for the jumpers at JP2 and JP3 used to set the flash memory size. The "jumpers" are 0 Ω surface-mounted resistors.

> **NOTE:** Z-World recommends that any customer applications should not be constrained by the sector size of the flash EPROM since it may be necessary to change the sector size in the future.

A Flash Memory Bank Select jumper configuration option exists at JP5 with 0 Ω surface-mounted resistors. This option, used in conjunction with some configuration macros, allows Dynamic C to compile two different co-resident programs for the upper and lower halves of the 256K flash in such a way that both programs start at logical address 0000. This is useful for applications that require a resident download manager and a separate downloaded program. See Application Note 218, ***Implementing a Serial Download Manager for a 256K Flash***, for details.

3.4.3 Dynamic C Premier BIOS Source Files

The Dynamic C Premier BIOS source files handle different standard RAM and flash EPROM sizes automatically.

3.5 Speaker

The Intellicom comes with a 35 Ω speaker that is controlled through the Dynamic C function **spkrOut**. Both the volume and the frequency of the signal are set with this function call. The maximum average volume was measured to be 75 dBA @ 30 cm (12 inches) from the speaker. Figure 13 shows typical volume measurements for various frequencies with the speaker grille open and closed to maintain water resistance for the front mounting panel.

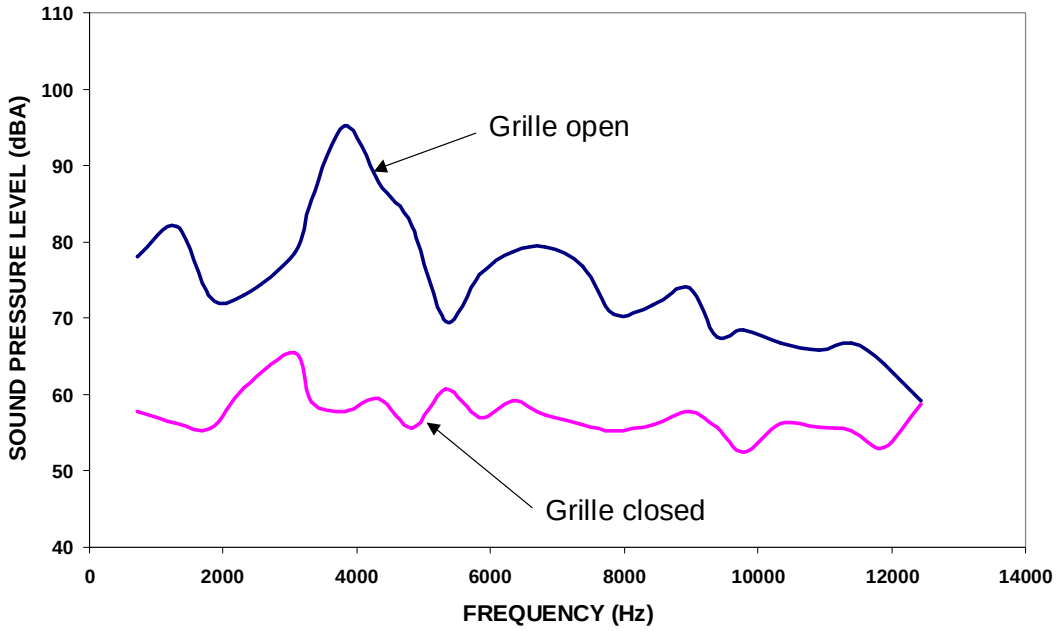


Figure 13. Intellicom Speaker Sound Pressure Level 30 cm (12 inches) from Speaker

3.6 Vacuum Fluorescent Display

A vacuum fluorescent display (VFD) may be substituted for the LCD by removing R22 and substituting a VFD for LCD. Note that a VFD has no backlighting and no contrast control.

> **NOTE:** Contact your Z-World Sales Representative at (530)757-3737 for information on ordering this option from the factory.

The instructions for accessing the display are similar to those for accessing the keypad insert in Appendix B, "Keypad and Plastic Enclosure."

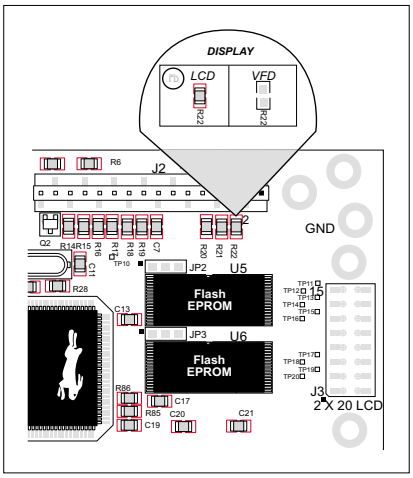


Figure 14. Location of Display Control Resistor, R22

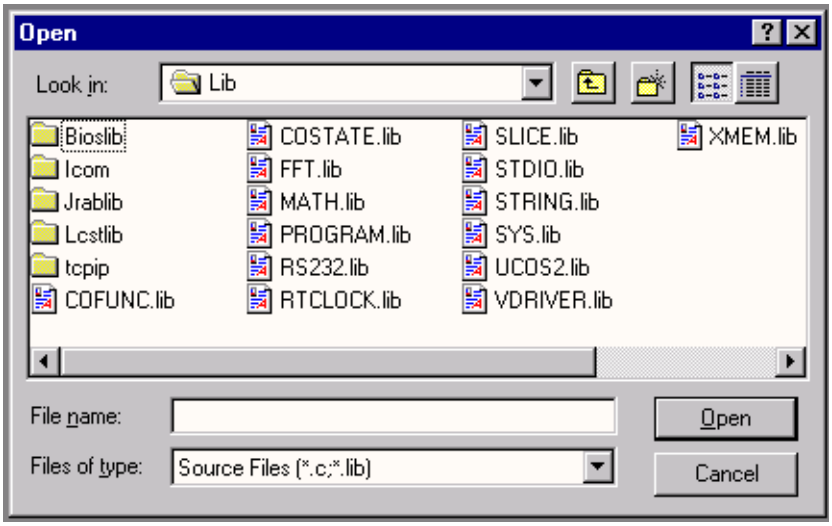
4. SOFTWARE

Dynamic C is an integrated development system for writing embedded software. It runs on an IBM-compatible PC and is designed for use with Z-World controllers and other controllers based on the Rabbit microprocessor.

Chapter 4 provides the libraries, function calls, and sample programs related to the Intellicom.

4.1 Dynamic C Libraries

With Dynamic C running, click **File** > **Open**, and select **Lib**. The following list of Dynamic C libraries and library directories will be displayed.



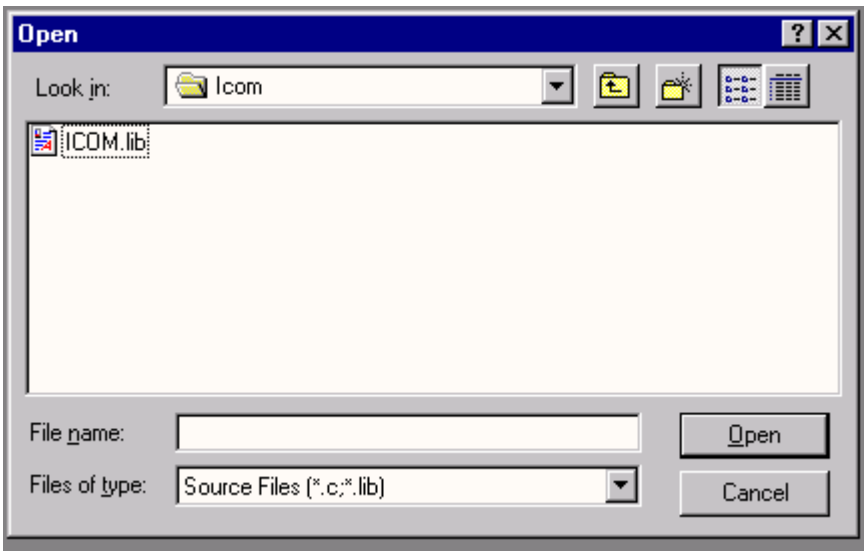
Two library directories are specific to the Intellicom.

- **ICOM**—libraries associated with features specific to the Intellicom unit.
- **TCPIP**—libraries specific to using TCP/IP functions on the Intellicom board.

Other functions applicable to all devices based on the Rabbit 2000 microprocessor are described in the ***Dynamic C Premier User's Manual***.

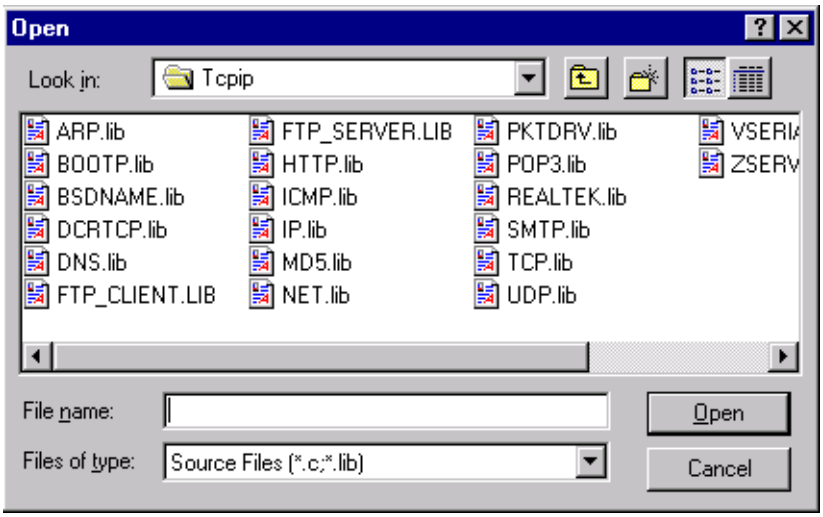
4.1.1 Library Directories

The **ICOM** directory contains libraries required to operate the Intellicom unit.



- **ICOM.LIB**—This library supports OP6600 and OP6700 Intellicom boards only. The functions in this library are described in this chapter.

The **TCPIP** directory contains libraries with generic TCP/IP functions.



- **ARP.LIB**—address resolution protocol functions.
- **BOOTP.LIB**—bootstrap protocol functions.
- **BSDNAME.LIB**—BSD-style socket routines.
- **DCRTCP.LIB**—TCP/IP functions.
- **DNS.LIB**—handles host name resolution.
- **FTP_CLIENT.LIB**—FTP client functions.
- **FTP_SERVER.LIB**—FTP server functions.
- **HTTP.LIB**—HTTP handler.
- **ICMP.LIB**—ICMP handler.
- **IP.LIB**—handles the network layer (just above the link layer and the device driver).
- **MD5.LIB**—implements the MD5 algorithm defined in TCP/IP RFC 1321.
- **NET.LIB**—general networking API. This is the "top-level" library for the networking library suite. It includes the packet-driver interface.
- **PKTDRV.LIB**—packet driver functions.
- **POP3.LIB**—POP3 functions.
- **REALTEK.LIB**—packet driver functions for the RealTek RTL8019AS.
- **SMTP.LIB**—SMTP handler.
- **TCP.LIB**—transmission control protocol.
- **UDP.LIB**—user datagram protocol.
- **VSERIAL.LIB**—virtual Telnet functions.
- **ZSERVER.LIB**—miscellaneous TCP/IP server data structures and routines.

The functions in these libraries are described in the ***Dynamic C TCP/IP User's Manual*** included in the manual set with the ***Dynamic C Premier User's Manual***. Additional TCP/IP libraries are added on an ongoing basis.

4.2 Intellicom Function APIs

4.2.1 Board Initialization

```
void brdInit (void);
```

Initializes port registers for the operation of the board. Call this function at the beginning of the application.

Return Value

None

See Also

`dispInit, keyInit`

4.2.2 Digital I/O

```
void digOut (int channel, int value);
```

Sets the state of a digital output.

Parameters

`channel` is the output channel number (0, 1, 2, or 3).

`value` is the output value (0 or 1).

Return Value

None.

See Also

`digIn`

```
int digIn (int channel);
```

Reads the state of a digital input.

Parameters

`channel` is the input channel number (0, 1, 2, or 3).

Return Value

The state of the input (0 or 1).

See Also

`digOut`

4.2.3 Serial Communication

Library files included with Dynamic C provide a full range of serial communications support. The **RS232.LIB** library provides a set of circular-buffer-based serial functions. The **PACKET.LIB** library provides packet-based serial functions where packets can be delimited by the 9th bit, by transmission gaps, or with user-defined special characters. Both libraries provide blocking functions, which do not return until they are finished transmitting or receiving, and nonblocking functions, which must be called repeatedly until they are finished. For more information, see the ***Dynamic C Premier User's Manual*** and Technical Note 213, ***Rabbit 2000 Serial Port Software***.

The following function calls are specific to the Intellicom.

```
int serMode (int mode);
```

User interface to set up up serial communication lines for the Intellicom board. Call this function after **serXOpen()**.

Parameters

mode is the defined serial port configuration of the devices installed.

Mode	Serial Port	
	B	C
0	RS-485	RS-232, 3-wire
1	RS-232, 3-wire	RS-232, 3-wire
2	RS-232, 5-wire	CTS/RTS

Return Value

0 if correct mode, 1 if not.

See Also

serB485Tx, serB485Rx

```
void serB485Tx();
```

Sets pin 3 (DE) high to disable Rx and enable Tx.

See Also

serMode, serB485Rx

```
void serB485Rx();
```

Resets pin 3 (DE) low to enable Rx and disable Tx.

See Also

serMode, serB485Tx

4.2.4 Keypad Controls

```
void keyProcess (void);
```

Scans and processes keypad data (up to 8 × 8 matrix) for key assignment, debouncing, press and release, and repeat. Provides debouncing, user-definable key code, separate press and release code (both optional), two- and three-speed auto repeat.

Return Value

None.

See Also

keyConfig, keyGet, keypadDef

```
void keyConfig (char cRaw, char cPress,
        char cRelease, char cCntHold, char cSpdLo,
        char cCntLo, char cSpdHi );
```

Assigns user-defined keys to keypad positions. Defines ticks for key debouncing and speed.

Parameters

cRaw is the Raw Key Code Index, a 2 × 6 keypad matrix with the following raw keycode index assignments.

	Col 5	Col 4	Col 3	Col 2	Col 1	Col 0
Row 1	5	4	3	2	1	0
Row 0	13	12	11	10	9	8

cPress is the Key Press Code, an 8-bit value returned when a key is pressed (0 = Unused). See **keypadDef** for default press codes.

cRelease is the Key Release Code, an 8-bit value to be returned when a key is released (0 = Unused).

cCntHold is Hold Ticks, how long to hold before repeating (0 = No Repeat).

cSpdLo is Low-Speed Repeat Ticks, how many times to repeat (0 = None).

cCntLo is Low-Speed Hold Ticks, how long to hold before going to high-speed repeat (0 = Slow Only).

cSpdHi isHigh-Speed Repeat Ticks, how many times to repeat after low-speed repeat (0 = None).

Return Value

None.

See Also

keyProcess, keyGet, keypadDef

char keyGet (void);

Gets next keypress.

Return Value

The next keypress, or 0 if none.

See Also

keyConfig, keyProcess, keypadDef

void keyInit (void);

Initializes keypad process.

Return Value

None.

See Also

brdInit

void keypadDef();

Configures keypad to default layout:

[1][2][3][4][5][.]
[6][7][8][9][0][Enter]

Return Value

None.

See Also

keyConfig, keyGet, keyProcess

4.2.5 Display Controls

```
void dispContrast (char vcontrast);
```

Sets display contrast.

Parameters

Suggested values are 40–128 for high to low contrast, although 4–252 can be used. Contrast adjustment not supported on VFDs.

Return Value

None.

See Also

dispOnoff, dispBacklight

```
void dispCursor (unsigned int wStyle);
```

Sets cursor type: on, off, or blinking.

Parameters

wStyle is one of the following cursor macros:

```
DISP_CUROFF      for cursor off
DISP_CURON       for cursor on
DISP_CURBLINK     for cursor blink
```

Return Value

None.

See Also

dispClear, dispGoto

```
void dispGoto (unsigned wX, unsigned wY);
```

Positions the cursor.

Parameters

wX is the column position, 0 to 19.

wY is the row position, 0 to 3.

Return Value

None.

See Also

dispClear, dispCursor

void dispClear (void);

Clears the display and homes cursor.

Return Value

None.

See Also

dispGoto, dispCursor

void dispPutc (char cByte);

Puts a character on the display.

Parameter

cByte is the character to display.

Return Value

None.

See Also

dispPrintf

void dispPrintf (char *pcFormat, ...);

Prints formatted string to the display, similar to **printf** call.

Parameter

pcFormat is the formatted string.

Return Value

None.

See Also

dispPutc

void dispOnoff (int onOff);

Turns the display on or off.

Parameters

Set or write 1 to turn the display on. Clear or write 0 to turn the display off.

Return Value

None.

See Also

dispContrast, dispBacklight

void dispBacklight (int onOff);

Sets the backlight on or off. Not supported on VFDs.

Parameters

Set or write 1 to turn the backlight on. Clear or write 0 to turn the backlight off.

Return Value

None.

See Also

dispContrast, dispOnoff

void dispInit();

Initializes the display. Specifically, the function reinitializes the display controller, clears the display, and puts a nonblinking underline cursor in the top left position.

Return Value

None.

See Also

brdInit

4.2.6 Speaker Controls

```
void spkrOut (unsigned int wFreq, unsigned int wAmp );
```

Outputs speaker frequency and volume with various frequency and voltage values.

Parameters

`wFreq`—suggested frequency values are from 575 Hz to 3,000 Hz: for example, enter 1000 for 1 kHz. Values less than 575 (575 Hz) will be ignored.

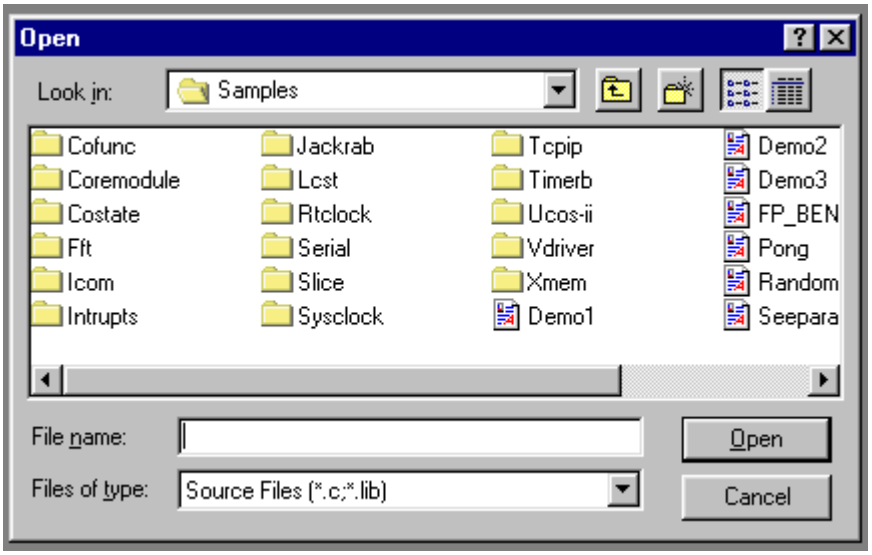
`wAmp`—voltage amplitude (volume) values are 0, 1, 2, and 3: 0 = off, and 3 = loudest volume.

Return Value

None.

4.3 Sample Programs

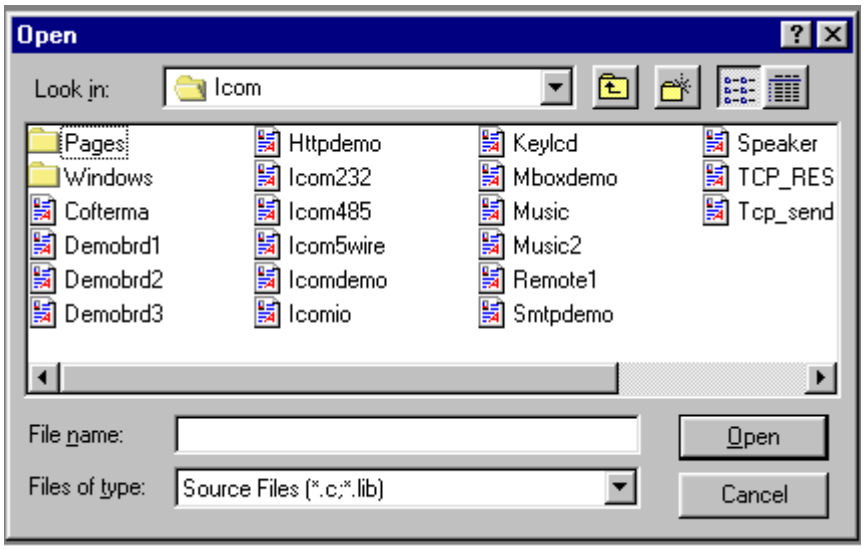
Sample programs are provided in the Dynamic C **Samples** folder, which is shown below.



The various folders contain specific sample programs that illustrate the use of the corresponding Dynamic C libraries. For example, the sample program **PONG.C** demonstrates the output to the **STDIO** window.

The **ICOM** and **TCPIP** folders provide sample programs specific to the Intellicom board. Each sample program has comments that describe the purpose and function of the program. Follow the instructions at the beginning of the sample program.

Let's take a look at the **ICOM** folder.



- **COFTERMA.C**—Demonstrates cofunctions, the cofunction serial library, and using a serial ANSI terminal such as Hyperterminal from an available PC COM port connection.
- **DEMOBRD1.C**—Flashes LEDs on Demonstration Board included in Development Kit. See Appendix D for hookup instructions for the Demonstration Board.
- **DEMOBRD2.C**—Flashes LEDs on Demonstration Board included in Development Kit and illustrates the Dynamic C **runwatch** function. See Appendix D for hookup instructions for the Demonstration Board.
- **DEMOBRD3.C**—Flashes LEDs on Demonstration Board included in Development Kit and demonstrates the use of costatements. See Appendix D for hookup instructions for the Demonstration Board.
- **HTTPDEMO.C**—Allows a Web browser to view and change the state of the Intellicom board. See Appendix D for hookup instructions for the Demonstration Board.
- **ICOM232.C**—Demonstrates a simple RS-232 loopback.
- **ICOM485.C**—Demonstrates a simple RS-485 transmission from master to slave.
- **ICOM5WIRE.C**—Demonstrates a 5-wire RS-232 loopback in an Intellicom set up for 5-wire RS-232.
- **ICOMDEMO.C**—Demonstration program to illustrate Intellicom features. This demonstration program comes up when the Intellicom is first powered up before new programs are compiled and run.
- **ICOMIO.C**—Demonstrates how to turn the digital I/O on and off.
- **KEYLCD.C**—Demonstrates use of LCD and keypad.
- **MBOXDEMO.C**—Implements a Web server that allows e-mail messages to be entered and then shown on the LCD display. See Appendix D for hookup instructions for the Demonstration Board.
- **MUSIC.C**—Speaker demonstration: plays one line of "Bicycle Built For Two" (with lyrics).
- **MUSIC2.C**—Speaker demonstration: plays one line of "Für Elise" as background music while other processing is going on.
- **REMOTE1.C**—Demonstrates simple serial data communication using a remote ANSI terminal such as Hyperterminal from an available PC COM port connection.
- **SMTPDEMO.C**—Uses the **TCPIP\SMTP.LIB** library to send an e-mail when a key on the keypad or a switch on the Demonstration Board is pressed. See Appendix D for hookup instructions for the Demonstration Board.
- **SPEAKER.C**—Demonstrates how to adjust the speaker frequency and volume.
- **TCP_RESPOND.C**—Shows how to receive messages and respond.
- **TCP_SEND.C**—Shows how to send message to specific addresses and ports.

The programs **TCP_SEND.C** and **TCP_RESPOND.C** are meant to be executed on two different Intellicom boards so that the two boards communicate with each other. In the absence of a second board, **PCSEND.EXE** (used with **TCP_SEND.C**) and **PCRESPOND.EXE** (used with **TCP_RESPOND.C**) in the **SAMPLES\ICOM\WINDOWS** directory can be used on the PC console side at the command prompt. Both the executables and the C source code are located in the **WINDOWS** directory.

Using PCSEND

PCSEND.C is the source code for **PCSEND.EXE** used on the PC console side to communicate with an Intellicom board. The executable **PCSEND.EXE** is similar to **TCP_SEND.C**, but is run at the command prompt to communicate with an Intellicom board running **TCP_RESPOND.C**.

Using PCRESPOND

PCRESPOND.C is the source code for **PCRESPOND.EXE** used on the PC console side to communicate with an Intellicom board. The executable **PCRESPOND.EXE** is similar to **TCP_RESPOND.C**, but is run at the command prompt to communicate with an Intellicom board running **TCP_SEND.C**.

4.4 Using Dynamic C

To run a sample program, open it with the **File** menu (if it is not still open), compile it using the **Compile** menu, and then run it by selecting **Run** in the **Run** menu. The Intellicom must be in **Program** mode (see Section 3.1, “Switching Between Program Mode and Run Mode,”) and must be connected to a PC using the programming cable as described in Section 4, “Programming Cable Connections,”.

More complete information on Dynamic C is provided in the ***Dynamic C Premier User’s Manual***. TCP/IP-specific functions are described in the ***Dynamic C TCP/IP User’s Manual***.

5. USING THE TCP/IP FEATURES

Chapter 5 provides an introduction to using the TCP/IP features on your Intellicom.

5.1 TCP/IP Connections

Before proceeding you will need to have the following items.

- If you don't have Ethernet access, you will need at least a 10Base-T Ethernet card (available from your favorite computer supplier) installed in a PC.
- Two RJ-45 straight through Ethernet cables and a hub, or an RJ-45 crossover Ethernet cable.

The Ethernet cables and Ethernet hub are available from Z-World in a TCP/IP tool kit. More information is available at www.zworld.com.

1. **Connect the AC adapter and the programming cable as shown in Chapter 2, "Getting Started,"**

2. **Ethernet Connections**

If you do not have access to an Ethernet network, use a crossover Ethernet cable to connect the Intellicom board to a PC with at least a 10Base-T Ethernet card.

If you have access to an Ethernet network, use a straight through Ethernet cable to establish an Ethernet connection to the Intellicom board from an Ethernet hub. These connections are shown in Figure 15.

The PC running Dynamic C through the serial port on the Intellicom board does not need to be the same as the PC with the Ethernet card.

3. **Apply Power**

Plug in the AC adapter. The Intellicom board is now ready to be used.

> **NOTE:** A hardware RESET is accomplished by unplugging the AC adapter, then plugging it back in.

When working with the Intellicom board, the green **LNK** light is on when a program is running and the board is properly connected either to an Ethernet hub or to an active Ethernet card. The red **ACT** light flashes each time a packet is received.

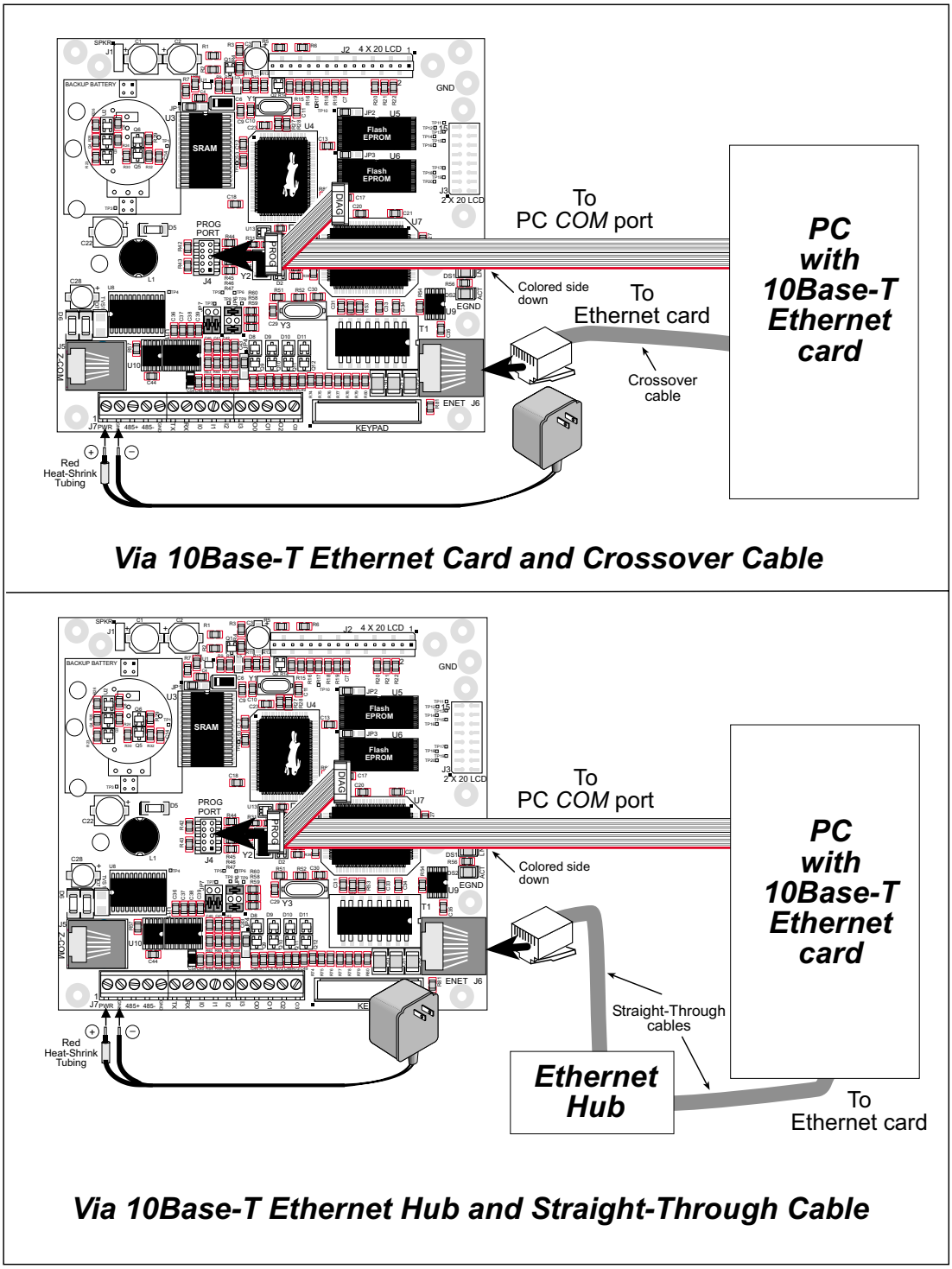


Figure 15. Ethernet Connections

5.2 Running TCP/IP Sample Programs

We have provided a number of sample programs demonstrating various uses of TCP/IP for networking embedded systems. These programs require that the user connect his PC and the Intellicom board together on the same network. This network can be a local private network (preferred for initial experimentation and debugging), or a connection via the Internet.

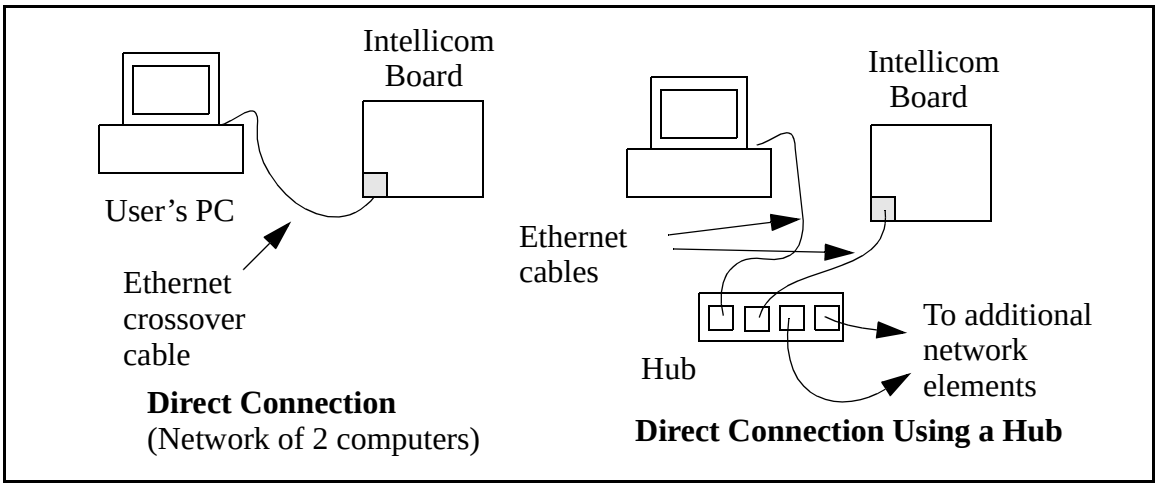
Obtaining IP addresses to interact over an existing, operating, network can involve a number of complications, and must usually be done with cooperation from your ISP and/or network systems administrator (if your company has one). For this reason, it is suggested that the user begin instead by using a direct connection between a PC and the Intellicom board using an Ethernet crossover cable or a simple arrangement with a hub. (A crossover cable should not be confused with regular straight through cables.) The hub and a wide variety of cables can also be purchased from a local computer store.

In order to set up this direct connection, the user will have to use a new PC (right out of the box), or disconnect a PC from the corporate network, or as yet another approach install a second Ethernet adapter and set up a separate private network attached to the second Ethernet adapter. Disconnecting your PC from the corporate network may be easy or nearly impossible, depending on how it is set up. Mobile PCs, such as laptops, are designed to be connected and disconnected, and will present the least problem. If your PC boots from the network or is dependent on the network for some or all of its disks, then it probably should not be disconnected. If a second Ethernet adapter is used, be aware that Windows TCP/IP will send messages to one adapter or the other, depending on the IP address and the binding order in Microstate products. Thus you should have different ranges of IP addresses on your private network from those used on the corporate network. If both networks service the same IP address, then Windows may send a packet intended for your private network to the corporate network. A similar situation will take place if you use a dial-up line to send a packet to the Internet. Windows may try to send it via the local Ethernet network if it is also valid for that network.

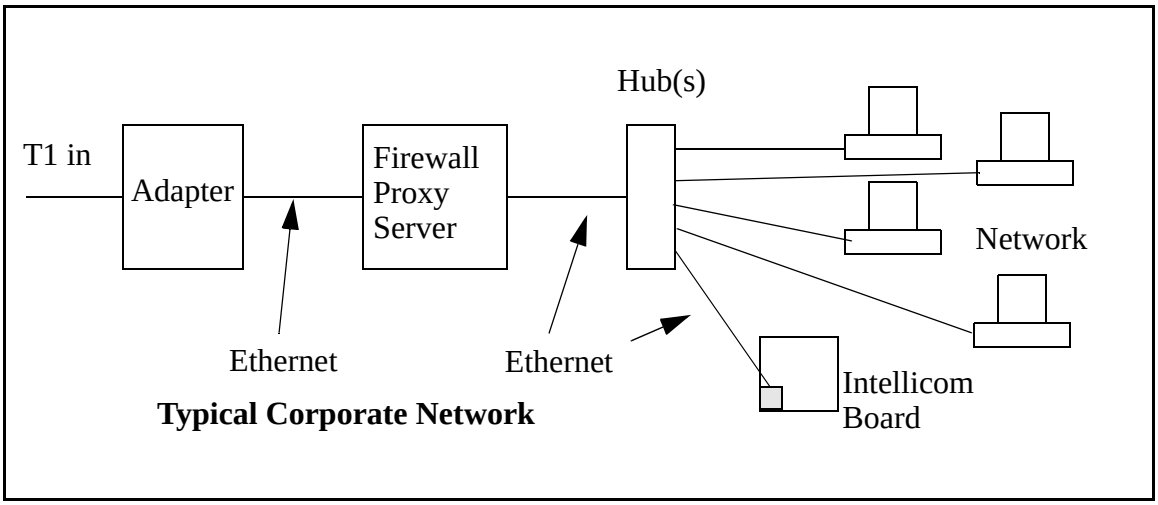
The following private IP addresses are set aside for local networks and are not allowed on the Internet: 10.0.0.0 to 10.255.255.255, 172.16.0.0 to 172.31.255.255, and 192.168.0.0 to 192.168.255.255.

The Intellicom board uses a 10Base-T type of Ethernet connection, which is the most common scheme. The RJ-45 connectors are similar to U.S. style telephone connectors, are except larger and have 8 contacts.

An alternative to the direct connection using a crossover cable is a direct connection using a hub. The hub relays packets received on any port to all of the ports on the hub. Hubs are low in cost and are readily available. The Intellicom board uses 10 Mbps Ethernet, so the hub or Ethernet adapter must be either a 10 Mbps unit or a 10/100 Mbps unit.



In a corporate setting where the Internet is brought in via a high-speed line, there are typically machines between the outside Internet and the internal network. These machines include a combination of proxy servers and firewalls that filter and multiplex Internet traffic. In the configuration below, the Intellicom board could be given a fixed address so any of the computers on the local network would be able to contact it. It may be possible to configure the firewall or proxy server to allow hosts on the Internet to directly contact the controller, but it would probably be easier to place the controller directly on the external network outside of the firewall. This avoids some of the configuration complications by sacrificing some security.



If your system administrator can give you an Ethernet cable along with its IP address, the netmask and the gateway address, then you may be able to run the sample programs without having to setup a direct connection between your computer and the Intellicom board. You will also need the IP address of the nameserver, the name or IP address of your mail server, and your domain name for some of the sample programs.

5.3 IP Addresses Explained

IP (Internet Protocol) addresses are expressed as 4 decimal numbers separated by periods, for example:

216.103.126.155

10.1.1.6

Each decimal number must be between 0 and 255. The total IP address is a 32-bit number consisting of the 4 bytes expressed as shown above. A local network uses a group of adjacent IP addresses. There are always 2^N IP addresses in a local network. The netmask (also called subnet mask) determines how many IP addresses belong to the local network. The netmask is also a 32-bit address expressed in the same form as the IP address. An example netmask is:

255.255.255.0

This netmask has 8 zero bits in the least significant portion, and this means that 2^8 addresses are a part of the local network. Applied to the IP address above (216.103.126.155), this netmask would indicate that the following IP addresses belong to the local network:

216.103.126.0

216.103.126.1

216.103.126.2

etc.

216.103.126.254

216.103.126.255

The lowest and highest address are reserved for special purposes. The lowest address (216.102.126.0) is used to identify the local network. The highest address (216.102.126.255) is used as a broadcast address. Usually one other address is used for the address of the gateway out of the network. This leaves 256 - 3 = 253 available IP addresses for the example given.

5.4 How IP Addresses are Used

The actual hardware connection via an Ethernet uses Ethernet adapter addresses (also called MAC addresses.) These are 48-bit addresses and are unique for every Ethernet adapter manufactured. In order to send a packet to another computer, given the IP address of the other computer, it is first determined if the packet needs to be sent directly to the other computer or to the gateway. In either case, there is an IP address on the local network to which the packet must be sent. A table is maintained to allow the protocol driver to determine the MAC address corresponding to a particular IP address. If the table is empty, the MAC address is determined by sending an Ethernet broadcast packet to all devices on the local network asking the device with the desired IP address to answer with its MAC address. In this way, the table entry can be filled in. If no device answers, then the device is nonexistent or inoperative, and the packet cannot be sent.

Private IP addresses are arbitrary and can be allocated as desired provided that they don’t conflict with other IP addresses. However, if they are to be used with the Internet, then they must be numbers that are assigned to your connection by proper authorities, generally by delegation via your service provider.

5.5 Dynamically Assigned Internet Addresses

In many instances, there are no fixed IP addresses. This is the case when, for example, you are assigned an IP address dynamically by your dial-up Internet service provider (ISP) or when you have a device that provides your IP addresses using the Dynamic Host Configuration Protocol (DHCP). The Intellicom can use such IP addresses to send and receive packets on the Internet, but you must take into account that this IP address may only be valid for the duration of the call or for a period of time, and could be a private IP address that is not directly accessible to others on the Internet. These private address can be used to perform some Internet tasks such as sending e-mail or browsing the Web, but usually cannot be used to participate in conversations that originate elsewhere on the Internet. If you want to find out this dynamically assigned IP address, under Windows 98 you can run the **`winipcfg`** program while you are connected and look at the interface used to connect to the Internet.

Many networks use private IP addresses that are assigned using DHCP. When your computer comes up, and periodically after that, it requests its networking information from a DHCP server. The DHCP server may try to give you the same address each time, but a fixed IP address is usually not guaranteed.

If you are not concerned about accessing the Intellicom from the Internet, you can place the Intellicom on the internal network using a private address assigned either statically or through DHCP.

5.6 Placing Your Device on the Internet

In many corporate settings, users are isolated from the Internet by a firewall and/or a proxy server. These devices attempt to secure the company from unauthorized network traffic, and usually work by disallowing traffic that did not originate from inside the network. If you want users on the Internet to communicate with your Intellicom, you have several options. You can either place the Intellicom directly on the Internet with a real Internet address or place it behind the firewall. If you place the Intellicom behind the firewall, you need to configure the firewall to translate and forward packets from the Internet to the Intellicom.

5.7 How to Set IP Addresses in the Sample Programs

Most of the sample programs such as shown in the example below use macros to define the IP address assigned to the board and the IP address of the gateway, if there is a gateway.

```
#define MY_IP_ADDRESS "216.112.116.155"
#define MY_NETMASK "255.255.255.248"
#define MY_GATEWAY "216.112.116.153"
```

In order to do a direct connection the following IP addresses can be used for the Intellicom board:

```
#define MY_IP_ADDRESS "10.1.1.2"
#define MY_NETMASK "255.255.255.248"
// #define MY_GATEWAY "216.112.116.153"
```

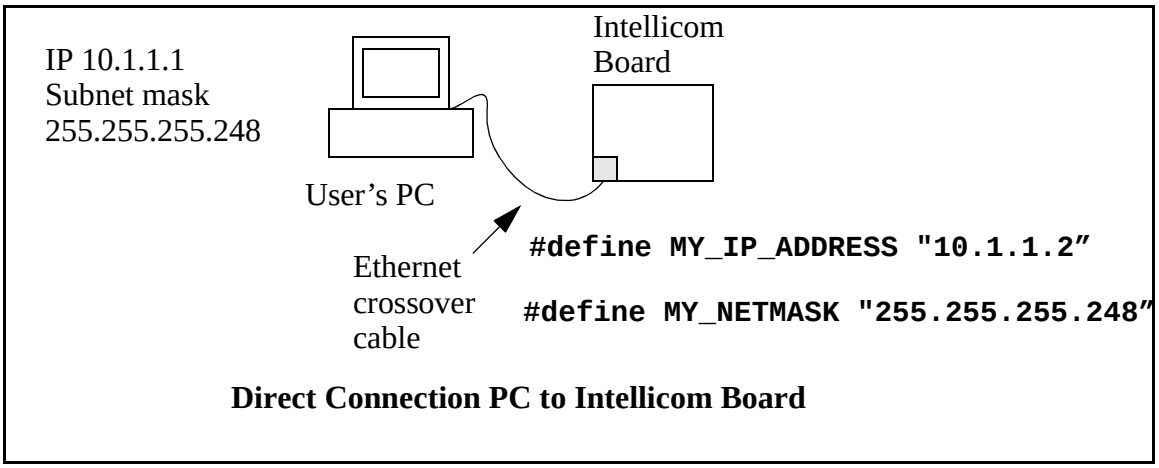
In this case, the gateway is not used and is commented out. The IP address of the board is defined to be 10.1.1.2. The IP address of your PC can be defined as 10.1.1.1.

5.8 How to Set Up your Computer's IP Address For Direct Connect

When your computer is connected directly to the Intellicom board via an Ethernet connection, you need to assign an IP address to your computer. To assign the PC the address 10.1.1.1 with the subnetmask 255.255.255.248 under Windows 98, do the following.

Click on **Start > Settings > Control Panel** to bring up the Control Panel, and then double-click the Network icon. In the window find the line of the form **TCP/IP > Ethernet adapter name**. Double-click on this line to bring up the TCP/IP properties dialog box. You can edit the IP address directly and the subnet mask. (Disable "obtain an IP address automatically.") You may want to write down the existing values in case you have to restore them later. It is not necessary to edit the gateway address since the gateway is not used with direct connect.

The method of setting the IP address may differ for different versions of Windows, such as 95, NT or 2000.



Direct Connection PC to Intellicom Board

5.9 Run the PINGME.C Demo

In order to run this program, edit the IP address and netmask in the **PINGME.C** program (**SAMPLES\TCPIP\ICMP**) to the values given above (10.1.1.2 and 255.255.255.248). Compile the program and start it running under Dynamic C. The crossover cable is connected from your computer's Ethernet adapter to the Intellicom board's RJ-45 Ethernet connector. When the program starts running, the green LNK light on the Intellicom board should be on to indicate an Ethernet connection is made. (Note: If the LNK light does not light, you may not have a crossover cable, or if you are using a hub perhaps the power is off on the hub.)

The next step is to ping the board from your PC. This can be done by bringing up the MS-DOS window and running the pingme program:

```
ping 10.1.1.2
```

or by **Start** > **Run**

and typing the entry

```
ping 10.1.1.2
```

Notice that the red ACT light flashes on the Intellicom board while the ping is taking place, and indicates the transfer of data. The ping routine will ping the board four times and write a summary message on the screen describing the operation.

5.10 Running More Demo Programs With a Direct Connection

The programs **STATIC.C** and **SSI3.C** (**SAMPLES\TCPIP\HTTP**) demonstrate how to make the Intellicom board be a Web server. This program allows you to turn the LEDs on an attached Demonstration Board from the Development Kit on and off from a remote Web browser. In order to run these sample programs, edit the IP address as for the pingme program, compile the program and start it executing. Then bring up your Web browser and enter the following server address: http://10.1.1.2.

This should bring up the Web page served by the sample program.

The sample program **RXSAMPLE.C** (**SAMPLES\TELNET**) allows you to communicate with the Intellicom board using the Telnet protocol. To run this program, edit the IP address, compile the program, and start it running. Run the Telnet program on your PC (**Start > Run** **telnet 10.1.1.2**). Each character you type will be printed in Dynamic C's **STDIO** window, indicating that the board is receiving the characters typed via TCP/IP.

5.11 Where Do I Go From Here?

NOTE: If you purchased your OP6800 through a distributor or Z-World partner, contact the distributor or Z-World partner first for technical support.

If there are any problems at this point:

- Check the Z-World Technical Bulletin Board at www.zworld.com/support/bb/.
- Use the Technical Support e-mail form at www.zworld.com/support/support_submit.html.
- Call Z-World Technical Support at (530)757-3737.

If the sample programs ran fine, you are now ready to go on.

Refer to the ***Dynamic C TCP/IP User's Manual*** to develop your own applications. ***An Introduction to TCP/IP*** provides background information on TCP/IP, and is included on the CD, and is also available on Z-World's Web site.

LEGAL NOTICE

Z-WORLD PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE-SUPPORT DEVICES OR SYSTEMS UNLESS A SPECIFIC WRITTEN AGREEMENT REGARDING SUCH INTENDED USE IS ENTERED INTO BETWEEN THE CUSTOMER AND Z-WORLD PRIOR TO USE. Life-support devices or systems are devices or systems intended for surgical implantation into the body or to sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling and user's manual, can be reasonably expected to result in significant injury.

No complex software or hardware system is perfect. Bugs are always present in a system of any size. In order to prevent danger to life or property, it is the responsibility of the system designer to incorporate redundant protective mechanisms appropriate to the risk involved.

All Z-World products are 100 percent functionally tested. Additional testing may include visual quality control inspections or mechanical defects analyzer inspections. Specifications are based on characterization of tested sample units rather than testing over temperature and voltage of each unit. Z-World products may qualify components to operate within a range of parameters that is different from the manufacturer's recommended range. This strategy is believed to be more economical and effective. Additional testing or burn-in of an individual unit is available by special arrangement.

APPENDIX A. INTELLICOM SPECIFICATIONS

Appendix A provides the specifications for the Intellicom and describes the conformal coating.

A.1 Electrical and Mechanical Specifications

Figure A-1 shows the mechanical dimensions for the Intellicom board.

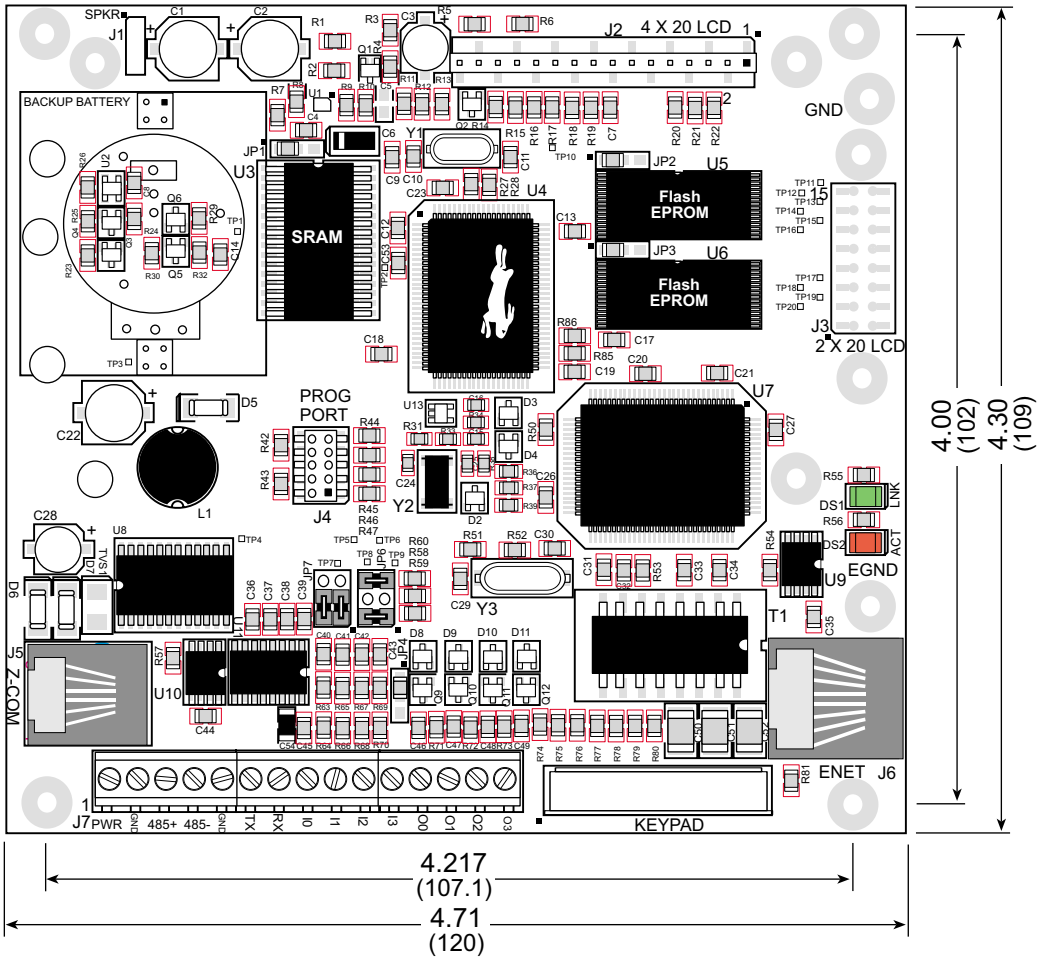


Figure A-1. Intellicom Board Dimensions

Table A-1 lists the electrical, mechanical, and environmental specifications for the Intellicom board.

Table A-1. Intellicom Board Specifications

Parameter	Specification
Board Size (with backup battery board)	4.30" × 4.71" × 0.80" (109 mm × 120 mm × 20.3 mm)
Enclosure Size	5.7" × 6.7" × 2.0" (145 mm × 170 mm × 51 mm)
Display	Supertwist 4 × 20 LCD with backlighting
Keypad	2 × 6 domed tactile keypad with customizable legend
Connectors	15 screw terminals, 1 RJ-12, and 1 RJ-45
Operating Temperature	0°C to +50°C
Storage Temperature	–20°C to +60°C
Humidity	5% to 95%, noncondensing
Input Voltage	9 V to 40 V DC
Current	100 mA @ 24 VDC typical (backlighting on)
Ethernet Interface	Direct connection to 10Base-T Ethernet networks via RJ-45 connection
Digital Inputs	4 protected, 0 V to 5 V DC (protection from –36 V to + 36 VDC max.)
Digital Outputs	4 open collector, sinking (200 mA, 40 V DC max.)
Speaker Output	Software-adjustable volume and frequency
Microprocessor	Rabbit 2000™
Clock	18.432 MHz
SRAM	128K, surface mount (supports 32K–512K)
Flash EPROM	256K for program and data plus 256K for file storage (supports 128K–512K)
Timers	7 eight-bit timers available
Serial Ports	• 1 RS-232 (3-wire), 1 RS-485, and 1 RS-232 programming port • RS-232 (3-wire) and RS-485 may be reconfigured for 1 RS-232 (5-wire) or 2 RS-232 (3-wire)
Serial Rate	Maximum asynchronous 115,200 bps for both serial ports
Watchdog/Supervisor	Yes

Table A-1. Intellicom Board Specifications (continued)

Parameter	Specification
Time/Date Clock	Yes
Backup Battery	On backup battery board, 1000 mA·h, BR2477A

A.2 Conformal Coating

The areas around the crystal oscillator and the battery-backup circuit on the Intellicom have had the Dow Corning silicone-based 1-2620 conformal coating applied. The conformally coated areas are shown in Figure A-2. The conformal coating protects these high-impedance circuits from the effects of moisture and contaiminants over time.

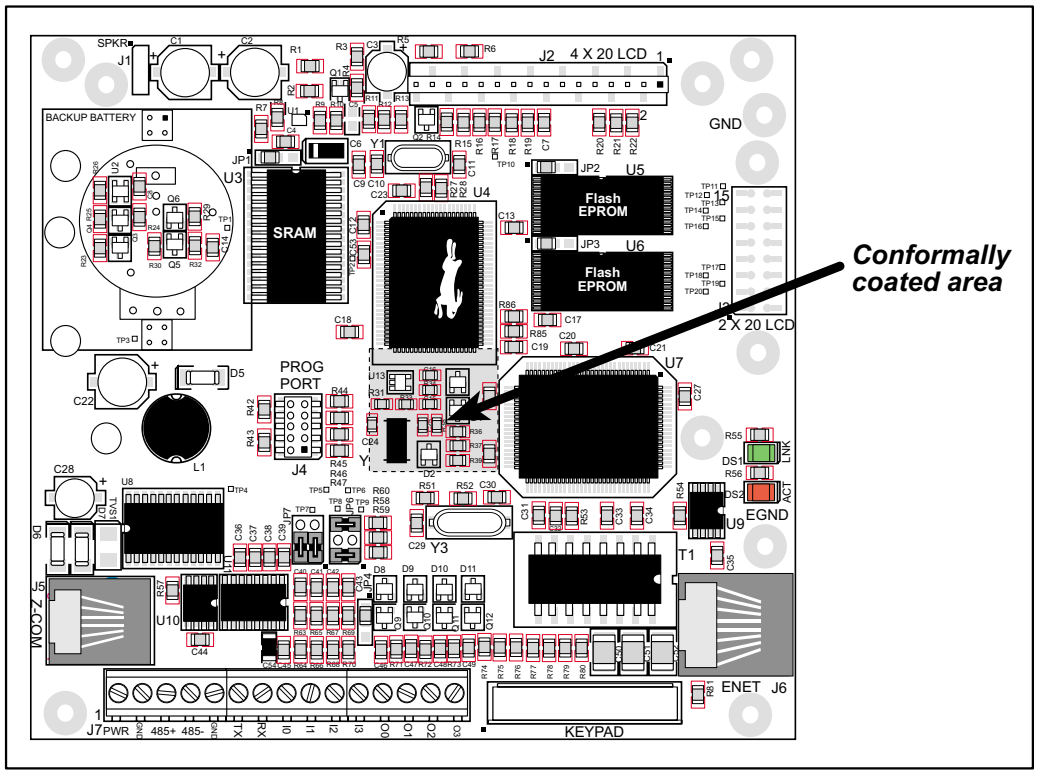


Figure A-2. Intellicom Areas Receiving Conformal Coating

Any components in the conformally coated area may be replaced using standard soldering procedures for surface-mounted components. A new conformal coating should then be applied to offer continuing protection against the effects of moisture and contaminants.

NOTE: For more information on conformal coatings, refer to Technical Note 303, ***Conformal Coatings***.

A.3 Jumper Configurations

Figure A-3 shows the header locations used to configure the various Intellicom options via jumpers.

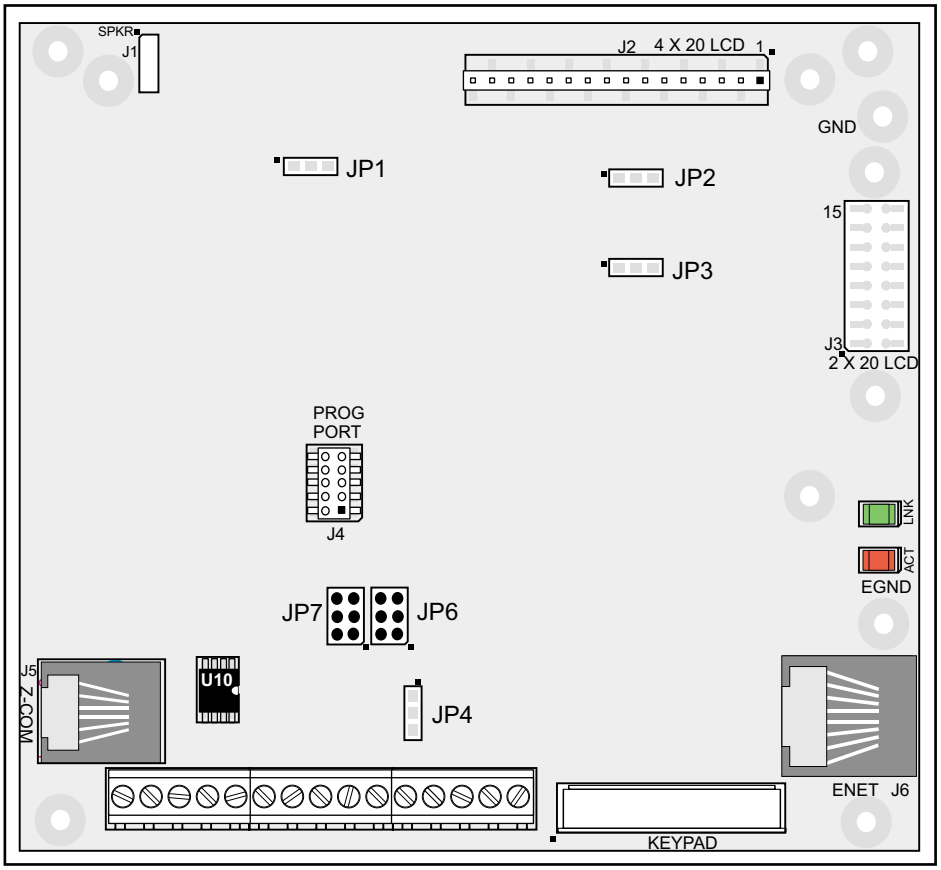


Figure A-3. Location of Intellicom Configurable Positions

Table A-2 lists the configuration options.

Table A-2. Intellicom Jumper Configurations

Header	Description	Pins Connected		Factory Default
JP1	SRAM Size	1–2	128K	✕
		2–3	512K	
		None	32K	
JP2	Flash 1 Memory Size (U5)	1–2	128K/256K	✕
		2–3	512K	
JP3	Flash 2 Memory Size (U6)	1–2	128K/256K	✕
		2–3	512K	
JP4	Digital Input Pull-Up/Pull-Down Resistors	1–2	Pulled up	✕
		2–3	Pulled down	
JP5	Flash Memory Bank Select	1–2	Normal Mode	✕
		2–3	Bank Mode	
JP6	RS-485 Bias and Termination Resistors	1–2 5–6	Bias and termination resistors connected	✕
		None	Bias and termination resistors ***not*** connected	
JP7	RS-232/RS-485 Select	1–3 2–4	RS-232 TxB/RxB (also TxC/RxC or RTS/CTS) signals on J7	
		3–5 4–6	RS-232 TxC/RxC and RS-485 signals on J7	✕
		1–5 2–6	RS-232 TxB/RxB signals on J5 (U10 must be removed)	

NOTE: Only headers JP6 and JP7 use actual jumpers. The other connections are made using 0 Ω surface-mounted resistors.

APPENDIX B.
KEYPAD AND PLASTIC ENCLOSURE

B.1 Keypad Insert

The keypad is designed to accept paper inserts prepared on regular paper. The templates shown below in Figure B-1 can be used to create custom inserts. The numbers shown on the upper template correspond to the codes returned by Dynamic C when that key is pressed.

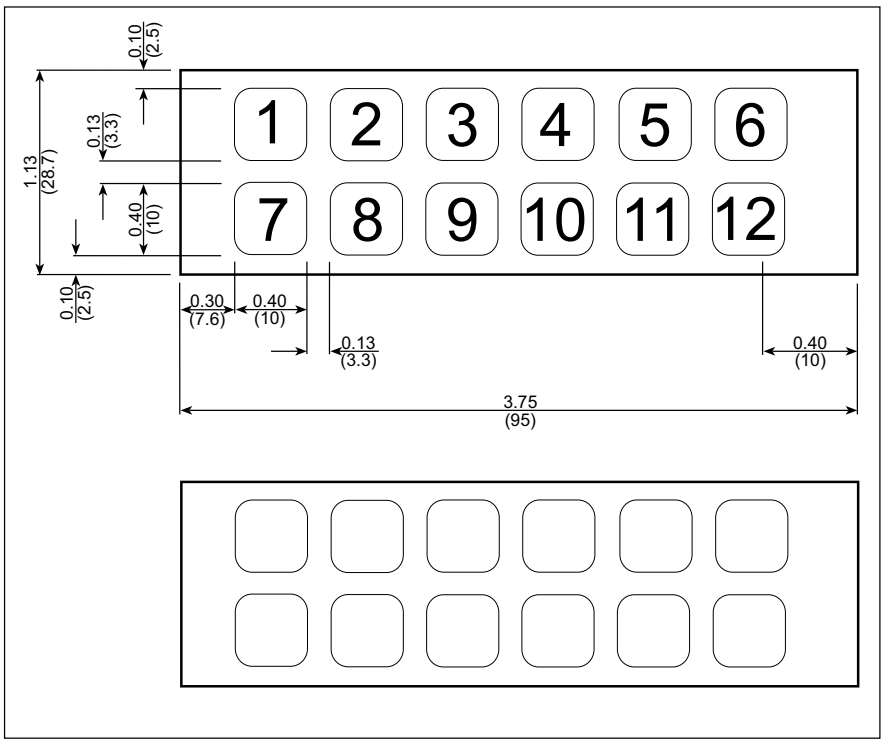


Figure B-1. Intellicom 2 × 6 Keypad Template

These instructions describe how to change the keypad insert.

1. Set the outer plastic casing aside and lay the front panel face down on a soft cloth so that the Intellicom board is facing up.
2. Unplug the speaker and the keypad as shown in Figure B-2.
3. Remove the four screws shown in Figure B-2 that hold the Intellicom board to the front panel.
4. Lift the Intellicom board up front the front panel and set it aside. Note that the LCD is attached permanently to the Intellicom board.
5. Remove the four screws shown in Figure B-3 that hold the keypad to the front panel.
6. Remove the old insert and place the new insert in between the keypad and the mylar front. You may tape down the portion of the insert that extends beyond the keypad.
7. Line up the keypad over the front panel and replace the four 2-56 screws as shown in Figure B-3. Line up the Intellicom board/LCD and replace the four screws as shown in Figure B-2. Reconnect the keypad and the speaker to the Intellicom board.

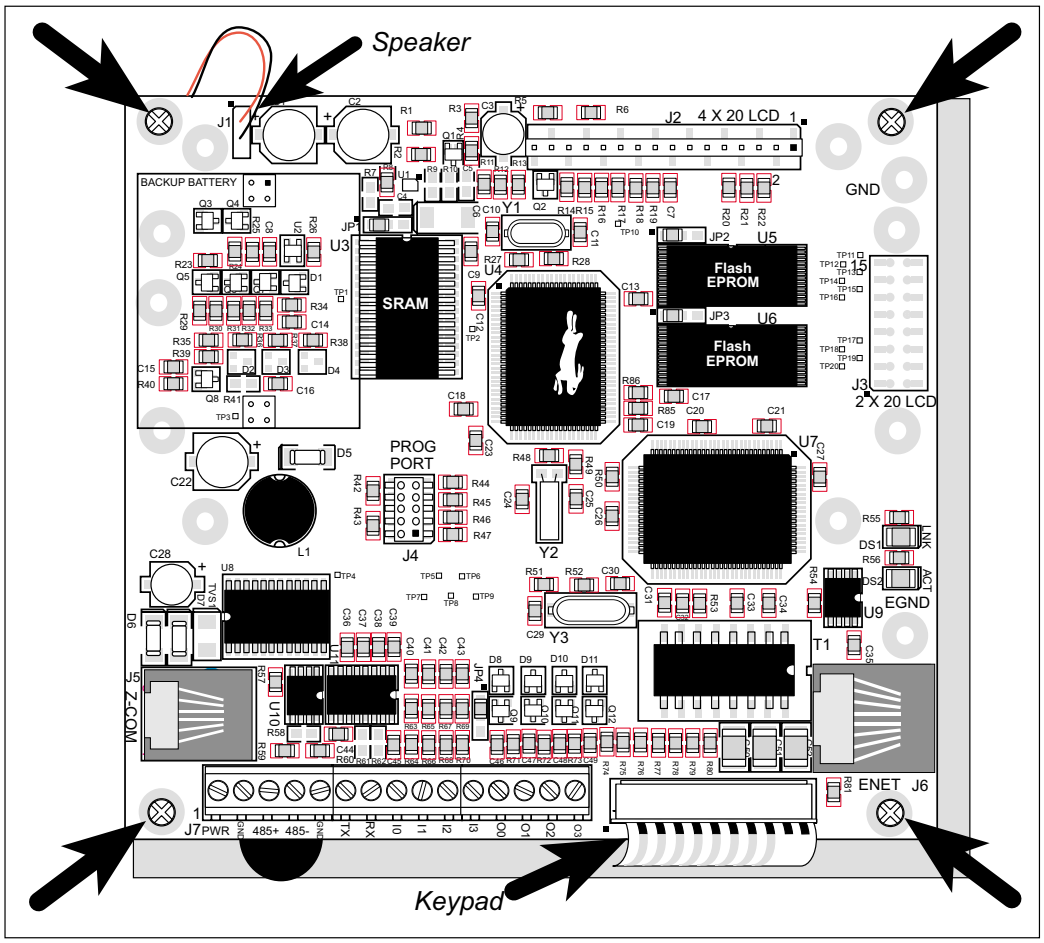


Figure B-2. Removing Intellicom Board from Front Panel

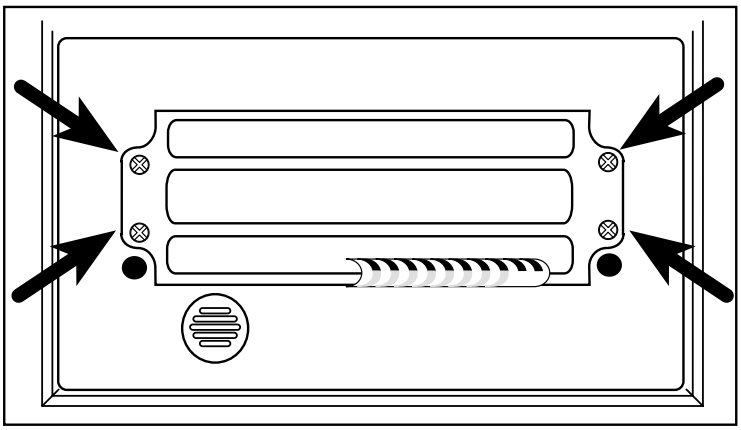


Figure B-3. Removing Keypad from Front Panel

B.2 Plastic Enclosure

Figure B-4 shows the dimensions of the Intellicom front panel bezel.

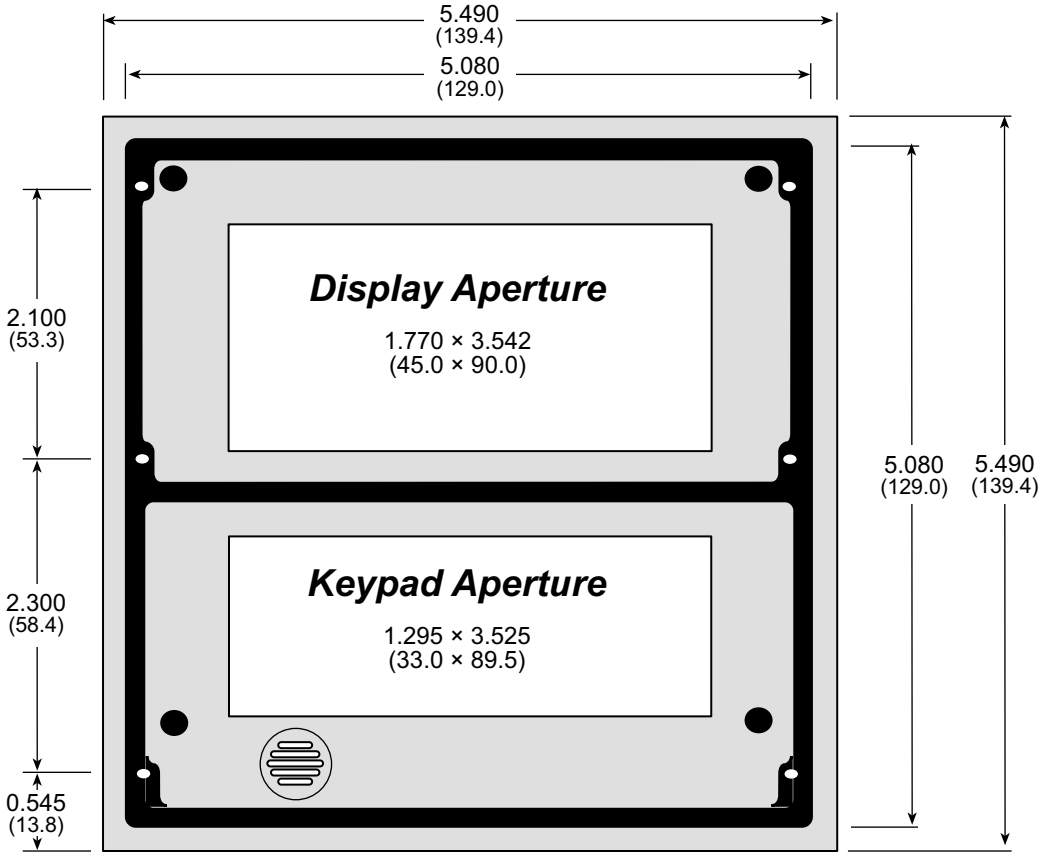


Figure B-4. Intellicom Front Panel Bezel Dimensions

Figure B-5 shows the dimensions of the outer casing, including the attached front panel.

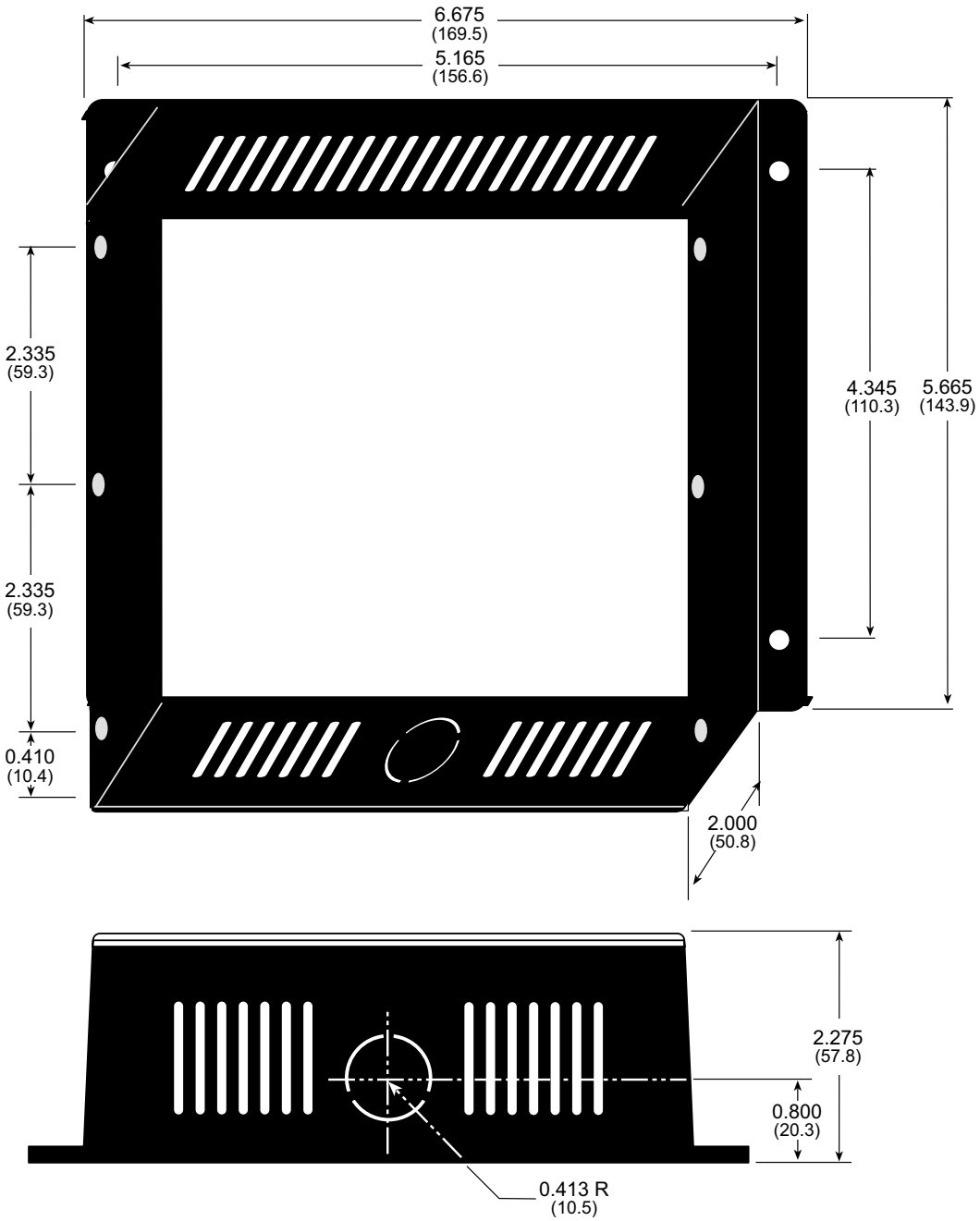


Figure B-5. Intellicom Outer Casing Dimensions

B.2.1 Assembling Intellicom Enclosure

There are two recommended assemblies possible for the Intellicom:

1. Mount the front panel bezel in an opening you have created. This option allows you to have a water-resistant unit by using the gasket supplied with the Intellicom to form a water-resistant seal between the front panel bezel and your opening.
2. Mount the front panel bezel using the outer casing supplied with the Intellicom.

B.2.1.1 Custom Mounting In An Opening

Prepare an opening to accommodate the Intellicom front panel bezel shown in Figure B-4. The thickness of the surface the Intellicom front bezel is mounted on should be either 0.0625 inches (1.6 mm) or 0.125 inches (3.2 mm). Use the brackets on the plastic tree included with the Intellicom (see Figure B-6) to attach the front panel bezel to the surface.

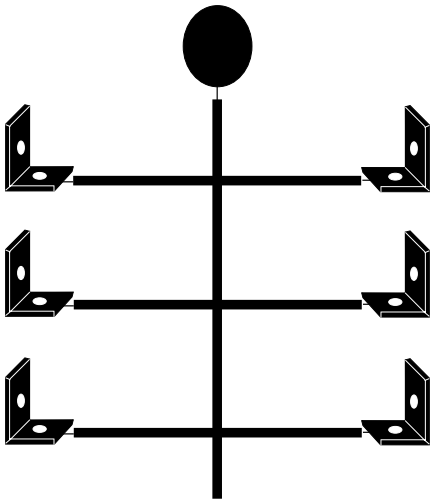


Figure B-6. Mounting Brackets and Speaker Plug

A watertight mounting is also possible.

First, remove the speaker from the front panel bezel, and insert the speaker plug to close the holes in the speaker grille. Apply some hot glue around the edges of the plug to form a watertight seal. Replace the speaker—a dab of glue around the edge of the speaker will hold it in place.

Place the rubber gasket supplied with the Intellicom between the front panel bezel and the surface the Intellicom will be mounted. A watertight seal will result when the brackets are attached.

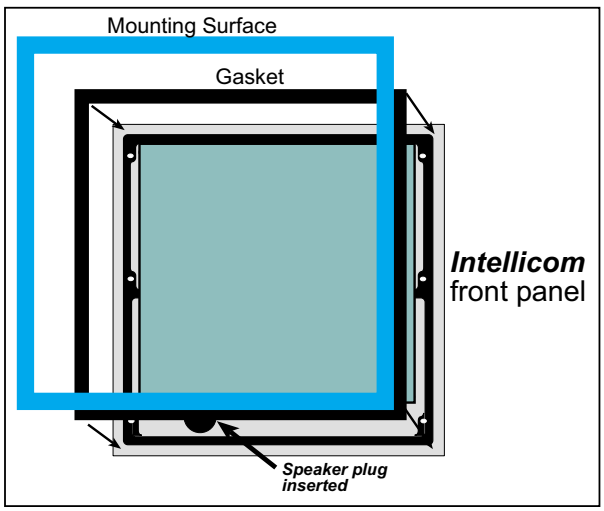


Figure B-7. Watertight Mounting of Intellicom

B.2.1.2 Supplied Outer Casing

Once the desired wires have been connected to header J7 on the Intellicom board, the Intellicom may be mounted in the plastic outer casing as shown in Figure B-8. Secure the plastic casing with the six screws supplied with the Intellicom

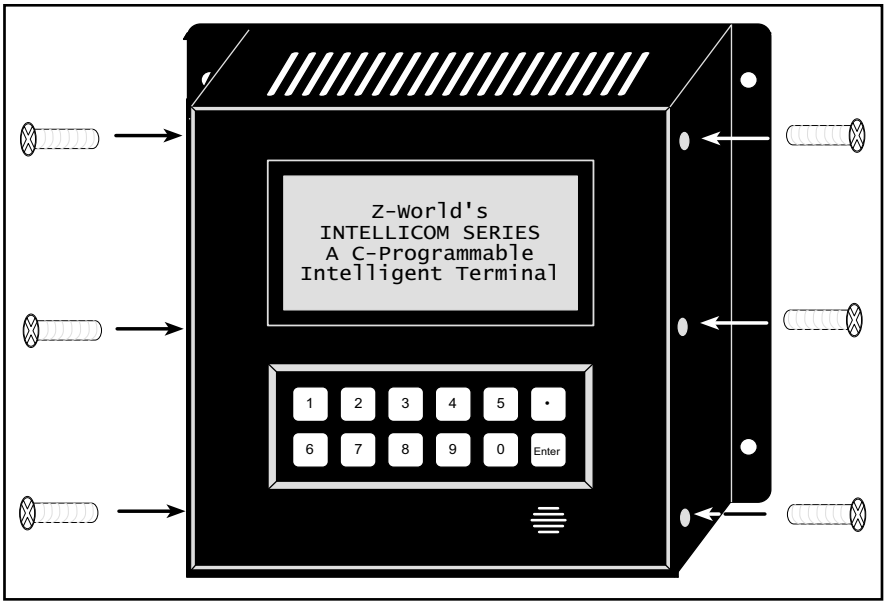


Figure B-8. Mounting Intellicom in Plastic Outer Casing

If you are using the RJ-45 jack at J6 for an Ethernet connection with the Intellicom installed in the plastic outer casing, remove the protective rubber boot around the Ethernet cable RJ-45 jack that plugs into the Intellicom board. This will ensure that the Ethernet cable can bend back within the depth of the plastic outer casing.

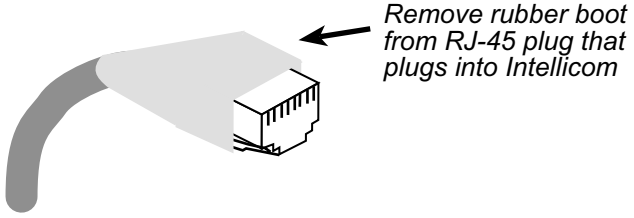


Figure B-9. Remove Rubber Boot from RJ-45 Connection to Intellicom

The outer casing has a knockout for a conduit on one side. The casing is symmetric, and so the conduit knockout can face up or down. Use a small hacksaw to remove the knockout if you are using a conduit. The conduit opening has an O.D. of 0.826 inches (21.0 mm), which accommodates standard trade size ½ or 17 mm diameter conduit.

When routing cables through the conduit, Z-World has found that an Ethernet cable (minus the rubber boot on the RJ-45 plug) should be routed first, followed by the RS-485 cable with the RJ-12 plug, followed by other wire.

Figure B-10 shows an Intellicom wired through a conduit.

Figure B-10. Rear View of Intellicom with Outer Casing Showing Wiring from Conduit

APPENDIX C. POWER MANAGEMENT

Appendix C describes the power circuitry distributed on the Intellicom.

C.1 Power Supplies

Power is supplied to the Intellicom board from an external source either through header J7 or from another Intellicom through header J5, the RJ-12 jack.

The Intellicom board itself is protected against reverse polarity by Shottky diodes at D6 and D7 as shown in Figure C-1. The Shottky diode has a low forward voltage drop, 0.3 V, which keeps the minimum DCIN required to power the Intellicom lower than a normal silicon diode would allow.

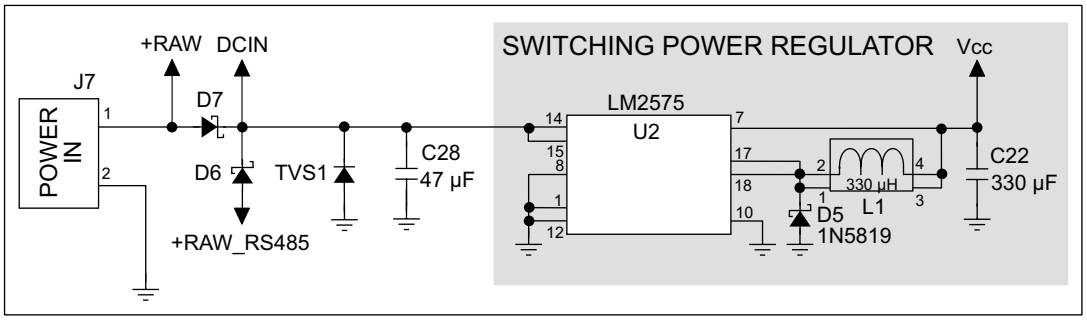


Figure C-1. Intellicom Power Supply Schematic

Capacitor C28 provides surge current protection for the voltage regulator, and allows the external power supply to be located some distance away from the Intellicom board. A switching power regulator is used. The input voltage range is from 9 V to 40 V.

C.2 Batteries and External Battery Connections

A battery board with a 1000 mA·h lithium coin cell provides power to the real-time clock and SRAM when external power is removed from the circuit. This allows the Intellicom to continue to keep track of time and preserves the SRAM memory contents.

Figure C-2 shows the battery-board circuit.

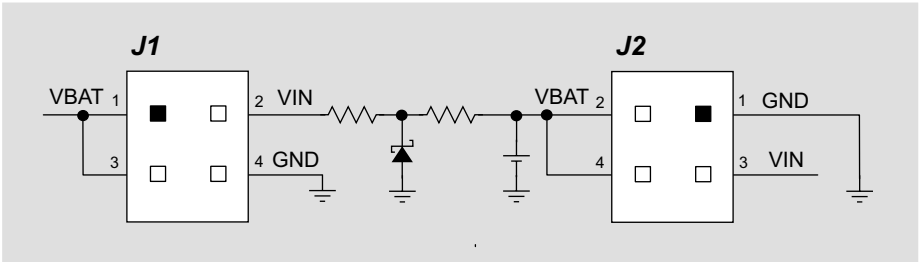


Figure C-2. Intellicom Backup-Battery Board

Alternatively, starting with the 175-0206 version of the Intellicom, there is provision to add a soldered-in battery directly on the Intellicom board.

The drain on the battery is typically less than 20 µA when there is no external power applied. The battery can last more than 5 years:

$$\frac{1000\ \text{mA·h}}{20\ \mu\text{A}} = 5.7\ \text{years.}$$

The drain on the battery is typically less than 4 µA when external power ***is*** applied. The battery can last for its full shelf life:

$$\frac{1000\ \text{mA·h}}{4\ \mu\text{A}} = 28.5\ \text{years (shelf life = 10 years).}$$

Since the shelf life of the battery is 10 years, the battery can last for its full shelf life when external power is applied to the Intellicom.

C.2.1 Battery-Backup Circuit

The battery-backup circuit serves two purposes:

- It reduces the battery voltage to the real-time clock, thereby reducing the current consumed by the real-time clock and lengthening the battery life.
- It ensures that current can flow only ***out*** of the battery to prevent charging the battery.

Figure C-3 shows the battery-backup circuitry on the Intellicom board.

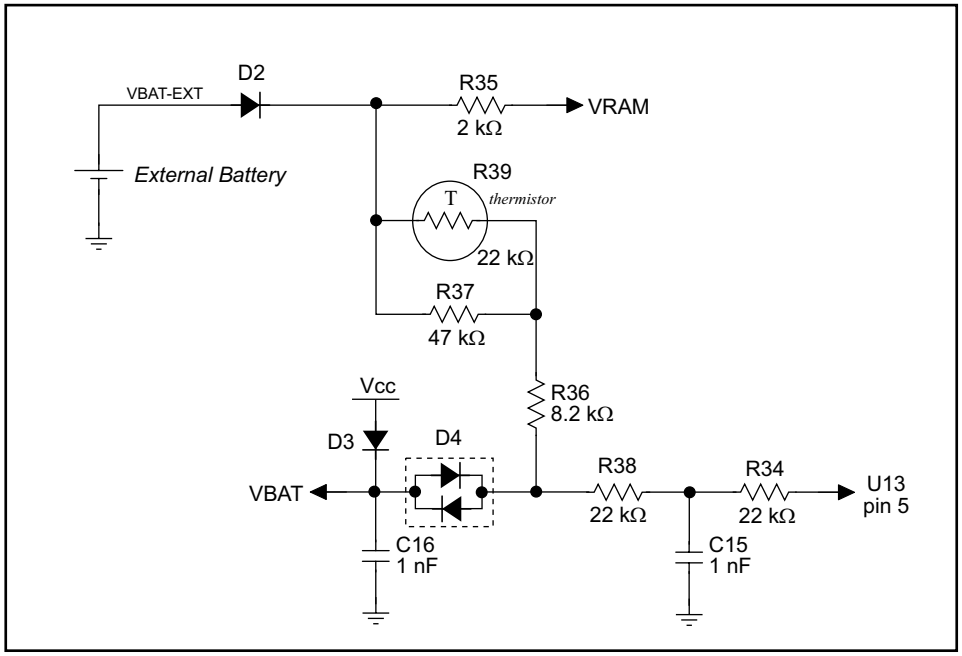


Figure C-3. Intellicom Battery-Backup Circuit

The battery-backup circuit serves three purposes:

- It reduces the battery voltage to the SRAM and to the real-time clock, thereby limiting the current consumed by the real-time clock and lengthening the battery life.
- It ensures that current can flow only ***out*** of the battery to prevent charging the battery.
- A voltage, VOSC, is supplied to U13, which keeps the 32.768 kHz oscillator working when the voltage begins to drop.

VRAM and Vcc are nearly equal (<100 mV, typically 10 mV) when power is supplied to the Intellicom. VRAM is also available on pin 34 of header J2 to facilitate battery backup of the external circuit. Note that the recommended minimum resistive load at VRAM is 100 kΩ, and new battery life calculations should be done to take external loading into account.

C.2.2 Power to VRAM Switch

The VRAM switch, shown in Figure C-4, allows the battery backup to provide power when the external power goes off. The switch provides an isolation between Vcc and the battery when Vcc goes low. This prevents the Vcc line from draining the battery.

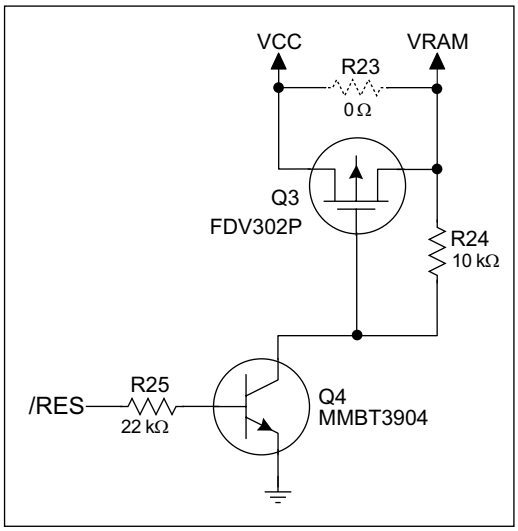


Figure C-4. VRAM Switch

Transistor Q3 is needed to provide a very small voltage drop between Vcc and VRAM (<100 mV, typically 10 mV) so that the processor lines powered by Vcc will not have a significantly different voltage than VRAM.

When the Intellicom is ***not*** resetting (pin 2 on U4 is high), the /RES line will be high. This turns on Q4, causing its collector to go low. This turns on Q3, allowing VRAM to nearly equal Vcc.

When the Intellicom ***is*** resetting, the /RES line will go low. This turns off Q3 and Q4, providing an isolation between Vcc and VRAM.

The battery-backup circuit keeps VRAM from dropping below 2 V.

C.2.3 Reset Generator

The Intellicom uses a reset generator, U2, to reset the Rabbit 2000 microprocessor when the voltage drops below the voltage necessary for reliable operation. The reset occurs between 4.50 V and 4.75 V, typically 4.63 V.

C.2.4 Replacing the Backup-Battery Board

The pluggable backup-battery board makes it easy to replace the backup battery with a fresh backup battery on another backup battery board. Before replacing the backup-battery board, make sure that the Intellicom is receiving power from the standard power supply. This makes sure that data in RAM are not lost when the battery-backup board is removed temporarily.

To replace the backup-battery board, remove the screw and unplug the old battery board as shown in Figure C-5.

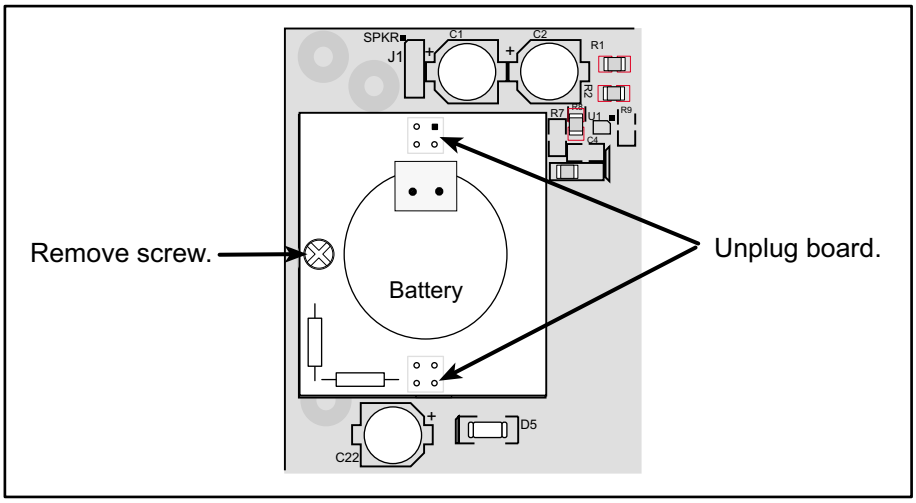


Figure C-5. Replacing Backup-Battery Board

Then align the replacement battery board over the outline, and plug it in. Be careful to align the connectors. Replace the screw.

Do ***not*** attempt to recharge the old battery and do ***not*** dispose of it in regular trash to avoid any risk of explosion or fire. You may either return the old backup-battery board to Z-World for recycling or send the battery yourself to an approved recycling facility.

C.3 Chip Select Circuit

Figure C-6 shows a schematic of the chip select circuit.

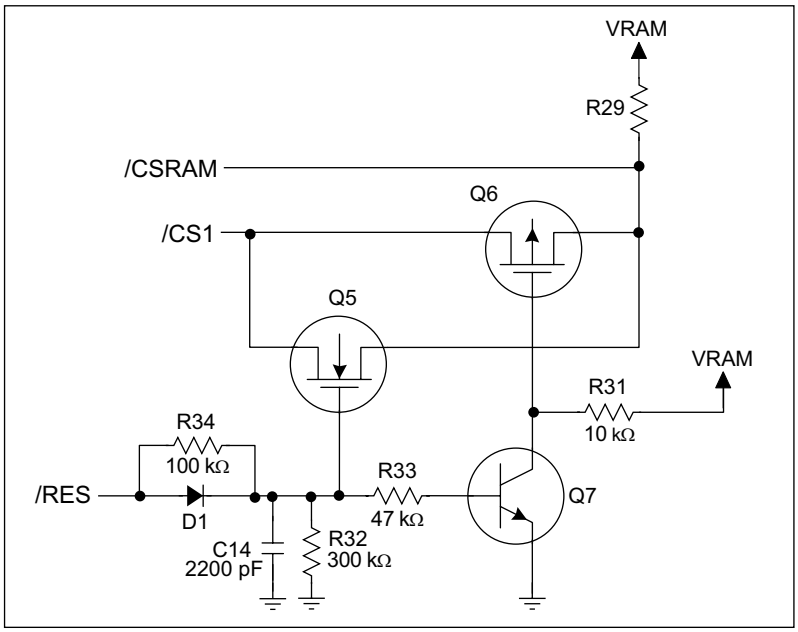


Figure C-6. Chip Select Circuit

The current drain on the battery in a battery-backed circuit must be kept at a minimum. When the Intellicom is not powered, the battery keeps the SRAM memory contents and the real-time clock (RTC) going. The SRAM has a powerdown mode that greatly reduces power consumption. This powerdown mode is activated by raising the chip select (CS) signal line. Normally the SRAM requires Vcc to operate. However, only 2 V is required for data retention in powerdown mode. Thus, when power is removed from the circuit, the battery voltage needs to be provided to both the SRAM power pin and to the CS signal line. The CS control circuit accomplishes this task for the CS signal line.

In a powered-up condition, the CS control circuit must allow the processor's chip select signal /CS1 to control the SRAM's CS signal /CSRAM. So, with power applied, /CSRAM must be the same signal as /CS1, and with power removed, /CSRAM must be held high (but only needs to be battery voltage high). Q5 and Q6 are MOSFET transistors with opposing polarity. They are both turned on when power is applied to the circuit. They allow the CS signal to pass from the processor to the SRAM so that the processor can periodically access the SRAM. When power is removed from the circuit, the transistors will turn off and isolate /CSRAM from the processor. The isolated /CSRAM line has a 100 kΩ pullup resistor to VRAM (R29). This pullup resistor keeps /CSRAM at the VRAM voltage level (which under no power condition is the backup battery's regulated voltage at a little more than 2 V).

Transistors Q5 and Q6 are of opposite polarity so that a rail-to-rail voltage can be passed. When the /CS1 voltage is low, Q5 will conduct. When the /CS1 voltage is high, Q6 will conduct. It takes time for the transistors to turn on, creating a propagation delay. This delay is typically very small, about 10 ns to 15 ns.

The signal that turns the transistors on is a high on the processor's reset line, /RES. When the Intellicom is not in reset, the reset line will be high, turning on n-channel Q5 and Q7. Q7 is a simple inverter needed to turn on Q6, a p-channel MOSFET. When a reset occurs, the /RES line will go low. This will cause C14 to discharge through R32 and R34. This small delay (about 160 µs) ensures that there is adequate time for the processor to write any last byte pending to the SRAM before the processor puts itself into a reset state. When coming out of reset, CS will be enabled very quickly because D1 conducts to charge capacitor C14.

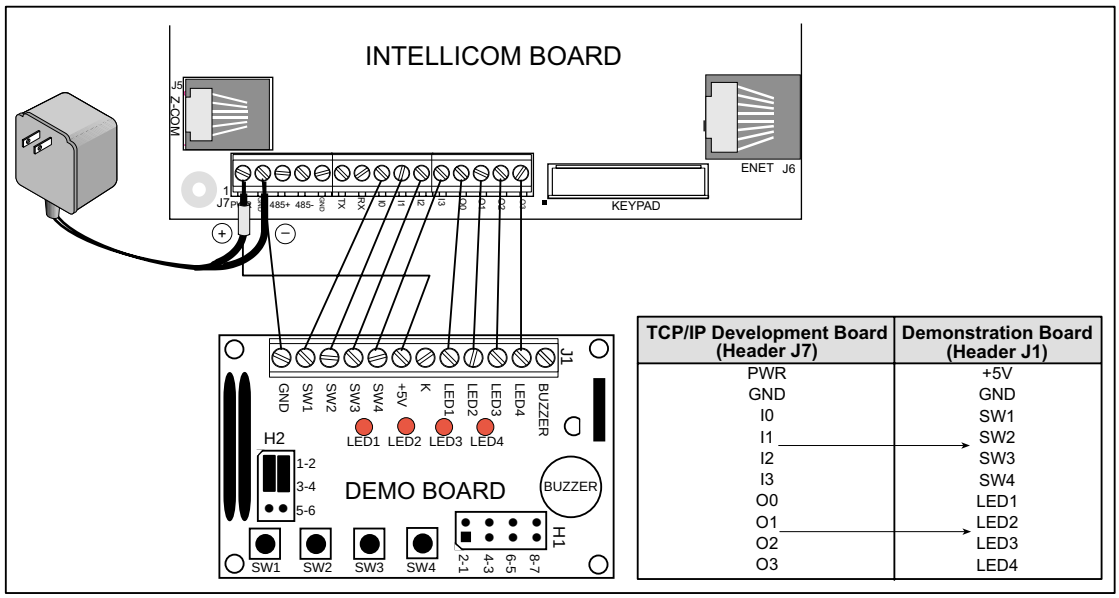
APPENDIX D. RUNNING SAMPLE PROGRAMS

Appendix D shows how to connect the Demonstration Board to the Intellicom board, and goes through a detailed look at one sample program and the associated features in Dynamic C.

D.1 Connecting Demonstration Board

Before running sample programs based on the Demonstration Board, you will have to connect the Demonstration Board from the Intellicom Development Kit to the Intellicom board. Proceed as follows.

1. Use the wires included in the Intellicom Tool Kit to connect header J1 on the Demonstration Board to header J7 on the Intellicom board. The connections are shown in Figure D-1.
2. Make sure that your Intellicom board is connected to your PC and that the power supply is connected to the Intellicom board and plugged in as described in Chapter 2, “Getting Started,”



TCP/IP Development Board (Header J7)	Demonstration Board (Header J1)
PWR	+5V
GND	GND
I0	SW1
I1	SW2
I2	SW3
I3	SW4
O0	LED1
O1	LED2
O2	LED3
O3	LED4

Figure D-1. Connections Between Intellicom Board and Demonstration Board

D.2 Running Sample Program DEMOBRD1.C

The sample program **DEMOBRD1.C** in the **SAMPLES\ICOM** folder will be used to illustrate some of the functions of Dynamic C.

Now, open **DEMOBRD1.C**. The program will appear in a window, as shown in Figure D-2 below (minus some comments). Use the mouse to place the cursor on the function name **WrPortI** in the program and type **<ctrl-H>**. This will bring up a documentation box for the function **WrPortI**. In general, you can do this with all functions in Dynamic C libraries, including libraries you write yourself. Close the documentation box and continue.

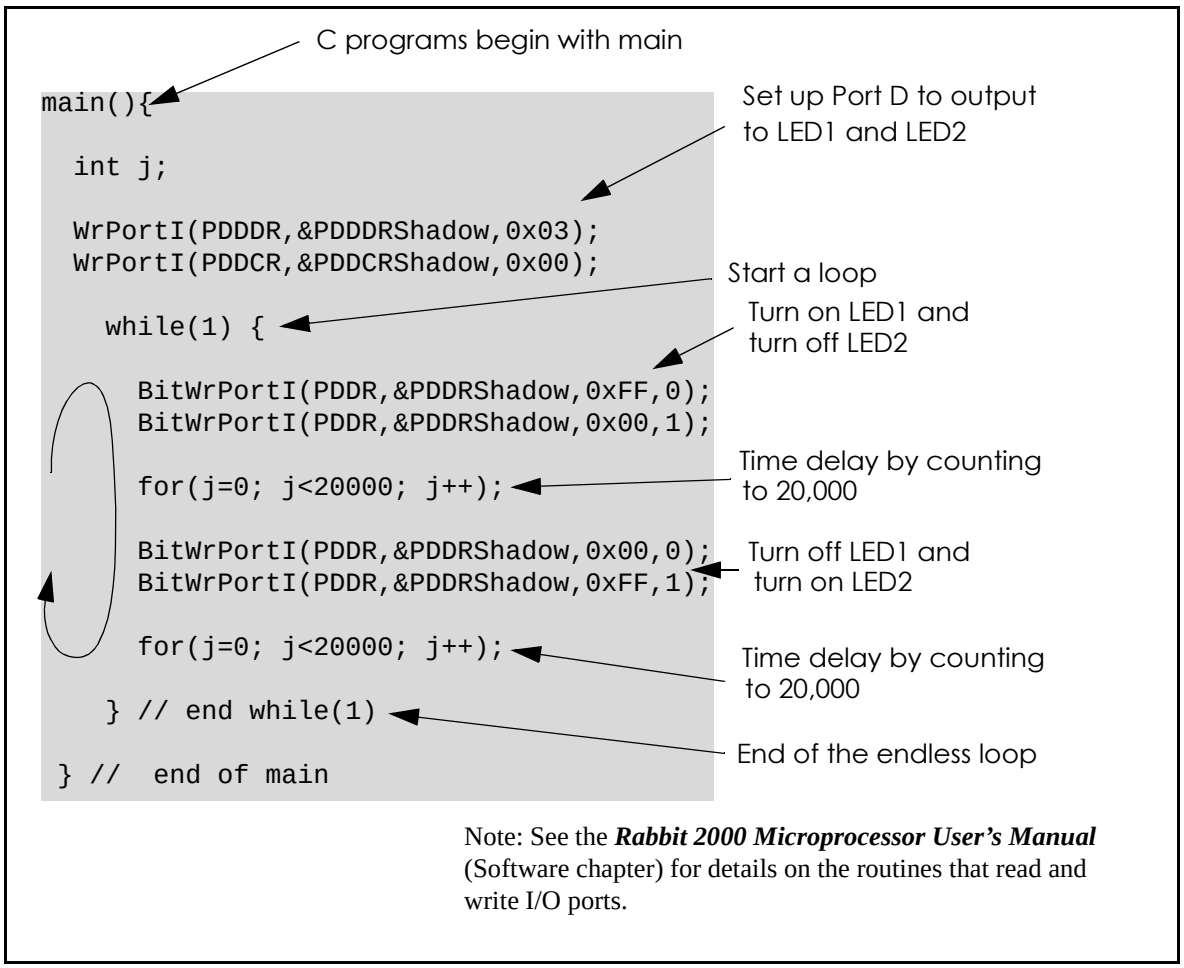


Figure D-2. Sample Program DEMOBRD1.C

To run the program **DEMOBRD1.C**, open it with the **File** menu, compile it using the **Compile** menu, and then run it by selecting **Run** in the **Run** menu. LED1 and LED2 on the Demonstration Board should start going on and off if everything went well. If this doesn't work, review the following points.

- The target should be ready, which is indicated by the message "BIOS successfully compiled..." If you did not receive this message or you get a communication error, recompile the BIOS by typing **<ctrl-Y>** or select **Recompile BIOS** from the **Compile** menu.

- A message reports “No Rabbit Processor Detected” in cases where the wall transformer is either not connected or is not plugged in.
- The programming cable must be connected to the Intellicom board. (The colored wire on the programming cable is closest to pin 1 on header J4 on the Intellicom board, as shown in Figure 1.) The other end of the programming cable must be connected to the PC serial port. The COM port specified in the Dynamic C **Options** menu must be the same as the one the programming cable is connected to.
- To check if you have the correct serial port, select **Compile**, then **Compile BIOS**, or type **<ctrl-Y>**. If the “BIOS successfully compiled …” message does not display, try a different serial port using the Dynamic C **Options** menu until you find the serial port you are plugged into. Don’t change anything in this menu except the COM number. The baud rate should be 115,200 bps and the stop bits should be 1.

D.2.1 Single-Stepping

Compile or re-compile **DEMOBRD1.C** by clicking the **Compile** button on the task bar. The program will compile and the screen will come up with a highlighted character (green) at the first executable statement of the program. Use the **F8** key to single-step. Each time the **F8** key is pressed, the cursor will advance one statement. When you get to the **for(j=0, j< ...** statement, it becomes impractical to single-step further because you would have to press **F8** thousands of times. We will use this statement to illustrate watch expressions.

D.2.1.1 Watch Expression

Type **<ctrl-W>** or chose **Add/Del Watch Expression** in the **Inspect** menu. A box will come up. Type the lower case letter j and click on *add to top* and *close*. Now continue single-stepping with **F8**. Each time you step, the watch expression (**j**) will be evaluated and printed in the watch window. Note how the value of **j** advances when the statement **j++** is executed.

D.2.1.2 Break Point

Move the cursor to the start of the statement:

```
for(j=0; j<20000; j++);
```

To set a break point on this statement, type **F2** or select **Breakpoint** from the **Run** menu. A red highlight will appear on the first character of the statement. To get the program running at full speed, type **F9** or select **Run** on the **Run** menu. The program will advance until it hits the break point. The break point will start flashing both red and green colors. Note that LED1 on the Demonstration Board is now solidly turned on. This is because we have passed the statement turning on LED1.

To remove the break point, type **F2** or select **Toggle Breakpoint** on the **Run** menu. To continue program execution, type **F9** or select **Run** from the **Run** menu. Now LED1 should be flashing again because the program is running at full speed.

You can set break points while the program is running by positioning the cursor to a statement and using the **F2** key. If the execution thread hits the break point, a break point will

take place. You can toggle the break point off with the **F2** key and continue execution with the **F9** key. Try this a few times to get the feel of things.

D.2.1.3 Editing the Program

Click on the **Edit** box on the task bar. This will set Dynamic C into the edit mode so that you can change the program. Use the **Save as** choice on the **File** menu to save the file with a new name so as not to change the demo program. Save the file as **MYTEST.C**. Now change the number 20000 in the **for (..** statement to 10000. Then use the **F9** key to recompile and run the program. The LEDs will start flashing, but it will flash much faster than before because you have changed the loop counter terminal value from 20000 to 10000.

D.2.1.4 Watching Variables Dynamically

Go back to edit mode (select edit) and load the program **DEMOBRD2.C** using the **File** menu **Open** command. This program is the same as the first program, except that a variable **k** has been added along with a statement to increment **k** each time around the endless loop. The statement:

```
runwatch();
```

has been added. This is a debugging statement that makes it possible to view variables while the program is running.

Use the **F9** key to compile and run **DEMOBRD2.C**. Now type **<ctrl-W>** to open the watch window and add the watch expression **k** to the top of the list of watch expressions. Now type **<ctrl-U>**. Each time you type **<ctrl-U>**, you will see the current value of **k**, which is incrementing about 5 times a second.

As an experiment add another expression to the watch window:

```
k*5
```

Then type **<ctrl-U>** several times to observe the watch expressions **k** and **k*5**.

D.2.1.5 Summary of Features

So far you have practiced using the following features of Dynamic C.

- Loading, compiling and running a program. When you load a program it appears in an edit window. You can compile by selecting **Compile** on the task bar or from the **Compile** menu. When you compile the program, it is compiled into machine language and downloaded to the target over the serial port. The execution proceeds to the first statement of main where it pauses, waiting for you to command the program to run, which you can do with the **F9** key or by selecting **Run** on the **Run** menu. If want to compile and start the program running with one keystroke, use **F9**, the run command. If the program is not already compiled, the run command will compile it first.
- Single-stepping. This is done with the **F8** key. The **F7** key can also be used for single-stepping. If the **F7** key is used, then descent into subroutines will take place. With the **F8** key the subroutine is executed at full speed when the statement that calls it is stepped over.

- Setting break points. The **F2** key is used to turn on or turn off (toggle) a break point at the cursor position if the program has already been compiled. You can set a break point if the program is paused at a break point. You can also set a break point in a program that is running at full speed. This will cause the program to break if the execution thread hits your break point.
- Watch expressions. A watch expression is a C expression that is evaluated on command in the watch window. An expression is basically any type of C formula that can include operators, variables and function calls, but not statements that require multiple lines such as *for* or *switch*. You can have a list of watch expressions in the watch window. If you are single-stepping, then they are all evaluated on each step. You can also command the watch expression to be evaluated by using the **<ctrl-U>** command. When a watch expression is evaluated at a break point, it is evaluated as if the statement was at the beginning of the function where you are single-stepping. If your program is running you can also evaluate watch expressions with a **<ctrl-U>** if your program has a **`rundwatch()`** command that is frequently executed. In this case, only expressions involving global variables can be evaluated, and the expression is evaluated as if it were in a separate function with no local variables.

D.2.2 Cooperative Multitasking

Cooperative multitasking is a convenient way to perform several different tasks at the same time. An example would be to step a machine through a sequence of steps and at the same time independently carry on a dialog with the operator via a human interface. Cooperative multitasking differs from a different approach called preemptive multitasking. Dynamic C supports both types of multitasking. In cooperative multitasking each separate task voluntarily surrenders its compute time when it does not need to perform any more activity immediately. In preemptive multitasking control is forcibly removed from the task via an interrupt.

Dynamic C has language extensions to support multitasking. The major C constructs are called *costatements, cofunctions,* and *slicing*. These are described more completely in the ***Dynamic C Premier User's Manual***. The example below, sample program **`DEMOBRD3.C`**, uses costatements. A costatement is a way to perform a sequence of operations that involve pauses or waits for some external event to take place. A complete description of costatements is in the ***Dynamic C Premier User's Manual***. The **`DEMOBRD3.C`** sample program has two independent tasks. The first task flashes LED2 once a second. The second task uses button SW1 on the Demonstration Board to toggle the logical value of a virtual switch, **`vswitch`**, and flash LED1 each time the button is pressed. This task also debounces button SW1.

Note that the Demonstration Board has to be connected to the Intellicom board as described in Section D.1 to be able to run **`DEMOBRD3.C`**.

```
main() {
    int vswitch;        // state of virtual switch controlled by button S1

    WrPortI(PDDDR, &PDDDRShadow, 0x03); // set port D bits 0-1 as outputs
    WrPortI(PDDCR, &PDDCRShadow, 0x00); // set port D to not open drain mode
    vswitch = 0;                        // initialize virtual switch as off

(1) while (1) {                         // endless loop

        // First task will flash LED4 for 200 ms once per second.

(2)     costate {
            BitWrPortI(PDDR, &PDDRShadow, 0xFF, 1);    // turn LED on
(3)         waitfor(DelayMs(200));                     // wait 200 ms
            BitWrPortI(PDDR, &PDDRShadow, 0x00, 1);    // turn LED off
            waitfor(DelayMs(800));                     // wait 800 ms
(4)     }

        // Second task - debounce SW1 and toggle vswitch

        costate {
(5)         if (!BitRdPortI(PDDR, 2)) abort; // if button not down skip out
            waitfor(DelayMs(50));            // wait 50 ms
            if(!BitRdPortI(PDDR, 2))  abort; // if button not still down exit

            vswitch = !vswitch;       // toggle since button was down 50 ms

            while (1) {
                waitfor(!BitRdPortI(PDDR, 2));  // wait for button to go up
                waitfor(DelayMs(200));          // wait additional 200 ms
                if (!BitRdPortI(PDDR, 2))
                    break;    // if button still up break out of while loop
            }
        }                     // end of costate

        // make LED1 agree with vswitch

(6)     BitWrPortI(PDDR, &PDDRShadow, vswitch, 0);

(7) }   // end of while loop
}       // end of main
```

The numbers in the left margin are reference indicators, and are not a part of the code. Load and run the program. Note that LED2 flashes once per second. Push button SW1 several times and note how LED1 is toggled.

The flashing of LED2 is performed by the costatement starting at the line marked (2). Costatements need to be executed regularly, often at least every 25 ms. To accomplish this, the costatements are enclosed in a **`while`** loop. The term **`while`** loop is used as a handy way to describe a style of real-time programming in which most operations are done in one loop. The while loop starts at (1) and ends at (7).

The statement at (3) waits for a time delay, in this case 200 ms. The costatement is being executed on each pass through the big loop. When a **waitfor** condition is encountered the first time, the current value of **MS_TIMER** is saved and then on each subsequent pass the saved value is compared to the current value. If a **waitfor** condition is not encountered, then a jump is made to the end of the costatement (4), and on the next pass of the loop, when the execution thread reaches the beginning of the costatement, execution passes directly to the **waitfor** statement. Once 200 ms has passed, the statement after the waitfor is executed. The costatement has the property that it can wait for long periods of time, but not use a lot of execution time. Each costatement is a little program with its own statement pointer that advances in response to conditions. On each pass through the big loop, as little as one statement in the costatement is executed, starting at the current position of the costatement's statement pointer. Consult the ***Dynamic C Premier User's Manual*** for more details.

The second costatement in the program debounces the switch and maintains the variable **vswitch**. Debouncing is performed by making sure that the switch is either on or off for a long enough period of time to ensure that high-frequency electrical hash generated when the switch contacts open or close does not affect the state of the switch. The **abort** statement is illustrated at (5). If executed, the internal statement pointer is set back to the first statement within the costatement, and a jump to the closing brace of the costatement is made.

At (6) a use for a shadow register is illustrated. A shadow register is used to keep track of the contents of an I/O port that is write only - it can't be read back. If every time a write is made to the port the same bits are set in the shadow register, then the shadow register has the same data as the port register. In this case a test is made to see the state of the LED and make it agree with the state of vswitch. This test is not strictly necessary, the output register could be set every time to agree with vswitch, but it is placed here to illustrate the concept of a shadow register.

To illustrate the use of snooping, use the watch window to observe **vswitch** while the program is running. Add the variable **vswitch** to the list of watch expressions. Then toggle **vswitch** and the LED. Then type **<ctrl-U>** to observe **vswitch** again.

D.2.3 Advantages of Cooperative Multitasking

Cooperative multitasking, as implemented with language extensions, has the advantage of being intuitive. Unlike preemptive multitasking, variables can be shared between different tasks without having to take elaborate precautions. Sharing variables between tasks is the greatest cause of bugs in programs that use preemptive multitasking. It might seem that the biggest problem would be response time because of the big loop time becoming long as the program grows. Our solution for that is a device caused slicing that is further described in the ***Dynamic C Premier User's Manual***.

APPENDIX E. PROGRAMMING CABLE

Appendix E provides additional information for the Rabbit 2000™ microprocessor when using the **DIAG** and **PROG** connectors on the programming cable. The **PROG** connector is used only when the programming cable is attached to the programming connector (header J4) while a new application is being developed. Otherwise, the **DIAG** connector on the programming cable allows the programming cable to be used as an RS-232 to CMOS level converter for serial communication, which is appropriate for monitoring or debugging an Intellicom system while it is running.

The programming port, which is shown in Figure E-1, can serve as a convenient communications port for field setup or other occasional communication need (for example, as a diagnostic port). If the port is simply to perform a setup function, that is, write setup information to flash memory, then the controller can be reset through the programming port and a cold boot performed to start execution of a special program dedicated to this functionality.

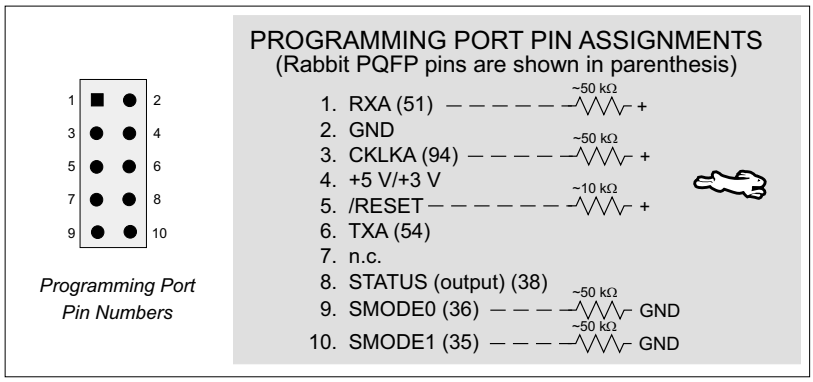


Figure E-1. Programming Port Pin Assignments

When the **PROG** connector is used, the /RESET line can be asserted by manipulating DTR and the STATUS line can be read as DSR on the serial port. The target can be restarted by pulsing reset and then, after a short delay, sending a special character string at 2400 bps. To simply restart the BIOS, the string 80h, 24h, 80h can be sent. When the BIOS is started, it can tell whether the programming cable is connected because the SMODE1 and SMODE0 pins are sensed as being high. This will cause the Rabbit 2000 to enter the bootstrap mode. The Dynamic C programming mode then can have an escape message that will enable the diagnostic serial port function.

Alternatively, the **DIAG** connector can be used to connect the programming port. The /RESET line and the SMODE1 and SMODE0 pins are not connected to this connector. The programming port is then enabled as a diagnostic port by polling the port periodically to see if communication needs to begin or to enable the port and wait for interrupts. The pull-up resistors on RXA and CLKA prevent spurious data reception that might take place if the pins floated.

If the clocked serial mode is used, the serial port can be driven by having two toggling lines that can be driven and one line that can be sensed. This allows a conversation with a device that does not have an asynchronous serial port but that has two output signal lines and one input signal line.

The line TXA (also called PC6) is zero after reset if the cold-boot mode is not enabled. A possible way to detect the presence of a cable on the programming port is for the cable to connect TXA to one of the SMODE pins and then test for the connection by raising PC6 (by configuring it as a general output bit) and reading the SMODE pin after the cold-boot mode has been disabled. The value of the SMODE pin is read from the SPCR register.

Once you establish that the programming port will never again be needed for programming, it is possible to use the programming port for additional I/O lines. Table E-1 lists the pins available for this alternate configuration.

Table E-1. Intellicom Programming Port Pinout Configurations

Pin	Pin Name	Default Use	Alternate Use	Notes
1	RXA	Serial Port A	PC6—Input	
2	GND			
3	CLKA		PB1—Bitwise or parallel programmable input	
4	VCC			
5	RESET			Connected to reset generator U4
6	TXA	Serial Port A	PC7—Output	
8	STATUS		Output	
9	SMODE0		Input	Must be low when BL2000 boots up
10	SMODE1		Input	Must be low when BL2000 boots up

INDEX

M

O

P

R

S

T

V

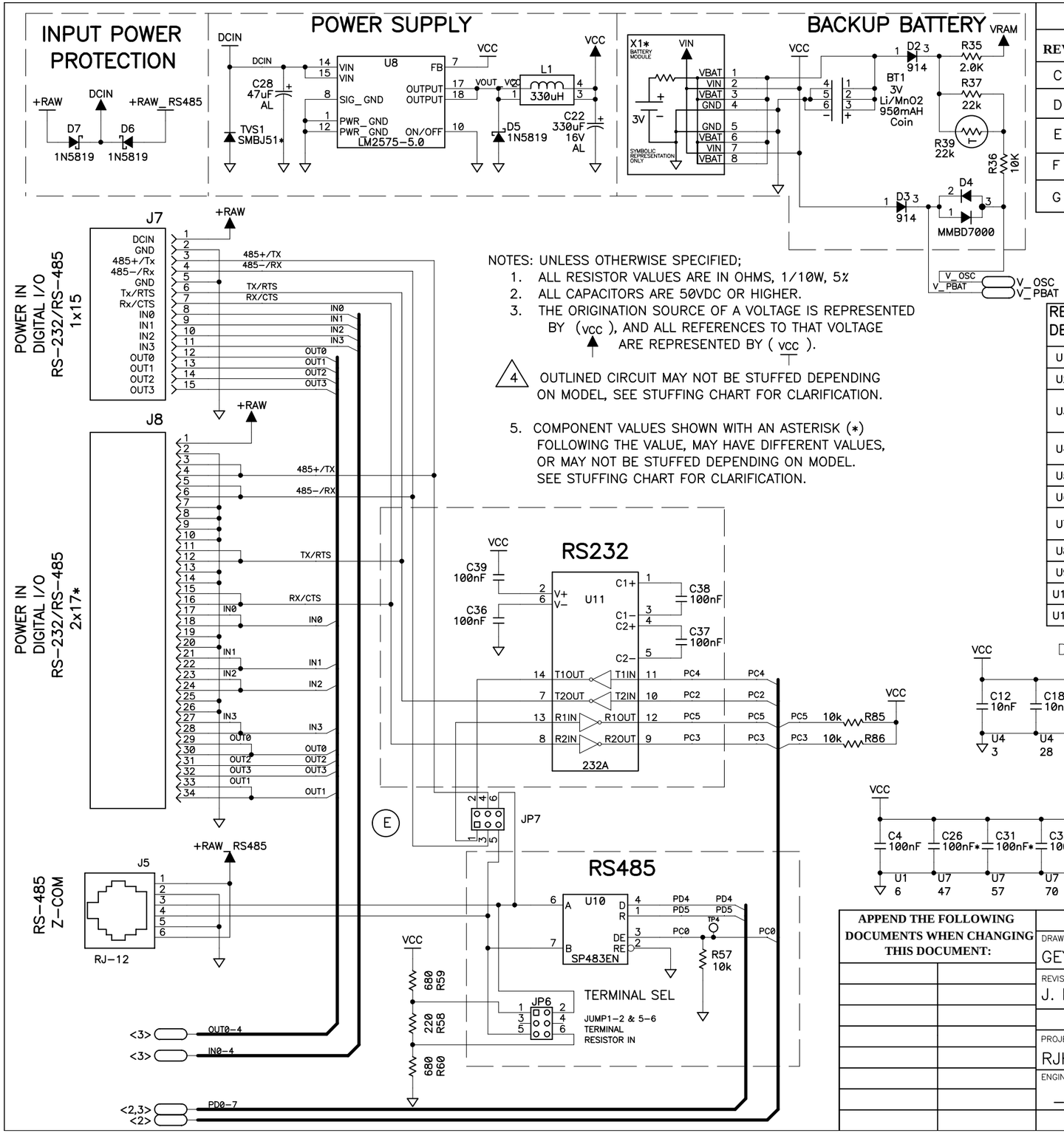
W

SCHEMATICS

090-0095 Intellicom Schematic

090-0042 Demonstration Board Schematic

090-0128 Programming Cable Schematic



NOTES: UNLESS OTHERWISE SPECIFIED;

1. ALL RESISTOR VALUES ARE IN OHMS, 1/10W, 5%
2. ALL CAPACITORS ARE 50VDC OR HIGHER.
3. THE ORIGINATION SOURCE OF A VOLTAGE IS REPRESENTED BY (VCC), AND ALL REFERENCES TO THAT VOLTAGE ARE REPRESENTED BY (VCC).

4 OUTLINED CIRCUIT MAY NOT BE STUFFED DEPENDING ON MODEL, SEE STUFFING CHART FOR CLARIFICATION.

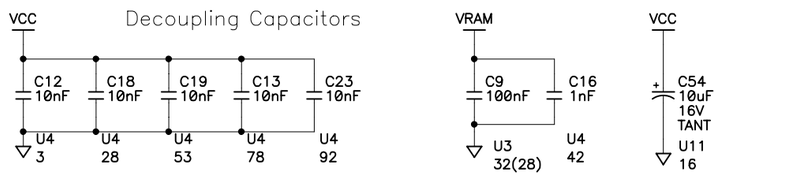
5. COMPONENT VALUES SHOWN WITH AN ASTERISK (*) FOLLOWING THE VALUE, MAY HAVE DIFFERENT VALUES, OR MAY NOT BE STUFFED DEPENDING ON MODEL. SEE STUFFING CHART FOR CLARIFICATION.

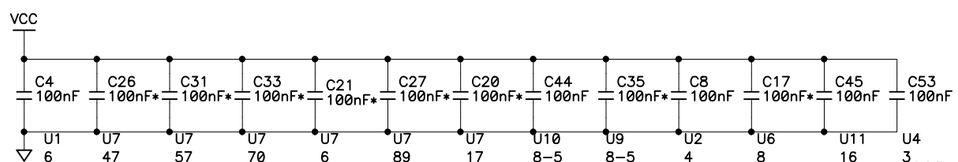
REVISION HISTORY			REVISION APPROVAL			
REV	ECO	DESCRIPTION	PROJECT ENGINEER	APPROVAL DATE	DOCUMENT CONTROL	APPROVAL DATE
C	E11145	SEE ECO FOR HISTORY	XT	14AUG00	KAH	18AUG00
D	E11180	CHG TOLERANCE OF R35 & R39 FROM 1% TO 5%	LSW	30AUG00	KAH	29AUG00
E	E11320	CORRECT NOTE ON PAGE 3. REFERENCED WRONG COMPONENTS.	RJH	2JAN01	KIS	2JAN01
F	E11342	ADD R82 & R83 TO KEEP RS485 WITH 5-WIRE RS232	EP	5JAN01	KIS	9JAN01
G	E11620	UPDATE RABBIT BATTERY BACKUP CIRCUIT	JF	8/6/01	KlS	8/3/01

TABLE A

REF DES	DEVICE	DEVICE VOLTAGE INFORMATION					DEVICE: FILTER CAP REF DES(s)
		AGND	GND	VCC	VRAM	NO CONNECTS	
U1	LM4872		2	6			C4
U2	ETC811L						C8
U3	SRAM 512K X 8		15		32		C9
	SRAM 32K X 8		14		28		
U4	RABBIT 2000		2,27,39 52,77,89	3,28,53, 78,92	42		C12,13,18,19, 23, 53 C16 – PIN42 (VRAM)
U5	FLASH		24	8			C17
U6	FLASH		24	8			
U7	RLT8019AS		14,28,44 52,83,86	6,17,47 57,70,89			C20,21,26,27,31,33
U8	LM2575-5.0					2-6.9.11.13.16.19-24	
U9	93C46		5	8		7	C35
U10	SP483E		5	8			C44
U11	232A		15	16			C45

Decoupling Capacitors





APPEND THE FOLLOWING DOCUMENTS WHEN CHANGING THIS DOCUMENT:	

DRAWING CONTENT:		
DRAWN BY: (INITIAL RELEASE)	GEY	14SEP99
REVISED BY:	J. FENG	30JUL01
APPROVALS: INITIAL RELEASE		
PROJECT ENGINEER:	RJH	24MAY00
ENGINEERING MANAGER:	___	___
SIGNATURES		DATE

TITLE: SCHEMATIC DIAGRAM OP6600/6700 SERIES & RABBIT 2000 TCP/IP DEVELOPMENT KIT

Z-WORLD
2900 SPAFFORD ST.
DAVIS, CA 95616
530 - 757 - 4616

SIZE B | DWG NO. 090-0095

SCALE NONE | RELEASE DATE 24MAY00 | SHEET 1 OF 4

SRAM*

ONLY ONE DEVICE INSTALLED U3: OPTIONAL 512K, 256K, 128K, OR 32K SRAM

PROCESSOR

U4 — RABBIT 2000

<3> A0–19
<3> D0–7
<3> PA0–7
<3> PB0–7
<1,3> PC0–7
<1,3> PD0–7
<3> PE0–7

PA0–SD0, PA1–SD1, PA2–SD2, PA3–SD3, PA4–SD4, PA5–SD5, PA6–SD6, PA7–SD7

PB0–CLKB, PB1–CLKA, PB2–/SWR, PB3–/SRD, PB4–SA0, PB5–SA1, PB6, PB7–/SLAVEATTN

PC0–TXD, PC1–RXD, PC2–TXC, PC3–RXC, PC4–TXB, PC5–RXB, PC6–TXA, PC7–RXA

PD0, PD1, PD2, PD3, PD4–ATXB, PD5–ARXB, PD6–ATXA, PD7–ARXA

PE0–I0–INT0A, PE1–I1–INT1A, PE2–I2, PE3–I3, PE4–I4–INT0B, PE5–I5–INT1B, PE6–I6, PE7–I7–/SCS

BUFEN, IORD, IOWR, /RES, RESET, STATUS, SMODE0, SMODE1, CLK, WDTOUT, VBAT, XTALA2, XTALA1, XTALB2, XTALB1

V_PBAT, V_OSC

R38 22K, C15 1nF, U4 42, R34 47K, R33 330K, C25 33pF, R31 22M, Y2 SMT 32.768KHz*, C24 10pF, U13 74AHC1GU04, R27 2k, C10 33pF, R28 1M, Y1 18.432MHz, C11 33pF

U3_ALT_PINOUT

A0–A19, I/O0–I/O7, /OE1, /WE1, /CSRAM

SRAM 32K X 8*

SRAM SELECT*

JP1: 32K SRAM NONE 1; 128K SRAM 1–2 2; 512K SRAM 2–3 3

VRAM, S17, A17

U3

SRAM*

SRAM TYPE: 512K X 8 | 128K X 8; PIN ID A17 | CS2; PIN ID A18 | NC

BANK SELECT

NORMAL MODE / BANK MODE

JP5: A17, A18

F1_A17, F1_A18

FLASH 1*

U5 — FLASH*

FLASH TYPE: 512K X 8 | 256K X 8 | 128K X 8; PIN ID A17 | A17 | NC; PIN ID A18 | NC/*RST | NC

FLASH 2* ⚠4

U6 — FLASH*

FLASH TYPE: 512K X 8 | 256K X 8 | 128K X 8; PIN ID A17 | A17 | NC; PIN ID A18 | NC/*RST | NC

/CS0, /CS1, /CS2, /OE0, /OE1, /WE0, /WE1, /CSRAM

POWER TO VRAM SWITCH

R23 (0 ohm)*, Q3 FDV302P, R24 10k, R25 22k, Q4 MMBT3904

CS Control

R30 (0 ohm)*, R29 100k, Q6 FDV302P, Q5 2N7002

RESET GENERATOR

U2 ETC811L — RESET, GND, VCC, MR

R26 10k, C14 1nF, R32 100k

⚠4 FLASH 2 SELECT*

JP3: 1–2 128K/256K FLASH; 2–3 512K FLASH

FLASH 1 SELECT*

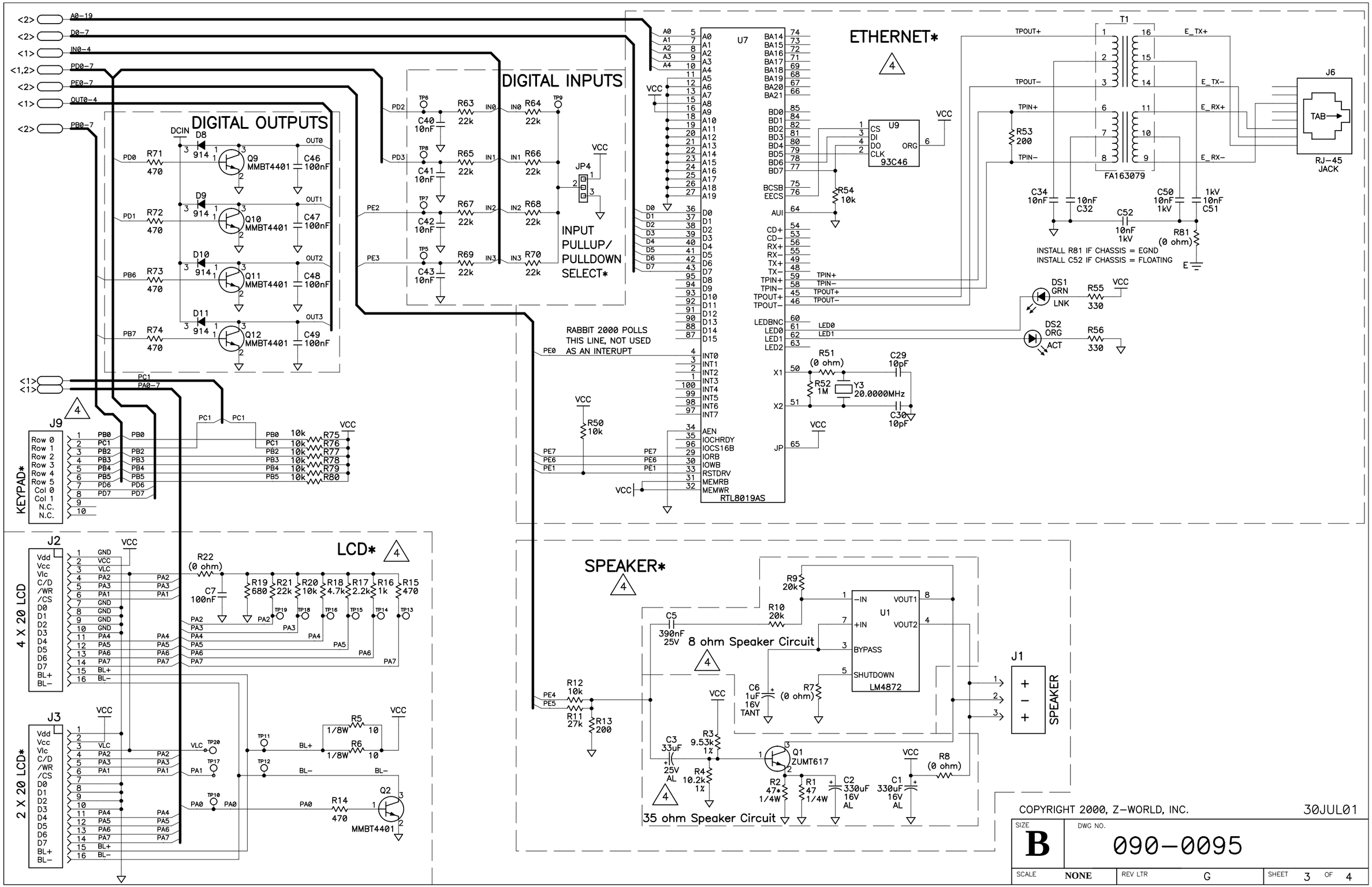
JP2: 1–2 128K/256K FLASH; 2–3 512K FLASH

J4 RABBIT PROGRAMMING PORT

RXA, GND, CLKA, VCC, /RESET, TXA, N.C., STATUS, SMODE0, SMODE1

R45 47k, R47 47k, R46 100, R43 100, R42 47k, R44 47k

SIZE	DWG NO.	
B	090–0095	
SCALE NONE	REV LTR G	SHEET 2 OF 4

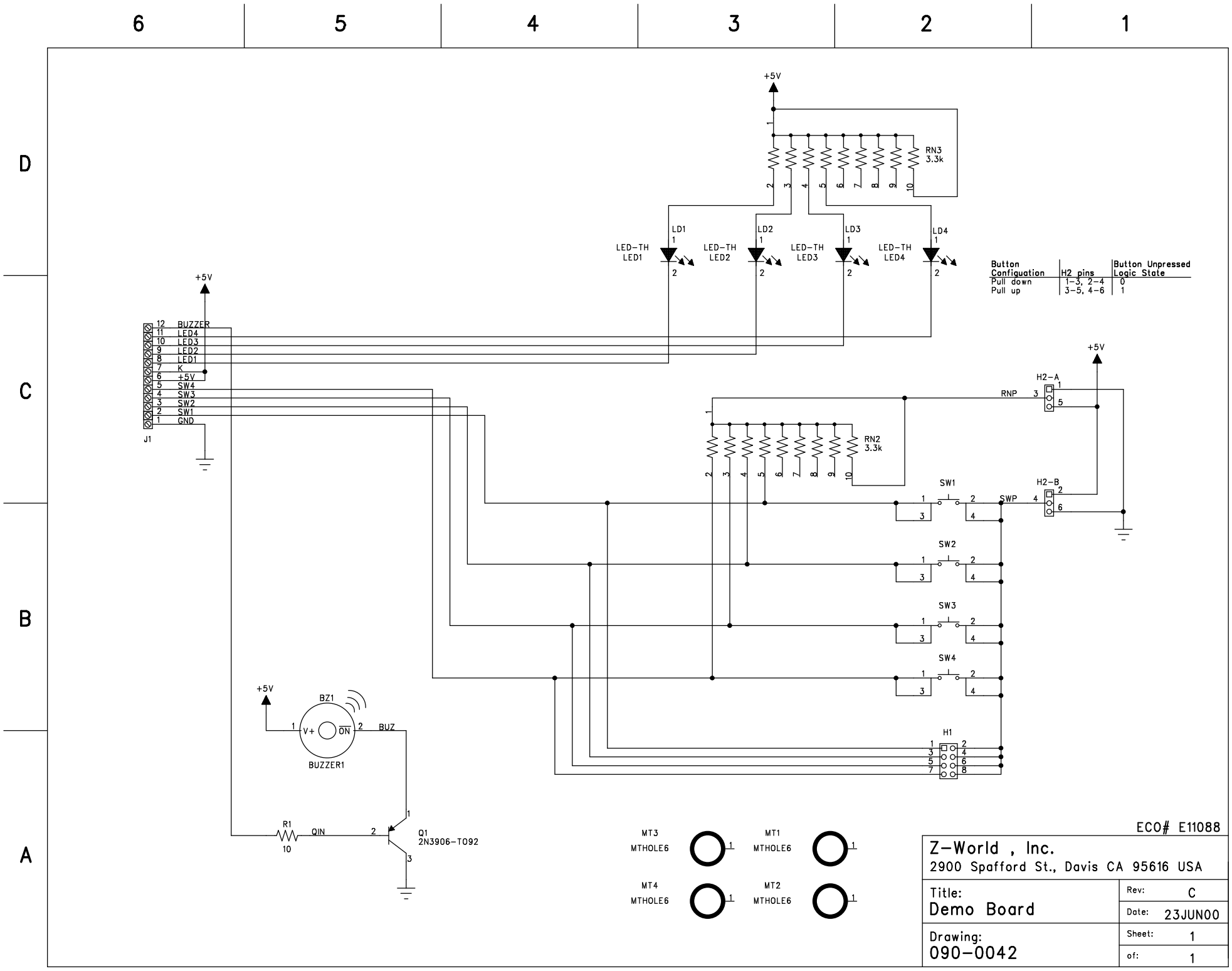

DIGITAL OUTPUTS
DIGITAL INPUTS
ETHERNET*
LCD*
SPEAKER*
KEYPAD*
4 X 20 LCD
2 X 20 LCD*
8 ohm Speaker Circuit
35 ohm Speaker Circuit
INPUT PULLUP/ PULLDOWN SELECT*
RABBIT 2000 POLLS THIS LINE, NOT USED AS AN INTERUPT
INSTALL R81 IF CHASSIS = EGND
INSTALL C52 IF CHASSIS = FLOATING
RTL8019AS
LM4872
93C46
FA163079
RJ-45 JACK
MMBT4401
ZUMT617
COPYRIGHT 2000, Z-WORLD, INC.
30JUL01
090-0095
SIZE B
SCALE NONE
REV LTR G
SHEET 3 OF 4

STUFFING TABLE

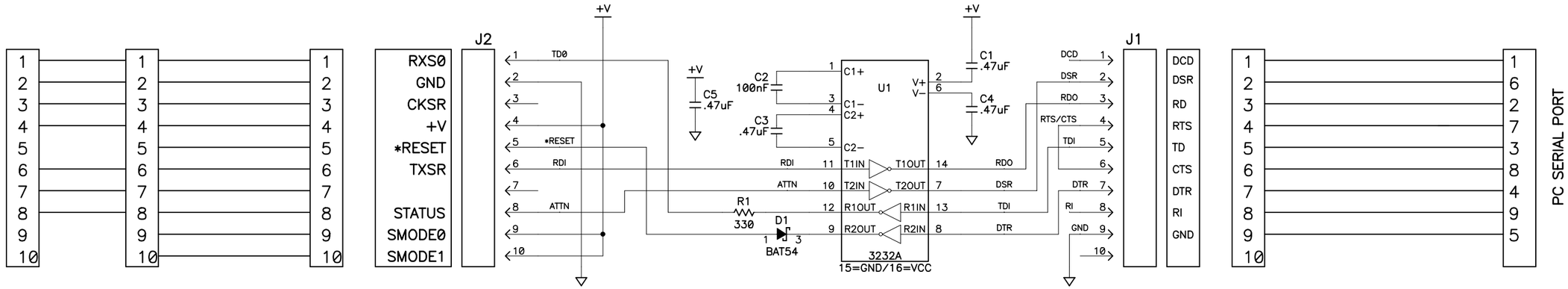
CIRCUIT		PART	MODEL: RABBIT 2000 TCP/IP	MODEL: OP6700 SERIES	MODEL: OP6600 SERIES
BATTERY MODULE		X1	NOT INSTALLED	INSTALLED	INSTALLED
BATTERY		BT1	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED
CS CONTROL BYPASS		R30	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED
PWR– VRAM SW BYPASS		R23	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED
PWR SPLY TRANSZORB		TVS1	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED
SRAM	MAIN	U3	128K SRAM	128K SRAM	128K SRAM
		C9	100nF	100nF	100nF
	SRAM SELECT	JP1	ZERO ohm ACROSS PINS 1–2	ZERO ohm ACROSS PINS 1–2	ZERO ohm ACROSS PINS 1–2
FLASH 1	MAIN	U5	256K FLASH	256K FLASH	256K FLASH
	FLASH 1 SELECT	JP2	ZERO ohm ACROSS PINS 1–2	ZERO ohm ACROSS PINS 1–2	ZERO ohm ACROSS PINS 1–2
FLASH 2	MAIN	U6	256K FLASH	256K FLASH	NOT INSTALLED
		C17	100nF	100nF	NOT INSTALLED
	FLASH 2 SELECT	JP3	ZERO ohm ACROSS PINS 1–2	ZERO ohm ACROSS PINS 1–2	NOT INSTALLED
POWER IN CONN 2 x 17		J8	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED
KEYPAD CONNECTOR		J9	NOT INSTALLED	INSTALLED	INSTALLED
LCD	4 X 20 CONN	J2	NOT INSTALLED	INSTALLED	INSTALLED
	2 X 20 CONN	J3	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED
	MAIN	C7	NOT INSTALLED	100nF	100nF
		Q2	NOT INSTALLED	MMBT4401	MMBT4401
		R5	NOT INSTALLED	10 ohm 1/8W	10 ohm 1/8W
		R6	NOT INSTALLED	10 ohm 1/8W	10 ohm 1/8W
		R14	NOT INSTALLED	470 ohm	470 ohm
		R15	NOT INSTALLED	470 ohm	470 ohm
		R16	NOT INSTALLED	1k	1k
		R17	NOT INSTALLED	2.2k	2.2k
		R18	NOT INSTALLED	4.7k	4.7k
		R19	NOT INSTALLED	680 ohm	680 ohm
		R20	NOT INSTALLED	10k	10k
		R21	NOT INSTALLED	22k	22k
		R22	NOT INSTALLED	ZERO ohm	ZERO ohm
SPEAKER	MAIN	R11	NOT INSTALLED	27k	27k
		R12	NOT INSTALLED	10k	10k
		R13	NOT INSTALLED	200 ohm	200 ohm
	35 ohm CIRCUIT	C1	NOT INSTALLED	330uF 16V	330uF 16V
		C2	NOT INSTALLED	330uF 16V	330uF 16V
		C3	NOT INSTALLED	33uF 25V	33uF 25V
		J1	NOT INSTALLED	INSTALLED	INSTALLED
		Q1	NOT INSTALLED	ZUMT617	ZUMT617
		R1	NOT INSTALLED	47 ohm 1/4W	47 ohm 1/4W
		R2	NOT INSTALLED	NOT INSTALLED	NOT INSTALLED
		R3	NOT INSTALLED	9.53k 1%	9.53k 1%
		R4	NOT INSTALLED	10.2k 1%	10.2k 1%
		R8	NOT INSTALLED	ZERO ohm	ZERO ohm
	8 ohm CIRCUIT		NOT INSTALLED	NOT INSTALLED	NOT INSTALLED

STUFFING TABLE

CIRCUIT		PART	MODEL: RABBIT 2000 TCP/IP	MODEL: OP6700 SERIES	MODEL: OP6600 SERIES
DIGITAL INPUT PULLUP/ PULLDOWN SELECT		JP4	ZERO ohm ACROSS PINS 1–2	ZERO ohm ACROSS PINS 1–2	ZERO ohm ACROSS PINS 1–2
ETHERNET	MAIN	U7	RLT8019AS	RLT8019AS	NOT INSTALLED
		C20	100nF	100nF	NOT INSTALLED
		C21	100nF	100nF	NOT INSTALLED
		C26	100nF	100nF	NOT INSTALLED
		C27	100nF	100nF	NOT INSTALLED
		C31	100nF	100nF	NOT INSTALLED
		C33	100nF	100nF	NOT INSTALLED
		R50	10k	10k	NOT INSTALLED
	ETHERNET CRYSTAL	Y3	20.0000MHz	20.0000MHz	NOT INSTALLED
		C29	10pF	10pF	NOT INSTALLED
		C30	10pF	10pF	NOT INSTALLED
		R51	ZERO ohm	ZERO ohm	NOT INSTALLED
		R52	1 MEG	1 MEG	NOT INSTALLED
	EEPROM	U9	93C46	93C46	NOT INSTALLED
		C35	100nF	100nF	NOT INSTALLED
		R54	10k	10k	NOT INSTALLED
	LEDS	DS1	GRN	GRN	NOT INSTALLED
		DS2	ORG	ORG	NOT INSTALLED
		R55	330 ohm	330 ohm	NOT INSTALLED
		R56	330 ohm	330 ohm	NOT INSTALLED
	TRANSFORMER	T1	FA163079	FA163079	NOT INSTALLED
		C32	10nf	10nf	NOT INSTALLED
		C34	10nf	10nf	NOT INSTALLED
		C50	10nf 1KV	10nf 1KV	NOT INSTALLED
		C51	10nf 1KV	10nf 1KV	NOT INSTALLED
		C52	10nf 1KV	10nf 1KV	NOT INSTALLED
		J6	RJ–45	RJ–45	NOT INSTALLED
		R53	200 ohm	200 ohm	NOT INSTALLED
		R81	ZERO ohm	ZERO ohm	NOT INSTALLED


6
5
4
3
2
1
D
C
B
A
+5V
RN3
3.3k
LD1
LD2
LD3
LD4
LED-TH
LED1
LED-TH
LED2
LED-TH
LED3
LED-TH
LED4
Button Configuation
H2 pins
Button Unpressed Logic State
Pull down
1-3, 2-4
0
Pull up
3-5, 4-6
1
BUZZER
LED4
LED3
LED2
LED1
K
+5V
SW4
SW3
SW2
SW1
GND
J1
RN2
3.3k
RNP
H2-A
H2-B
SWP
SW1
SW2
SW3
SW4
H1
BZ1
V+
ON
BUZ
BUZZER1
R1
10
QIN
Q1
2N3906-TO92
MT3
MTHOLE6
MT1
MTHOLE6
MT4
MTHOLE6
MT2
MTHOLE6
ECO# E11088
Z-World , Inc.
2900 Spafford St., Davis CA 95616 USA
Title:
Demo Board
Rev: C
Date: 23JUN00
Drawing:
090-0042
Sheet: 1
of: 1

REVISION HISTORY			REVISION APPROVAL			
REV	ECO	DESCRIPTION	PROJECT ENGINEER	APPROVAL DATE	DOCUMENT CONTROL	APPROVAL DATE
A	E11523	INITIAL RELEASE OF SCHEMATIC	EP	5/14/01	KIS	5/14/01
B	E11691	CORRECT DE9 PINOUT	EP	10/5/01	KIS	10/4/01
C	E11816	ADD 3.3V CAPABILITY AND RED TUBING	DM	1/24/02	KlS	1/24/02



Prog. / Diagnostic Cable

Serial Interface Board

Cable 10–pin to D9 female

NOTES: UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTOR VALUES ARE IN OHMS, 1/10W, 5%
2. ALL CAPACITORS ARE 50VDC OR HIGHER.
3. THE ORIGINATION SOURCE OF A VOLTAGE IS REPRESENTED BY (VCC), AND ALL REFERENCES TO THAT VOLTAGE ARE REPRESENTED BY (VCC).

APPEND THE FOLLOWING DOCUMENTS WHEN CHANGING THIS DOCUMENT:		DRAWING CONTENT:	
		DRAWN BY: (INITIAL RELEASE) E. PEAK	14MAY01
		REVISED BY: D MUSGROVE	01/21/02
		APPROVALS: INITIAL RELEASE	
		PROJECT ENGINEER: ERIC PEAK	5/14/01
		ENGINEERING MANAGER: R MATTHEWS	5/14/01
		SIGNATURES	DATE

TITLE
SCHEMATIC DIAGRAM RABBIT PROG. CABLE 3.3V – 5.0V

WORLD
2900 SPAFFORD ST.
DAVIS, CA 95616
530 - 757 - 4616

SIZE B | DWG NO. 090–0128 | SCALE NONE | RELEASE DATE | SHEET 1 OF 1