

# XTEND-C3 <sup>©</sup>

## Users Manual



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# 1. INTRODUCTION

The XTEND development kit provides support for the enhanced debug and emulation features of the XA. This means users can download and debug code-using features such as single step, go with breakpoints and disassembly. The XTEND provides a single platform to ease XA development and also serves as a prototype or target board.

The XTEND provides support for FLASH memory, which can be used for easy software upgrades of XTEND units in the field or at customer sites.

Please let FDI know if you have any questions or problems with the XTEND products.

# 2. INSTALLING THE XTEND SOFTWARE

There are several diskettes and CDs included in the XTEND kit:

- XTEND Disk or Diskettes (depending on your specific configuration), which contains the Windows installation as well as the XTEND Software and Examples.
- Philips Semiconductors XA Development Tools Diskette that includes the XA assembler, simulator and 8051-to-XA translators.
- Third-party Development Tool Packages for the XA Family (Such as Raisonance and Tasking)

The XTEND sample applications software will be copied to the location specified by the XTEND installation software. The default location for the XTEND installation software is the 'C:\FDI\XTEND-C3' directory. You may specify a different location for the software to be installed, but remember to make note of the difference.

### **To install the XTEND-C3 software:**

1. Insert the FDI XTEND Software Diskette into the floppy drive
2. From the 'Start' menu, select 'Run...'
3. Enter the following information in the block: "a:\setup.exe"
4. Select 'OK'
5. Follow the directions of the install program for selecting the target directory to install.
6. Install development software. (Tasking, Raisonance, etc...)

## **3. Guide to Your XTEND**

### **3.1 Kit Contents**

The following is a list of items included in the Standard XTEND Kit:

1. XTEND Printed Circuit Board Assembly
2. One RS-232 Serial Cable to connect the XTEND board to your PC.
3. One DB9-to-DB25 adapter.
4. XTEND Software on Disk or Diskettes (depending on your specific configuration)
5. Philips Semiconductors XA Tools Software Diskette
6. UL Approved Wall Power Supply (For U.S. and some International Shipments only)
7. XTEND Users Manual and Schematics
8. Third-party Development Tool Packages for the XA Family (Demo)

### **3.2 Specifications**

The *XTEND*, XA Trainer and Expandable Narrative Design, is designed to provide the user with a low cost, stable hardware and software platform for application development with the XA. In many cases the *XTEND* may serve as a quick prototype for the actual user application. With the use of the optional expansion boards, which include a wire-wrap or prototype area, the user can quickly and easily get a new design running with the XA.

The *XTEND* includes the following features:

1. The XTEND-C3 supports the XA-C3
2. Philips XA Microcontroller Socket supporting both internal and external code execution
3. 128KB Standard FLASH ROM Code Space, expandable to 256KB (dual sockets for 8-bit or 16-bit access)
4. Code Space supports EPROM, FLASH (5V), NVSRAM, or SRAM

5. 64KB Standard High-Speed Data Space SRAM, expandable to 256KB (dual sockets for 8-bit or 16-bit access)
6. One DB-9 RS232 Serial Communications
7. On-board speaker for tone generation
8. Interface for character type LCD Modules with 16 character LCD included
9. 60-pin Expansion Header for Full Expansion Capability
10. 9 VDC Input with on-board 5V regulator
11. 5.25" x 7.25" 4-layer PCB with Full Silk-screen Information
12. 2.5" x 1" wire-wrap area on-board
13. Two User Input Pushbuttons
14. 8-channel, 8-bit ADC (SPI based)
15. CAN 2.0B Interface using industry standard CiA DB9 Connector
16. SPI Interface
17. Optional SPI EEPROM Socket

The *XTEND* hardware, software and documentation are designed and written with ease of use in mind. The intent is to provide the user with a well-documented platform, which can easily be modified to support different user and application requirements.

The XA example or reference design software is structured and thoroughly documented so that users can easily modify the basic functions to suit their needs. The XA monitor allows host communication with a PC and provides an easy platform for user software development and modification. Complete software for all the *XTEND* functions is provided on the enclosed disks and may be freely modified and used.

For flexibility the *XTEND* supports both internal and external memory operation on the XA. This allows the user to operate in single-chip mode, if memory allows, and thus preserve the XA I/O and hardware functions for other uses. The *XTEND* also supports external memory operation with up to 1MB each of code and data memory. The external code space can be populated with EPROM, FLASH or NVSRAM for flexibility.

The *XTEND* provides one RS232 serial communications port, which is connected to the high-speed UART of the XA.

The *XTEND* provides a CAN 2.0B Interface that utilizes the industry standard CiA DB9 connector.

The *XTEND* also supports an SPI interface and optional SPI EEPROM socket.

### **3.3 Power Requirements**

The XTEND is powered by a wall mounted UL and CSA listed power supply designed for 110VAC outlets. It provides 9V DC at 500 milliamps. Any user supplied DC power source of 7.5V to 12V DC would also work fine since the XTEND utilizes an on-board 5V regulator. The current requirement for the standard XTEND board is approximately 300mA and varies according to configuration options. If there are additional user circuits or expansion boards present, a larger power supply may be required.

The power connector on the XTEND board is a 2.1mm phono plug with center positive polarity. There is also a set of alternate power input connector pins located at J12 that can be used to provide unregulated DC power to the board.

For some International Applications where a special 220V Power Supply is required, or for larger power supply options, contact Condor Power Supplies at phone number (408) 745-7141 or DigiKey at (800) 344-4539.

### **3.4 Operating Frequency**

The XTEND operates at a standard frequency of 20MHz. The crystal located at Y1, immediately adjacent to the XA, determines this frequency. The user can change the operating frequency of the XTEND by replacing the crystal with any frequency desired.

The XTEND board will support any maximum XA operating frequency supported by Philips Semiconductors. Please refer to the XA data sheet for minimum and maximum values.

If the XA UART is being used, the user should also pay attention to the relationship between the XA operating frequency and the baud rate range supported. If the CAN interface is being used, the user should also pay attention to the relationship between the crystal frequency and the CAN data rate.

### 3.5 *Optional Oscillator Usage*

The XTEND supports the use of a ‘canned’ oscillator instead of a crystal for applications that require one. This may be desirable in applications where the user requires the oscillator to drive additional circuits or external loads on the expansion bus. This is supported via a few simple changes to the XTEND board:

1. Remove the crystal Y1.
2. Install a Half-sized oscillator in Y2 location. (See “Appendix D – Parts List” for availability details)

Note: The XTEND-C3 provides a buffered clock output signal. This buffered clock is available on the XTEND board and also to the expansion connector on pin 41.

### 3.6 *Jumpers*

The XTEND has user selectable jumpers for configuring various functions on the board. (See “9.3 Jumper Locations”) for the actual physical location of these jumpers.

#### 3.6.1 *Default Jumper Settings*

<b>Jumper</b>	<b>Default</b>	<b>Description</b>
JP1	1-2	External Code ROM Enabled
JP2	1-2	29EE512 Code Device Enabled
JP4	9-10, 11-12, 13-14, 15-16	Pushbuttons and temperature sensor enabled via ADC input header
JP5	1-2	16-bit memory mode enabled
JP7	1-2	Timer 2 selected for speaker
JP9	1-2, 5-6, 11-12	32Kx8 SRAMs selected in 16-bit mode
JP10	1-2	LED S/W Controlled
JP11	1-2	MAX112 selected

### 3.6.2 Jumper Descriptions

**JP1 - External Code ROM Enable:** Jumper 1-2 to operate the XA from external code space (i.e. ROMLESS operation). Make sure the external EPROM's are installed properly, Even/Low Byte in U5 and Odd/High Byte in U6.

Jumper 2-3 will operate the XA from its internal code space.

<b>NOTE:</b> JP1 indirectly drives the -EA/WAIT input of the XA. The -EA function is <i>only</i> sampled by the XA at power-up or when a hardware reset is performed by depressing the reset switch S1.
---

**JP2 - Code Space Size:** This jumper determines the size of the installed devices in the code space sockets (U5 & U6).

Devices Installed	Jumper Position
64K x 8 EPROM or FLASH ('512)	1-2
128K x 8 EPROM or FLASH ('010)	1-2
512K x 8 EPROM or FLASH ('040)	2-3

**JP4 – ADC Input Header:** This header provides a simple method of adding external inputs to the on-board ADC of the XTEND-C3.

<b>ADC Input</b>	<b>Jumper Position</b>
Channel 0	1-2
Channel 1	3-4
Channel 2	5-6
Channel 3	7-8
Channel 4 (Mode Pushbutton)	9-10
Channel 5 (Select Pushbutton)	11-12
Channel 6 (Temp Sensor)	13-14
Channel 7 (Variable Resistor)	15-16

The Mode Pushbutton (S2), Select Pushbutton (S3), Temperature Sensor (RT1), and Variable Resistor (RP3) are interfaced via the ADC (U17). Removing jumpers 13-14 & 15-16 from JP4 will disconnect the Temperature Sensor and Reference.

**JP5 – Memory Bus Width Select:** This jumper allows the use of the XA in either 8-bit or 16-bit external memory mode.

**Note:** At the time the XTEND-C3 was released, the XA-C3 did NOT support external 8-bit memory operation. Consult with your local Philips representative to determine the status of 8-bit memory support on the XA-C3.

External Bus Width	Jumper Position
16-bit bus width selected	1-2
8-bit bus width selected ( <i>Do not use</i> )	2-3

**Note:** This jumper only affects external memory operations to code and data devices (FLASH and SRAM). External peripherals such as the LCD are not affected.

When 8-bit memory mode is selected, both JP5 and JP9 must be configured properly. Devices should only be populated in sockets U5B and U7 (note the location for 8-bit operation is U5B, which is shifted from 16-bit operation). There must not be ANY devices loaded in U6 & U8.

**JP7 - Speaker Select/Enable:** This jumper allows the user to enable the speaker by selecting one of two XA timer output signals to drive the speaker. The options are Timer 0, or P1.7 . Since Timer 1 is primarily used for the baud rate generation for the serial port (i.e. for the monitor), it is not an option. The speaker will emit sound only when the proper timer is selected and the output is enabled. Consult the XA data book for proper programming of the timers.

The speaker has an impedance of 50 ohms and an operating range of 50Hz to 8kHz.

Timer Utilized	Jumper Position
Speaker Disabled	Off/No Connect
Speaker driven by T2EX	1-2
Speaker driven by Timer 0	2-3

**JP9 - Data Space Device Type:** This jumper block defines what type of device is installed in the data space sockets (U7 & U8). The data space sockets support SRAM in 0.300” or 0.600” wide packages operating in either 8-bit or 16-bit memory mode.

<b>Data Space Device</b>	<b>Bus Width</b>	<b>Jumper Position</b>
32K x 8 or 128K x 8	16-bit	1-2, 5-6, 11-12
512K x 8	16-bit	1-2, 7-8, 11-12
128K x 8	8-bit	3-4, 5-6, 11-12
512K x 8	8-bit	3-4, 9-10, 13-14

**Note:** 8-bit mode REQUIRES the use of either 128Kx8 or 512Kx8 SRAM in U7 (32Kx8 SRAMs are not supported).

**Note:** At the time the XTEND-C3 was released, the XA-C3 did NOT support external 8-bit memory operation. Consult with your local Philips representative to determine the status of 8-bit memory support on the XA-C3.

When 8-bit memory mode is selected, both JP5 and JP9 must be configured properly. Devices should only be populated in sockets U5B and U7 (note the location for 8-bit operation is U5B, which is shifted from 16-bit operation). There must not be ANY devices loaded in U6 & U8.

**JP10 - LED Select:** This jumper allows the use of the LED as either a software-controlled user output (via the map register), or a simple power-on indicator. When jumpered 1-2, the LED is controlled via the map register (74HCT259), bit Q4. The address for this bit is 0xB8008H. Writing this location with a ‘1’ turns the LED off, and writing a ‘0’ to this location turns the LED on. When jumpers 2-3 are loaded, the LED provides a ‘power indicator’ function. When power is supplied to the XTEND, the LED will be on.

**JP11 - ADC Type:** This jumper determines the type of Maxim ADC controller (U17) utilized.

Maxim ADC Utilized	Jumper Position
MAX1112	On
MAX192/MAX186	Off

### 3.7 XA Port Utilization

The following table defines the usage of each port of the XA on the XTEND board:

Port.Bit	Name	Usage
0.0 - 0.7	Data D0-7 & Addr A4-11	Lower address/data bus
1.0	WRH- (Write high byte)	Write control for Data MSB
1.1	A1 (address bit 1)	Address Bus
1.2	A2 (address bit 2)	Address Bus
1.3	A3 (address bit 3)	Address Bus
1.4	SPI Data Out	SPI Interface
1.5	SPI Data In	SPI Interface
1.6	SPI Clock	SPI Interface
1.7	T2EX (Timer 2 Ext)	Speaker, Expansion
2.0 - 2.7	Data D8-15 & Addr A12-19	Upper address/data bus
3.0	RXD (Serial Rcv)	Used only Serial Port
3.1	TXD (Serial Xmt)	Used only Serial Port
3.2	INT0 (Interrupt 0)	Expansion
3.3	INT1 (Interrupt 1)	Expansion
3.4	T0 (Timer 0)	Expansion and Speaker
3.5	T1 (Timer 1)	Bus Width and Expansion
3.6	WRL- (Write low byte)	Write Control for Data LSB
3.7	RD- (Read Control)	Read Control for Data

## Notes:

1. All of these signals ALSO go to the expansion connector. If the expansion connector is used, care must be exercised to avoid hardware conflicts on these signals.
2. When these port signals are configured for one option, the other possible options are not available. The user should be aware of these potential hardware conflicts when configuring these signals for a particular application.
3. When using MonXA, Timer 1 is used as the baud rate generator for the UART, the external pin (P3.5/T1) may be used as an I/O. Note: Timer 1 interrupt is NOT available for user programs.
4. When using XVW, Timer 2 is used as the baud rate generator for the UART, the external pin (P1.6/T2) may be used as an I/O. Note: Timer 2 interrupt is NOT available for user programs.
5. The Temperature Sensor and Reference may be disconnected by removing jumpers 13-14 & 15-16 from JP4.

**Please refer to the XTEND schematics for complete hardware details of these multi-function pins. The schematics are included in the kit.**

### **3.8 PAL U3 Definition**

The PAL Device located at U3 is used to decode the lower address ranges including: code space devices, data space devices, the LCD, and the Map Register. The device utilized is typically a 22V10 device with a maximum speed of 15ns at 24MHz. Slower devices may be utilized when the XA is operated at lower frequencies. The use of a 22V10 allows the user to implement a wide variety of additional functions without having to change devices.

The source for this PAL was developed using CUPL as the compiler to generate the JEDEC file. This file is included on the XTEND Diskette, 'C3-U3-Rx.PLD' and 'C3-U3-Rx.JED'.



### 3.9 Serial Port Connection

The XTEND uses RS232 Port (J5) for communication with Crossview Pro and MonXA.

The XTEND kit utilizes DB9 female serial port connectors that are designed for a one-to-one connection to a PC-AT Compatible Serial Port. If a replacement cable is required, a simple one-to-one connection from a DB9 female to a DB9 male connector will work.

The following table lists the pinout of the XTEND serial port:

<b>Pin Number</b>	<b>Signal Name</b>	<b>Description</b>
1	No Connect	Unused Pin
2	Transmit Data	Transmit from XA
3	Receive Data	Receive to XA
4	No Connect	Unused Pin
5	Ground	System Ground
6	No Connect	Unused Pin
7	No Connect	Unused Pin
8	No Connect	Unused Pin
9	No Connect	Unused Pin

Note: CTS and RTS are NOT used by either of the XTEND software monitors.

### 3.10 CAN Interface

The XTEND-C3 provides a fully CAN 2.0B compliant CiA DB9 Interface (J4). For complete details of the XTEND-C3 CAN Interface, consult the CiA Specification and page 6 of the XTEND-C3 schematics.

The following table lists the pinout of the XTEND-C3 CAN port:

Pin Number	Signal Name	Description
1	No Connect	Unused Pin
2	CANL	CAN Low Signal
3	CANGND	Isolated CAN Ground
4	No Connect	Unused Pin
5	No Connect	Unused Pin
6	No Connect	Unused Pin
7	CANH	CAN High Signal
8	No Connect	Unused Pin
9	CANVCC	Isolated CAN Power

### 3.11 External Memory Timing

The XA-C3 utilizes variable memory timing configurations programmed via internal registers of the processor. Consult the XA-C3 Databook for complete definitions of the programming of these registers.

The default values utilized by the XTEND software are:

Register	Value
BTRL	00h
BTRH	00h

### **3.12                    *Low Voltage Operation (3V Vcc)***

The XA is capable of operation at low voltages, such as 3V, that are used in many typical battery operated applications. The XTEND supports this alternative voltage level via a few simple changes:

1. Verify that the XA being used is a 3V version of the part
2. Change the voltage regulator (7805) to a 3V regulator
3. Change the 74ABT373 (if used) in locations U2 & U4 to 74LV373 parts.
4. Install proper low voltage EPROM's and Data SRAMs if required.
5. Change the RS-232 driver IC to a proper low voltage part. (MAX3232 or equivalent)
6. Change any other necessary logic parts from 'HCT' type to 'HC' or 'LV' type parts, which support 3V operation.

## 4. EXPANSION CAPABILITIES

### 4.1. Expansion Connector

The XTEND includes an expansion connector to support custom user circuits or to facilitate a handy debug probing location. This connector includes most of the signals (both multiplexed and de-multiplexed) from the XA.

Several signals on the expansion connector have multiple functions, which would not fit the space available for silkscreen labels. These signals are detailed in the table below. For full details on the use of the alternate functions, consult the Philips XA Databook.

<b>Name in Silkscreen</b>	<b>Alternate Function</b>	<b>Alternate Description</b>
WAIT	EA#	External Access
WRH#	A0 / P1.0	Address 0
P14	SPI Data Out	SPI Bus Data Output
P15	SPI Data In	SPI Bus Data Input
P16	SPI Clock	SPI Bus Clock Output
P17	T2EX	Timer 2 External Control
T1	BUSW	Bus Width
RxD0	P3.0	Port Pin
TxD0	P3.1	Port Pin
INT0	P3.2	Port Pin
INT1	P3.3	Port Pin

## 4.2. Onboard Expansion

The XTEND supports the following on-board optional memory and I/O expansion capabilities:

- Up to 1MB of on-board Code Space EPROM is supported.

To expand the code space from 128KB to 1MB:

1. Remove the 29EE512 FLASH EPROM's from U5 & U6.
2. Insert the new devices into the code space sockets. Remember, the EVEN (low byte) device should be inserted into U5 and the ODD (high byte) device should be inserted into U6.
3. There are no jumpers to change.

- Up to 1MB of on-board Data Space SRAM is supported.

To expand the data space from 64K to 256K:

1. Remove the 32Kx8 SRAM's in U7 & U8
2. Insert the 128Kx8 SRAM's into the data space sockets U7 & U8.
3. There are no jumpers to change.

To expand the data space from 64K to 1MB:

1. Remove the 32Kx8 SRAM's in U7 & U8
2. Insert the 512Kx8 SRAM's into the data space sockets U7 & U8.
3. Configure JP9 as per defined in section 3.6.2

- On-board Wire-wrap Area for prototyping of end-user circuits

## 5. APPLICATION EXAMPLES

Two functionally identical application examples are included on the XTEND diskette. The one in the XVW subdirectory was written to be compiled and debugged using the Tasking Toolset. The one in the MON-XA directory was written to be compiled and debugged using the Raisonance Toolset. Both of the example directories contain a Quickstart to guide the user through the project creation, compilation, and debug process. These examples may be used as a starting point to develop XA applications. These examples demonstrate how to:

- Set-up and configure the XA SFR's
- Initialize the Bus and I/O ports
- Use a timer as a periodic interrupt
- Control the on-board LED
- Read the on-board push button switches

## 6. TECHNICAL SUPPORT

Philips Semiconductors provide technical support for the XA Family. Please contact your local Philips sales office or Field Applications Engineer. Additional support may be obtained by going to the Philips website at [www-us.semiconductors.Philips.com/mcu/feedback/](http://www-us.semiconductors.Philips.com/mcu/feedback/)

Technical support for the XTEND Development Kit is provided by *Future Designs, Inc.* Please fax your support question to (256) 883-1241 or e-mail it to [support@teamfdi.com](mailto:support@teamfdi.com) for the fastest response.

**FDI** also provides a Web site at:

<http://www.teamfdi.com>

This web site provides the latest product information, monitor updates, pal updates etc. for the XTEND Family. You may also call **FDI** at (256) 883-1240.

## 7. GENERAL SALES INFORMATION

Authorized sales representatives for the XTEND family of products include:

In the U.S. contact FDI (256) 883-1240

In Europe, contact;

Ashling Microsystems +353 61 334466

Or

Tasking +31 33 455 8584

The XTEND may be available worldwide from any authorized Philips distributor. Please contact the Philips office nearest you for more details about the local availability and pricing for the XTEND.

## 8. Appendix A - Troubleshooting your XTEND

The following steps may be followed to verify Proper Operation of the XTEND hardware:

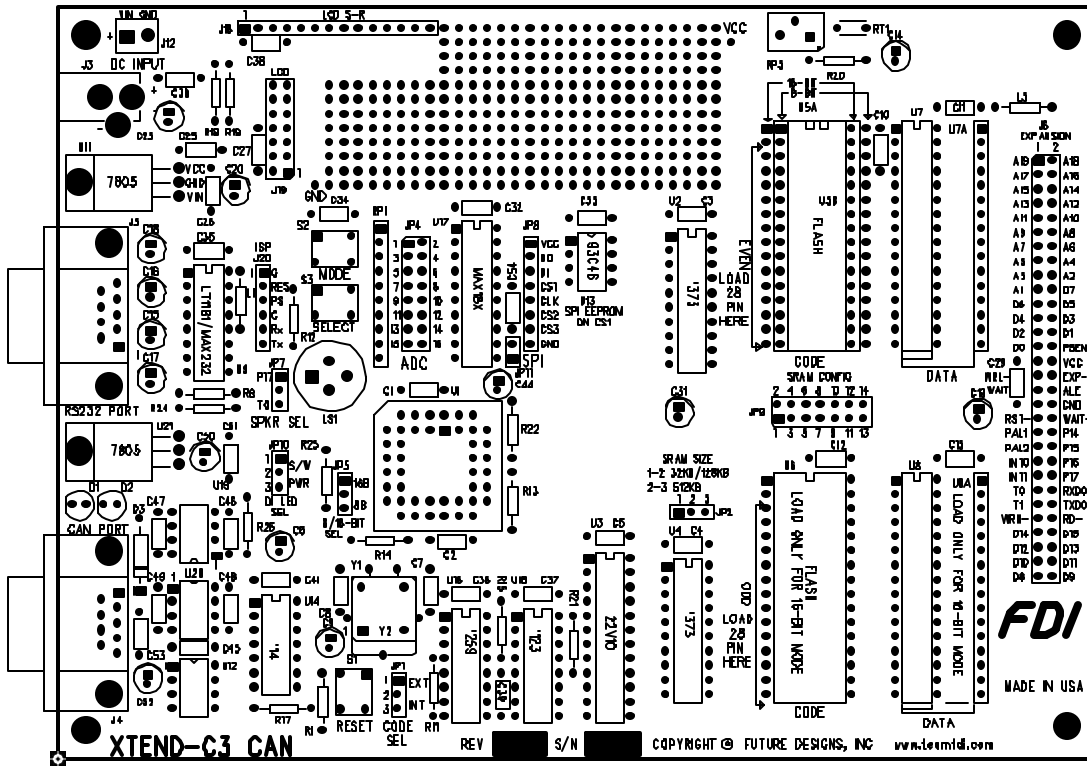
1. Connect male end (pins) of the supplied serial cable to J5 (RS232 Port) of the XTEND board (See section “9.2 Connector Locations”) for physical location of J5.
2. Connect the female end (sockets) of the serial cable to an available DB-9 serial port of your host PC (COM2 is preferred). For DB25 type serial ports, a standard DB9-to-DB25 adapter is provided.
3. Make sure the jumpers are configured for the default settings (See Section “3.6 Jumpers”)
4. On the PC, start your modem communications software. (Windows V3.xx Terminal, Windows 9X HyperTerminal, or a DOS-based program such as QMODEM)
5. On the PC, configure your communication software with the following suggested serial port settings:
  - 9600 bits per second
  - 8 data bits
  - 1 Stop bit
  - No Parity
6. Plug the included power supply into an available 110V AC outlet. For International (220V) power supply support, see section “3.3 Power Requirements” for additional information.
7. Plug the DC connector at the end of the power supply cable into the receptacle J3 of the XTEND board (See Section “9.2 Connector Locations” for physical location of J3).
8. The XTEND will place a power up message such as “MonXA-C3 VX.XX” on the LCD. Hit the space bar twice.
9. The XTEND-C3 MON-XA software monitor should display a sign-on message such as;
  - “TELEXEVA for FDI XTEND-C3 boards
  - XEVA>>”

If the prompt does not appear:

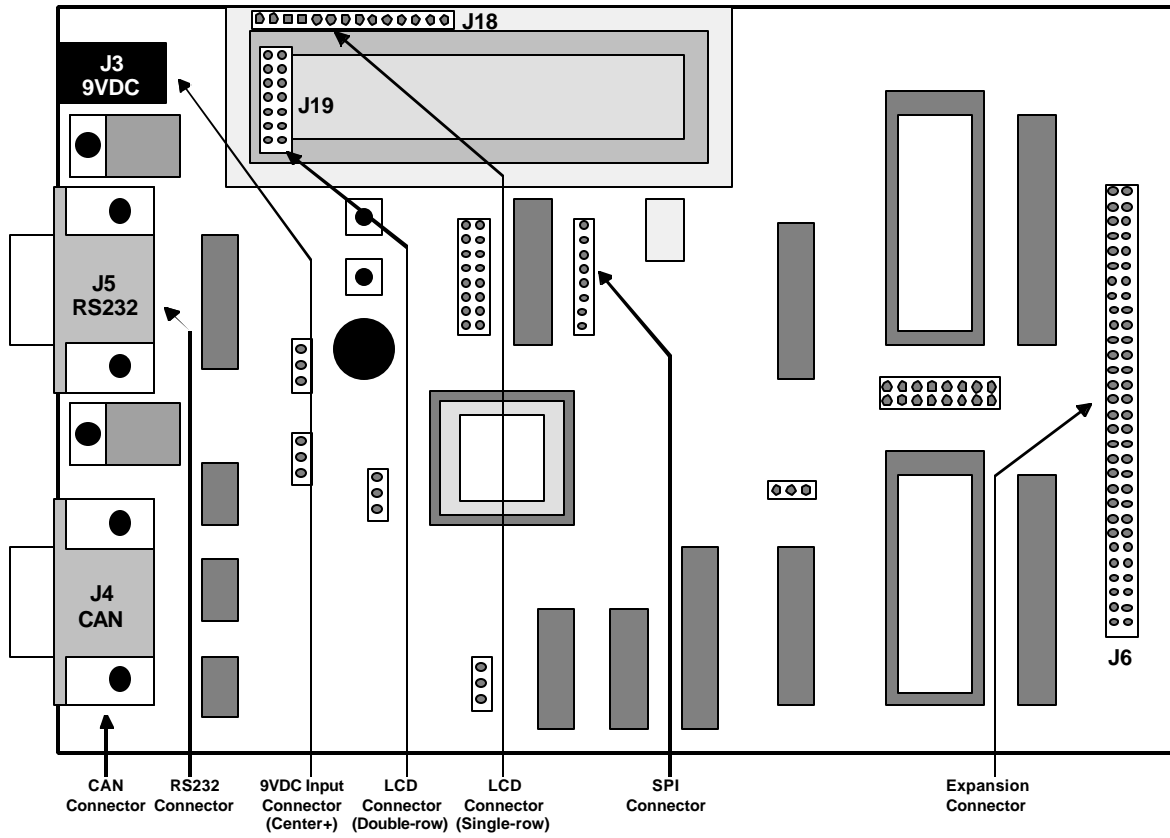
1. Re-check each step above
2. Push the reset button (S1) on the XTEND board
3. Remove the XA from the PLCC socket (U1) and verify that it is seated correctly.
4. Try a different baud rate setting on the PC.
5. Verify that the serial cable is properly connected from the XTEND to the PC

# 9. APPENDIX B - BOARD LAYOUT AND CONNECTOR LOCATIONS

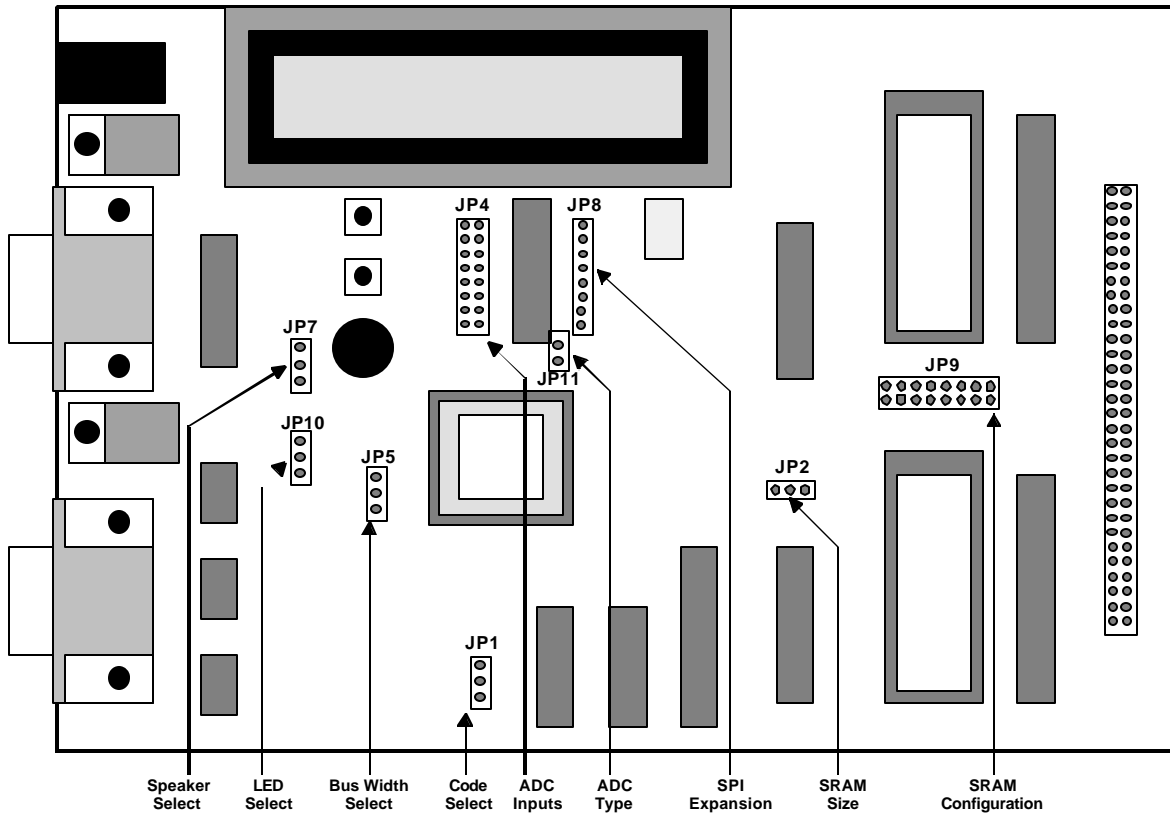
## 9.1. XTEND-C3 Board Layout



## 9.2. Connector Locations



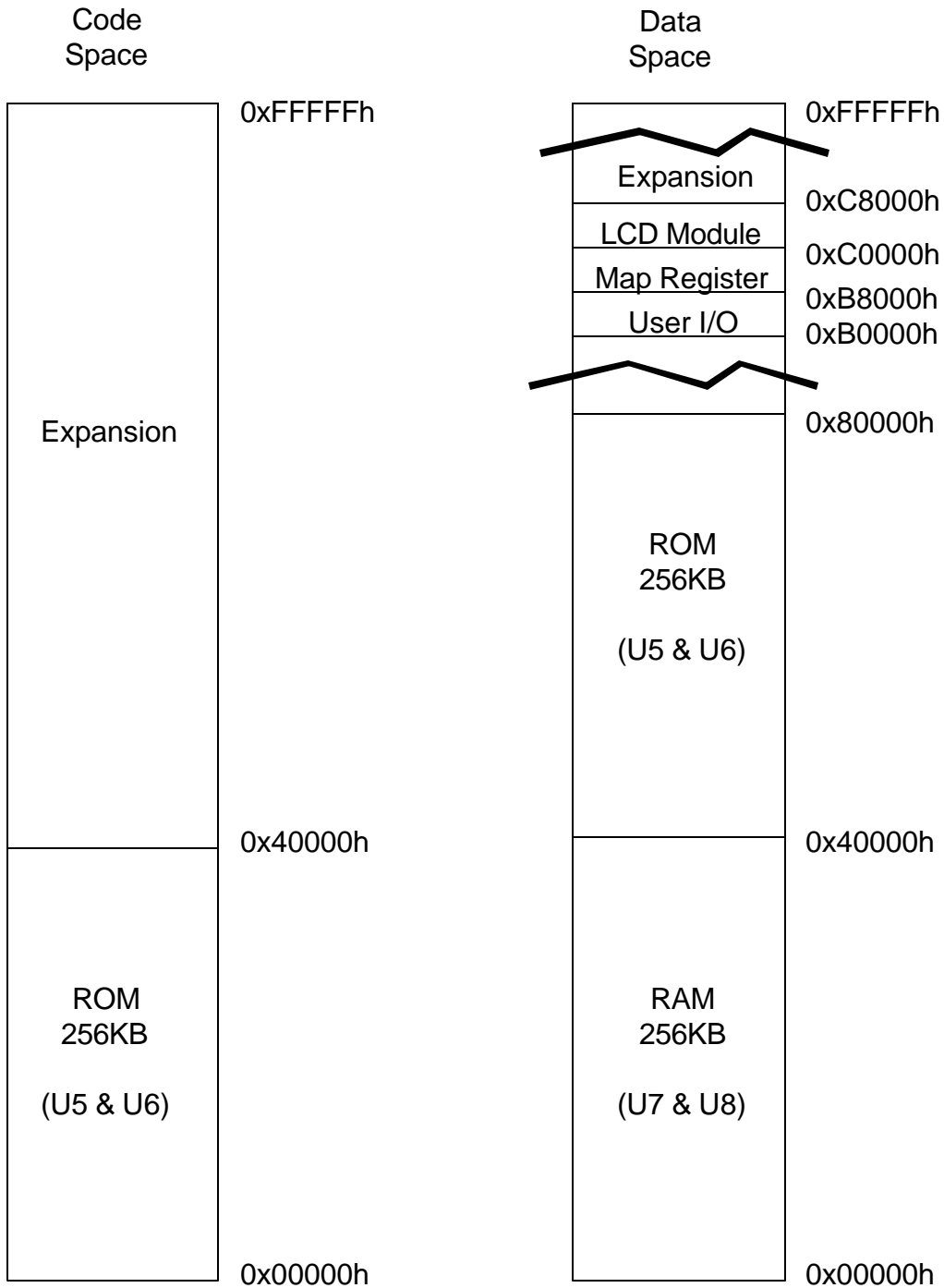
### 9.3. Jumper Locations



# 10. APPENDIX C - MEMORY MAP FOR XTEND

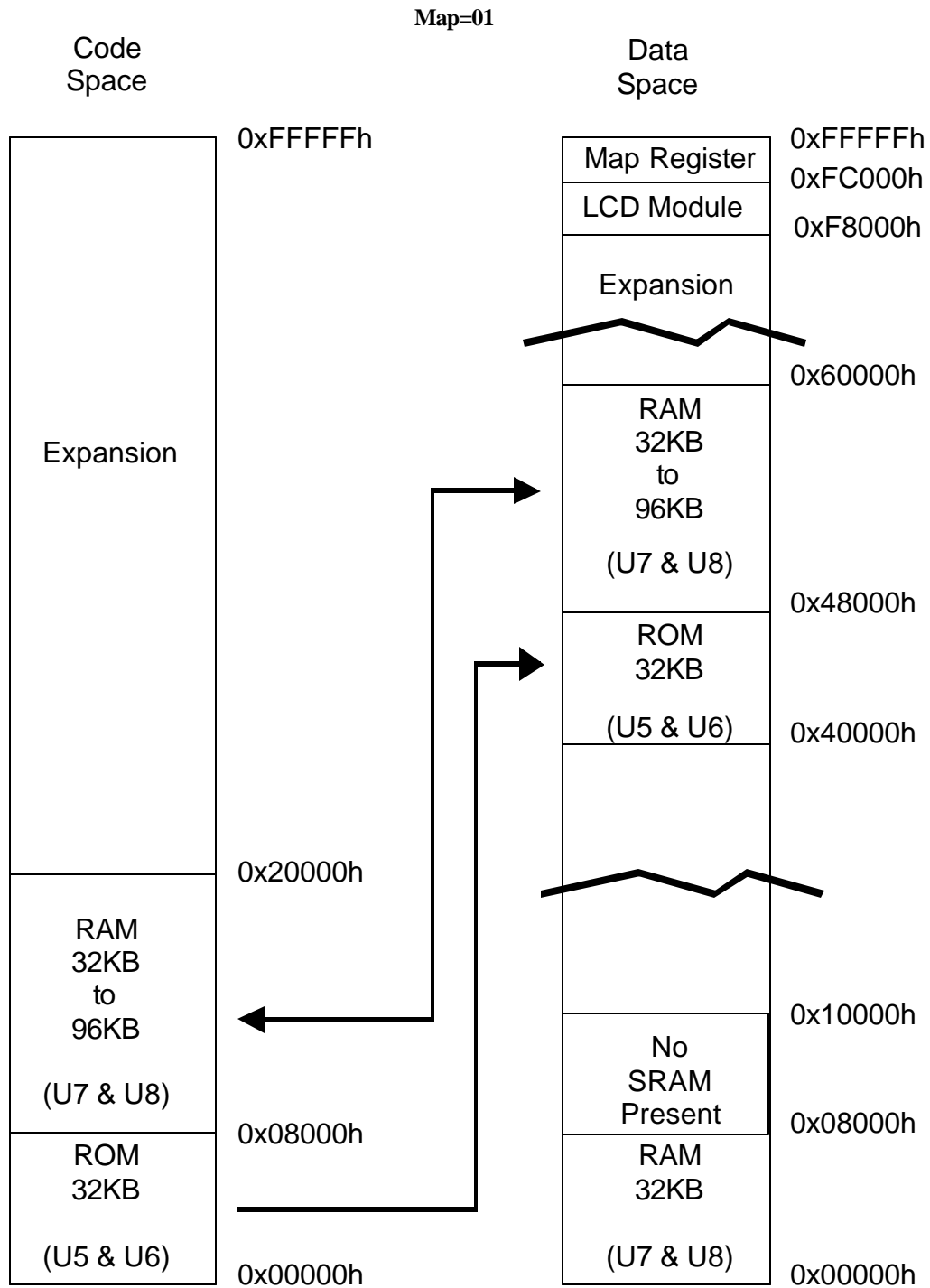
## 10.1 Memory Map – Target Mode

No Overlay, Map=00



This is standard map for use of the XTEND as a user target board rather than a development tool. This setting is the power-on default without any user initialization.

## 10.2 Memory Map – Tasking XVW Mode

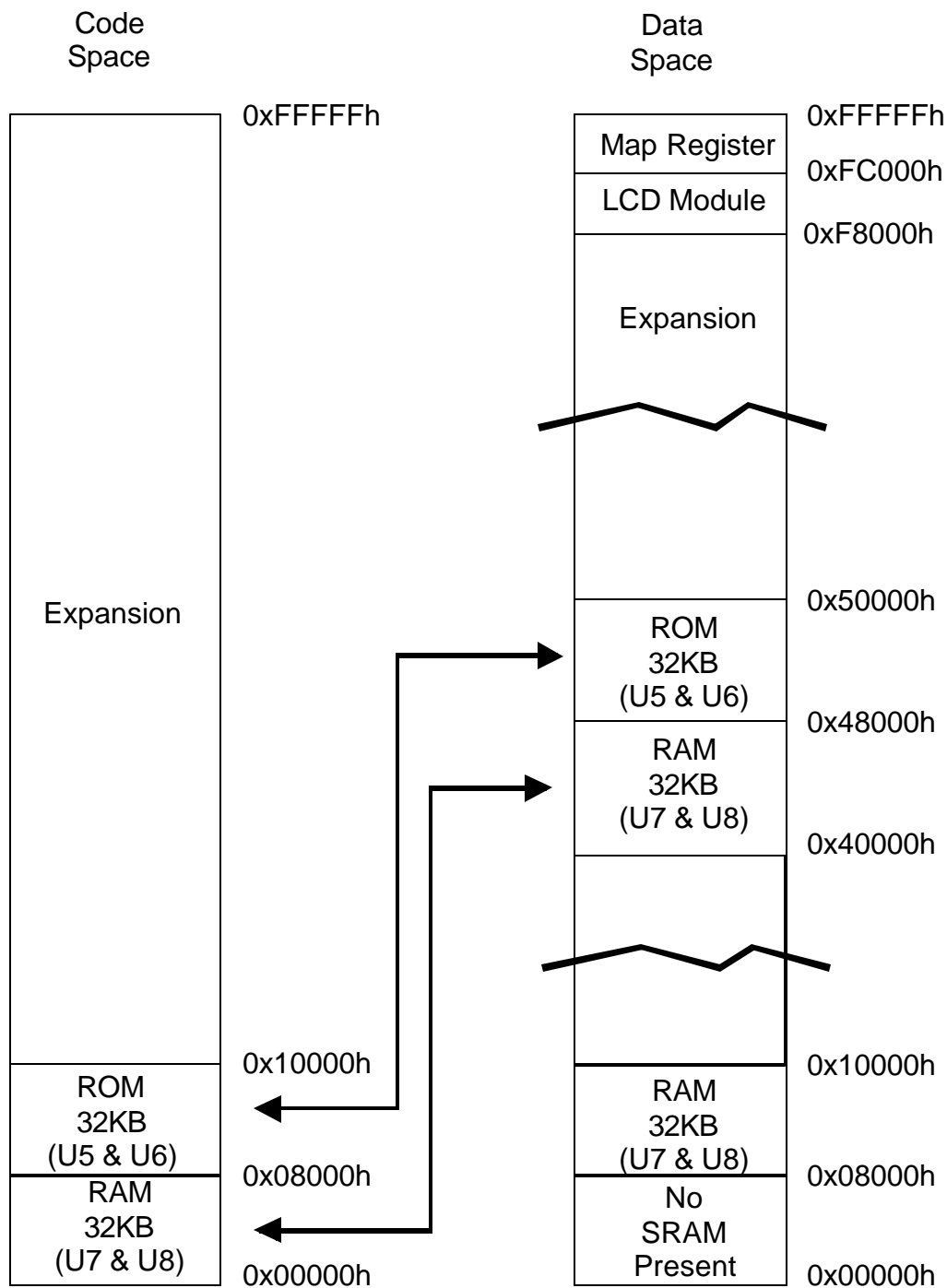


Memory Map for use with XVW and 64KB or 256KB Data Memory  
32KB or 96KB Overlay, Map=10

This map setting supports the large (256KB) memory option on the XTEND. The Tasking CrossView Pro (XVW) ROM Monitor/Debugger operates in this mode.

### 10.3 Memory Map – Raisonance MON-XA Mode

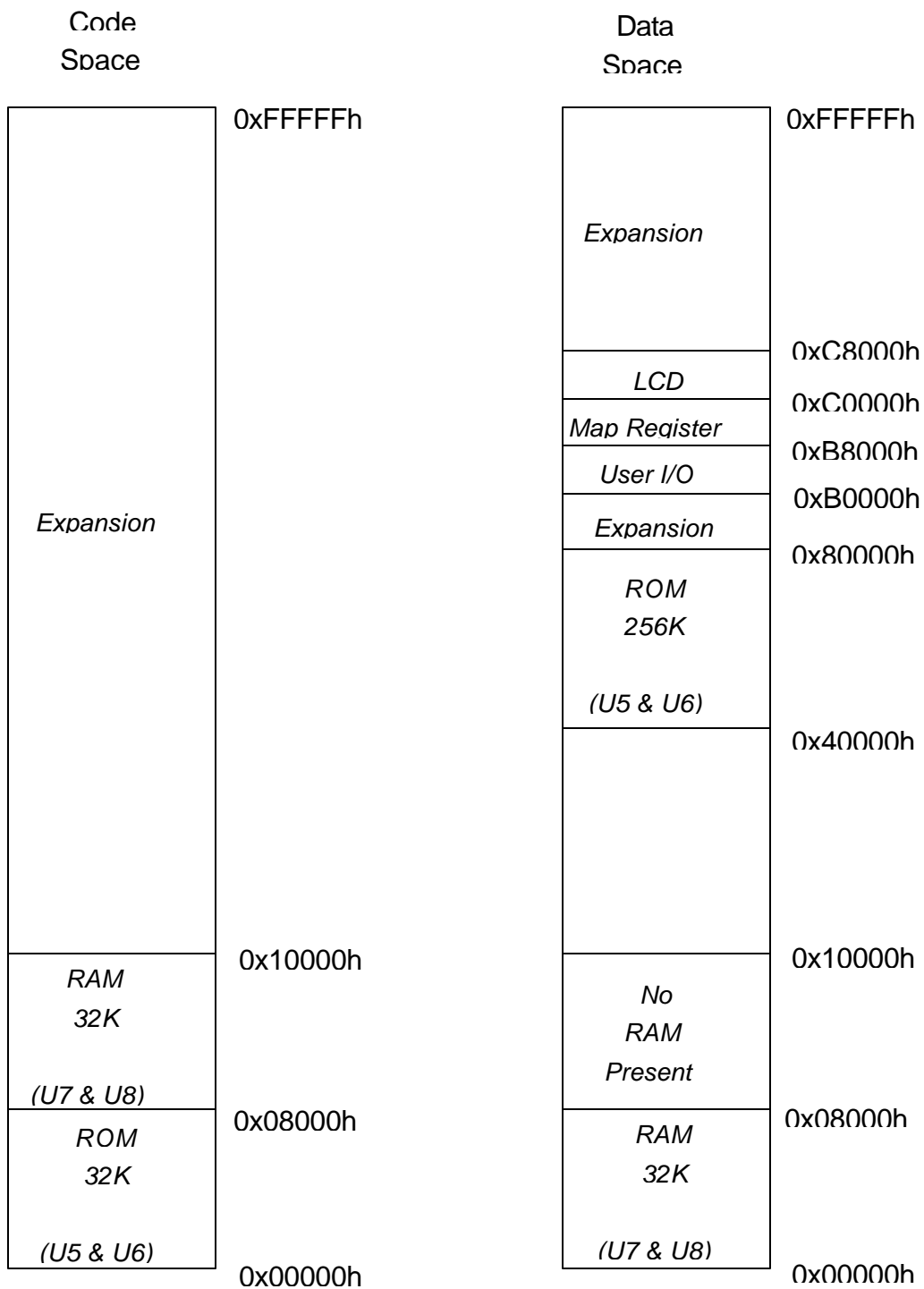
Map=10



This map setting supports the Raisonance Debugger. The maximum downloadable code size is 32KB.

# 10.4 Memory Map - FLASH Reprogram Mode

Map=11



This mode supports FLASH reprogramming by mapping the FLASH ROMs into data space at 0x40000h so it can be written in the XA Harvard Architecture.

# 11. APPENDIX D - PARTS LIST

Item	Qty	Part	Reference(m)	Vendor	P/N
1	1	LCD ASSY, 16X1 WITH HEADER	LCD		
2	1	ANTI-STATIC, 8x10		3M	1900 8X10
3	8	0.01UF, 50V, AXIAL	C45-C49, C51, C53, C54	AVX	SA105E103ZAA
4	22	0.1UF, 50V, AXIAL	C1-C5, C10-C13, C25-C27, C29, C30, C32-C38, C41	AVX	SA105E104ZAA
5	9	10UF, 35V, RADIAL	C6, C9, C14, C19-20, C23, C31, C50, C52	NICHICON	UVX1V100MDA
6	4	1UF, 50V, RADIAL	C15, C16, C17, C18	NICHICON	UVX1H010MDA
7	1	470PF, 200V, AXIAL, 5% NPO	C39	AVX	SA102A471JAA
8	2	27PF, 200V, AXIAL, 5% NPO	C8, C7	AVX	SA102A270JAA
9	1	4.7UF, 16V, RADIAL, TANT	C44	SPRAGUE	199D16V4.7
10	1	1N5818	D3	ANY	1N5818
11	1	GREEN, T1 3/4	D2	QUALITY SEMICONDUCTOR	MV5474C
12	1	RED, T1 3/4	D1	QUALITY SEMICONDUCTOR	MV5774C
13	2	FERRITE BEAD, 60OHM (MIN)	L3, L1	PANASONIC	EXC-ELSA-35
14	6	RUBBER FEET 0.4 ROUND	FEET	3M	SJ5003-0
15	1	PWR, 2.1MM, FEM, PCB MNT	J3	JAMECO	PP014
16	1	DB9, RA, PCB, FEM	J5	KRISTA	24-326
17	1	HDR2X7, 0.100	JP9	MOLEX	10-89-1141
18	1	REC 14X1, 0.100, 0.025" POST	J18	BERG	66951-014
19	2	REC 16X1, 0.100, IC PINS	SKT7A, SKT8A	AMP	643648-3
20	1	REC 7X2, 0.100, 0.025" POST	J19	BERG	66953-007
21	1	HDR 30X2, 0.100, 0.025" POST	J6	JAMECO	68574
22	1	DB9, RA, PCB, MALE	J4	JAMECO	104942
23	0	HDR, 6X1, 0.100, STR, BREAK-TO-FIT	(J20)	ANY	
24	0	2PIN, MTA156, STR, AMP ONLY	(J12)	AMP	640445-2
25	4	SOCKET, 16X1, 0.100, STR, BREAK-TO-FIT	SKT5A, SKT5B, SKT5C, SKT5D		
26	2	FLASH 1.0X0.5	FLASH LABEL		
27	1	PLD, 0.25"X1.0"	PLD LABEL		
28	11	JUMPERS	[JP1, JP2, JP4X4, JP5, JP7, JP9X3, JP10]	KRISTA	24-872
29	1	HDR, 2X1, 0.100, STR, BREAK-TO-SIZE	JP11	ANY	0.025 POST BREAKAWAY
30	5	HDR, 3X1, 0.100, STR, BREAK-TO-SIZE	JP1, JP2, JP5, JP7, JP10	ANY	0.025 POST BREAKAWAY
31	1	HDR, 2X8, 0.100, STR, BREAK-TO-SIZE	JP4	ANY	
32	1	HDR, 8X1, 0.100, STR, BREAK-TO-SIZE	JP8	ANY	0.025 POST BREAKAWAY
33	1	XTEND-C3, 5.25 x 7.25, 4L, REV A	PWB		
34	1	100, 1/4W, 5%	R12	ANY	
35	1	10K POT SGL TRN	RP3	BOURNS	3386H-1-103
36	5	10K, 1/4W, 5%	R1, R11, R19, R21, R26	ANY	
37	1	1K, 1/4W, 1%	R20	ANY	
38	2	1K, 1/4W, 5%	R13, R25	PHILIPS	CR25-1K5%TR (5KREEL)
39	1	3.3K, 1/4W, 5%	R15	ANY	
40	3	470, 1/4W, 5%	R8, R18, R24	ANY	
41	3	33, 1/4W, 5%	R14, R17, R22	ANY	
42	1	NWK, 10K, CMN, SIP10, CNFML	RP1	BOURNS	4610X-101-103
43	2	ALUMINUM	RU11, RU21	ANY	
44	1	14PIN DIP, 0.300	SKT14	AMP	2-641599-5
45	7	16PIN DIP, 0.300 TIN	SKT7-1, SKT7-2, SKT8-1, SKT8-2,		
46	3	20PIN, 0.300	SKT9, SKT16, SKT18	AMP	2-641600-3
47	1	24PIN DIP (0.300)	SKT2, SKT4, SKT17	AMP	2-640464-3
48	1	32PIN DIP (0.600)	SKT3	AMP	2-641932-3
49	1	44PIN PLCC AMP ONLY	SKT6	AMP	2-644018-3
50	4	8PIN DIP	SKT1	AMP	821575-1
51	1	PIEZO	SKT12, SKT13, SKT19, SKT20	AMP	2-640463-3
52	3	PUSHBUTTON, MOMENTARY, MINATURE	LS1	STAR	QMB111PX
53	1	1K, RADIAL	S1, S2, S3	PANASONIC	EVQ-PAG04K
54	1	74HCT123N, DIP16	RT1	PANASONIC	ERT-D2FGL102S
55	2	29EE512, FLASH, 64KB, 150NS, DIP32	U18	PHILIPS	74HCT123N
56	1	MAX232, 10UF, DIP16	U5A, U6, (U5B)	SST	SST29EE512-90-4C-PH
57	1	PLD 22V10, EE, 15NS, DIP24	U9	ANY	MAX232N or DS14C232CN
58	2	SRAM, 32KX8, 20NS OR FASTER, DIP28	U3	CYPRESS	PALCE22V10/15PC
59	2	LM7805CT, TO-220	U7, U8	SHARP	LH52258AD-20
60	1	74HCT14, DIP14	U11, U21	ANY	
61	1	74HCT259N, DIP16	U14	ANY	74HCT14N
62	2	74VHC373N	U16	ANY	
63	1	XA-C37, MICRO, 16BIT, CAN, 32KB OTP, PLCC44	U2, U4	FAIRCHILD	74VHC373N
64	1	CAN DVR, PCA82C251	U1	PHILIPS	P51XAC37KBA
65	0	EEPROM, 1K, DIP8	U12	PHILIPS	PCA82C251N
66	2	HCPL-7710, DIP8	(U13)	ATMEL	AT93C46A-10PC
67	1	8CH, 8BIT ADC, SPI, MAX1112CPP	U19, U20	HP	HCPL-7710
68	1	20MHZ, HC49S, 18PF, LOW PROFILE	U17	MAXIM	MAX1112CPP
			Y1	ANY	HC49/US 5mm

Replacement parts are available from:

<p>Digi-key Corporation  701 Brooks Ave. South  Thief River Falls, MN 56701-0677  Orders: 1-800-344-4539</p>	<p>JAMECO Electronic Components  1355 Shoreway Road  Belmont, CA 94002-4100  Orders: 1-800-831-4242</p>
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