RSC-4x Target Board V2 Manual

For FluentChip™ Technologies

SENSORY®

P/N 80-0299-D

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Introduction

Welcome to the RSC-4x Family and the world of low-cost, high-performance speech recognition! The resources in the **RSC-4x Target Board V2 Toolkit** work in conjunction with **Phyton's In-Circuit Emulator (**sold separately) to enable you to produce innovative and powerful products that feature a high level of system integration using low-cost leading-edge speech technologies. This manual discusses the use of these resources for development of products featuring an RSC-4x chip. It assumes the reader is an experienced software developer who understands assembly language programming, embedded systems development methods, relocatable object code, and similar general concepts, but who may not be specifically familiar with Sensory's ICs. **This Toolkit supports the RSC-4x Family only. It cannot be used to develop products for the RSC-164, 264, 364, or SVC families of chips.**

NOTE: The Demo/Eval Board V2 can be configured for the RSC-4128 or the RSC-464 with the S7 switch near the USB port. When the RSC-464 is selected, the Demo/Eval Board V2 mimics the RSC-464 chip. Port1 is disconnected from J5 to prevent its use in the demo or application, since this port does not exist on the-RSC-464. It also uses buffered PWM audio output to simulate the RSC-464 PWM, which is a little louder than that of the RSC-4128.

Included in the RSC-4x Target Board V2 Toolkit

- RSC-4x Target Board V2 (Target Board V2), featuring a footer that allows mounting a PICE while offering resources necessary for memory and I/O utilization.
- USB Cable
- Speaker
- Wall-Mount Power Supply (120V) 9VDC
- *RSC-4x V2 Toolkits CD*
  - RSC-4x Target Board V2 Manual (this manual) — use this as a Quick Start Guide
  - FluentChip™ Technology (FC) firmware, which is capable of running Hidden Markov Modeling (HMM) and neural network speaker independent (SI), speaker dependent (SD), speaker verification (SV) speech recognition; speech and music synthesis; and related technologies
  - "QuickSynthesis™ 4" (QS4), which allows a developer to compress speech for low data-rate synthesis
  - "SensoryLoader4" (SL4), which is used to download programs to the Target Board V2
  - RSC-4x Family documentation
  - Quick T2SI™ Product Brief
  - RSC-4x V2 Technology Demos with documentation

This toolkit works in conjunction with:

- Phyton's free Project-SE IDE, which includes an assembler and linker with an optional C compiler (the compiler requires licensing from Phyton)
- Quick T2SI™ Toolkit (sold separately), which can create HMM-based SI recognition sets by simply typing the vocabulary on a PC and downloading it to the included Target Board V2.
  Note: Quick T2SI v2.1.0 or later is required for compatibility with the Target Board V2.

The RSC-4x Family of ICs provides the following technology features important for low-cost consumer products:

- Low-voltage operation (2 AA alkaline batteries)
- Power-down sleep mode to conserve power
- Pulse Width Modulator (PWM) to directly drive a speaker
- Memory sufficient for storing seven (7) SD or SV words in RSC4128 on-chip memory (1 word for RSC464)
- Integrated microphone amplifier requiring only a few additional passive components

Developing a product that effectively integrates Sensory's speech technologies requires hardware platform development, software development, product integration, and human-interaction testing. For the best speech recognition performance, each of these design areas should be error-free. Sensory helps to facilitate successful implementation by providing free design consultations and product reviews. Refer to the Speech Recognition Hardware Design Guide (80-0073) for more details. (For documentation, select "Documentation" from the window that launches when you insert the CD.)

Additional Resources

For IC specification and on-chip hardware resources information, refer to:

- RSC-4128 Datasheet (80-0206)
- RSC-464 Datasheet (80-0282)

For programming with the FluentChip™ Technology Library, refer to:

- FluentChip Reference Manual

For assembling and linking programs, refer to:

- Phyton IDE Quick Start Guide (80-0247)

For information on the Sensory Quick T2SI™ Toolkit (offered separately), refer to Quick T2SI Toolkit Product Brief (80-0245) or contact Sensory Sales, sales@sensoryinc.com.

The Phyton Project-SE IDE (assembler, linker and simulator) is free and may be downloaded from Phyton's website at http://www.phyton.com/downloads/project-se.exe. You can also order the optional Phyton C Compiler from the Sensory or Phyton websites.

Check for updates and the most recent versions of the technology libraries on the Sensory website at http://www.sensoryinc.com.

Getting Started

Sensory demo and development toolkits allow developers to quickly grasp how Sensory's speech technologies work. The included demo programs show the basic functions of each technology. Included pieces of example code (samples) show how to integrate each technology into your own projects. Where necessary, we offer guidance in configuring the hardware for specific needs.

Step One: Installing Sensory Tools

1) ***We recommend that you read all of the documents available on this CD before attempting to install any software or connect the Target V2 Board to your PC.***
2) Return to the window that launched when you inserted the CD (the CD launch screen).
3) Click "Install FluentChip". This will install Sensory's speech technology libraries.
4) Click "Install QuickSynthesis 4". This will allow you to compress speech files for playback.
5) Click "Install SensoryLoader4". This will allow you to download demos and applications from your PC to the Target Board V2.

Step Two: Installing Phyton Tools

1) Download the Phyton Project-SE and install everything but the C compiler unless it has been licensed and you have a security dongle.
   http://www.phyton.com/downloads/project-se.exe

Step Three: Installing USB Driver

Sensory's programming boards utilize the FT232B(L) USB UART IC chip manufactured by Future Technology Devices Int'l. In order to interface with a PC, you need to download and install their USB driver.

- To download the driver, refer to:
- http://www.ftdichip.com/Drivers/VCP.htm

- For installation instructions, refer to:
- http://www.ftdichip.com/Documents/InstallGuides.htm

- For more information, refer to the Future Technology Devices Int'l website at:
- http://www.ftdichip.com

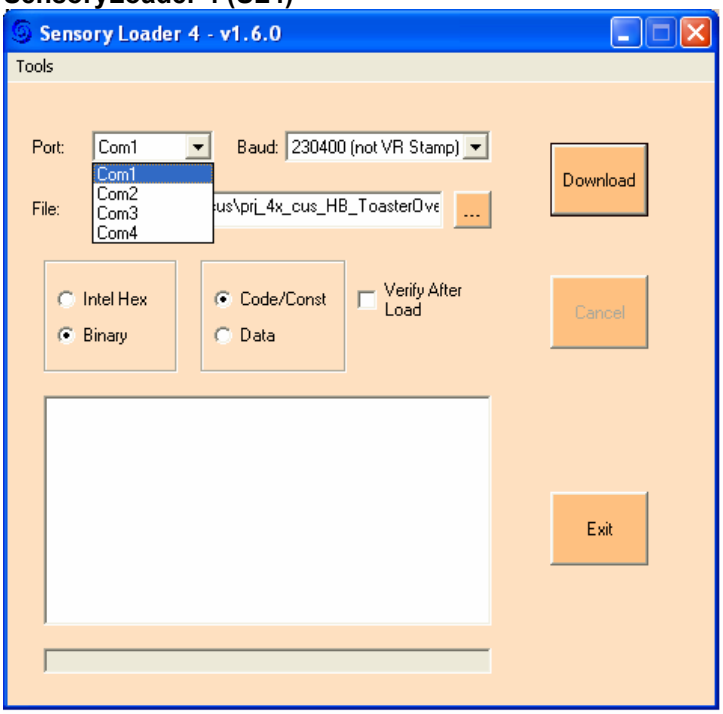
Note: Many USB problems not resolved by COM port configuration can be resolved by eliminating USB hubs or by selecting another USB port.

Uninstalling USB Drivers
If you need to remove the drivers, go to the Windows Control Panel and choose "Add or Remove Programs". Remove "FTDI USB Serial Converter Drivers".

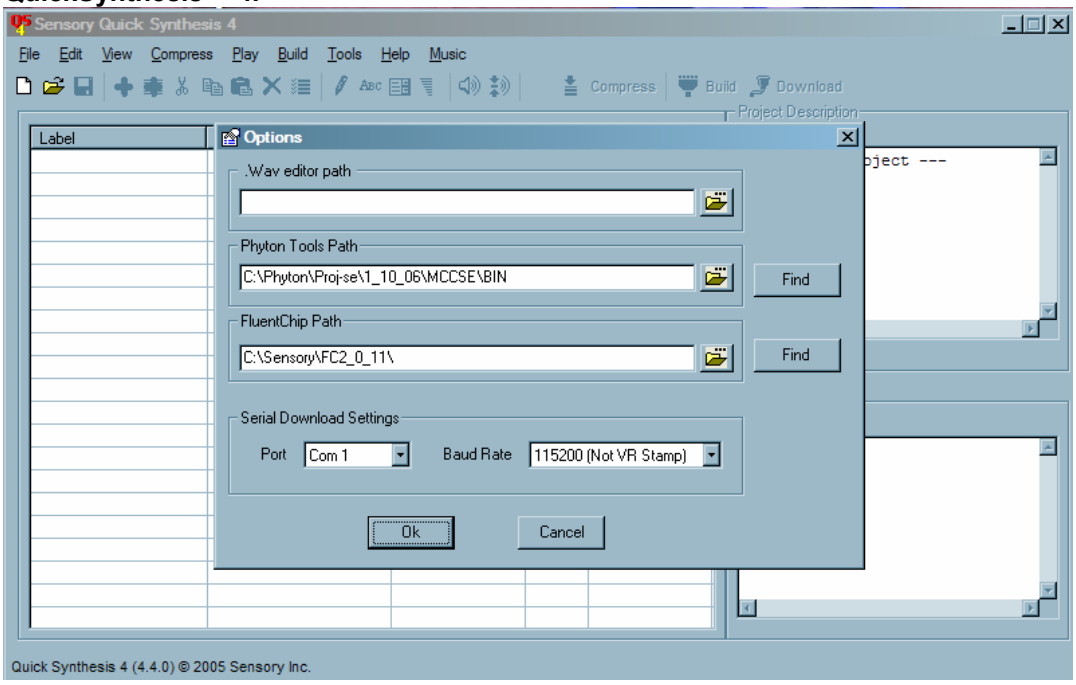
COM Port Configuration

The COM port you select for the VCP Driver must match the COM port you select for Sensory software tools. The following screen shots show where to change the COM port:

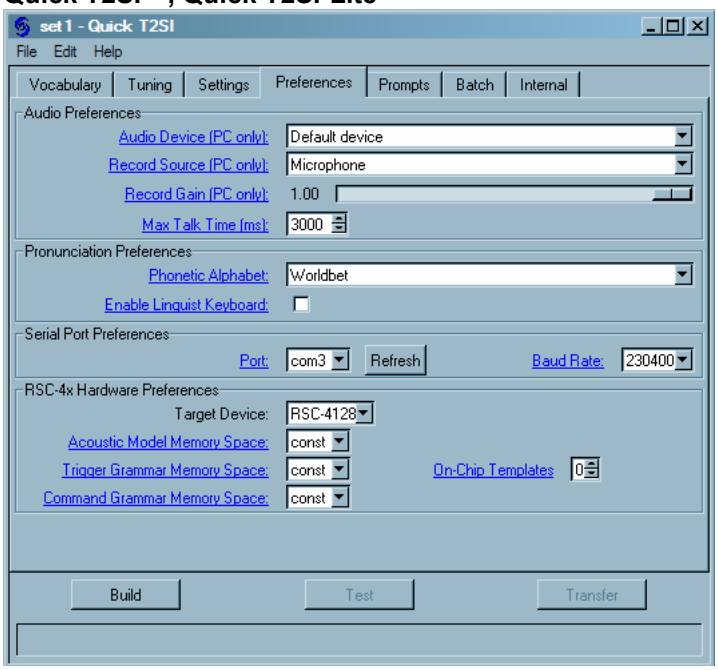
SensoryLoader 4 (SL4)



QuickSynthesis™ 4.

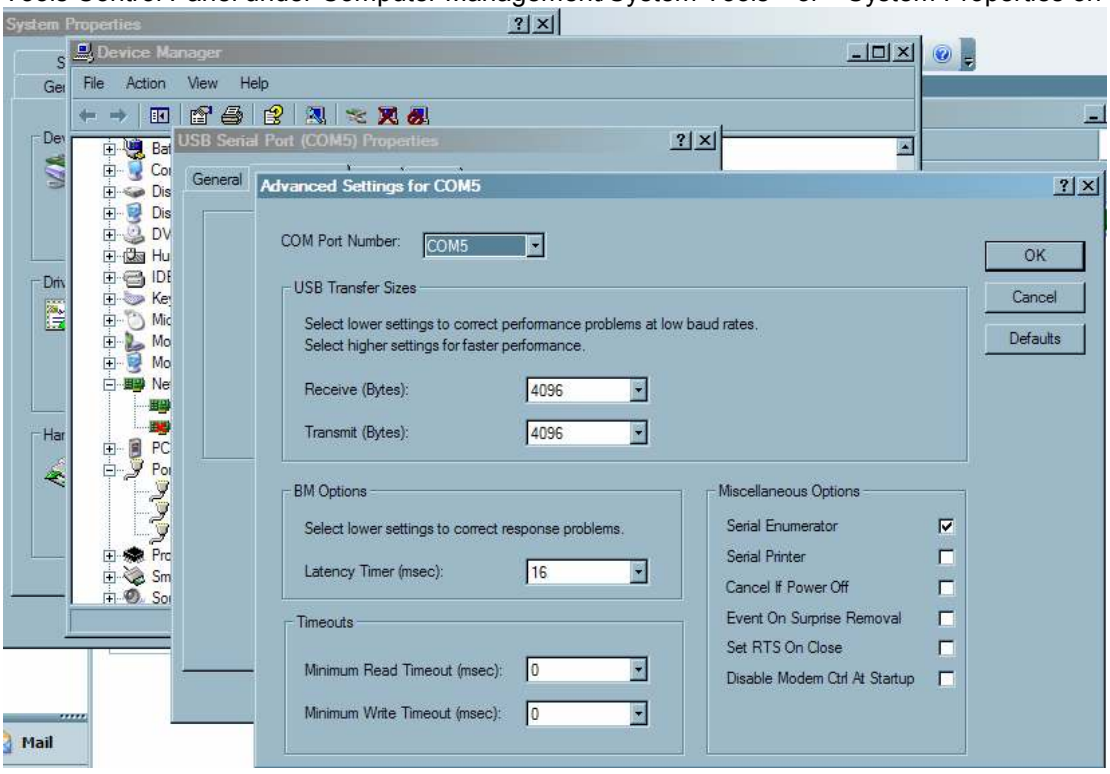


Quick T2SI™, Quick T2SI-Lite™



For additional information on setting the COM port for Quick T2SI™ or Quick T2SI-Lite™, refer to "QuickStartGuide.chm" located in the docs folder. For QuickSynthesis™ 4, refer to "QuickSynthesis4.chm" located in the FluentChip™ docs directory.

To see the port selected for the VCP driver, please refer to the Device Manager in your PC's Administrative Tools Control Panel under Computer Management/System Tools—or—System Properties on My Computer.



Step Four: Configuring the Target Board V2

WARNING

Do NOT change the jumpers on the Target Board V2 while the power is turned on. Before changing any jumpers, remove the batteries or disconnect the power supply.

To configure the Target Board V2, refer to the following "Target Board V2 Hardware" section. Each technology requires different board and jumper settings.

Step Five: Running Applications and Using Samples

Make sure that the Target Board V2 is configured correctly for the required technology before running an application. For more comprehensive information, refer to the following "Target Board V2 Hardware" section.

Building Sample Programs

- To build and run a sample using the IDE, refer to Phyton IDE Quick Start Guide (80-0247).

Target Board V2 Hardware

The Target Board V2 provides hardware features, such as memory locations, buttons, and LEDs, that allow application developers to create hardware mockups of their final product.

Using 0-wait states requires fast memory in the final product. It is important to verify that the end product uses the same memory speed configuration as the prototyping environment.

This chapter contains a description of the hardware on the Target Board V2 as well as parts locator drawings. Refer to the RSC-4x Target Board V2 Schematic (70-0065) for more details.

WARNING

Do NOT change the jumpers while the power is turned on. Before changing any jumpers, remove the batteries or disconnect the power supply.

1) Insert three AA batteries in the battery holder, or connect a wall-mount power supply rated at 9VDC to the Target Board V2.
2) Connect the included speaker to the Target Board V2.
3) Connect the Target Board V2 to your PC using the Phyton PIC module and included USB interface cable.
4) Turn on the power by rotating the round dial switch clockwise. You can use this dial to adjust the volume

The first time you use the Target Board V2, confirm that all jumper blocks are installed at the default settings.

The description of the Target Board V2 hardware is divided by sections corresponding to the hardware areas and their jumpers. Most sections are headed by a table that serves as a reference. The sections are:

- **Downloader**
- **Audio Output**
- **USB Connection**
- **Parallel Memory Configuration**
- **Serial Memory Configuration**
- **Microphone Gain**
- **Application LEDs and Switches**
- **Selecting the Chip Type**
- **Selecting the Wait State**
- **The "PROGRAM" Button**
- **The "RESET" Button**
- **Power Supply, LEDs, and Switches**

Downloader

Table: Jumper Settings – Download

REF	NAME	Shorting Block	Descriptions
JP21	-	YES at DOWNLOAD	Shorting block at JP21 (1-2)

This jumper has no effect on the Target V2 Board.

Audio Output

The Target Board V2 includes audio jacks for both DAC and PWM audio outputs.

- To use DAC output, connect the speaker to J2 (SPKR DAC). You can adjust the loudness with the round dial (R7).
- To use PWM output, connect the speaker to J23 (SPKR PWM).

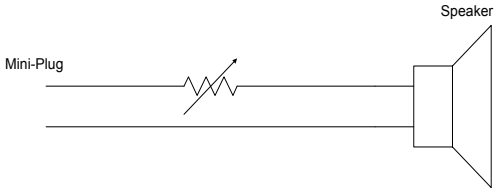
Table: Jumper Settings – Audio Output

REF	NAME	Shorting Block	Descriptions
JP2	DAC/GND	NO	Non-amplified DAC output. To use this, remove shorting block at JP46.
JP3	SPKR/DAC	NO	Use this header for connecting the speaker instead of the J2 audio jack.
JP4	SPKR/WPM	NO	Use this header for connecting the speaker instead of the J3 audio jack.
JP46	-	YES	Without JP46, there will be no audio signal at the J2 audio jack or JP3.

Adding Volume Control for PWM

To add volume control to the PWM output of the board:

- Disconnect the speaker cord from the mini-plug jack on the PCB.
- Cut into one side of the cord and insert a 200 Ohm potentiometer in series with the wire.



USB

The Target Board V2 can connect to another computer via USB using a Virtual COM Port (VCP) Driver, which mimics an RS232 interface over a USB connection.

Table: Jumper Settings – USB

REF	NAME	Shorting Block	Descriptions
JP45	-	NO	No shorting block on any of these pins (EXT VDD, RX PC, TX, PC, GND)
JP43	TX	YES	-
JP44	RX	YES	-
JP40	RXPC	YES at INT	Shorting block at JP40 (1-2)
JP41	TXPWR	YES at INT	Shorting block at JP41 (1-2)
JP42	PXPC	YES at INT	Shorting block at JP42 (1-2)

Port pins P01 and P00 are used for TX and RX respectively. To use different port pins, remove the shorting blocks from JP43 and JP44, and connect your custom port pins for TX and RX at JP43-1 and JP44-1 respectively.

Parallel Memory Configuration

There are 3 parallel memory ICs on the board. They can be used only if you configure the Phyton IDE environment to use the external code memory space.

- U20 – 8Mbit Flash to run 1WS applications
- U21 – 4Mbit SRAM to run 0-wait state applications
- U22 – 1Mbit OTP for the downloader and Karaoke feature

Note: U19 (DIP) is in the bus, but it is not used in the standard parallel memory configuration.

Table: Jumper Settings – Parallel Memory Configuration

REF	NAME	Shorting Block	Descriptions
JP10	DPCE	NO	U19: DIP: -CE
JP11	DPOE	NO	U19: DIP: -OE
JP12	CFRT	YES	U20: Code Flash: Reset
JP13	CFCE	YES	U20: Code Flash: -CE
JP14	CFWE	YES	U20: Code Flash: -WE
JP15	CFOE	YES	U20: Code Flash: -OE
JP16	CSWE	YES	U21: Code SRAM: -WE
JP17	CSOE	YES	U21: Code SRAM: -OE
JP18	CSCE	YES	U21: Code SRAM: -CE
JP19	DLCE	YES	U22: Downloader OTP: -CE
JP20	DLOE	YES	U22: Downloader OTP: -OE

When you remove the shorting blocks for the parallel memory, the signal will be pull-down or pull-up such that the device will be disabled. For example, if you remove a shorting block for CFCE, the flash IC (U20) will be disabled.

Using EPROM or ROM Emulator in DIP Socket (U19)
If you would like to use an EPROM or ROM emulator, remove all the shorting blocks from the Parallel Memory configuration except for JP10. The shorting block at JP10 enables the memory device on the DIP socket. Connect -RDR (at J6) to Pin 2 of JP11. In this configuration, the memory IC in the DIP socket is the only parallel memory device on the bus. There will be no download feature in this configuration.

Serial Memory Configuration

There are 3 serial memory ICs on the board:

- U23 – 128Kbit Serial EEPROM on the DIP socket
- U25 – DIP socket for Winbond Serial ROM or Flash (SOCKET ONLY)
- U24 – 32Mbit Serial Flash soldered on board

Table: Jumper Settings – Serial Memory Configuration

REF	NAME	Shorting Block	Descriptions
JP22	-CE	YES(1)	U24: Serial Flash: -CE
JP23	CLK	YES(1)	U24: Serial Flash: CLK
JP24	SO	YES(1)	U24: Serial Flash: Serial Data Out
JP25	SI	YES(1)	U24: Serial Flash: Serial Data In
JP26	CLK	NO	U25: Serial ROM (Winbond): CLK
JP27	DATA	NO	U25: Serial ROM (Winbond): Data
JP28	ADDRESS	NO	U25: Serial ROM (Winbond): Address
JP29	CLK	YES(2)	U23: Serial EEPROM: CLK
JP30	DATA	YES(2)	U23: Serial EEPROM: DATA

Only a DIP socket is provided for the Winbond Serial ROM. In standard operation, this device is not used. In standard operation, if a serial memory device is used, it is either Serial Flash (U24) or Serial EEPROM (U23).

- To use Serial Flash (U25), place the shorting blocks on JP22, JP23, JP24, and JP25.
- To use Serial EEPROM (U23), place the shorting blocks on JP29 and JP30.

The Target Board V2 is shipped with the shorting blocks placed for Serial Flash.

Serial EEPROM

A 128Kbit Serial EEPROM 24LC128 DIP socket in U23 has been provided for storing recognition template data or application-specific data. You may replace it with different sizes of Serial EEPROM from 24C01 through 24LC128, which are supported by the FluentChip™ Technology Library. For more details, refer to the FluentChip Reference Manual.

Microphone Gain

The Target Board V2 is shipped with the shorting blocks placed to achieve a microphone gain of -46dB when the on-board microphone is used.

Table: Jumper Settings – Microphone Gain

REF	NAME	Shorting Block	Descriptions
JP5	NORM	YES	Always leave this shorting block.
JP6	LOW	Factory Select	Gain select
JP7	MED	Factory Select	Gain select
JP8	HI	Factory Select	Gain select
JP9	CUST	NO	For use with the custom or external microphone. When CUST is used, do not leave a jumper in JP6, JP7, or JP8.

When using an external microphone connected to J4, select the appropriate microphone resistor and solder it to R12. Refer to *"Selecting a Microphone"* below.

Selecting a Microphone
Selecting a proper microphone and its source resistor are essential for achieving good recognition results. Placement of the microphone will also affect recognition performance. Refer to the Selecting a Microphone Design Guide (80-0259).

- **On-board Microphone** – There is an on-board microphone. When no microphone is connected to the microphone jack (J4) on the Target Board V2, the on-board microphone is automatically connected to the circuit. The Target Board V2 is shipped with the jumper pre-selected to match the on-board microphone for the optimal gain.

- **External Microphone** – A stereo audio jack (J4) is provided for an external microphone. You can connect an off-the-shelf microphone.

Microphone Gain Jumpers
For custom microphones, you can select your own resistor value. A location for the through-hole resistor is provided at R12 for this purpose. To use custom gain, you can solder a resistor at R12 and select the jumper block at CUST (JP9). Make sure that you do not leave a shorting block in JP6, JP7, or JP8, but keep the shorting block in JP5.

Application LEDs and Switches

There are four LEDs on the board that are connected to I/O ports. One is green, one red, and two yellow. There are five switches (buttons) on the board that are connected to I/O ports. They are labeled, “A”, “B”, “C”, “D”, and “E”. The “E” button is used as a “Wake-up” button in the samples because the system cannot be woken using the P2 ports.

Table: Jumper Settings – LEDS and SWITCHES

REF	NAME	Shorting Block	Descriptions
JP32	GRN	YES	Connected to P2.0
JP33	YEL	YES	Connected to P2.1
JP34	YEL	YES	Connected to P2.2
JP35	RED	YES	Connected to P2.3
JP36	SW-A	YES	Connected to P2.4
JP37	SW-B	YES	Connected to P2.5
JP38	SW-C	YES	Connected to P2.6
JP39	SW-D	YES	Connected to P2.7
JP31	SW-E	YES	Connected to P0.2

Selecting the Chip Type

The Target Board V2 can be configured for the RSC-4128 or RSC-464 with the S7 switch near the USB port. When the RSC-464 is selected, the Target Board V2 mimics the RSC-464 chip. Port1 is disconnected from J5 to prevent its use in the demo or application, since this port does not exist on the RSC -464. It also uses buffered PWM audio output to simulate the RSC-464 PWM, which is a little louder than that of the RSC-4128.

Selecting the Wait State

The memory inside the PICE is fast enough for running 0-wait state. It is important to verify that the end product uses the memory that is fast enough to run 0-wait state.

Since the code runs on the memory in the PICE, selecting the state with S8 on the Target Board V2 has no effect.

The "PROGRAM" Button

Instead of using the "PROGRAM" button to download the program, run the program with PICE.

The "RESET" Button

The "RESET" button resets the Target Board V2 as well as PICE.

Power Supply, LEDs, and Switches

Power Inputs

There is a battery holder on the Target Board V2 that holds 3 AA batteries. You can use batteries or connect a wall-mount power supply rated at 9VDC to the J1 connector. When the power supply is connected to the J1 connector, the batteries will automatically be disconnected from the circuit. When batteries are used, the batteries are connected to the voltage regulator U2, which regulates VDD to 3VDC. When a wall-mount power supply is used, Q1 and D1 pre-regulate the power supply input voltage to 5VDC. The emitter of Q1 is then connected to the voltage regulator U2.

Power On/Off and Volume Control Dial

When you turn the Power/Volume dial clockwise, you will hear a click indicating that the power has turned on. The audio output volume starts at the minimum level, and increases with further clockwise turns. Volume control is only available for amplified DAC output.

Power On/Off LED

A green LED is connected to the PDN (power-down) output of the RSC-4x chip via a 74HC32 gate. The LED is off when the board is powered down or when the power is disconnected.

SRAM and Flash LEDs

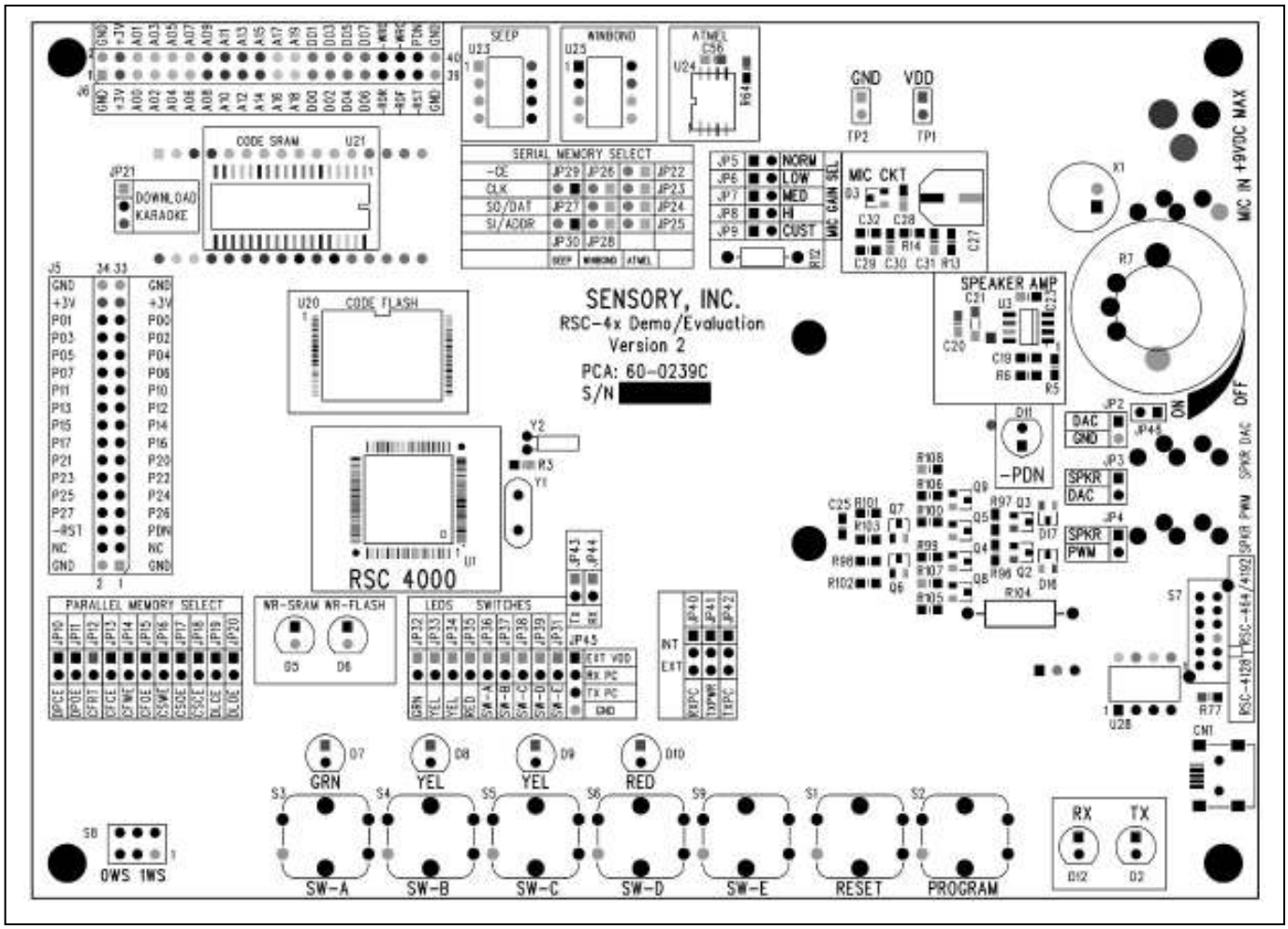
The yellow LED (WR-SRAM) lights when the SRAM (U21) is being written to. The green LED (WR-FLASH) lights when the Flash (U20) is being written to.

RX and TX LEDs

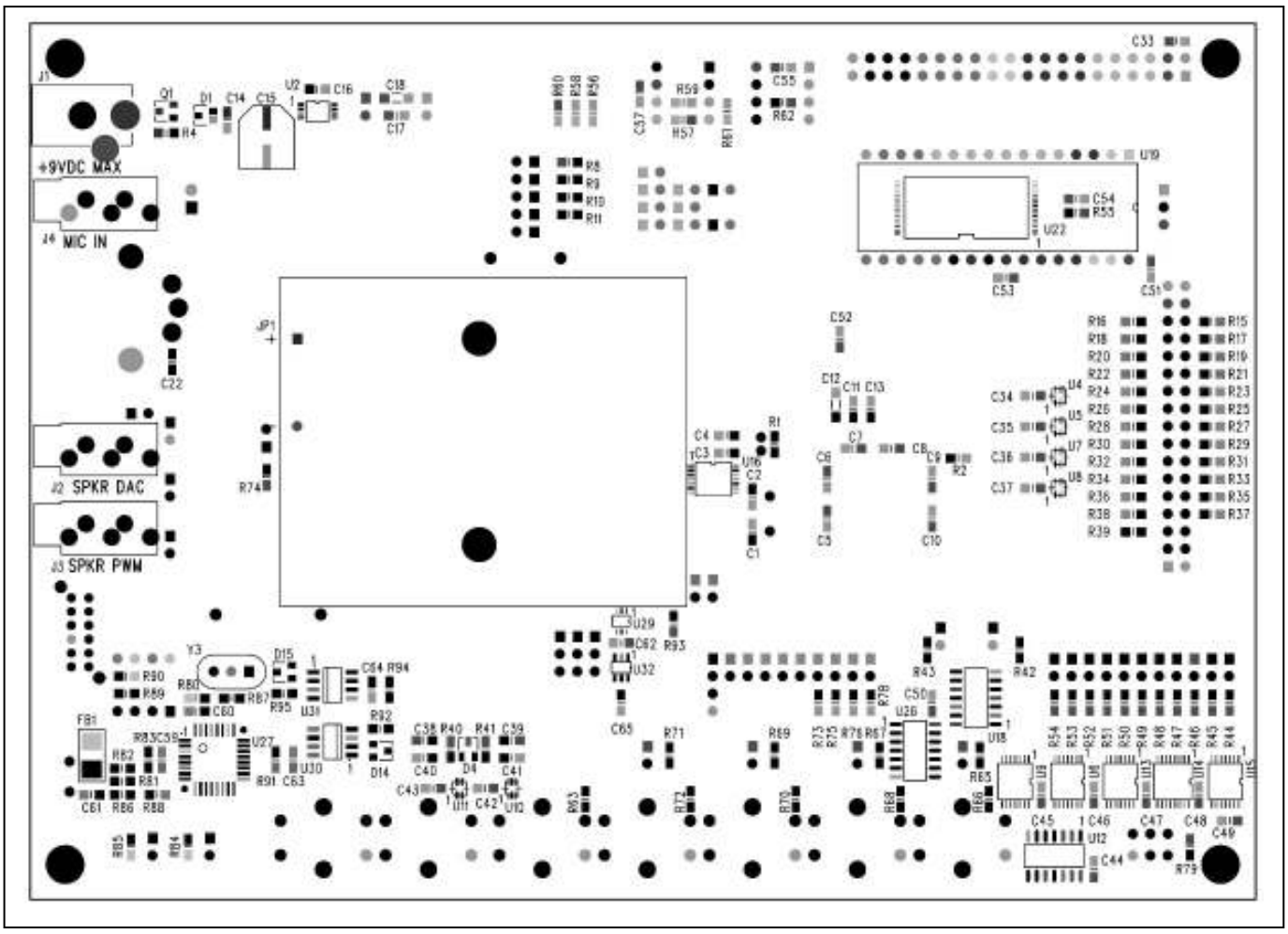
The green LED (RX) lights when data is being received from the PC. The yellow LED lights (TX) when data is being sent to the PC.

RSC-4x Target Board V2 Parts Locator

Top View



Bottom View



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The Limited Warranty, Exclusive Remedies and Limited Liability set forth above are fundamental elements of the basis of the agreement between Sensory and you. Sensory would not be able to provide the Software on an economic basis without such limitations.

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This Software and the documentation are provided with "RESTRICTED RIGHTS". Use, duplication, or disclosure by the U.S. Government is subject to restrictions as set forth in this EULA and as provided in DFARS 227.7202-1(a) and 227.7202-3(a) (1995), DFARS 252.227-7013 (c)(1)(ii)(OCT 1988), FAR 12.212(a)(1995), FAR 52.227-19, or FAR 52.227-14, as applicable. Manufacturer: Sensory, Inc., 575 N. Pastoria Avenue, Sunnyvale, CA 94085.

11. Consumer End Users Only (outside of the USA)
The limitations or exclusions of warranties and liability contained in this EULA do not affect or prejudice the statutory rights of a consumer, i.e., a person acquiring goods otherwise than in the course of a business.

12. General Provisions
This EULA shall be governed by the internal laws of the State of California. This EULA contains the complete agreement between the parties with respect to the subject matter hereof, and supersedes all prior or contemporaneous agreements or understandings, whether oral or written. All questions concerning this EULA shall be directed to: Sensory, Inc., 575 N. Pastoria Avenue, Sunnyvale, CA 94085 Attention: General Counsel.

The Interactive Speech™ Product Line

Sensory's **Interactive Speech™** product line makes consumer electronics more intelligent by enabling them to talk and hear with speech synthesis, voice recognition, and other advanced audio and interactive technologies. It is designed for integration into cost-sensitive consumer electronic applications such as home electronics, smart toys, music players and personal communication devices. The hardware line includes the award-winning RSC-4x family of mixed signal processors, the *VR Stamp*™ 40-pin DIP module, and the SC-691 music and speech synthesis slave processor. Embedded software options include our FluentSoft™ Recognizer, which enables speech recognition on non-Sensory processors and DSPs. Sensory's BlueGenie™ Voice User Interface, the first Voice Recognition and Synthesis option for BlueTooth enabled devices, offers user friendly control of headsets, music players and other BT devices requiring hands-free operation.

RSC Microcontrollers and Tools

The RSC product family contains low-cost 8-bit speech-optimized microcontrollers that are fully integrated and include A/D, pre-amplifier, D/A, RAM, and ROM circuitry. With Sensory's FluentChip™ firmware, the RSC family offers speech recognition, speaker verification, speech and music synthesis, voice recording and playback, and an entire suite of interactive robotic and sonic networking technologies. The family is supported by a complete suite of evaluation and development toolkits that include the ability to quickly create speaker independent recognition sets in many languages.

Speech Recognition Modules and Tools

The VR Stamp™ is a complete speech recognition module based on the RSC-4x and is ideal for fast design and easy production. A low-noise audio channel and standardized 40-pin DIP footprint allow rapid prototyping, less debugging, and shorter time to market. The *VR Stamp Toolkit* includes everything needed to get started today, including VR Stamps, Module Programming Board, sample applications, and a complete set of development tools featuring the Phyton IDE and limited-life C compiler, QuickSynthesis™ 4 and Quick T2SI-Lite™ speech tools.

SC6 Slave Processor and Tools

The SC-691 is a standard slave synthesizer that accepts compressed speech data from other microprocessors or microcontrollers and converts it to speech. The chip operates up to 12.32 MIPS, and provides high-quality, low data-rate speech compression and MIDI music synthesis, with unlimited speech duration using external memory. Sensory offers hardware and software tools for analyzing speech files, editing speech data and generating coded speech.

FluentSoft™ Recognizer

The FluentSoft™ Recognizer is the engine powering the FluentSoft™ SDK. It provides a noise-robust, large-vocabulary, speaker-independent solution with continuous digit recognition and word-spotting capabilities. This small-footprint software recognizes thousands of words and runs on non-Sensory processors including Intel XScale, TI OMAP, and ARM9, and supports operating systems such as MS Windows, Linux, and Symbian.

BlueGenie™ Voice User Interface

The BlueGenie Voice Interface software suite runs on CSR's BC-5 MM Kalimba DSP, and enables manufacturers of Bluetooth products to integrate full voice control and synthetic speech output without the need for visual displays or complex user interfacing. It frees designers to pack functionality onto small form factor Bluetooth devices and answers consumer demand for a truly hands-free experience.

SENSORY®

575 N. Pastoria Avenue, Sunnyvale, CA 94085
Tel: (408) 625-3300 Fax: (408) 625-3350