



EasyVR 3

User Manual

Release 1.0.10

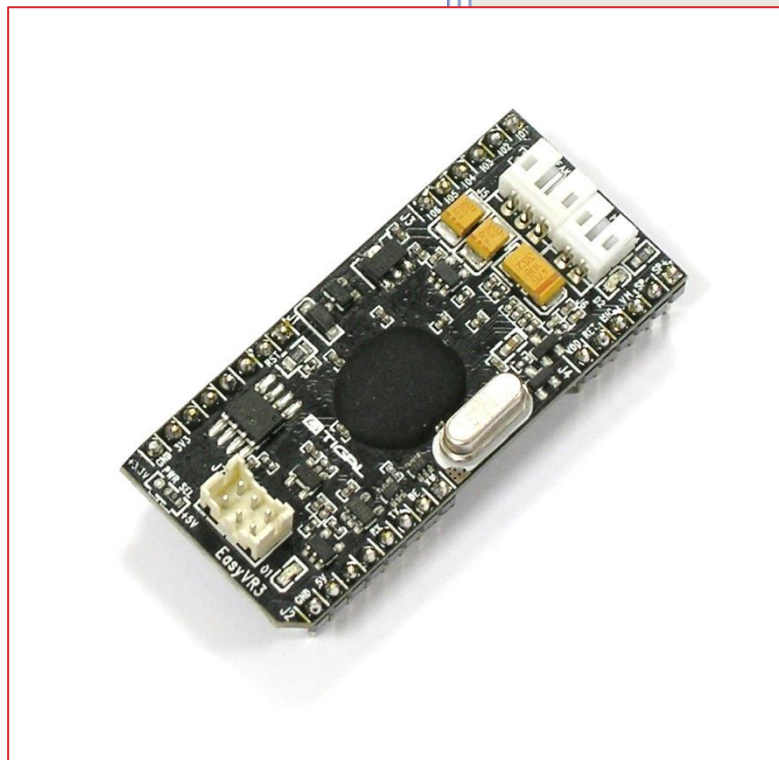


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Document History Information

| Revision | Date | Description |
|----------|------------|--|
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| 1.0.3 | 2015/02/09 | <ul style="list-style-type: none">New drawings and updated descriptions |
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EasyVR 3 Module

Product Description

EasyVR 3 is a multi-purpose speech recognition module designed to easily add versatile, robust and cost effective speech recognition capabilities to almost any application.

The EasyVR 3 module can be used with any host with an UART interface powered at 3.3V – 5V, such as PIC and Arduino boards. Some application examples include home automation, such as voice controlled light switches, locks, curtains or kitchen appliances, or adding “hearing” to the most popular robots on the market.

It can be easily plugged into a solder-less breadboard or standard prototyping board, and it is compatible with the mikroBUS™ specifications (see www.mikroe.com/mikrobus).



Separate male headers are provided inside the package, along with a microphone cable assembly and speaker wires (loudspeaker not included).

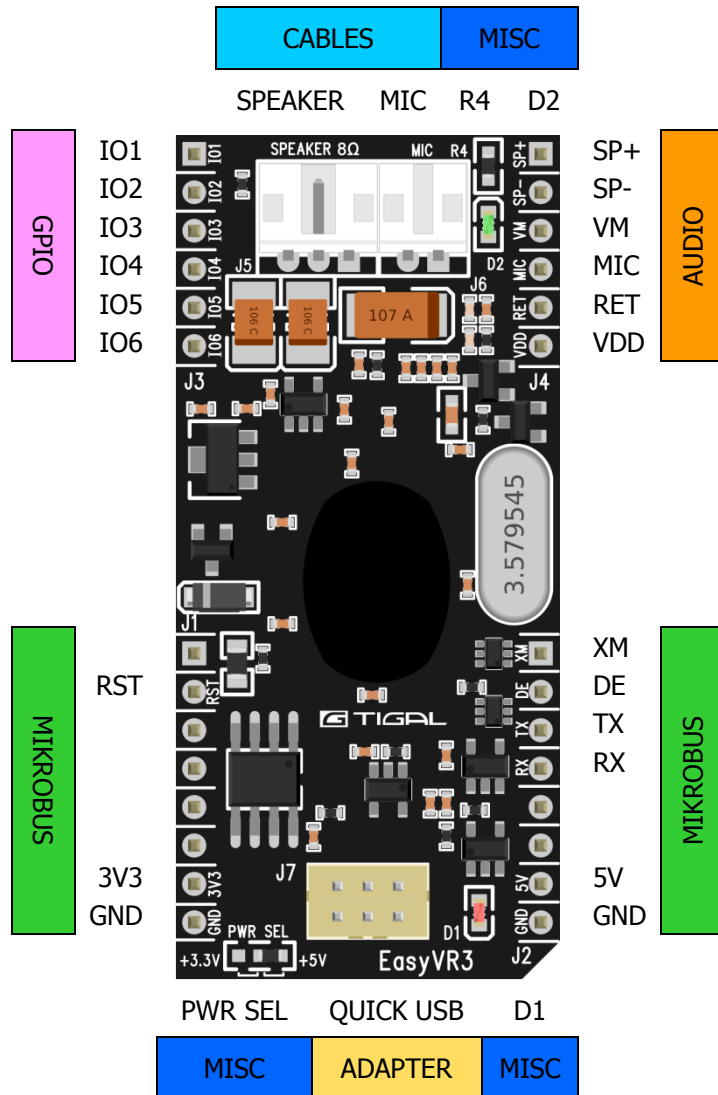
EasyVR 3 Features

- Up to 28 custom Speaker Independent (SI) command vocabularies¹.
Supported Languages:
 - US English
 - British English
 - French
 - German
 - Italian
 - Japanese
 - Korean
 - Mandarin
 - Spanish
- Up to 32 user-defined Speaker Dependent (SD) or Speaker Verification (SV) commands, that can be trained in ANY language.
- A selection of built-in Speaker Independent (SI) commands for ready-to-run basic controls, in the following languages:
 - English (US)
 - Italian
 - German
 - French
 - Spanish
 - Japanese
- SonicNet technology for wireless communications between modules or any other sound source (Audio CD, DVD, MP3 Player)
- Up to 22 minutes of pre-recorded sounds or speech².
- DTMF tone generation.
- Differential audio output that directly supports 8Ω speakers.
- Easy-to-use Graphical User Interface to program Voice Commands and audio.
- Standard UART interface (powered at 3.3V - 5V).
- Simple and robust documented serial protocol to access and program through the host board.
- 6 General purpose I/O lines that can be controlled via UART commands.

¹ A *QuickT2SI™ Lite* license (sold separately) is required to enable creation of Speaker Independent vocabularies (maximum 12 commands per set).

² At maximum compression rate.

Technical specifications








The outer headers J1 and J2 are the mikroBUS™ interface connectors, providing selectable 3.3V/5V power input to the module and voltage translated digital I/O lines, including: UART receive/transmit lines and control pins.

The header J3 provides configurable I/O expansion lines (inputs with weak internal pull-up by default), powered at the internal logic voltage VDD.

The header J4 contains the main analog signals, such as microphone signals and amplified DAC outputs, which are also available on the internal right angle connectors J5 and J6.

The module can also be operated through the programming connector J7 alone, by using the QuickUSB adapter/cable.

Pin assignment

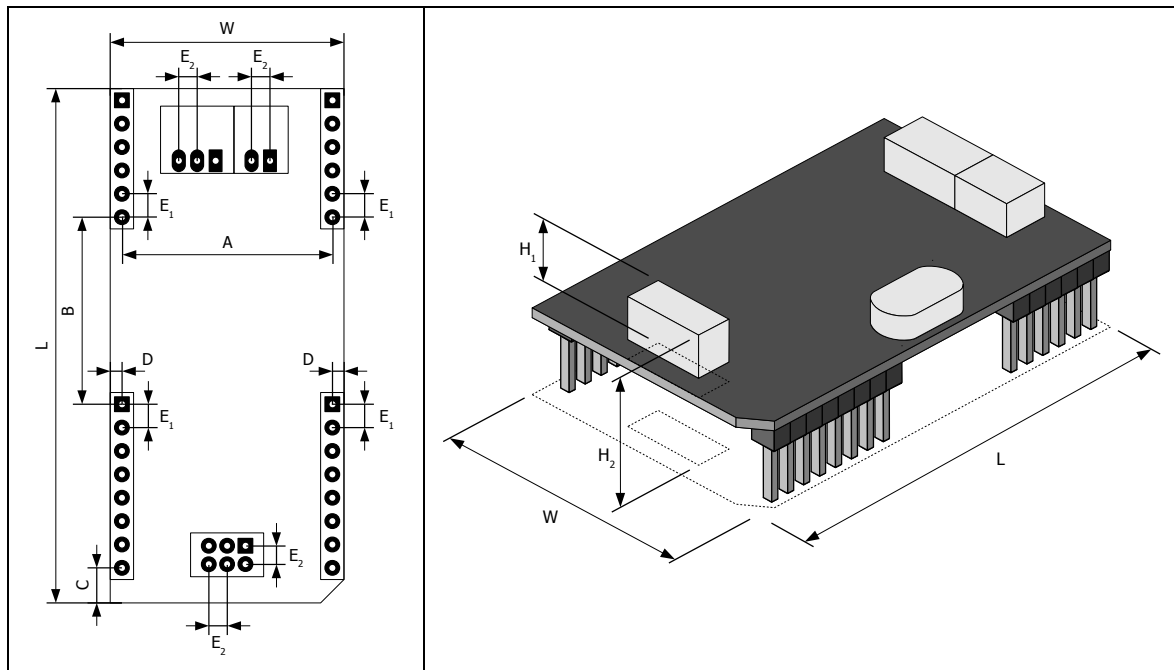
| Group | Name | Number | Pin | Type | Description |
|---|--|--------|-------|------|---|
|  MIKROBUS | J1 | 1 | - | - | (Not connected) |
| | | 2 | RST | I | Active low asynchronous reset (internal pull-up) |
| | | 3-6 | - | - | (Not connected) |
| | | 7 | 3V3 | I | 3.3V DC power input |
| | | 8 | GND | - | Ground |
| | J2 | 1 | XM | I | Boot select (internal pull-down) |
| | | 2 | DE | O | (Reserved) |
| | | 3 | TX | O | Serial Data Transmit |
| | | 4 | RX | I | Serial Data Receive |
| | | 5-6 | - | - | (Not connected) |
| | | 7 | 5V | I | 5.0V DC power input |
| | | 8 | GND | - | Ground |
| |  GPIO | J3 | 1 | IO1 | I/O |
| 2 | | | IO2 | I/O | General purpose I/O (VDD logic levels) |
| 3 | | | IO3 | I/O | General purpose I/O (VDD logic levels) |
| 4 | | | IO4 | I/O | General purpose I/O (VDD logic levels) |
| 5 | | | IO5 | I/O | General purpose I/O (VDD logic levels) |
| 6 | | | IO6 | I/O | General purpose I/O (VDD logic levels) |
|  AUDIO | J4 | 1 | SP+ | O | Differential audio output (can directly drive 8Ω speaker) |
| | | 2 | SP- | O | |
| | | 3 | VM | O | Microphone power (to support custom microphones) |
| | | 4 | MIC | I | Microphone audio input |
| | | 5 | RET | - | Microphone return (analog ground) |
| | | 6 | VDD | O | Internal logic voltage (for reference only) |
|  CABLES | J5 | 1 | SP- | O | Differential audio output (can directly drive 8Ω speaker) |
| | | 3 | SP+ | O | |
| | | 2 | - | - | (Not connected) |
| | J6 | 1 | MIC | I | Microphone audio input |
| | | 2 | RET | - | Microphone return (analog ground) |
|  ADAPTER | J7 | 1 | RX_P | O | Programming cable serial data receive |
| | | 2 | RTS_P | I | Programming cable request to send (reset/boot control) |
| | | 3 | GND | - | Programming cable ground |
| | | 4 | 5V_P | I | Programming cable 5V DC power output |
| | | 5 | TX_P | I | Programming cable serial data transmit |
| | | 6 | CTS_P | O | Programming cable clear to send (tied to ground) |

Note: The General Purpose I/O lines (J3.1-6) are at nominal 3.0VDC level. Do not connect higher voltages directly to these pins!

Settings and indicators

| Group | Name | Type | Description |
|--------|----------------|-------------------------|--|
| ● MISC | PWR SEL | 3-Way Jumper (SMD 0603) | Select power input and voltage level between +3.3V and +5V with a zero Ohm resistor or solder bridge |
| | D1 | LED | Red light indicator, normally ON when the board is powered, briefly blinking on serial data received |
| | D2 | LED | Green light indicator, turns ON when the module is listening to its audio input |
| | R4 | Resistor (SMD 0603) | Microphone gain resistor, default is 1.2k Ω |

Physical dimensions



| Symbol | Parameter | Units (mm / Inches) | |
|----------------------|---|---------------------|-------|
| W | Width | 25.4 | 1.000 |
| L | Length | 56.4 | 2.220 |
| H₁ | Height (without outer strips J1-J4) | 9.5 | 0.375 |
| H₂ | Height (with outer strips J1-J4) | 17.0 | 0.670 |
| E₁ | Connector pitch and pin spacing (of outer strips J1-J4) | 2.54 | 0.100 |
| E₂ | Connector pitch (of inner connectors J5-J7) | 2.00 | 0.079 |
| A | Headers horizontal spacing | 22.86 | 0.900 |
| B | Headers vertical spacing | 20.32 | 0.800 |
| C | Header vertical offset | 3.81 | 0.150 |
| D | Header horizontal offset | 1.27 | 0.050 |

Recommended Operating Conditions

| Symbol | Parameter | Min | Typ | Max | Unit |
|--------|-------------------------------------|------|-----|-----|------|
| 5V | DC Power Input (Host) = V_{SEL} | 3.15 | 5.0 | 5.5 | V |
| 3V3 | | 3.15 | 3.3 | 5.5 | V |
| 5V_P | DC Power Input (Programming cable) | 4.0 | 5.0 | 5.5 | V |
| Ta | Ambient Operating Temperature Range | 0 | 25 | 70 | °C |

Power Supply Requirements

| Symbol | Parameter | Min | Typ | Max | Unit |
|-------------|---|-----|-----|-----|---------------------|
| I_{SLEEP} | Sleep current ($V_{SEL} = 5.0V$) | | 6 | | mA |
| I_{OPER} | Operating current ($V_{SEL} = 5.0V$) | | 25 | 35 | mA |
| I_{AUDIO} | Audio playback current (with 8Ω speaker) | | 175 | 250 | mA _(RMS) |
| I_{TOT} | Total current consumption (excluding I/O) | | 25 | 285 | mA _(RMS) |
| I_{PEAK} | Peak supply current (excluding I/O) | | 400 | | mA |

Electrical Characteristics

These are applicable to pins RX, TX_P.

| Symbol | Parameter | Min | Typ | Max | Unit |
|----------|--|-----|-----|-----|------|
| V_{IH} | Input High Voltage | 2.1 | | 5.5 | V |
| V_{IL} | Input Low Voltage | 0.0 | | 0.9 | V |
| I_{IL} | Input Leakage Current ($0 < V_i < 5.5V$) | | -65 | | μA |

These are applicable to pins TX, DE.

| Symbol | Parameter | Min | Typ | Max | Unit |
|----------|--|-----|-----|-----|------|
| V_{OH} | Output High Voltage ($I_{OH} = -0.3$ mA, $V_{SEL} = 3.3V$) | 2.6 | | 3.3 | V |
| | Output High Voltage ($I_{OH} = -0.3$ mA, $V_{SEL} = 5.0V$) | 4.3 | | 5.0 | V |
| V_{OL} | Output Low Voltage ($I_{OL} = 5$ mA) | 0.0 | | 0.2 | V |

These are applicable to pin XM.

| Symbol | Parameter | Min | Typ | Max | Unit |
|----------|------------------------------------|-----|-------|-----|------|
| V_{IH} | Input High Voltage | 1.4 | (0.8) | 5.5 | V |
| V_{IL} | Input Low Voltage | 0.0 | (0.7) | 0.5 | V |
| I_{IN} | Input Current ($0 < V_i < 3.3V$) | 0 | 0.2 | 0.4 | mA |
| | Input Current ($0 < V_i < 5.5V$) | 0 | 0.5 | 0.7 | mA |

These are applicable to pin RST.

| Symbol | Parameter | Min | Typ | Max | Unit |
|----------|--|-----|-----|-----|------|
| V_{IH} | Input High Voltage | 2.1 | | 5.5 | V |
| V_{IL} | Input Low Voltage | 0.0 | | 0.6 | V |
| I_{IL} | Input Leakage Current ($0 < V_i < 5.5V$) | | -85 | | μA |

These are applicable to pin RX_P.

| Symbol | Parameter | Min | Typ | Max | Unit |
|-----------------|---|-----|-----|-----|------|
| V _{OH} | Output High Voltage (I _{OH} = -5 mA) | 2.4 | | 3.0 | V |
| V _{OL} | Output Low Voltage (I _{OL} = 8 mA) | 0.0 | | 0.6 | V |

These are applicable to pins IO1 – IO6.

| Symbol | Parameter | Min | Typ | Max | Unit |
|-----------------|---|--------|-----|------|------|
| V _{IH} | Input High Voltage | 2.4 | 3.0 | 3.3 | V |
| V _{IL} | Input Low Voltage | -0.1 | 0.0 | 0.75 | V |
| I _{IL} | Input Leakage Current (0 < V _I < 3V, Hi-Z Input) | | <1 | 10 | μA |
| R _{PU} | Pull-up Resistance | Strong | 10 | | kΩ |
| | | Weak | 200 | | kΩ |
| V _{OH} | Output High Voltage (I _{OH} = -5 mA) | 2.4 | | 3.0 | V |
| V _{OL} | Output Low Voltage (I _{OL} = 8 mA) | 0.0 | | 0.6 | V |

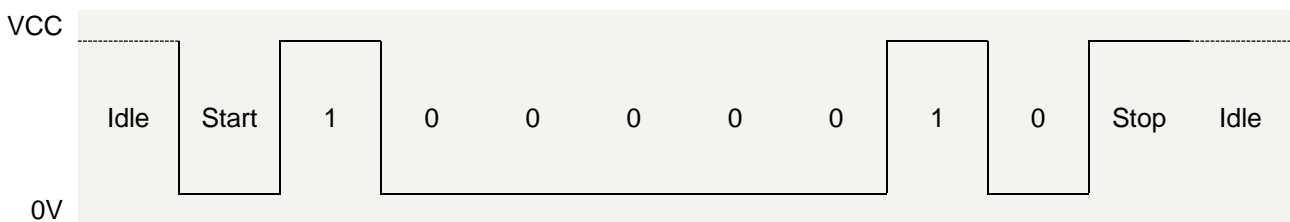
Serial Interface

The EasyVR 3 communicates via an asynchronous serial interface (commonly known as UART interface), with the following features:

- Baud Rate: **9600** (default), 19200, 38700, 57600, 115200
- Frame: **8** Data bits, **No** parity, **1** Stop bit

The receiver input data line is RX, while the transmitter output data line is TX. No handshake lines are used.

Example of a serial data frame representing character "A" (decimal 65 or hexadecimal 41):



See also chapter **Communication Protocol** later on this manual for communication details.

Microphone

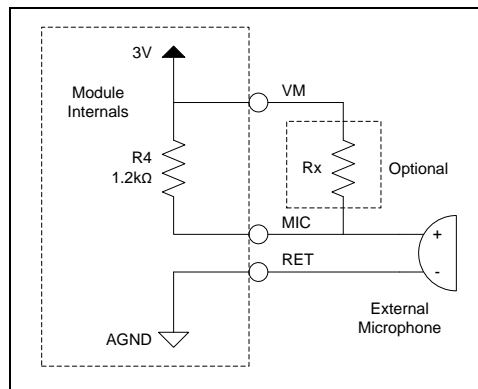
The microphone provided with the EasyVR 3 module is an omnidirectional electret condenser microphone (Horn EM9745P-382):

- Sensitivity -38dB (0dB=1V/Pa @1KHz)
- Load Impedance 2.2K
- Operating Voltage 3V
- Almost flat frequency response in the range 100Hz – 20kHz

The microphone circuit is optimized for use at ARMS_LENGTH (default, about 60cm) or FAR_MIC distance settings.

If you use a microphone with different specifications the recognition accuracy may be adversely affected. Differences in rated load impedance and sensitivity can be compensated to a certain extent by changing the microphone gain. This can be done in several ways:

- Replacing the internal gain resistor R4 (1.2kΩ)
- Adding an external resistor Rx going in parallel with R4 (it can only reduce gain, useful for HEADSET distance settings)
- Removing the internal resistor R4 and using only the external resistor Rx



Microphone circuit

Modifying gain resistance

You can calculate the overall microphone gain resistance using the formula below:

$$R_s = I \times 10^{\frac{G-S}{20}}$$

- R_s** is the optimal microphone gain resistance
I is the impedance rating of the microphone
G is the desired overall system gain, defined as follows:

1. If the module is configured for HEADSET microphone distance (typically a few centimeters from the user's mouth), then the overall system gain should be -49 dB (0dB=1v/Pa@1KHz);
2. If the module is configured for ARMS_LENGTH microphone distance (typically 60-90 cm from the user's mouth – this is the default setting of EasyVR), then the overall system gain should be -44 dB;
3. If the module is configured for FAR_MIC microphone distance (up to about 3 meters from the user's mouth), then the overall system gain should be -43 dB.

S is the sensitivity rating of the microphone you want to use, and it is specified in –dB in the microphone's specification³.

³ Converting uBars to Pascal: microphone manufacturers specify the sensitivity referencing to uBars or Pascal. If the microphone sensitivity is referenced to uBars, simply add 20 dB to the rating. For example, -58 dB/uBars + 20dB = -38 dBV/Pa.

Examples

1) The optimal gain resistance for the bundled microphone at ARMS_LENGTH distance is:

$$R_s = 2200 \times 10^{\frac{-44 - (-38)}{20}} = 1103$$

Use the closest standard 5% resistor to R_s . In this example, it would be 1.1 k Ω . The EasyVR uses a 1.2 k Ω resistor to allow use of "FAR" settings without replacing the internal resistor.

Sometimes you might also need to compensate some gain loss for a voltage lower than the microphone ratings (using a larger resistor value sets a higher input gain).

2) The gain resistance for the bundled microphone at HEADSET distance would be:

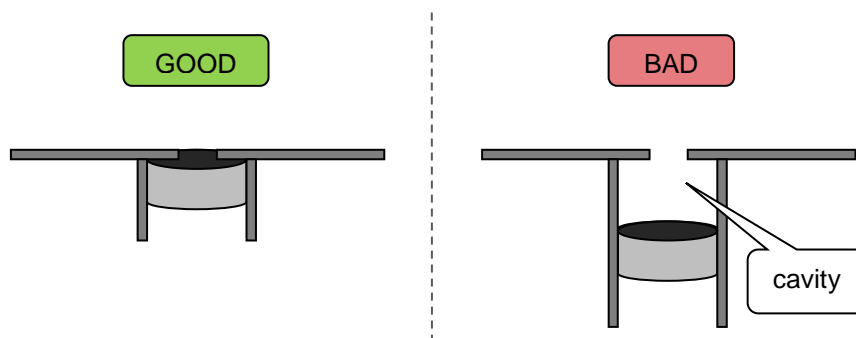
$$R_s = 2200 \times 10^{\frac{-49 - (-38)}{20}} = 620$$

In this case you may just add an external 1.2 k Ω resistor to get a gain resistance of 600 Ω (close enough).

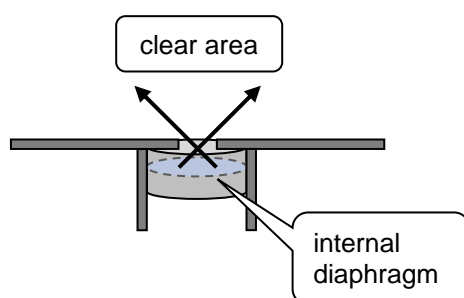
Positioning guidelines

Please note that improper acoustic positioning of the microphone will reduce recognition accuracy. Many mechanical arrangements are possible for the microphone element, and some will work better than others. When mounting the microphone in the final device, keep in mind the following guidelines:

1. **Flush Mounting** - The microphone element should be positioned as close to the mounting surface as possible and should be fully seated in the plastic housing. There must be no airspace between the microphone element and the housing. Having such airspace can lead to acoustic resonance, which can reduce recognition accuracy.

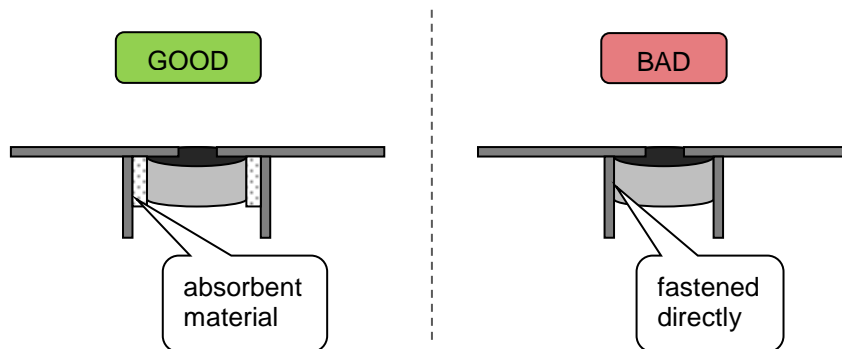


2. **No Obstructions, Large Hole** - The area in front of the microphone element must be kept clear of obstructions to avoid interference with recognition. The diameter of the hole in the housing in front of the microphone should be at least 5 mm. Any necessary plastic surface in front of the microphone should be as thin as possible, being no more than 0.7 mm, if possible.



3. **Insulation** - The microphone should be acoustically isolated from the housing if possible. This can be accomplished by surrounding the microphone element with a spongy material such as rubber or foam. The provided microphone has this kind of insulating foam. The purpose is to prevent auditory

noises produced by handling or jarring the device from being “picked up” by the microphone. Such extraneous noises can reduce recognition accuracy.

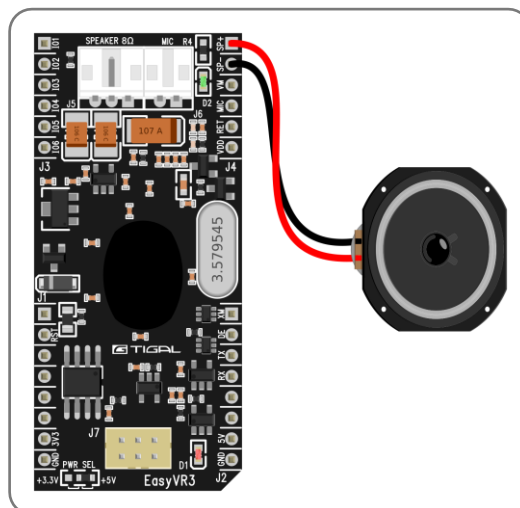


- Distance** - If the microphone is moved from 15 cm to 30 cm from the speaker's mouth, the signal power decreases by a factor of four. The difference between a loud and a soft voice can also be more than a factor of four. Although the internal preamplifier of the EasyVR compensates for a wide dynamic range of input signal strength, if its range is exceeded, the user application can provide feedback to the speaker about the voice volume (see appendix **Error codes**).

Audio Output

The EasyVR 3 audio output interface is capable of directly driving an 8Ω speaker. It can also be connected to an external audio amplifier to drive lower impedance loudspeakers.

Note: Connecting speakers with lower impedance directly to the module may permanently damage the EasyVR audio output or the whole module.



It is possible to connect higher impedance loads such as headphones, provided that you scale down the output power according to the speaker ratings, for example using a series resistor. The exact resistor value depends on the headphone sensitivity and the desired output volume (usually in the order of 1-10kΩ).

Note: Connecting headphone speakers directly to the EasyVR audio output may damage your hearing.

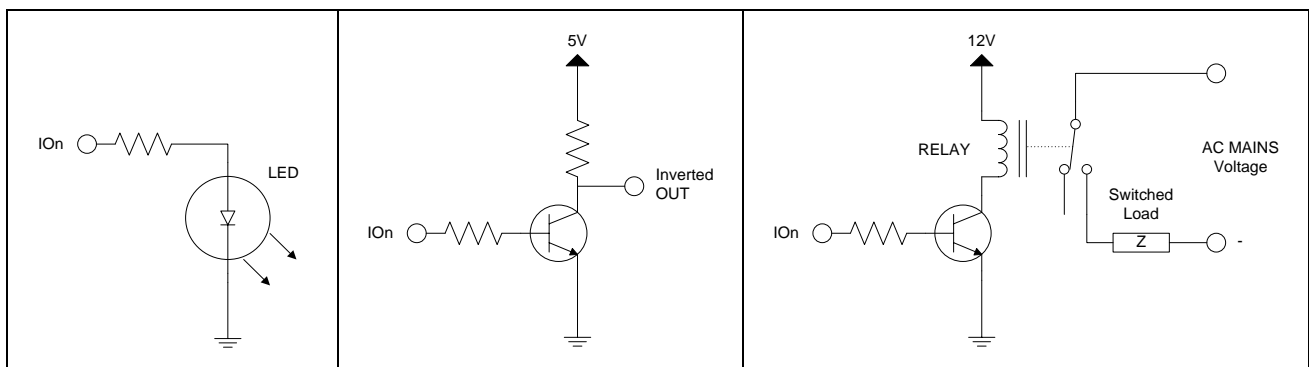
General Purpose I/O

Since the EasyVR communication interface takes two pins of the host controller, a few spare I/O pins are provided, which can be controlled with the communication protocol, to get those pins back for basic tasks, such as lighting an LED or reading a switch.

The six I/O pins IO1–IO6 are connected directly to the embedded microcontroller on the EasyVR module, so they are referenced to the internal 3.0V regulated power supply VDD. If you need to interface to circuits using a different supply, there are a number of solutions you can adopt. Some of these are outlined below (here IO_n indicates any one of the six I/O pins of the EasyVR).

Use a pin as an output

All the I/O pins are inputs with weak internal pull-up after power on. You must explicitly configure a pin before you can use it as an output (see the example code **Use general purpose I/O pins**).



I/O pin directly driving a low-current LED

I/O pin connected to high impedance 5V circuit (such as MCU input pin)

I/O pin switching a load on a high voltage line using a 12V relay

The exact components values in these circuits may vary. You need to calculate required values for your application and choice of components. For example, resistor value for the LED circuit can be calculated approximately as:

$$R_{LED} = \frac{V_{OH} - V_{LED}}{I_{OH}}$$

Where V_{LED} is the LED forward voltage, as reported on the LED datasheet, at the driving current I_{OH} (see section [Electrical Characteristics](#)). Let's assume a typical low-current LED has a $V_F=1.8V$ at 5mA, the resistor value is:

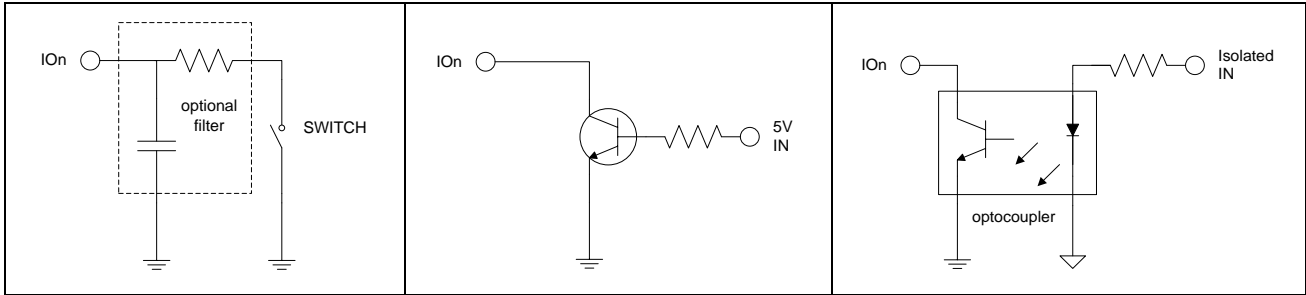
$$R_{LED} = \frac{2.4 - 1.8}{0.005} = 120 \text{ Ohm}$$

Now stay on the safe side and choose a slightly larger resistor, such as 150Ω.

If you want to drive higher current LEDs, you need a circuit like the second one, where you put the LED between the output resistor and the collector of the NPN transistor.

Use a pin as an input

All the I/O pins are inputs with weak internal pull-up after power on or reset. You may also configure the pin to have a strong pull-up or no pull-up at all (see the example code **Use general purpose I/O pins**).



I/O pin connected to a switch (or switching sensor)

I/O pin connected 5V source (such as MCU output pin)

I/O pin with isolated input (for safety circuits)

All these circuits assume the EasyVR pin has been configured with an internal pull-up (passive components value can be adjusted to account for weak or strong pull-up).

Disabling the internal pull-up could be used to put the pin in high-impedance state, for example to simulate a tri-state or open-drain output port.

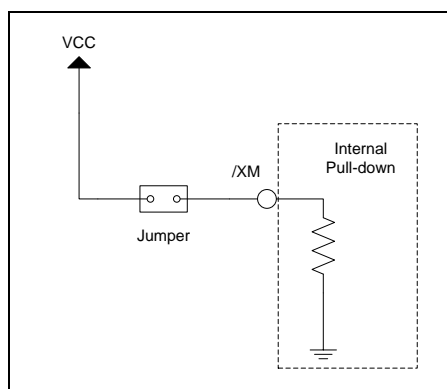
Again, you should refer to the manufacturer's datasheet when interfacing any external components and to calculate required resistors values or other passive components.

Flash Update

The EasyVR module includes a boot loader that allows to update the firmware and to download new sound tables or custom grammars to the on-board memory.

The *boot mode* is activated by keeping the **XM** signal to a high logical level at power on or reset. This can be easily done with a jumper (or switch) taking the signal to a suitable pull-up resistor.

To download a firmware update, a sound table or a custom grammar to the EasyVR, power on the module with the jumper closed. For normal operation, just leave the jumper open. Do not change the jumper position while the module is already powered on. It is safe to change **XM** level while the module is reset (**RST** low).



Boot mode selection circuit

To learn how to download new sound tables or custom grammars to your EasyVR 3 module, have a look at the section **Using Custom Data**.

Quick start for using the module

EasyVR 3 as a Development Board

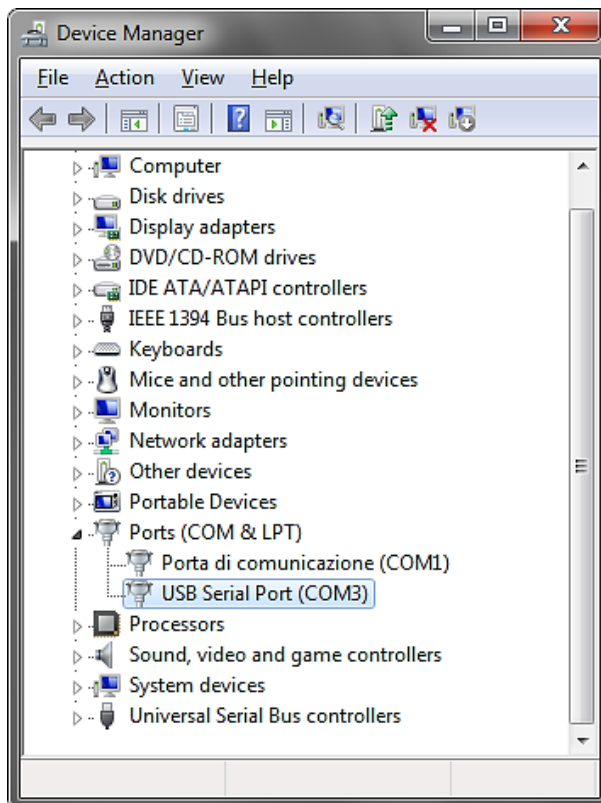
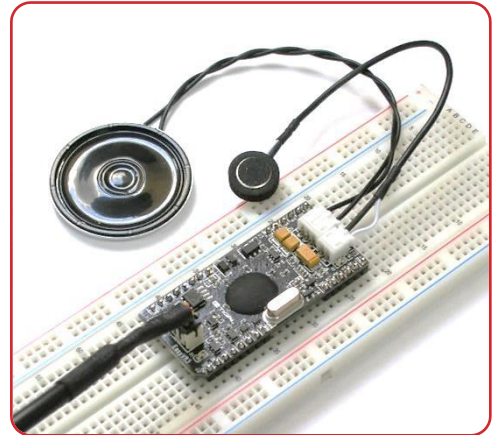
The QuickUSB serial adapter cable can be used to program voice commands and sound outputs into an EasyVR 3 module and quickly test it from your PC.

Just connect the microphone and an 8Ω speaker to the module, plug-in the adapter cable and you are ready to go.

The EasyVR 3 boot mode is managed automatically through the serial handshake lines, so you don't need to set any jumper.

How to get started

1. Connect the microphone to the 2-way socket MIC (J6)
2. Connect an 8Ω speaker to the 3-way socket SPEAKER (J5)
3. Connect a QuickUSB cable to the 3x2 pins socket (J7)
4. Plug the USB end of the adapter cable to your PC.
The first time it may take some time to install the required drivers (see [Software Setup](#))
5. If your installation is successful you will see a new virtual COM port in your Device Manager:



(The actual COM port number may vary)

6. Now start the EasyVR Commander software
7. Choose your COM Port and click connect
8. Then enjoy your EasyVR!

Serial Adapter Interface

Connector J7 is a 6-pin socket specifically designed for the QuickUSB serial adapter cable, but another adapter may also be used provided that it uses the same connector type, pin assignment and electrical specifications.

| Pin | Name | Type | Notes |
|-----|-------|------|---|
| 1 | RX_P | I | Adapter should have TTL/LVTTL compatible inputs ($V_{IH} = 2.0V$) |
| 2 | RTS_P | O | Adapter outputs can have 3.3V or 5V levels RTS handshake is required for automatic reset and boot mode control |
| 3 | GND | - | Ground |
| 4 | 5V_P | O | Adapter should provide a 5V DC power output for the module (see Recommended Operating Conditions and Power Supply Requirements) |
| 5 | TX_P | O | Adapter outputs can have 3.3V or 5V levels |
| 6 | CTS_P | I | CTS is tied to GND on the module |

Connector type is Hirose DF11 Series (female on the adapter cable, male on the module).

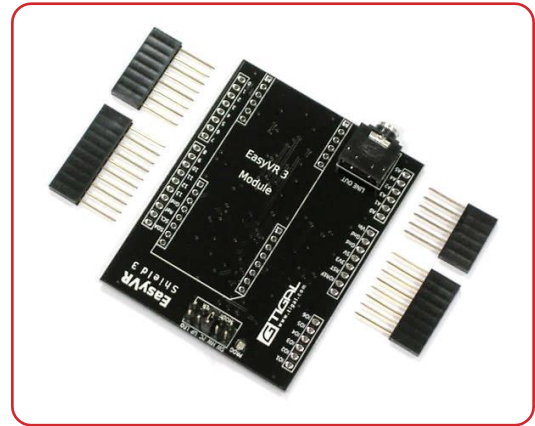
EasyVR Shield 3 for Arduino

Product description

The EasyVR Shield 3 is an adapter board for the EasyVR 3 module, designed to simplify its use among the Arduino community.

The Shield is compatible with any Arduino board using UNO-R3 Shield headers, running at either 3.3V or 5V levels, by using the IOREF pin to select the EasyVR operating voltage.

It is also backward compatible with earlier Arduino boards that don't have the IOREF pin, which are using 5V I/O levels by default.



If your board does not have the IOREF pin but it is running at 3.3V, you can still operate the EasyVR Shield 3 correctly if you manually connect pins IOREF and 3V3 together, for example with a jumper wire.

The board comes with separate Arduino stackable headers for the Shield interface. The EasyVR 3 module is also provided separately.

EasyVR Shield 3 Features

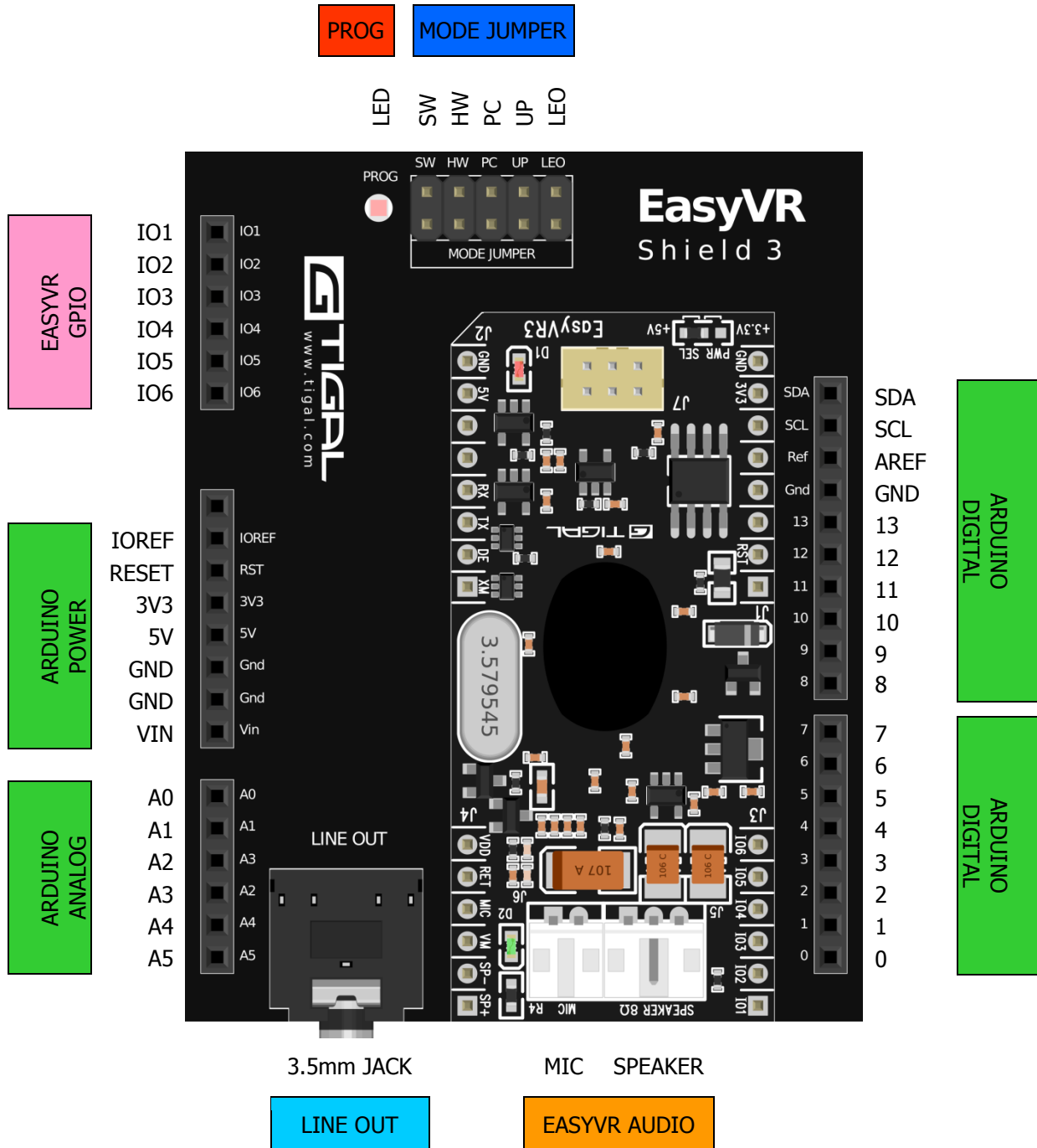
- Compatible with Arduino boards that have the 1.0 Shield interface (UNO R3) and legacy boards including, but not limited to:
 - Arduino Duemilanove
 - Arduino Uno
 - Arduino Mega
 - Arduino Leonardo
 - Arduino Due
- Supports 5V and 3.3V main boards through the IOREF pin
- Supports direct connection to the PC on main boards with a separate USB/Serial chip and a special software-driven “bridge” mode on boards with only native USB interface, for easy access by the EasyVR Commander
- Enables different modes of serial connection and also flash updates to the embedded EasyVR module (through the Mode Jumper)
- Supports remapping of serial pins used by the Shield (in SW mode)
- Provides a 3.5mm audio output jack suitable for headphones or as a line out



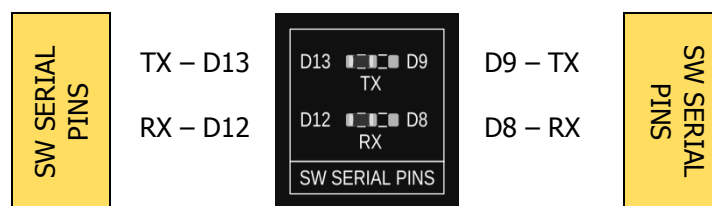
EasyVR Shield 3 fully assembled

Technical specifications

Board overview



(Top View)



(Detail - Bottom View)

Pin assignment

| Group | Pin | Description |
|-------------------|------------|--|
| ● ARDUINO HEADERS | - | Arduino UNO-R3 Shield interface, pass-through connectors (Pins 0-1 are in use when J12 is set to UP, PC, HW or LEO) (Pins 12-13 or 8-9 are in use when J12 is set to SW) |
| ● EASYVR AUDIO | - | Audio cables connectors of the EasyVR 3 module (microphone and speaker) |
| ● LINE OUT | - | 3.5mm stereo/mono jack (16Ω - 32Ω headphones or line-level output) |
| ● MODE JUMPER | SW | Arduino Software Serial (connected to pins 12-13 or 8-9) |
| | HW | Arduino Hardware Serial (connected to pins 0-1) |
| | PC | PC Mode (Arduino disabled, EasyVR in command mode) |
| | UP | Update Mode (Arduino disabled, EasyVR in boot mode) |
| | LEO | Leonardo Update (Arduino enabled, EasyVR in boot mode) |
| ● PROG | - | Red light indicator for Flash programming modes (UP and LEO) |
| ● SW SERIAL PINS | RX | Use resistor to select Software Serial RX pin: 12 or 8 |
| | TX | Use resistor to select Software Serial TX pin: 13 or 9 |
| ● EASYVR GPIO | IO1 | General purpose I/O as found on the embedded EasyVR 3 module (referenced at the internal VDD logic level – see note below) |
| | IO2 | |
| | IO3 | |
| | IO4 | |
| | IO5 | |
| | IO6 | |

Note: The General Purpose I/O lines (IO1-IO6) are at nominal 3.0VDC level. Do not connect higher voltages directly to these pins!

Mode Jumper settings

This jumper selects the operating mode of the EasyVR Shield and it can be placed in one of four positions:

- **SW – Software Serial mode**
Use it for controlling the EasyVR module from your Arduino sketch through a software serial port (using pins 12-13). You can also connect the EasyVR Commander in this mode, provided that the running sketch implements bridge mode (see the Arduino library examples).
- **HW – Hardware Serial mode**
Use it for controlling the EasyVR module from your Arduino sketch through the hardware serial port (using pins 0-1).
- **PC – PC Connection mode**
Use it for direct connection with the EasyVR Commander. In this mode, the Arduino controller is held in reset and only the embedded USB/Serial adapter is used.
- **UP – Flash Update mode**
Use it for firmware updates or to download sound table data and custom grammars to the on-board flash memory from the EasyVR Commander. In this mode, the Arduino controller is held in reset and only the embedded USB/Serial adapter is used. The EasyVR module is set in boot mode.
- **LEO – Leonardo Update mode**
This is similar to the regular *Flash Update* mode, for Arduino boards that don't have a separate USB/Serial adapter, such as Arduino Leonardo. The EasyVR module is set in boot mode, but the Arduino controller is not reset and it must be running the special "bridge" sketch.

Software Serial Pins settings

On the bottom side of the board there are two SMD resistors that you can move to select the two pins of Arduino that the EasyVR will be connected to when in Software Serial mode (*Mode Jumper* on **SW**).

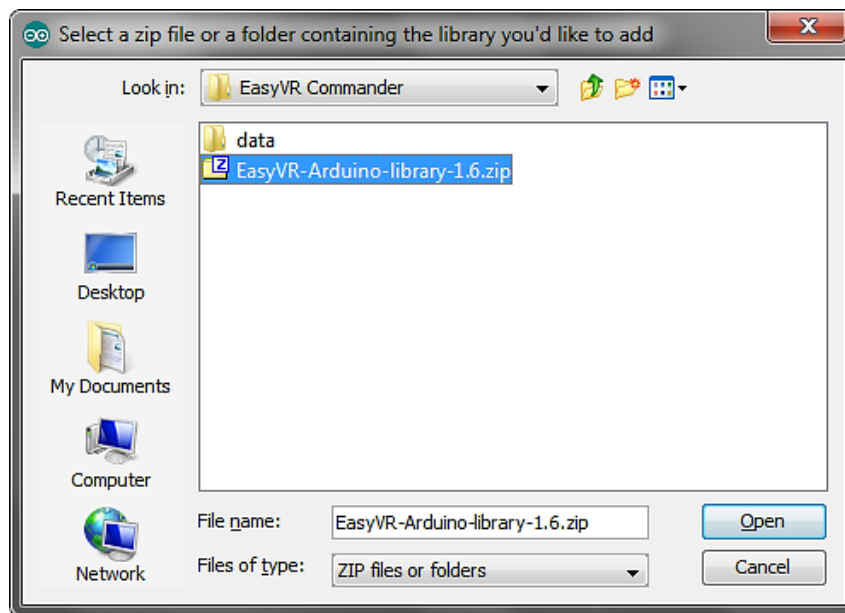
- **RX – Software Serial Receiver pin**
 - D12 – Use digital pin 12 as serial receiver (default)
 - D8 – Use digital pin 8 as serial receiver
- **TX – Software Serial Transmitter pin**
 - D13 – Use digital pin 13 as serial transmitter (default)
 - D9 – Use digital pin 9 as serial transmitter

The choice of pins 12-13 is maintained for backward compatibility with the previous hardware revisions of the EasyVR Shield. However those pins may also be used for the SPI interface, so another choice of pins 8-9 is provided. If you want to use different pins make sure the receiver pin supports change interrupts.

Quick start guide for using the Shield

Follow these few steps to start using your EasyVR Shield 3 and Arduino:

1. Insert the EasyVR Shield on top of your Arduino board
2. If you want audio output, either wire an 8Ω speaker into the *SPEAKER* connector (J5) on the EasyVR module or connect headphones or amplified speakers to the *LINE OUT* 3.5mm audio jack on the Shield
3. Connect the supplied microphone to the *MIC* connector (J6) on the EasyVR module
4. Install the EasyVR Arduino libraries⁴ on your PC (details at <http://arduino.cc/en/Guide/Libraries>)
5. Connect your Arduino board to your PC via USB.



With Arduino Leonardo – Due (Native USB)

Test the Shield with Arduino

1. Make sure the Mode jumper (J7) is in the HW position
2. Open the example sketch TestEasyVR from your IDE menu “File” > “Examples” > “EasyVR”
3. Upload the sketch and open the “Serial Monitor” window
4. Send a question mark “?” (without quotes)
5. After a few seconds you should receive an “EasyVR detected” message

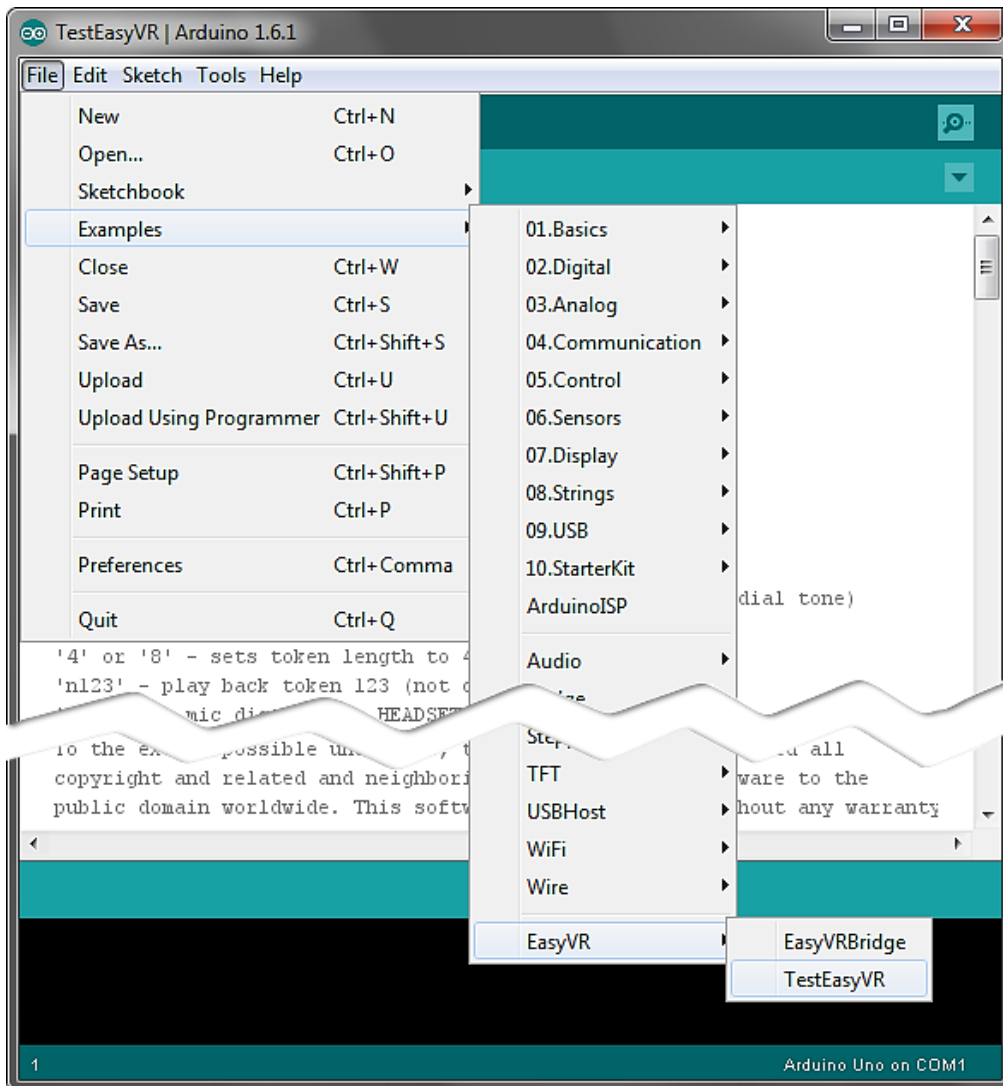
Test the Shield with the EasyVR Commander

1. Make sure the Mode jumper (J7) is in the HW position
2. Open and upload the example sketch TestEasyVR or EasyVRBridge (see menu “File” > “Examples” > “EasyVR”)
3. Close the serial monitor window in the Arduino IDE
4. Open the EasyVR Commander and connect to the same serial port used by Arduino

Download a new sound-table or firmware update

1. Make sure the Mode jumper (J7) is in the LEO position
2. Open and upload the example sketch TestEasyVR or EasyVRBridge (see menu “File” > “Examples” > “EasyVR”)
3. Open the EasyVR Commander and select the Arduino serial port
4. While disconnected choose “Update Custom Data” from the “File” menu

⁴ The Arduino library archive file can be found in the EasyVR Commander program folder.



With Arduino 2009 – Uno – Mega

Test the Shield with Arduino

1. Set the Mode jumper (J7) in the SW position
2. Open the example sketch TestEasyVR from your IDE menu “File” > “Examples” > “EasyVR”
3. Upload the sketch and open the “Serial Monitor” window
4. See comments on top of the sketch for usage details

Test the Shield with the EasyVR Commander

1. Make sure the Mode jumper (J7) is in the PC position
2. Open the EasyVR Commander and connect to the same serial port used by Arduino

Download a new sound-table or firmware update

1. Make sure the Mode jumper (J7) is in the UP position
2. Open the EasyVR Commander and select the Arduino serial port
3. While disconnected choose “Update Custom Data” from the “File” menu (or “Update Firmware” from the “Help” menu)

When the EasyVR Commander is connected, you can also generate a template code for Arduino, that will use the provided libraries (see [EasyVR Arduino Library Documentation](#)). All you need is to write actions for each recognized command.

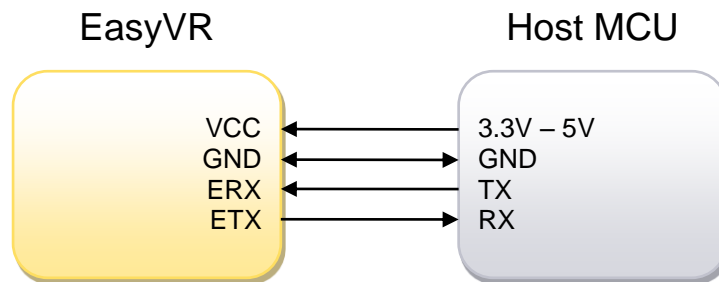
EasyVR Programming

Communication Protocol

Introduction

Communication with the EasyVR module uses a standard UART interface compatible with 3.3-5V TTL/CMOS logical levels, according to the powering voltage VCC.

A typical connection to an MCU-based host:



The initial configuration at power on is 9600 baud, 8 bit data, No parity, 1 bit stop. The baud rate can be changed later to operate in the range 9600 - 115200 baud.

The communication protocol only uses printable ASCII characters, which can be divided in two main groups:

- Command and status characters, respectively on the TX and RX lines, chosen among lower-case letters.
- Command arguments or status details, again on the TX and RX lines, spanning the range of capital letters.

Each command sent on the TX line, with zero or more additional argument bytes, receives an answer on the RX line in the form of a status byte followed by zero or more arguments.

There is a minimum delay before each byte sent out from the EasyVR module to the RX line, that is initially set to 20 ms and can be selected later in the ranges 0 - 9 ms, 10 - 90 ms, and 100 ms - 1 s. That accounts for slower or faster host systems and therefore suitable also for software-based serial communication (bit-banging).

Since the EasyVR serial interface also is software-based, a very short delay might be needed before transmitting a character to the module, especially if the host is very fast, to allow the EasyVR to get back listening to a new character.

The communication is host-driven and each byte of the reply to a command has to be acknowledged by the host to receive additional status data, using the *space* character. The reply is aborted if any other character is received and so there is no need to read all the bytes of a reply if not required.

Invalid combinations of commands or arguments are signaled by a specific status byte, that the host should be prepared to receive if the communication fails. Also a reasonable timeout should be used to recover from unexpected failures.

If the host does not send all the required arguments of a command, the command is ignored by the module, without further notification, and the host can start sending another command.

The module automatically goes to lowest power sleep mode after power on. To initiate communication, send any character to wake-up the module.

Arguments Mapping

Command or status messages sent over the serial link may have one or more numerical arguments in the range -1 to 31, which are encoded using mostly characters in the range of uppercase letters. These are some useful constants to handle arguments easily:

ARG_MIN

| | |
|-----------|-----------------------------|
| '@' (40h) | Minimum argument value (-1) |
|-----------|-----------------------------|

ARG_MAX

| | |
|-----------|------------------------------|
| '`' (60h) | Maximum argument value (+31) |
|-----------|------------------------------|

ARG_ZERO

| | |
|-----------|-------------------------|
| 'A' (41h) | Zero argument value (0) |
|-----------|-------------------------|

ARG_ACK

| | |
|-----------|----------------------------|
| ' ' (20h) | Read more status arguments |
|-----------|----------------------------|

Having those constants defined in your code can simplify the validity checks and the encoding/decoding process. For example (in pseudo-code):

```
# encode value 5
FIVE = 5 + ARG_ZERO
# decode value 5
FIVE - ARG_ZERO = 5
# validity check
IF ARG < ARG_MIN OR ARG > ARG_MAX THEN ERROR
```

Just to make things clearer, here is a table showing how the argument mapping works:

| ASCII | '@' | 'A' | 'B' | 'C' | ... | 'Y' | 'Z' | '^' | '[' | '\' | ']' | '_' | '`' |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| HEX | 40 | 41 | 42 | 43 | ... | 59 | 5A | 5B | 5C | 5D | 5E | 5F | 60 |
| Value | -1 | 0 | 1 | 2 | ... | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |

Command Details

This section describes the format of all the command strings accepted by the module. Please note that numeric arguments of command requests are mapped to upper-case letters (see above section).

CMD_BREAK

| | |
|--|--|
| | Abort recognition, training or playback in progress if any or do nothing |
| 'b' (62h) | Known issues: In firmware ID 0, any other character received during recognition will prevent this command from stopping recognition that will continue until timeout or other recognition results. |
| Expected replies: STS_SUCCESS, STS_INTERR | |

CMD_SLEEP

| | |
|--|---|
| 's' (73h) | Go to the specified power-down mode |
| [1] | Sleep mode (0-8): 0 = wake on received character only 1 = wake on whistle or received character 2 = wake on loud sound or received character 3-5 = wake on double clap (with varying sensitivity) or received character 6-8 = wake on triple clap (with varying sensitivity) or received character |
| Expected replies: STS_SUCCESS, STS_AWAKEN | |

CMD_LEVEL

| | |
|--------------------------------------|--|
| 'v' (76h) | Set SD level |
| [1] | Strictness control setting (1-5): 1 = easy 2 = default 5 = hard A higher setting will result in more recognition errors. |
| Expected replies: STS_SUCCESS | |

CMD_KNOB

| | |
|--------------------------------------|--|
| 'k' (6Bh) | Set SI knob to specified level |
| [1] | Confidence threshold level (0-4): 0 = loosest:more valid results 2 = typical value (default) 4 = tightest:fewer valid results Note: knob is ignored for trigger words |
| Expected replies: STS_SUCCESS | |

CMD_MIC_DIST

| | |
|--------------------------------------|--|
| 'k' (6Bh) | Set the microphone operating distance |
| [1] | Fixed to (-1) |
| [2] | Distance settings (1-3): 1 = "headset" (around 5cm from speaker's mouth) 2 = "arms length" (default setting, from about 50cm to 1m) 3 = "far mic" (up to around 3m) |
| Expected replies: STS_SUCCESS | |

CMD_LANGUAGE

| | |
|--------------------------------------|--|
| 'l' (6Ch) | Set SI language |
| [1] | Language: 0 = English 1 = Italian 2 = Japanese 3 = German 4 = Spanish 5 = French |
| Expected replies: STS_SUCCESS | |

CMD_TIMEOUT

| | |
|--------------------------------------|--|
| 'o' (6Fh) | Set recognition timeout |
| [1] | Timeout (-1 = default, 0 = infinite, 1-31 = seconds) |
| Expected replies: STS_SUCCESS | |

CMD_RECOG_SI

| | |
|--|---|
| 'i' (69h) | Activate SI recognition from specified word set |
| [1] | Word set index (0-3) |
| Expected replies: STS_SIMILAR, STS_TIMEOUT, STS_ERROR | |

CMD_TRAIN_SD

| | |
|---|--|
| 't' (74h) | Train specified SD/SV command |
| [1] | Group index (0 = trigger, 1-15 = generic, 16 = password) |
| [2] | Command position (0-31) |
| Expected replies: STS_SUCCESS, STS_RESULT, STS_SIMILAR, STS_TIMEOUT, STS_ERROR | |

CMD_GROUP_SD

| | |
|--|--|
| 'g' (67h) | Insert new SD/SV command |
| [1] | Group index (0 = trigger, 1-15 = generic, 16 = password) |
| [2] | Position (0-31) |
| Expected replies: STS_SUCCESS, STS_OUT_OF_MEM | |

CMD_UNGROUP_SD

| | |
|--------------------------------------|--|
| 'u' (75h) | Remove SD/SV command |
| [1] | Group index (0 = trigger, 1-15 = generic, 16 = password) |
| [2] | Position (0-31) |
| Expected replies: STS_SUCCESS | |

CMD_RECOG_SD

| | |
|--|--|
| 'd' (64h) | Activate SD/SV recognition |
| [1] | Group index (0 = trigger, 1-15 = generic, 16 = password) |
| Expected replies: STS_RESULT, STS_SIMILAR, STS_TIMEOUT, STS_ERROR | |

CMD_ERASE_SD

| | |
|--------------------------------------|--|
| 'e' (65h) | Erase training of SD/SV command |
| [1] | Group index (0 = trigger, 1-15 = generic, 16 = password) |
| [2] | Command position (0-31) |
| Expected replies: STS_SUCCESS | |

CMD_NAME_SD

| | |
|--------------------------------------|--|
| 'n' (6Eh) | Label SD/SV command |
| [1] | Group index (0 = trigger, 1-15 = generic, 16 = password) |
| [2] | Command position (0-31) |
| [3] | Length of label (0-31) |
| [4-n] | Text for label (ASCII characters from 'A' to ``') |
| Expected replies: STS_SUCCESS | |

CMD_COUNT_SD

| | |
|------------------------------------|--|
| 'c' (63h) | Request count of SD/SV commands in the specified group |
| [1] | Group index (0 = trigger, 1-15 = generic, 16 = password) |
| Expected replies: STS_COUNT | |

CMD_DUMP_SD

| | |
|-----------------------------------|--|
| 'p' (70h) | Read SD/SV command data (label and training) |
| [1] | Group index (0 = trigger, 1-15 = generic, 16 = password) |
| [2] | Command position (0-31) |
| Expected replies: STS_DATA | |

CMD_MASK_SD

| | |
|-----------------------------------|--------------------------------------|
| 'm' (6Dh) | Request bit-mask of non-empty groups |
| Expected replies: STS_MASK | |

CMD_RESETALL

| | |
|--------------------------------------|-------------------------------|
| 'r' (72h) | Reset all commands and groups |
| 'R' (52h) | Confirmation character |
| Expected replies: STS_SUCCESS | |

CMD_ID

| | |
|---------------------------------|---------------------------------|
| 'x' (78h) | Request firmware identification |
| Expected replies: STS_ID | |

CMD_DELAY

| | |
|--------------------------------------|---|
| 'y' (79h) | Set transmit delay |
| [1] | Time (0-10 = 0-10 ms, 11-19 = 20-100 ms, 20-28 = 200-1000 ms) |
| Expected replies: STS_SUCCESS | |

CMD_BAUDRATE

| | |
|--------------------------------------|---|
| 'a' (61h) | Set communication baud-rate |
| [1] | Speed mode: 1 = 115200 2 = 57600 3 = 38400 6 = 19200 12 = 9600 |
| Expected replies: STS_SUCCESS | |

CMD_QUERY_IO

| | |
|---|---|
| 'q' (71h) | Configure, query or modify general purpose I/O pins |
| [1] | Pin number (1 = pin IO1, 2 = pin IO2, 3 = pin IO3) |
| [2] | Pin mode (0 = output low, 1 = output high, 2 = input*, 3 = input strong**, 4 = input weak***) * High impedance input (no pull-up) **Strong means ~10K internal pull-up ***Weak means ~200K internal pull-up (default after power up) |
| Expected replies: STS_SUCCESS (mode 0-1), STS_PIN (mode 2-4) | |

CMD_PLAY_SX

| | |
|---|---|
| 'w' (77h) | Wave table entry playback |
| [1-2] | Two positive values that form a 10-bit index to the sound table (index = [1] * 32 + [2], 0 = built-in "beep", 1-1023 = sound index) |
| [3] | Playback volume (0-31, 0 = min volume, 15 = full scale, 31 = double gain) |
| Expected replies: STS_SUCCESS, STS_ERROR | |

CMD_PLAY_DTMF

| | |
|--------------------------------------|--|
| 'w' (77h) | Play a DTMF key tone or dial tone |
| [1] | Fixed to (-1) |
| [2] | Index of phone tone to play (0-9 for digits, 10 for '*' key, 11 for '#' key and 12-15 for extra keys 'A' to 'D', -1 for the dial tone) |
| [3] | Tone duration minus 1 (0-31 in 40ms units for keys, in seconds for the dial tone) |
| Expected replies: STS_SUCCESS | |

CMD_DUMP_SX

| | |
|---|----------------------|
| 'h' (68h) | Read wave table data |
| Expected replies: STS_TABLE_SX, STS_OUT_OF_MEM | |

CMD_DUMP_SI

| | |
|---|--|
| 'h' (68h) | Read custom and built-in grammars data |
| [1] | Index of SI grammar to read (0-31) or (-1) to get the total count of SI grammars (including the first 4 built-in wordsets) |
| Expected replies: STS_GRAMMAR, STS_COUNT | |

CMD_SEND_SN

| | |
|--------------------------------------|--|
| 'h' (68h) | Send a SonicNet™ token |
| [1] | Length of token (4 or 8 in bits) |
| [2-3] | Two positive values that form an 8-bit token index (index = [2] * 32 + [3], 0-15 for 4-bit tokens or 0-255 for 8-bits tokens) |
| [4-5] | Two positive values that form a 10-bit delay for token output since the next sound playback (delay = [4] * 32 + [5], 0 = send immediately, 1-1023 = delay in units of 27.46ms) |
| Expected replies: STS_SUCCESS | |

CMD_RECV_SN

| | |
|---|---|
| 'h' (68h) | Receive a SonicNet™ token |
| [1] | Length of token (4 or 8 in bits) |
| [2] | Rejection level (0-2 = higher values mean fewer results, 1 = default) |
| [3-4] | Two positive values that form a 10-bit timeout for token detection (timeout = [3] * 32 + [4], 0 = wait forever, 1-1023 = timeout in units of 27.46ms) |
| Expected replies: STS_TOKEN, STS_TIMEOUT | |

Status Details

Replies to commands follow this format. Please note that numeric arguments of status replies are mapped to upper-case letters (see the related section).

STS_MASK

| | |
|---------------------------------|---|
| 'k' (6Bh) | Mask of non-empty groups |
| [1-8] | 4-bit values that form 32-bit mask, LSB first |
| In reply to: CMD_MASK_SD | |

STS_COUNT

| | |
|---|---|
| 'c' (63h) | Count of commands or total number of SI grammars |
| [1] | Integer (0-31 = command/grammar count, -1 = 32 commands/grammars) |
| In reply to: CMD_COUNT_SD, CMD_DUMP_SI | |

STS_AWAKEN

| | |
|--|-------------------------------------|
| 'w' (77h) | Wake-up (back from power-down mode) |
| In reply to: Any character after power on or sleep mode | |

STS_DATA

| | |
|---------------------------------|---|
| 'd' (64h) | Provide command data |
| [1] | Training information (-1=empty, 1-6 = training count, +8 = SD/SV conflict, +16 = SI conflict) Known issues: In firmware ID 0, command creation/deletion might cause other empty commands training count to change to 7. Treat count values of -1, 0 or 7 as empty training markers. Never train commands more than 2 or 3 times. |
| [2] | Conflicting command position (0-31, only meaningful when trained) |
| [3] | Length of label (0-31) |
| [4-n] | Text of label (ASCII characters from 'A' to '') |
| In reply to: CMD_DUMP_SD | |

STS_ERROR

| | |
|---|--|
| 'e' (65h) | Signal recognition error |
| [1-2] | Two positive values that form an 8-bit error code (error = [1] * 16 + [2], see appendix) |
| In reply to: CMD_RECOG_SI, CMD_RECOG_SD, CMD_TRAIN_SD, CMD_PLAY_SX | |

STS_INVALID

| | |
|---|-----------------------------|
| 'v' (76h) | Invalid command or argument |
| In reply to: Any invalid command or argument | |

STS_TIMEOUT

| | |
|--|-----------------|
| 't' (74h) | Timeout expired |
| In reply to: CMD_RECOG_SI, CMD_RECOG_SD, CMD_TRAIN_SD | |

STS_INTERR

| | |
|--|-------------------------|
| 'i' (69h) | Interrupted recognition |
| In reply to: CMD_BREAK while in training, recognition or playback | |

STS_SUCCESS

| | |
|---|------------------------|
| 'o' (6Fh) | OK or no errors status |
| In reply to: CMD_BREAK, CMD_DELAY, CMD_BAUDRATE, CMD_TIMEOUT, CMD_KNOB, CMD_LEVEL, CMD_LANGUAGE, CMD_SLEEP, CMD_GROUP_SD, CMD_UNGROUP_SD, CMD_ERASE_SD, CMD_NAME_SD, CMD_RESETALL, CMD_QUERY_IO, CMD_PLAY_SX | |

STS_RESULT

| | |
|--|---|
| 'r' (72h) | Recognized SD/SV command or Training similar to SD/SV command |
| [1] | Command position (0-31) |
| In reply to: CMD_RECOG_SD, CMD_TRAIN_SD | |

STS_SIMILAR

| | |
|--|---|
| 's' (73h) | Recognized SI word or Training similar to SI word |
| [1] | Word index (0-31) |
| In reply to: CMD_RECOG_SI, CMD_RECOG_SD, CMD_TRAIN_SD | |

STS_OUT_OF_MEM

| | |
|---|---|
| 'm' (6Dh) | Memory error (no more room for commands or sound table not present) |
| In reply to: CMD_GROUP_SD, CMD_DUMP_SX | |

STS_ID

| | |
|----------------------------|---------------------------------|
| 'x' (78h) | Provide firmware identification |
| [1] | Version identifier (0) |
| In reply to: CMD_ID | |

STS_PIN

| | |
|----------------------------------|---|
| 'p' (70h) | Provide pin input status |
| [1] | Logic level (0 = input low, 1 = input high) |
| In reply to: CMD_QUERY_IO | |

STS_TABLE_SX

| | |
|---------------------------------|---|
| 'd' (64h) | Provide sound table data |
| [1-2] | Two positive values that form a 10-bit count of entries in the sound table (count = [1] * 32 + [2]) |
| [3] | Length of table name (0-31) |
| [4-n] | Text of table name (ASCII characters from 'A' to '') |
| In reply to: CMD_DUMP_SX | |

STS_GRAMMAR

| | |
|--|---|
| 'z' (7Ah) | Provide custom grammar data |
| [1] | Some flags for this grammar (currently 16 is returned for trigger grammars, 0 for commands) |
| [2] | Number of commands in this grammar (0-31) |
| [3] | Length of first command label (0-31) |
| [4-n] | Text of first command label (ASCII characters from 'A' to ``') |
| ... | Repeat last two fields for all the commands in this grammar |
| In reply to: <u>CMD_DUMP_SI</u> | |

STS_TOKEN

| | |
|---------------------------------|---|
| 'f' (66h) | Detected a SonicNet™ token |
| [1-2] | Two positive values that form the index of a received token (index = [1] * 32 + [2], 0-15 for 4-bit tokens or 0-255 for 8-bit tokens) |
| In reply to: CMD_RECV_SN | |

Communication Examples

These are some examples of actual command and status characters exchanged with the EasyVR module by host programs and the expected program flow with pseudo-code sequences.

The pseudo-instruction `SEND` transmits the specified character to the module, while `RECEIVE` waits for a reply character (a timeout is not explicitly handled for simple commands, but should be always implemented if possible).

Also, the `OK` and `ERROR` routines are not explicitly defined, since they are host and programming language dependent, but appropriate code should be written to handle both conditions.

Lines beginning with a `#` (sharp) character are comments.

Please note that in a real programming language it would be best to define some constants for the command and status characters, as well as for mapping numeric arguments, that would be used throughout the program, to minimize the chance of repetition errors and clarify the meaning of the code.

See the [Protocol header file](#) for sample definitions that can be used in a C language environment.

Here below all the characters sent and received are written explicitly in order to clarify the communication protocol detailed in the previous sections.

Recommended wake up procedure

```
# wake up or interrupt recognition or do nothing
# (uses a timeout or max repetition count)

DO
    SEND 'b'
LOOP UNTIL RECEIVE = 'o'
```

Recommended setup procedure

```
# ask firmware id
SEND 'x'
IF NOT RECEIVE = 'x' THEN ERROR

# send ack and read status (expecting id=0)
SEND ' '
id = RECEIVE
IF id = 'A' THEN
    # it's a VRbot
ELSE IF id = 'B' THEN
    # it's an EasyVR
ELSE
    # next generation?
END IF

# set language for SI recognition (Japanese)
SEND 'l'
SEND 'C'
IF RECEIVE = 'o' THEN OK ELSE ERROR

# set timeout (5 seconds)
SEND 'o'
SEND 'F'
IF RECEIVE = 'o' THEN OK ELSE ERROR
```

Recognition of a built-in or custom SI command

```
# start recognition in wordset 1
SEND 'i'
SEND 'B'
# wait for reply:
# (if 5s timeout has been set, wait for max 6s then abort
# otherwise trigger recognition could never end)
result = RECEIVE

IF result = 's' THEN
    # successful recognition, ack and read result
    SEND ' '
    command = RECEIVE - 'A'
    # perform actions according to command
ELSE IF result = 't' THEN
    # timed out, no word spoken
ELSE IF result = 'e' THEN
    # error code, ack and read which one
    SEND ' '
    error = (RECEIVE - 'A') * 16
    SEND ' '
    error = error + (RECEIVE - 'A')
    # perform actions according to error
ELSE
    # invalid request or reply
    ERROR
END IF
```

Adding a new SD command

```
# insert command 0 in group 3
SEND 'g'
SEND 'D'
SEND 'A'
IF RECEIVE = 'o' THEN OK ELSE ERROR

# set command label to "ARDUINO_2009"
SEND 'g'
SEND 'D'
SEND 'A'
SEND 'Q'    # name length (16 characters, digits count twice)
SEND 'A'
SEND 'R'
SEND 'D'
SEND 'U'
SEND 'I'
SEND 'N'
SEND 'O'
SEND '_'
# encode each digit with a ^ prefix
# followed by the digit mapped to upper case letters
SEND '^'
SEND 'C'
SEND '^'
SEND 'A'
SEND '^'
SEND 'A'
SEND '^'
SEND 'J'
IF RECEIVE = 'o' THEN OK ELSE ERROR
```

Training an SD command

```

# repeat the whole training procedure twice for best results
# train command 0 in group 3
SEND 't'
SEND 'D'
SEND 'A'
# wait for reply:
# (default timeout is 3s, wait for max 1s more then abort)
result = RECEIVE

IF RECEIVE = 'o' THEN
    # training successful
    OK
ELSE IF result = 'r' THEN
    # training saved, but spoken command is similar to
    # another SD command, read which one
    SEND ' '
    command = RECEIVE - 'A'
    # may notify user and erase training or keep it
ELSE IF result = 's' THEN
    # training saved, but spoken command is similar to
    # another SI command (always trigger, may skip reading)
    SEND ' '
    command = RECEIVE - 'A'
    # may notify user and erase training or keep it
ELSE IF result = 't' THEN
    # timed out, no word spoken or heard
ELSE IF result = 'e' THEN
    # error code, ack and read which one
    SEND ' '
    error = (RECEIVE - 'A') * 16
    SEND ' '
    error = error + (RECEIVE - 'A')
    # perform actions according to error
ELSE
    # invalid request or reply
    ERROR
END IF

```

Recognition of an SD command

```

# start recognition in group 1
SEND 'd'
SEND 'B'
# wait for reply:
result = RECEIVE

IF result = 'r' THEN
    # successful recognition, ack and read result
    SEND ' '
    command = RECEIVE - 'A'
    # perform actions according to command
ELSE IF result = 't' THEN
    # timed out, no word spoken
ELSE IF result = 'e' THEN
    # error code, ack and read which one
    SEND ' '
    error = (RECEIVE - 'A') * 16
    SEND ' '
    error = error + (RECEIVE - 'A')
    # perform actions according to error
ELSE
    # invalid request or reply
    ERROR
END IF

```

Read used command groups

```
# request mask of groups in use
SEND 'm'
IF NOT RECEIVE = 'k' THEN ERROR
# read mask to 32 bits variable
# in 8 chunks of 4 bits each
SEND ' '
mask = (RECEIVE - 'A')
SEND ' '
mask = mask + (RECEIVE - 'A') * 24
SEND ' '
mask = mask + (RECEIVE - 'A') * 28
...
SEND ' '
mask = mask + (RECEIVE - 'A') * 224
```

Read how many commands in a group

```
# request command count of group 3
SEND 'c'
SEND 'D'
IF NOT RECEIVE = 'c' THEN ERROR
# ack and read count
SEND ' '
count = RECEIVE - 'A'
IF count = -1 THEN count = 32
```

Read a user defined command group

```
# dump command 0 in group 3
SEND 'p'
SEND 'D'
SEND 'A'
IF NOT RECEIVE = 'd' THEN ERROR
# read command data
SEND ' '
training = RECEIVE - 'A'
# extract training count (2 for a completely trained command)
tr_count = training AND 7
# extract flags for conflicts (SD or SI)
tr_flags = training AND 24
# read index of conflicting command (same group) if any
SEND ' '
conflict = RECEIVE - 'A'
# read label length
SEND ' '
length = RECEIVE - 'A'
# read label text
FOR i = 0 TO length - 1
  SEND ' '
  label[i] = RECEIVE
  # decode digits
  IF label[i] = '^' THEN
    SEND ' '
    label[i] = RECEIVE - 'A' + '0'
  END IF
NEXT
```

Use general purpose I/O pins

```
# set IO1 pin to logic low level
SEND 'q'
SEND 'B'
SEND 'A'
IF RECEIVE = 'o' THEN OK ELSE ERROR

# set IO2 pin to logic high level
SEND 'q'
SEND 'C'
SEND 'B'
IF RECEIVE = 'o' THEN OK ELSE ERROR

# set IO2 pin as input with strong pull-up and read state
SEND 'q'
SEND 'C'
SEND 'D'
IF NOT RECEIVE = 'p' THEN ERROR
# ack and read logic level
SEND ' '
pin_level = RECEIVE - 'A'

# set IO3 pin as high impedance input (reading state is optional)
SEND 'q'
SEND 'D'
SEND 'C'
IF NOT RECEIVE = 'p' THEN ERROR
```

Use custom sound playback

```
# play a beep at full volume (works with any or no table)
SEND 'w'
SEND 'A'
SEND 'A'
SEND 'P'
IF RECEIVE = 'o' THEN OK ELSE ERROR

# play entry 13 at half volume
SEND 'w'
SEND 'A'
SEND 'N'
SEND 'H'
IF RECEIVE = 'o' THEN OK ELSE ERROR

# play entry 123 (=3*32+26) at max volume
SEND 'w'
SEND 'A' + 3
SEND 'A' + 26
SEND 'A' + 31
IF RECEIVE = 'o' THEN OK ELSE ERROR
```

Read sound table

```
# dump sound table
SEND 'h'
IF NOT RECEIVE = 'h' THEN ERROR
# read count of entries and name length
SEND ' '
count = (RECEIVE - 'A') * 32
SEND ' '
count = count + (RECEIVE - 'A')
SEND ' '
length = RECEIVE - 'A'
# read name text
FOR i = 0 TO length - 1
  SEND ' '
  label[i] = RECEIVE
NEXT
```

Built-in Command Sets

In the tables below a list of all built-in commands for each supported language, along with group index (trigger or word set), command index and language identifier to use with the communication protocol.

| Trigger Word set | Command Index | Language | | | | | | |
|------------------|---------------|--------------|------------|-------------------------|-------------|----------------|--------------|--|
| | | 0 | 1 | 2 | 3 | 4 | 5 | |
| | | English (US) | Italian | Japanese (Rōmaji) | German | Spanish | French | |
| 0 | 0 | robot | robot | ロボット <i>robotto</i> | roboter | robot | robot | |
| 1 | 0 | action | azione | アクション <i>acution</i> | aktion | acción | action | |
| | 1 | move | vai | 進め <i>susu-me</i> | gehe | muévete | bouge | |
| | 2 | turn | gira | 曲がれ <i>magare</i> | wende | gira | tourne | |
| | 3 | run | corri | 走れ <i>hashire</i> | lauf | corre | cours | |
| | 4 | look | guarda | 見ろ <i>miro</i> | schau | mira | regarde | |
| | 5 | attack | attacca | 攻撃 <i>kougeki</i> | attaque | ataca | attaque | |
| | 6 | stop | fermo | 止まれ <i>tomare</i> | halt | para | arrête | |
| 2 | 7 | hello | ciao | こんにちは <i>konnichiwa</i> | hallo | hola | salut | |
| | 0 | left | a sinistra | 左 <i>hidari</i> | nach links | a la izquierda | à gauche | |
| | 1 | right | a destra | 右 <i>migi</i> | nach rechts | a la derecha | à droite | |
| | 2 | up | in alto | 上 <i>ue</i> | hinauf | arriba | vers le haut | |
| | 3 | down | in basso | 下 <i>shita</i> | hinunter | abajo | vers le bas | |
| | 4 | forward | avanti | 前 <i>mae</i> | vorwärts | adelante | en avant | |
| | 5 | backward | indietro | 後ろ <i>ushiro</i> | rückwärts | atrás | en arrière | |
| 3 | 0 | zero | zero | ゼロ <i>zero</i> | null | cero | zéro | |
| | 1 | one | uno | 一 <i>ichi</i> | eins | uno | un | |
| | 2 | two | due | 二 <i>ni</i> | zwei | dos | deux | |
| | 3 | three | tre | 三 <i>san</i> | drei | tres | trois | |
| | 4 | four | quattro | 四 <i>yon</i> | vier | cuatro | quatre | |
| | 5 | five | cinque | 五 <i>go</i> | fünf | cinco | cinq | |
| | 6 | six | sei | 六 <i>roku</i> | sechs | seis | six | |
| | 7 | seven | sette | 七 <i>nana</i> | sieben | siete | sept | |
| | 8 | eight | otto | 八 <i>hachi</i> | acht | ocho | huit | |
| | 9 | nine | nove | 九 <i>kyu</i> | neun | nueve | neuf | |
| | 10 | ten | dieci | 十 <i>jyuu</i> | zehn | diez | dix | |

Error codes

Below the list of the most useful error codes that may be returned by training or recognizing commands.

| | | |
|------------|------------------------|--|
| 03h | ERR_DATACOL_TOO_NOISY | too noisy |
| 04h | ERR_DATACOL_TOO_SOFT | spoke too soft |
| 05h | ERR_DATACOL_TOO_LOUD | spoke too loud |
| 06h | ERR_DATACOL_TOO_SOON | spoke too soon |
| 07h | ERR_DATACOL_TOO_CHOPPY | too many segments/too complex |
| 11h | ERR_RECOG_FAIL | recognition failed |
| 12h | ERR_RECOG_LOW_CONF | recognition result doubtful |
| 13h | ERR_RECOG_MID_CONF | recognition result maybe |
| 14h | ERR_RECOG_BAD_TEMPLATE | invalid SD/SV command stored in memory |
| 17h | ERR_RECOG_DURATION | bad pattern durations |
| 4Ah | ERR_SYNTH_BAD_VERSION | bad release number in speech file |
| 4Eh | ERR_SYNTH_BAD_MSG | bad data in speech file or invalid compression |
| 80h | ERR_NOT_A_WORD | recognized word is not in vocabulary |

The first group of codes (03h – 07h) is due to errors in the way of speaking to the EasyVR or disturbances in the acquired audio signal that may depend on the surrounding environment.

The second group (11h – 13h) indicates an insufficient score of the recognized word (from lowest to highest). Acceptance of lower score results may be allowed by lowering the “knob” or “level” settings, respectively for built-in and custom commands (see CMD_KNOB and CMD_LEVEL).

A third group of codes (14h – 17h) reports errors in the stored commands that may be due to memory corruption. We suggest you check power level and connections, then erase all the commands in the faulty group and train them again.

The fourth group (4Ah – 4Eh) deals with errors in the compressed sound data, either because the wrong version of the QuickSynthesis™ tool has been used to generate the sound table or because a not supported compression scheme has been selected (or data is generically invalid).

The last code (80h) means that a word has been recognized that is not in the specified built-in sets. This is due to how Speaker Independent recognition works and should be ignored.

Protocol header file

This file “protocol.h” can be used with applications written in the C language. You can download a recent copy from the [VeeAR website](http://www.veear.eu).

```
#ifndef PROTOCOL_H
#define PROTOCOL_H

#define CMD_BREAK          'b' // abort recog or ping
#define CMD_SLEEP         's' // go to power down
#define CMD_KNOB          'k' // set si knob <1>
#define CMD_MIC_DIST     'k' // set microphone (<1>=-1) distance <2>
#define CMD_LEVEL        'v' // set sd level <1>
#define CMD_LANGUAGE     'l' // set si language <1>
#define CMD_TIMEOUT      'o' // set timeout <1>
#define CMD_RECOG_SI     'i' // do si recog from ws <1>
#define CMD_TRAIN_SD     't' // train sd command at group <1> pos <2>
#define CMD_GROUP_SD     'g' // insert new command at group <1> pos <2>
#define CMD_UNGROUP_SD  'u' // remove command at group <1> pos <2>
#define CMD_RECOG_SD     'd' // do sd recog at group <1> (0 = trigger mixed si/sd)
#define CMD_ERASE_SD     'e' // reset command at group <1> pos <2>
#define CMD_NAME_SD     'n' // label command at group <1> pos <2> with length <3> name <4-n>
#define CMD_COUNT_SD    'c' // get command count for group <1>
#define CMD_DUMP_SD     'p' // read command data at group <1> pos <2>
#define CMD_MASK_SD     'm' // get active group mask
#define CMD_RESETALL    'r' // reset all commands and groups
#define CMD_ID          'x' // get version id
#define CMD_DELAY       'y' // set transmit delay <1> (log scale)
#define CMD_BAUDRATE    'a' // set baudrate <1> (bit time, 1=>115200)
#define CMD_QUERY_IO    'q' // configure, read or write I/O pin <1> of type <2>
#define CMD_PLAY_SX     'w' // wave table entry <1-2> (10-bit) playback at volume <3>
#define CMD_PLAY_DTMF   'w' // play (<1>=-1) dial tone <2> for duration <3>
#define CMD_DUMP_SX     'h' // dump wave table entries
#define CMD_DUMP_SI     'z' // dump si settings for ws <1> (or total ws count if -1)
#define CMD_SEND_SN     'j' // send sonicnet token with bits <1> index <2-3> at time <4-5>
#define CMD_RECV_SN     'f' // receive sonicnet token with bits <1> rejection <2> timeout <3-4>

#define STS_MASK        'k' // mask of active groups <1-8>
#define STS_COUNT      'c' // count of commands <1> (or number of ws <1>)
#define STS_AWAKEN     'w' // back from power down mode
#define STS_DATA       'd' // provide training <1>, conflict <2>, command label <3-35>
(counted string)
#define STS_ERROR      'e' // signal error code <1-2>
#define STS_INVALID    'v' // invalid command or argument
#define STS_TIMEOUT    't' // timeout expired
#define STS_INTERR     'i' // back from aborted recognition (see 'break')
#define STS_SUCCESS    'o' // no errors status
#define STS_RESULT     'r' // recognised sd command <1> - training similar to sd <1>
#define STS_SIMILAR    's' // recognised si <1> (in mixed si/sd) - training similar to si <1>
#define STS_OUT_OF_MEM 'm' // no more available commands (see 'group')
#define STS_ID         'x' // provide version id <1>
#define STS_PIN        'p' // return pin state <1>
#define STS_TABLE_SX   'h' // table entries count <1-2> (10-bit), table name <3-35> (counted
string)
#define STS_GRAMMAR    'z' // si grammar: flags <1>, word count <2>, labels... <3-35> (n
counted strings)
#define STS_TOKEN      'f' // received sonicnet token <1-2>

// protocol arguments are in the range 0x40 (-1) to 0x60 (+31) inclusive
#define ARG_MIN        0x40
#define ARG_MAX        0x60
#define ARG_ZERO       0x41

#define ARG_ACK        0x20 // to read more status arguments

#endif //PROTOCOL_H
```

A better source of information and a reference protocol implementation for the C/C++ language and can be found in the [Arduino Library](https://github.com/veear/ArduinoLibrary) source.

EasyVR Arduino Library

The [EasyVR](#) library implements the serial communication protocol to manage the EasyVR module and the EasyVR Shield from Arduino boards and controllers and it enables easy access to all the EasyVR features.

Installation

To install the [EasyVR](#) library on your Arduino IDE use the menu Sketch > Import Library ... > Add Library and open the released zip archive.

Examples

You can easily open the example sketches included with the [EasyVR](#) library from inside the Arduino IDE, using the menu File > Examples > EasyVR and choosing one of the available sketches.

EasyVR library settings

Macros

- #define [EASYVR_RX_TIMEOUT](#)
- #define [EASYVR_STORAGE_TIMEOUT](#)
- #define [EASYVR_WAKE_TIMEOUT](#)
- #define [EASYVR_PLAY_TIMEOUT](#)
- #define [EASYVR_TOKEN_TIMEOUT](#)

Detailed Description

By defining these symbols before the library include directive, you can alter the default settings used by the library implementation.

These settings are available for completeness. The default settings should be appropriate for normal use cases.

Macro Definition Documentation

#define EASYVR_RX_TIMEOUT

Receive timeout (in ms). The maximum time that is spent waiting for a reply from the EasyVR module.

#define EASYVR_STORAGE_TIMEOUT

Reply timeout for storage operations (in ms). The maximum time that is spent waiting for a reply after a command that involves write access to the EasyVR internal storage.

#define EASYVR_WAKE_TIMEOUT

Wakeup maximum delay (in ms). The maximum time that the EasyVR module can spend for waking up from idle states.

#define EASYVR_PLAY_TIMEOUT

Playback maximum duration (in ms). The maximum time that is spent waiting for a synchronous playback operation to complete. Asynchronous playback is not affected.

#define EASYVR_TOKEN_TIMEOUT

Token maximum duration (in ms). The maximum time that is spent by the EasyVR module for sending a SonicNet token and reply.

EasyVR Class Reference

Public Types

- enum [ModuleId](#) { [VRBOT](#), [EASYVR](#), [EASYVR2](#), [EASYVR2_3](#), [EASYVR3](#) }

- enum [Language](#) { [ENGLISH](#), [ITALIAN](#), [JAPANESE](#), [GERMAN](#), [SPANISH](#), [FRENCH](#) }
- enum [Group](#) { [TRIGGER](#), [PASSWORD](#) }
- enum [Wordset](#) { [TRIGGER_SET](#), [ACTION_SET](#), [DIRECTION_SET](#), [NUMBER_SET](#) }
- enum [Distance](#) { [HEADSET](#), [ARMS_LENGTH](#), [FAR_MIC](#) }
- enum [Knob](#) { [LOOSER](#), [LOOSE](#), [TYPICAL](#), [STRICT](#), [STRICTER](#) }
- enum [Level](#) { [EASY](#), [NORMAL](#), [HARD](#), [HARDER](#), [HARDEST](#) }
- enum [Baudrate](#) { [B115200](#), [B57600](#), [B38400](#), [B19200](#), [B9600](#) }
- enum [WakeMode](#) { [WAKE_ON_CHAR](#), [WAKE_ON_WHISTLE](#), [WAKE_ON_LOUDSOUND](#), [WAKE_ON_2CLAPS](#), [WAKE_ON_3CLAPS](#) }
- enum [ClapSense](#) { [CLAP_SENSE_LOW](#), [CLAP_SENSE_MID](#), [CLAP_SENSE_HIGH](#) }
- enum [PinConfig](#) { [OUTPUT_LOW](#), [OUTPUT_HIGH](#), [INPUT_HIZ](#), [INPUT_STRONG](#), [INPUT_WEAK](#) }
- enum [PinNumber](#) { [IO1](#), [IO2](#), [IO3](#), [IO4](#), [IO5](#), [IO6](#) }
- enum [SoundVolume](#) { [VOL_MIN](#), [VOL_HALF](#), [VOL_FULL](#), [VOL_DOUBLE](#) }
- enum [SoundIndex](#) { [BEEP](#) }
- enum [GrammarFlag](#) { [GF_TRIGGER](#) }
- enum [RejectionLevel](#) { [REJECTION_MIN](#), [REJECTION_AVG](#), [REJECTION_MAX](#) }
- enum [ErrorCode](#) { [ERR_DATACOL_TOO_LONG](#), [ERR_DATACOL_TOO_NOISY](#), [ERR_DATACOL_TOO_SOFT](#), [ERR_DATACOL_TOO_LOUD](#), [ERR_DATACOL_TOO_SOON](#), [ERR_DATACOL_TOO_CHOPPY](#), [ERR_DATACOL_BAD_WEIGHTS](#), [ERR_DATACOL_BAD_SETUP](#), [ERR_RECOG_FAIL](#), [ERR_RECOG_LOW_CONF](#), [ERR_RECOG_MID_CONF](#), [ERR_RECOG_BAD_TEMPLATE](#), [ERR_RECOG_BAD_WEIGHTS](#), [ERR_RECOG_DURATION](#), [ERR_T2SI_EXCESS_STATES](#), [ERR_T2SI_BAD_VERSION](#), [ERR_T2SI_OUT_OF_RAM](#), [ERR_T2SI_UNEXPECTED](#), [ERR_T2SI_OVERFLOW](#), [ERR_T2SI_PARAMETER](#), [ERR_T2SI_NN_TOO_BIG](#), [ERR_T2SI_NN_BAD_VERSION](#), [ERR_T2SI_NN_NOT_READY](#), [ERR_T2SI_NN_BAD_LAYERS](#), [ERR_T2SI_TRIG_OOV](#), [ERR_T2SI_TOO_SHORT](#), [ERR_SYNTH_BAD_VERSION](#), [ERR_SYNTH_ID_NOT_SET](#), [ERR_SYNTH_TOO_MANY_TABLES](#), [ERR_SYNTH_BAD_SEN](#), [ERR_SYNTH_BAD_MSG](#), [ERR_CUSTOM_NOTA](#), [ERR_SW_STACK_OVERFLOW](#), [ERR_INTERNAL_T2SI_BAD_SETUP](#) }
- enum [BridgeMode](#) { [BRIDGE_NONE](#), [BRIDGE_NORMAL](#), [BRIDGE_BOOT](#) }

Public Member Functions

- [EasyVR](#) (Stream &s)
- bool [detect](#) ()
- bool [stop](#) ()
- int8_t [getID](#) ()
- bool [setLanguage](#) (int8_t lang)
- bool [setTimeout](#) (int8_t seconds)
- bool [setMicDistance](#) (int8_t dist)
- bool [setKnob](#) (int8_t knob)
- bool [setLevel](#) (int8_t level)
- bool [setDelay](#) (uint16_t millis)
- bool [changeBaudrate](#) (int8_t baud)
- bool [sleep](#) (int8_t mode)
- bool [addCommand](#) (int8_t group, int8_t index)
- bool [removeCommand](#) (int8_t group, int8_t index)
- bool [setCommandLabel](#) (int8_t group, int8_t index, const char *name)
- bool [eraseCommand](#) (int8_t group, int8_t index)
- bool [getGroupMask](#) (uint32_t &mask)
- int8_t [getCommandCount](#) (int8_t group)
- bool [dumpCommand](#) (int8_t group, int8_t index, char *name, uint8_t &training)
- int8_t [getGrammarsCount](#) (void)
- bool [dumpGrammar](#) (int8_t grammar, uint8_t &flags, uint8_t &count)
- bool [getNextWordLabel](#) (char *name)
- void [trainCommand](#) (int8_t group, int8_t index)
- void [recognizeCommand](#) (int8_t group)
- void [recognizeWord](#) (int8_t wordset)
- bool [hasFinished](#) ()
- int8_t [getCommand](#) ()

- int8_t [getWord](#) ()
- int16_t [getToken](#) ()
- int16_t [getError](#) ()
- bool [isTimeout](#) ()
- bool [isAwakened](#) ()
- bool [isConflict](#) ()
- bool [isMemoryFull](#) ()
- bool [setPinOutput](#) (int8_t pin, int8_t value)
- int8_t [getPinInput](#) (int8_t pin, int8_t config)
- void [detectToken](#) (int8_t bits, int8_t rejection, uint16_t timeout)
- void [sendTokenAsync](#) (int8_t bits, uint8_t token)
- bool [sendToken](#) (int8_t bits, uint8_t token)
- bool [embedToken](#) (int8_t bits, uint8_t token, uint16_t delay)
- void [playSoundAsync](#) (int16_t index, int8_t volume)
- bool [playSound](#) (int16_t index, int8_t volume)
- bool [dumpSoundTable](#) (char *name, int16_t &count)
- bool [playPhoneTone](#) (int8_t tone, uint8_t duration)
- bool [resetAll](#) (bool wait=true)
- int [bridgeRequested](#) (Stream &port)
- void [bridgeLoop](#) (Stream &port)

Detailed Description

An implementation of the EasyVR communication protocol.

Member Enumeration Documentation

enum [ModuleId](#)

Module identification number (firmware version)

Enumerator

- VRBOT** Identifies a VRbot module
- EASYVR** Identifies an [EasyVR](#) module
- EASYVR2** Identifies an [EasyVR](#) module version 2
- EASYVR2_3** Identifies an [EasyVR](#) module version 2, firmware revision 3
- EASYVR3** Identifies an [EasyVR](#) module version 3, firmware revision 0

enum [Language](#)

Language to use for recognition of built-in words

Enumerator

- ENGLISH** Uses the US English word sets
- ITALIAN** Uses the Italian word sets
- JAPANESE** Uses the Japanese word sets
- GERMAN** Uses the German word sets
- SPANISH** Uses the Spanish word sets
- FRENCH** Uses the French word sets

enum [Group](#)

Special group numbers for recognition of custom commands

Enumerator

- TRIGGER** The trigger group (shared with built-in trigger word)
- PASSWORD** The password group (uses speaker verification technology)

enum [Wordset](#)

Index of built-in word sets

Enumerator

TRIGGER_SET The built-in trigger word set
ACTION_SET The built-in action word set
DIRECTION_SET The built-in direction word set
NUMBER_SET The built-in number word set

enum Distance

Microphone distance from the user's mouth, used by all recognition technologies

Enumerator

HEADSET Nearest range (around 5cm)
ARMS_LENGTH Medium range (from about 50cm to 1m)
FAR_MIC Farthest range (up to 3m)

enum Knob

Confidence thresholds for the knob settings, used for recognition of built-in words or custom grammars (not used for the mixed trigger group)

Enumerator

LOOSER Lowest threshold, most results reported
LOOSE Lower threshold, more results reported
TYPICAL Typical threshold (default)
STRICT Higher threshold, fewer results reported
STRICTER Highest threshold, fewest results reported

enum Level

Strictness values for the level settings, used for recognition of custom commands (not used for the mixed trigger group)

Enumerator

EASY Lowest value, most results reported
NORMAL Typical value (default)
HARD Slightly higher value, fewer results reported
HARDER Higher value, fewer results reported
HARDEST Highest value, fewest results reported

enum Baudrate

Constants to use for baudrate settings

Enumerator

B115200 115200 bps
B57600 57600 bps
B38400 38400 bps
B19200 19200 bps
B9600 9600 bps (default)

enum WakeMode

Constants for choosing wake-up method in sleep mode

Enumerator

WAKE_ON_CHAR Wake up on any character received
WAKE_ON_WHISTLE Wake up on whistle or any character received
WAKE_ON_LOUDSOUND Wake up on a loud sound or any character received
WAKE_ON_2CLAPS Wake up on double hands-clap or any character received
WAKE_ON_3CLAPS Wake up on triple hands-clap or any character received

enum ClapSense

Hands-clap sensitivity for wakeup from sleep mode. Use in combination with [WAKE_ON_2CLAPS](#) or [WAKE_ON_3CLAPS](#)

Enumerator

CLAP_SENSE_LOW Lowest threshold
CLAP_SENSE_MID Typical threshold
CLAP_SENSE_HIGH Highest threshold

enum **PinConfig**

Pin configuration options for the extra I/O connector

Enumerator

OUTPUT_LOW Pin is a low output (0V)
OUTPUT_HIGH Pin is a high output (3V)
INPUT_HIZ Pin is an high impedance input
INPUT_STRONG Pin is an input with strong pull-up (~10K)
INPUT_WEAK Pin is an input with weak pull-up (~200K)

enum **PinNumber**

Available pin numbers on the extra I/O connector

Enumerator

IO1 Identifier of pin IO1
IO2 Identifier of pin IO2
IO3 Identifier of pin IO3
IO4 Identifier of pin IO4 (only EasyVR3)
IO5 Identifier of pin IO5 (only EasyVR3)
IO6 Identifier of pin IO6 (only EasyVR3)

enum **SoundVolume**

Some quick volume settings for the sound playback functions (any value in the range 0-31 can be used)

Enumerator

VOL_MIN Lowest volume (almost mute)
VOL_HALF Half scale volume (softer)
VOL_FULL Full scale volume (normal)
VOL_DOUBLE Double gain volume (louder)

enum **SoundIndex**

Special sound index values, always available even when no soundtable is present

Enumerator

BEEP Beep sound

enum **GrammarFlag**

Flags used by custom grammars

Enumerator

GF_TRIGGER A bit mask that indicate grammar is a trigger (opposed to commands)

enum **RejectionLevel**

Noise rejection level for SonicNet token detection (higher value, fewer results)

Enumerator

REJECTION_MIN Lowest noise rejection, highest sensitivity
REJECTION_AVG Medium noise rejection, medium sensitivity
REJECTION_MAX Highest noise rejection, lowest sensitivity

enum **ErrorCode**

Error codes used by various functions

Enumerator

ERR_DATACOL_TOO_LONG too long (memory overflow)
ERR_DATACOL_TOO_NOISY too noisy
ERR_DATACOL_TOO_SOFT spoke too soft
ERR_DATACOL_TOO_LOUD spoke too loud
ERR_DATACOL_TOO_SOON spoke too soon
ERR_DATACOL_TOO_CHOPPY too many segments/too complex
ERR_DATACOL_BAD_WEIGHTS invalid SI weights
ERR_DATACOL_BAD_SETUP invalid setup
ERR_RECOG_FAIL recognition failed
ERR_RECOG_LOW_CONF recognition result doubtful
ERR_RECOG_MID_CONF recognition result maybe
ERR_RECOG_BAD_TEMPLATE invalid SD/SV template
ERR_RECOG_BAD_WEIGHTS invalid SI weights
ERR_RECOG_DURATION incompatible pattern durations
ERR_T2SI_EXCESS_STATES state structure is too big
ERR_T2SI_BAD_VERSION RSC code version/Grammar ROM dont match
ERR_T2SI_OUT_OF_RAM reached limit of available RAM
ERR_T2SI_UNEXPECTED an unexpected error occurred
ERR_T2SI_OVERFLOW ran out of time to process
ERR_T2SI_PARAMETER bad macro or grammar parameter
ERR_T2SI_NN_TOO_BIG layer size out of limits
ERR_T2SI_NN_BAD_VERSION net structure incompatibility
ERR_T2SI_NN_NOT_READY initialization not complete
ERR_T2SI_NN_BAD_LAYERS not correct number of layers
ERR_T2SI_TRIG_OOV trigger recognized Out Of Vocabulary
ERR_T2SI_TOO_SHORT utterance was too short
ERR_SYNTH_BAD_VERSION bad release number in speech file
ERR_SYNTH_ID_NOT_SET (obsolete) bad sentence structure
ERR_SYNTH_TOO_MANY_TABLES (obsolete) too many talk tables
ERR_SYNTH_BAD_SEN (obsolete) bad sentence number
ERR_SYNTH_BAD_MSG bad message data or SX technology files missing
ERR_CUSTOM_NOTA none of the above (out of grammar)
ERR_SW_STACK_OVERFLOW no room left in software stack
ERR_INTERNAL_T2SI_BAD_SETUP T2SI test mode error

enum *BridgeMode*

Type of Bridge mode requested

Enumerator

BRIDGE_NONE Bridge mode has not been requested
BRIDGE_NORMAL Normal bridge mode ([EasyVR](#) baudrate 9600)
BRIDGE_BOOT Bridge mode for [EasyVR](#) bootloader (baudrate 115200)

Constructor & Destructor Documentation***EasyVR* (Stream & s)**

Creates an [EasyVR](#) object, using a communication object implementing the #Stream interface (such as #HardwareSerial, or the modified #SoftwareSerial and #NewSoftSerial).

Parameters:

| | |
|---|---|
| s | the Stream object to use for communication with the EasyVR module |
|---|---|

Member Function Documentation

bool detect ()

Detects an [EasyVR](#) module, waking it from sleep mode and checking it responds correctly.

Return values:

| | |
|-------------|---------------------------------------|
| <i>true</i> | if a compatible module has been found |
|-------------|---------------------------------------|

bool stop ()

Interrupts pending recognition or playback operations.

Return values:

| | |
|-------------|---|
| <i>true</i> | if the request is satisfied and the module is back to ready |
|-------------|---|

int8_t getID ()

Gets the module identification number (firmware version).

Return values:

| | |
|----------------|--|
| <i>integer</i> | is one of the values in ModuleId |
|----------------|--|

bool setLanguage (int8_t lang)

Sets the language to use for recognition of built-in words.

Parameters:

| | |
|-------------|--|
| <i>lang</i> | (0-5) is one of values in Language |
|-------------|--|

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool setTimeout (int8_t seconds)

Sets the timeout to use for any recognition task.

Parameters:

| | |
|----------------|--|
| <i>seconds</i> | (0-31) is the maximum time the module keep listening for a word or a command |
|----------------|--|

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool setMicDistance (int8_t dist)

Sets the operating distance of the microphone. This setting represents the distance between the microphone and the user's mouth, in one of three possible configurations.

Parameters:

| | |
|-------------|--|
| <i>dist</i> | (1-3) is one of values in Distance |
|-------------|--|

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool setKnob (int8_t knob)

Sets the confidence threshold to use for recognition of built-in words.

Parameters:

| | |
|-------------|--|
| <i>knob</i> | (0-4) is one of values in Knob |
|-------------|--|

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool setLevel (int8_t level)

Sets the strictness level to use for recognition of custom commands.

Parameters:

| | |
|--------------|---|
| <i>level</i> | (1-5) is one of values in Level |
|--------------|---|

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool setDelay (uint16_t millis)

Sets the delay before any reply of the module.

Parameters:

| | |
|---------------|---|
| <i>millis</i> | (0-1000) is the delay duration in milliseconds, rounded to 10 units in range 10-100 and to 100 units in range 100-1000. |
|---------------|---|

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool changeBaudrate (int8_t baud)

Sets the new communication speed. You need to modify the baudrate of the underlying Stream object accordingly, after the function returns successfully.

Parameters:

| | |
|-------------|--|
| <i>baud</i> | is one of values in Baudrate |
|-------------|--|

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool sleep (int8_t mode)

Puts the module in sleep mode.

Parameters:

| | |
|-------------|--|
| <i>mode</i> | is one of values in WakeMode , optionally combined with one of the values in ClapSense |
|-------------|--|

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool addCommand (int8_t group, int8_t index)

Adds a new custom command to a group.

Parameters:

| | |
|--------------|--|
| <i>group</i> | (0-16) is the target group, or one of the values in #Groups |
| <i>index</i> | (0-31) is the index of the command within the selected group |

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool removeCommand (int8_t group, int8_t index)

Removes a custom command from a group.

Parameters:

| | |
|--------------|--|
| <i>group</i> | (0-16) is the target group, or one of the values in #Groups |
| <i>index</i> | (0-31) is the index of the command within the selected group |

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool setCommandLabel (int8_t group, int8_t index, const char * name)

Sets the name of a custom command.

Parameters:

| | |
|--------------|--|
| <i>group</i> | (0-16) is the target group, or one of the values in #Groups |
| <i>index</i> | (0-31) is the index of the command within the selected group |
| <i>name</i> | is a string containing the label to be assigned to the specified command |

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool eraseCommand (int8_t group, int8_t index)

Erases the training data of a custom command.

Parameters:

| | |
|--------------|--|
| <i>group</i> | (0-16) is the target group, or one of the values in #Groups |
| <i>index</i> | (0-31) is the index of the command within the selected group |

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool getGroupMask (uint32_t & mask)

Gets a bit mask of groups that contain at least one command.

Parameters:

| | |
|-------------|--|
| <i>mask</i> | is a variable to hold the group mask when the function returns |
|-------------|--|

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

int8_t getCommandCount (int8_t group)

Gets the number of commands in the specified group.

Parameters:

| | |
|--------------|---|
| <i>group</i> | (0-16) is the target group, or one of the values in #Groups |
|--------------|---|

Return values:

| | |
|----------------|---|
| <i>integer</i> | is the count of commands (negative in case of errors) |
|----------------|---|

bool dumpCommand (int8_t group, int8_t index, char * name, uint8_t & training)

Retrieves the name and training data of a custom command.

Parameters:

| | |
|-----------------|--|
| <i>group</i> | (0-16) is the target group, or one of the values in #Groups |
| <i>index</i> | (0-31) is the index of the command within the selected group |
| <i>name</i> | points to an array of at least 32 characters that holds the command label when the function returns |
| <i>training</i> | is a variable that holds the training count when the function returns. Additional information about training is available through the functions isConflict() and getWord() or getCommand() |

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

int8_t getGrammarsCount (void)

Gets the total number of grammars available, including built-in and custom.

Return values:

| | |
|----------------|---|
| <i>integer</i> | is the count of grammars (negative in case of errors) |
|----------------|---|

bool dumpGrammar (int8_t grammar, uint8_t & flags, uint8_t & count)

Retrieves the contents of a built-in or a custom grammar. Command labels contained in the grammar can be obtained by calling [getNextWordLabel\(\)](#)

Parameters:

| | |
|----------------|--|
| <i>grammar</i> | (0-31) is the target grammar, or one of the values in Wordset |
| <i>flags</i> | is a variable that holds some grammar flags when the function returns. See GrammarFlag |
| <i>count</i> | is a variable that holds the number of words in the grammar when the function returns. |

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool getNextWordLabel (char * name)

Retrieves the name of a command contained in a custom grammar. It must be called after [dumpGrammar\(\)](#)

Parameters:

| | |
|-------------|---|
| <i>name</i> | points to an array of at least 32 characters that holds the command label when the function returns |
|-------------|---|

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

void trainCommand (int8_t group, int8_t index)

Starts training of a custom command. Results are available after [hasFinished\(\)](#) returns true.

Parameters:

| | |
|--------------|--|
| <i>group</i> | (0-16) is the target group, or one of the values in #Groups |
| <i>index</i> | (0-31) is the index of the command within the selected group |

Note:

The module is busy until training completes and it cannot accept other commands. You can interrupt training with [stop\(\)](#).

void recognizeCommand (int8_t group)

Starts recognition of a custom command. Results are available after [hasFinished\(\)](#) returns true.

Parameters:

| | |
|--------------|---|
| <i>group</i> | (0-16) is the target group, or one of the values in #Groups |
|--------------|---|

Note:

The module is busy until recognition completes and it cannot accept other commands. You can interrupt recognition with [stop\(\)](#).

void recognizeWord (int8_t wordset)

Starts recognition of a built-in word. Results are available after [hasFinished\(\)](#) returns true.

Parameters:

| | |
|----------------|---|
| <i>wordset</i> | (0-3) is the target word set, or one of the values in Wordset , (4-31) is the target custom grammar, if present |
|----------------|---|

Note:

The module is busy until recognition completes and it cannot accept other commands. You can interrupt recognition with [stop\(\)](#).

bool hasFinished ()

Polls the status of on-going recognition, training or asynchronous playback tasks.

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation has completed |
|-------------|--------------------------------|

int8_t getCommand ()

Gets the recognised command index if any.

Return values:

| | |
|--------|--|
| (0-31) | is the command index if recognition is successful, (-1) if no command has been recognized or an error occurred |
|--------|--|

int8_t getWord ()

Gets the recognised word index if any, from built-in sets or custom grammars.

Return values:

| | |
|--------|--|
| (0-31) | is the command index if recognition is successful, (-1) if no built-in word has been recognized or an error occurred |
|--------|--|

int16_t getToken ()

Gets the index of the received SonicNet token if any.

Return values:

| | |
|----------------|--|
| <i>integer</i> | is the index of the received SonicNet token (0-255 for 8-bit tokens or 0-15 for 4-bit tokens) if detection was successful, (-1) if no token has been received or an error occurred |
|----------------|--|

int16_t getError ()

Gets the last error code if any.

Return values:

| | |
|---------|--|
| (0-255) | is the error code, (-1) if no error occurred |
|---------|--|

bool isTimeout ()

Retrieves the timeout indicator.

Return values:

| | |
|-------------|-----------------------|
| <i>true</i> | if a timeout occurred |
|-------------|-----------------------|

bool isAwakened ()

Retrieves the wake-up indicator (only valid after [hasFinished\(\)](#) has been called).

Return values:

| | |
|-------------|---|
| <i>true</i> | if the module has been awakened from sleep mode |
|-------------|---|

bool isConflict ()

Retrieves the conflict indicator.

Return values:

| | |
|-------------|--|
| <i>true</i> | is a conflict occurred during training. To know what caused the conflict, use getCommand() and getWord() (only valid for triggers) |
|-------------|--|

bool isMemoryFull ()

Retrieves the memory full indicator (only valid after [addCommand\(\)](#) returned false).

Return values:

| | |
|-------------|--|
| <i>true</i> | if a command could not be added because of memory size constraints (up to 32 custom commands can be created) |
|-------------|--|

bool setPinOutput (int8_t pin, int8_t value)

Configures an I/O pin as an output and sets its value

Parameters:

| | |
|------------|---|
| <i>pin</i> | (1-3) is one of values in PinNumber |
| <i>pin</i> | (0-1) is one of the output values in PinConfig , or Arduino style HIGH and LOW macros |

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

int8_t getPinInput (int8_t pin, int8_t config)

Configures an I/O pin as an input with optional pull-up and return its value

Parameters:

| | |
|------------|---|
| <i>pin</i> | (1-3) is one of values in PinNumber |
| <i>pin</i> | (2-4) is one of the input values in PinConfig |

Return values:

| | |
|----------------|---------------------------------|
| <i>integer</i> | is the logical value of the pin |
|----------------|---------------------------------|

void detectToken (int8_t bits, int8_t rejection, uint16_t timeout)

Starts listening for a SonicNet token. Manually check for completion with [hasFinished\(\)](#).

Parameters:

| | |
|------------------|---|
| <i>bits</i> | (4 or 8) specifies the length of received tokens |
| <i>rejection</i> | (0-2) specifies the noise rejection level, it can be one of the values in RejectionLevel |
| <i>timeout</i> | (1-28090) is the maximum time in milliseconds to keep listening for a valid token or (0) to listen without time limits. |

Note:

The module is busy until token detection completes and it cannot accept other commands. You can interrupt listening with [stop\(\)](#).

void sendTokenAsync (int8_t bits, uint8_t token)

Starts immediate playback of a SonicNet token. Manually check for completion with [hasFinished\(\)](#).

Parameters:

| | |
|--------------|--|
| <i>bits</i> | (4 or 8) specifies the length of trasmitted token |
| <i>token</i> | is the index of the SonicNet token to play (0-255 for 8-bit tokens or 0-15 for 4-bit tokens) |

Note:

The module is busy until playback completes and it cannot accept other commands. You can interrupt playback with [stop\(\)](#).

bool sendToken (int8_t bits, uint8_t token)

Plays a SonicNet token and waits for completion.

Parameters:

| | |
|--------------|--|
| <i>bits</i> | (4 or 8) specifies the length of trasmitted token |
| <i>token</i> | is the index of the SonicNet token to play (0-255 for 8-bit tokens or 0-15 for 4-bit tokens) |

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool embedToken (int8_t bits, uint8_t token, uint16_t delay)

Schedules playback of a SonicNet token after the next sound starts playing.

Parameters:

| | |
|-------------|---|
| <i>bits</i> | (4 or 8) specifies the length of trasmitted token |
|-------------|---|

| | |
|--------------|--|
| <i>token</i> | is the index of the SonicNet token to play (0-255 for 8-bit tokens or 0-15 for 4-bit tokens) |
| <i>delay</i> | (1-28090) is the time in milliseconds at which to send the token, since the beginning of the next sound playback |

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

Note:

The scheduled token remains valid for one operation only, so you have to call [playSound\(\)](#) or [playSoundAsync\(\)](#) immediately after this function.

void playSoundAsync (int16_t index, int8_t volume)

Starts playback of a sound from the sound table. Manually check for completion with [hasFinished\(\)](#).

Parameters:

| | |
|---------------|--|
| <i>index</i> | is the index of the target sound in the sound table |
| <i>volume</i> | (0-31) may be one of the values in SoundVolume |

Note:

The module is busy until playback completes and it cannot accept other commands. You can interrupt playback with [stop\(\)](#).

bool playSound (int16_t index, int8_t volume)

Plays a sound from the sound table and waits for completion

Parameters:

| | |
|---------------|--|
| <i>index</i> | is the index of the target sound in the sound table |
| <i>volume</i> | (0-31) may be one of the values in SoundVolume |

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

Note:

To alter the maximum time for the wait, define the EASYVR_PLAY_TIMEOUT macro before including the [EasyVR](#) library.

bool dumpSoundTable (char * name, int16_t & count)

Retrieves the name of the sound table and the number of sounds it contains

Parameters:

| | |
|--------------|---|
| <i>name</i> | points to an array of at least 32 characters that holds the sound table label when the function returns |
| <i>count</i> | is a variable that holds the number of sounds when the function returns |

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool playPhoneTone (int8_t tone, uint8_t duration)

Plays a phone tone and waits for completion

Parameters:

| | |
|-----------------|---|
| <i>tone</i> | is the index of the tone (0-9 for digits, 10 for '*' key, 11 for '#' key and 12-15 for extra keys 'A' to 'D', -1 for the dial tone) |
| <i>duration</i> | (1-32) is the tone duration in 40 milliseconds units, or in seconds for the dial tone |

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

bool resetAll (bool wait = true)

Empties internal memory for custom commands and groups.

Parameters:

| | |
|-------------|--|
| <i>wait</i> | specifies whether to wait until the operation is complete (or times out) |
|-------------|--|

Return values:

| | |
|-------------|--------------------------------|
| <i>true</i> | if the operation is successful |
|-------------|--------------------------------|

Note:

It will take about 35 seconds for the whole process to complete and it cannot be interrupted. During this time the module cannot accept any other command. The sound table and custom grammars data is not affected.

int bridgeRequested (Stream & port)

Tests if bridge mode has been requested on the specified port

Parameters:

| | |
|-------------|--|
| <i>port</i> | is the target serial port (usually the PC serial port) |
|-------------|--|

Return values:

| | |
|------------|---------------------------------------|
| <i>non</i> | zero if bridge mode should be started |
|------------|---------------------------------------|

Note:

The EasyVR Commander software can request bridge mode when connected to the specified serial port, with a special handshake sequence.

void bridgeLoop (Stream & port)

Performs bridge mode between the [EasyVR](#) serial port and the specified port in a continuous loop. It can be aborted by sending a question mark ('?') on the target port.

Parameters:

| | |
|-------------|--|
| <i>port</i> | is the target serial port (usually the PC serial port) |
|-------------|--|

EasyVR Commander

The EasyVR Commander software can be used to easily configure your EasyVR module connected to your PC through a QuickUSB cable, an adapter board, or by using the microcontroller host board with the provided “bridge” program (available for ROBONOVA controller board, Arduino 2009/UNO, Parallax Basic Stamp).

You can define groups of commands or passwords and generate a basic code template to handle them. It is required to edit the generated code to implement the application logic, but the template contains all the functions or subroutines to handle the speech recognition tasks.

Getting Started

Connect the QuickUSB cable, adapter board or a microcontroller host board with a running “bridge” program⁵ to your PC, and then check that all devices are properly turned on and start the EasyVR Commander. Select the serial port to use from the toolbar or the “File” menu, and then go with the “Connect” command.

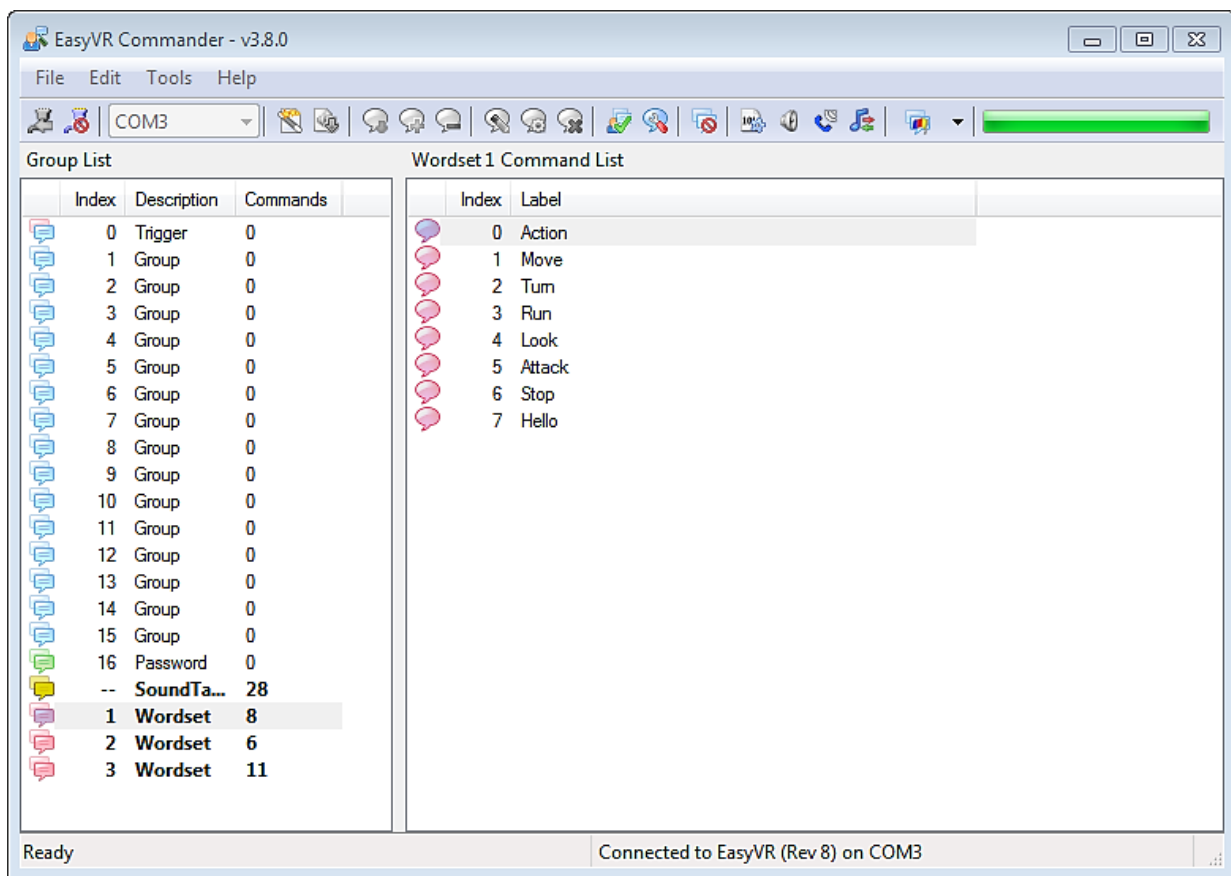


Figure 1 – Main application window

There are five kinds of commands in the software (see Figure 1 and Figure 4):

- **Trigger** - is a special group where you have the built-in SI trigger word "Robot" and you may add one user-defined SD trigger word. Trigger words are used to start the recognition process
- **Group** - where you may add user-defined SD commands
- **Password** - a special group for "vocal passwords" (up to five), using Speaker Verification (SV) technology
- **Wordset** - built-in set of SI commands (for instance in Figure 1 above, the Wordset 1 is selected)
- **Grammar** – custom set of SI commands (created with Quick T2SI Lite software).

⁵ On some systems the EasyVR Commander can automatically upload the “bridge” program to the host board once connected. That applies to Robonova controller board and Parallax Basic Stamp.

Speech Recognition

The recognition function of the EasyVR works on a single group at a time, so that users need to group together all the commands that they want to be able to use at the same time.

When EasyVR Commander connects to the module, it reads back all the user-defined commands and groups, which are stored into the EasyVR module non-volatile memory.

You can add a new command by first selecting the group in which the command needs to be created and then using the toolbar icons or the “*Edit*” menu.

A command should be given a label and then it should be trained twice with the user's voice: the user will be guided throughout this process (see Figure 2) when the “*Train Command*” action is invoked.

Note: Only Latin characters and digits can be used for labels, as well as the underscore character.

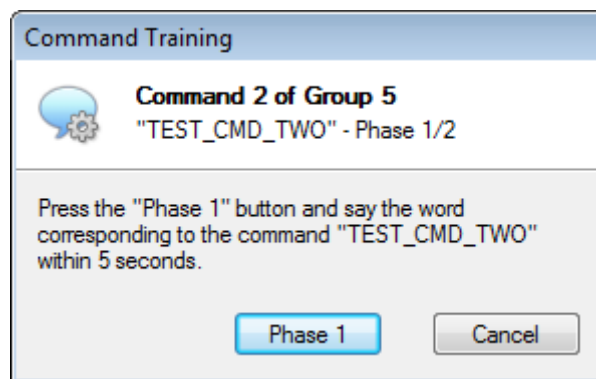
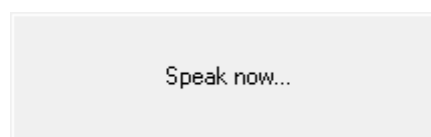


Figure 2 – Guided training dialog

After clicking on “Phase 1” or “Phase 2” buttons, remember you have to start speaking only when you see this little window:



If any error happens, command training will be cancelled. Errors may happen when the user's voice is not heard correctly, there is too much background noise or when the second word heard is too different from the first one.

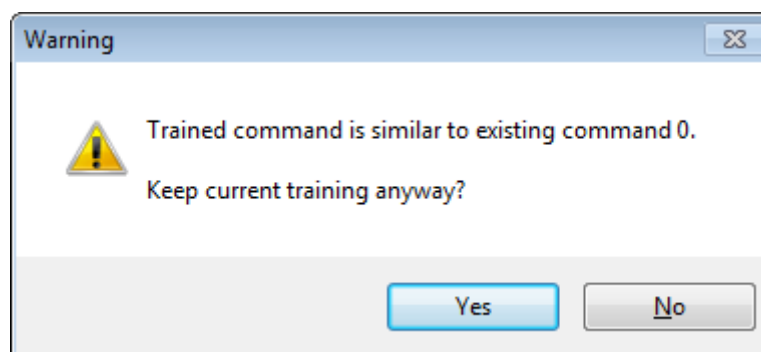


Figure 3 – Alert dialog in case of conflict

The software will also alert if a command is too similar to an existing one by specifying the index of the conflicting command in the "Conflict" column. For example, in the following Figure 4 the command "TEST_CMD_ONE" sounds too similar to "TEST_CMD_ZERO" (i.e. they have been trained with a similar pronunciation).

Note: TEST_CMD_ZERO and TEST_CMD_ONE are just examples of labels, you should use label names that reflects the real command that you are going to train.

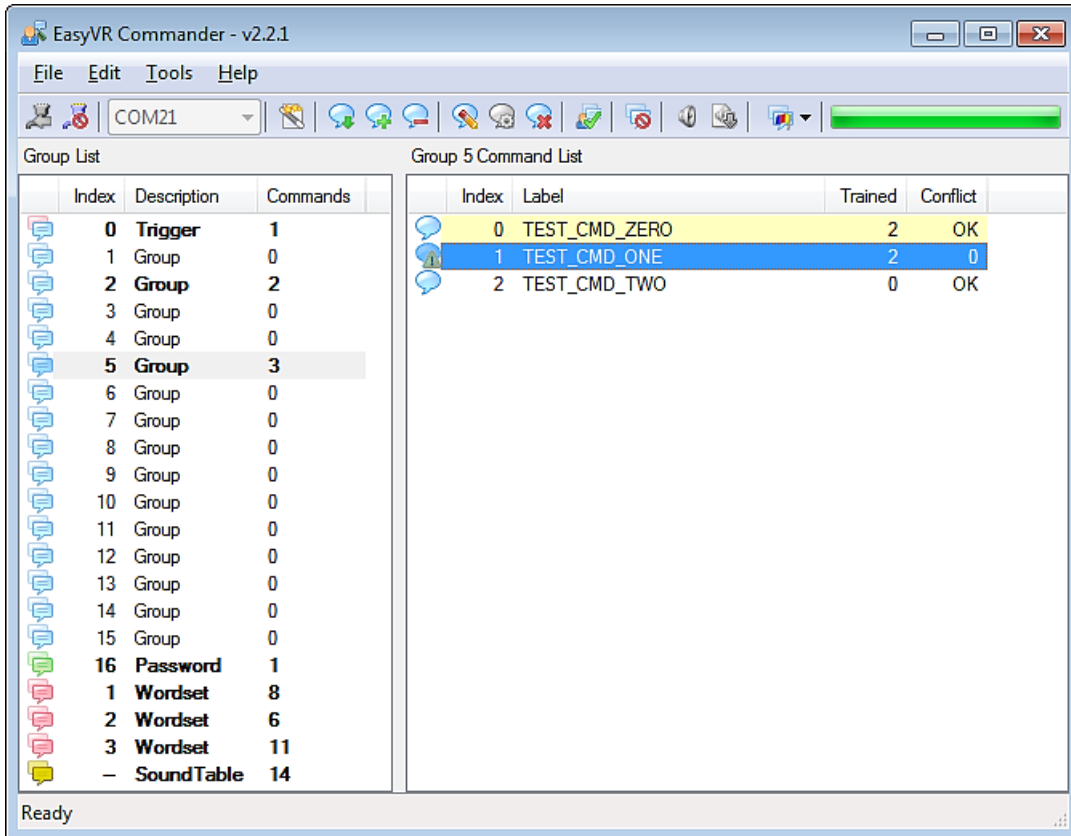


Figure 4 – Conflicting commands

The current status is displayed in the EasyVR Commander list view where groups that already contain commands are highlighted in bold.

The selected group of commands can also be tested, by using the icon on the toolbar or the "Tools" menu, to make sure the trained commands can be recognized successfully.

Note: If you want to re-train a command you need to erase the previous training first.

Note: "Vocal passwords" (Group 16) are much more sensitive to environment noise and distance from the microphone: be sure to train and to verify the password in similar conditions.

Recognition Settings

The module comes programmed with some default settings that can affect voice recognition. These parameters can be altered in those case where the default values do not offer the best performance.

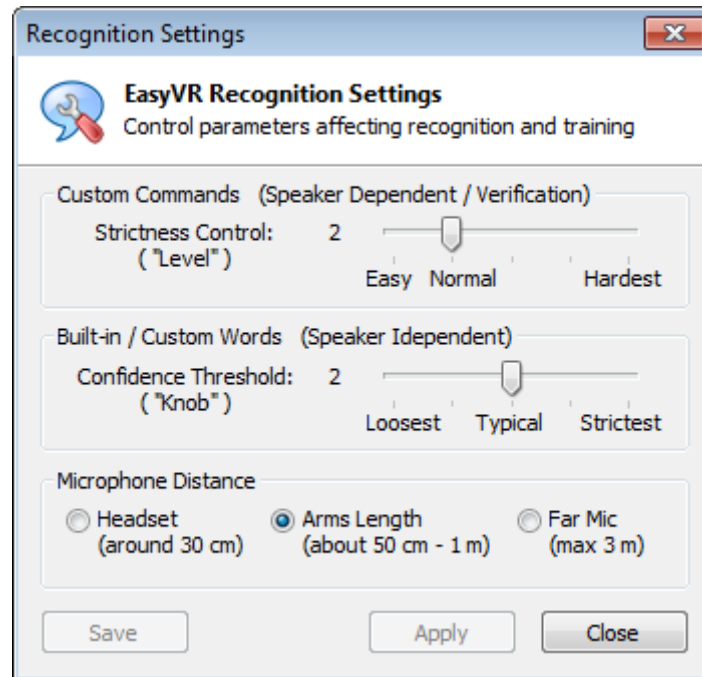


Figure 5 – Interface for changing recognition settings

The first two parameters (“Level” and “Knob”) affect the way recognition results are evaluated and reported, each one for a different kind of voice recognition algorithm (Speaker Dependent / Verification and Speaker Independent).

Both these values are used for a sort of acceptance threshold: each word or command recognized is assigned a score by the algorithm, which is compared to the threshold.

In some situations the algorithm may flag a correct result as an error or a low confidence result. In those cases you may try to lower the threshold and allow more results to be reported as correct. The drawback is that even words that were correctly refused before, now might also be accepted.

The vice-versa is also true: you can increase the threshold to avoid some incorrect words to be reported as good, but then you may also lose a few correct results. So, in the end, you need to find the best compromise.

The last parameter affect the internal microphone pre-amplifier and AGC (Automatic Gain Control) stages and is an indication of the expected operating distance of the microphone from the speaker’s mouth.

Note: The EasyVR module is optimized for the default distance setting “Arms Length”. Any other settings may require hardware modifications to the onboard gain resistor.

To change the recognition settings of the currently connected EasyVR device press the “Apply” button. The window is non-modal, so you can test the effects of your changes while leaving it open.

The “Save” button makes the EasyVR Commander remember your settings and automatically apply them to every connected device. The module itself does not store any option.

Phone Tones Generation (DTMF)

The EasyVR module is also capable of generating DTMF sounds. This feature can be tested by using the “Dial Tones” command in the “Tools” menu.

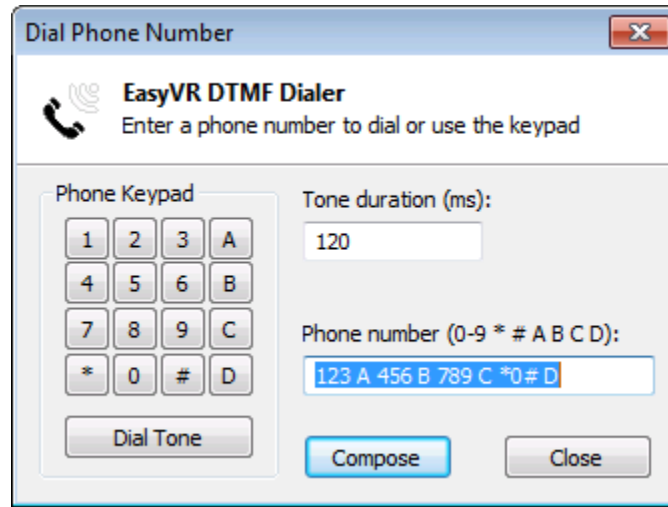


Figure 6 – Interface for generating phone tones

The tone duration can be specified in increments of 40 ms (milliseconds). The dial tone has a fixed duration of 3 seconds (its duration can be modified when programming the EasyVR).

Testing SonicNet™

Another feature available from the “Tools” menu is the “SonicNet”, a wireless communication protocol based on transmission and detection of special sequences of tones, called “tokens”.

Two kinds of tokens can be selected: a short version, with up to 16 different tokens, and a long version that provides up to 256 tokens.

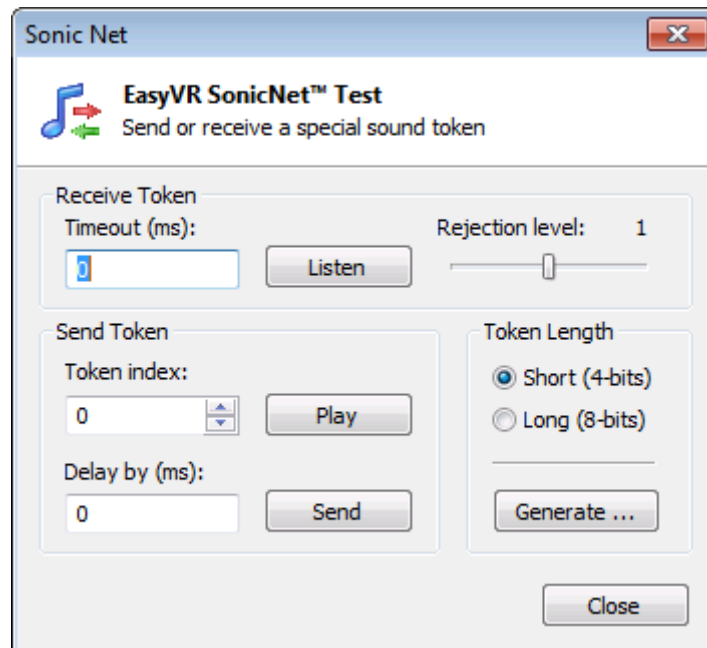


Figure 7 – Interface for testing SonicNet features

The EasyVR module can listen for incoming tokens continuously, or for as long as about 28 seconds

(specified with a granularity of around 27.5 ms). Another parameter for token detection is the rejection level that specifies the receiver sensitivity: higher rejection means lower sensitivity that is a lower detection rate, and vice-versa.

When the timeout parameter is set to 0, the module will listen continuously and you can use the “Play” button to send a token from your PC soundcard and the “Stop” button to stop listening.

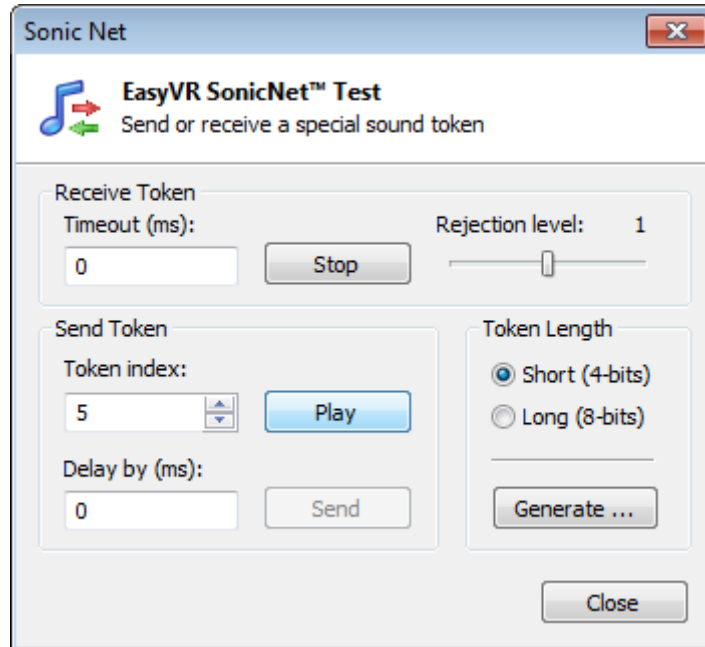
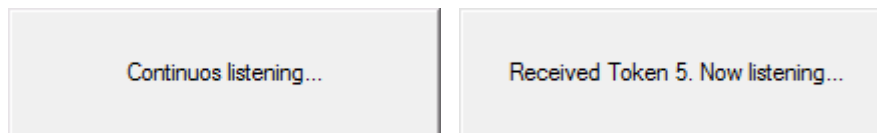


Figure 8 - Modified interface during continuous listening

A prompt window will display the current state of token detection:



Tokens may also be transmitted from the module with the “Send” button. An optional delay parameter can be used to indicate that the token will be mixed with the next sound played from the Soundtable, after the specified amount of time since the playback begins. In this case the SonicNet dialog will close to let you choose a sound to play back.

Note: If you want to mix tokens with a compressed audio sample, you must use a compression scheme with a sample rate of 9.3kHz when building the Soundtable in the QuickSynthesis™ tool.

If the delay is 0, the token is sent out immediately. Other values can be specified up to around 28 seconds of delay (with a granularity of around 27.5 ms).

Finally, you can also export all the tokens of the specified length to some folder on your PC as Wave files (.WAV format) by using the “Generate...” button. You can then use those files to embed SonicNet™ tokens into other software or external sound sources (such as portable players, CDs or DVDs, etc...)

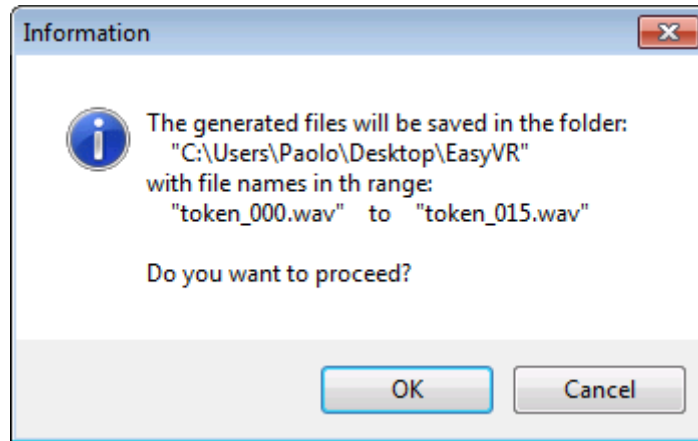


Figure 9 - Export of 4-bit tokens

Using Custom Data

Sound Table

The EasyVR module can play one of the sounds or sentences saved on its internal flash memory. A predefined “beep” sound is also always available, even when no sounds have been downloaded to the module.

The custom sounds are organized in a so-called “*sound table*” that users can prepare and build with the special QuickSynthesis™ tool. Please refer to this application’s own manual for details about the creation of a sound table. Let’s summarize the basic steps here:

- Prepare the audio files you want to include in the sound table in WAV format, uncompressed 16-bit 22050Hz mono. To create the sound files you may use a free software like Audacity for example (<http://audacity.sf.net>)
- Open Sensory’s QuickSynthesis™ 5 and create a new project, specifying “RSC4 family”
- Add your WAV files and specify one of the supported compression scheme (see table below)
- Optionally add sentences, by combining basic WAV sounds. That allows you to save memory when you have speech audio files, if they share some pieces (like “You said” + “One”, “You said” + “Two”, and so on)
- Build the project with QuickSynthesis™ and use default settings (“*Build linkable module*”, “*Load in CONST space*”, “*Load above or at: 0*”). You will be asked to recompress new or modified sound files, just confirm and proceed
- Now save your project and build it once again, so that the EasyVR Commander will see that your build is up to date.

The audio compression formats supported by the EasyVR module (from highest to lowest compression rate):

| Compression Scheme | Available Time (8kHz 15% silence) | Available Time (9.3kHz 15% silence) |
|--------------------|-----------------------------------|-------------------------------------|
| SX-2 | 8.7 minutes | 7.5 minutes |
| SX-3 | 7.6 minutes | 6.6 minutes |
| SX-4 | 6.8 minutes | 5.9 minutes |
| SX-5 | 6.1 minutes | 5.2 minutes |
| SX-6 | 5.6 minutes | 4.8 minutes |
| 4-bit ADPCM | 87 seconds | N/A |
| 8-bit PCM | 45 seconds | 38 seconds |

For audio file containing speech, the SX-3 compression is usually a good choice. If you need higher quality try lower compression rates. Please note that due to the sampling rate used, the audio files cannot contain very high frequencies (less than half the sampling rate).

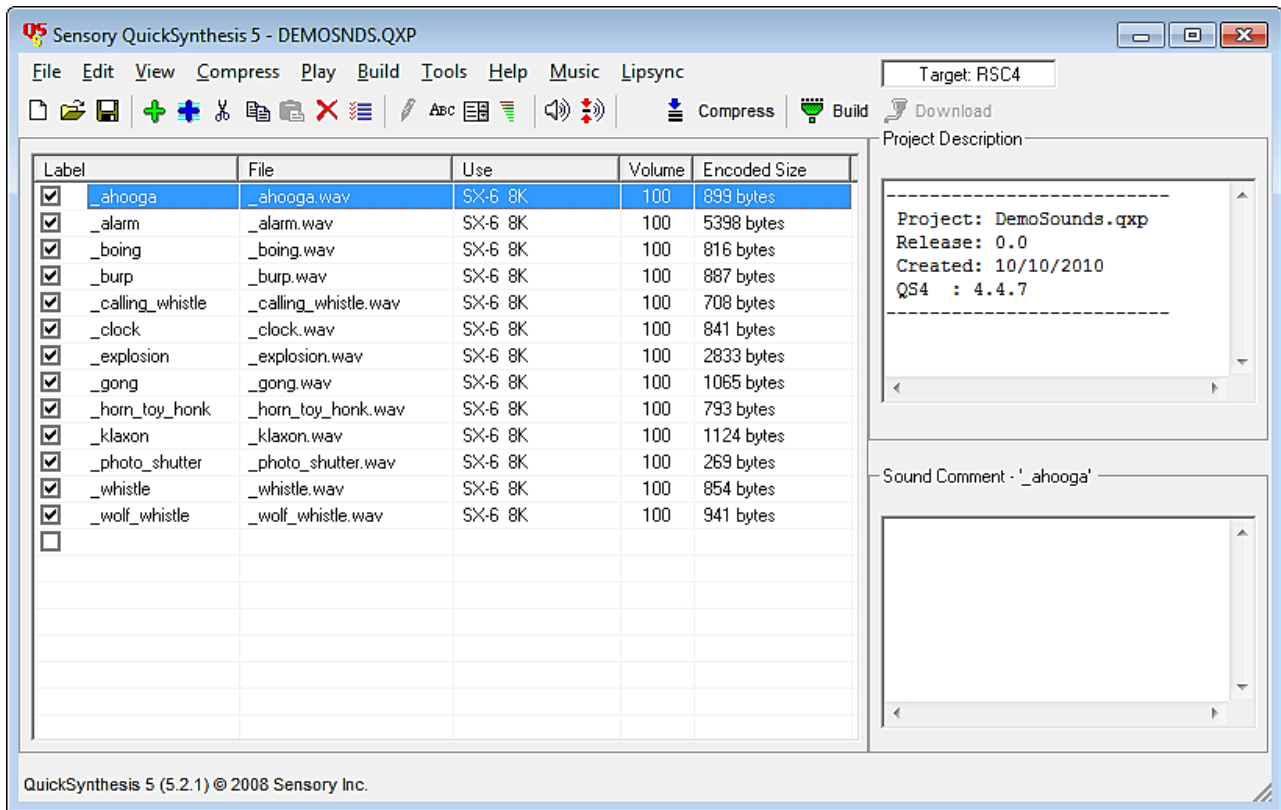


Figure 10 - External tool for creating a Soundtable

Note: Only one Soundtable can be downloaded to the EasyVR module, so make sure you include all the sounds you want to use in a single project.

Speaker Independent Custom Vocabularies

The set of built-in Speaker Independent recognition vocabularies can be expanded with custom grammars, that you can create with the QuickT2SI™ tool (a separate license is required to use the software).

When you create a QuickT2SI™ project, you are presented with a list of words or short phrases (also called “commands”) and an optional trigger word/phrase. The so-called “trigger” is a special set that contains only one word or phrase, with an improved recognition performance, that is used as an entry point for any vocal interaction with a device that is continuously listening to the user’s voice.

If you need to use a trigger word, it is important to carefully choose it so that it has good performance, with very few unintended activations and a high recognition rate. When the user says the trigger word followed by a command, the system can discard unintended activations when the trigger is not followed by a command within a short amount of time (usually around 3 seconds). Moreover, there is only one trigger word to listen to, instead of a list of several commands, so the chance to pick up a random command from background noise or talk is also lower, when using a trigger word.

For assistance on using the QuickT2SI™ Software, please refer to the software help file.

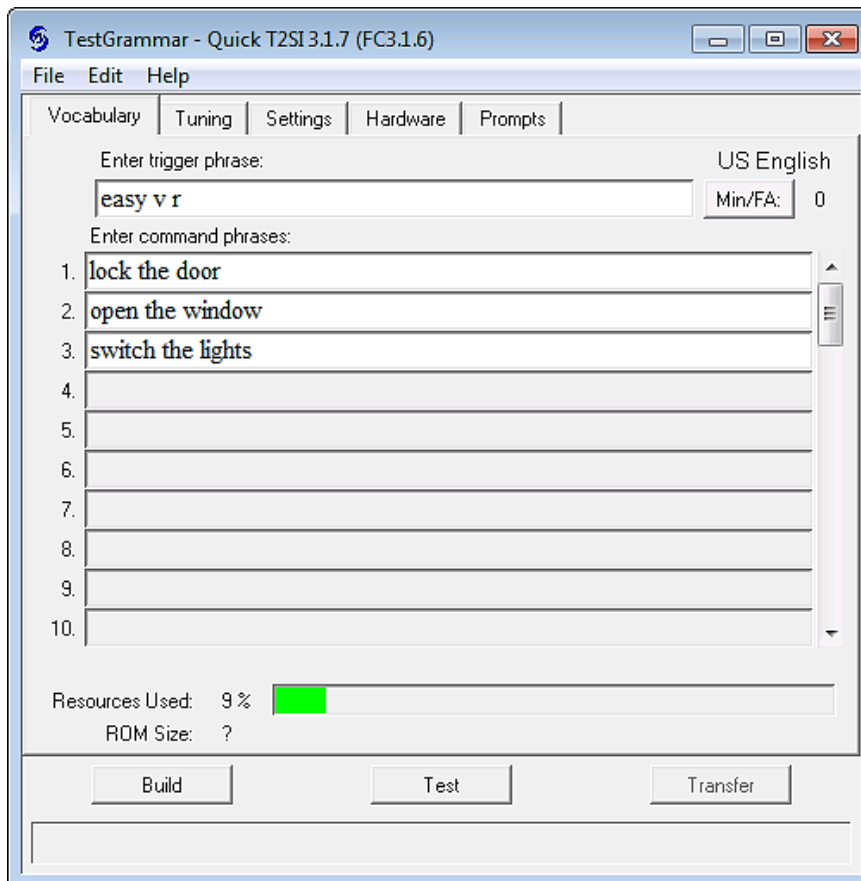


Figure 11 - External tool for custom vocabularies

Several projects can also be combined together if they are using the same acoustic model (language data) using the Acoustic Model Combiner included with the tool. This is useful if you have many command vocabularies, in order to save space in the EasyVR memory.

Updating Custom Data

Once the sound table and/or custom recognition grammars have been created, they can be processed by the EasyVR Commander and downloaded to the module. Note that you must first disconnect from the module and do the steps required to start it in “boot-mode” (see the section [Flash Update](#)).

Now the command “*Update Custom Data*” is enabled, either on the toolbar or the “*File*” menu, and it can be used to start the update process. First you are required to list all the QuickSynthesis™ and QuickT2SI™ projects you want to use. A new file containing the specified custom data will be generated and the contents will be displayed, so that you can verify them before updating the module.

Note: The projects must have been built already with the QuickSynthesis™ or the QuickT2SI™ tool, before the custom data generation can be completed successfully. If a recent build is not available you will receive a warning message, the project files can be opened in their respective tools and a fresh build started (make sure the project file has been saved before the build).

Once back in the EasyVR Commander the project can be reloaded by pressing the “Refresh” button. If the process completes successfully, the “*Download*” button will be enabled and the flash update process can start.

The default format of generated data is suitable for the EasyVR 3. For previous versions of the module or the shield please make sure to check the option “*Old Format (EasyVR 2.0)*”.

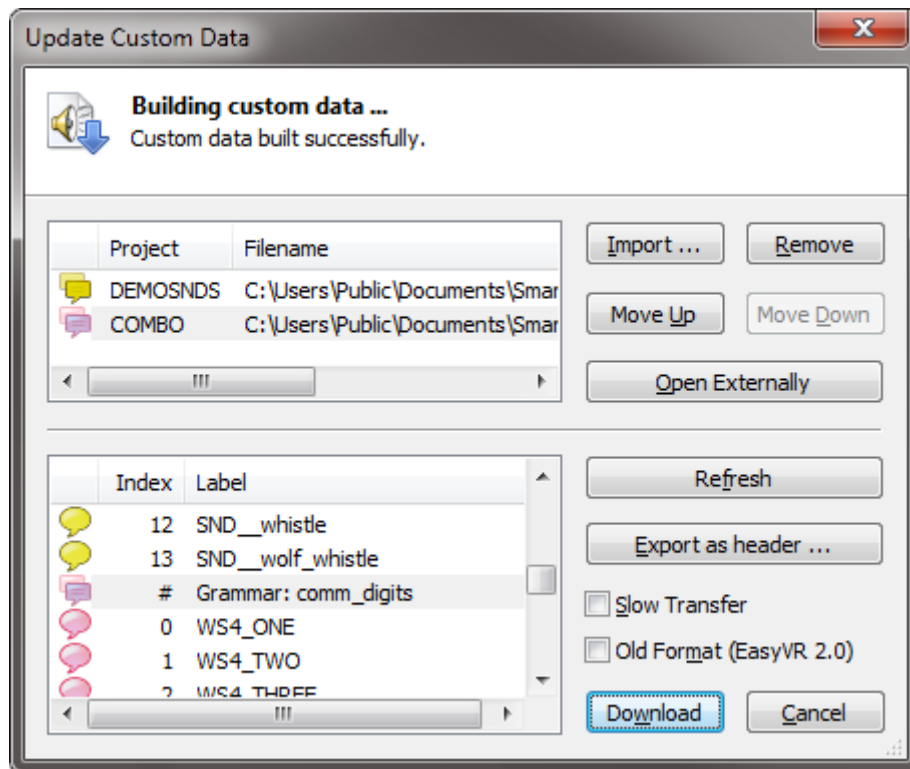


Figure 12 – Interface to build and download custom data

The download process will connect at a higher speed to the EasyVR module, so the “bridge” program running on your host device might not work (in particular Robonova and Basic Stamp cannot be used for this purpose) and you might need a true “serial adapter”.

The full speed used is 230400 bps, but the option “*Slow transfer*” can be used to reduce it to 115200, for better compatibility with slower serial adapters⁶. One adapter that can go to full speed is the QuickUSB cable. Otherwise any USB/Serial adapter with TTL/CMOS interface can be used for updating the flash. The EasyVR Shield can be used for the download, provided that the mode jumper is in UP or LEO position.

Note: Every download will overwrite the previously transferred custom data.

After the download completes, a new connection can be established with the EasyVR module (in “normal-mode”) and the new sounds will be displayed by the EasyVR Commander, in the special group “*SoundTable*” (the last one in the list with a yellow icon). They can be played back and tested using the “*Play Sound*” command on the toolbar or in the “*Tools*” menu. See also how to do that in your application in the code example [Use custom sound playback](#).

Custom grammars will be displayed just after the built-in word sets and they work exactly the same way. Trigger words, when specified, will have their own vocabulary with only one entry. You can test and use the custom trigger and command grammars as you do with the built-in ones.

Note: The built-in trigger word set is handled in a special way, as it is active also when recognizing from the first user defined command group. This is the only case where SD and SI commands are mixed together and does not apply to custom trigger vocabularies.

⁶ Arduino UNO (and other boards with USB/Serial adapter based on ATMEGA8U2) need the option “*Slow transfer*” enabled

Updating Firmware

The EasyVR firmware can be updated in a similar way to custom data by using the command “Update Firmware...” from the “Help” menu. Note that you must first disconnect from the module and do the steps required to start it in “boot-mode” (see the section [Flash Update](#)).

The specified file will be verified as an official firmware release and basic version information will be displayed. If the firmware passes the verification step, then the “Download” button will be enabled.

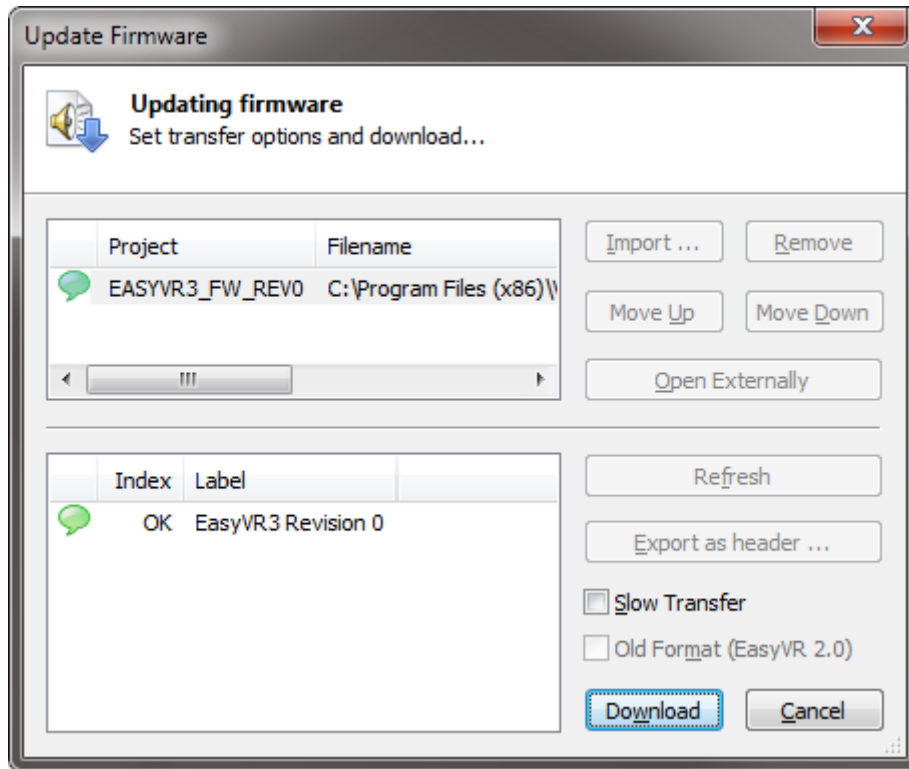


Figure 13 - Interface for updating EasyVR firmware

Note: After a new firmware is downloaded to the module, the custom data already present is erased and it must be downloaded again if necessary.

QuickUSB Adapter Cable

Product Description

The QuickUSB is an USB-to-UART adapter cable, easy to use and supported on all the major operating systems.

It plugs into a standard USB port and brings all the UART signals to a convenient 6-pin 2mm pitch female connector (Hirose DF11 Series).

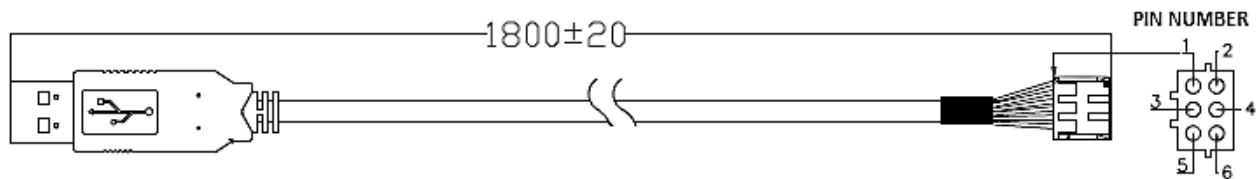


QuickUSB Features

- USB 2.0 Full Speed interface
- Full UART (RX/TX and RTS/CTS) at 3.3V
- Data transfer rates from 300 bps to 3 Mbps
- Extended operating temperature range: -40°C to 85°C
- Cable Length: 1.8 m

Technical Specifications

Drawings and Schematics

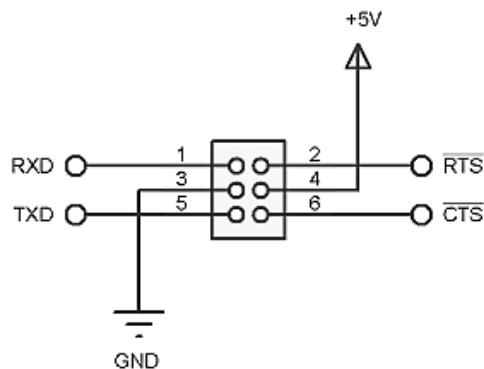


A SIDE

USB Type A Plug
(male connector)

B SIDE

Hirose DF11-6DS-2C
(female connector)



Pin Description

| Pin | Type | Name | Description |
|-----|-------|------|-----------------------------------|
| 1 | I | RXD | Asynchronous Data Receive line |
| 2 | O | RTS# | Request To Send flow control line |
| 3 | GND | GND | Power and signal ground |
| 4 | Power | VCC | 5V power output (USB VBUS) |
| 5 | O | TXD | Asynchronous Data Transmit line |
| 6 | I | CTS# | Clear To Send flow control line |

Operating Conditions

| Symbol | Parameter | Min | Typ | Max | Unit |
|--------|-------------------------------------|-----|-----|-----|------|
| VCC | DC Power Output (VBUS) * | 4.5 | 5.0 | 5.5 | V |
| Ta | Ambient Operating Temperature Range | -40 | 25 | 85 | °C |

(*) Output current might be limited by USB Host and internal adapter settings

Electrical Characteristics

These are applicable to pins RXD, CTS.

| Symbol | Parameter | Min | Typ | Max | Unit |
|-----------------|--------------------|-----|-----|-----|------|
| V _{IH} | Input High Voltage | 1.5 | | 3.3 | V |
| V _{IL} | Input Low Voltage | 0.0 | | 1.0 | V |

These are applicable to pin TXD, RTS.

| Symbol | Parameter | Min | Typ | Max | Unit |
|-----------------|---|-----|-----|-----|------|
| V _{OH} | Output High Voltage (I _{OH} = -1 mA) | 2.2 | 2.7 | 3.2 | V |
| V _{OL} | Output Low Voltage (I _{OL} = 2 mA) | 0.3 | | 0.5 | V |

QuickStart Instructions

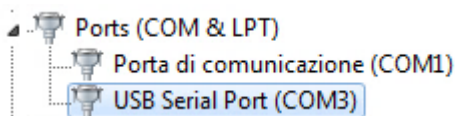
Software Setup

The first time you want to use the QuickUSB you need to install the required software drivers for your Operating System. Please follow this procedure (one-time only):

1. Plug the USB end of the cable to your PC and leave the other end unconnected
2. If you have a recent OS version please allow the system to search for updated drivers:
 - a. If the setup was successful, unplug the cable, the procedure is complete
 - b. If the setup failed, unplug the cable and continue to the next step
3. Download the latest official drivers for your OS version from the [FTDI VCP Drivers](#) page
4. Run the driver setup package, or follow any alternate installation procedure accompanying the download
5. After the software setup is complete go back to step 1 above, the OS should now be able to find the required drivers automatically

Using the Adapter

Once the required software drivers are correctly installed and configured by the Operating System, you should not need to repeat the above procedure anymore.



Just plug the cable on the target board first, then plug the USB connector to a free port on your PC.

The adapter will be visible as a new USB Serial Port device and a virtual COM port on Windows. This COM port number is the one to use with the EasyVR Commander.

How to get support

Please feel free to contact us with any questions, queries or suggestions.

If your question is about technical support or troubleshooting for one of our products, we kindly ask you to first check our FAQ for a possible solution: <http://www.veear.eu/faq>

If you cannot find an existing solution on the FAQ, please contact us using the contact form on our website at <http://www.veear.eu/support>. The more detail you provide, the better support we can give.

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ROBOTECH

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