

Embeddable Digital Video Recorder Hardware Manual

Model 4011 | Ver. 1.2.1 | November 2016

SENSORAY | p. 503.684.8005 | email:info@SENSORAY.com |
www.SENSORAY.com

7313 SW Tech Center Drive | Portland, OR 97203

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A Return Material Authorization (RMA) number must be obtained from the factory and clearly marked on the outside of the package before any equipment will be accepted for warranty work. Sensoray will pay the shipping costs of returning to the owner parts that are covered by warranty. A restocking charge of 25% of the product purchase price will be charged for returning a product to stock.

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Introduction

Model 4011 is a compact digital video recorder (DVR) designed for embedded OEM applications. It records audio and video (A/V) to USB storage media and can capture JPEG images on-the-fly without interrupting recording. Its outputs allow live video, recorded A/V or JPEG snapshots to be displayed on an external monitor. Date and time are maintained by a real-time clock with battery backup. To implement a complete DVR simply connect power, your own custom keypad and a USB storage device. Videos and snapshots are saved to the DCIM directory, which is created if not present.

The board encodes standard NTSC/PAL composite video using efficient H.264 compression. Audio from the on-board microphone is digitized and compressed using AAC encoding. The compressed A/V streams are multiplexed and recorded as MP4 files on a user-supplied USB storage device, with file names automatically generated by the real-time clock. Bit rates can be tailored to match application requirements and storage capacity.

Text overlays can be applied to appear in the recorded video and preview.

An external USB storage device is required for DVR operation. If desired, a second USB storage device may also be connected and the 4011 will simultaneously record to both devices. A common application for this is recording to a removable device while creating an archival copy on a non-removable device. USB connectors are located on both sides of the board to facilitate connection to both removable and embedded storage devices.

The DVR user interface supports a user-supplied keypad working in conjunction with the board's flexible on-screen menu system. Each keypad connector pin can be routed directly to any keypad switch and configured to match the control scheme of your custom keypad. If preferred, a standard keyboard can be plugged into any USB port and used to control the DVR.

A qualified external USB Wi-Fi adapter is required for wireless streaming. The wireless connection can be used to view, record or configure the video stream. Firmware version 1637 or higher is required for wireless operation.

Connectors

Video in (J10), video out (J2)

Molex 0705530001. Mating part: Molex 0050579402.

Pin	Signal
1	video
2	ground

Power (J11)

Molex 0705530002. Mating part: Molex 0050579403.

Pin	Signal
1	+12 V DC
2	not connected
3	ground

Audio out (J13)

Molex 0705530003. Mating part: Molex 0050579404.

Pin	Signal
1	left channel
2	ground
3	ground
4	right channel

Keypad (J1/P3)

J1 - standard flexible flat cable (FFC) connector. Accepts a ZIF-style flex tail, 0.1" pitch. Molex 90500-4007, 7 pin. Common line: pin 6. J1 is facing inwards.

P3 - alternative connector for 7-9 button keypads. FCI/Amphenol 76382-408LF, 76382-409LF, 76382-410LF. Mating connectors are FCI/Amphenol 65801-008LF, 65801-009LF, 65801-010LF, respectively. Common line: pin 5. P3 is facing outwards. Connector P3 is installed by custom order only.

Recommended mapping for keypad pins and functions:

Pin	Signal
1	Record/Pause

2	Stop/Back
3	Snapshot
4	Down
5	Menu/OK
6	Common (ground)
7	Up

Context-dependent keyboard functions mapping:

Key	Functions	
	Outside of the menu	Inside the menu
Enter (or Space)	Menu	OK
Up arrow	Rewind by set amount	Move 1 line up
Down arrow	Fast forward by set amount	Move 1 line down
Escape	Stop	Back
R	Record/Pause	
S	Snapshot	
M	Mute/unmute microphone	

Menu system

The 4011 is controlled using a keypad or a standard keyboard and the on-screen menu system.

Top menu

- Play video
- View snapshots
- File management
- Setup
- Help with Keys

Play video

Selecting “Play video” brings the next menu level:

- Play from internal
- Play from external

in case both internal and external storage devices are present. If only one is present the files list is displayed. File selection is made using arrow keys. Pressing OK/Enter starts playback.

View snapshots

Behavior is similar to “Play video”.

File management

Selecting “File management” brings up the following selections:

- Copy video from internal
- Copy video from external
- Copy snapshots from internal
- Copy snapshots from external
- Delete from internal
- Delete from external

Some of the choices may not be present depending on the storage devices connected.

Setup

Selecting “Setup” brings up the next menu level:

Set Date/Time

Allows setting the battery backed-up real-time clock. The real-time clock is used to automatically generate file names for saved video files and snapshots. There is also an option of having the date/time text overlay present in recorded video and snapshots.

Record Storage Device

Allows selecting the recording destination device(s): internal, external or both.

Video:

Selecting this brings up the video menu.

Video Standard

Allows selecting between NTSC and PAL.

Interpolate

Turning interpolation ON gets rid of motion artifacts at an expense of some vertical resolution loss.

Video Bit Rate

Determines the compression level of recorded video. The higher the bit rate, the higher is the quality, the more space is required on the storage device.

Playback Seek

Adjusts the amount of time skipped when using Rewind and Fast Forward functions.

Snapshot Quality:

Adjusts the jpeg encoding of snapshots. A larger number means higher quality, the more space is required on the storage device.

Recording at Power-on:

If set and there is a storage device present when the 4011 turns on it will immediately start recording.

Audio:

Selecting this opens up the Audio menu.

Audio Volume

Adjusts microphone sensitivity. The higher the value the louder recorded audio is.

Mute recording at start

If set no sound will be recorded until the unmute is pressed.

Audio Input

Select the audio source between the built-in microphone and the audio line in.

Playback Volume

Adjusts how loud the sound is when a recorded video is played. The higher the value the louder it is.

Overlays

Brings up an Overlay menu. Text can be placed anywhere over the video or snapshot at the time of recording.

Text Display

This controls the size of the text and if the text should be displayed. The options are 8x14, 16x16 and off.

Text

The message to be displayed is selected here. There are commonly used defaults and up to five custom messages.

Custom Text

Using a keyboard up to five custom texts can be entered. Once entered with a keyboard these messages will be stored for reuse. Standard formatting functions allow automatic insertion of date or time.

- ^d inserts date

- ^t inserts the time

- ^n inserts a new line

Date Format

The way the date is displayed can be selected.

Time Format

The way the time is displayed can be selected.

Background

By making the background more transparent less of the image is obscured. A black background makes reading text on a light video much easier.

Move Up/Down/Left/Right

Use these options to move the text around the image.

System Information

Displays various system information, including firmware version, detected storage devices with free space available. Allows saving system parameters to the flash drive, restoring those from the flash drives, or resetting to default values.

Update firmware (*)

This selection is available if a firmware file is detected in the root directory of one of the connected storage devices. Please obtain the firmware file `s4011.fw` from Sensoray and copy it to a USB drive. Update process usually takes about 60 s, after which the board restarts.

- 1) Load `s4011.fw` from Sensoray onto a USB drive. In the root directory not inside any folder. If the firmware has a name other than `s4011.fw` rename it to `s4011.fw`
- 2) Connect the USB drive to the 4011.
- 3) Select Setup->Update firmware This will take about 60 seconds. DO NOT remove the USB drive or turn off the 4011 until the update completes and it restarts.

Note: the firmware must be named `s4011.fw` with no extra characters.

Update custom.zip (*)

This selection is available if `custom.zip` file is detected in the root directory on one of the connected storage devices. Selecting it installs a custom splash screen. The splash screen has to be created as a JPEG file with the name `splash.jpg` with one of the following resolutions: 720x480 for NTSC systems, or 720x576 for PAL systems. This file has to be placed into the directory called `images`, and zipped to `custom.zip`. To remove a custom splash screen place a zero byte `custom.zip` file into the root directory of a storage device and then select "Update custom.zip". To create a zero length file in Windows open a command prompt window and type `copy NUL /b custom.zip`.

Enable/Disable Wi-Fi (*)

This selection is available if a qualified USB Wi-Fi adapter was connected when the 4011 started. By default the wireless network will be enabled at start up if a qualified device is detected. This turns on the wireless network if it is off or turn off the network if it is on.

Help with Keys

This will display which keyboard keys have functions and what they do.

Wireless

To implement a network, plug in an approved USB-Wi-Fi adapter into one of the USB ports. The firmware must also be updated to version 1637 or higher.

After attaching the Wi-Fi adapter and completing the update a Wi-Fi network named “s4011” becomes available.

NOTE: the adapter must be plugged in before the 4011 starts up.

As with any wireless network, connection is handled by the operating system of the connecting device. This network will be unsecured by default. Any device can connect to it without a password and can connect either to the video stream directly, via RTSP, or access the browser based interface.

Browser based interface

After a network connection is established, an interface is available at <http://192.168.0.100>. Hyperlinks on this page provide quick access to the features and controls of the 4011.

Live View allows the video to be viewed through the browser, this may increase latency due to the way in which the video is processed on the receiving device.

RTSP Streams gives a list of RTSP streams available, RTSP can be played using a program like VLC or RTSP Player. These are available for desktop or mobile devices.

Stream Control allows a video stream to be sent to a device using UDP. Set the destination IP address and port.

Stream Configuration controls how video is encoded by the 4011. Resolution, frame rate, and bit rate set the quality of the image. OSD allows arbitrary text to be put anywhere on the image with the option of using the time, date or other values.

NOTE: Wi-Fi networks are subject to more interference and uncertainty than wired connections. If the video quality of a wireless stream is less than expected, reducing the bit rate or frame rate may provide a smoother video. Lowering the bandwidth to 1Mb/s is required to get maximum range.

Video allows making changes in the video stream for contrast, brightness, saturation and hue.

Clock gives the option of changing the time on the clock. The real-time clock has a battery backup and can sync to a connected computer.

Network Configuration has the wireless network parameters. The name of the network can be changed and a password can be added to protect the network data using WPA2 encryption. After making changes it is necessarily to reconnect to the network.

NOTE: If there are many Wi-Fi networks nearby, available bandwidth may decrease. Switch to a less used channel to minimize interference.

Direct access to RTSP

By using an RTSP client like VLC or RTSP Player, an already configured video stream can be viewed without a browser, which may streamline use with a mobile device. Type the URL `rtsp://192.168.0.100:554/0` into the location field of the RTSP viewing application.

There are many free programs available to directly view RTSP streams through Google Play and the iTunes. The two Sensoray tested were:

VLC <http://www.videolan.org/vlc/index.html>

RTSP Player <http://rtsp-player.soft112.com/>

Contact Sensoray for the latest Wi-Fi firmware and a list of approved Wi-Fi devices.

Devices:

Devices will not work without being qualified by Sensoray.

The Wi-Fi firmware works with two devices using the Realtek rtl8192cu chipset.

1. The **Edimax adapter** is among the smallest available, ideal for applications where size or weight are critical.
2. The **Lib-Link adapter** has a large antenna for superior range up to 100 feet.

Both are readily available through 3rd parties.

Lib-Link wireless USB Adapter

<https://www.adafruit.com/product/1030>

Edimax ew-7811un

<https://www.amazon.com/Edimax-EW-7811Un-150Mbps-Raspberry-Supports/dp/B003MTTJOY>

Bandwidth

The wireless connection supports streaming up to 5Mb/s depending on local radio propagation. A 1Mb/s stream tested to 100 feet. Generally, the closer

together the devices and the fewer objects between them, the more bandwidth will be available.

Updating Wi-Fi Firmware

To switch to Wi-Fi enabled firmware from old (less than 1637) non-Wi-Fi enabled firmware requires two updates. During this update parameters can be changed so it is recommended to reset parameters to avoid errors. Save parameters before performing this update if using settings that are not default. This is best done using two USB storage devices. The procedure is:

- 1) Load the transition firmware onto the first USB drive. It will be about 8MB. If the firmware has a name other than s4011.fw rename it to s4011.fw
- 2) Load the Wi-Fi enabled firmware onto the second drive. It will be about 13MB. If the firmware has a name other than s4011.fw rename it to s4011.fw
- 3) Connect the first USB drive to the DVR.
- 4) Use the menu to select Setup->Update Firmware this update should take about 30 seconds. DO NOT remove the USB drive or power off the DVR until it has finished updating and restarts.
- 5) After the DVR finishes rebooting remove the first USB drive from the DVR.
- 6) Connect the second USB drive to the DVR.
- 7) Use the menu to select Setup->System Information->Reset Parameters
- 8) Connect the WI-FI USB adapter to the DVR.
- 9) Use the menu to select Setup->Update Firmware this update should take about 60 seconds. DO NOT remove the USB drive or power off the DVR until it has finished updating and restarts.

NOTE: For the network to be available, the WI-FI adapter must be connected before the DVR is powered up.

For firmware 1637 and newer the normal update procedure can be followed.

Specifications

Input video	Composite, NTSC or PAL, 75 Ohm
Output video	Composite, NTSC or PAL, 75 Ohm
Video compression	H.264 High Profile at Level 3
Snapshots compression	JPEG
Recorded file format	MP4
Audio	Built-in microphone
USB ports	3, high speed
Power	12 V DC (± 4 V), 2.5 W
Mechanical	3.3 x 2.5 x 0.8 inch
Operational temperature	0 to +50 °C

Revision history

Version	Notes
1.2.1 December 2016	Improved formatting.
1.2.0 November 2016	Wi-Fi section updated.
1.1.1, November 2016	Added Wi-Fi section.
1.1.0, May 2016	Full form release.
1.0.0, April 2016	Initial short form release.