Embeddable Analog HD Mini DVR

Model 4031

Hardware Manual
Ver. 1.1.4 | December 2023

SENSORAY | embedded electronics

Designed and manufactured in the U.S.A

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Limited warranty

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The warranty provided herein does not cover equipment subjected to abuse, misuse, accident, alteration, neglect, or unauthorized repair or installation. Sensoray shall have the right of final determination as to the existence and cause of defect.

As for items repaired or replaced under warranty, the warranty shall continue in effect for the remainder of the original warranty period, or for ninety days following date of shipment by Sensoray of the repaired or replaced part, whichever period is longer.

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 4031 is a compact digital video recorder, designed for embedded OEM applications. It captures video from analog HD (TVI, CVI, AHD) sources in resolutions up to 1080p30, or analog SD (composite) source, and records to a microSD card. Analog audio can be captured from a microphone or a line source.

The video processor implements H.264 or MJPEG video compression, producing output data formatted as MPEG transport stream (MPEG-TS), MP4 or AVI file formats. Audio compression is performed using AAC-LC. The stream multiplexer employs high precision hardware timestamps to ensure perfect audio-video sync during playback. Snapshot capture is also supported, with MJPEG compression available for both snapshots and AVI streams.

Model 4031 provides a set of general purpose IO lines that could be used to control DVR's functions. It can also be configured to automatically start recording on power up. The delay between applying the power and start of recording doesn't exceed 20 seconds. With MPEG-TS recording format the recording is preserved after power is turned off without issuing a Stop record command.

A device USB interface for connecting to a computer allows configuring DVR operation, retrieving recordings from the microSD card, and updating firmware.

Operation

Recording

The 4031 is designed primarily for autonomous embedded operation. However, it can be used as a user-controlled DVR with the help of a keypad (not provided). See "Keypad functions" chapter for details.

In an embedded application the 4031 starts recording automatically after the power has been applied. The startup time is approximately 15 seconds. The recording continues until there is no more free space on the media, or the power is turned off. The recording format must be transport stream (.ts), so that recorded files are valid even when the recording is terminated by the power off event. Recordings are placed in "DCIM" directory, named with the date and time (in 24-hour format) of recording start, e.g. 20190504_134928.ts.

The SD card must be formatted as FAT32. If necessary, please use a formatting utility http://www.verbatim.com/index/search.php?words=fat32+tool

Retrieving the files

When the 4031 is connected to a host computer with a USB cable, it is detected as a Mass Storage device. The recorded videos are in /DCIM directory.

Firmware updates

Model 4031 features flash memory that contains the firmware used to operate the hardware on the device. This firmware can be updated in the field to fix problems or add new features. Please follow the procedures below.

1. Obtain the latest firmware file, s2263.fw, from Sensoray.
2. Disconnect the 4031 from the power supply. Connect it to the PC using a USB cable.
3. After the 4031 has booted up, it will appear as a Mass Storage Device with the name matching that of the microSD card plugged into the 4031.
4. Eject the device. In Windows right click on the device in the File Manager and select Eject.
5. The Mass Storage device will disappear and reappear as another device named Update2263 containing a README.txt and config.txt files.
6. Copy s2263.fw to Update2263.
7. Wait until Update2263 disappears, and A Mass Storage device reappears.

Once the copy process has completed, disconnect the 4031 from the PC, and reconnect it to the power supply. Do not have the 4031 powered from both USB and external power simultaneously. This will conclude the firmware update. Firmware version is displayed in README.txt file.

Using config.txt

Changing operating parameters of the 4031 is possible using config.txt file. When the 4031 is in the update mode, a file config.txt is present in the root directory of Update2263 drive. This file reflects the operating parameters of the 4031.

To change operating parameters, copy config.txt to the host computer, make necessary changes and copy the file back to Update2263 drive. Please note that the values of parameters highlighted in bold below may not be correct in the original file. Those should be set to default values (provided in comments) regardless of the values contained in the original config.txt.

```
Video[0].StreamMode = 0         // 0 = TransportStream (H264+audio)
Video[0].BitRate = 2000000   // in bits-per-second 100k-20M
Video[0].RateMode = 0          // 0=CVBR 1=VBR-best 2=FixedQP
2=VBR-good 3=VBR-average 4=VBR-bad 5=VBR-worst
Video[0].Interlaced = 1        // 0=interpolated 1=interlaced en-
coding (ignored when progressive input)
Video[0].Flip = 0              // bit 0: vertical flip,  bit 1:
horizontal flip
Video[0].GOPSize = 30          // Group-Of-Pictures size (1 to 255)
Video[0].FrameRate = 30        // Converted internally to integer
frame rate divider)
Video[0].H264Level = 40        // 9=1.0b 10=1.0 11=1.1 12=1.2
13=1.3 20=2.0 21=2.1 22=2.2 30=3.0 31=3.1 32=3.2 40=4.0(default)
41=4.1 42=4.2 50=5.0
Video[0].H264Profile = 100   // 66=Baseline 77=Main 100=High
Video[0].IntraFrameQP = 23   // used with RateMode=2 (0-51)
Video[0].InterPFrameQP = 23  // used with RateMode=2 (0-51)
Video[0].OSD.X = 0
Video[0].OSD.Y = 0
Video[0].OSD.Message =
Video[0].OSD.DateFormat = 0   // 0=MM-DD-YYYY 1=DD-MM-YYYY 2=MM-
DD-YY 3=DD-MM-YY 4=MMM-DD-YYYY 5=DD-MMM-YYYY 6=MMM-DD-YY 7=DD-
MMM-YY 8=MMM DD, YYYY 9=DDMMMYYYY 10=MMM DD, YY 11=DDMMMYY
12=YYYYMMDD 13=YYYYMMMDD 14=YYMMDD 15=YYMMMDD
Video[0].OSD.TimeFormat = 0   // seconds shown: 0=whole 1=tenths
2=hundredths 3=thousandths 4=HH:MM 5=HH:MM AM/PM 6=HH:MM a/p
```

```
Video[0].OSD.Transparent = 0  // 0=black background
1=transparent background 2=shaded 50% 3=shaded 75%
Video[0].OSD.Enabled = 0       // 0=disabled 1=8x14 2=16x16
Audio.VolumeLeft = 0           // 0-119  note: when AGC is on,
volume control isn't used
Audio.VolumeRight = 0          // 0-119
Audio.AGCLeft = 0              //  0=off 1=AGC
Audio.AGCRight = 0             //  0=off 1=AGC
Audio.Input = 0                // 0=Mic 1=Line 2=Digital
Audio.OutVolumeLeft = 100      // 0-100
Audio.OutVolumeRight = 100     // 0-100
Audio.Channels = 2             // 1=mono 2=stereo
Audio.MonoMode = 0             // 0=mix left&right, 1=left only,
2=right only
Audio.BitRate = 192000         // 32k-512k in bps
Audio.SampleRate = 48000       // 48kHz or 44.1kHz
Audio.Mute = 0                 // 0=not muted 1=mute left 2=mute
right 3=mute both
Capture.Brightness = 128       // video adjustment (0-255)
Capture.Saturation = 128       // video adjustment (0-255)
Capture.Hue = 0                // video adjustment (-127 to +127)
Capture.Contrast = 128         // video adjustment (0-255)
Recording.Filename =           // 4031 default "DCIM/^d_^t.ts"
```
Recording.Source = 0   // 4031 default 1
Recording.StartMode = 0   // 4031 default 1=start recording
automatically
Recording.Format = 0   // 4031 default 0

Parameters not listed above should not be modified.

 If any of the parameters need to be modified, please follow the following procedure.

1. Copy `config.txt` from Update2263 drive to the host.
2. Edit `config.txt`.
3. Copy the file back to Update2263 drive.

Once the unit is disconnected from the USB port and powered from a power supply, the new settings take effect.

Setting date and time
The clock is set using the following procedure:

1. Bring the unit into the firmware update mode (follow steps 2-5 listed in "Firmware Updates" chapter, p.5).

2. Create a file named `clock-N.txt`, where N is the offset in hours for the current time zone from UTC. For example, PST and PDT would use `clock-8.txt` and `clock-7.txt`, respectively. In Rome, Italy, those files will be `clock+1.txt` and `clock+2.txt`, for CET and CEST, respectively. The date is calculated from the timestamp on the file (stored as UTC) adjusted by the time zone offset, before being stored in the real-time clock. To create a file from a Windows computer, open the Update2263 device in File Manager, right click on the right pane, and select New/Text document. Change the name from New Text Document.txt to a name reflecting the desired time zone.

3. Eject the Update2263 device. Please note that the next time the unit is brought into the Firmware Update mode, the `clock-N.txt` file will no longer be present.

Connectors

All mating connectors use crimping contacts Molex 0500798100 for 26-28 AWG wire. Contacts labeled "reserved" should be left unconnected.

JP1, video inputs/output

Molex 0532610671. Mating part: Molex 51021-0600.

Pin	Signal
1	composite out[1]
2	ground
3	video input 1
4	ground
5	video input 2
6	ground

Notes.
 1. To be implemented.

JP2, audio inputs

Molex 0532610771. Mating part: Molex 51021-0700.

Pin	Signal
1	ground
2	microphone in +
3	microphone in -
4	ground
5	line input right
6	ground
7	line input left

Note: microphone input expects an electret condenser microphone:
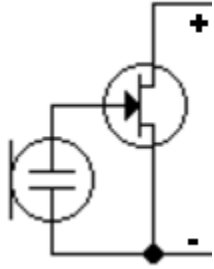
JP3, power

Molex 0532610571. Mating part: Molex 51021-0500.

Pin	Signal
1	ground
2	reserved
3	reserved
4	power, negative terminal (ground)
5	power (9-36 VDC), positive terminal

JP6, interfaces

Molex 0532611071. Mating part: Molex 51021-1000.

Pin	Signal
1	RS-232 TX[1)
2	RS-232 RX[1)
3	ground
4	I2C SCL[1)
5	I2C SDA[1)
6	ground
7	ground
8	USB data -
9	USB data +
10	USB +5V (V_{BUS})

Notes:
1. Functionality not implemented in standard firmware.
2. USB port is a device.

JP4, keypad GPIOs

Molex 0532610871. Mating part: Molex 51021-0800.

Pin	Signal
1	DIO33V6
2	DIO33V5
3	DIO33V4
4	DIO33V3
5	DIO33V2
6	DIO33V1
7	DIO33V0
8	ground

Specifications

Video Input/Output	
Input video formats	HD-TVI, HD-CVI, AHD, composite (NTSC/PAL)
Maximum input resolution/frame rate	1920x1080p30
Recorded video streams	
H.264	configurable, up to HP@ L3 (MP4, AVI, transport stream)
JPEG	Single snapshots, AVI
Storage media	microSD card[1]
Electrical, mechanical and environmental	
Dimensions	48x25x10 mm
Mass	16 g (without a heat sink)
Operating temperature	0º to 70º C. Please see "Thermal considerations" section.
Power	9-36 V DC, not to exceed 2.5 W

Notes:

1. Only FAT32 file system is supported on storage media. If reformatting is required, the following utility could be used:

`www.verbatim.com/includes/binary_details.php3?show=1&id=840`

Thermal Considerations

Measures must be taken to remove about 1 W of heat from the integrated circuit U1 on the video processor board (marked as model 2960). The implementation choice depends on the mechanical and environmental requirements of the particular application.
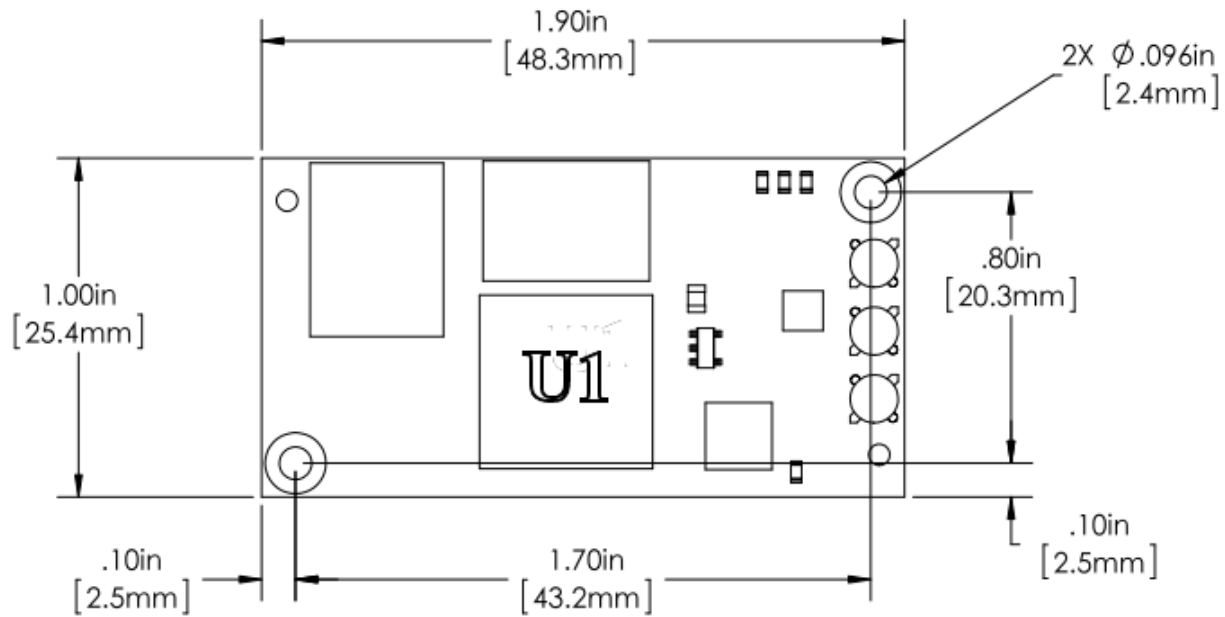

Fig.2. Location of U1 on model 2960 board.

One approach is to use a miniature self-adhesive heat sink, for example Advance Thermal Solutions ATS-54150D-C1-R0.

Alternatively, a heat conducting path may be provided between U1 and the product's enclosure. To ensure good thermal contact and avoid damaging the device we recommend using Bergquist (or equivalent) thermal pads with the highest thermal conductivity possible (5.0 W/m*K), for example, GPHC5.0 or GP5000S35 of the smallest possible thickness.

In any case the temperature of U1 should not exceed 85°C during operation.

Revision history

Version	Notes
1.1.4, December 2023	Removed keypad functions section.
1.1.3, December 2023	Added SD card formatting information.
1.1.2, November 2020	Removed references to unsupported features.
1.1.1, June 2020	Clock setting procedure clarified.
1.1.0, February 2020	USB port description clarified. References to unsupported features removed. Menu system description added.
1.0.1, June 2019	Clock setting procedure description added.
1.0.0, May 2019	Initial release.