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USB Audio/Video Codec Model 2253
Hardware Manual

Version 1.2.1 | February 2014

SENSORAY | embedded electronics



Designed and manufactured in the U.S.A.

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Limited warranty

Sensoray Company, Incorporated (Sensoray) warrants the hardware to be free from defects in material and workmanship and perform to applicable published Sensoray specifications for two years from the date of shipment to purchaser. Sensoray will, at its option, repair or replace equipment that proves to be defective during the warranty period. This warranty includes parts and labor.

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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Special handling instructions

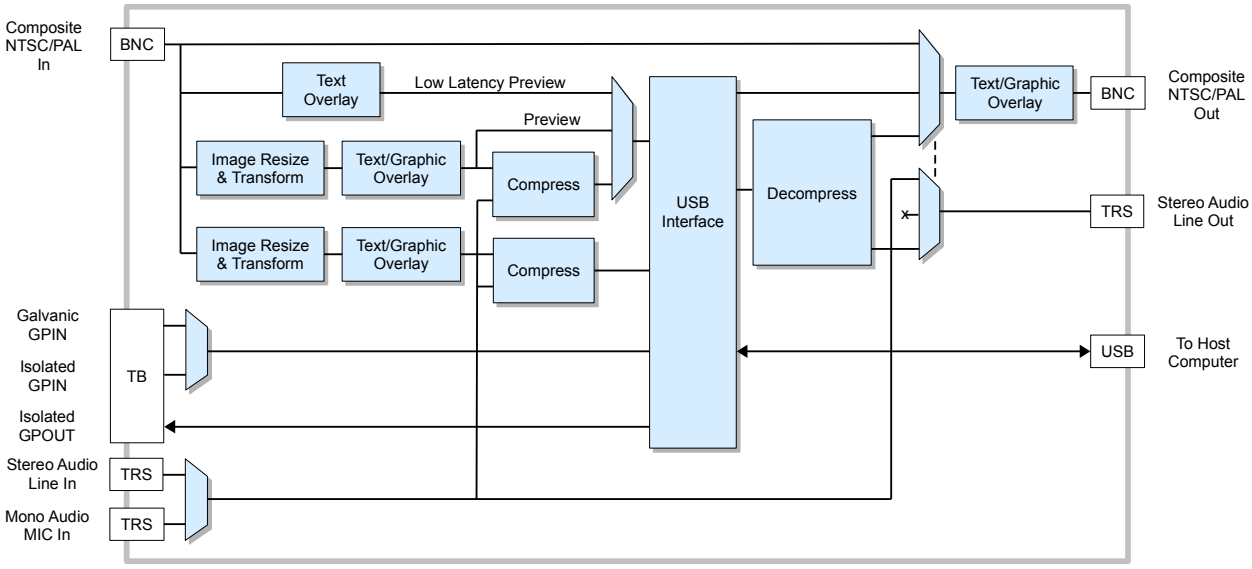
The circuit board contains CMOS circuitry that is sensitive to Electrostatic Discharge (ESD). Special care should be taken in handling, transporting, and installing circuit board to prevent ESD damage to the board. In particular:

- Do not remove the circuit board from its protective anti-static bag until you are ready to install the board into its enclosure.
- Handle the circuit board only at grounded, ESD protected stations.

Introduction

Model 2253 is a compact USB compatible audio/video codec that is powered from a single USB port. Its extremely small size and low power consumption make it ideal for both portable and embedded applications.

Simplified 2253 block diagram



The board's unique features, such as its ability to produce two concurrent output video streams, open up a variety of possible applications. The streams can be any combination of compressed and uncompressed. For compressed stream(s) the choice of H.264, MPEG-4 ASP, or MJPEG video compression types is available. Compression type, target bit rate and resolution can be set independently for the two output streams. Note that there is a bandwidth limitation in the case of two uncompressed streams; the maximum total data bandwidth is limited to approximately that of one full-resolution YUV stream. Reducing resolution, or color depth, or frame rate for one or both streams may be necessary to satisfy this limit.

Model 2253 captures audio from its microphone or stereo line input. Output audio formats are uncompressed PCM, G.711, or AAC.

The available output containers are mp4 for H.264, and AVI for MPEG-4 ASP and JPEG. Elementary video and audio streams are available as well.

The board can perform as a decoder for all supported compression types. **Note: Audio/video decoding are not supported in model 2253 software versions 1.1.x. Please contact Sensoray for details.**

Up to 160 characters of overlay text may be positioned anywhere in the video frame prior to compression.

Overlay images or text can be displayed on top of the compressed output streams, preview streams, or composite video output. The overlaid video may be sourced from either the composite video input or a decoded compressed stream. BMP and PNG image formats are supported, with 24 or 32 bits per pixel and up to eight transparency levels.

Model 2253 supports three general purpose input/output signals (GPIOs): two inputs and one output. One input and the output are opto-isolated.

The board implements a USB 2.0 high speed interface which also provides power for the device.

System requirements

A high speed USB 2.0 port is required on the host computer.

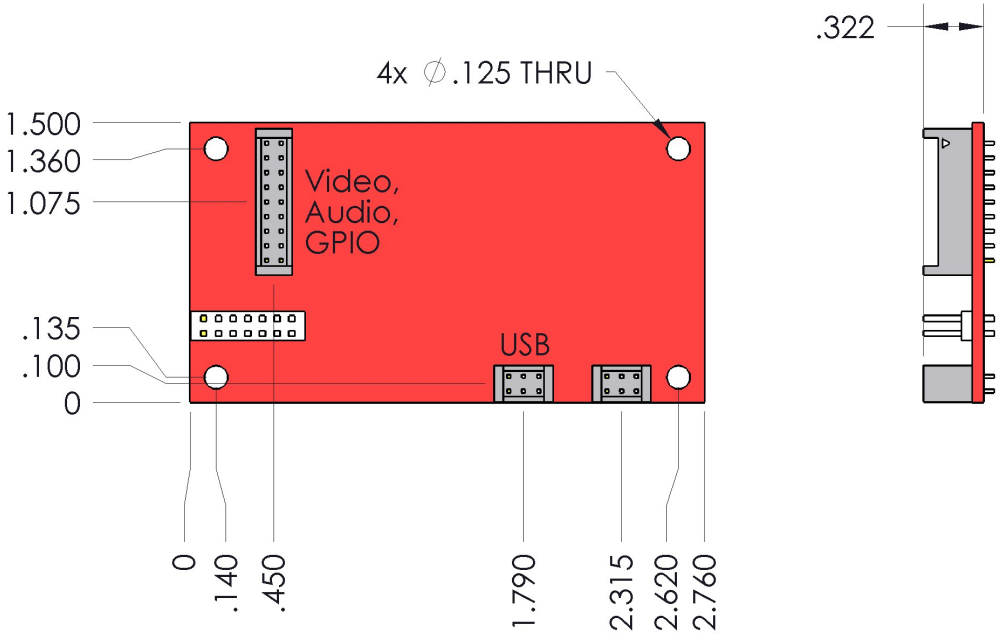
A basic Model 2253 application (simultaneous capture of a compressed stream and preview of an uncompressed stream) will work on a Pentium III class processor since no significant processing is required from the host.

RAM size is dictated primarily by operating system and application requirements. An average desktop should not have problems running a 2253 application. Embedded CPUs are sometimes limited by the peripheral's performance. Please contact Sensoray for an evaluation 2253 unit to test it with an embedded CPU of your choice.

Connectors

Model 2253 has two connectors intended for customer use: a 6-pin USB connector (J1), and an 18-pin input/output connector (JP2). All other connectors, as well as dip-switch SW1, are reserved for factory use.

Figure 1: Model 2253 mechanical drawing.



Do not connect any electric circuits or install any shunts on any connectors other than J1 and JP2.

USB connector

USB connector (J1) is a Hirose DF11-6DP-2DSA(01) (6-pin header). The mating part is a crimping socket DF11-6DS-2C with DF11-2428SCFA contacts. The cable must comply with the requirements of chapter 6.6 of "USB Serial Bus Specification Revision 2."

Table 1: USB connector pinout

Pin	Signal	Description
1	VBUS	USB: VBUS (+5V from the USB host)
2	D-	USB: D-
3	RSVD	Reserved digital output. Do not connect!
4	D+	USB: D+
5	GND	USB: Ground
6	XLED	External LED.

XLED is a 3.3 V logic signal connected via a 470 Ohm resistor. XLED stays high after the board's internal firmware has started. It goes low momentarily when the data is sent from the board via the USB interface (activity indication). A suggested use for XLED signal is driving an LED anode, with cathode connected to ground. The maximum current sourced by XLED is limited by a 470 Ohm resistor, and should not exceed 4 mA.

Input/output connector

The input/output connector is Hirose DF11-18DP-2DSA(01) (18-pin header). The mating part is a crimping socket DF11-18DS-2C with DF11-2428SCFA contacts. The recommended adapter cable length should not exceed 10 inches.

Table 2: Input/output connector pinout

Pin	Signal	Description
1	MICIN	Microphone input
2	MIC-BIAS	Microphone bias
3	GND	Ground
4	AINR	Audio line input, right channel
5	AOUTR	Audio line output, right channel
6	GND	Ground
7	AINL	Audio line input, left channel
8	AOUTL	Audio line output, left channel
9	GND	Ground
10	GPI-C1	General purpose input C1 (galvanically coupled)
11	GPI-A	General purpose input, opto-isolated, anode
12	GPI-C	General purpose input, opto-isolated, cathode
13	GPO-C	General purpose output, opto-isolated, collector
14	GPO-E	General purpose output, opto-isolated, emitter
15	GND	Ground
16	CVIN	Composite video input
17	GND	Ground
18	CVOUT	Composite video output

Microphone input

The microphone input is designed to work with condenser microphones. A microphone bias circuit is provided (2.5 V via a 2.1 KΩ resistor).

Audio line input

Line inputs are designed to work with standard input levels (0.707 V RMS). The input impedance is 10 KΩ.

Audio line output

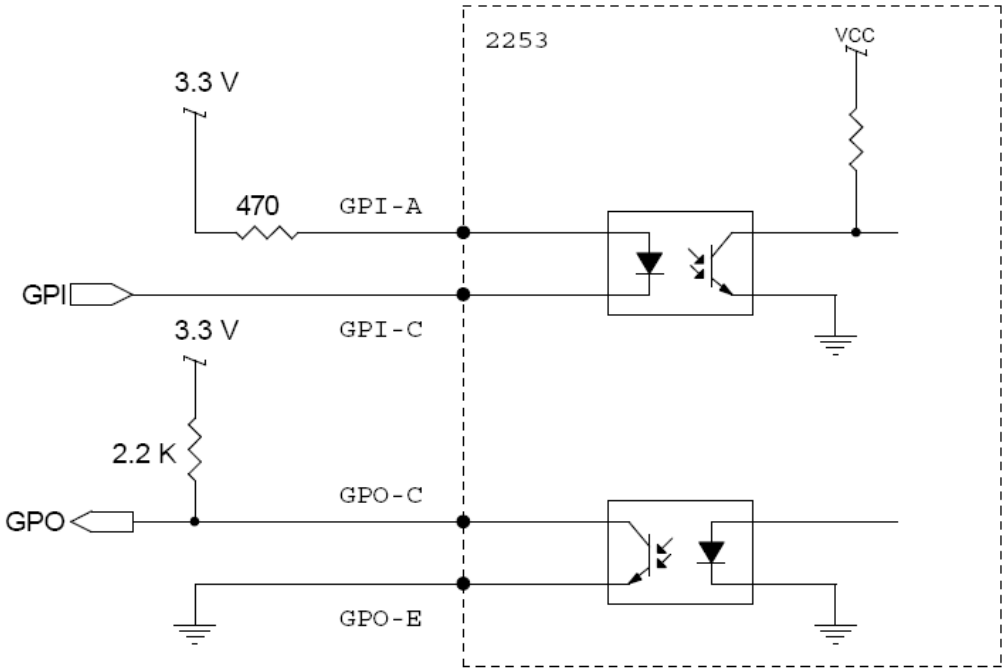
Line outputs provide output levels of 0.707 V RMS into a 10 KΩ load.

General purpose inputs/outputs (GPIO)

Note: These GPIOs are not accessible on model 2253P.

Model 2253 has 2 general purpose inputs (GPIs), and one general purpose output (GPO). One of the GPIs and the GPO are opto-isolated. The second GPI is galvanically coupled. The opto-isolated GPIO and recommended circuits are shown in Figure 2.

Figure 2: Opto-isolated GPIO.



The GPI-C1 is a galvanically connected GPI. It provides a simple way of communicating with the 2253 in cases where optical isolation is not required, by means of shorting this signal to the ground (pin 15 of GPIO connector). Please see the Software Reference for details.

Models 2253TA / 2253S

Model 2253TA is an optional carrier board for model 2253 with breakout connectors for video, audio, and GPIO signals. Model 2253S is an assembly consisting of a 2253 mounted on a 2253TA breakout board, in a compact metal enclosure.

GPIO connections

With the 2253 mounted on a model 2253TA breakout board, the 2253's GPIO signals are available on the 2253TA's 6-pin terminal block. The pinout of the terminal block is listed in Table 3. Note that the contacts are labeled differently on the 2253TA board and the back panel of the 2253S enclosure.

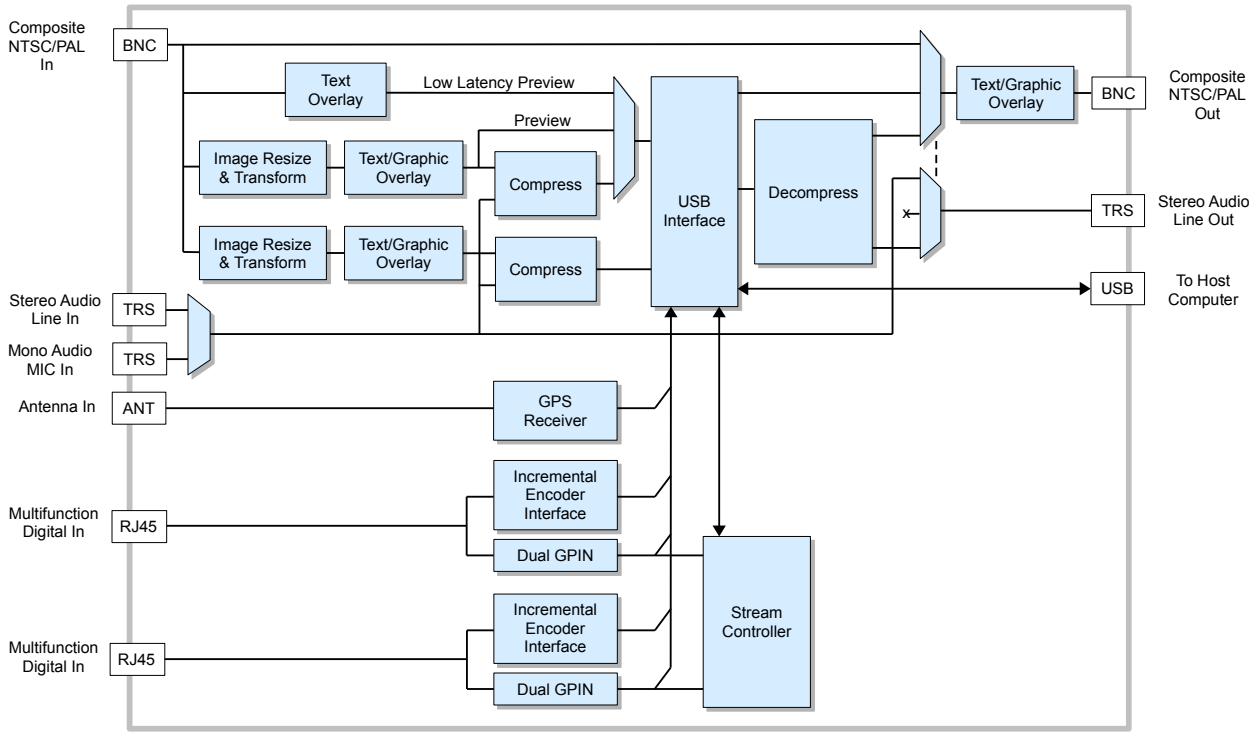
Table 3: 2253TA terminal block pinout

Label		Signal	Description
2253TA	**Enclosure**		
TB6	1	GND	Ground
TB5	2	GPI-C1	General purpose input C1 (galvanically coupled)
TB4	3	GPI-C	General purpose input, opto-isolated, cathode
TB3	4	GPI-A	General purpose input, opto-isolated, anode
TB2	5	GPO-E	General purpose output, opto-isolated, emitter
TB1	6	GPO-C	General purpose output, opto-isolated, collector

Model 2253P

Model 2253P consists of a model 2253 mounted in a robust metal enclosure, with the addition of a GPS receiver and two multifunction interfaces in lieu of the GPIO ports found on the 2253. Each multifunction interface can be independently configured to operate as an incremental encoder interface or as two digital inputs. When a port is configured as dual digital inputs, each of the inputs can optionally be used to pause and start a stream.

2253P simplified block diagram



Encoder counts, GPS data, and GPIO input states can be read from the 2253P via 2253 API functions. If desired, encoder counts and GPS data can be overlaid onto the video by sending them back to the 2253P as overlay data.

ENC/GPIO connectors

The multifunction interfaces are accessible through two RJ-45 sockets (Figure 3). Each socket can be connected to an incremental quadrature encoder, or to two digital input signals, or it may be left unconnected. The RJ-45 pinout is defined by whether it is connected to an encoder or used as dual digital inputs.

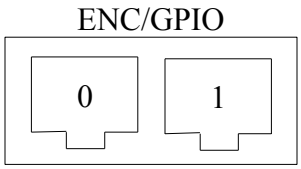


Figure 3

Encoder connections

An encoder may be powered by the 2253P (via VCC and GND pins) or from an external power supply. In the latter case, the power supply return must be connected to one of the RJ-45 GND pins.

Table 4: Multifunction RJ-45 pinout when used with incremental encoder

Pin	Name	Description	Connect to	
			TTL/CMOS	RS-422
1	A+	Clock A positive input	Encoder clock A output	Encoder clock A+ output
2	A-	Clock A negative input	no connect	Encoder clock A- output
3	B+	Clock B positive input	Encoder clock B output	Encoder clock B+ output
4	B-	Clock B negative input	no connect	Encoder clock B- output
5	VCC	+5 VDC power, 100 mA maximum	Encoder VCC. Use this for encoders that do not require VCC current limiting.	
6	VCCLIM	+5 VDC power via 180 ohm series resistor	Encoder VCC. Use this for encoders that require external current limiting.	
7	GND	Power return/signal ground	Encoder GND. These can also be connected to cable shield if used, or external encoder power supply if used.	
8	GND	Power return/signal ground		

GPIO connections

Table 5: Multifunction RJ-45 pinout when used as dual digital inputs

Pin	Name	Description	Connect to	
			TTL/CMOS	RS-422
1	GPIOA	GPIO A positive input	GPIO A signal source	GPIO A+ signal source
2	NC	GPIO A negative input	no connect	GPIO A- signal source
3	GPIOB	GPIO B positive input	GPIO B signal source	GPIO B+ signal source
4	NC	GPIO B negative input	no connect	GPIO B- signal source
5	VCC	+5 VDC power, 100 mA maximum	VCC for external contacts or other general use.	
6	NC	unused	no connect	
7	GND	Power return/signal ground	GND for external contacts of other general use.	
8	GND	Power return/signal ground		

Antenna connector

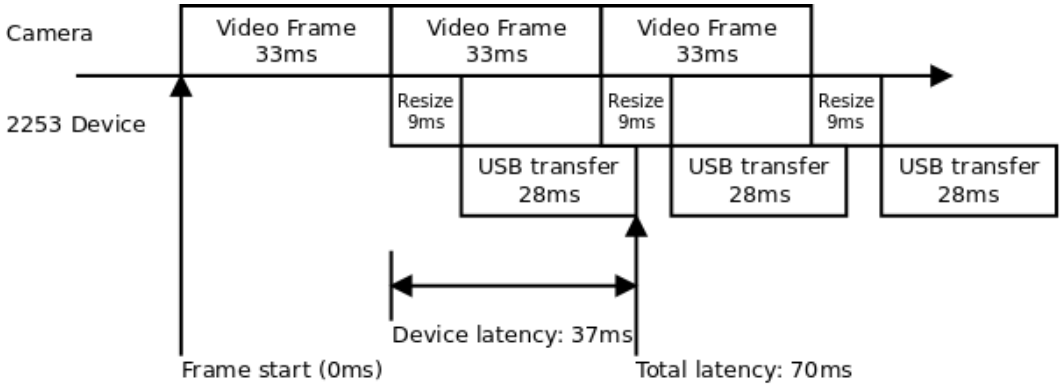
A threaded connector (labeled “GPS”) is provided to connect the GPS receiver to an external, active antenna. Connect the antenna to the 2253P by screwing it onto the threaded connector.

Specifications

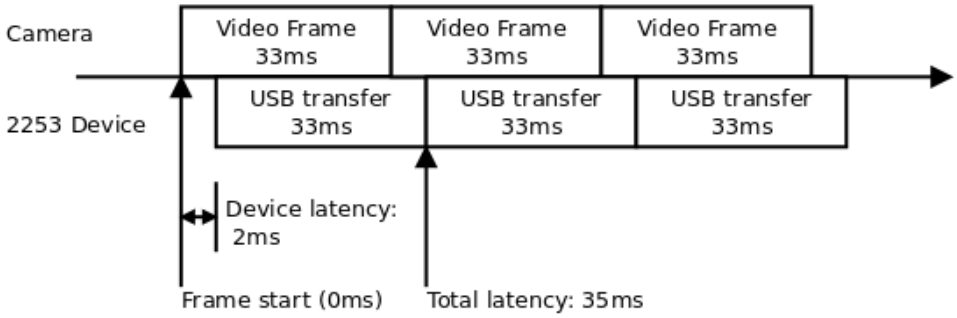
Video	
Analog input	1 NTSC/PAL composite, 75 Ohm
Analog output	1 NTSC/PAL composite, 75 Ohm
Capture frame rate	Up to full frame rate (30 fps NTSC, 25 fps PAL); optional decimation by 5, 3, or 2.
Capture resolution	Up to 704x480 (NTSC), 704x576 (PAL).
Capture formats	Color YUV 422 (UYUV); monochrome 1 byte/pixel (Y800).
Preview format	640x480@ 30 fps (NTSC); 720x576@25 fps (PAL); YUV4:2:2, GREY8, JPEG, RGB
Preview latency	See Figure 4
Image transformation	2 independent image transformers: resize to various resolutions; rotate 90°/180°/270°; mirror horizontally or vertically
Audio	
Analog inputs	1 line stereo + 1 microphone mono, software selectable (only one may be active)
Analog output	1 line stereo
Overlay	
Text Overlay	Up to 160 characters for full resolution images
Video Output Overlay	Up to 256 regions of BMP and PNG (with 24 or 32 bits/pixel), or unicode text. 16-bit color, 3-bit alpha channel
Video Capture Overlay	Up to 8 monochrome regions of BMP and PNG (with 24 or 32 bits/pixel), or unicode text
Streams	
Video encoding	H.264 HP @ L3; MPEG-4 ASP; JPEG
Audio encoding	G.711 (A-law, μ-law): 8 bit samples @ 8 kHz, 64/128 (mono/stereo) kbps stream AAC-LC: 48 kHz sample rate, 32-512 kbps stream
Output stream formats	Elementary audio/video with timestamps MPEG-4 program stream (.MP4) MJPEG snapshots or AVI video Transport Stream
Digital I/Os (2253/2253TA)	
Digital inputs	1 galvanically coupled, 1 opto-isolated (only one may be used)
Digital outputs	1 opto-isolated
Multifunction Interface (2253P)	
Channels	2
Operating modes	32-bit incremental encoder interface, 10 MHz maximum count rate; Dual digital inputs with edge detection

Input signals	Differential: RS-422, < 7V CMV; Single-ended: 5V TTL/CMOS compatible, w/integral 3.3 KΩ pull-up
Output power	5V for external encoder/contact loads, 100 mA maximum
Connector type	RJ-45 receptacle per channel
GPS Interface (2253P)	
Output data	Decoded: latitude, longitude, speed, heading, time, date; Undecoded: all raw data, in conformance with NMEA 0183
Antenna type	GPS active antenna (not included)
Antenna connector	SMA
System	
Interface	USB 2.0 High-speed
Power consumption (from USB port)	<1.5 W (300 mA @ 5 V) Note: this includes (excluding 2253P encoder power
Weight (2253)	14 g
Operating temperature	Standard version: 0 to 70 °C Extended version: -40 to +85 °C
Dimensions	2253: 2.755” x 1.5” 2253S/2253P: 5.14" x 3.28" x 1.14"

Figure 4: Preview latency



A. Normal preview mode with optional resizer



B. Low-latency preview mode at native resolution (resizer not available)

Revision history

Version	Notes
1.0.0, July 2010	Initial release.
1.1.0, December 2010	Information on GPIO pinout of the breakout board (2253TA) is added. Audio support added.
1.1.1, March 2011	Audio specs added.
1.2.0, December 2013	2253P added. New mechanical dwg for 2253 Rev H and above.
1.2.1, February 2014	Revised 2253 block diagram. Added 2253P block diagram.

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