

RECON™

Revision 4 – RoHS Compliant

Digital Video Recorder

Hardware Technical Reference

Revision 1.0

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fast forward video

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RECON™

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Overview

Fast Forward Video's Recon™ circuit board is a high quality digital video recording and playback device designed for standalone operation. It was designed as a subsystem for applications requiring video conforming to National Television Standards Committee (NTSC) or Phase Alternation by Line (PAL) specifications. The Recon performs compression and decompression at user-specified ratios as low as 4:1 at 30 frames (60 fields) per second in NTSC. The compression method conforms to the Joint Photographic Experts Group (JPEG) standard. The primary design goal was professional image quality. In addition, the Recon adheres strictly to standards including RS-170A (NTSC) and CCIR-601.

When recording, the Recon converts an analog (or SDI) NTSC or PAL video signal to a component digital format, compresses the digital video signal to a JPEG data stream, and sends the compressed video directly to an ATA/IDE (ATA/ATAPI-4) hard disk. Control of the board is available through a serial port RS-232 interface. This port may optionally be configured as RS422/485.

When playing back, the Recon retrieves the compressed video data from an IDE hard disk, decodes the JPEG data into digital component video, and converts the digital video to SDI or analog NTSC or PAL video signal.

Composite video and Y/C connectors, decoder, and encoder are included on the Recon. The board's pixel resolution is full bandwidth CCIR-601, which is 720 X 486 in NTSC and 720 X 576 in PAL. Sampling is maintained at 4:2:2.

The Revision 4 Recon is RoHS compliant.

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Architecture

The Recon's primary design goal was to maintain video quality at a level suitable for use in professional video applications. This goal dictated that the sync timing of the output signal must conform strictly to the RS-170 standard (NTSC).

Most important, however, is image quality. Based on subjective evaluation of JPEG compressed video, Fast Forward Video determined that a compression ratio of 5:1 or lower would yield image quality comparable to the Betacam SP™ format, and thus satisfy most professional video users.

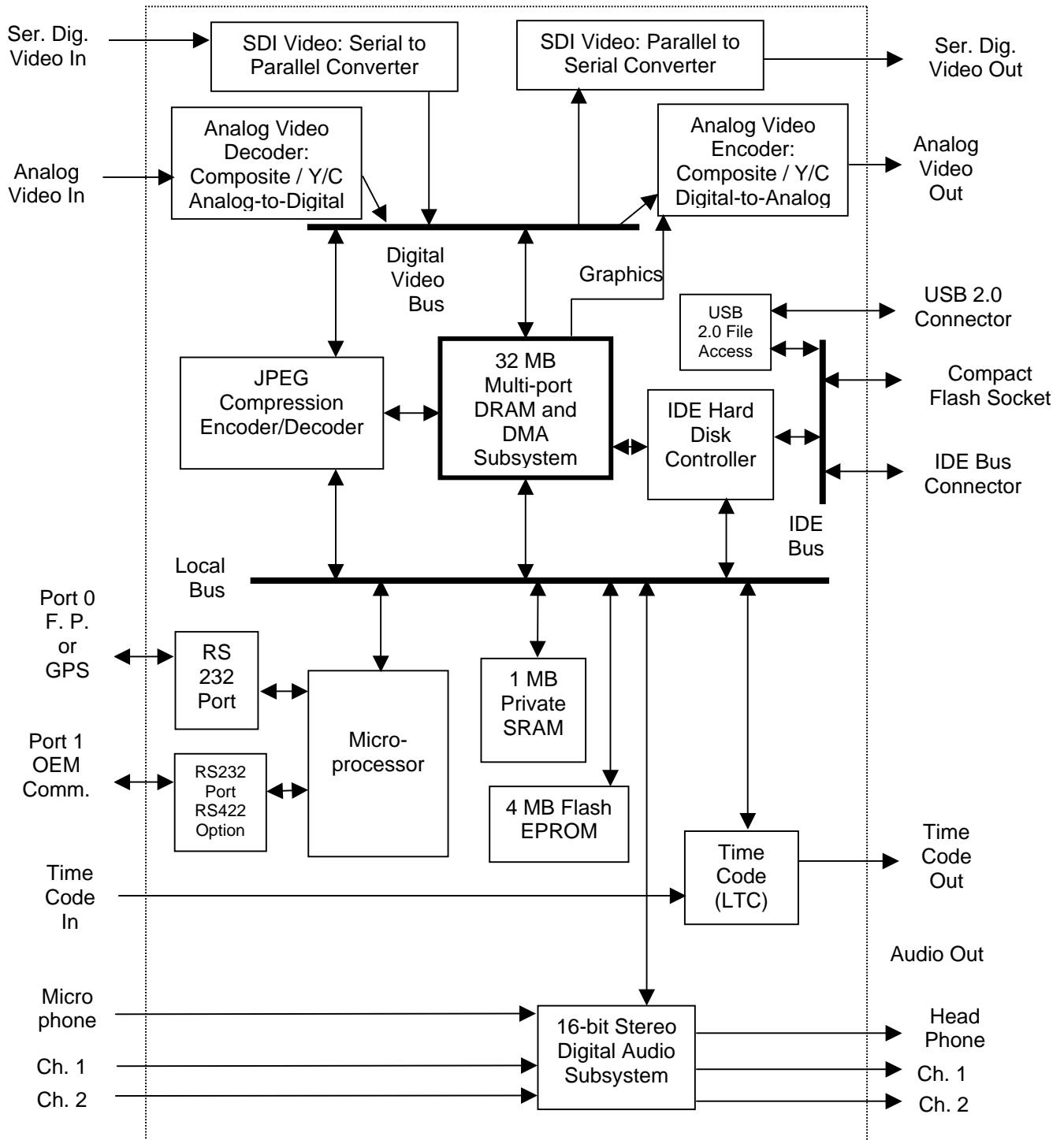
To support a sustained data rate at this level, the designers of the Recon included an IDE hard disk controller on the circuit board.

The design includes an on-board 80386EX microprocessor to oversee the hardware and to provide a control interface over the serial ports.

All of the Recon's subsystems share 32 megabytes of dynamic random access memory. This memory is based on a true multi-port architecture that allows direct access by the JPEG codec, the disk controller, and the local 80386EX microprocessor. Direct access to this memory permits each of the subsystems to perform to their maximum potential without concern for DMA contention.

Following is a block diagram of the Recon, Rev. 4.

HARDWARE BLOCK DIAGRAM



SPECIFICATIONS

RECON CIRCUIT BOARD

Specifications

VIDEO INPUT

Analog Input: Composite, SDI and S-Video (Y/C).
Levels: 1.0Vp-p, 75 ohms
Standards: 525/60 (NTSC) or 625/50 (PAL)

VIDEO OUTPUT

Analog Output: Composite, SDI and S-Video (Y/C).
Horizontal Resolution: 550 TV lines (at 5:1 compression)
Levels: 1.0Vp-p, 75 ohms
Standards: 525/60 (NTSC) or 625/50 (PAL)
Connections: multi-pin for S-Video (Y/C)

VIDEO INPUT DECODER

Format: Digital 4:2:2 YCrCb
60 fields per second NTSC
50 fields per second PAL

Digital Color Space: YUV
Sampling: 13.5 MHz
Pixel Resolution: 720 x 486 pixels (525/60)
720 x 576 pixels (625/50)

S/N Ratio: 50 dB
Bandwidth: 7 MHz (-3 dB)
Differential Gain: 2%
Differential Phase: 2 deg.
ADC Differential Linearity: +/- 0.7 LSB
ADC Integral Linearity: +/- 1.0 LSB

VIDEO OUTPUT ENCODER

Digital Color Space: Digital 4:2:2 YCrCb
Analog Bandwidth: Y: 6.75 MHz
C: 1.3 MHz

Composite: 4.5 MHz
DAC Resolution: 10 bits x 3
S/N Ratio: 60 dB

VIDEO COMPRESSION

Codec: Zoran
Method: JPEG (Joint Photographic Experts Group)
Compression Ratio: Variable from 20:1 to 4:1.

MEMORY

Multi-port Frame Buffer: 32 MB DRAM
Aggregate Bandwidth: Greater than 45 MB/second

ATAPI/IDE DISK CONTROLLER

Protocol:	ATAPI DMA mode 2
Maximum Data Rate:	16.6 MB/sec
Maximum Hard Drives:	2
Supported Hard Drives:	Hitachi Travelstar; Fujitsu MHS/MHT Series; Solid State disks available; Sandisk Compact Flash

MICROPROCESSOR

Type:	Intel 80386EX
Clock Speed:	40 MHz
Local ROM/EPROM:	4MB Flash EEPROM
Local SRAM:	1MB 0 wait state

COMMUNICATIONS INTERFACE

RS-232 (RS22/485 optional):	Conforms to Sony "Remote-1 (9 pin)" protocol. 38400 baud, 8 data bits, odd parity, 1 stop bit.
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AUDIO SPECIFICATIONS

Resolution:	16 bits
Sampling Rate, FS:	48 Khz
Channels:	2 Line or 1 Microphone In, 2 Out
Dynamic Range:	90 dB
Total Harmonic Distortion:	-80 dB
Crosstalk:	-80 dB
Interchannel Gain Mismatch:	+/- 0.5 dB
Input Voltage:	1 VRMS nominal
Input Impedence:	35k ohms
Input Programmable Gain Span:	22.5 dB
Full Scale Output Voltage:	1 VRMS
Output Impedence:	10K ohms
Output Attenuation Range:	80 dB

SOFTWARE

Optional:	Recon control interface. Runs on Windows 9x/2000, and XP.
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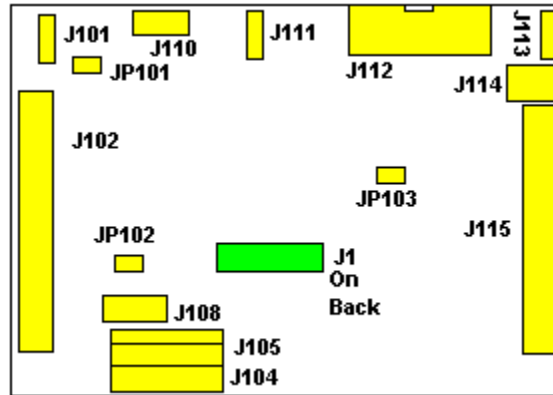
GENERAL

Size:	2.8" W x 3.9" L x 1" D
Power Consumption:	3 watts not including hard disk Requires regulated input of +5V.
Warranty:	1 year

Specifications subject to change without notice

Jumper and Connector Locations

Part Number 309-PC023-4, Revision B – (bare board)



LEGEND		
REF #	FUNCTIONAL DESCRIPTION	MFR. P/N OR DESCRIPTION
J101	POWER	MOLEX P/N 70553-0002
J102	ATA / IDE HARD DRIVE	STD. 2-Row, 44 pin IDE – 2mm
J104	RS-232 PORT	STD. 2-ROW, 10 PIN IDE
J105	RS-422 PORT (OPTION)	STD. 2-ROW, 10 PIN IDE
J106	PIXEL BUS (OPTION)	SAMTEC P/N SFM-110-L2-S-D-L-C
J108	RS-232 PORT (OPTION)	MOLEX P/N 53398-0490
J109	COMPACT FLASH (OPTION)	CF, Type I or Type II
J110	GPI PORT	STD. SINGLE ROW, 8 PIN IDE
J111	EXTERNAL TRIGGER / LED OUT	STD. 3 PIN IDE
J112	AUDIO AND TIME CODE INPUT/OUTPUT	STD. 2-ROW, 14 PIN IDE
J113	AUDIO HEAD PHONE OUTPUT	STD. 3 PIN IDE
J114	USB PORT	MINI B RECEPTACLE, RT. ANGLE
J115	VIDEO INPUT/OUTPUT	STD. 2-ROW, 20 PIN IDE, RIGHT ANGLE
JP101	MICROPROCESSOR RESET	STD. 2 PIN IDE
JP102	FIRMWARE UPDATE JUMPER	STD. 2 PIN IDE
JP103	BOOT CODE WRITE ENABLE JUMPER	STD. 2 PIN IDE
J1	MICROPROCESSOR BUS EXPANSION	SAMTEC P/N SFM-125-L2-S-D-L

CONNECTOR PIN-OUTS

POWER

Connector Pin-Outs

POWER J101	
Pin	Function
1	Ground
2	Ground
3	+5 volts in

IDE HARD DRIVE J102			
Pin	Function	Pin	Function
1	RESET	23	DIOW
2	GROUND	24	GROUND
3	DD07	25	DIOR
4	DD08	26	GROUND
5	DD06	27	IORDY
6	DD09	28	CSEL (GROUND)
7	DD05	29	DMACK
8	DD10	30	GROUND
9	DD04	31	INTRQ
10	DD11	32	Not Connected
11	DD03	33	DA1
12	DD12	34	PDIAG (not connected)
13	DD02	35	DA0
14	DD13	36	DA2
15	DD01	37	CS0
16	DD14	38	CS1
17	DD00	39	DASP (not connected)
18	DD15	40	GROUND
19	GROUND	41	+ 5V
20	Key pin (N/C)	42	+ 5V
21	DMARQ	43	GROUND
22	GROUND	44	Not Connected

RS-232 J104	
Pin	Function
1	Not connected
2	DTR
3	Transmit Data (TX)
4	Not connected
5	Receive Data (RX)
6	Not connected
7	Not connected
8	Not connected
9	Ground
10	Not connected

RS-422 (OPTIONAL) J105	
Pin	Function
1	Ground
2	Ground
3	Transmit Data (-)
4	Transmit Data (+)
5	Receive Data (+)
6	Receive Data (-)
7	Ground
8	Ground
9	Not used
10	Not used

RS-232 - PORT 0 J108	
Pin	Function
1	Ground
2	DTR
3	Receive data (RX)
4	Transmit data (TX)

CONNECTOR PIN - OUTS

JUMPER BLOCKS

JUMPER BLOCKS	
Install jumpers or short pins to force the following behavior when applying power to the board:	
	Behavior
JP101	Short momentarily for hardware RESET.
JP102	Forces board into firmware update mode at 38400 baud, 8 data bits, ODD parity, 2 stop bits
JP103	Enables boot code write to Flash. This is not usually necessary in the field.

GENERAL PURPOSE INPUTS			
J110 – 8 pin			
J2 Pin	GPI	Function	Source/Sink (I)
1		LED 1 Output	8 mA max.
2		LED 2 Output	8 mA max.
3	1	● Record	16 mA min.
4	2	■ Stop	8 mA min.
5	3	► Play	8 mA min.
6	4	◄◄ Left Arrow	8 mA min.
7	5	►► Right Arrow	8 mA min.
8		Ground	8 mA min.

EXTERNAL TRIGGER CONNECTIONS		
J111		
Pin	Connection	Operation
1	Trigger Input	Records when shorted to GND, Stops when Hi
2	LED Output	Solid Hi – recording; Alternate Hi/Lo – Pass-Thru
3	Ground	

AUDIO AND TIME CODE J112	
Pin	Function
1	Ground
2	Left channel - in
3	Ground
4	Right channel - in
5	Ground
6	Left channel - out
7	Ground
8	Right channel - out
9	Ground
10	Microphone In – 1Vp-p level. Chg. Audio In Configuration Item #51 using Serial Protocol.
11	Ground
12	Time Code In
13	Ground
14	Time Code Out

VIDEO INPUT/OUTPUT J115	
Pin	Function
1	Reference video in
2	Ground
3	C (chroma) in
4	Ground
5	SDV in
6	Ground
7	SDV out
8	Ground
9	Y (luminance) in
10	Ground
11	Composite video in
12	Ground
13	C (chroma) out
14	Ground
15	Composite out #2
16	Ground
17	Y (luminance) out
18	Ground
19	Composite video out
20	Ground

CONNECTOR PIN-OUTS

PIXEL BUS – OPTION J106

PIXEL BUS – OPTION J106			
+5 Vdc	1	2	+3 Vdc
HREF	3	4	VREF
Pixel Bus Bit 0	5	6	Pixel Bus Bit 1
Pixel Bus Bit 2	7	8	Pixel Bus Bit 3
Pixel Bus Bit 4	9	10	Pixel Bus Bit 5
Pixel Bus Bit 6	11	12	Pixel Bus Bit 7
SCL	13	14	DC Coupled Composite Sync In
SDA	15	16	No Connection
No Connection	17	18	Ground
27 MHz	19	20	Ground

HEAD PHONE OUTPUT

J113

Pin	Function
1	Left Head Phone Out
2	Right Head Phone Out
3	Ground

USB INTERFACE

J114 – Mini “B” connector

Pin	Function	Operation
1	USBPWRV	+5V from computer; indicates USB is connected
2	USB D-	Differential data (-)
3	USB D+	Differential data (+)
4	Pull-down	
5	Ground	

Operation

There are five level sensitive, fully de-bounced inputs available for user control. These inputs are suitable to be connected directly to off-the-shelf pushbuttons. The action described below occurs immediately upon contact closure, that is, when the input is shorted to ground.

GPI SWITCHES

Record	●	When recording, all other keys are disabled EXCEPT the key combination to stop recording.
Stop recording	■ + ●	
Play	▶	Key has no effect when in pass-through mode. To switch from pass-through mode to playback mode, you must cue to a recorded frame using either the ◀◀ or ▶▶ key.
Pause playback	■	
Cue to first frame (beginning) of previous clip	◀◀	
Cue to first frame of next clip	▶▶	
Cue to first recorded frame	◀◀ for 1 second	Press and hold the ◀◀ key.
Cue to last recorded frame	▶▶ for 1 second	Press and hold the ▶▶ key.
Step forward one frame	■ + ▶▶	Hold the ■ key, then touch the ▶▶ key. When both keys are held down, advances at a rate of about 5 frames per second. Advances one field or frame according to the configured slow motion mode (Configuration Item Code #50).
Step back one frame	■ + ◀◀	Hold the ■ key, then touch the ◀◀ key. When both keys are held down, steps back at a rate of about 5 frames per second.
Scan forward	▶ + ▶▶	Press and hold the ▶ key first, then touch the ▶▶ key. Successive presses of this combination alternate between 5X and 30X play speed.
Scan reverse	▶ + ◀◀	Press and hold the ▶ key first, then touch the ◀◀ key. Successive presses of this combination alternate between 5X and 30X play speed.
Switch from play mode to pass-through mode	■ + ●	Hold the ■ key, then touch the ● key.
Delete all video & Format disk (formats based on config. items C0 and C1)	◀◀ + ▶▶ + ●	Press and hold first the ◀◀ key, then the ▶▶ key, then ●. Release all three. Both LEDs flash requesting confirmation of delete. Press ● for 5 seconds. When LED indicates Pass-Thru, Delete is complete.

OPERATION

LED DETAILS

LED DETAILS

The LED outputs supply a maximum of 8mA current. The LEDs should be connected between the output and GND. The LED functions are indicated in the table below:

MODE	ACTION	LED	DISPLAY
Pass-Thru	Pause	2	Single short blink per second.
Pass-Thru	Record	2	LED On
Playback	Pause	1	Single short blink per second.
Playback	Play Normal Speed	1	LED On
Playback	Forward Scan	1	Blinks with Short, Short, Long, Short sequence
Playback	Reverse Scan	1	Blinks with Short, Long, Short sequence
Confirm Video Delete		1 & 2	LEDs alternate short blinks.

USB OPERATION

The USB connection is used to view recorded video using the QuickTime player on a computer. The files must be recorded using the FAT32 Disk format and the QuickTime file format. These settings MUST be set on the DVR and the "Delete All Video" command used to format the drives prior to recording. The USB drivers are included in Windows 2000 and Windows XP for the connection. The drive should show up as an external drive when the USB cable is connected and the DVR is powered On, unless the unit is in Record. The DVR will not allow USB access when recording since all data on the drive could be damaged / deleted by doing so. Connecting the USB cable during Play will stop playback and put the DVR into Pass-Thru because the DVR and the USB cannot access the drive simultaneously.

The files containing video will be FAT32 long filenames using the Clip Title, a space, and AAAABB.mov, where the Clip Title is the settable Title message or the incrementing default "CLIP0000", and 'AAAA' and 'BB' are hexadecimal numbers. The numbers are added at the end of the long filename to differentiate files of the same clip when the drive space required exceeds the FAT32 2GB file size limitation. All other files on the drive are not video files, and therefore, are not playable. Long video clips will span file boundaries. The filenames will indicate sequential files in a clip by incrementing the digits 'AAAABB' in ascending numbers for each file in one clip. All disk space is used when looking at the drive with a computer because all unrecorded space is automatically put in "Available Records" (RAXxxxxx.FFV) when formatted FAT32. All formatting MUST be performed using the Recon4 hardware.

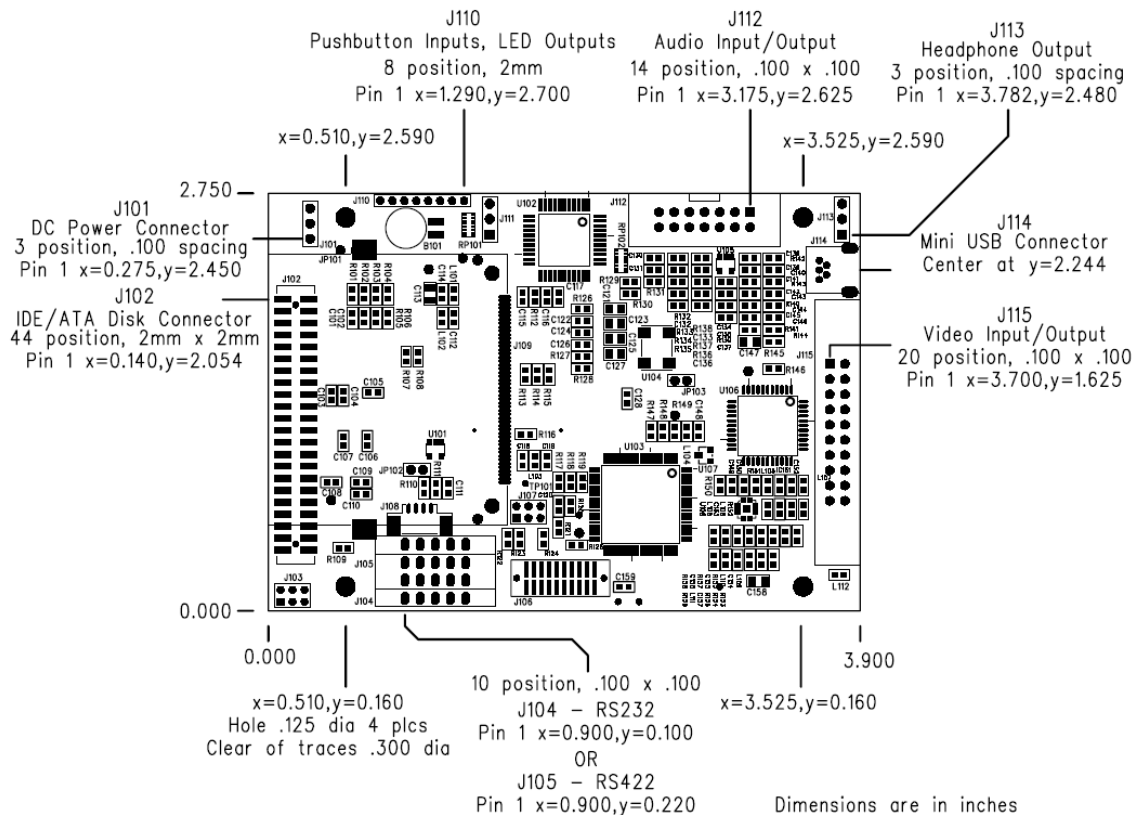
Video requires a fast computer to play smoothly in real time. If your video does not play smoothly, QuickTime Pro has a setting under the Movie tab to "Play all frames". This slows the video to the speed of the computer, but shows all of the frames recorded.

Appendix

MECHANICAL DIMENSIONS

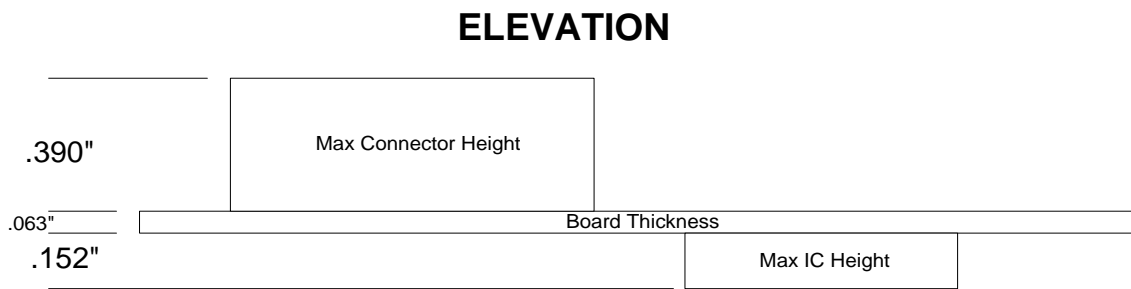
Note that there are a few connectors that are not documented. This is intentional, since officially these connectors are not supported and are not guaranteed to remain unchanged from one revision to another. We can provide locations on request, but the customer must understand that they use them at their own risk.

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Part #309-PC023-4 Rev B
Fast Forward Video
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APPENDIX

ELEVATION



REVISION HISTORY

Rev. 1.0 – Initial Release