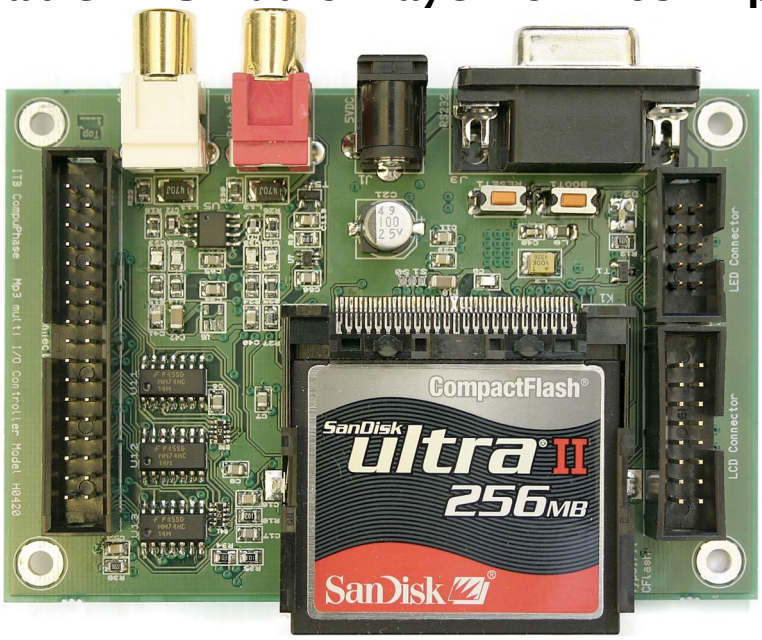
H0420

Programmable MP3 Audio Player for Kiosk Applications



SCRIPTABLE

RoHS COMPLIANT

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The H0420 is a compact and solid state general purpose controller with an embedded MP3-audio decoder that runs under the control of a scripting language. The audio fragments and the script that controls the operation and behaviour of the MP3 player are stored on a CompactFlash card. Auxiliary devices, such as an LCD, (electronic) switches or data terminals may be attached through a 16-bit general purpose I/O bus, a standard header connector supporting 16 switches, and an RS232 connector respectively.

Features

- Solid state design.
- Decodes MPEG Layer 3 stereo/mono channels, supporting all MPEG sampling frequencies and bit rates up to 320 kb/s, including variable bit rate and the very low bit rates of the MPEG 2.5 extension (8 kb/s and 16 kb/s).
- High quality audio, based on a 24-bit D/A converter with 8× oversampling digital filter, low noise and low distortion.
- Low power mode for portable applications.
- 16 switch inputs, with bounce-filters and schmitt-triggers.
- 16 general purpose inputs/outputs (I/O pins), individually configurable.
- 1 analogue output, software-controlled, with an optional frequency/signal generator.
- I/O pins are able to drive a LED or opto-coupler, when configured as output.
- A standard LCD module, with a HD44780 controller, is directly supported, 8-bit interface (this takes 11 of the 16 I/O pins).

- Standard serial interface (RS232 with software handshaking).
- MP3 audio data is read from a CompactFlash card; type 1 and type 2 cards are supported.
- Parses the ID3 tag information (version 2) with support for Synchronized Lyrics, for Karaoke or for synchronizing events to the MP3 music.
- Programmable by the end-user through a script (in the PAWN language) stored on the CompactFlash card. The developer environment is freely available and it includes a source-level debugger.
- Supports encrypted MP3 tracks and encrypted CompactFlash cards, using an 128-bit key.
- Gapless and clickless sound loops are possible with the H0420 MP3 player
- General purpose file I/O to the CompactFlash card is supported, for applications as keeping a log file, or updating play lists or scripts remotely.
- Optional extension bus with I^2C, SPI and parallel bus.

Specifications

Absolute maximum ratings

Operating voltage (Vcc).....-0.3 V to +6.0 V.
Input voltage on I/O pins.....-0.3 V to + 6.0 V.

General

Operating voltage (Vcc).....4.1 V to 5.5 V DC; see "Accessories" on page 3 for a low-voltage option.
Current consumption.....Typical: 140 mA (during MP3 playback, no I/O-bus activity); 105 mA when idle; 50 mA in stand-by mode.
Storage medium.....CompactFlash cards, types 1 and 2.
EMC / ESD.....All I/O lines and pins are EMC-filtered and ESD-protected.
User-programmable.....Yes, through a script in the PAWN embedded scripting language.
Firmware upgradeable.....Yes, through RS232 connected to a host computer (PC).

Audio

Frequency response.....20 Hz to 20 kHz.
Dynamic range.....98 dB (typical).
Distortion.....THD < 0.025% at 1 kHz.
Noise.....SNR 98 dB (typical).
Treble / bass adjustment.....under software control; frequency and attenuation/enhancement is configurable; max. attenuation/enhancement is ± 18 dB.
Volume adjustment.....under software control; maximum attenuation is 96 dB.
Output impedance.....100 Ω.
Output level.....max. ± 1.5 V.
Auto-mute.....auto-mute circuit based on "zero-output detection" is present.
Audio out connectors.....2 × RCA (cinch).
Advised input impedance.....for best audio quality, equipment attached to the audio outputs should have an input impedance of at least 2.7 kΩ.

Control

RS232 interface.....9-pin D-Sub connector, configured as DCE; standard I/O signal levels.
Switch inputs.....16 inputs, equipped with bounce-filters.

Digital I/O.....16 pins; TTL-level at max. 10 mA source / 0.9 mA sink; filtered to ~50 kHz max.; max. switching rate ~4 kHz; configurable per pin.
Analogue output.....1 pin; 0 to Vcc–0.2 V, software-controlled. The analogue pin may be driven by a frequency/signal generator; 0.001 Hz to 10 kHz, sine, square root, triangle, saw tooth or inverted saw tooth.
Real-Time clock.....accurate to ± 2.5 seconds per 24 hours.

Mechanical

Construction.....Four-layer surface-mounted PCB.
Dimensions.....70 × 100 × 18 mm (length × width × height); the CompactFlash card exceeds the edge with 3 mm; the push-button for the eject mechanism exceeds the edge by max. 3.5 mm (this mechanism may optionally be removed).
Weight.....0.065 kg.
Mounting.....4 holes Ø 3.2 mm spaced (centre to centre) at approximately 90 mm horizontally and approximately 60 mm vertically; the mounting holes are (electrically) connected to the digital and analogue ground; 3 mm of clearance is needed below the PCB.
See also section “Drawings” on page 9 for details and precise measurements.

Operating conditions

Temperature.....designed for -40 °C to +85 °C; audio quality decreases below -25 °C.
Humidity.....5% to 90% non-condensing.
Vibration.....full solid-state device, no moving parts.

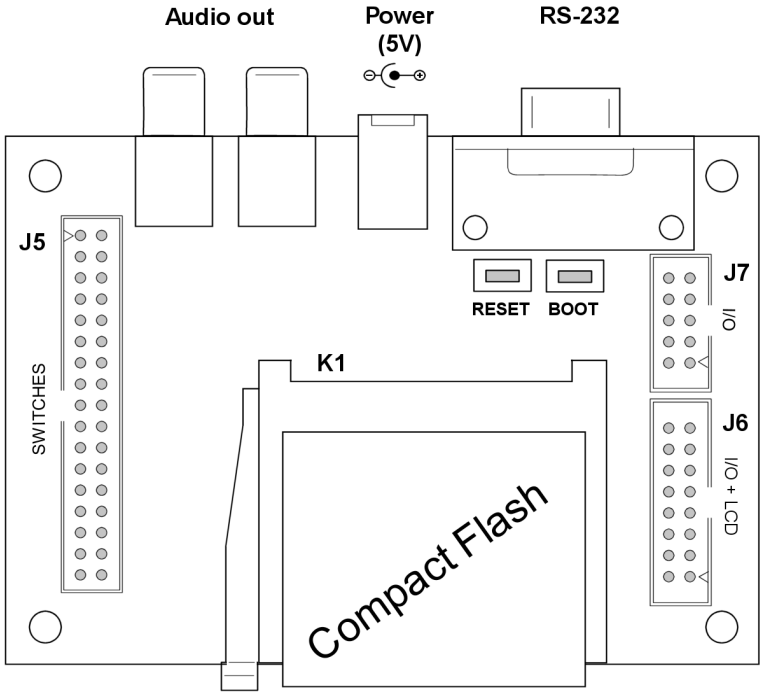
Conformity

European Community.....EN 55022 (emission) , EN 55024 (immunity).
U.S.A.....t.b.a.
RoHS.....Compliant with EU Directive 2002/95/EC.

Accessories

Power supply.....external power supply; 100 VAC to 240 VAC 50/60 Hz, auto-switching, regulated.
Power amplifier.....2 × 2.1 Watt (stereo) on 5 V power supply.
Ethernet interface.....10 Mbit/s Ethernet interface with TCP/IP stack; auto-configuring.
Printed manual.....the product comes with the PAWN programmers manual and in PDF format; a printed manual is available as an option.
Expansion bus.....IEEE 1386 Mezzanine connector is optionally mounted; see page 8 for the specification of the expansion bus.
Low voltage operation.....The device can be configured to run at 3.3 V DC on special order.

Interface specifications



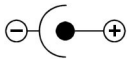
Schematic of the PCB plus the lay-out of connectors, at scale 1:1

CompactFlash card

Connector K1 accepts CompactFlash cards types 1 and 2. The connector is fitted with an eject mechanism (this mechanism may optionally be removed). The firmware supports cards formatted with FAT16 and FAT32. If the CompactFlash card contains multiple partitions, the firmware uses the first "active" FAT16 or FAT32 partition that it finds. The firmware supports subdirectories, locked partitions, and both reading and writing.

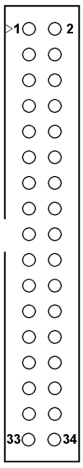
Power connector

The power connector is a standard low voltage power connector with a pin size of 2.1 mm. The pin is the plus pole.



Button inputs

Connector block J5 is a 34-pin IDC header connector, 2.54 mm pitch. It allows up to 16 switches to be attached to the controller. Each "sense" pin is fitted with a weak pull-up, a bounce-filter and a Schmitt-trigger. The maximum switch frequency that can be detected is 50 Hz.



1	Switch 0 sense pin	**2**	Ground
3	Switch 1 sense pin	**4**	Ground
5	Switch 2 sense pin	**6**	Ground
7	Switch 3 sense pin	**8**	Ground
9	Switch 4 sense pin	**10**	Ground
11	Switch 5 sense pin	**12**	Ground
13	Switch 6 sense pin	**14**	Ground
15	Switch 7 sense pin	**16**	Ground
17	Switch 8 sense pin	**18**	Ground
19	Switch 9 sense pin	**20**	Ground
21	Switch 10 sense pin	**22**	Ground
23	Switch 11 sense pin	**24**	Ground
25	Switch 12 sense pin	**26**	Ground
27	Switch 13 sense pin	**28**	Ground
29	Switch 14 sense pin	**30**	Ground
31	Switch 15 sense pin	**32**	Ground
33	Not connected	**34**	Ground

J5 **34-pin IDC header connector, 2.54 mm pitch**

A switch is "down" when the "sense" pin is pulled low (e.g. shorted to the respective "ground" pin). On the H0420, all ground pins are linked to a single ground. The sense pins have a weak pull-up to Vcc.

The switch inputs may also be used to detect logic levels from other digital equipment (such as TTL levels). Because of the internal pull-up resistors, open-drain outputs can be connected to the "sense" pins as well.

General purpose input/output pins

Connector blocks J6 and J7 provide, in total, 16 digital pins that can be configured, per pin, as input or output. The I/O pins are filtered to a maximum switching frequency of approximately 50 kHz; however the maximum I/O switching rate is approximately 4 kHz. In addition to the digital pins, J6 provides one analogue output pin.

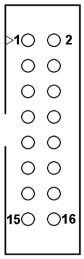
When used as inputs, the pins are high-impedance with a weak pull-up resistor. Low level is defined as below 1.5V and high level is defined as above 3.5V, provided that Vcc is 5V (the advised voltage). The range between 1.5V and 3.5V is undefined.

When configured as outputs, each pin either provides a TTL-level signal, or it can drive a LED (or similar load, like an opto-coupler); usually no *external* current limiting resistor is needed for driving a LED because each output pin is equipped with an *internal* current limiting resistor (220 Ω). The current limit depends on the LED's forward voltage; it is ~14mA at 2V. The internal current limiting resistor clamps the output current to a maximum of 23 mA when the pin is shorted to ground or Vcc. The current for all the pins (16 digital) combined may not exceed 160mA.

Because of the current limiting resistors, *outputs* are TTL compatible only under the following conditions:

High level.....>2 V at < 10 mA source
Low.....<0.8 V at < 0.9 mA sink

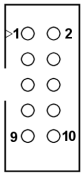
If the noise margin for low level is too small, consider a pull down resistor to shift it down. Pins that are configured as *inputs* are always TTL compatible.



1	Ground	**2**	Logic power supply, Vcc
3	Analogue out (0 to Vcc-0.2)	**4**	IO8 (Digital I/O pin 8)
5	IO9	**6**	IO10
7	IO0 (Digital I/O pin 0)	**8**	IO1
9	IO2	**10**	IO3
11	IO4	**12**	IO5
13	IO6	**14**	IO7
15	Power supply, Vcc	**16**	Ground

J6 **16-pin IDC header connector, 2.54 mm pitch**

The combination of all I/O pins and the filtered power supply at pin 2 may draw 160 mA maximum. Pin 15 of connector JP6 is connected directly to the power connector; you can use this pin to draw higher currents.

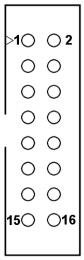


1	Ground	**2**	IO11
3	Ground	**4**	IO12
5	Ground	**6**	IO13
7	Ground	**8**	IO14
9	Ground	**10**	IO15

J7 **10-pin IDC header connector, 2.54 mm pitch**

LCD connection

Connector block J6 can also double as a LCD connector. The pin lay-out conforms to the standard LCD-interface with HD44780 controller. The firmware drives the LCD in "byte mode"; "nibble mode" is not supported.



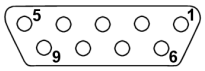
1	Ground (Vss)	**2**	Logic power supply, (Vdd)
3	LC-driving supply (Vo)	**4**	Register Select (RS)
5	Read/write (R/W)	**6**	Enable (E)
7	Data bit (DB0)	**8**	Data bit (DB1)
9	Data bit (DB2)	**10**	Data bit (DB3)
11	Data bit (DB4)	**12**	Data bit (DB5)
13	Data bit (DB6)	**14**	Data bit (DB7)
15	Backlight power, (Vcc, A)	**16**	Backlight ground (K)

J6 **16-pin IDC header connector, 2.54 mm pitch**

When attaching a backlight unit to the connector on pins 15 and 16, you may need to put a resistor in the power line (pin 15). In the H0420, pin 15 is connected directly to the power connector.

RS232

The device provides a standard 9-pin "D-sub" RS232 connector, and it is configured as a DCE device (Data Communications Equipment). Internally, the DTR and DSR lines are connected, and the RTS and CTS lines are connected too. A standard "straight connection" cable should therefore be suitable (do not use a null-modem cable).



RS232

1 N.C.
2 TxD
3 RxD
4 Internally connected to pin 6
5 Ground
6 Internally connected to pin 4
7 Internally connected to pin 8
8 Internally connected to pin 7
9 N.C.

The RS232 interface supports the XON/XOFF protocol (software handshaking), but no hardware handshaking protocols. The use of software handshaking is configurable.

The settings of the RS232 interface (baud rate, number of stop and data bits) is controlled by the script on the CompactFlash card.

Baud rates.....all common Baud rates (1200, 2400, 4800, 9600, 19200, 28800, 38400, 57600 or 115200); special Baud rates, such as 31250 for MIDI, are supported as well.
Stop bits.....1 or 2.
Data bits.....5, 6, 7 or 8.
Parity.....none, odd, even, mark or space.
Handshaking.....none or XON/XOFF.

Real-time clock

The H0420 programmable MP3 player has a "real-time clock" to keep the time and date, plus script functions to manipulate the time and date, including an "alarm clock" function.

The real-time clock is based on a quartz crystal oscillator with an accuracy of ± 2.5 seconds per 24 hours at room temperature. The quartz crystal is not temperature-compensated (accuracy may degrade at low or high temperatures). The real-time clock is not battery backed: after a power loss the time in the device will reset to 00:00 hours at 1 January 1970.

Scripting

The script controls the operation of the H0420 and the peripherals. The script is written in the PAWN language and it is stored (in compiled form) on the CompactFlash card. In absence of a script, the H0420 plays all MP3 files on the CompactFlash card in a random sequence. To react on switches or I/O pins and to communicate over RS232 or an optional LCD, a PAWN script is required. Full information on the PAWN language can be found on the company web site: http://www.compuphase.com/.

ID3 tag support

The scripting language gives the programmer access to the information in an ID3 tag (version 2), with information on the artist, album & track, full title, copyright, duration. In addition, an optional "synchronized lyrics" frame will cause scriptable events to be "fired" on the time stamps of the lyrics. Although the synchronized lyrics frame was originally designed for purposes of Karaoke and sub-titling songs, another use would be to tag *cues* or *commands* at specific positions in a song or audio fragment. The script can then interpret and execute these commands.

File I/O

The script can read and write files from/to the CompactFlash card for the purposes of storing configuration data, usage logging or reading a play list.

Extension connector

An extension connector is optionally mounted at the bottom side of the board. Suitable connectors are from the Molex "IEEE 1386 – Mezzanine" series, product numbers:

Headers	714360164	8mm
	714361164	9mm
	714362164	10mm
Sockets	714390164	8/9/10mm
	714391164	11/12mm
	714393164	14/15mm

See the section "Drawings" (page 9) for the position and orientation if the extension connector.

Pin description

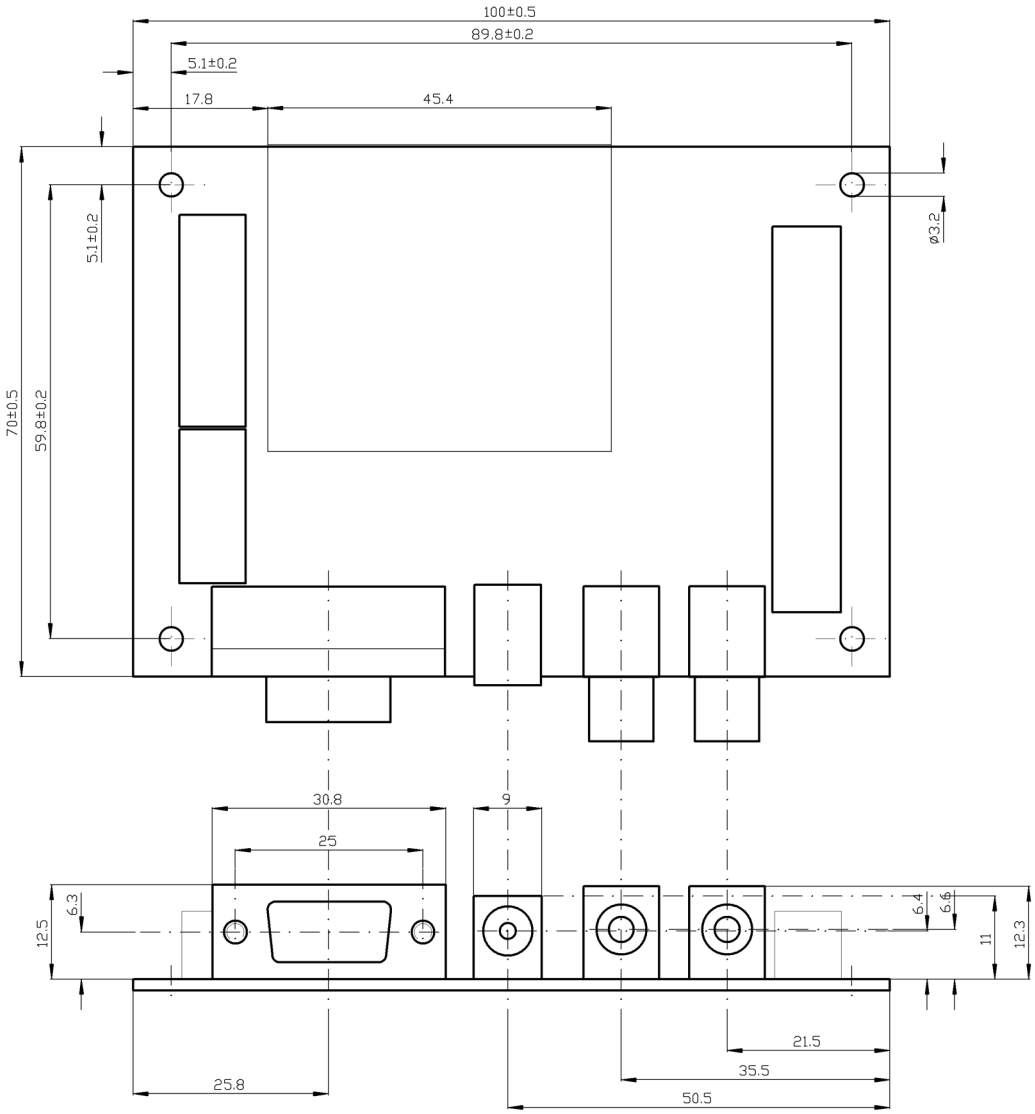
Audio right channel	1		64	Audio left channel
Audio ground	2		63	Audio ground
Vcc	3		62	Vcc
ATA D11	4		61	ATA D3
GND	5		60	GND
ATA D12	6		59	ATA D4
ATA D13	7		58	ATA D5
+3.3V	8		57	+3.3V
ATA D14	9		56	ATA D6
GND	10		55	GND
ATA D15	11		54	ATA D7
ATA $\overline{CS1}$	12		53	+3.3V
+3.3V	13		52	ATA $\overline{CS0}$
ATA $\overline{IOWR}$	14		51	GND
GND	15		50	ATA $\overline{IORD}$
I^2C_B SCL, or SPI $\overline{CS2}$	16		49	+3.3V
GND	17		48	ATA $\overline{INTRQ}$
I^2C_B SDA, or SPI $\overline{CS1}$	18		47	$\overline{RESET}$ (device reset)
GND	19		46	GND
I^2C $\overline{IRQ}$	20		45	SPI SI (serial in)
SPI SO (serial out)	21		44	SPI SCK
GND	22		43	GND
ATA IORDY	23		42	ATA $\overline{RESET}$
GND	24		41	GND
ATA A1	25		40	ATA A2
ATA A0	26		39	GND
GND	27		38	ATA $\overline{DASP}$
D0	28		37	ATA D1
+3.3V	29		36	GND
ATA D2	30		35	ATA D8
ATA D10	31		34	ATA D9
GND	32		33	GND

The ATA bus is used internally for accessing the CompactFlash card. These pins are reserved, and should not be used by any extension board.

The I^2C clock and data pins are also used for "chip select" signals for up to two SPI devices. In practice, this means that an extension board can use *either* I^2C *or* SPI to communicate with the H0420, but not both.

Drawings

Top side



See also section "Mechanical" on page 3. Unless specified otherwise, dimensions have a tolerance of ± 0.5 mm.

Reverse side (extension connector)