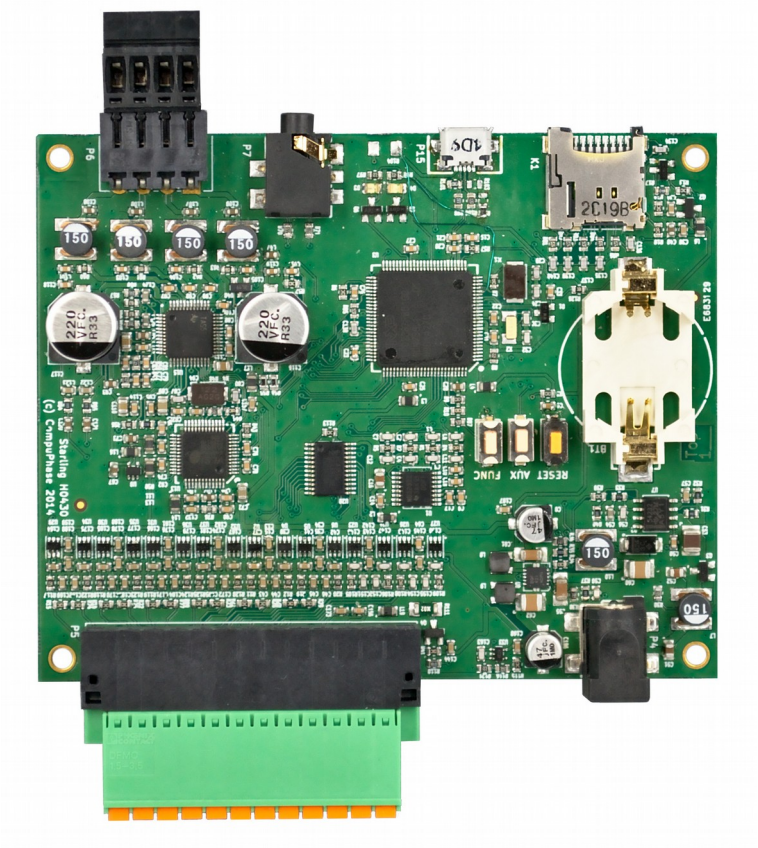
Starling — model H0430



ITB CompuPhase **Eerste Industriestraat 19-21** **1401 VL Bussum** **The Netherlands**
telephone: +31 (0)35 6939261 **fax: +31 (0)35 6939293** **email: info@compuphase.com**

The Starling audio controller/player model H0430 is a solid-state programmable controller equipped with a class D power amplifier and interfaces for auxiliary peripherals and/or connectivity.

Features

- Decoder for MP3, Ogg Vorbis and uncompressed PCM; AAC on request.
- Power amplifier 2×15 Watt in 8Ω.
- Volume and tone control; VU-meter for audio volume monitoring or leveling.
- Wide range input power: 7.5 V to 28 V DC.
- Micro-SD card support for content (audio and user programs), including support for SD-HC.
- USB interface, for file transfer or control.
- Two RS232 ports, one SPI port.
- Sixteen general-purpose I/O pins with configurable logical voltage. Four pins are shared with the SPI port. Eight pins have a configurable debounce filter to optionally debounce switch or relay contacts.
- One analogue output pin.
- Temperature sensor.
- Real-time clock with backup battery.
- Two general-purpose switches, two general-purpose LEDs.
- User programmable in the Pawn programming language.
- Optional strong encryption (128-bit key) of the audio content.
- Designed for industrial temperature range (-40 °C to +85 °C).

RoHS COMPLIANT

Specifications

Absolute maximum ratings

Operating voltage.....-0.3 V to +28 V.
Input voltage on I/O pins.....-0.5 V to +6.5 V.

General

Operating voltage.....+7.5 V DC to +28 V DC.
Current consumption.....at 7.5 V: 125 mA when playing audio but without load (no speakers connected).
At 12 V: 110mA when playing audio but without load (no speakers connected).
Supported formats.....MPEG layer III (“MP3”) for MPEG versions 1, 2 & 2.5;
Ogg Vorbis, floor 1; RIFF WAV (8-bit & 16-bit), including A-Law, µ-Law and IMA ADPCM; MIDI format 0;
AAC-LC(+PNS) & HE-AAC level 3 (SBR+PS); **AAC support requires a license**.

Speaker output

Speaker impedance.....4 Ω minimum, 8 Ω nominal.
Power output per channel.....4.1 W at 8 V, 10 W at 13 V, 15 W at 18 V (10% THD, 1 kHz).
Distortion+Noise.....THD+N < 0.2% at 1 kHz, at 8 V and 1 W output;
THD+N < 0.13% at 1 kHz, at 13 V and 1 W output.
Noise.....SNR 93 dB at 1kHz (A-weighted).
Cross-talk.....-82 dB at 1 kHz and 0.25 W output.

Headphone/line output

Load impedance.....16 Ω minimum, 30 Ω nominal for headphones, 600 Ω nominal for line-out.
Distortion+Noise.....THD+N < 0.1% at 1 kHz.
Noise.....SNR 93 dB at 1kHz +0 dBu (A-weighted).
Cross-talk.....-80 dB at 1 kHz and 600 Ω load; -53 dB at 1 kHz and 30 Ω load.

Integrated peripherals

Temperature sensor.....Measures -40 °C to +125 °C; typical accuracy 0.5 °C.
Real-time clock.....Inaccuracy < ±1.7 seconds per 24 hours.
Pseudo-random numbers.....Cryptographic strength, cycle length 2^{32}, initialized from a true random seed.
RS232 interfaces.....Two interfaces conforming to 3-wire RS232 ports; standard signal levels.
SPI interface.....Standard SPI interface, with programmable voltage level and a slave select line.
USB.....Full-speed device, identified as CDC/ACM class.
Digital I/O.....16 general-purpose I/O pins, with programmable voltage level (2.5 V to 5.0 V); max. 40 mA source or sink; all pins are ESD/EMC filtered.
Analogue out.....1 software-controlled analogue output pin.

Mechanical

Dimensions.....100 mm × 80 mm.
Maximum height above PCB.....11.2 mm (DC power connector).
Maximum height below PCB.....1.6 mm

PCB thickness.....1.6 mm.
Weight.....0.070 kg.
Mounting holes.....Four mounting holes Ø3 mm spaced 93 mm horizontally and 73 mm vertically. The holes are *not* electrically connected to PCB ground.
See also *Drawings* on page 7.

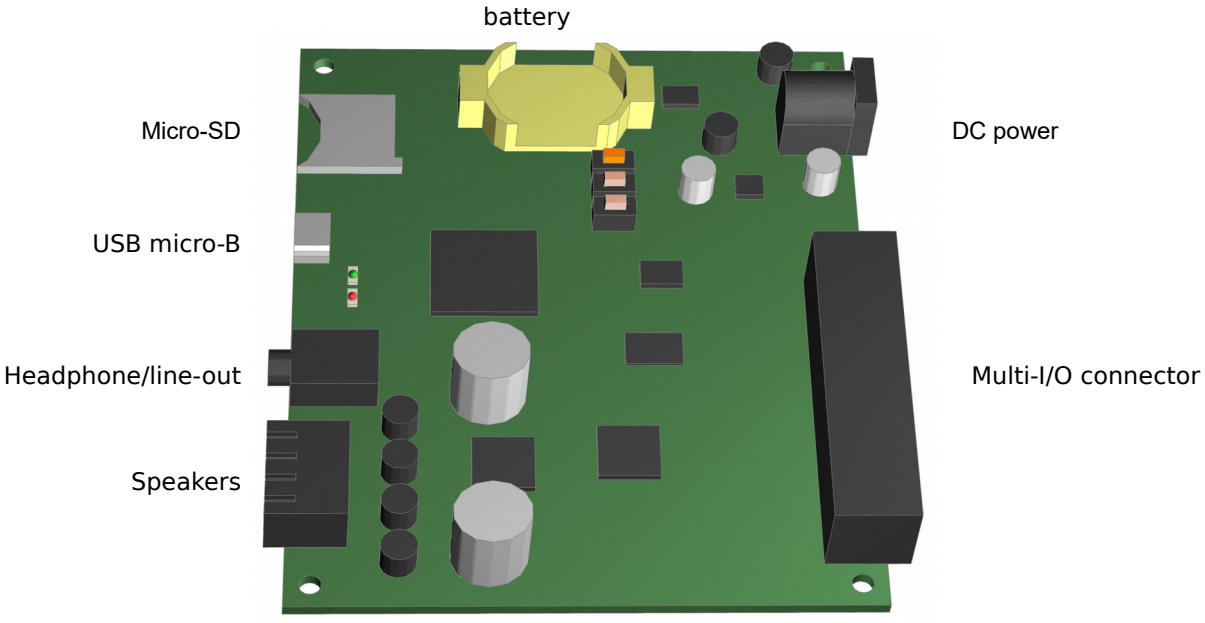
Operating conditions

Temperature.....Designed for -40 °C to +85 °C.
Humidity.....5% to 95% non-condensing.
Vibration.....Full solid-state device, no moving parts.

Conformity

EMC (emission/immunity).....Compliant with EU Directive 2004/108/EC: EN 55022 and EN 55024 + A1 (2001) + A2 (2003).
Electrical safety.....Compliant with EU Directive 2006/95/EC: EN 60950-21
RoHS.....Compliant with EU Directive 2002/95/EC.

Interface specifications



Micro-SD memory card

The Starling is equipped with a push/push Micro-SD card connector. When a card is inserted, it exceeds the edge of the Starling circuit board by approximately 3.3 mm.

Both the original format and the “high capacity” formats (SD-HC cards) are supported. SD-XC cards are supported after reformatting them with a standard FAT file system.

The Micro-SD memory card must hold all the audio tracks and the user programs (“scripts”).

USB connector

The USB connector is a standard micro-B connector. The Starling is configured as an USB “device”.

The Starling implements the “communications device class” (USB CDC), so that it functions as a virtual

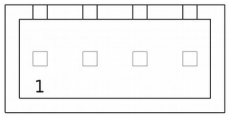
serial port. The USB port also serves for debugging scripts.

Headphone / Line-out connector

Line-level or headphone output is available on a stereo 3.5 mm TRS (“jack”) connector. The tip is the left channel, ring the right channel and sleeve the common return.

Speaker connector

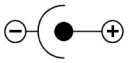
The speaker connector is a two-part terminal block, consisting of a plug with four screw terminals and a socket on the H0430. For the wire polarity, see the diagram below.



1	Right channel, black wire
2	Right channel, red wire
3	Left channel, black wire
4	Left channel, red wire

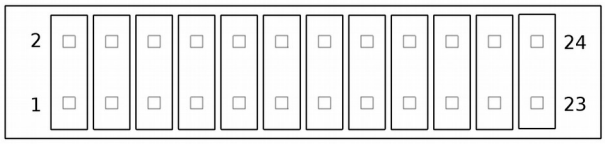
Power connector

The Starling needs DC voltage in the range of 7.5 V to 28 V. The DC power connector specifications are outer diameter Ø5.5 mm, pin diameter Ø2.1 mm. The (centre) pin is the positive pole.



Multi-I/O connector block

The multi-I/O connector is a two-part terminal block, consisting of a plug with 24 spring-cage terminals and a socket on the H0430.



1	General I/O pin 0	2	General I/O pin 1
3	General I/O pin 2	4	General I/O pin 3
5	General I/O pin 4	6	General I/O pin 5
7	General I/O pin 6	8	General I/O pin 7
9	General I/O pin 8	10	General I/O pin 9
11	General I/O pin 12	12	General I/O pin 11
13	SPI MOSI / general I/O pin 14	14	SPI SSEL / general I/O pin 13
15	SPI MISO / general I/O pin 16	16	SPI SCK / general I/O pin 15
17	Analogue output	18	Ground
19	Power (fused at 400 mA)	20	Ground

21	RS232 port 2 TxD	22	RS232 port 2 RxD
23	RS232 port 1 TxD	24	RS232 port 1 RxD

General purpose I/O

The 16 general purpose digital I/O pins can be configured as input or output. The I/O pins are EMC and ESD filtered, and slew-rate limited to 1 MHz. I/O pins 12 through 15 are multiplexed with SPI functionality; they can be configured as either SPI or digital I/O.

When the I/O pins are configured as inputs, the pins are 5 V-tolerant. I/O pins 0 through 11 have a pull-up resistor of 10 kΩ; I/O pins 12 through 15 have no pull-up or pull-down. The pins 0 through 7 have a configurable software debounce filter; the pins 8 through 15 have a fixed software debounce filter. When the debounce filter is active on a pin, the maximum input frequency is 50 Hz.

When the I/O pins are configured as outputs, the high-level voltage for the pins is the configurable *external voltage*, which is 3.3 V by default.

Each output pin has a series resistor of 120Ω for current limiting and short-circuit protection. The output current drawn from a pin should not exceed 24mA. The output pins can directly drive a LED (or a similar load, such as an opto-coupler), usually without requiring an *external* current-limiting resistor. The current limit depends on the forward voltage of the LED and the configured voltage of the output pins. At the default pin voltage of 3.3 V and a green LED with a typical forward voltage of 2.1 V, the current is:

$$I = \frac{V_{ext} - V_F}{R_{limit}} = \frac{3.3 - 2.1}{120} = 10\,mA$$

The analogue pin is output-only; it has a range from 0 V to the *external voltage*. The analogue output pin is limited to 100 kHz. The pin has a series resistor of 220Ω for current limiting and short-circuit protection.

SPI (serial communication)

The SPI pins are multiplexed with the I/O pins. When SPI is enabled, I/O pins 12 through 15 are not available.

The voltage levels of the SPI signal pins is the configurable *external voltage*, which is 3.3 V by default. The maximum SPI clock frequency is 8 MHz.

RS232 (serial communication)

All common Baud rates are supported (1200, 2400, 4800, 9600, 19200, 28800, 38400, 57600 or 115200); special Baud rates, such as 31250 for MIDI, are supported as well. The number of data bits and stop bits, and the parity is configurable in the user program.

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

Power out

An output power pin is provided on the multi-I/O connector; this power output pin must be enabled by the script, it is disabled by default.

The voltage of the power output pin (if enabled) is the *external voltage*. The power output has a self-resetting fuse for short-circuit protection. The maximum current that can be drawn from the power pin (V_{EXT}) is 400 mA. The voltage of V_{EXT} is configurable (by script) between 2.5 V and 5.0 V and it must be enabled before use.

Real-Time clock (battery backup)

A real-time clock for keeping the time is integrated. A CR2032 battery needs to be installed for the real-time clock to keep running without main input power.

The real-time clock is based on a quartz crystal oscillator with an inaccuracy of maximum 1.7 seconds deviation per 24 hours, at room temperature. The oscillator is not temperature-compensated.

When no battery is present, the device resets to 00:00 hours at 1 January 1970 after loosing power.

Temperature sensor

The temperature sensor has a range of -40 °C to +125 °C, with a precision of 0.5 °C and an accuracy of ±2 °C. The temperature can be read using the Pawn scripting language.

Note that although the temperature sensor measures temperatures up to +125 °C, temperatures above +85 °C are outside the specifications for the operating conditions of the Starling.

General-purpose switches

The Starling model H0430 has three “push-button” switches on the circuit board, marked RESET, FUNC and AUX. The switch marked RESET always resets the device, this cannot be reprogrammed. The switches marked FUNC and AUX have as the default functionality to increase and decrease the amplifier gain respectively. The default operation can be disabled by a user program and the FUNC and AUX can also be used from within a user program.

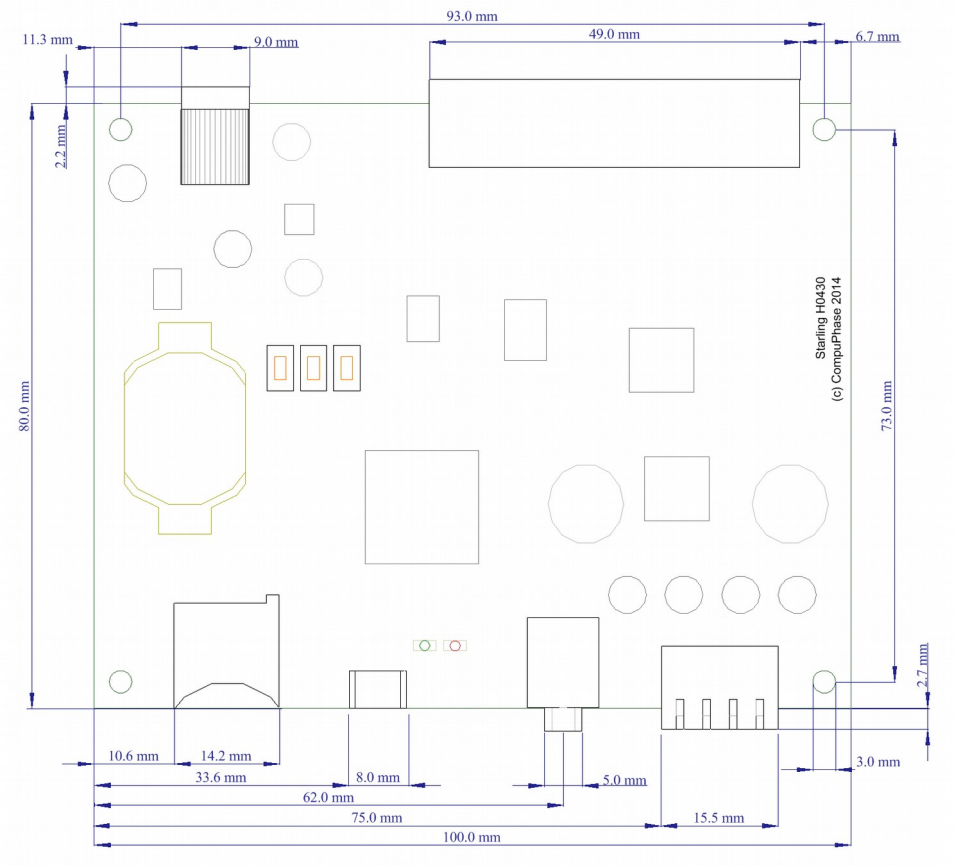
General-purpose LEDs

The Starling has two general-purpose LEDs, one red, one green. The default function of the green LED is to indicate power, while the red LED blinks during access of the memory card. A user program can change the functionality of the LEDs.

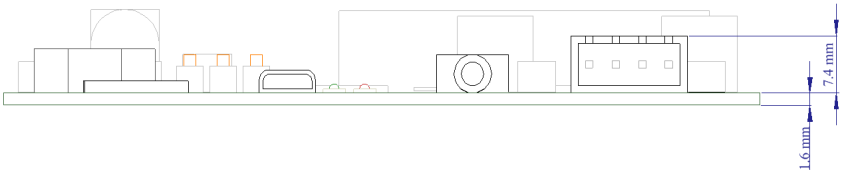
User program

The script controls the operation of the Starling and its peripherals. The script is written in the PAWN language and it is stored (in compiled form) on the memory card. Version 4.0 (or later) of the PAWN toolkit is required for the Starling. Full information on the PAWN language can be found on the company web site: http://www.compuphase.com/pawn/.

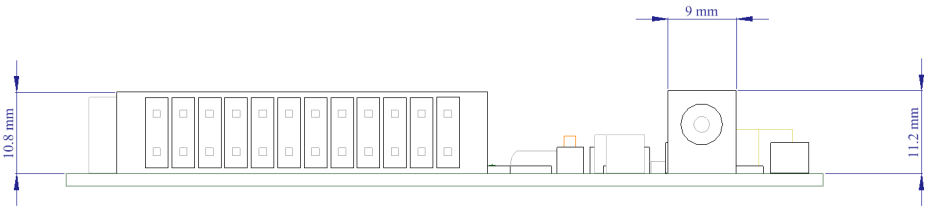
Drawings



Top view



Side view: micro-SD, USB, headphone/line-out and speaker connectors



Side view: power and multi-I/O connectors