



HX3695 Preliminary Data Sheet v0.2

Product Definition

HX3695 is an ultra-low power Integrated AFE for Wearable, Optical, Heart-Rate Monitor and Bio-sensor.

Description

HX3695 is an ultra-low power integrated AFE for Wearable, Optical, Heart-Rate Monitor and Bio-sensor with I2C/SPI interface. HX3695 include transmitter and receiver two parts. The receiver have four PPG input channels, $\pm 172\mu\text{A}$ offset IDAC and a high resolution ADC. The transmitter has eight fully-integrated LED drivers with 8-bit current control. The device has a high dynamic range transmit and receive circuitry that helps with the sensing of very small signal.

Features

Accurate, Continuous Heart-Rate Monitoring:

1. Up to 110-dB dynamic range for accurate heart-rate detection
2. Support eight phase data in each conversion period
3. Selectable PPG channel and LED driver in each conversion phase
4. Low power for continuous operation on a wearable device with a typical value:
20 μA for an LED, 20 μA for the Receiver
@ FS=25Hz, LED on time = 32 μs , LED driver = 25mA

Transmitter:

1. 8 LEDs in common anode configurations
2. 8-Bit programmable LED current to 200 mA
3. Selectable LED on time
4. Simultaneous support of 8 LEDs for optimized SpO₂, HRM, or multi-wavelength HRM
5. Average current of 20 μA adequate for a typical heart-rate monitoring scenario:
@ FS=25Hz, LED on time = 32 μs , LED driver = 25mA

Receiver:

1. Supports 4 time-multiplexed PD inputs
2. 21-Bit representation of the current Input from a photodiode in unipolar straight binary format
3. Individual DC offset subtraction IDAC (Up to $\pm 172\mu\text{A}$) at TIA input for each phase
4. TIA mode resistor range from 10K to 2M
5. Software sleep mode: approximately 1.5 μA current

Pulse Frequency: 1 SPS to 1000 SPS

FIFO With 256-Sample Depth

I2C/SPI Interface

Operating Temperature Range: -20°C to 85°C

Supplies:

1. TX_SUP = 3.3 V~5.25 V
2. VDDA = 2.7 V~3.6 V
3. IO_SUP = 1.8 V~VDDA

Applications

1. Optical Heart-Rate Monitoring (HRM)
2. Heart-Rate Variability (HRV)
3. Pulse Oximetry (SpO₂) Measurements
4. Maximum Oxygen Consumption (VO₂ Max)

PKG Information

2955*2655*468 μm WCLSP42

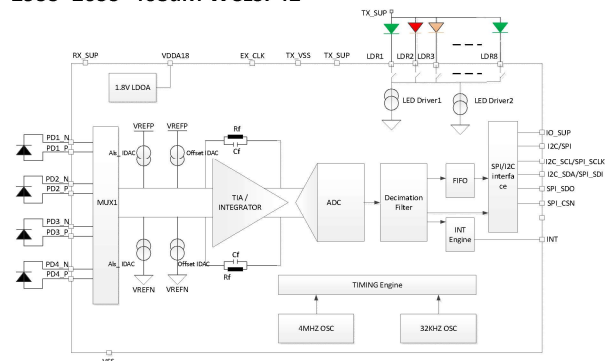


Figure 1. Simplified Block Diagram

*Disclaimer:

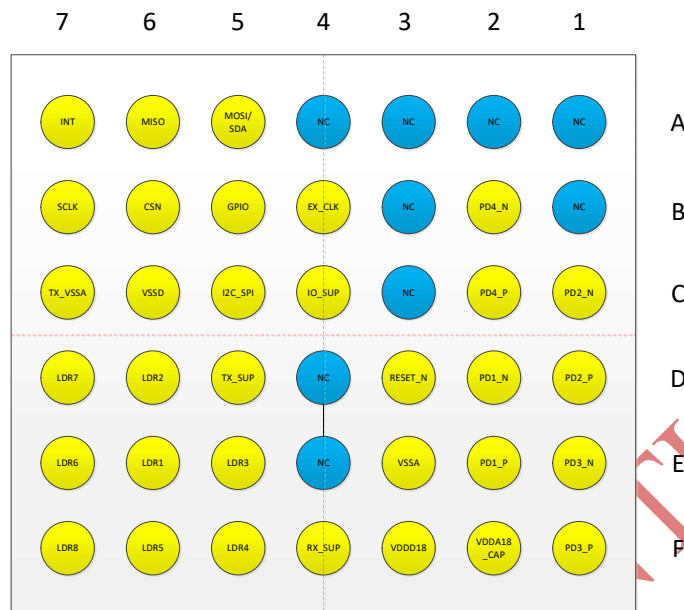
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**Pin Configuration****Figure 2. HX3695 WLCSP42 Bottom View Pin Configuration****PIN List**

Pin	Name	Type	Description
A1	NC	NC	---
A2	NC	NC	---
A3	NC	NC	---
A4	NC	NC	---
A5	SPI_SDI_I2C_SDA	D	SPI: serial data in I2C: serial data transmit pin
A6	SPI_SDO	D	SPI: serial data out
A7	INT	D	Interrupt output, selectable open drain(default) or cmos
B1	NC	NC	---
B2	PD4_N	A	External photo diode anode input pin
B3	NC	NC	---
B4	EX_CLK		External clock input
B5	GPIO		General Input out Pin
B6	SPI_CSN	D	SPI: chip select
B7	SPI_CLK_I2C_SCL	D	Clock signal for SPI/I2C serial data
C1	PD2_N	A	External photo diode cathode input pin



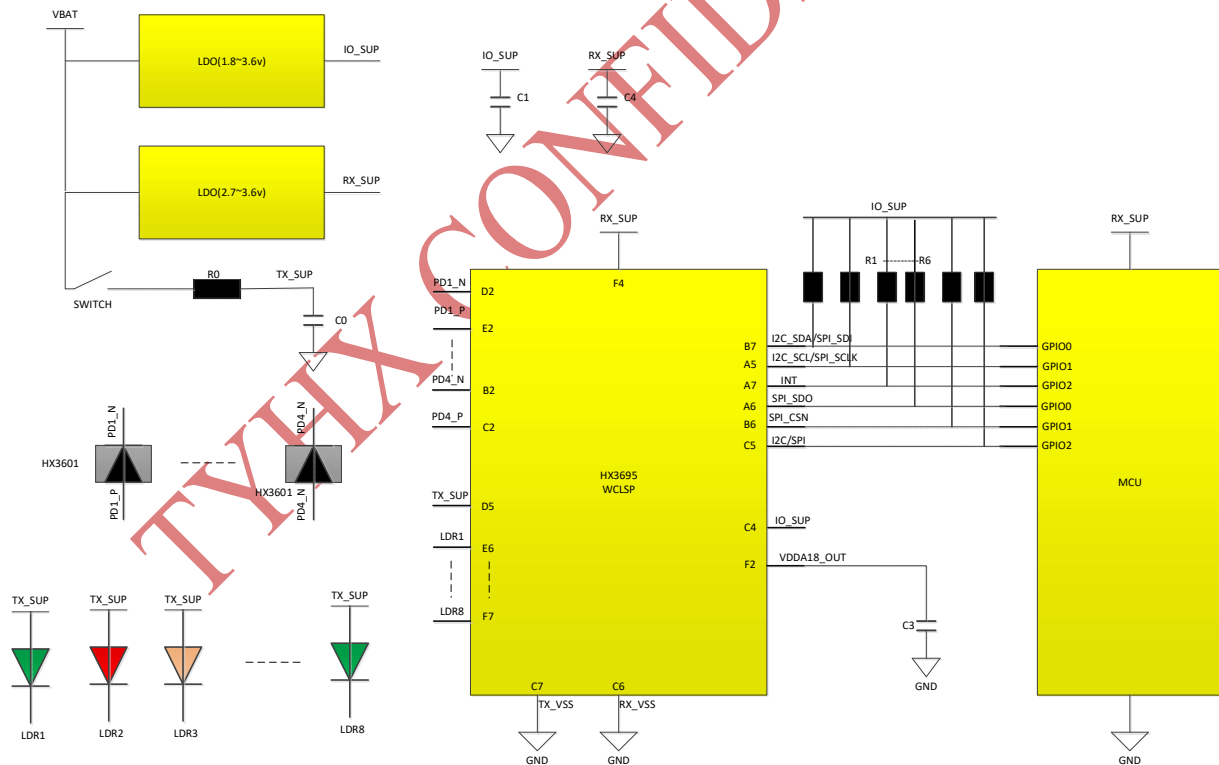
Pin	Name	Type	Description
C2	PD4_P	A	External photo diode cathode input pin
C3	NC	NC	---
C4	IO_SUP	POW	Digital IO power supply
C5	SPI_I2C	D	select SPI I2C mode
C6	VSSD	A	Power supply ground
C7	TX_VSSA	A	Power supply ground for LED drivers
D1	PD2_P	A	External photo diode anode input pin
D2	PD1_N	A	External photo diode cathode input pin
D3	RESETN	D	Soft reset pin
D4	NC	NC	---
D5	TX_SUP	POW	Power supply ground for LED drivers
D6	LED_DR2	A	LED driver2, up to 200Ma
D7	LED_DR7	A	LED driver7, up to 200Ma
E1	PD3_N	A	External photo diode anode input pin
E2	PD1_P	A	External photo diode anode input pin
E3	VSSA	A	Power supply ground
E4	NC	NC	----
E5	LED_DR3	A	LED driver3, up to 200Ma
E6	LED_DR1	A	LED driver1, up to 200Ma
E7	LED_DR6	A	LED driver6, up to 200Ma
F1	PD3_P	A	External photo diode cathode input pin
F2	VDDA18_CAP	A	Internal 1.8V LDO output, need 10uf capacitor to GND
F3	VDDD18	A	Internal 1.8V LDO output, need 10uf capacitor to GND
F4	RX_SUP	POW	Power supply voltage
F5	LED_DR4	A	LED driver4, up to 200Ma
F6	LED_DR5	A	LED driver5, up to 200Ma
F7	LED_DR8	A	LED driver8, up to 200Ma

Table 1 HX3695 PIN list

**Application Information****Reference Schematic**

A typical I2C interface application Schematic Diagram for HX3695 is shown in Figure 3. The I2C signals and the Interrupt are open-drain outputs and require pull-up resistor (Rp). It is recommended use 10 kΩ resistor when running at 400kbps.

DEVICE NAME	Value	Description
LDO	2.7~3.6 V	Low noise
R0	0 Ω	
R1---R6	10 KΩ	
C0	4.7 uF	
C1 C4	1 uF	
C3	10 uF	

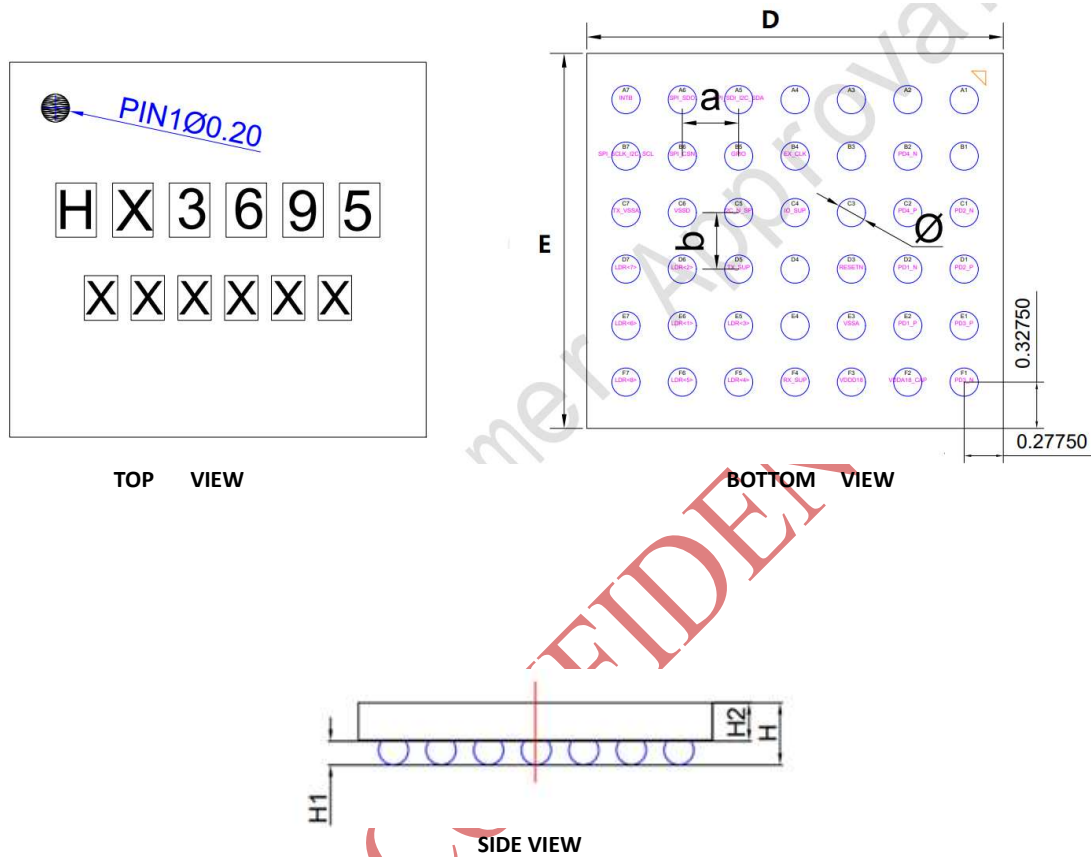
**Figure 3 Typical Interface Application Schematic Diagram**

Notes: When the chip is powered off (RX_SUP = 0V), the SWITCH must be turned off



Package Information

WCLSP42 Mechanical Dimension



SYMBOL	ITEM	DATA(um)
D*E	PACKAGE SIZE	2955*2655±100
Ø	BALL Diameter	241±20
a/b	BALL PITCH X/Y	400/400
N	BALL COUNT	42
H	PACKAGE HEIGHT	468±39.2
H1	BALL HEIGHT	132±13.2
H2	EMC THICKNESS	336±26

Recommended PCB Pad Layout

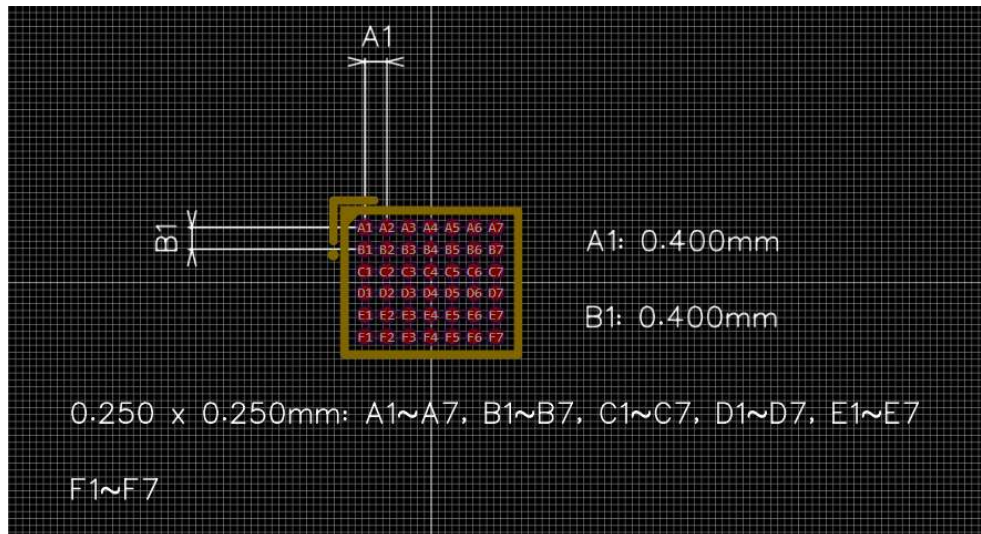


Figure4.WCLSP42 BALL PCB LAYOUT

Soldering Information

HX3695 has been tested and has demonstrated an ability to be reflow soldered to a PCB substrate. The process, equipment and materials used in these test are detailed below. The reflow soldering profile describes the expect maximum heat exposure of components during the reflow soldering process. Temperature is measured on top of components. The soldering process should be limited to a maximum of three phases according to this reflow soldering profile.

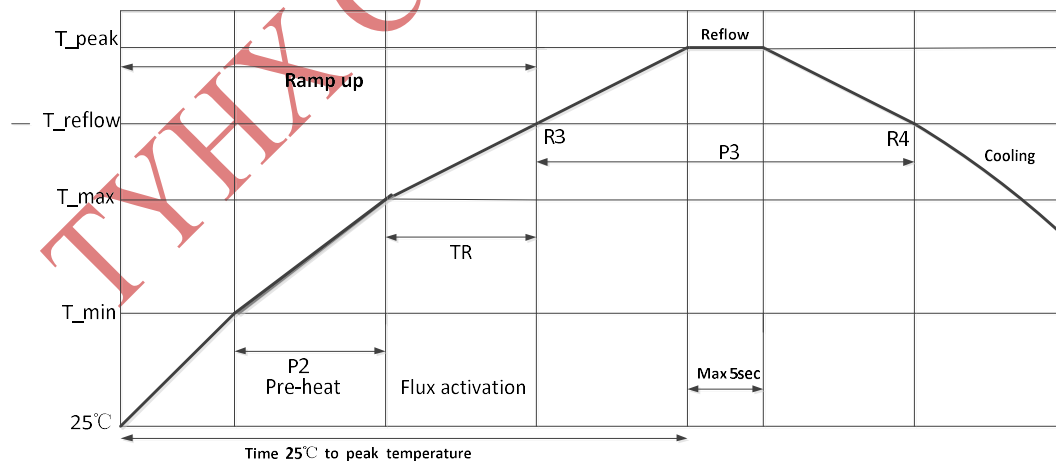


Figure5. HX3695 Reflow Profile Graph



The detail parameters are listed in the following table:

Table2 Reflow Soldering Profile Parameters

	Peak temperature (Tpeak)	250°C; Max 5sec
Pre-Heat	Temperature min (Tmin)	150°C; 2°C/Sec
	Temperature max(Tmax)	150-217°C; 100S to 180S
	P2: (T min to max)	90-110s
	Temperature (Treflow)	217 °C
Time maintain above	Time (P3)	60-90sec
	R3 Slope (from 217°C to peak)	2°C/sec(typ) to 2.5°C/sec(max)
	R4 Slope (from peak to 217°C)	1.5°C/sec(typ) to 4°C/sec(max)
	Time to peak temperature	480s Max
	Cooling down slope (peak to 217°C)	2-4°C/sec

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