Design Guide on Comparison between

RAK831 & RAK2245 Pi HAT

New features on the RAK2245

1. The GPS module on the RAK**2245** can now be accessed from the Raspberry Pi via I2C in addition to the UART interface provided in the RAK**831**. Software to communicate over I2C will be provided by RAK.

2. The accurate 1 pulse-per-second (1PPS) signal from the GPS is connected internally on RAK**2245** Pi HAT to the LoRa baseband chip. This enables native, very accurate, LoRa timestamps without the previous cable connection needed on RAK**831**.

3. The RAK**2245** Pi HAT now has a built-in ID EEPROM following the Raspberry Pi HAT convention to identify and configure the HAT.

Raspberry Pi GPIO port Numbering

First some basic information about a Raspberry Pi, the GPIO port and the numbering scheme.

All models of the Raspberry Pi have the same pin connection on the 40 Pin headers. Earlier models had 26 pins which have the same functions as the first 26 pins of the 40 pin header. However, the RAK**831** and RAK**2245** Pi HAT require the 40 pin version to operate

Pins are referenced by the physical (hardware) pin number (1-40) and by their software function which is often referred to as the BCM GPIO number.

PIN 1
(Square soldier pad)

GPIO Number (Software)	Header Pin Number (Hardware)		GPIO Number (Software)
3.3 Volt	1	2	5 Volt
GPIO 2 or **I2C SDA**	3	4	5 Volt
GPIO 3 or **I2C SCL**	5	6	Ground
GPIO 4	7	8	GPIO 14 or **Serial TxD**
Ground	9	10	GPIO 15 or **Serial RxD**
GPIO 17	11	12	GPIO 18
GPIO 27	13	14	Ground
GPIO 22	15	16	GPIO 23
3.3 Volt	17	18	GPIO 24
GPIO 10 or **SPI0 MOSI**	19	20	Ground
GPIO 9 or **SPI0 MISO**	21	22	GPIO 25
GPIO 11 or **SPI0 SCLK**	23	24	GPIO 8 or **SPI0 CE0**
Ground	25	26	GPIO 7 or **SPI0 CE1**
GPIO 0	27	28	GPIO 1
GPIO 5	29	30	Ground
GPIO 6	31	32	GPIO 12
GPIO 13	33	34	Ground
GPIO 19	35	36	GPIO 16
GPIO 26	37	38	GPIO 20
Ground	39	40	GPIO 21

Notes

The alternate pin descriptions above are those used by the RAK radio boards.

The alternate functions of the other pins can be found at https://pinout.xyz

Pin changes

To support the new features above we have changed some of the PIN definitions between RAK2245 Pi HAT and RAK831 convert board. **The difference of PIN definition between RAK2245 Pi HAT and RAK831 'Convert Board'**

(Green means no difference, Red means different.)

Header	Raspberry Pi	RAK831	RAK2245 Pi HAT
1	3.3 Volts	DC_3V3	3V3
2	5 Volts	DC_5V	5V
3	GPIO 2 or I2C SDA	RADIO_EN_A [5]	PI_GPS_SDA (I2C) [1]
4	5 Volts	DC_5V	5V
5	GPIO 3 or I2C SCL	RADIO_EN_B [5]	PI_GPS_SCL (I2C) [1]
6	Ground	GND	GND
7	GPIO 4	PA_EN_A [5]	NC
8	GPIO 14 or Serial TxD	NC	UART_RXD_GPS [1]
9	Ground	GND	GND
10	GPIO 15 or Serial RxD	NC	UART_TXD_GPS [1]
11	GPIO 17	RESET	RESET
12	GPIO 18	NC	NC
13	GPIO 27	RADIO_RST [5]	NC
14	Ground	GND	GND
15	GPIO 22	SX1301_GPIO1 LED [4]	NC
16	GPIO 23	NC	NC
17	3.3 Volt	NC	NC
18	GPIO 24	NC	NC
19	GPIO 10 or SPI0 MOSI	SX1301_MOSI	PI_MOSI
20	Ground	GND	GND
21	GPIO 9 SPI0 MISO	SX1301_MISO	PI_MISO
22	GPIO 25	NC	NC
23	GPIO 11 or SPI0 SCLK	SX1301_SCK	PI_CLK
24	GPIO 8 or SPI0 CE0	SX1301_CSN	PI_CS0
25	Ground	GND	GND
26	GPIO 7 or SPI0 CE1	NC	NC
27	GPIO 0 or HAT	NC	PI_ID_SDA [3]
28	GPIO 1 or HAT	NC	PI_ID_SCL [3]
29	GPIO 5	SX1301_GPIO3 (LED) [4]	NC
30	Ground	GND	GND
31	GPIO 6	SX1301_GPIO4 (LED) [4]	NC
32	GPIO 12	NC	NC
33	GPIO 13	SX1301_GPIO2 (LED) [4]	RESET_GPS
34	Ground	GND	GND
35	GPIO 19	SX1301_GPIO0 (LED) [4]	STANDBY_GPS
36	GPIO 16	PA_G16	NC
37	GPIO 26	NC	NC
38	GPIO 20	PA_G8 [5]	NC
39	Ground	GND	GND
40	GPIO 21	LNA_EN_A [5]	NC

Notes

	Feature	RAK831	RAK2245 Pi HAT
1	GPS Module	GPS module could be connected to RasPi using links via a Serial connection but software was not activated	GPS module controlled by Raspi by Serial UART or by I2C
2	1-PPS signal	1-PPS signal derived from GPS module and fed to RAK831 radio board via a RF Cable	Connection is made on the PiHAT circuit board between the GPS module and SX1301 chip
3	Pi HAT Specification	Not applicable	RAK2245 conforms to the Pi HAT specification. This allows the Raspberry Pi to identify the RAK2245 PiHAT and automatically configure the GPIO pins. This is achieved via an EEPROM on the RAK2245 which communicates via Header (hardware) pins 27 and 28
4	SX1301 LED	The SX1301 radio chip includes LED drivers to indicate chip status. These signals were also fed to Raspi inputs to allow software to monitor radio chip status. These connections are not used in the Gateway software and require additional software in the Raspi.	
5		The SX1301 radio chip has additional outputs which were connected to the Raspi to allow monitoring the SX1301 radio chip. These connections are not used in the Gateway software and require additional software in the Raspi.	
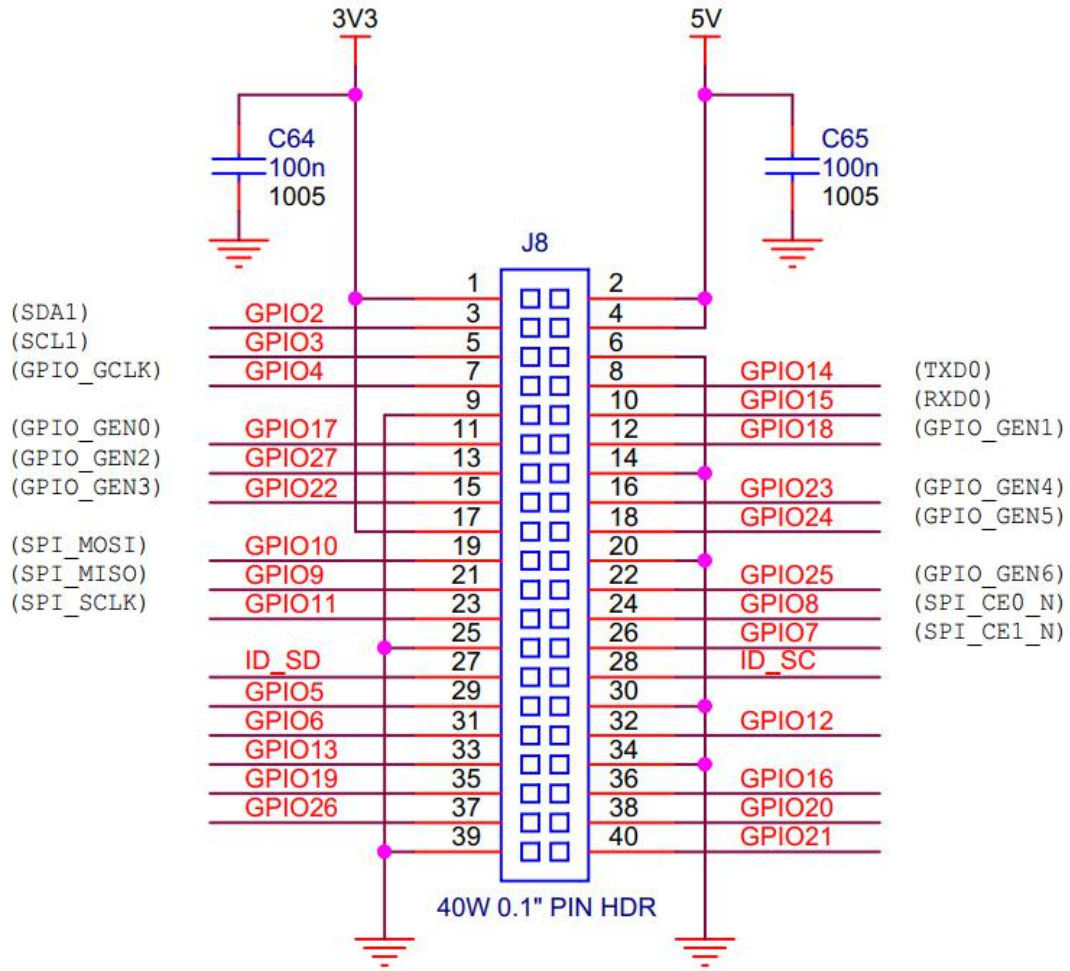
GPIO EXPANSION

ID_SD and ID_SC PINS:

These pins are reserved for HAT ID EEPROM.

At boot time this I2C interface will be interrogated to look for EEPROM that identifies the attached board and allows automatic setup of the GPIOs (and optionally, Linux drivers.)

DO NOT USE these pins for anything other than attaching an I2C ID EEPROM.

Leave unconnected if ID EEPROM not required.