

ING918X Hardware Design Guide

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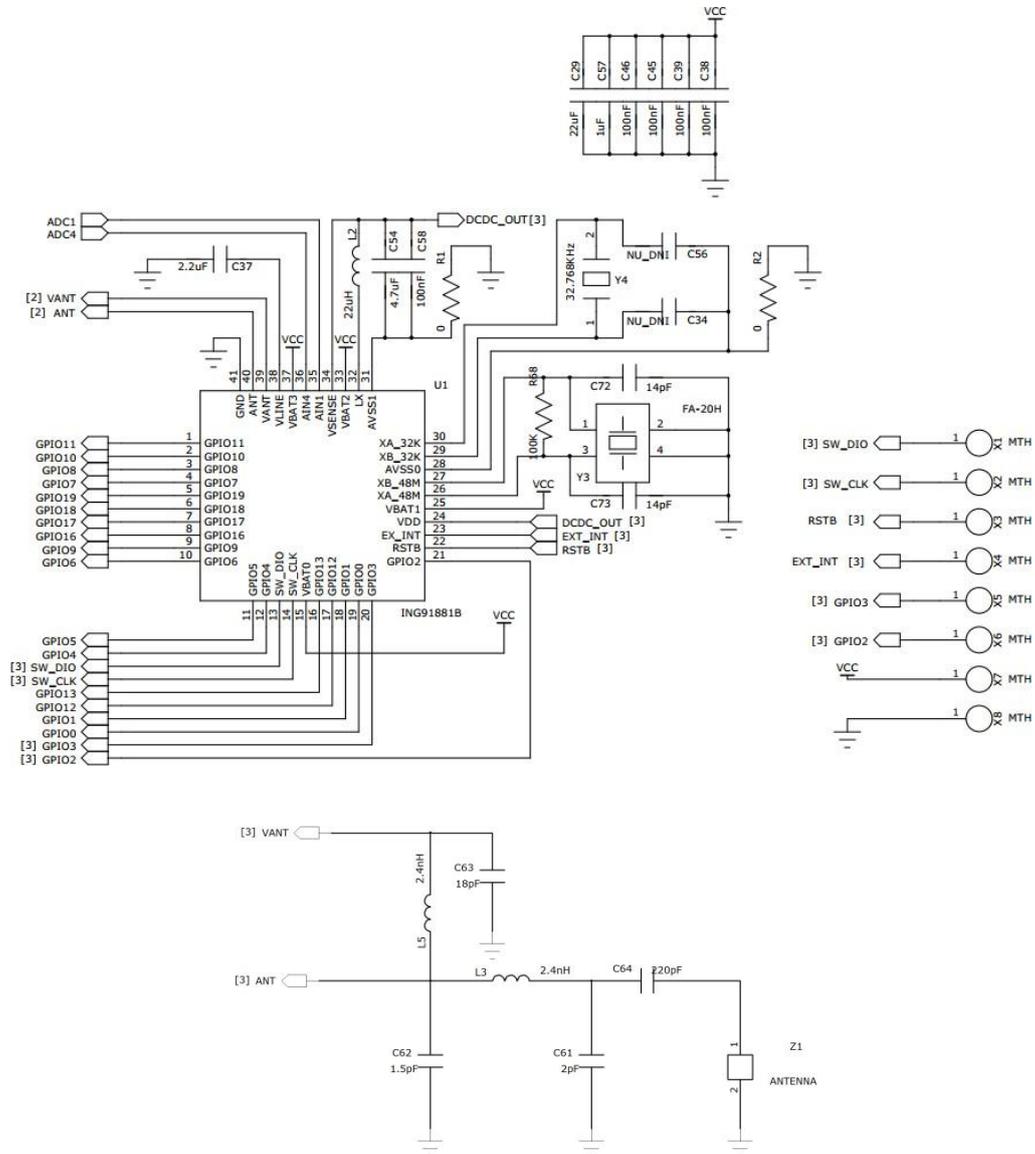
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Reference circuit



一、 Power Supply

The chip supports 1.62-3.63V DC power supply. The recommended power supply voltages from tech process are 1.8V, 2.5V and 3.0V. Each VBAT pin on the PCB is attached with a 0.1u capacitor. If conditions permit, the power input can increase the capacitance to suppress power interference.

二、 DCDC periphery

- The ground avss of DCDC is connected to the chip ground through a 0 ohm resistance. The 22uH inductance parameter requirement used by DCDC: inductance 22u, maximum ESR 500mohm, current greater than 10mA.
- DCDC related pins: VSENSE LX AVSS VDD wiring should be as short as possible. In order to avoid interference of 48M clock, they can be layout on other layers.

三、 Internal pull-up/down

The RSTB pin has a pull-up resistor (about 10k) inside the chip to the power supply, EXT_INT pin has pull-down resistance inside the chip (about 10k) to the ground. At the same time, as the default communication interface, the SW interface and GPIO3 also have pull-up and pull-down default configurations. And other GPIOs are default high impedance which need to be configured to pull-up or pull-down.

四、 SW debug port

SW_DIO and SW_CLK is a SW debug port, and cannot be used as an ordinary gpio.

五、 PWM Configuration

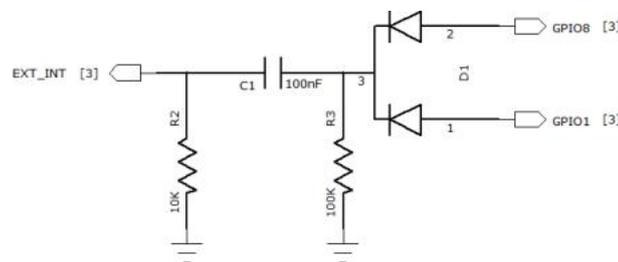
The PWM function can only use GPIOs from GPIO0 to GPIO11. Other peripherals such as I2C, Uart, SPI, etc. can be configured to any GPIO pins; but as the default program downloading UART, it can only be GPIO2 and GPIO3.

六、 EXT_INT port

EXT_ The INT pin has two functions:

- a) Burning program: If EXT_ INT is high, it will enter the burning mode. At this time, it can cooperate with computer software or mcu to update the firmware through the serial port (gpio2 sends/gpio3 receives).
- b) Wake-up from sleep: When the chip configured as external interrupt wake-up, pulled high the EXT_ INT, the chip can be woken up. If INT is kept high, the chip cannot enter sleep again, so EXT_ INT shall use pulse wake-up with width greater than 100uS and less than 1mS. Continuous high level signal can be converted into pulse signal through capacitance resistance..

If it is necessary to support multi-channel wake-up source, refer to the circuit diagram:



七、UART software upgrade

The following four signal lines are required for firmware upgrade through the serial port: EXTINT, RSTB, GPIO2 and GPIO3. Test points for these four signals are reserved on the PCB to facilitate burning and debugging.

- If the master needs to be upgraded through the master MCU in the application, these signal lines also need to be controlled by the MCU.
- GPIO2 and GPIO3 are the same as other GPIOs in normal operation, and can be used as common GPIO and peripheral interfaces.

八、48M Crystal

The 48M crystal determines the frequency offset of RF. The crystal selection and matching capacitance need to be tested in small batches before mass production. Changing the crystal requires readjusting the matching capacitance and re-testing.

Main parameters of 48M crystal:

Load Capacitance: About 10pF. The matching capacitance needs to be adjusted according to different capacitance values: $CL1=CL2=2(CI-Cs)$

Equivalent Resistance: Less than 50 ohms

7.4.3 48MHz 晶体振荡器

表 7-6 48MHz 晶体振荡器参数

Parameters	Symbol	Min.	Typ.	Max.	Unit	Notes
Nominal frequency	F_{N48M}		48		MHz	
Frequency accuracy	F_{ACC_48M}	-20		+20	ppm	Frequency accuracy depends on XTAL spec.
Load capacitance	C_L_{48M}		10		pF	
Equivalent resistance	ESR_{48M}		50		ohm	

48MHz 晶体振荡器 IO 结构如图 2-4.

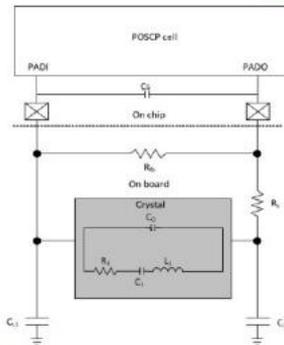


图 7-2 48MHz 振荡器

为了达到准确的时钟频率，反馈电阻 C_b 推荐值 100KOhm，板级电容 C_{L1} 和 C_{L2} 与芯片寄生电容 C_s 以及晶体负载电容 C_L 有关，计算公式为 $C_{L1} = C_{L2} = 2(C_L - C_s)$ 其中 C_s 固定为 2.5pF，推荐使用 C_L 值为 10pF 的晶体，所以 C_{L1} 和 C_{L2} 推荐值 15pF。如果客户使用不同于推荐值参数的晶体和板级电容，请于桃芯科技联系。

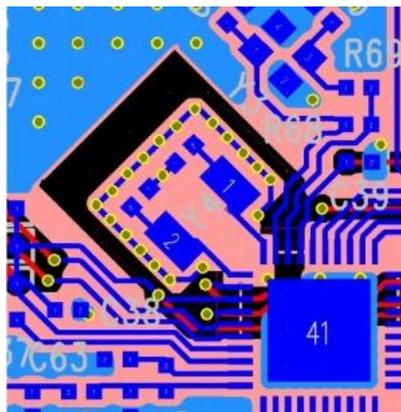
Reference Crystal:

- Hubei Taijing Electronic Technology Co., Ltd., crystal model: SX20Y048000B31T-8.8, parameter: 48.000MHZ 8.8PF \pm 10PPM, board level matching capacitor 12pF.
- Shenzhen Jingkexin Industrial Co., Ltd., crystal model: SJK-7F48000M8HD310E3, parameter: 48.000MHZ 8.8PF \pm 10PPM, board level matching capacitor 13pF.

九、32K Crystal

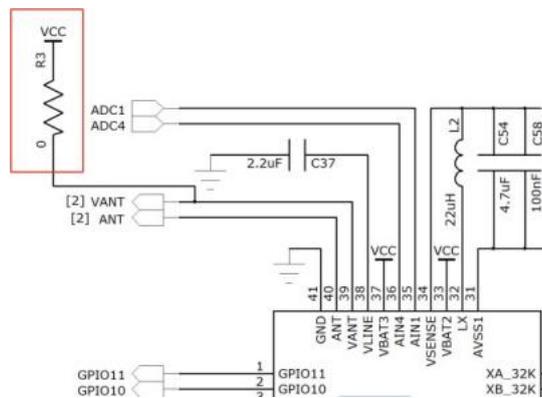
32k can use either the RC inside the chip or the external 32K crystal. Generally, 32k inside the chip can meet most applications. After software calibration, the 24-hour deviation is 2-3 seconds.

In particular, if the external 32K crystal is used, pay attention to isolation (wrap the 32K related wiring with gnd) to avoid interference.



十、RF Transmission Power

- The chip can set the maximum transmission power of 6.5dBm through software configuration. Experienced users need to match RF parameters, which can improve the transmission power and is more power saving friendly.
- Increase the transmission power: The transmission power can be increased to 10db by external power supply to the *vant* pin. If this is required, the reference circuit is as follows. Please consult INGCHIPS Technology for software configuration.



十一、Improve transmission power through external PA

For specific scenarios, the transmitting power and receiving sensitivity need to be improved, then PA could be added. GPIO2 and GPIO6 are tx_en and rx_en respectively, and the reference design circuit is as following diagram. For software configuration, please consult INGCHIPS Technology.

