

Special Considerations when using a 32K Crystal

D/N : HA0259E

Introduction

Holtek offers a diverse range of MCUs which can be operated with various oscillator options. Different oscillator options provide the user with a larger functional range for various applications. Holtek MCUs support oscillator types which include high frequency crystal (HXT), external RC (ERC), internal high frequency RC (HIRC), external low frequency crystal (LXT) and internal low frequency RC (LIRC). The oscillator selection is made through option and register configurations.

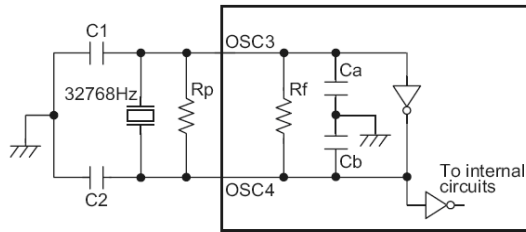
The external low frequency crystal means that a 32768Hz crystal oscillator (RTC) is used and is widely used in Holtek MCU devices. The following description introduces some special points which should be considered when using a 32768Hz crystal oscillator.

Operating Principles

When the MCU enters the idle or halt mode, the system clock will be disabled to reduce power consumption. In some applications however, to maintain some functions such as timer or other functions, the system may need to provide an extra clock. The 32768Hz crystal oscillator, the so-called RTC (Real Time Clock), is used for such requirements. For different MCUs, the 32768Hz crystal oscillator will connect to different pins. For example, in the HT48R063/064/065/066 it is connected to the OSC1 and OSC2 pins, while in the HT48R0662/067 it is connected to the XT1 and XT2 pins. On the HT46R92/94 it is connected to the OSC3 and OSC4 pins.

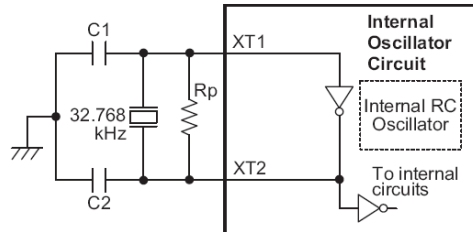
Looking at the internal oscillator circuit of the Holtek MCUs, there are two types:

- Includes an internal RC circuit as shown in figure 1, e.g. HT46R92 MCU
- No internal RC circuit as shown in figure 2, e.g. HT66F40 MCU



Note: 1. Rp is normally not required.
2. Although not shown OSC3/OSC4 pins have a parasitic capacitance of around 7pF.

Figure 1



Note: 1. Rp, C1 and C2 are required.
2. Although not shown pins have a parasitic capacitance of around 7pF.

Figure 2

In figure 1, the HT46R92 internal oscillator circuit includes Rf, Ca and Cb. Rf is used to generate an operating point for the oscillator with a general impedance around 10MΩ while Ca and Cb compose a Pierce oscillator with an external 32768Hz crystal oscillator. Rp is used as a low voltage oscillator stop control which is not normally required. C1 and C2 are used for oscillator frequency trimming or oscillator matching as well as for start time control using the recommended value of 12pF or none.

In figure 2, the oscillator circuit in the HT66F40 does not include internal RC components. To ensure normal start up and accuracy of the 32768Hz crystal oscillator, it is necessary to connect two external small capacitors, C1, C2 as well as Rp. The C1 and C2 values are normally 8pF~12pF, however these value should be used for reference only. The recommended value for Rp is 5MΩ~10MΩ.

The Holtek MCUs which do not include internal RC components as part of their internal oscillator are as follows:

HT49R50B/HT49C50B, HT56R2x, HT56R62/644/654/65, HT56R64, HT56R66/666, HT56R678-R, HT56R688/678/668/67, HT56C678/668, HT67Fx0, HT69Fx0, HT45R37, HT46R06x, HT48R06x, HT45F23, HT46R01B/02B, HT48R01B/02B, HT46R01C/02C, HT48R01C/02C, HT66F03/04, HT68F03/04, HT66F20/30/40/50/60, HT68F20/30/40/50/60

Points to consider when using the 32768Hz crystal oscillator with Holtek MCUs:

- Check the Holtek MCU datasheet to see if the MCU can work with a 32768Hz crystal oscillator and check whether the oscillator RC components are embedded inside the oscillator circuit. If no internal RC components are embedded then Rp, C1 and C2 must be connected. C1 and C2 are low temperature drift capacitors.

- The 32768Hz crystal oscillator must be located as close as possible to the MCU and the routing to the MCU should be as short as possible. The VDD or GND circuit can be used as a guard to reduce EMI.
- When the system is powered on, to reduce the start up time of the 32768Hz crystal oscillator, a quick start bit in an internal register can setup a quick start function. Note however that this quick start function will increase the oscillator current consumption. After the oscillator is fully enabled, the quick start bit can be reset to reduce power consumption. As an example, take the LXTLP bit in the HT66Fx0: LXTLP=0 means the quick start of the 32768Hz crystal oscillator is enabled while LXTLP=1 means low power consumption.

Conclusion

The example above has described special points to consider when using the 32768Hz crystal oscillator.