Reset Circuit Applications in the HT66Fx0 Series MCU

Introduction

The Reset Circuit of the HT66Fx0 series MCUs uses an I/O pin-shared structure. The following content provides a description of the reset circuit application.

External Reset Function

The Reset pin in the HT66Fx0 series of MCUs is pin-shared with PB0 and is setup by a configuration option. When the PB0/RESB pin is selected as RESB, the pin function is an external reset pin which is the same as the other MCUs. If selected as PB0, the pin function is a CMOS I/O pin. Here a description on the RESB pin as set by the configuration options is provided.

The MCU can experience a reset operation through the external Reset (by pulling low the Reset pin). The following operations will occur at an MCU Reset:

1. Restart the MCU and reset the important internal registers, except for the TO and PDF flag, and the I/O port. The program will start from 0000H.
2. If the WDT is enabled, it will be cleared to zero and start re-counting.
3. The stack pointer points to the top to clear the contents.
4. All interrupts are disabled.
5. Set the PA port as the ADC inputs and other I/O pins as digital inputs.
6. Stop all the counters and clear the pre-scaler.

Reset Circuits Introduction

A reset function may be triggered if the MCU experiences interference due to environmental electromagnetic waves which may result in unexpected results. To avoid this from happening, it is necessary to take noise immunity measures. When noise from the application operating environment is small, the following RC reset circuit is recommended as a Reset Circuit.
The basic reset circuit is suitable for use in low noise environments. The reset time is decided by $R_{RES}$ and $C_{RES}$ and is usually chosen to be long enough to allow the system to first power up to a stable condition. When the MCU is powered-off, the charge on $C_{RES}$ should be discharged as soon as possible. Recommended values for $R_{RES}$ and $C_{RES}$ are $10k\Omega$~$100k\Omega$ and $0.1$~$1\mu F$.

The PCB wiring distance of the reset circuit has a direct effect on the noise immunity capability of the MCU. Generally short wiring between $C_{RES}$ and the RES B pin and the VSS pins in the MCU will be necessary.

When operating in noisier environments, a high noise immunity RC reset circuit as shown in the diagram can be used:

The high noise immunity RC reset circuit is used for dealing higher noise environments. The reset time is decided by $R_{RES}$ and $C_{RES}$ and it is generally chosen to be long enough to allow the MCU to first power up to a stable condition. If the MCU is powered off, the charge on $C_{RES}$ should be discharged as soon as possible. Recommended values for $R_{RES}$ and $C_{RES}$ are $10k\Omega$~$100k\Omega$ and $0.1$~$1\mu F$.

$CN$ is used to decouple noise from the power line and can have a general value of $0.01\mu F$. The $300\Omega$ resistor and diode are used to increase the ESD protection capability. As for the PCB layout, short wiring between RES B and the VDD pins in the MCU is also required.
For some designs, it is likely that the MCU will be required to reset under a specific voltage. Presently there are four internal low voltage reset voltage specifications in the HT66Fx0 series MCU: 2.1V, 2.55V, 3.15V, and 4.2V. If none of these satisfy the compulsory reset voltage of the design, the following two methods, are also suitable for use in large noise environments.

**External Transistor LVR Circuit**

![Diagram of External Transistor LVR Circuit]

The LVR voltage is divided by $R_{B1}$ and $R_{B2}$ or determined by the voltage of a voltage-regulator diode. Using the $R_{B1}$ and $R_{B2}$ voltage divider on the left, when $V_b$ is greater than 0.5V then Q1 is turned on, and the reset pin voltage is the $V_C$ voltage of Q1. The $V_b$ voltage is $V_{DD} * R_{B1} / (R_{B1} + R_{B2})$, and $V_{DD} * R_{B1} / (R_{B1} + R_{B2}) > 0.5$ for $V_{DD} > (R_{B1} + R_{B2}) / (2 * R_{B1})$. The $V_C$ voltage is almost equal to $V_{DD}$. When the Q1 switches off, the $V_C$ voltage is VSS, so the LVR voltage level is about $(R_{B1} + R_{B2}) / (2 * R_{B1})$. It is recommended to set the $R_C$ resistor to be larger than $R_{B2} / 30$. Using a voltage-regulator diode, when the $V_{DD}$ voltage is lower than the reversed punch-through voltage of the regulator $V_Z$, Q1 will be off and the Reset voltage will be VSS. If Q1 is on, meaning that $V_{DD}$ is larger than $V_Z + 0.5V$, the reset voltage is nearly equal to $V_{DD}$, so the LVR voltage level is about $V_Z + 0.5V$. When $R_{B1}$ is used for to set $V_Z$, it is best if the $R_C$ resistor is larger than 100kΩ, and $R_{B2}$ is about 10kΩ.

The location of the transistor Q1 on the PCB is very important. Short wiring distance of the Collector and Emitter of Q1 and the RESB and VDD pins in the MCU will be necessary.

**External LVD Reset**

![Diagram of External LVD Reset]
The low voltage detector IC, the HT70XXA-1 series MCU, can have 2.2V, 2.4V, 2.7V, 3.3V, 3.9V, 4.4V and 5.0V voltage detect options, forcing the MCU to reset at the selected voltage level. However, an external basic RC reset or high noise immunity RC reset circuit will be needed in order to implement a complete reset function.

The recommended values for $R_{RES}$, $C_{RES}$, $R_N$ and $C_N$ is the same as the basic RC reset as well as the high immunity RC reset circuit and the PCB layout requirements.

Internal Reset Unit

In order to enhance the MCU protection function and reduce the design and cost of the external application circuits, the MCU itself also contains a power-on reset (POR) and low voltage reset (LVR) circuits.

The POR circuit includes a low RC time constant reset circuit with power-on reset function. The internal MCU initialization status is the same as the RESB reset except for the clearing of the TO and PDF flags to “0.” When using this reset function, the POR time constant is smaller, therefore the power on rise time should be as low as possible (no less than 0.035V/ms by specification requirements) and the VDD power-on voltage should be no more than 0.1V when power is applied so as to ensure normal POR operation.

As the description above mentioned, there are four voltage specifications for the internal LVR in the HT66Fx0. These are, 2.1V, 2.55V, 3.15V and 4.2V. If the LVR option is enabled, then when VDD is smaller than the selected voltage with a duration larger than 120us~480us, the LVR will be activated, and the internal initialization of the MCU will be the same as the RESB Reset.

In addition, the MCU also includes an internal WDT function which is mainly used to monitor if the internal functions of the MCU (software and hardware) are operating normally. When the WDT is enabled, users must take proper measures within the program to arrange to clear the WDT using instructions (CLR WDT, CLR WDT1, CLR WDT2.) so as to prevent a WDT overflow during normal operation. The WDT overflow is used to implement an MCU reset when the system operates erroneously.

There are three types of WDT clock sources: LIRC, LXT and instruction clock (the system clock divided by four) which is selected using configuration options. The LIRC is the internal RC oscillator which can be affected by the operating voltage and temperature. Users should avoid erroneous WDT overflow reset from occurring.
Whether to enable the WDT or not, can be both controlled by configuration options and the WDTEN3~WDTEN0 bits in the WDTC register as shown below.

<table>
<thead>
<tr>
<th>Configuration Option</th>
<th>WDTEN3 ~ WDTEN0</th>
<th>Watchdog Timer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable</td>
<td>Other Values</td>
<td>Enable</td>
</tr>
<tr>
<td>Enable</td>
<td>1010</td>
<td>Enable</td>
</tr>
<tr>
<td>Disable</td>
<td>Other Values</td>
<td>Enable</td>
</tr>
<tr>
<td>Disable</td>
<td>1010</td>
<td>Disable</td>
</tr>
</tbody>
</table>

Only when the configuration option is set to Disable and also the WDTEN3~WDTEN0 bits to 1010 will the WDT be disabled. In another situations, the WDT will always be enabled status.