LVDTH calculation and the use of LVDHYS

1 Objective

In applications if the supply voltage is not stable, or trend to decrease over time, such as batteries, we would like the MCU to stop running when the supply voltage is too low, and thus can prevent wrong executions which may cause permanent damages. LVDCFG configures how to behave when the low voltage condition is detected: to generate a hardware reset, to trigger an interrupt, or do nothing, the user program may just monitor the LVTIF flag. For LVD function to work properly, the user should know what LVDTHD values will meet his requirement.

This document is about how to determine the setting values for LVDTHD (Supply Low Voltage Detection Threshold) and LVDHYS as well, the latter is for the LVD hysteresis feature. These contents apply to IS31CS8973.

2 To obtain the LVDTH Values

This chapter describes several ways to determine the LVDTHD/LVDHYS setting value, from simple to complicated, rough to precise. In the following sections, we take 2.8V as an example.

2.1 Looking up in the figure

First, which can also be seen on the datasheet, is the figure shown below. According to the figure, we roughly specify the detection voltage on the vertical axis and estimate its corresponding value on the horizontal axis, which is the result we want to use.

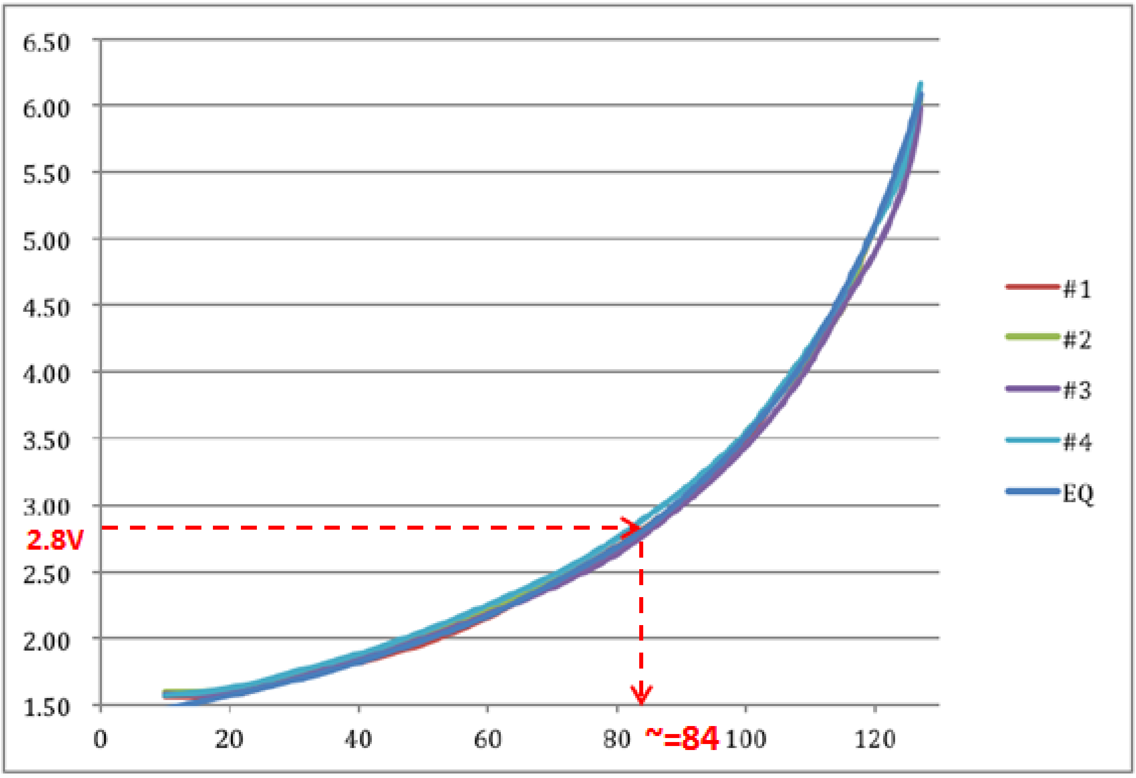

Figure 1: LVDTHD[6-0] vs Detection Voltage(volt)

2.2 Using LVDTH Equation, assuming BGREF = 1.0V

If we ignore the variation in each single chip, that is, assuming BGREF=1.0V. Then LVDTH setting value can be calculated in advance according to the equation:

LVDTHV = BGREF / [0.16 + 0.0044*(128 - LVDTHD[6-0])]

The solution to the equation is:

LVDTHD[6-0] = (0.7232*LVDTHV – BGREF)/(0.0044*LVDTHV)

Replace LVDTHV with 2.8 and replace BGREF with 1, we have the LVDTHD value for 2.8V detection which is 83.

2.3 Using LVDTH Equation, calculating BGREF with calibration values in IFB

The manufacturing process would have calibrated the values of LVDTHD for detecting 4V and 3V. The calibration value for 4V is stored in 0x23 of IFB and the value for 3V is stored in 0x24. To calculate the real BGREF, we change the equation form as below:

BGREF = LVDTHV * [0.16 + 0.0044*(128 - LVDTHD[6-0])]

For example, if Vth_4V is 110 and Vth_3V is 80, read out from IFB, then

BGREF_1 = 4.0 * [0.16 + 0.0044*(128 - 110)] = 0.9568

BGREF_2 = 3.0 * [0.16 + 0.0044*(128 - 90)] = 0.9816

We use the average of BGREF_1 and BGREF_2, that is, (0.9568+0.9816)/2 = 0.9692

Continue to calculate the LVDTHD value for 2.8V detection as in last section:

Vth_2.8V = (0.7232*2.8 – 0.9692)/(0.0044*2.8) = 85

3 Using LVDHYS: configuration example

Given a simple scenario, the user wants the MCU to trigger low voltage reset at 2.5V, and to resume running at 2.8V. With the above methods, Vth_2.5V and Vth_2.8V have been determined, for example, 76 and 85. As for the last method, run-time computations are needed to obtain the values. Figure 2 merely shows a simple configuration:

```
#define VTH_25 76
#define VTH_28 85
void LVDReset()
{
  TB=0xAA;                // TB protection
  TB=0x55;
  LVDTHD = VTH_25;        // --,LVDTHD[6-0]
  LVDHYS = 0x80|VTH_28;  // LVDHYEN,LVDHYS[6-0]
  LVDCFG = 0xC0;          // LVDEN,LVREN
  TB=0x00;
}
```

Figure 2: LVD Rest configuration sample code

Only if LVDHYEN=1, the value of LVDHYS[6-0] will replace LVDTHD[6-0] once the low voltage condition is detected. Therefore LVDHYS should be set larger than the original LVDTHD. As LVDTHD replaced by a higher voltage threshold, the MCU will be more stable to maintain the reset state.

4 Revision History

4.1 V1.0

1. First release.
2. Document No. : AP-IS31CS8973-002
3. Release Date : 2018/10/16
4. Prepared by: Huang_jy , Checked by: Lin_ly, Approved by : Chung_yc
5. Issued by: Huang_jy