AN 17.0

EMC142X Pullup Resistor Circuit Considerations

1 Preface

This application note provides information on the pullup resistors used for selecting temperature limits on EMC142X devices.

2 Audience

This application note assumes that the reader is familiar with hardware design and the functionality of the EMC142X devices with this feature. Current devices include EMC1422, EMC1423, and EMC1424.

3 Overview

The pullup resistors on EMC142X devices perform dual functions, i.e. pullup and temperature selection. The temperature selection function is performed by sampling the resistor at power up by forcing known currents into the resistor and measuring the resulting voltage. This feature works well on isolated buses, but may be corrupted if there are multiple components attached to the same ALERT# or SYS_SHDN# bus.

4 References

The following documents should be referenced when using this application note:

- SMSC EMC1422 Datasheet
- SMSC EMC1423/24 Datasheet

5 General Description of Pullup Resistor Functions

This section provides a basic overview of how the internal circuitry detects the pullup resistor connected to the EMC142X. In this section and all following sections, only the ALERT# pin will be discussed. However, all of the examples and explanations apply to both ALERT# and SYS_SHDN# pins.

5.1 Pullup Resistor Decoding Operation

The function select circuit in the EMC142X is used to decode the pullup resistor value on the SYS_SHDN# and ALERT# pins. Several known currents are sent to the external pullup resistor and the voltage developed across the resistor is compared to an internal reference voltage. If the external voltage is greater than the internal reference voltage, the comparator trips. The current that trips the comparator is then used to decode the resistor value. The total time taken by the circuit is 100 us.

The function select block can tolerate a +/- 10% variation on the external pullup resistors. However, for the widest safety margin, SMSC recommends using a 1% pullup resistor with a TCR less than

100ppm. This resistor will remain within the detection band of the EMC142X over temperature, resistor variations, and extra external loading.

Figure 5.1, "Resistor Decoder Functional Block Diagram" shows how the decoding operation works. A known current source is sent to the external pullup resistor and the voltage developed across the external resistor is compared to an internal reference voltage. The internal reference voltage has been set at 0.4V below VDD.

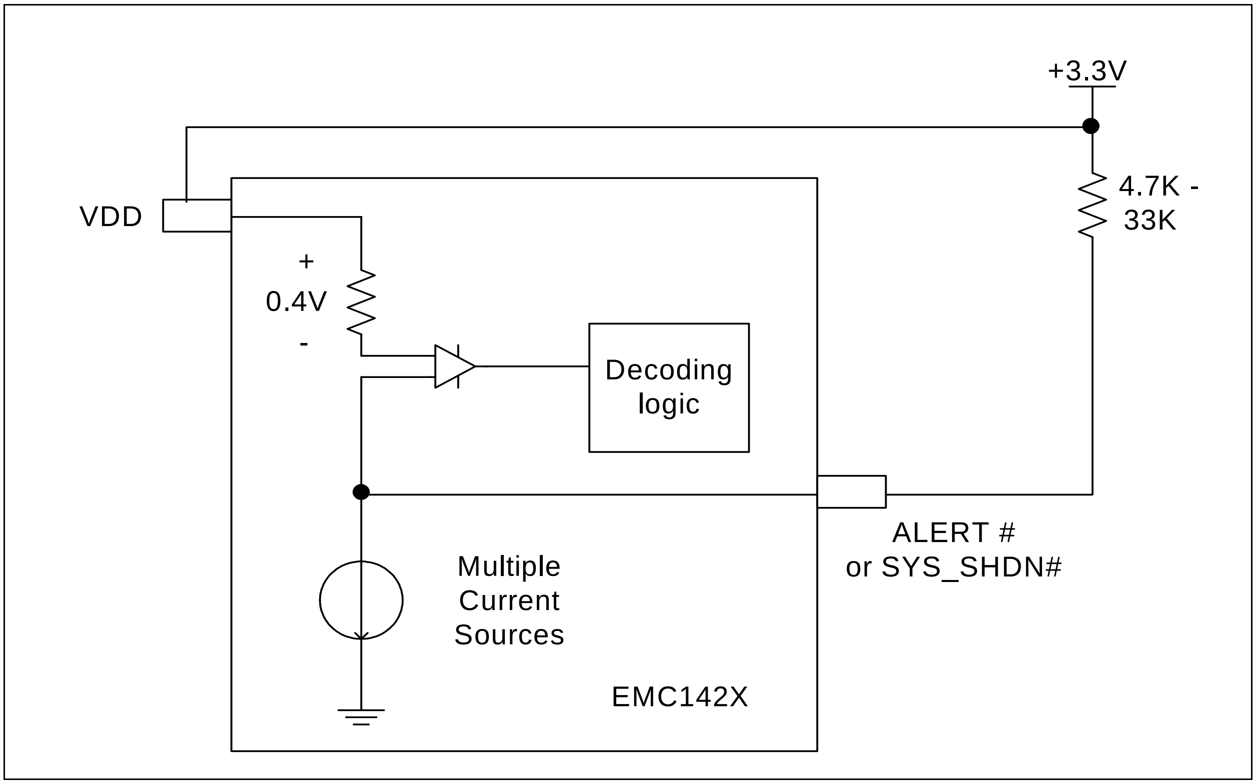

Figure 5.1 Resistor Decoder Functional Block Diagram

Table 1, "Decoding Currents and Voltages"summarizes all of the resistors, currents, and voltages used during the decoding operation.

Table 1 Decoding Currents and Voltages

EXTERNAL PULLUP RESISTOR (1% TOLERANCE, OHMS)	CURRENT (UA)	VOLTAGE DEVELOPED AT ALERT# OR SYS_SHDN# PIN (V)
4.70k	none	none
6.80k	70.4	0.478
10.0k	48.0	0.480
15.0k	32.0	0.480
22.1k	21.6	0.475
33.2k	14.4	0.475

Table 2, "Decoding Leakage Current Limits" shows the limits of the decoding circuit to reject external leakage currents from devices tied to the ALERT# or SYS_SHDN# lines. These currents are nominal and should be used for guidelines only.

Note that the 22.1k and 15.0k resistors are most susceptible to leakage currents. If the system design calls for 22.1k or 15.0k and , isolation circuitry is needed if the design will potentially have more than this level of leakage.

Table 2 Decoding Leakage Current Limits

EXTERNAL PULLUP RESISTOR ALERT# OR SYS_SHDN#	LEAKAGE CURRENT CAUSING DECODE ERROR (UA)
4.70k	18
6.80k	12
10.0k	9.0
15.0k	4.5
22.1k	3.0
33.2k	1.0

6 System Configurations and Recommendations

The pullup detection circuit, while useful, can be corrupted by external circuits in the system. There are several scenarios that could occur in a system. Each one has a unique solution to ensure correct decoding of the pullup resistor.

Table 3 Isolation Circuit Selection

SYSTEM TYPE	ISOLATION REQUIRED	SECTION
Host only with low leakage digital input	None	Section 6.1, "Single ALERT# or SYS_SHDN# System"
Shared bus with same pullup rail	Series Diode	Section 6.2, "Shared ALERT# or SYS_SHDN# System"
Shared bus with high leakage inputs/outputs or >VDD pullup rail	Transistor	Section 6.3, "Shared ALERT# or SYS_SHDN# with 3.3V to 5V Pullup Rails System"
Shared bus with high leakage inputs/outputs or <VDD pullup rail	Transistor, and Series Diode	Section 6.4, "Shared ALERT# or SYS_SHDN# with 1.8V to 3.3V Pullup Rails System"

6.1 Single ALERT# or SYS_SHDN# System

A simple resistor to VDD will yield the best results when only the EMC142X is connected to the ALERT# line.

Figure 6.1, "Single ALERT# Input Circuit" shows this basic circuit. It is critical that the logic input of the host device is a low leakage device, i.e. less than 1uA of current.

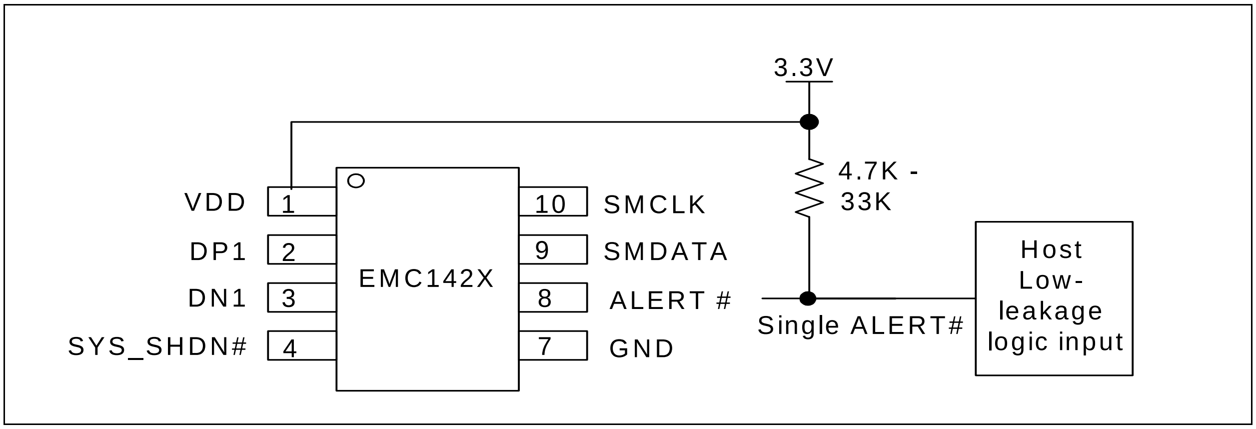

Figure 6.1 Single ALERT# Input Circuit

6.2 Shared ALERT# or SYS_SHDN# System

When other components are attached to the ALERT# line, the small currents can be drawn away from the pullup resistor causing an erroneous decode by the EMC142X device.

If the EMC142X device will share these bus lines with other hardware pulled up to the same +3.3V (VDD) rail, an isolation circuit consisting of a simple series diode (low voltage drop Schottky recommended) may be required. Figure 6.2, "Shared ALERT# with Same Pullup Rail Isolation Circuit" provides a typical scenario highlighting the required isolation diode. This diode isolates the EMC142X circuit from the accumulation of leakage currents from multiple devices on the ALERT# line.

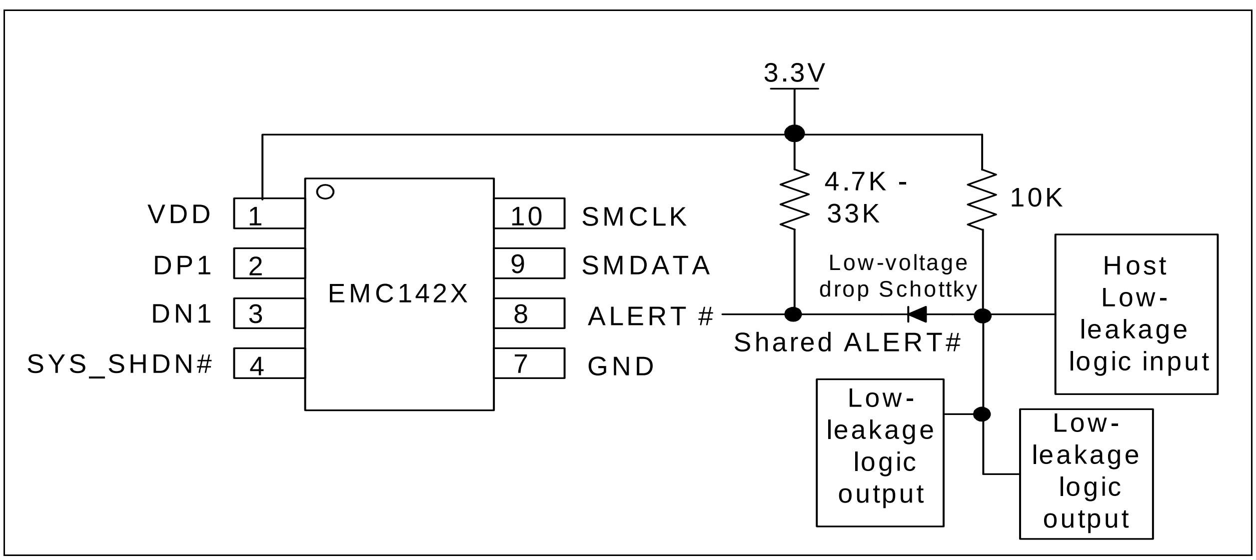

Figure 6.2 Shared ALERT# with Same Pullup Rail Isolation Circuit

6.3 Shared ALERT# or SYS_SHDN# with 3.3V to 5V Pullup Rails System

In a large complex system there may be multiple devices driving the same ALERT# lines on potentially different supply rails. If the common pullup voltage is greater than or equal to that of the EMC142X, then the circuit in Figure 6.3 will ensure proper decoding. This circuit additionally will allow the EMC142X device to shut down without affecting the other devices on the shared line. SMSC recommends using a standard 2N7002 which has been found to work well.

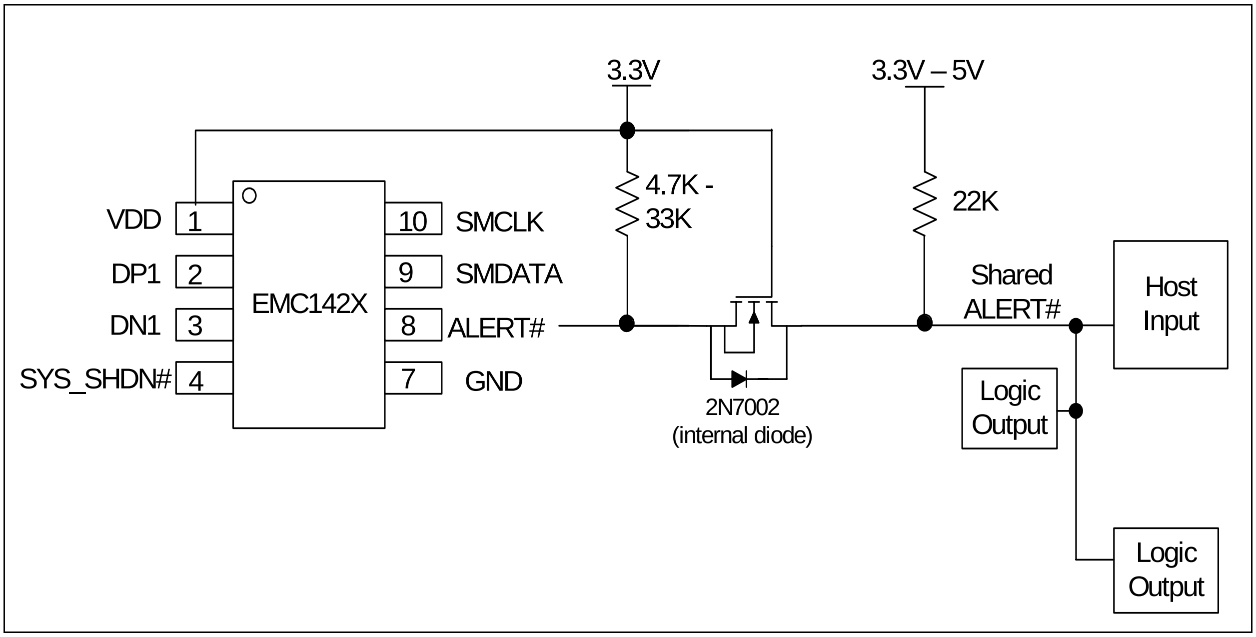

Figure 6.3 Shared ALERT# on 3.3V to 5V Supply Rail Isolation Circuit

6.4 Shared ALERT# or SYS_SHDN# with 1.8V to 3.3V Pullup Rails System

The worst case scenario for the EMC142X decoding circuit is a shared ALERT# line connected to a lower voltage supply rail than VDD. Figure 6.4, "Shared ALERT# on 1.8V to 3.3V Supply Rail Isolation Circuit" shows a solution for this case. A blocking diode is required in both directions on the ALERT# line. With the blocking circuits, the device will decode the pull up resistor accurately as designed regardless of the state of the shared devices. SMSC recommends using a standard 2N7002, and a low voltage drop Schottky diode.

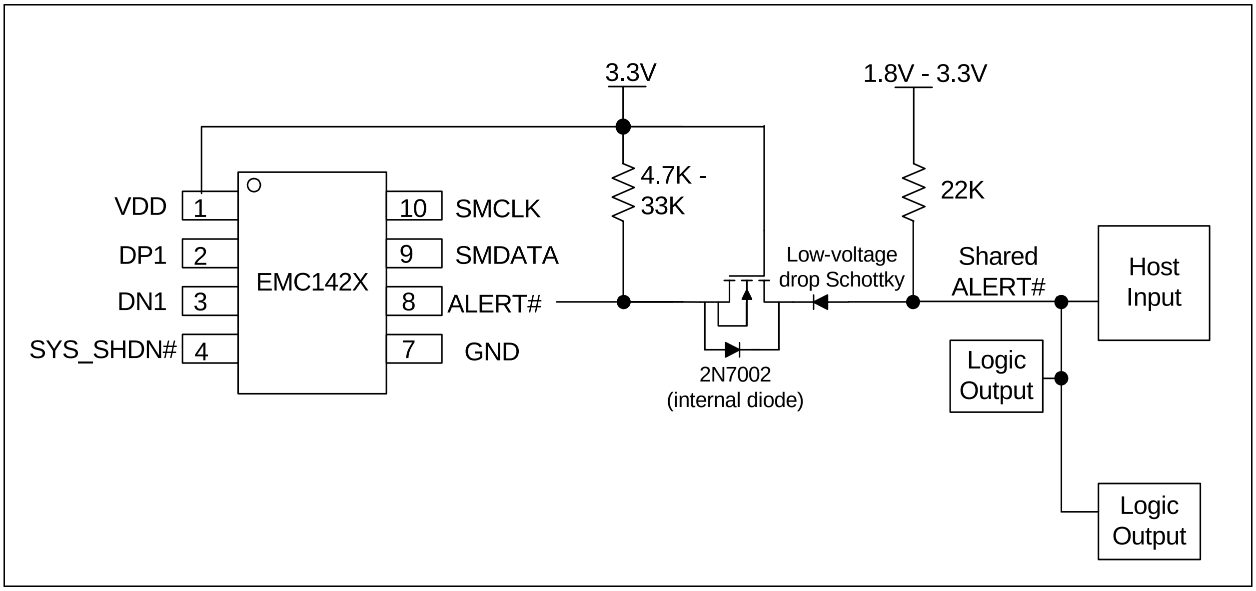

Figure 6.4 Shared ALERT# on 1.8V to 3.3V Supply Rail Isolation Circuit

80 ARKAY DRIVE, HAUPPAUGE, NY 11788 (631) 435-6000, FAX (631) 273-3123