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Application Notes

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38K0/38K2 Group

Application Circuit Reference

Renesas Single-Chip Microcomputers

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Revision History	38K0/38K2 Group Application Circuit Reference

Rev. No.	Date	Contents
0.0	2001/11/7	Draft version
1.0	2001/11/26	First Edition of PDF Version
1.1	2002/1/30	Page 9, Figure 1.4.3 (1) Circuit example: connection between programmer connector and 38K0/38K2 for standard serial interface of boot ROM area and FOUSB interface.
1.2	2002/10/20	P4 Figure 1.2.1(4) D0+/D0- Pin Connection, 68pF condenser of addition to D0+/D0-
		P5 Figure1.3.1 D1+/D1- (D2+/D2-) Pin Connection, 68pF condenser of addition to D1+/D1- (D2+/D2-)
		P5 Figure1.3.1 D1+/D1- (D2+/D2-) Pin Connection, 68pF condenser of addition to D1+/D1- (D2+/D2-)
1.4	2003/2/17	P5 Additional Notes for Down-port Settings P9 Corrections for “Table 1.4.3 Application Program Selections according to Port”

* Related Materials

RENESAS Microcomputers: 38K0 (38K2) Group Data Sheet

Instructions for MFW-1 Multi-Flash Programmer (Sunny Giken Inc.)

* Home page of **RENESAS** Semiconductors.

http://www.renesas.com/en/usb

- Table of Contents -

1.1 Introduction

This reference note describes implementing RENESAS 38K0/38K2 Group MCUs for USB application systems through various example circuits. The reference value of each component used in these example circuits needs to be adjusted when applying to your system. Therefore, RENESAS recommends calibrating each value to fit the target application,

1.2 38K0/38K2 Group Standard USB Circuits

This section describes the standard USB circuits for the 38K0/38K2 Group. For more details concerning other peripheral functions, refer to the 38K0/38K2 Group data sheet.

1.2.1 USB-related Pins

Table 1.2.1 shows USB-related pin functions of 38K0/38K2 Group MCUs.

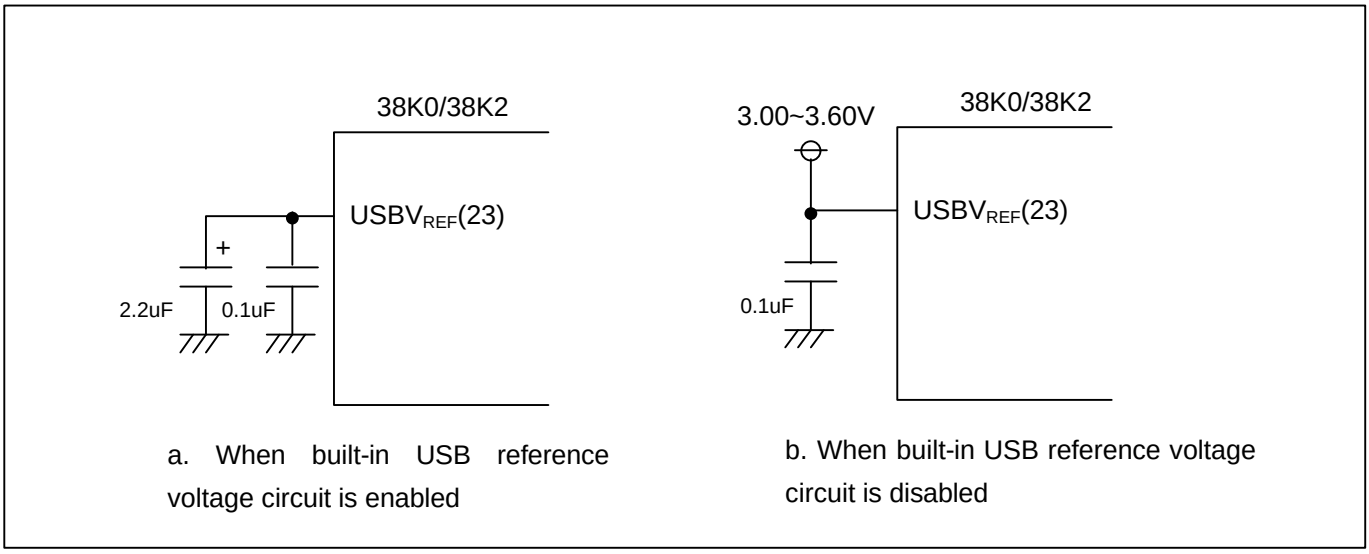
Table 1.2.1 38K0/38K2 Group USB –related Pins

Pin No.	Symbol	Name	Function
23	$USBV_{REF}$	USB reference power source	Power source pin for USB port circuit (3.00~3.60V). ***Power supply source can be selected in register setting.**
24	TrON	USB reference voltage output	Output pin to pull-up D0+ by 1.5k-ohm external resistor. Outputs USBVref voltage when register is enabled.
25	D0+	USB upstream I/O	USB upstream I/O port. USB input level. USB output level output structure.
26	D0-		

(1) USB Reference Power Supply Pin (USBVref)

The USB ports of the 38K0/38K2 MCU operate at 3.00~3.60V. The supply voltage is provided from the USBVref pin (USB reference power source pin). Normally, the built-in USB reference voltage circuit generates 3.30V. But the 38K0/38K2 Group allows the user to enable/disable this circuit through VREFE (USB reference voltage enable bit), bit 4 of USBCON (USB control register). When the circuit is disabled, supply 3.00~3.60V from this pin.

When the reference circuit is enabled, this pin must be pulled down to ground with a 0.1uF by-pass capacitor and a 2.2uF capacitor (electrolytic type), as shown in Fig. 1.2.1(1)-a. The capacitors must be placed as close to the pin as possible, When the reference circuit is disabled, the pin must be supplied with 3.00~3.60V externally and connected to ground with a 0.1uF capacitor, as shown in the figure.



a. When built-in USB reference voltage circuit is enabled

b. When built-in USB reference voltage circuit is disabled

Figure 1.2.1(1) USBV$_{REF}$ Pin Connection

(1) USB Reference Voltage Output Pin (TrON)

This is the pull-up voltage output pin for the up-port. The $USBV_{REF}$ voltage supplied either internally or externally is output from this pin. Connect the D0+ pin to the TrON pin through a 1.5k-ohm resistor.

The output of the TrON pin can be turned ON/OFF by bit TRONCON (TrON output control bit: bit 1 of USBCON). Normally, the TrON pin must be turned ON after detection of the $USBV_{BUS}$ voltage (supply voltage from USB up-port bus). However, the 38K0/38K2 MCU does not perform this control through hardware. Therefore, the user must add external hardware to detect the USBVbus voltage and supply the TrON voltage, as shown in Figure 1.2.1 (2)-a. Or the user must utilize an interrupt pin for the $USBV_{BUS}$ voltage detection as shown in Figure 1.2.1 (2)-b and turn on the TrON pin by software.

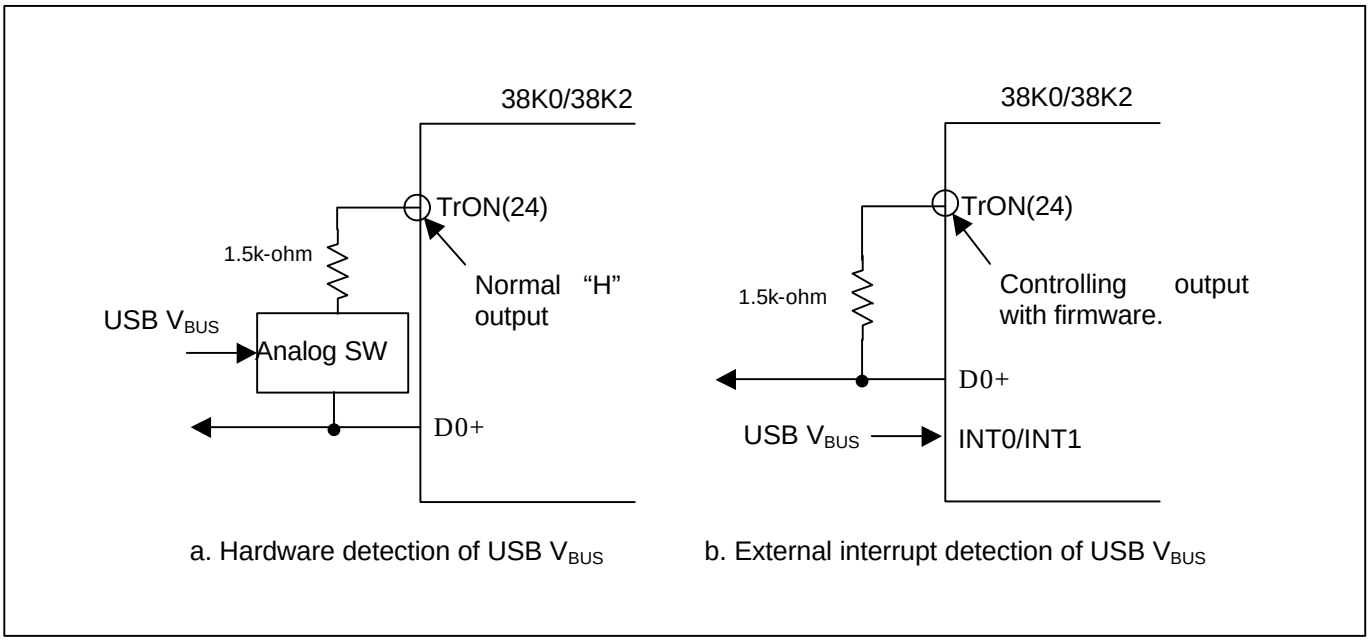


Figure 1.2.1(2) TrON Pin Connection

-- Note --

Figure 1.2.1(3) shows the relation between the $USBV_{BUS}$ power source and the TrON signal when the USB reference voltage circuit is enabled for operation.

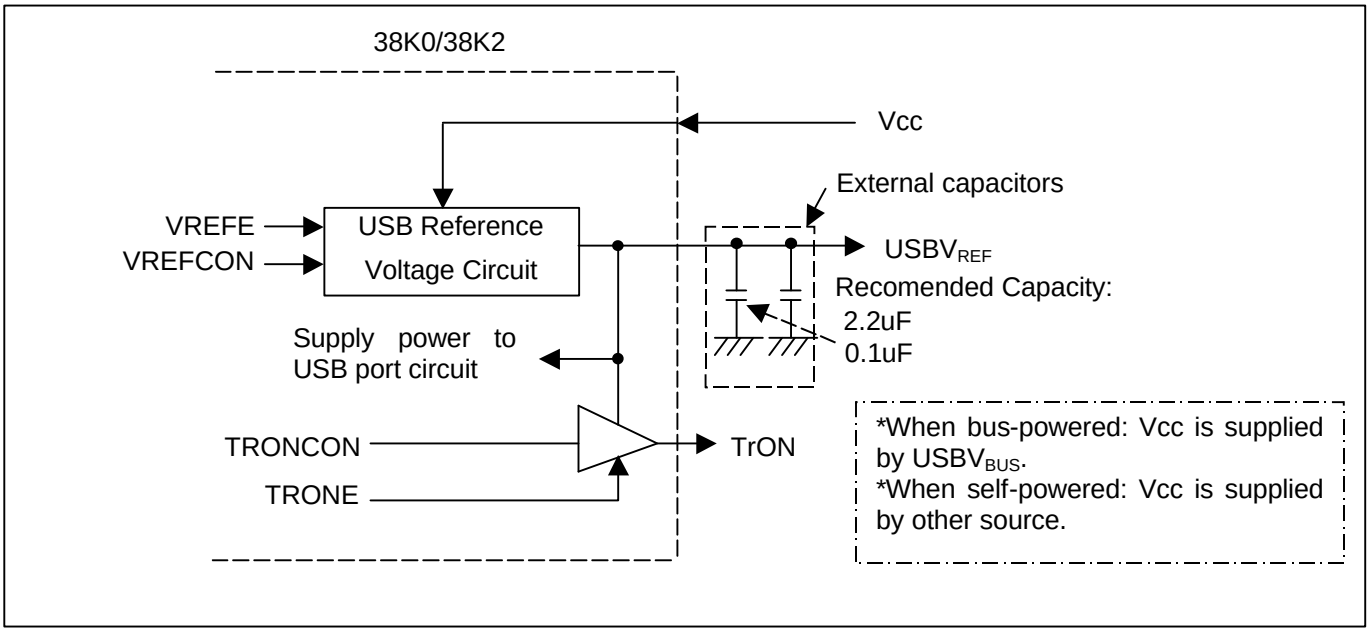


Figure 1.2.1(3) Relation between $USBV_{BUS}$ and TrON Signals

(2) USB Up-Stream I/O Pins (D0+/D0-)

Pins D0+/D0- represent the USB up-stream signal pair D+ and D-. To enable proper impedance matching, serially insert 27-ohm (recommended value) resistors between the MCU pins and signal lines and 68pF (recommended value) capacitors between the pins and resistors, as shown in Figure 1.2.1. Because these values vary according to the board impedance, select optimal values by measuring the signal skew in actual evaluation. In addition, insert a 15-ohm pull-down resistor for each signal line and, if necessary, common-mode ferrite beads as an EMI countermeasure (reference: signal line is equal to or greater than 120 ohms/100mA, supply line is equal to or greater than 120 ohms/2A at 100MHz).

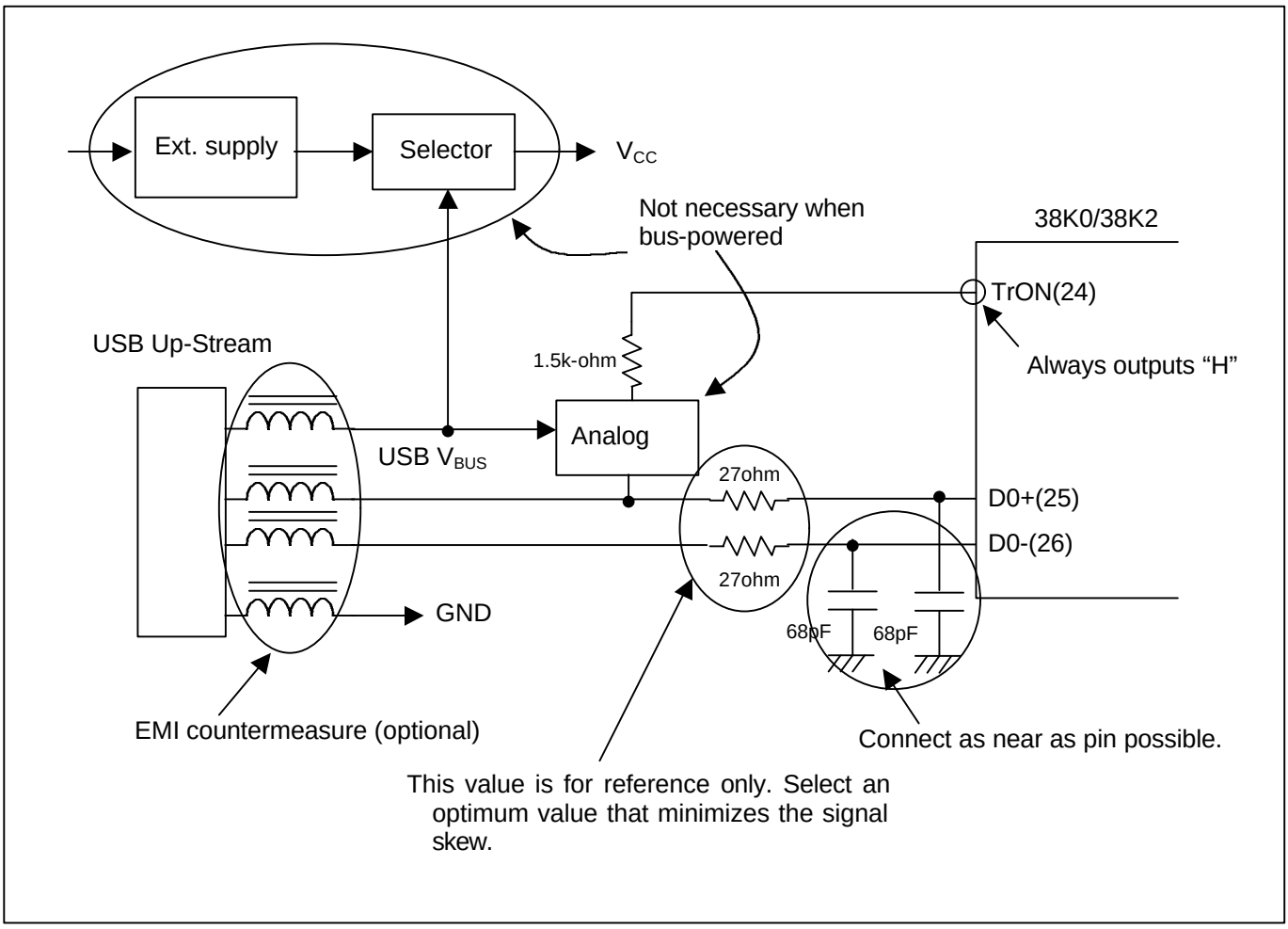


Figure 1.2.1 (4) D0+/D0- Pin Connection

For details concerning the Vcc pin, refer to Section 1.4.1 "Vcc and USBVref Voltages".

1.3 38K2 Down-Port Pin Reference Circuit

This section describes the HUB down-port circuit of the 38K2 Group. For details concerning the USB standard circuit, refer to Section 1.2 “38K0/38K2 Group USB Standard Circuit”. For more details concerning other peripheral functions, refer to the 38K0/38K2 Group data sheet.

1.3.1 HUB-related Pins

Table 1.3.1 shows HUB-related pin functions.

Table 1.3.1 HUB-related Pin Functions

Pin No.	Symbol	Name	Function
27	D1-	USB down-stream 1 I/O	Down-stream 1 signal pair D+ and D-
28	D1+		
29	D2-	USB down-stream 2 I/O	Down-stream 2 signal pair D+ and D-
30	D2+		

(1) USB Downstream 1/2 Input/Output (D1-/D1+/D2- D2+)

These are the D+ and D- signal lines for USB hub downstreaming. To enable proper impedance matching, serially insert 27-ohm (recommended value) resistors between the MCU pins and signal lines and 68pF (recommended value) capacitors between the pins and resistors, as shown in Figure 1.3.1. Because these values vary according to the board impedance, select optimal values by measuring the signal skew in actual evaluation. In addition, insert a 15-ohm pull-down resistor for each signal line and, if necessary, common-mode ferrite beads as an EMI countermeasure (reference: signal line is equal to or greater than 120 ohms/100mA, supply line is equal to or greater than 120 ohms/2A at 100MHz). (Note 1)

Note 1: For 382K Group - when setting the downports (P020-P23), use the input (default) settings for Port 2 direction register (bit 0 – bit 3).

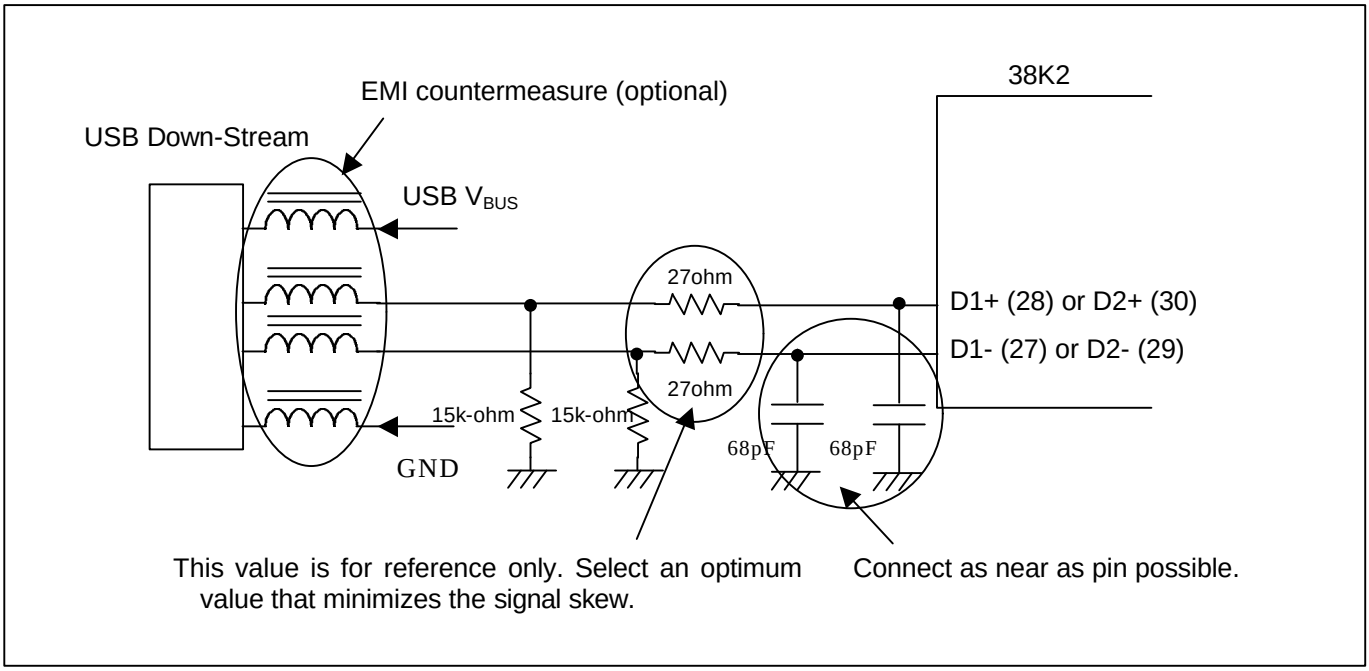
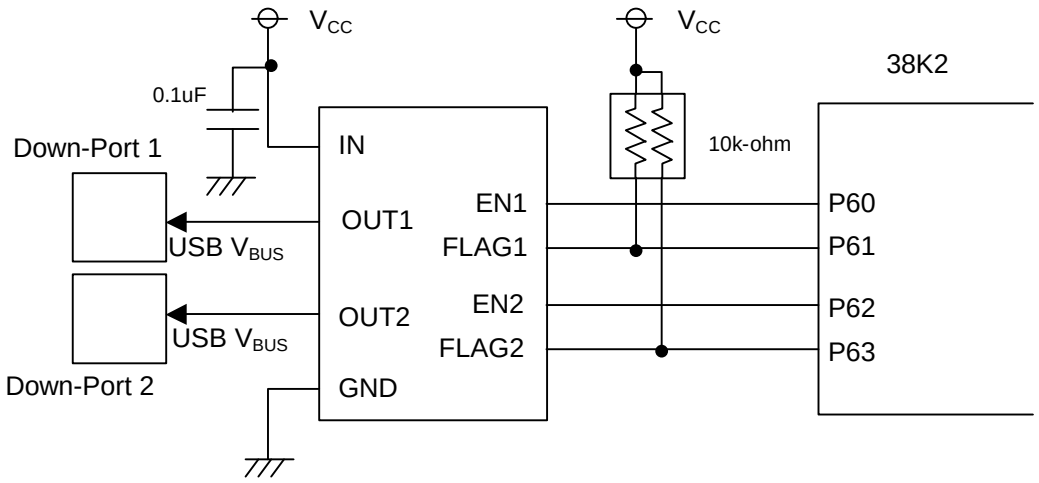


Figure1.3.1 D1+/D1- (D2+/D2-) Pin Connection

1.3.2 Over-Current Detection/Protection

USB Version 1.1 (or later) Specification requires an ON/OFF switch for each bus-powered HUB down-port. Figure 1.3.2 shows an example of this requirement (down-port power ON/OFF, over-current detection/protection) with a standard current control IC.



Example functions of standard current control IC.

Pin Name	Functions
EN1	Down-port 1 Supply SW
OUT1	Down-port 1 Supply Output
FLAG1	Down-port 1 Over-Current Detection
EN2	Down-port 2 Supply SW
OUT2	Down-port 2 Supply Output
FLAG2	Down-port 2 Over-Current Detection
IN	Power Supply Pin
GND	

Figure 1.3.2 Standard Current Control IC Connection Example

1.4 Cautions

This section describes various cautionary items to be aware of when designing a board with 38K0/38K2 MCUs.

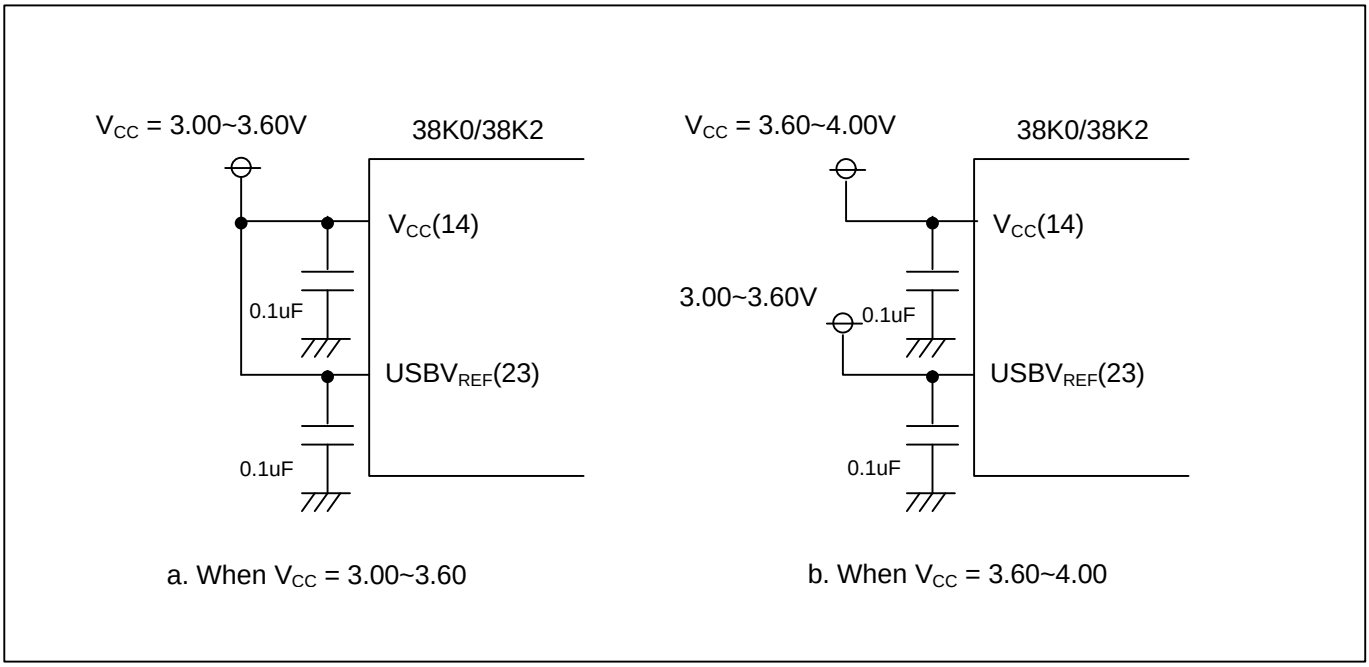
1.4.1 Vcc Pin and USBVref Pin Voltage

The guaranteed range of the MCU supply voltage (Vcc) will change depending on the MCU operation speed (defined by the system clock and main clock-phi), as shown in Table 1.4.1. When Vcc = 3.00~4.00V, the USB reference voltage circuit must be turned off and USB power (3.00~3.60V) must be supplied from the USBVref pin. Please note that the voltage level of the USBVref pin cannot exceed the level of the Vcc pin.

Figure 1.4.1 shows two examples of the connection between USBVref and Vcc pins (when Vcc = 3.00~4.00V).

Table 1.4.1 Relation between Clock, Supply Voltage Vcc, and USB Ref. Power Supply USBVREF

System Clock	Main Clock-phi	Supply Voltage V_{CC} (Dev. Status)	USB Ref. Power Supply $USBV_{REF}$
12MHz	12MHz	4.50~5.25V (Planning)	Internal USB Reference Voltage Circuit enabled
	6MHz (divide-by-2)	4.00~5.25 (Under development)	
8MHz	8MHz	4.00~5.25	
6MHz	6MHz	4.00~5.25	
		3.00~4.00 (Under development)	3.00~3.60V supplied from $USBV_{REF}$ pin.



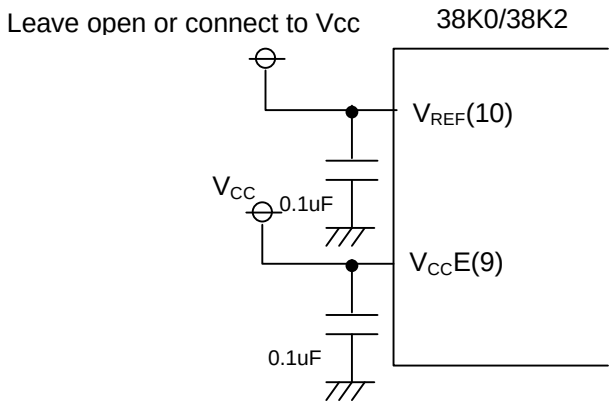
a. When V_{CC} = 3.00~3.60

b. When V_{CC} = 3.60~4.00

Figure 1.4.1 Vcc (3.00~4.00V) Connection

1.4.2 Vref and VccE Voltage Pins

The Vref pin is an input pin that provides the reference voltage to the AD converter circuit. The VccE pin is an input pin that supplies power to the AD converter circuit and Ports 1, 3, and 4. (These ports supply the bus voltage when using the EXB function. Because the VccE pin is used for supplying power to the AD converter circuit, the Vref pin must be left open or the voltage of the pin must be equal to or lower than the voltage of the VccE pin, as shown in Figure 1.4.2. The VccE pin, which is a power supply pin, should be connected to Vcc when the corresponding circuits above are not in use.



b. When $V_{REF} <= V_{CC}E$

Figure 1.4.2 Connection Example of Vref and VccE Pins

1.4.3 On-Board Flash Programming

38K0/38K2 Group Flash memory version allows you to reprogram application F/W on-board by pre-programming the rewriting control program to the Flash memory boot ROM area (or user ROM area) in advance. Note 1

This rewriting control program, as shown in Table 1.4.3, can be programmed with either a serial writer (MFW-1) or the FOUSB method Note 2 (3V/5V, 6MHz/12MHz), by setting the port status at MCU reset. Note 3

Table 1.4.3 Selection of rewriting control program through port settings

P26	P27	P42	P16	Mode
*	*	H	H	Serial Mode (note 4)
*	H	L	H	FOUSB 3V/6MHz (Notes 5 & 6)
H	L	L	H	FOUSB 5V/12MHz
L	L	L	H	FOUSB 5V/6MHz

*: Don't care

Note 1. The boot program in the Flash memory boot ROM area can be reprogrammed with either a program-writer or in the parallel mode.
Note 2. "FLASH OVER USB™" (abbreviation: "FOUSB") is a registered trademark of Renesas Technology Corporation.
Note 3. Renesas Technology software programs are in HEX code. The FOUSB function can be used during the trial period for evaluation purposes only. Please contact us directly concerning purchase of source code and modify functions.
Note 4. The serial mode is not affected by power supply voltage or external oscillation frequency.
Note 5. When using FOUSB at 3V, peripheral circuits must be converted to 3V operations as well. For more details, please refer to Page 7. Note that even at 3V operations, programming voltage CNV_{SS} must be at 4.50 – 5.25V.
Note 6. FOUSB will not run on settings other than those listed above.

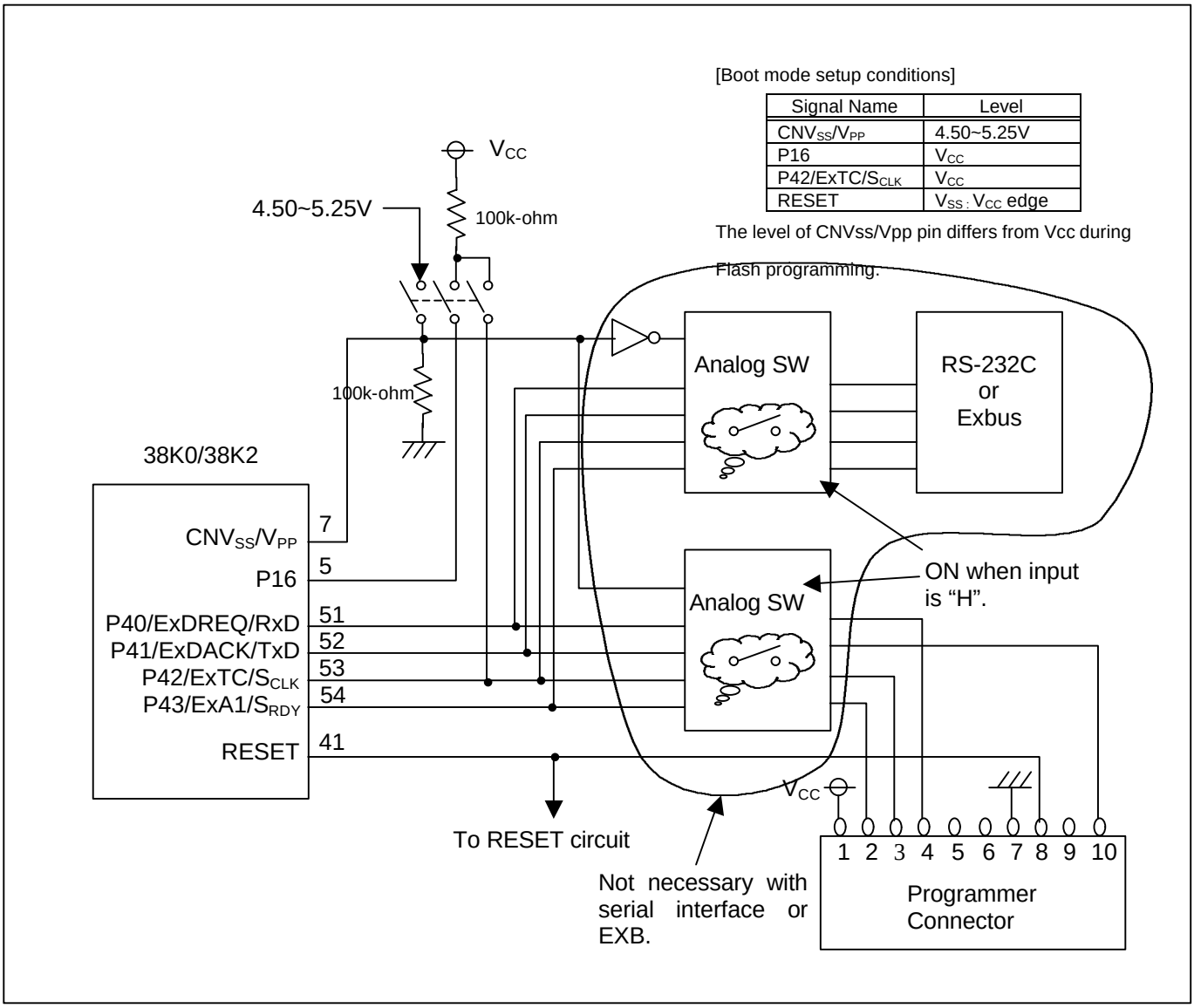


Figure 1.4.3 (1) Example Circuit showing Boot ROM Area Standard Serial Interface and FOUSB Interface.

Figure 1.4.3 (2) shows a configuration specific for the FOUSB interface operation. The specified switch must be set in the same manner as shown in Fig. 1.4.3 (1) and then a reset must be applied to invoke the firmware.

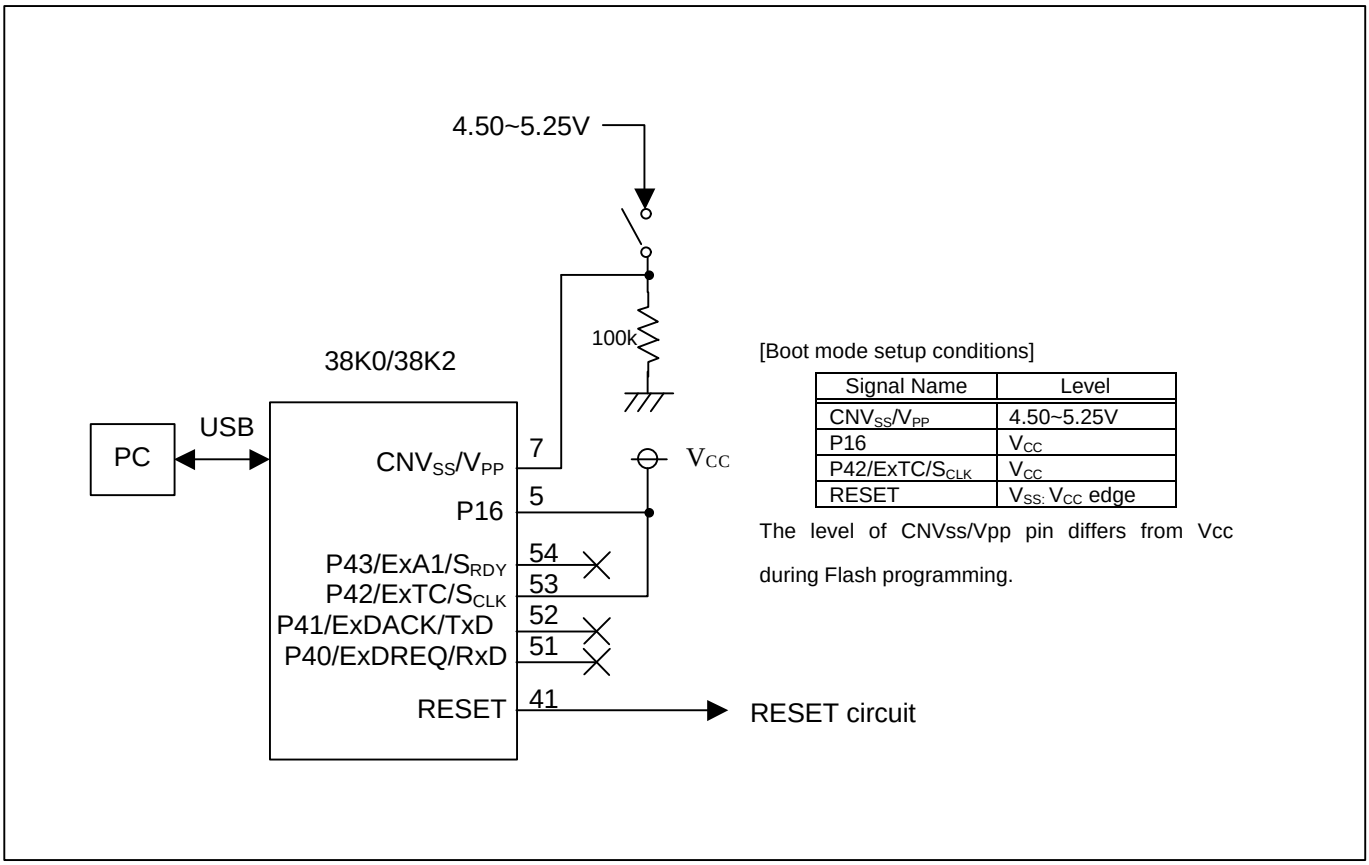


Figure 1.4.3 (2) Circuit Example specific for FOUSB interface.

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