

Introduction

The ISL1208 Real Time Clock (RTC) device shares much of the functionality of the M41T00 device plus some added features, and in some instances may be desirable as a replacement for that device. This Tech Brief will describe the differences between the devices and give guidelines on any changes in hardware or software that are required to drop the ISL1208 into the M41T00 socket. This document should be used as a guideline. Any final design changes should be made after consulting the details in the appropriate data sheets.

Hardware Compatibility

Packaging

The SOIC packages for the two devices contain identical pinouts. There are functional differences between the devices for pin 3 (V_{BAT}) and pin 7(SQW/OUT). A discussion of these two pins and functions follows.

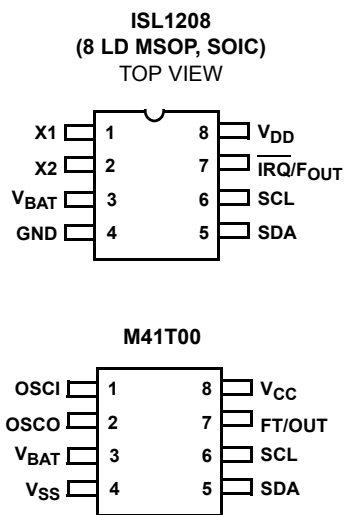


FIGURE 1. PACKAGE PINOUTS

FT/OUT Pin

Pin 7 of the M41T00 is dedicated to the clock output function, fixed at a frequency of 512Hz. Pin 7 of the ISL1208 combines the clock output with an interrupt output function. This pin is open drain in both products, so a pull-up is required. The ISL1208 has an alarm interrupt and the M41T00 has no alarm function. The hardware interrupt in the ISL1208 is generated upon occurrence of an alarm if the clock output function is not used. If the designer chooses to use the ISL1208 in the M41T00 socket, the alarm function (see ISL1208 data sheet) may be added.

Register 07h of the M41T00 uses the two LSB's to enable the FT/OUT frequency output (see Table 1). Register 08h of the ISL1208 uses the 4 LSB's to control the Fout frequency

(15 frequencies plus disable), so a software change will be needed for this function. The duty cycle is fixed for both devices at 50%. The M41T00 also allows setting pin 7 high or low when not used, using Bit 7 of Register 07h for control. The ISL1208 defaults this pin to high when not used.

V_{BAT} Pin

The two devices share the same pin for the battery input, pin 3. The ISL1208 has a wider range for V_{BAT} , however, from 1.8V to 5.5V (vs 2.0V to 3.5V for the M41T00). Also, battery switchover is normally at 2.2V (typ) for the ISL1208 (vs $V_{BAT} - 0.5V$ for the M41T00). A separate mode can be programmed for the ISL1208 so that it switches over at $V_{DD} = V_{BAT}$ (similar to the M41T00), if the designer requires that functionality (see ISL1208 data sheet).

BATTERY BACKUP

Both the M41T00 and the ISL1208 are volatile devices and will lose their register contents when fully powered down ($V_{BAT}, V_{DD} = 0V$).

Crystal and Oscillator Requirements

Both devices require a standard 32.768kHz crystal, with similar crystal specifications. Both devices allow an external CMOS level clock to override the crystal oscillator by applying to the X1 pin. Note that the ISL1208 requires a control bit to be set (XTOSCB, Register 07h, bit 5), in order to use an external clock.

The ISL1208 provides two methods of adjusting the clock frequency: an analog trimming register(ATR) and a digital trimming register(DTR). The M41T00 has just a digital trimming function, which is controlled by Register 07h. If factory calibration of the oscillator frequency is desired, the ATR function of the ISL1208 is faster and more efficient.

Register Compatibility

The registers for the two devices are set up somewhat differently. See Table 1. Registers 00h to 02h, the RTC timekeeping registers for the Seconds, Minutes, and Hours, in that order, are essentially the same. There is a difference in Register 00h whereby MSB is used to stop the oscillator. That function is done in the ISL1208 by the XTOSCB bit in register 07h. Also, register 02h for the M41T00 has two MSBs that control century counting; these are absent from the ISL1208. The RTC Date, Day of Week, and Year registers are identical bit setup, but different addresses (this is noted by the color shading of those registers in Table 1). Software will definitely need to be changed to write to and read from the RTC time registers in the ISL1208.

TABLE 1. REGISTER DESCRIPTIONS

ADDR	M41T00	ISL1208	COMMENTS
	RTC REGISTERS		
00h	RTC Seconds, BCD	RTC Seconds, BCD	M41T00 has a Stop bit (ST) in the MSB; otherwise BCD Seconds are the same.
01h	RTC Minutes, BCD	RTC Minutes, BCD	Identical contents.
02h	RTC Hours, BCD	RTC Hours, BCD	The two MSB's in the M41T00 are for Century bit control (years); otherwise BCD Hours are the same.
03h	RTC Day of Week, BCD	RTC Date, BCD	M41T00 Register 03h is identical to ISL1208 Register 06h.
04h	RTC Date, BCD	RTC Month, BCD	M41T00 Register 04h is identical to ISL1208 Register 03h.
05h	RTC Month, BCD	RTC Year, BCD	M41T00 Register 05h is identical to ISL1208 Register 04h.
06h	RTC Year, BCD	RTC Day of Week, BCD	M41T00 Register 06h is identical to ISL1208 Register 05h.
CONTROL/STATUS			
07h	Status Register	Status Register	M41T00 Status Register is used for frequency control calibration (6 bits), similar to the ATR/DTR function in the ISL1208.
Oscillator Enable	ST bit, Register 00h, bit 7	XTOSCB, Register 07h, bit 5	Oscillator shutdown or external oscillator. When set to "0", the device operates normally from the crystal oscillator. When set to "1", the oscillator is shut down. For the ISL1208, an external oscillator can be connected to X1.
FUNCTION	ISL1208 UNIQUE FUNCTIONS		
12 to 13h		User Ram	No User RAM on the M41T00.
Write RTC Register		WRTC, Register 07h, bit 4	Needs to be set to "1" in order to write to the RTC registers.
ATR Control		ATR, Register 0Ah	Provides Analog control of the oscillator; pulls the frequency with internal capacitor adjustment.
Frequency Output		FO3:0, Register 08h	Enables external clock output and selects frequency.
LPMODE		LPMODE, Register 08h, bit 5	Low power mode select. A "0" selects battery switchover at $V_{TRIP} = 2.2V$. A "1" selects battery switchover at $V_{BAT} > V_{DD}$.
Alarm		Registers 0Ch to 11h contain alarm setting	If no Frequency output is used, the alarm interrupt is output at IRQ/FO _{UT} .
DEVICE OPERATION			
V_{BAT}	2.0V to 3.5V	V_{BAT} from 1.8V to 5.5V	Battery switchover at V_{BAT} for the M41T00 vs $V_{CC} = 2.2V$ for the ISL1208 (default mode). For $V_{CC} = 3.3V$, the M41T00 with Lithium battery may need dropping diode.
V_{CC}	V_{CC} from 2.0 to 5.5V	V_{CC} from 2.7V to 5.5V	ISL1208 has wider V_{IN} range.
Pinout	Same	Same	M41T00 Pin 7 is FT/OUT; no Alarm function.

Status Register

The M41T00 has no status register but the ISL1208 does. The ISL1208 status register (addr 07h) includes a clock fail bit and one alarm bit (only one alarm in the ISL1208). The clock fail bit denotes the total loss of power to the device and therefore, the RTC registers are no longer valid. The status register for the ISL1208 also provides control bits as well as other status bits, including battery backup indication, write protection, oscillator on/off control and automatic reset of status bits after a read.

Control Register

The ISL1208, register 08h, is the control register. It contains clock output, battery switchover and alarm control bits (see ISL1208 data sheet). Note that these functions are not available in the M41T00, and if this register is set to 00h (default), that the device will function similar to the M41T00.

I²C Interface: Communicating with the ISL1208 vs the M41T00

There are two major differences between the M41T00 and the ISL1208 when using the I²C bus:

1. The first 7 bits of the slave address for the ISL1208 are 1101111, and for the M41T00 are 1101000. Therefore, a software change would need to be made to change the last 3 bits of the slave address.
2. The ISL1208 requires that the WRTC bit (addr 07h, bit 4) be set before writing to the RTC clock registers. This is to protect them from inadvertent writes. This will require a software change as well, since two I²C writes will be required for changing the RTC registers.

The proper order for writing to the ISL1208 RTC registers is:

1. Write to addr 07h data 08h (set WRTC bit).
2. Write RTC time to any or all addr 00h through 06h.

Note that the ISL1208 follows the I²C spec as closely as possible, and should interface well with microcontrollers that use hardware I²C communications.

Other RTC Devices

The ISL1209 device provides the same functionality as the ISL1208, but includes an event detector function in the 10-lead MSOP package, so a board change is needed for that device. The event detector takes a logic “event” input and uses it to either stop the RTC counter to store the event time, or trigger an interrupt to a microcontroller.

References

ISL1208 data sheet, Intersil Corporation, www.intersil.com

M41T00 data sheet, ST Microelectronics, www.st.com

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.
"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.
"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.
Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.
6. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.
(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.
(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)



SALES OFFICES

Renesas Electronics Corporation

<http://www.renesas.com>

Refer to "<http://www.renesas.com/>" for the latest and detailed information.

Renesas Electronics America Inc.
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852-2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886-2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5338