Transitioning from the DS1339 to the ISL1208 RTC Device

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Introduction

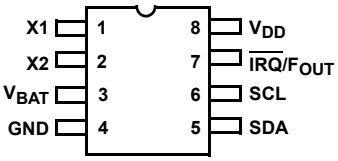
The ISL1208 Real Time Clock (RTC) device shares much of the functionality of the DS1339 device, and in some instances may be desirable as a replacement for that device. This Tech Brief will describe the differences between the devices and give guidelines on any changes in hardware or software that are required to drop the ISL1208 into the DS1339 socket.

Hardware compatibility

Packaging

Only the MSOP package for the ISL1208 is compatible (drop-in) with the DS1339 device. The main connections to the ISL1208 are the same as the DS1339: V_{DD}(Vcc), X1, X2, GND, SCL, SDA are all identical. The V_{BAT} pin is the same as the V_{BACKUP} pin, and $\overline{IRQ}$/FOUT replaces the SQW/$\overline{INTB}$ pin. We'll discuss these two pins and functions.

ISL1208
(8 LD MSOP)
TOP VIEW



DS1339
(8 LD USOP)
TOP VIEW

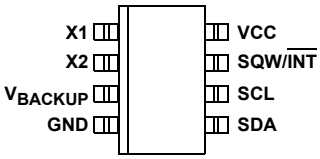


FIGURE 1. PACKAGE PINOUTS

The DS1339 has two alarms and the ISL1208 has one alarm. Both devices have a clock output pin which doubles as a hardware interrupt for the alarm function. If both alarms are used on the DS1339 (no clock output), then one alarm would need to be dropped when using the ISL1208.

V_{BAT} Pin

The two devices share the same pin for the battery input, pin 3. The ISL1208 has a wider range for Vbat, however, from 1.8V to 5.5V (vs. 1.3V to 3.7V for the M41T00). Also, battery switchover is normally at 2.2V (typ) for the ISL1208 vs.2.85V for the M41T00. A separate mode can be programmed for the ISL1208 so that it switches over at $V_{DD} = V_{BAT}$ ("Low Power Mode"), if the designer requires that functionality (see ISL1208 data sheet).

BATTERY BACKUP

Both the DS1339 and the ISL1208 are volatile devices and will lose their register contents when fully powered down. Both devices have a battery input pin which will accept a battery or supercap and allow active switchover (this enables RTC continous operation and RAM memory retention). The DS1339 device also contains trickle charge resistor/diode combinations which are not in the ISL1208 device. No trickle charging control is available with the ISL1208.

Oscillator Output

The DS1339 has 4 distinct frequencies for clock output at pin 7: 1.0Hz, 4.096kHz, 8.192kHz, 32.768kHz. The ISL1208 has 15 frequencies available from 1/32Hz to 32.768kHz. The duty cycle is fixed for both devices at 50%.

Crystal Requirements

Both devices require a standard 32.768kHz crystal. The DS1339 requires a C_L spec (load capacitance) of 6pF, while the ISL1208 requires 12pF. Although the ISL1208 will operate with the C_L = 6pF, a crystal with C_L = 12pF will provide better accuracy and adjustment range with the ISL1208.

Frequency Adustment

The ISL1208 provides two methods of adjusting the clock frequency, an analog trimming register(ATR) and a digital trimming register(DTR). The DS1339 has neither of these adjustments, so this is additional functionality that can be used if the customer so desires.

Register Compatibility

The registers for the two devices are set up very differently, See Table 1. The only common registers are registers 00h to 02h which are the RTC timekeeping registers for the Seconds, Minutes, and Hours, in that order. There is a difference in register 02h whereby the 12/24 hr bit is set up differently. All of the other registers either have differing addresses, bits or functionality. 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 regsters). Software will definitely need to be changed to write to and read from the ISL1208.

Alarm Registers

The Alarm register for the ISL1208 is set up similar to Alarm1 for the DS1339, but the control bit for enabling the alarm is set up different. Both devices can be set up for a periodic (repeatable) interrupt using the alarm time set, but the register programming is different. See the ISL1208 data sheet to make sure the device is programmed correctly.

TABLE 1. REGISTER COMPARISONS

ADDR.	DS1339 CONTENTS	ISL1208 CONTENTS	COMMENTS
00h	RTC seconds, BCD	RTC seconds, BCD	Identical contents
01h	RTC minutes, BCD	RTC minutes, BCD	Identical contents
02h	RTC Hours, BCD	RTC hours, BCD	Contents are similar, but the 12/24hr bit is different
03h	RTC Day of Week, BCD	RTC Date, BCD	DS1339 Register 03h is identical to ISL1208 Register 06h
04h	RTC Date, BCD	RTC Month, BCD	DS1339 Register 04h is identical to ISL1208 Register 03h
05h	RTC Month, Century, BCD	RTC Year, BCD	DS1339 Register 05h is similar to ISL1208 Register 04h, but adds a bit for Century
06h	RTC Year, BCD	RTC Day of Week, BCD	DS1339 Register 06h is identical to ISL1208 Register 05h
07h	Alarm 1, seconds	Status (see text)	Alarm 1 Seconds register is similar to ISL1208 Alarm Seconds, but the control bit is different.
08h	Alarm 1, minutes	Control (see text)	Alarm 1 Minutes register is similar to ISL1208 Alarm Minutes, but the control bit is different.
09h	Alarm 1, Hours	N/A	Alarm 1 Hours register is similar to ISL1208 Alarm Hours, but the 12/24 bit and control bit is different.
0Ah	Alarm 1 Day/Date	ATR control	Alarm 1 Day/Date register combines the ISL1208 Day and Date alarm register functions
0Bh	Alarm 2, minutes	DTR control	Alarm 2 Minutes register is similar to ISL1208 Alarm Minutes, but the control bit is different.
0Ch	Alarm 2, Hours	Alarm, seconds	Alarm 2 Hours register is similar to ISL1208 Alarm Hours, but the 12/24 bit and control bit is different.
0Dh	Alarm 2 Day/Date	Alarm, minutes	Alarm 2 Day/Date register combines the ISL1208 Day and Date alarm register functions
0Eh	Control (see text)	Alarm, Hours	
0Fh	Status (see text)	Alarm, Date	
10h	Trickle Charger	Alarm, Month	ISL1208 does not control trickle charge
11h	N/A	Alarm, Day of Week	
12h	N/A	General purpose memory	No GPM in the DS1339
13h	N/A	General purpose memory	No GPM in the DS1339

N/A - Indicates Register not available for access

Status Register

The DS1339 status register (addr 0Fh) has a bit for oscillator fail and one bit each for the Alarms to indicate alarm has been detected. 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 is different from the DS1339 oscillator fail bit, as it 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 Registers

The control registers for the two devices are set up very differently. The DS1339 has one control register (addr 0Eh) with the following bits:

TABLE 2.

7	6	5	4	3	2	1	0
EOSC-	0	0	RS2	RS1	INTCN	A2IE	AQIE

The EOSC- bit turns the oscillator ON or OFF. This is the same function as the XTOSCB bit in the ISL1208 status register (addr 07h) with the same polarity.

RS1 and RS2 control the clock output frequency in four steps, 1Hz, 4.096kHz, 8.192kHz, 32.768kHz. The ISL1208 has 16 different steps including those four options, and is controlled from addr 08h (Interrupt control) with 4 bits.

INTCN controls the alarms and interrupt outputs. Since the ISL1208 only has one alarm and one output there is no similar control bit.

A2IE, A1IE enable the alarms independently. The ISL1208 has a single alarm and one enable in the Interrupt control register (addr 08h).

The ISL1208 also has control register for analog and digital trimming of the RTC clock which are not available in the DS1339.

I^2C Interface: Communicating with the ISL1208 versus the DS1339

There are two major differences between the DS1339 and the ISL1208 when using the I^2C bus:

1. The first 7 bits of the slave address for the ISL1208 are 1101111, and for the DS1339 are 1101000. So 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 inadvertant writes. This will require a software change as well since two I^2C 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.

Other RTC Devices

The ISL1209 device provides the same functionality as the ISL1208, but includes an event detector function in the 10 Ld 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.

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