Replacing the x1226, x1227 or x1228 RTC with the ISL12026, ISL12026A, ISL12027 or ISL12028

TB460
Rev.0.00
Dec 4, 2008

Introduction

Intersil has recently introduced a new family of Real Time Clock (RTC) devices (the “ISL1202x” family), which include 4k of EEPROM. These devices are pin-to-pin compatible and include enhancements over an older family of devices (the “x122x” family). These enhancements include:

- Lower supply and battery backup current
- Reliable battery switchover
- Accurate Reset voltage trip points
- Oscillator functionality detection

Other enhancements are detailed in the data sheets. This Technical Brief provides information for an engineer wishing to use the new devices to replace the older devices in their system.

Replacing the x1226 with the ISL12026 and ISL12026A

The ISL12026, ISL12026A is an RTC device with 4k of EEPROM and includes an $\overline{IRQ}/F_{OUT}$ pin for outputting an alarm interrupt or constant frequency clock. The ISL12026, ISL12026A can drop into an x1226 socket with no hardware changes required, but certain changes to the battery switchover and battery operation should be reviewed. **Note that the ISL12026 cannot drop into applications where normal operation requires $V_{BAT}>V_{DD}$** (such as when V_{DD} = 3.0V and V_{BAT} = 3.2V).The default register setup only allows reading registers using the I^2C bus with $V_{BAT}>V_{DD}$, not writing. **For full I^2C read and write operation with $V_{BAT}>V_{DD}$, the ISL12026A is available** with the correct default setting for this operation.

There are only two changes that affect microcode or software. First, the change in general purpose EEPROM memory page size from 64 bytes to 16 bytes will require changes to the memory writing procedure. Second, the RTC registers require a full page write at a time instead of allowing a single byte write. A single byte write to the RTC registers will result in no update to those registers at all.

Note that there are additional status and control bits added to the registers of the ISL12026 and ISL12026A. Review their function thoroughly before substituting the ISL12026 or ISL12026A for the x1226. Table 1 lists the complete hardware and register changes. If the additional functionality is not needed, however, the ISL12026A default factory setting emulates the older device functionality.

Replacing the x1227 with the ISL12027

The ISL12027 is an RTC device with 4k of EEPROM and includes a $\overline{RESET}$ pin for outputting a hardware Reset signal for microcontroller or logic system reset, or a watchdog timer reset. The Reset function was improved in the ISL12027 to perform a Reset even if the oscillator has not started or has been stopped. The x1227 device would not issue a Reset with a stopped oscillator. The ISL12027 can drop into an x1227 socket with no hardware changes required, but certain changes to the battery switchover and battery operation should be reviewed. See the ISL12027 data sheet for more details.

There are only two changes that affect microcode or software. First, the change in general purpose EEPROM memory page size from 64 bytes to 16 bytes will require changes to the memory writing procedure. Second, the RTC registers require a full page write at a time instead of allowing a single byte write. A single byte write to the RTC registers will result in no update to those registers at all.

Note that there are additional status and control bits added to the registers of the ISL12027, and their function should be reviewed as well. Review their function thoroughly before substituting the ISL12027 for the x1227. Table 2 lists the complete hardware and register changes. If the additional functionality is not needed, however, the device default setting from the factory emulates the older device functionality.

Replacing the x1228 with the ISL12028

The ISL12028 is an RTC device with 4k of EEPROM and includes an $\overline{IRQ}/F_{OUT}$ pin for outputting an alarm interrupt or constant frequency clock, and a $\overline{RESET}$ pin for outputting a hardware Reset signal for microcontroller or logic system reset or a watchdog timer reset. The Reset function was improved in the ISL12028 to perform a Reset even if the oscillator has not started or has been stopped. The x1228 device would not issue a Reset with a stopped oscillator. The ISL12028 can drop into an x1228 socket with no hardware changes required, but certain changes to the battery switchover and battery operation should be reviewed. See the ISL12028 data sheet for more details.

There are only two changes that affect microcode or software. First, the change in general purpose EEPROM memory page size from 64 bytes to 16 bytes will require changes to the memory writing procedure. Second, the RTC registers require a full page write at a time instead of allowing a single byte write. A single byte write to the RTC registers will result in no update to those registers at all.

Note that there are additional status and control bits added to the registers of the ISL12027, and their function should be reviewed as well. Review their function thoroughly before substituting the ISL12028 for the x1228. Table 3 lists the complete hardware and register changes. If the additional functionality is not needed, however, the device default setting from the factory emulates the older device functionality.

Note that the ISL12029 device has been introduced as well, and is the same as the ISL12028 in all respects except for an open drain $\overline{IRQ}/F_{OUT}$ pin instead of the CMOS output pin found on the ISL12028. This change will reduce battery current drain in applications where the circuitry that connect to this pin is powered down in battery backup mode.

TABLE 1. REPLACING THE x1226 WITH THE ISL12026 AND ISL12026A

FUNCTION	OLD X1226	NEW ISL12026 or ISL12026A	AFFECTS SOFTWARE?
Battery Switchover	Device switches to battery mode once $V_{CC} < V_{BAT}$	Default mode is called "LP Mode" whereby the device switches to battery when $V_{DD}<V_{BAT}$. An option exists called “Normal Mode” which requires 1) $V_{CC} < V_{BAT}$ **AND** 2) $V_{CC} < V_{TRIP}$.	NO
Battery Switchover	Hysteresis on V_{CC} negative transition only in legacy mode	Hysteresis on both V_{DD} negative and positive transitions	NO
Battery Current	1.25µA battery backup current	800nA battery backup current	NO
Power Supply	Min rise/fall times for V_{CC} only	Max slew rate for V_{DD}	NO
I^2C Operation with $V_{BAT}>V_{DD}$	Device could work in battery backup as long as $V_{BAT} > V_{TRIP}$ and $V_{BAT} > V_{CC}$, including I^2C operation with $V_{BAT} > V_{CC}$.	ISL12026 will **NOT** allow I^2C writes in default mode in applications where $\mathbf{V_{BAT} > V_{DD}}$. The **ISL12026A** is needed for performing I^2C writes with $V_{BAT} > V_{DD}$. This operation is register selectable	NO. Selecting the correct device should not require changing a register setting.
EEPROM	64-byte page write	16-byte page write	**YES**
Status Register	(None)	Status bit to indicate oscillator stopped	NO - Optional additional functionality
Status Register	Legacy switchover only	BSW mode bit to change from legacy to standard mode for battery switchover	NO - Optional additional functionality
Control Registers	(None)	Memory map to expand slightly from addition of bits	NO - Optional additional functionality
RTC Registers	Byte write or page write	Page write ONLY	**YES**
Pin Names	$\overline{IRQ}$/PHZ	$\overline{IRQ}/F_{OUT}$	NO
Pin Names	V_{BACK}	V_{BAT}	NO
Pin Names	V_{CC}	V_{DD}	NO
Clock Inputs	External clocking on X1 with special input	No external clocking	NO

TABLE 2. REPLACING THE x1227 WITH THE ISL12027

FUNCTION	OLD X1227	NEW ISL12027	AFFECTS SOFTWARE?
Battery Switchover	Device switches to battery mode once V_{CC} < V_{BAT}	Device switches to battery when 1) V_{CC} < V_{BAT} **AND** 2) V_{CC} < V_{RESET} with option to work the old way (called "LP Mode")	NO
Battery Switchover	Hysteresis on V_{DD} negative transition only in legacy mode	Hysteresis on both V_{DD} negative and positive transitions	NO
Battery Current	1.25µA battery backup current	800nA battery backup current	NO
Power Supply	Min rise/fall times for V_{CC} only	Max slew rate for V_{DD}	NO
Reset Trip Voltages	4 available reset thresholds with ±2.5% accuracy (old floating gate reference)	5 available reset thresholds with ±1.5% accuracy (more accurate bandgap)	NO
Reset Trip Voltages	Thresholds adjusted using complicated analog voltage setting procedure	Thresholds programmed (1 of 5) using EEPROM register	NO
I^2C Operation with Battery	Device could work as long as V_{BAT} > V_{DD} > V_{RESET}	Selectable operation whether I^2C is active in battery backup	NO
Operation with NO Oscillator	No reset, no I^2C communication	Reset will occur with no battery, I^2C can communicate	NO
EEPROM	64-byte page write	16-byte page write	**YES**
Status Register	(None)	Status bit to indicate oscillator stopped	NO - Optional additional functionality
Status Register	Legacy switchover only	BSW mode bit to change from legacy to standard mode for battery switchover	NO - Optional additional functionality
Control Registers	(None)	Memory map to expand slightly from addition of bits	NO - Optional additional functionality
RTC Registers	Byte write or page write	Page write ONLY - No single byte writes to setup RTC registers	**YES**
Pin Names	V_{BACK}	V_{BAT}	NO
Pin Names	V_{CC}	V_{DD}	NO
Clock Inputs	External clocking on X1 with special input	No external clocking	NO

TABLE 3. REPLACING THE X1228 WITH THE ISL12028

FUNCTION	OLD X1228	NEW ISL12028	AFFECTS SOFTWARE?
Battery Switchover	Device switches to battery mode once $V_{CC} < V_{BAT}$	Device switches to battery when 1) $V_{CC} < V_{BAT}$ **AND** 2) $V_{CC} < V_{RESET}$ with option to work the old way (called "LP Mode")	NO
Battery Switchover	Hysteresis on V_{DD} negative transition only in legacy mode	Hysteresis on both V_{DD} negative and positive transitions	NO
Battery Current	1.25µA battery backup current	800nA battery backup current	NO
Power Supply	Min rise/fall times for V_{CC} only	Max slew rate for V_{DD}	NO
Reset Trip Voltages	4 available reset thresholds with ±2.5% accuracy (old floating gate reference)	5 available reset thresholds with ±1.5% accuracy (more accurate bandgap)	NO
Reset Trip Voltages	Thresholds adjusted using complicated analog voltage setting procedure	Thresholds programmed (1 of 5) using EEPROM register	NO
I^2C Operation with Battery	Device could work as long as $V_{BAT} > V_{DD} > V_{RESET}$	Selectable operation whether I^2C is active in battery backup	NO
Operation with NO Oscillator	No reset, no I^2C communication	Reset will occur with no battery, I^2C can communicate	NO
EEPROM	64-byte page write	16-byte page write	**YES**
Status Register	(None)	Status bit to indicate oscillator stopped	NO - Optional additional functionality
Status Register	Legacy switchover only	BSW mode bit to change from legacy to standard mode for battery switchover	NO - Optional additional functionality
Control Registers	(None)	Memory map to expand slightly from addition of bits	NO - Optional additional functionality
RTC Registers	Byte write or page write	Page write ONLY - No single byte writes to setup RTC registers	**YES**
Pin Names	$\overline{IRQ}$/PHZ	$\overline{IRQ}/F_{OUT}$	NO
Pin Names	V_{BACK}	V_{BAT}	NO
Pin Names	V_{CC}	V_{DD}	NO
Clock Inputs	External clocking on X1 with special input	No external clocking	NO

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)

RENESAS

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

Colophon 7.0