Replacing the X1226, X1227, X1228 or X1288 RTC with the ISL12026, ISL12027, ISL12028

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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 for 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 Application note 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

The ISL12026 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 can drop into an X1226 socket with no hardware changes required, but certain changes to the battery switchover and battery operation should be reviewed. See the ISL12026 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 ISL12026. Review their function thoroughly before substituting the ISL12026 for the X1226. Table 1 lists the complete hardware and register changes. If the additional functionality is not needed, however, the ISL12026 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 a $F_{OUT}/\overline{IRQ}$ 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 $F_{OUT}/\overline{IRQ}$ 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 (such as a microcontroller using a 32kHz clock).

Replacing the X1288 with the ISL12028

The X1288 device is the only device in the original RTC product line that contained 256k bits of EEPROM. Two packages are available for the X1288, a 16 Ld SOIC and a 14 Ld TSSOP. The ISL12028 in 14 Ld TSSOP can drop into the X1288 14 Ld TSSOP 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. The ISL12028 is not offered in 16 Ld SOIC package, so there is no new solution that drops into that pinout.

The ISL12028 is an RTC device with 4k of EEPROM and includes a $F_{OUT}/\overline{IRQ}$ 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 X1288 device would not issue a Reset with a stopped oscillator.

The major difference between the two parts is that the X1288 has 256k bits of EEPROM general purpose memory, and the ISL12028 has only 4k bits. If the deeper memory is still required when replacing the X1288 part with the ISL12028, then a separate serial I^2C EEPROM device will be needed. The 24C256 device is available in an 8 Ld TSSOP from multiple manufacturers. Note that the external EEPROM device will need to have a different slave address from the ISL12028, which is set to 1010111x (where x is the Read/$\overline{Write}$ bit).

There are two other changes that affect microcode or software. First, if the 4k of general purpose EEPROM is used, the memory page size changes from 128 bytes to 16 bytes and 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 is an additional status bit and control register added to the ISL12028, and their function should be reviewed as well. Table 4 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 $F_{OUT}/\overline{IRQ}$ pin instead of the CMOS output pin found on the ISL12028. This change will reduce battery current drain in applications where the circuitry that connects to this pin is powered down in battery backup mode (such as a microcontroller using a 32kHz clock).

TABLE 1. REPLACING THE X1226 WITH THE ISL12026

FUNCTION	OLD X1226	NEW ISL12026	AFFECTS SOFTWARE?
Battery Switchover	Devices Switches to Battery Mode Once $V_{CC} < V_{BAT}$	Device Switches to Battery when: 1) $V_{CC} < V_{BAT}$ **AND** 2) $V_{CC} < V_{TRIP}$ 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
I^2C operation with battery	Device could work in battery backup as long as $V_{BAT} > V_{TRIP}$ and $V_{BAT} > V_{CC}$	Selectable operation whether I^2C is active in battery backup, or will not be active if $V_{BAT} > V_{DD}$	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	**YES**
Alarm Function	Only Alarm0 (ALM0x) would trigger an $\overline{IRQ}$ transition	Both alarms will trigger $\overline{IRQ}$ if they are set to different times	NO
Pin Names	PHZ/$\overline{IRQ}$	$\overline{IRQ}/F_{OUT}$	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	Devices Switches to Battery Mode Once $V_{CC} < V_{BAT}$	Device Switches to Battery when: 1) $V_{CC} < V_{BAT}$ **AND** 2) $V_{CC} < V_{TRIP}$ 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**
Alarm Function	Only Alarm0 (ALM0x) would trigger an $\overline{IRQ}$ transition	Both alarms will trigger $\overline{IRQ}$ if they are set to different times	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 3. REPLACING THE X1228 WITH THE ISL12028

FUNCTION	OLD X1228	NEW ISL12028	AFFECTS SOFTWARE?
Battery Switchover	Devices Switches to Battery Mode Once $V_{CC} < V_{BAT}$	Device Switches to Battery when: 1) $V_{CC} < V_{BAT}$ **AND** 2) $V_{CC} < V_{TRIP}$ 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
Alarm Function	Only Alarm0 (ALM0x) would trigger an $\overline{IRQ}$ transition	Both alarms will trigger $\overline{IRQ}$ if they are set to different times	NO
Pin Names	PHZ/$\overline{IRQ}$	$F_{OUT}/\overline{IRQ}$	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 4. REPLACING THE X1288 WITH THE ISL12028

FUNCTION	OLD X1288	NEW ISL12028	AFFECTS SOFTWARE?
Battery Switchover	Devices Switches to Battery Mode Once $V_{CC} < V_{BAT}$	Device Switches to Battery when: 1) $V_{CC} < V_{BAT}$ **AND** 2) $V_{CC} < V_{TRIP}$ 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	32k x 8 size	512 x 8 size	**YES**
EEPROM	128-byte Page Write	16-byte Page Write	**YES**
Status Register	No Oscillator Stopped Bit	Status Bit to Indicate Oscillator Stopped	NO - optional additional functionality
Control Register	Legacy switchover only	BSW Mode bit to change from Legacy to Standard mode for battery switchover	NO - optional additional functionality
Control Registers	No PWR register	Memory Map to Expand to include one more Register, at address 014h the PWR register. Adds V_{TRIP} selection and battery mode control.	NO - optional additional functionality
RTC Registers	Byte write or page write	Page write ONLY - No single byte writes to setup RTC registers	**YES**
Alarm Function	Only Alarm0 (ALM0x) would trigger an $\overline{IRQ}$ transition	Both alarms will trigger $\overline{IRQ}$ if they are set to different times	NO
Pin Names	PHZ/$\overline{IRQ}$ (no change)	FOUT/$\overline{IRQ}$	NO
Pin Names	V_{BACK} (no change)	V_{BAT}	NO
Pin Names	V_{CC} (no change)	V_{DD}	NO
Clock Inputs	External Clocking on X1 with special input	No External clocking	NO

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