Élan™SC300 and Élan™SC310 Microcontrollers Solution For Systems Using A Back-Up Battery

AMD

Application Note

The Élan™SC300 and ÉlanSC310 microcontrollers (referred to in this document as ÉlanSC300) have a few issues that need to be addressed when using a back-up battery as a secondary power source for Micro Power Off mode. The three issues covered in this application note are the basic function of the ÉlanSC300 microcontroller's Micro Power Off mode, the difference between the ÉlanSC300 microcontroller's RTC and a 146818A-compatible RTC, and using a back-up battery in an ÉlanSC300 microcontroller-based system.

MICRO POWER OFF MODE

The Élan™SC300 microcontroller includes a built-in 146818A-compatible real-time clock (RTC) with 114 bytes of static random access memory (SRAM). The RTC SRAM is designed to hold configuration data and to maintain the accurate time and date when the rest of the system is powered down. This state is called the Micro Power Off mode.

Micro Power Off mode allows the system to conserve battery power by removing all power to all system components and the ÉlanSC300 microcontroller except for the AVCC and VCC pins. Maintaining power on these pins allows the RTC to remain powered up, preventing the system from losing its date, time, and system configuration data. This feature allows an AT-compatible system to be implemented without using an external RTC device.

Real-Time Clock

The ÉlanSC300 microcontroller's RTC is designed to operate properly while in Micro Power Off mode at voltages down to 2.4 V, with the power consumption typically around 30 µA. (For register settings that will affect power consumption during Micro Power Off mode, see the power consumption data in the *Élan™SC300 Microcontroller Data Sheet*, order #18514 and the *Élan™SC310 Microcontroller Data Sheet*, order #20668.) Any source below 2.4 V will not guarantee proper functionality, which could mean the loss of date, time, and system configuration data.

There are a few differences between the ÉlanSC300 microcontroller's RTC and a 146818A-compatible device. The ÉlanSC300 microcontroller's RTC relies on the VCC and AVCC planes to remain powered, rather than on a single V_{CC} powering an external RTC device.

A 146818A-compatible device has a dedicated reset pin that is used mainly to monitor the 146818A V_{CC} and will reset only the RTC when a low-power condition is detected. The ÉlanSC300 microcontroller's RTC uses the $\overline{RESIN}$ input pin for resetting the RTC. The $\overline{RESIN}$ input is derived from the main system power source, and when active will reset all internal registers in the ÉlanSC300 microcontroller. This causes an issue with the power-loss bit (VRT), Index 0DH, bit 7 of the RTC map. The VRT bit is intended to provide a method of determining when the RTC core voltage supply has dropped below an acceptable level.

On a 146818A-compatible device, anything below 2.4 V will cause a low-battery condition and will cause the power-loss bit to go Low. On the ÉlanSC300 microcontroller the 32-KHz clock used by the RTC to maintain time stops oscillating before the VRT bit or RAM contents get cleared because the VRT bit will only get cleared when the $\overline{RESIN}$ pin is asserted Low. Thus, the RTC time will be inaccurate even though the RAM contents are valid and the VRT bit is still set.

Note: *Although the 32-KHz clock stops oscillating before the power-loss bit is cleared, this event occurs well below the 2.4-V specification for proper ÉlanSC300 microcontroller functionality.*

This condition presents a problem because the BIOS will usually perform a checksum of the RAM contents or look at the VRT bit in order to determine the validity of the configuration data and the RTC time and date data, then notify you that they are no longer valid.

Suggested Workaround:

- Use the system to manually determine that the clock has stopped by comparing the current time to the DOS time.
- Implement a comparator circuit with the output connected to the $\overline{RESIN}$ input of the ÉlanSC300 microcontroller to allow comparison of the battery voltage (at the VCC Core and AVCC pins of the ÉlanSC300 microcontroller) to a reference voltage (2.4 V) only when the system is powered up by the main power source. Driving a pulse on $\overline{RESIN}$ will clear the VRT bit, thus allowing the BIOS to detect any subsequent low-battery condition by reading Index Register 0DH, bit 7 (VRT).

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Note: *This workaround requires the BIOS to read Index Register 0DH as opposed to performing a checksum on the RTC RAM. Pulsing RESIN active will clear VRT, but will not clear the RTC RAM contents.*

Backup Battery

The Micro Power Off mode implementation on the ÉlanSC300 microcontroller allows the main system power source to be turned off and a back-up power source to be switched on to maintain power to the AVCC and VCC pins. Keeping power applied to the AVCC and VCC pins on the ÉlanSC300 microcontroller allows the integrated RTC to remain powered on in Micro Power Off mode, preventing the loss of date, time, and system configuration data.

If an RTC back-up battery is installed on a system with power applied only to the AVCC and VCC pins, and the main power source is unavailable or turned off, the ÉlanSC300 microcontroller will come up in an undefined state. This causes power consumption in the mA range, which could drain the secondary battery, depending upon how long this condition is present.

When the ÉlanSC300 microcontroller is powered up by the main power source and has properly transitioned to Micro Power Off mode, the undefined condition will not be an issue as long as the back-up power source was installed prior to the transition into Micro Power Off mode. The undefined condition will occur only when power is applied initially to the AVCC and VCC pins on the ÉlanSC300 microcontroller with the main power source turned off or unavailable.

Suggested Workaround:

- You should implement a switching circuit to allow a clean transition from the main power source to the back-up battery source when the system is put into Micro Power Off mode. This circuit should also gate off the back-up source from the VCC and AVCC pins until a main power source is present the first time. See Figure 1 for a circuit example. Table 1 shows the materials required for this particular circuit.

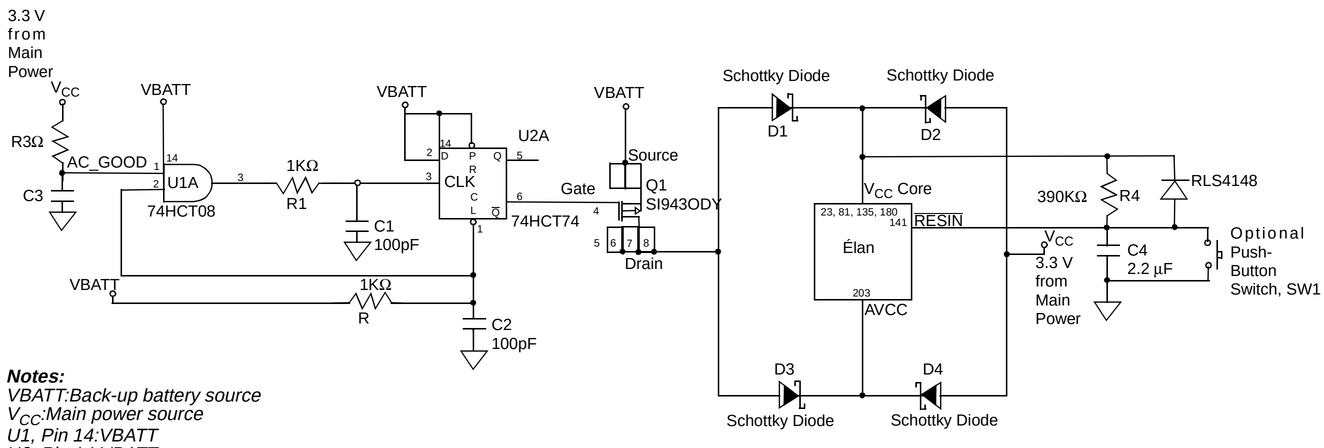
  When designing this circuit, ensure that the voltage at the anode of D1 and D3 is lower than that of the VCC and AVCC pins; otherwise, the ÉlanSC300 microcontroller will draw power from the back-up battery rather than the main power source. You should also ensure that the voltage at the VCC Core and AVCC pins does not drop out of DC specification (3.0 V–3.6 V) during normal power-on because of the forward drop of the Schottky diodes used.

- If the system design guarantees that the back-up battery will be in place before the main power source is present, the following components may be deleted from Figure 1: U1, R1, and C1. The AC_GOOD input of U1 would then be tied directly to U2, pin 3. This is because the CLK input of U2 must only be clocked when VBATT is present. The AC_GOOD signal can also be used to drive the IORESET input to the ÉlanSC300.

- During the manufacturing process, install the back-up battery when the system is powered by the main power source prior to the transition into Micro Power Off mode. This will prevent the ÉlanSC300 microcontroller from coming up in the undefined state.

Table 1. Bill of Materials

Item	Quantity	Reference	Part
1	1	U1	74HCT08
2	1	U2	74HCT74
3	1	Q1	Siliconix SI9430DY P-channel MOSFET
4	4	D1–D4	Rohm RB400D Schottky diode
5	2	R1, R2	1-kΩ resistor
6	2	C1, C2	100-pF capacitor
7	2	R3, R4	390-KΩ resistor
8	2	C3, C4	2.2-µF capacitor



Notes:
VBATT:Back-up battery source
V_{CC}:Main power source
U1, Pin 14:VBATT
U2, Pin 14:VBATT
RESIN:Derived from main power source

This drawing does not include the necessary capacitors and inductors required to assure adequate noise filtering on the V_{CC} and AVCC inputs.

The AC_GOOD signal can optionally be used to drive the $\overline{\text{IORESET}}$ input to Élan.

Micro Power Off mode requires that $\overline{\text{RESIN}}$ be maintained High and $\overline{\text{IORESET}}$ be asserted Low. For more information, see the Élan™SC300 Microcontroller Data Sheet, and the Élan™SC310 Microcontroller Data Sheet. The $\overline{\text{RESIN}}$ input to the ÉlanSC300 and ÉlanSC310 microcontrollers should be generated by an RC circuit that is derived from the battery-backed-up VCC Core power plane, which will remain deasserted (High) when the main power source is removed. It is likely that you will want a reset switch also tied to the $\overline{\text{RESIN}}$ circuit.

Figure 1. Clean-Transition Switching Circuit