

Serial real-time clock ICs





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RTC ICs spectrum

Widest portfolio of real-time clocks offers unlimited design solutions

An extended variety of products with the newest technology innovations are available including ultra low-power devices, the world's smallest package with embedded crystal, and ST's SNAPPHAT's with battery and crystal integrated. RTC functions include alarm, battery switchover, reset, and special features such as time stamp, anti-tamper for secure applications and audio.

Low-power for portable devices	Enhanced industry-standard	Highly-integrated
<ul style="list-style-type: none">• Low standby current• World's smallest RTC with embedded crystal• Small packages	<ul style="list-style-type: none">• Automatic battery switchover• Analog calibration• Embedded crystal	<ul style="list-style-type: none">• RTC with NVRAM and microprocessor supervisor functions• Securitizer RTC with physical tamper detect
M41T6x series	M41T81S, M41T00S, M41T01, M41T80, M41T11 M41T82/83/93, M41T00CAP	M41ST85W, M41T94, M41T00AUD, M41ST87W
		





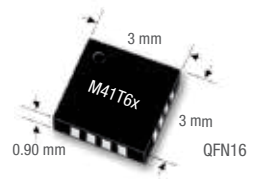
Low-power RTC ICs

Very low standby current extends battery backup life

Special low-power RTC series available in small packages, from 350 nA, with battery switchover, and with or without an embedded crystal to best fit battery-operated device constraints.

APPLICATION EXAMPLES

- Digital cameras
- Portable media players
- Medical instruments
- Point-of-sale terminals
- Test equipment
- Portable navigation



LOW-POWER RTCs FOR PORTABLE DEVICES PORTFOLIO

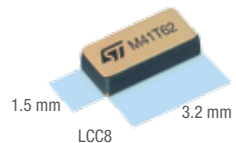
Part number	Package	Battery supply current (I_{BAT}) typ (nA)	Data bus type 400 kHz	Supply voltage		Timekeeping min (V)	Oscillator faildetect	Programmable alarms	Watchdog timer	Square wave output	Power-up output frequency (KHz)	Embedded crystal
				min - max (V)								
M41T60	QFN16	350	I ² C	1.3 - 4.4	1	• ¹	-	-	-	-	-	-
M41T62	QFN16	350	I ² C	1.3 - 4.4	1	• ¹	• ¹	• ¹	•	32	-	-
	LCC8	350	I ² C	1.3 - 4.4	1	• ¹	• ¹	• ¹	•	32	•	-
M41T63	QFN16	350	I ² C	1.3 - 4.4	1	•	-	•	•	32	-	-
M41T64	QFN16	350	I ² C	1.3 - 4.4	1	•	-	•	•	32	-	-
M41T65	QFN16	350	I ² C	1.3 - 4.4	1	• ¹	• ¹	•	-	-	-	-
M41T66	QFN16	525	I ² C	1.5 - 4.4	1	• ¹	• ¹	• ¹	•	32	-	-

Note: 1: With IRQ output

WORLD'S SMALLEST RTC WITH EMBEDDED CRYSTAL

M41T62LCC6F

- RTC in LCC8 package with embedded crystal
- 10ths and 100ths of seconds
- Programmable alarm with repeat modes and interrupt function
- Programmable watchdog timer
• 62.5 ms to 31 min
- Programmable square-wave output
• 1 Hz to 32 KHz





Enhanced industry-standard

Class-leading RTCs for precision applications

Enhanced industry-standard RTC with fixed reference added for highly-reliable battery switchover threshold, plus analog calibration, embedded crystal and oscillator fail detect.

APPLICATION EXAMPLES

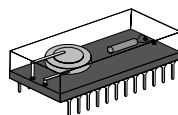
- Home multimedia
- Multi-function printers
- Metering (gas, electricity, water)
- Vehicle tracking systems

M41T00S

- Precision reference for battery switchover threshold
- Oscillator fail detect circuit
- 400 kHz I²C interface
- Automatic battery switchover and write-protect
- Calibration register - accuracy to 5 seconds per month
- BCD registers: century, year, month, day, date, hours, minutes, seconds
- 2.7 to 5.5 V operation
- Automatic leap year adjustment
- SO8 package

M41T00CAP

- Integrated backup battery and embedded crystal
- Based on M41T00S RTC
- CAPHAT™ PCDIP24 package
- 0 to 70 °C operation
- Up to 10 years of timekeeping without system power

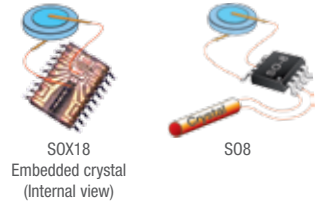


PCDIP24 CAPHAT™
Embedded crystal + battery (internal view)



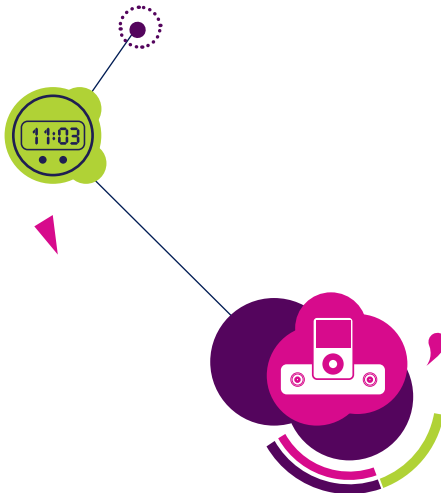
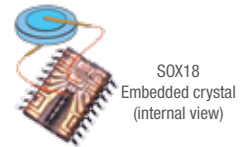
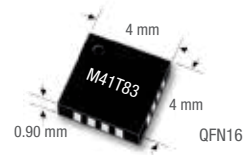
M41T81S

- Programmable alarm with repeat modes
- Oscillator fail detect circuit
- Battery monitor
- Automatic battery switchover and write-protect with precision reference
- Calibration register - accuracy to 5 seconds per month
- BCD registers: century, year, month, day, date, hours, minutes, seconds
- 400 kHz I²C interface
- Programmable watchdog
 - 62.5 ms to 128 s time-out
- Programmable square-wave
 - 1 Hz to 32 KHz
- Automatic leap year adjustment



M41T83, REAL-TIME CLOCKS WITH ANALOG CALIBRATION

- Factory-calibrated accuracy of ± 5 ppm typical after 2 reflows (SOX18)
- Analog calibration allows in-application calibration
- 365 nA standby (typ) at 3.0 V
- Automatic battery switchover and write-protect with precision reference
 - Precision reference
- 400 kHz I²C, 10 MHz SPI
- 12 bytes of NVRAM
 - 5 bytes shared with 2 alarm registers
- 2 programmable alarms with repeat modes
- Memory-mapped BCD year, month, day, date, hours, minutes, seconds, 10ths, 100ths of seconds
- 2.38 to 5.5 V operation
 - Timekeeping down to 1.8 V
- Programmable watchdog (62.5 ms to 128 s)
- Programmable squarewave output
 - 1 Hz to 32 KHz



ENHANCED INDUSTRY-STANDARD RTCs PORTFOLIO

Part number	Package	Battery supply current (I_{BAT})	NVRAM size	Data bus type	V_{CC}	Timekeeping min (V)	Battery switchover	Oscillator fail detect	Programmable alarms	Square wave output	Power-up output frequency (KHz)	Watchdog timer	Battery low detect	Power on Reset/low voltage detector output	Embedded crystal	Temperature compensated
		typ (nA)	(bytes)		min - max (V)											
M41T0	SO-8	900	-	I ² C ²	2 - 5.5	2	-	•	-	-	-	-	-	-	-	-
M41T00S	SO-8	600	-	I ² C ²	2.7 - 5.5	2	• ⁵	•	-	-	-	-	-	-	-	-
M41T01	SO-8	800	-	I ² C ²	2 - 5.5	2.5	•	-	-	•	-	-	-	-	-	-
M41T00AUD	DFN16	600	-	I ² C ²	3 - 3.6	1.7	• ⁵	• ³	-	-	-	-	-	-	-	-
M41T00CAP	PCDIP24 ¹	-	-	I ² C ²	2.7 - 5.5	-	• ⁵	•	-	-	-	-	-	-	•	-
M41T11	SO-8	800	56	I ² C	2 - 5.5	2	•	-	-	-	-	-	-	-	-	-
	SOH-28	800	56	I ² C	2 - 5.5	2	•	-	-	-	-	-	-	-	-	-
M41T56	SO-8	450	56	I ² C	4.5 - 5.5	2.5	•	-	-	-	-	-	-	-	-	-
M41T80	SO-8	1500	-	I ² C ²	2 - 5.5	2	-	-	• ³	• ³	32 ⁴	-	-	-	-	-
M41T81S	SO-8	600	-	I ² C ²	2.7 - 5.5	2	• ⁵	• ³	• ³	• ³	-	• ³	•	-	-	-
	SOX-18	600	-	I ² C ²	2.7 - 5.5	2	• ⁵	• ³	• ³	• ³	-	• ³	•	-	•	-
M41T82	SO-8	365	12	I ² C ²	2.38 - 5.5	1.8	• ⁵	•	-	-	-	-	•	•	-	-
M41T83	QFN16	365	12	I ² C ²	2.38 - 5.5	1.8	• ⁵	• ³	• ³	• ⁴	32	• ³	•	•	-	-
	SOX-18	365	12	I ² C ²	2.38 - 5.5	1.8	• ⁵	• ³	• ³	• ⁴	32	• ³	•	•	•	-
M41T93	QFN16	365	12	SPI ⁶	2.38 - 5.5	1.8	• ⁵	• ³	• ³	• ⁴	32	• ³	•	•	-	-
	SOX-18	365	12	SPI ⁶	2.38 - 5.5	1.8	• ⁵	• ³	• ³	• ⁴	32	• ³	•	•	•	-

Note:

1: Integrated battery and embedded crystal

2: 400 kHz

3: With IRQ output

4: Dedicated output

5: Fixed switchover reference

6: 10 MHz



Highly-integrated RTC

Combined RTC and Microprocessor supervisor

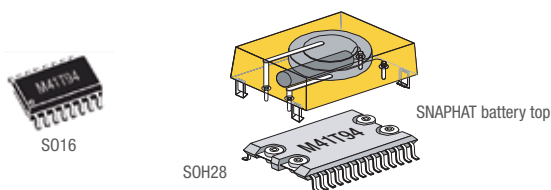
Highly-integrated RTCs with NVRAM and a large set of microprocessor supervisory functions, including battery monitor, power-on reset and low-voltage detect.

APPLICATION EXAMPLES

- Servers
- Medical equipment
- Point of sales
- Vending machines
- Gaming

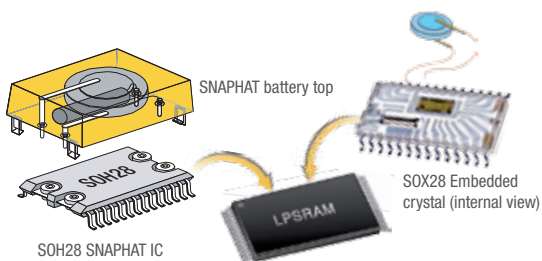
M41T94

- Automatic battery switchover
- Power-fail detect and write-protect
- 2 MHz SPI bus
- THS pin selects 5 or 3/3.3 V operation
- 400 nA standby (typ) at 3.0 V
- 44 bytes of NVRAM
- Programmable alarm with repeat mode
- Programmable square-wave output
 - 1 Hz to 32 KHz
- 10ths and 100ths of seconds



M41ST85W

- 400 kHz I²C
- 400 nA standby (typ) at 3.0 V
- 2.7 to 3.6 V
- 28-lead SNAPHAT[®] IC (SOH28)
- 28-lead embedded crystal SOIC (SOX28)
- Operating temperature: -40 to +85 °C
- 44 bytes of NVRAM
- Programmable alarm with repeat mode
- Programmable square-wave output
 - 1 Hz to 32 KHz
- 10ths and 100ths of seconds



SECURITIZOR RTC WITH PHYSICAL TAMPER DETECT

Combined real-time clock (RTC) IC including microprocessor supervisor, NVRAM supervisor, with physical tamper detect, plus internal and external RAM clear for secure applications.

APPLICATION EXAMPLES

- Black boxes
- Closed-circuit TV
- Financial security: ATM, cash, registers, POS, card readers
- Gaming machines
- Fire alarms
- Metering (gas, electricity, water)

M41ST87W

- 64-bit unique serial number
- -40 to +85 °C
- 3 V, 3.3 V, 5 V operation
- 500 nA standby (typ) at 3.0 V
- 28-lead embedded crystal IC
- Counters for 10ths and 100ths of seconds, seconds, minutes, hours, day, date, month, year, and century
- 128 bytes of clearable NVRAM
- Programmable alarm with repeat modes functions in battery-backed mode
- Programmable square-wave output
 - 1 Hz to 32 KHz
- Dedicated 32 KHz output
- Microprocessor supervisor
- NVRAM supervisor
- Tamper detect functions



HIGHLY-INTEGRATED RTCs PORTFOLIO

Part number	Package	Battery supply current (I _{BAT})	NVRAM size (bytes)	Data bus type	V _{CC}	Battery switchover	Oscillator fail detect	Programmable alarms	Square wave dedicated output	Power-up output frequency (kHz)	Watchdog timer	Battery low detect	Power on Reset/low voltage detector output	Power fail comparator	Reset inputs	Embedded crystal
		typ (nA)			min - max (V)											
M41ST85W	SOX-28	400	44	I ² C ²	2.7 - 3.6	• ⁴	-	• ³	•	-	• ³	•	•	•	•	•
	SOH-28	400	44	I ² C ²	2.7 - 3.6	• ⁴	-	• ³	•	-	• ³	•	•	•	•	-
M41ST87W	SSOP 20	500	128	I ² C ²	2.7 - 3.6	• ⁴	• ³	• ³	•	32	• ³	•	•	•	•	-
	SOX-28	500	128	I ² C ²	2.7 - 3.6	• ⁴	• ³	• ³	•	32	• ³	•	•	•	•	•
M41T94	SO-16	400	44	SPI ¹	2.7 - 5.5	• ⁴	•	• ³	•	-	• ³	•	•	-	•	-
	SOH-28	400	44	SPI ¹	2.7 - 5.5	• ⁴	•	• ³	•	-	• ³	•	•	-	•	-

Note:
 1: 2 MHz
 2: 400 kHz
 3: With IRQ output
 4: Fixed switchover reference

SERIAL REAL-TIME CLOCKS PORTFOLIO

Part number	Package	Package size	V _{CC}	I _{BAT}	Timekeeping	NVRAM	Oscillator fail detect	Features
		(mm)	min - max (V)	typ (nA)	min (V)	(bytes)		
M41T56	SO-8	3.9x4.9	4.5 - 5.5	450	2.5	56	-	
M41T60	QFN16	3x3x0.9	1.3 - 4.4	350	1	-	Yes	
M41T62	LCC8 QFN16	3.2x1.5 3x3x0.9	1.3 - 4.4	350	1	-	Yes	Crystal
M41T63	QFN16	3.0x3.0	1.3 - 4.4	350	1	-	Yes	
M41T64	QFN16	3x3x0.9	1.3 - 4.4	350	1	-	Yes	
M41T65	QFN16	3x3x0.9	1.3 - 4.4	350	1	-	Yes	
M41T66	QFN16	3x3x0.9	1.5 - 4.4	525	1	-	Yes	
M41T0	SO-8	3.9x4.9	2 - 5.5	900	2	-	Yes	
M41T01	SO-8	3.9x4.9	2 - 5.5	800	2.5	-	-	
M41T00AUD	DFN16	5x4x0.9	3 - 3.6	600	1.7	-	Yes	
M41T00CAP	PCDIP24	17.8x 34.3	2.7 - 5.5	-	-	-	Yes	CAPHAT
M41T00S	SO-8	3.9x4.9	2.7 - 5.5	600	2	-	Yes	
M41T11	SOH-28 SO-8	8.2x17.8 3.9x4.9	2 - 5.5	800	2	56	-	SNAPHAT
M41T80	SO-8	3.9x4.9	2 - 5.5	1500	2	-	-	
M41T81S	SOX-18 SO-8	7.6x11.6 3.9x4.9	2.7 - 5.5	600	2	-	Yes	Crystal
M41T82	SO-8	3.9x4.9	2.38 - 5.5	365	1.8	12	Yes	
M41T83	SOX-18 QFN16	7.6x11.6 4.0x4.0	2.38 - 5.5	365	1.8	12	Yes	Crystal
M41T93	SOX-18 QFN16	7.6x11.6 4.0x4.0	2.38 - 5.5	365	1.8	12	Yes	Crystal
M41ST85W	SOH-28 SOX-28	8.2x17.7 17.9x7.6	2.7 - 3.6	400	-	44	-	Crystal, SNAPHAT
M41ST87W	SOX-28 SSOP 20	7.6x17.9 5.3x7.2	2.7 - 3.6	500	-	128	Yes	Crystal
M41T94	SO-16 SOH-28	3.8x9.8 8.2x17.7	2.7 - 5.5	400	-	44	-	SNAPHAT

SNAPHAT® TOPS, BATTERY AND CRYSTAL INTEGRATED

Part number	Package	Crystal frequency nom (Hz)	Battery Lithium coin cell mAh
M4T28-BR12SH	SNAPHAT SOIC	32768	48
M4T32-BR12SH	SNAPHAT SOIC	32768	120

PACKAGE OPTIONS



LCC8
1.5 mm x 3.2 mm
Embedded crystal



QFN16
3 mm x 3 mm



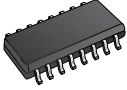
QFN16
4 mm x 4 mm



DFN16
5 mm x 4 mm



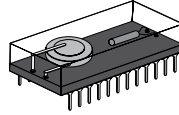
S08
3.80 mm x 4.80 mm



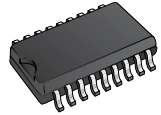
S016
3.80 mm x 9.80 mm



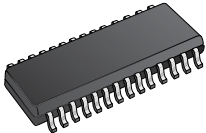
SSOP20
7.2 mm x 5.3 mm



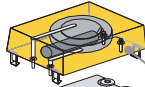
PCDIP24 CAPHAT™
34.29 mm x 17.83 mm
Self-contained battery
and crystal (internal view)



SOX18
11.61 mm x 7.62 mm
Embedded crystal SOIC

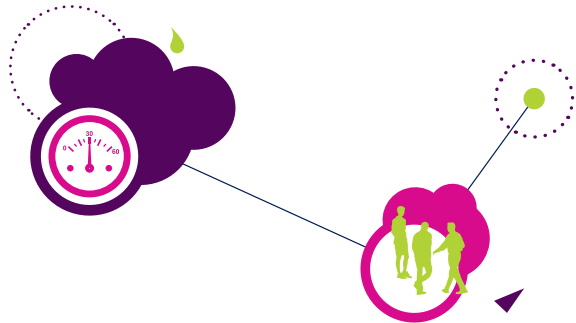


SOX28
18.01 mm x 7.67 mm
Embedded crystal



SOH28
17.71 mm x 8.23 mm

SNAPHAT™
Battery and crystal snap on module
to order separately (internal view)





Design support

Real-time clocks application notes, technical notes, online calculators and resources

Readers will find these documents helpful in understanding some of the subtleties of RTCs and what it takes to keep them running reliably.

Application notes	
AN922	Using a super cap to back up the M41T56, M41T00, M41T11, M41T81, M41T94 and M41ST84W (16-pin)
AN923	Managing century information using serial real-time clocks and TIMEKEEPER® NVRAMs
AN1011	Battery technology used in NVRAM and real-time clock (RTC) products from ST
AN934	How to use the digital calibration feature in Timekeeper® and serial real-time clock (RTC) products
AN1012	Predicting the battery life and data retention period of NVRAMs and serial RTCs
AN1879	How to use M41ST87 tamper detect and RAM clear
AN1572	Power-down time-stamp function in serial real-time clocks (RTCs)
AN2583	Understanding and applying the M41T00AUD real-time clock with audio
AN2678	Extremely accurate timekeeping over temperature using adaptive calibration
AN2971	Using the typical temperature characteristics of 32 KHz crystal to compensate the M41T83 and the M41T93 serial real-time clocks
AN3060	Applications guide for serial real-time clocks (RTCs)
AN1019	Second Source for "SNAPHAT" by Using a Dual Footprint
AN1009	"Negative Undershoot" NVRAM Data Corruption
AN1336	Power-Fail Comparator for NVRAM Supervisory Devices
AN1216	Implementing a periodic alarm with TIMEKEEPER® and serial real-time clocks (RTCs)

PRODUCT SUPPORT AT [HTTP://WWW.ST.COM/RTC](http://www.st.com/rtc)

- Datasheets
- Application notes
- Selector tables
- Serial RTC example code
- Underwriters Laboratories (UL) information
- Clock calibration tools
- RTC and NVRAM model files
- Design support calculators @ www.st.com/calculators
- Online technical support



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