

Real.Time.Clock Fighting Guide

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Timing Devices

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What does a Real Time Clock (RTC) do ?

- Keeps track of the Time and Date



- Record an event when it happens



- Set Reminders



Alarm

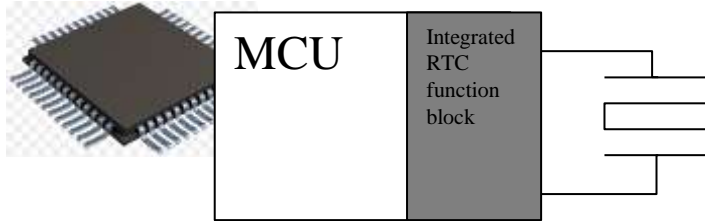


Countdown
Timer



Options To Realize RTC Functions

The “Mainstream” Option

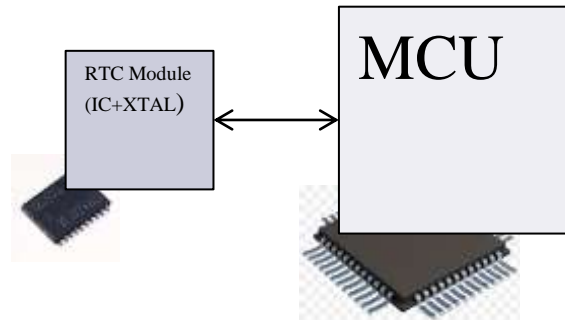


Most applications can be covered using the Integrated RTC function in MCU + an external 32.768KHz crystal

Unless you are looking for :

- Accurate Timekeeping
- Ultra Low Power consumption with battery switchover
- Event Detection and Anti Tamper

The “Elegant” Option



The Epson RTC Module (32.768KHz crystal + RTC-IC) extensive portfolio offers one or more of the following features



Low power

High Accuracy




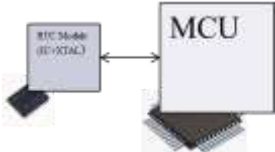





Backup battery/supercap switch



Event detection



Comparing the two Options ...

Feature	The Mainstream Option	The “Elegant” Option
		
Time-Keeping Accuracy Over full Op.temp range 40+85C		
Consumption Low Power Mode		
Anti-Tamper Event Detection Power Switching	<p style="text-align: center;">Not available</p>	 <p style="text-align: center;">EMERGENCY POWER</p>



Why use an Epson RTC Module to assist an MCU ?



Timing Accuracy

- Did you know that an uncompensated crystal can lose up to 7min/month*?
- Epson compensated RTCs can provide an accuracy of up to 9 seconds per month



Low Power

- Epson RTC consume as little as 100nA** in backup timekeeping mode
- Allowing for smaller (*lower cost*) supercaps/ batteries to achieve desired requirements



Additional features



- Epson RTCs offer
 - Battery switchover
 - Anti-tamper + event detection features

* Over full temp range -40+85C

** typical values on select models



High Accuracy Timekeeping

Playing 'Punctual' : Comparing MCU + crystal to a GPS Watch

Location : Outdoors in Munich



VS

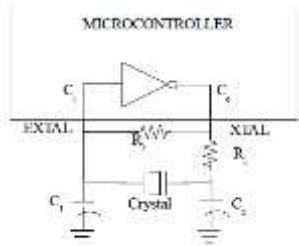


Figure 1. Typical Crystal Oscillator Circuit

Annual Weather Averages Near Munich

Averages are for Oberpfaffenhofen, which is 14 miles from Munich.

Based on weather reports collected during 2005–2015.



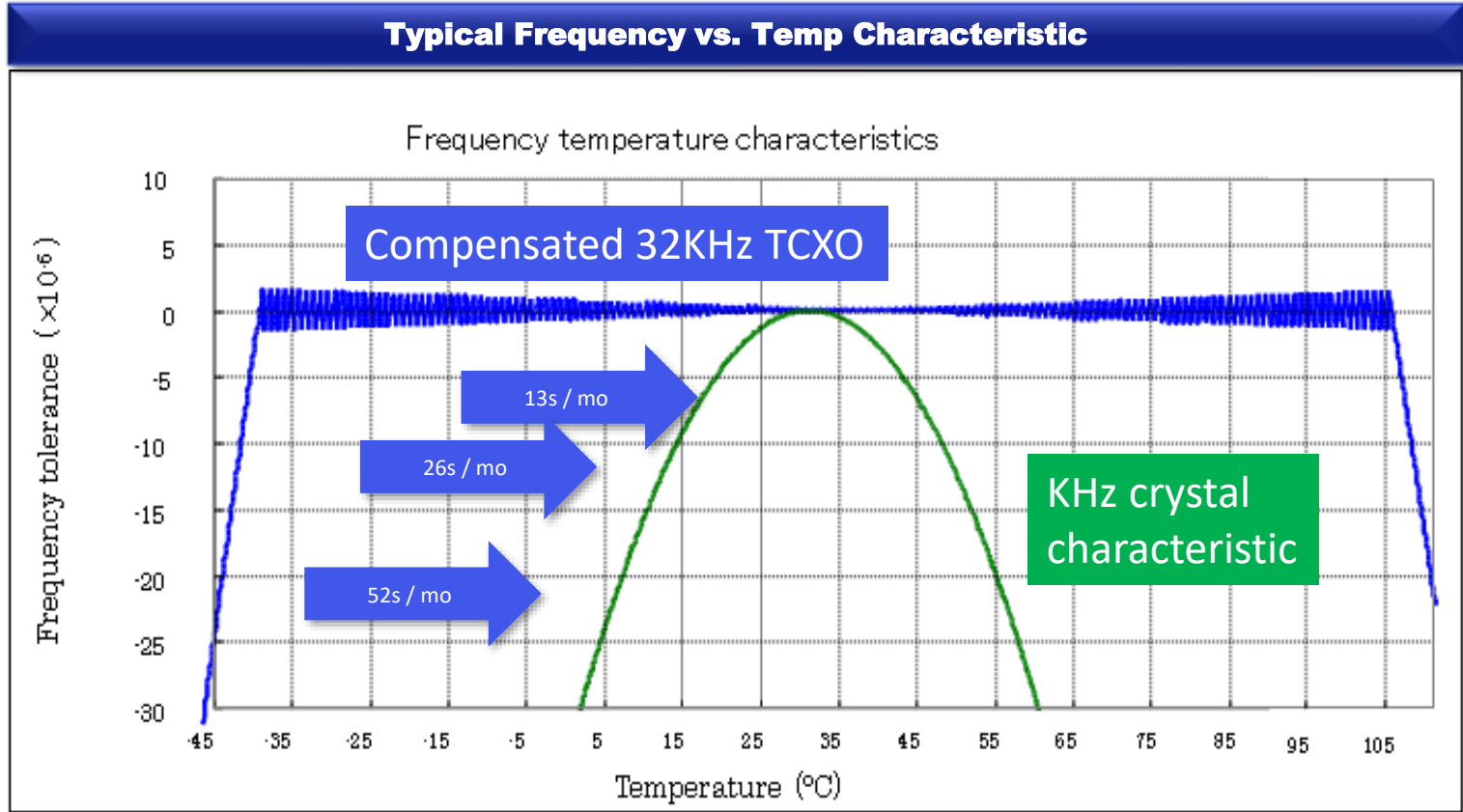
A crystal will always oscillate 'slower' when the temperature deviates from 25°C



Results : Timing Drift over 12 months



KHz xtal – TCXO freq stability comparison



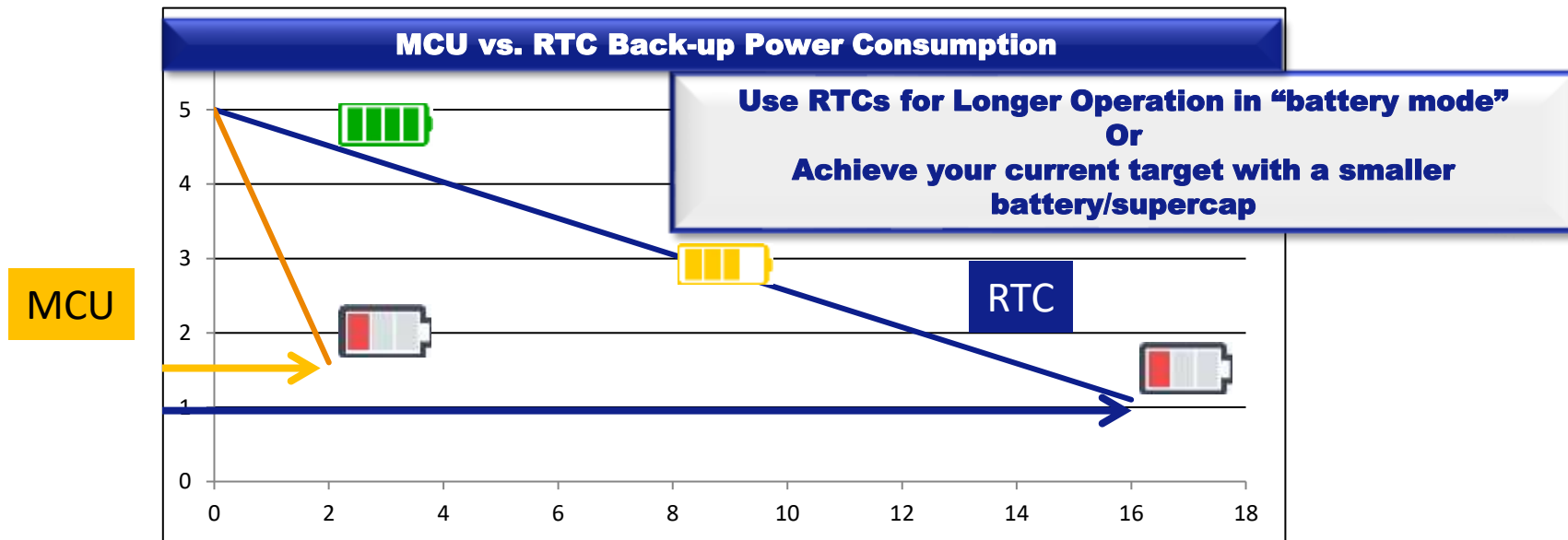
Stability specs of Compensated RTCs

Product	Bus Interface	0..50C	-40..85C	85..105C
RX8901CE	I2C		XS +/-3ppm	XS +/-5ppm
RX4901CE	SPI		XB +/-5ppm	XB +/-8ppm
RX8804CE	I2C		XA +/-3.4ppm XB +/-5ppm	XA & XB +/-8ppm
RX8900CE	I2C		UA +/-3.4ppm UB +/-5ppm	
TG-3541CE	No bus (TCXO)	XA +/- 1.9ppm XB +/- 3.8ppm	XA +/-3.4ppm XB +/-5ppm	XA & XB +/-8ppm

Stability in ppm	Monthly cumulative time deviation	Annual cumulative time deviation
3.4	9 seconds	< 2minutes
5.0	13 seconds	< 3 minutes
8.0	21 seconds	< 4.5 minutes



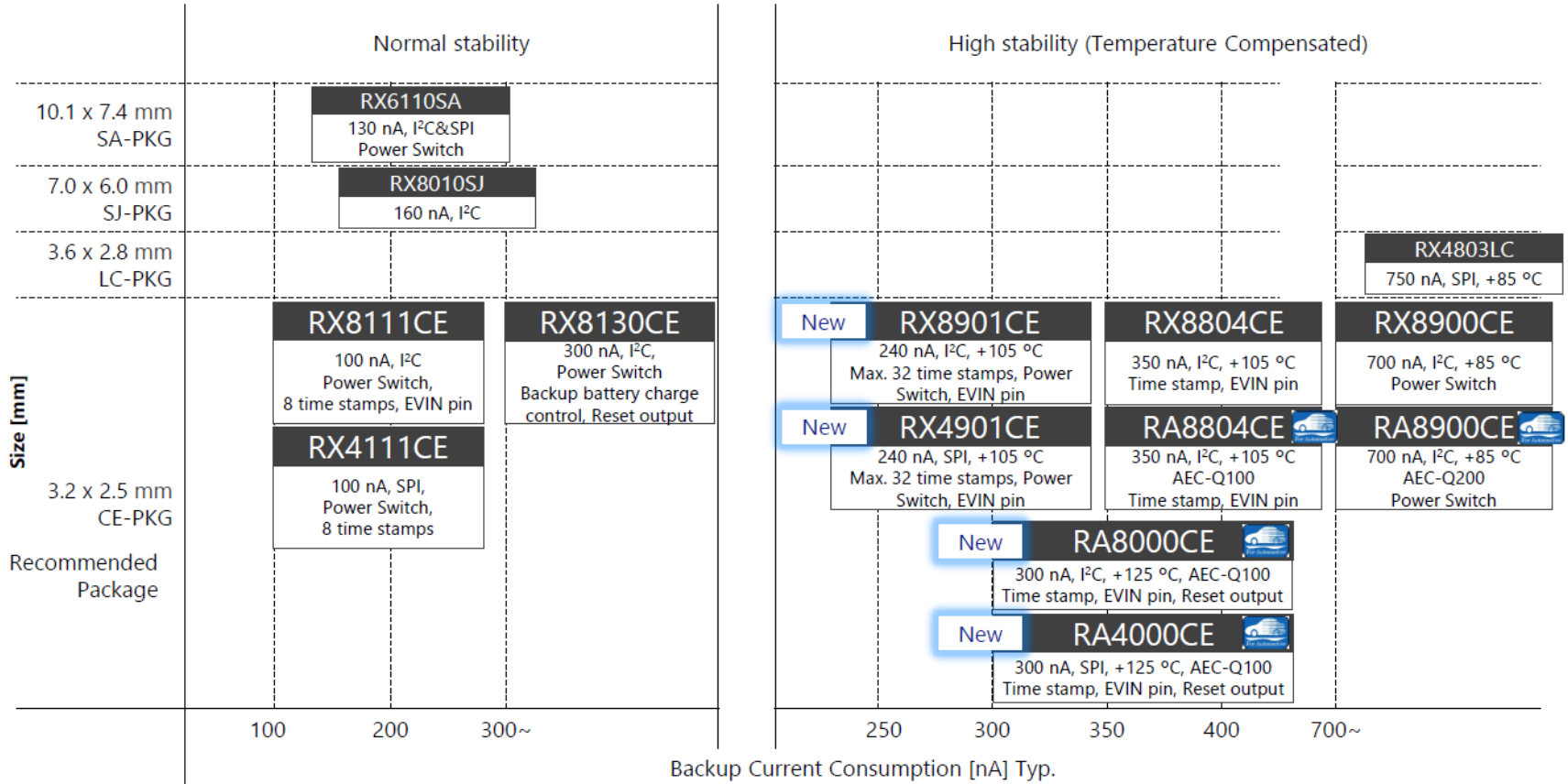
Benefits of Low Power RTCs: eg RX811CE (100nA)



Voltage detection and Power switch over from main to secondary supply is integrated in the RTC Module



Epson RTC Line-up & Consumption overview



Backup Current Consumption [nA] Typ.



Epson RTC Line-Up and Features

	RX8130CE	RX8900CE RA8900CE	RX8804CE RA8804CE ★	RX8111CE RX4111CE ★	RX8901CE RX4901CE ★	
Size	3.2x2.5x1.0mm (CE)					
Interface	I2C	I2C	I2C	I2C/SPI	I2C/SPI	
Frequency Tolerance	5±23ppm / +25°C	UA:±3.4ppm/40~85°C UB:±5ppm/-40~85°C	±1.9ppm/0~50°C ±3.4ppm/-40~85°C ±8ppm/-40~105°C	5±11.5ppm / +25°C	XS:±5ppm/40~105°C XB:±8ppm/-40~105°C	
Power Voltage	1.6~5.5V	1.6~5.5V	1.6~5.5V	1.6~5.5V	1.6~5.5V	
Clock Voltage	1.1~5.5V	1.6~5.5V	1.5~5.5V	1.1~5.5V	1.1~5.5V	
Current Consumption	Typ.	300nA / 3V	700nA / 3V	350nA / 3V	100nA / 3V	240nA / 3V
	Max.	500nA / 3V	1400nA / 3V	1500nA / 3V	350nA / 3V	1500nA / 3V
Alarm	■	■	■	■	■	
Timer	■	■	■	■	■	
Frequency Output	■	■ Temp. Compensated	■ Temp. Compensated	■	■ Temp. Compensated	
Clock Calibration	-	-	-	■	-	
Event Detection	-	-	1 EVIN	1 EVIN	Up to 3 EVIN	
Reset-Controller	■	-	-	-	-	
DTCXO	-	■	■	-	■	
Battery Switch Over	■	■	-	■	■	



Target Market Segments



Target Market Segments



Access Control

RTC Features :

- Low Power for battery operated smart locks.
- Accurate timekeeping independent of the network. Security feature for Banks / Govt Agencies



Security

RTC Features :

- Camera to have correct date/time on installation. Need **Low Power RTC** + backup battery
- **Anti-tamper feature** needed to avoid manipulation from non authorised users



Target Market Segments



Smart Grids



Timekeeping requirements for Smart Meters

Electricity Meter	Accurate Timing	Low Power Battery Timekeeping	Anti-Tamper	Recommended RTC
Residential EMEA	No	No	No	KHz + MHz crystal
Residential Emerging markets	Nice To Have	Yes	Yes	RX8111CE RX8901CE
Data Concentrator	Yes	Maybe	No	RX8804CE
Industrial	Nice to Have	No	Yes	RX8901CE
Grid Control	Yes	No	Nice to have	RX8804CE
Water / Gas Meter	Accurate Timing	Low Power Battery Timekeeping	Anti-Tamper	Recommended RTC
Residential	No	Maybe	Maybe	RX8111CE RX8130CE



Target Market Segments



Industry 4.0

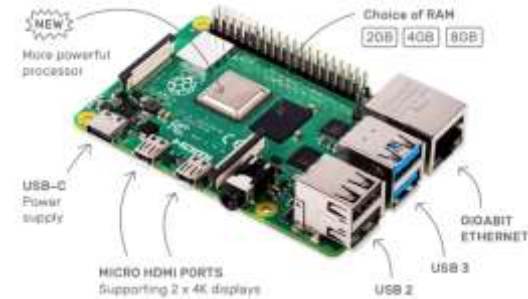


Human Machine Interface
(HMI)



PLC

Single Board Computer
(SBC)



Timekeeping Requirements for Industry Applications

	Correct Date&Time on Power On	Accurate Timekeeping	Low Power Battery Timekeeping	Comment	Recommended RTC
HMI	Yes	No	Yes	Date and Time programmed at the factory	RX8130CE RX8111CE
PLC	No	Yes	Yes	Discuss specs with customer	RX8804CE
SBC	No	No	Yes	When “hardware clock” + coin cell is needed	RX8130CE RX8111CE



Example : Reason why RTC module is required on PLCs

- As explained in the [Product manual](#)

Real Time Clock

The M262 Logic/Motion Controller includes a Real Time Clock (RTC) system (see page 40).

The system time is maintained by capacitors when the power is off. The time is maintained for 1 000 hours when the controller is not supplied.

The M262 Logic/Motion Controller includes a real-time clock (RTC) to provide system date and time information and to support related functions requiring a real-time clock.

The RTC also provides the system date and time to any TMS expansion modules (see *Modicon TMS, Expansion Module, Hardware Guide*) installed on the left side of the controller.

Provided the controller has been powered on for at least 2 hours, the system date and time are maintained for 1000 hours at 25 °C (77 °F) even when the controller is powered off.

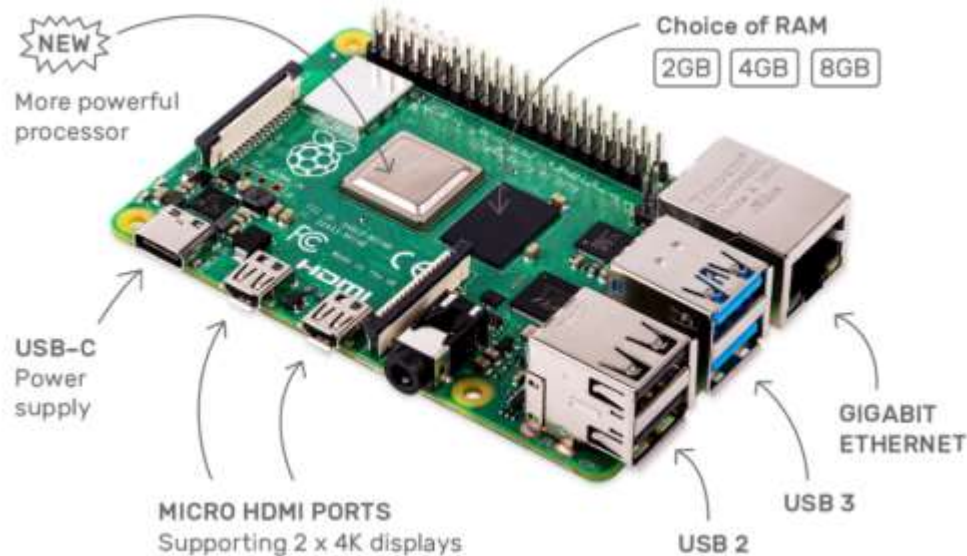
This table shows how RTC drift is managed:

RTC Characteristics	Description
RTC drift	<u>Less than 15 seconds per month with no user calibration at 25 °C (77 °F)</u>



Single Board Computer

- A **single-board computer (SBC)** is a complete computer built on a single circuit board, with microprocessor(s), memory, input/output (I/O) eg USB , HDMI Ports and other features required of a functional computer.



Please ask your customers for SBCs with hardware clock and coin-cell or goldcap



Timing BOM List for SBC / SOM

	KHz / MHz xtals	SPXOs	RTCs
SBC	✓✓✓ For MCU + Chipsets	✓ For Gb Ethernet (CMOS / differential output)	✓ With coin cell for backup clock
System on Module Expansion slot	✓✓✓ Mainly for Chipsets		



Target Market Segments



Smart Homes (Domestic Appliances)

RTC Features :

- Domestic Appliances
 - Accurate timekeeping on all household appliances
 - Battery Backup. Timekeeping continues even when the appliance is powered off.

- Garage Door Openers/
Window Blinds Controls
 - Low Power and/or
 - Accurate timekeeping



Success stories at the Major European Home Appliance OEMs

OEM	Appliance	Challenge	Solution	Comment
G*	Ovens	Accurate Clock over wide temp range	RX-8803SA , RX-4803SA, RX8900CE	Market requirement
M*	Various	Synched time across various appliances. Backup time when power is off	RX6110SA	Need low power and supercap
B*	Various	Accurate Clock over wide temp range	RX8900CE	



Teaser : Who never experienced this before ?



Which time is right ?

Must I manually adjust every appliance all the time ??



And what if I leave for vacation and power-off the non essential appliances ? What happens when I'm back ?



Do I *really* need to manually reprogram every appliance ??

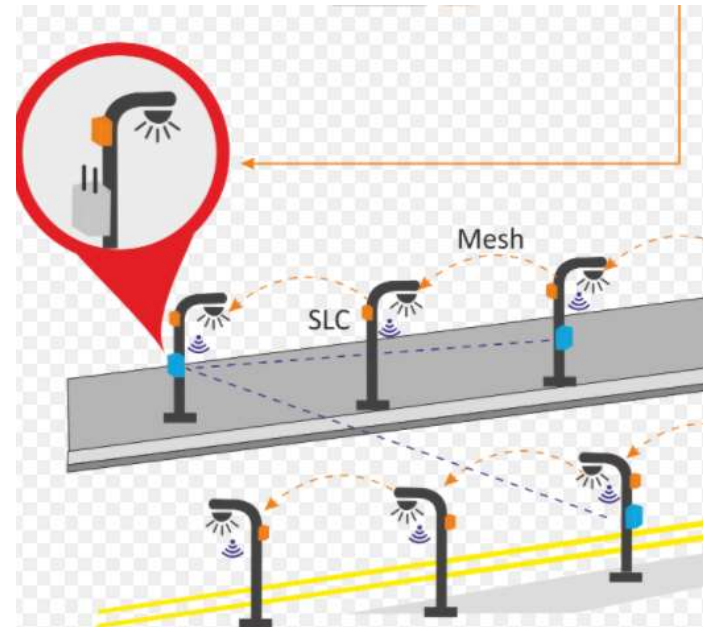


Target Market Segments



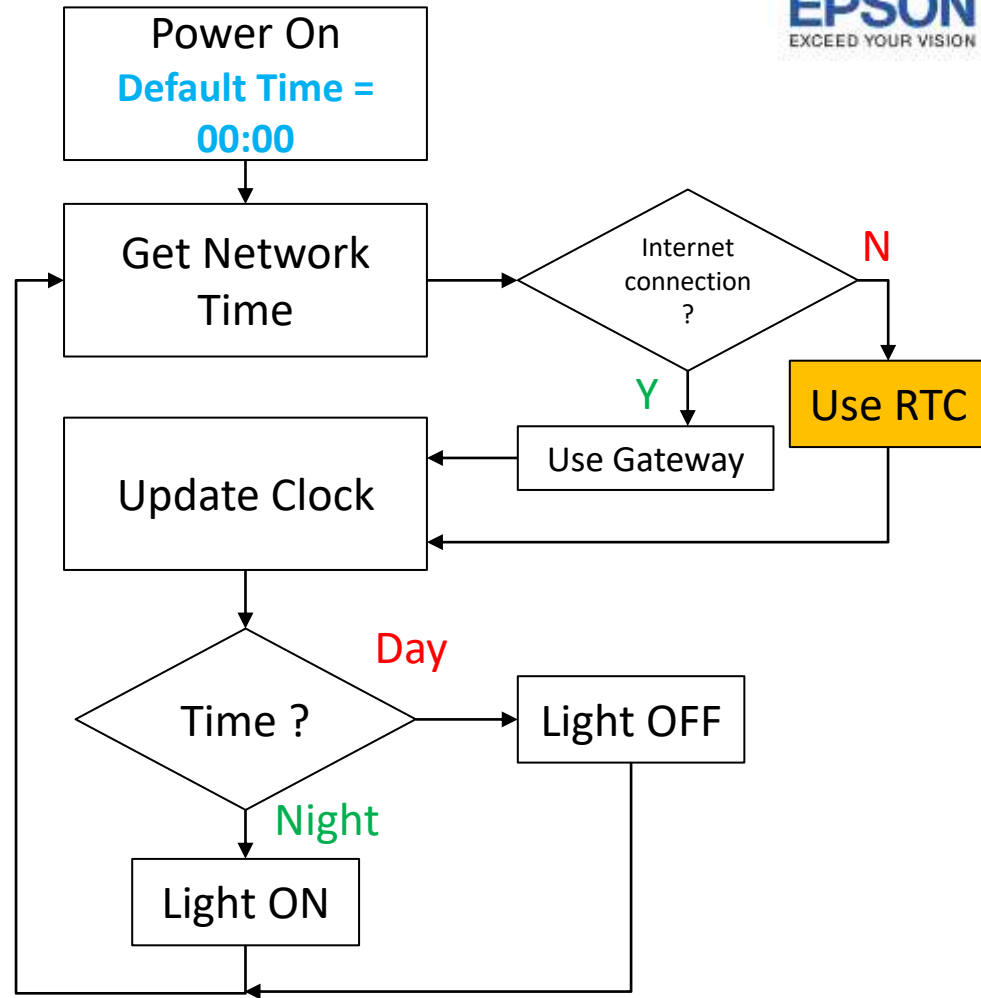
Smart Lighting

Controllers for Street lighting
/ Building Illumination



A day in the life of a smart lighting point

- Each smart Lighting point has a small MCU and is mesh-RF connected with a Gateway
- The Gateway defines time of day.
- The lighting point 'decides' to go ON (night) or OFF (day)
- What happens if there is a power cut and the gateway is not working ?



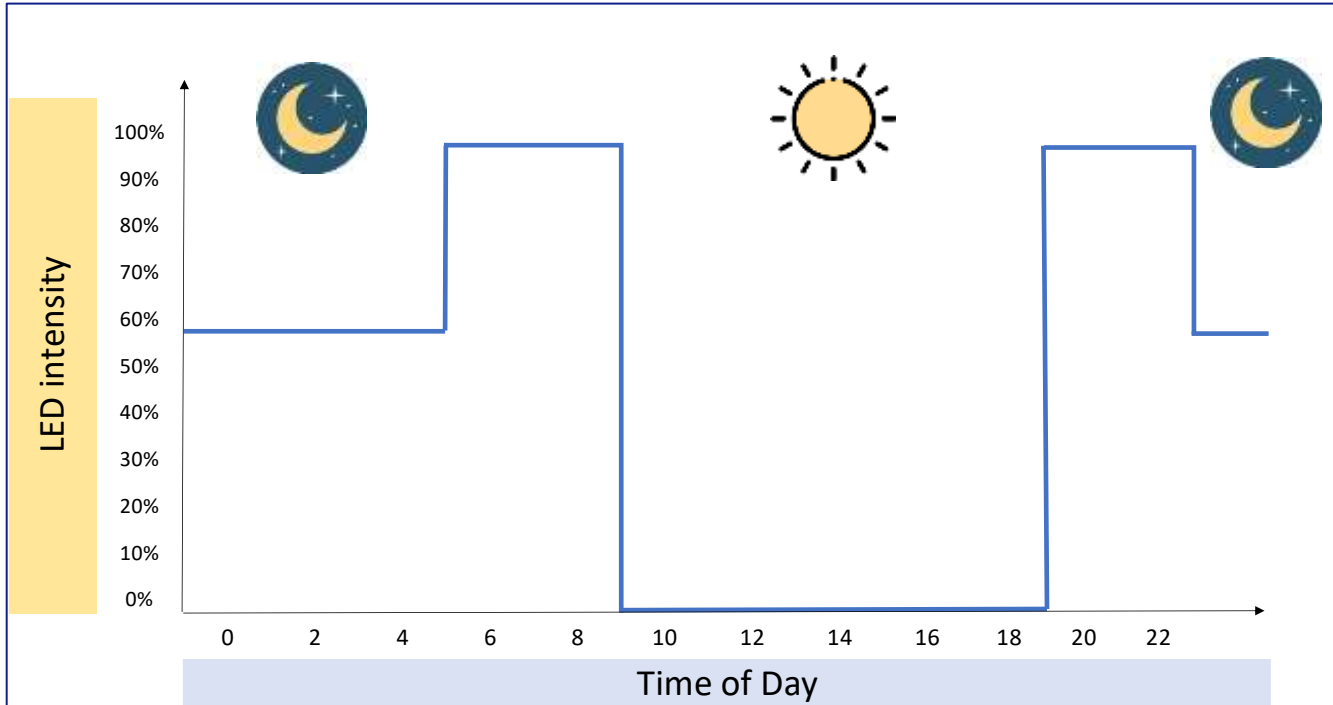
Smart Illumination Business Case (2)

- If the gateway is not working the lighting point stays in the default position ie Permanently ON even in broad daylight !
- Such events cause unnecessary electricity consumption for local councils / cities.
 - For most local councils Electricity bills amount to the highest spend on their budget.
- To avoid this event a RTC + supercap is installed in every lighting point to make sure the lamp always knows the right time of day.
- It is estimated that every lighting point will not stay off the grid for more than 4 hours
 - A low Power RTC plus an adequate Supercap being the solution to the problem
 - RX8130CE and RX8111CE are best suited to address this issue



Virtual Midnight Control

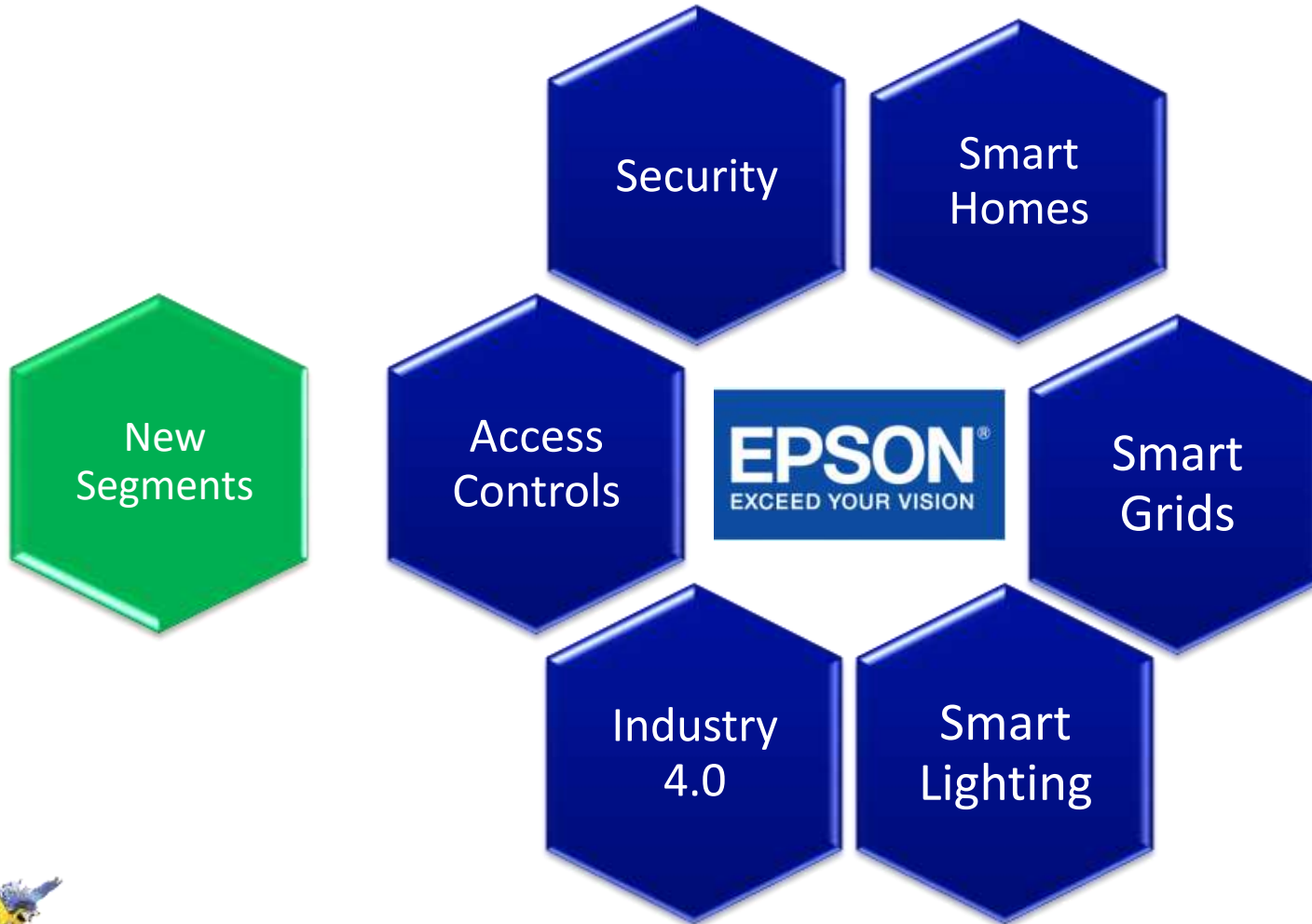
Timekeeping is important to maximise LED lifetimes and to reduce energy costs.



LED Illumination profiles no longer ON/OFF. Profiles are more complex and change depending on location and season



Target Market Segments



Electric Vehicle Wall chargers



- Main feature : Accurate Clock
- Multiple Energy Tariffs
 - charge when cheapest or
 - charge for next 30min
- Requests for TCXOs
- We think RTCs might be needed



Medical Handheld devices



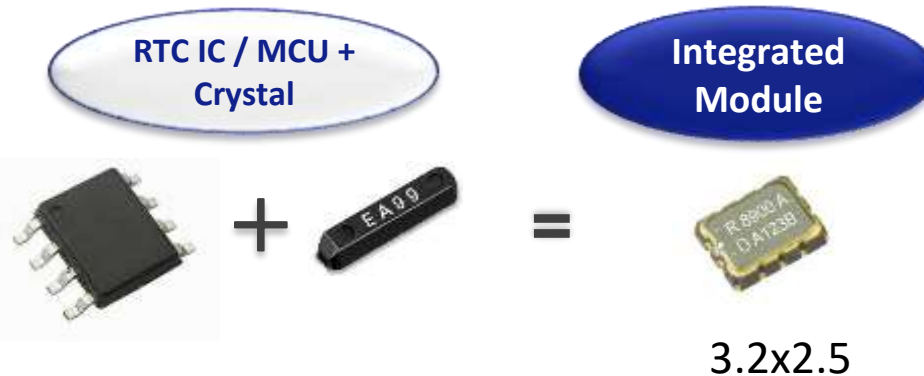
- Main feature : Low Power
- Extend operating life for battery driven devices
- New market segment with big growth potential



“ Is it worth the effort to promote RTCs ?”

- **YES !!!** RTC modules are not commodities
 - Not replaceable and not compatible in function and footprint
 - Your design is easily protected
- Few competitors (MicroCrystal, SII, Kyocera, NDK)
- Long term availability (decades)
- Relatively High Average Resale Price (0.5~0.75EUR)

Epson

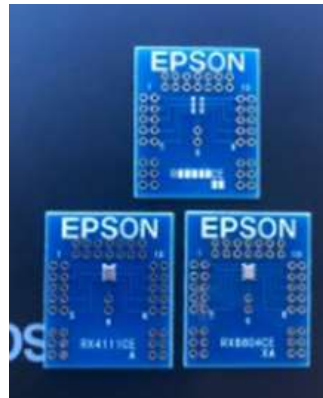


Tools for Sales and FAEs

- Extensive information on the RTC portfolio including application manuals and Linux drivers

<https://www5.epsondevice.com/en/products/rtc/>

- Possibility to offer RTC Adapter-boards for evaluation purposes.
 - To be offered to customers who are willing to test and evaluate the Epson RTC.



Fieldwork

The best way to sell RTCs is to ask questions. Your customers might surprise you !



Joint Venture :

- Some customers in your territory match the application profile ?
- Yes ? Let's set them as our target joint development customers



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