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"[Embedded - Microcontrollers](#)" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "[Embedded - Microcontrollers](#)"

Details

Product Status	Active
Core Processor	STM8
Core Size	8-Bit
Speed	16MHz
Connectivity	I ² C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, POR, PWM, WDT
Number of I/O	28
Program Memory Size	8KB (8K x 8)
Program Memory Type	FLASH
EEPROM Size	640 x 8
RAM Size	1K x 8
Voltage - Supply (Vcc/Vdd)	2.95V ~ 5.5V
Data Converters	A/D 4x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	32-LQFP
Supplier Device Package	32-LQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/stmicroelectronics/stm8s103k3t3c

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5 Pinout and pin description

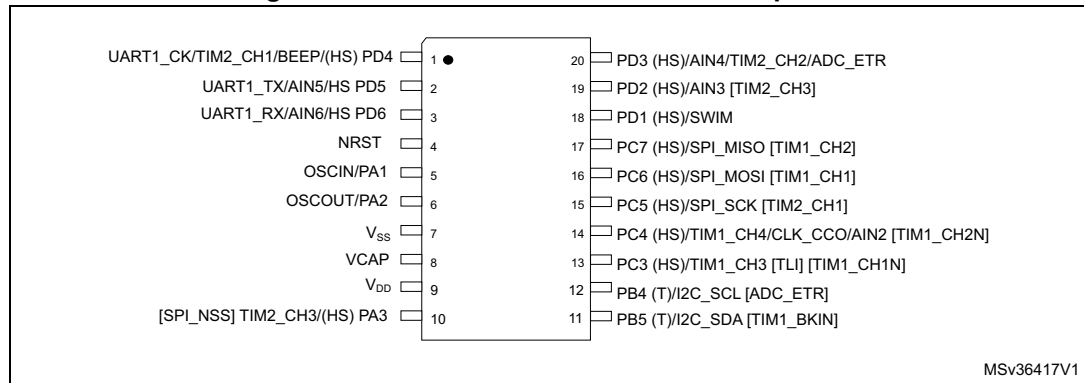
Table 4. Legend/abbreviations for pin description tables

Type	I= Input, O = Output, S = Power supply	
Level	Input	CM = CMOS
	Output	HS = High sink
Output speed	O1 = Slow (up to 2 MHz) O2 = Fast (up to 10 MHz) O3 = Fast/slow programmability with slow as default state after reset O4 = Fast/slow programmability with fast as default state after reset	
Port and control configuration	Input	float = floating, wpu = weak pull-up
	Output	T = True open drain, OD = Open drain, PP = Push pull
Reset state	Bold X (pin state after internal reset release). Unless otherwise specified, the pin state is the same during the reset phase and after the internal reset release.	

5.2 STM8S103F2/F3 TSSOP20/SO20/UFQFPN20 pinout and pin description

5.2.1 STM8S103F2/F3 TSSOP20/SO20 pinout

Figure 5. STM8S103F2/F3 TSSOP20/SO20 pinout



1. HS high sink capability.
2. (T) True open drain (P-buffer and protection diode to VDD not implemented).
3. [] alternate function remapping option (If the same alternate function is shown twice, it indicates an exclusive choice not a duplication of the function)

Table 8. General hardware register map (continued)

Address	Block	Register label	Register name	Reset status
0x00 5208 to 0x00 520F	Reserved area (8 byte)			
0x00 5210	I2C	I2C_CR1	I2C control register 1	0x00
0x00 5211		I2C_CR2	I2C control register 2	0x00
0x00 5212		I2C_FREQR	I2C frequency register	0x00
0x00 5213		I2C_OARL	I2C Own address register low	0x00
0x00 5214		I2C_OARH	I2C Own address register high	0x00
0x00 5215		Reserved		
0x00 5216		I2C_DR	I2C data register	0x00
0x00 5217		I2C_SR1	I2C status register 1	0x00
0x00 5218		I2C_SR2	I2C status register 2	0x00
0x00 5219		I2C_SR3	I2C status register 3	0x0X
0x00 521A		I2C_ITR	I2C interrupt control register	0x00
0x00 521B		I2C_CCRL	I2C Clock control register low	0x00
0x00 521C		I2C_CCRH	I2C Clock control register high	0x00
0x00 521D		I2C_TRISER	I2C TRISE register	0x02
0x00 521E		I2C_PECR	I2C packet error checking register	0x00
0x00 521F to 0x00 522F	Reserved area (17 byte)			
0x00 5230	UART1	UART1_SR	UART1 status register	0xC0
0x00 5231		UART1_DR	UART1 data register	0xFF
0x00 5232		UART1_BRR1	UART1 baud rate register 1	0x00
0x00 5233		UART1_BRR2	UART1 baud rate register 2	0x00
0x00 5234		UART1_CR1	UART1 control register 1	0x00
0x00 5235		UART1_CR2	UART1 control register 2	0x00
0x00 5236		UART1_CR3	UART1 control register 3	0x00
0x00 5237		UART1_CR4	UART1 control register 4	0x00
0x00 5238		UART1_CR5	UART1 control register 5	0x00
0x00 5239		UART1_GTR	UART1 guard time register	0x00
0x00 523A		UART1_PSCR	UART1 prescaler register	0x00
0x00 523B to 0x00 523F	Reserved area (21 byte)			

6.2.3 CPU/SWIM/debug module/interrupt controller registers

Table 9. CPU/SWIM/debug module/interrupt controller registers

Address	Block	Register label	Register name	Reset status
0x00 7F00	CPU ⁽¹⁾	A	Accumulator	0x00
0x00 7F01		PCE	Program counter extended	0x00
0x00 7F02		PCH	Program counter high	0x00
0x00 7F03		PCL	Program counter low	0x00
0x00 7F04		XH	X index register high	0x00
0x00 7F05		XL	X index register low	0x00
0x00 7F06		YH	Y index register high	0x00
0x00 7F07		YL	Y index register low	0x00
0x00 7F08		SPH	Stack pointer high	0x03
0x00 7F09		SPL	Stack pointer low	0xFF
0x00 7F0A		CCR	Condition code register	0x28
0x00 7F0B to 0x00 7F5F	Reserved area (85 byte)			
0x00 7F60	CPU	CFG_GCR	Global configuration register	0x00
0x00 7F70	ITC	ITC_SPR1	Interrupt software priority register 1	0xFF
0x00 7F71		ITC_SPR2	Interrupt software priority register 2	0xFF
0x00 7F72		ITC_SPR3	Interrupt software priority register 3	0xFF
0x00 7F73		ITC_SPR4	Interrupt software priority register 4	0xFF
0x00 7F74		ITC_SPR5	Interrupt software priority register 5	0xFF
0x00 7F75		ITC_SPR6	Interrupt software priority register 6	0xFF
0x00 7F76		ITC_SPR7	Interrupt software priority register 7	0xFF
0x00 7F77		ITC_SPR8	Interrupt software priority register 8	0xFF
0x00 7F78 to 0x00 7F79	Reserved area (2 byte)			
0x00 7F80	SWIM	SWIM_CSR	SWIM control status register	0x00
0x00 7F81 to 0x00 7F8F	Reserved area (15 byte)			

Table 12. Option byte description (continued)

Option byte no.	Description
OPT4	EXTCLK: External clock selection 0: External crystal connected to OSCIN/OSCOU 1: External clock signal on OSCIN
	CKAWUSEL: Auto wake-up unit/clock 0: LSI clock source selected for AWU 1: HSE clock with prescaler selected as clock source for AWU
	PRSC[1:0] AWU clock prescaler 0x: 16 MHz to 128 kHz prescaler 10: 8 MHz to 128 kHz prescaler 11: 4 MHz to 128 kHz prescaler
OPT5	HSECNT[7:0]: HSE crystal oscillator stabilization time 0x00: 2048 HSE cycles 0xB4: 128 HSE cycles 0xD2: 8 HSE cycles 0xE1: 0.5 HSE cycles

8.1 Alternate function remapping bits

Table 13. STM8S103K3 alternate function remapping bits for 32-pin devices

Option byte no.	Description ⁽¹⁾
OPT2	AFR7 Alternate function remapping option 7 Reserved.
	AFR6 Alternate function remapping option 6 0: AFR6 remapping option inactive: Default alternate function. ⁽²⁾ 1: Port D7 alternate function = TIM1_CH4.
	AFR5 Alternate function remapping option 5 0: AFR5 remapping option inactive: Default alternate function. ⁽²⁾ 1: Port D0 alternate function = CLK_CCO.
	AFR[4:2] Alternate function remapping options 4:2 Reserved.
	AFR1 Alternate function remapping option 1 0: AFR1 remapping option inactive: Default alternate functions. ⁽²⁾ 1: Port A3 alternate function = SPI_NSS; port D2 alternate function = TIM2_CH3.
	AFR0 Alternate function remapping option 0 Reserved.

1. Do not use more than one remapping option in the same port. It is forbidden to enable both AFR1 and AFR0.

2. Refer to pinout description.

HSE crystal/ceramic resonator oscillator

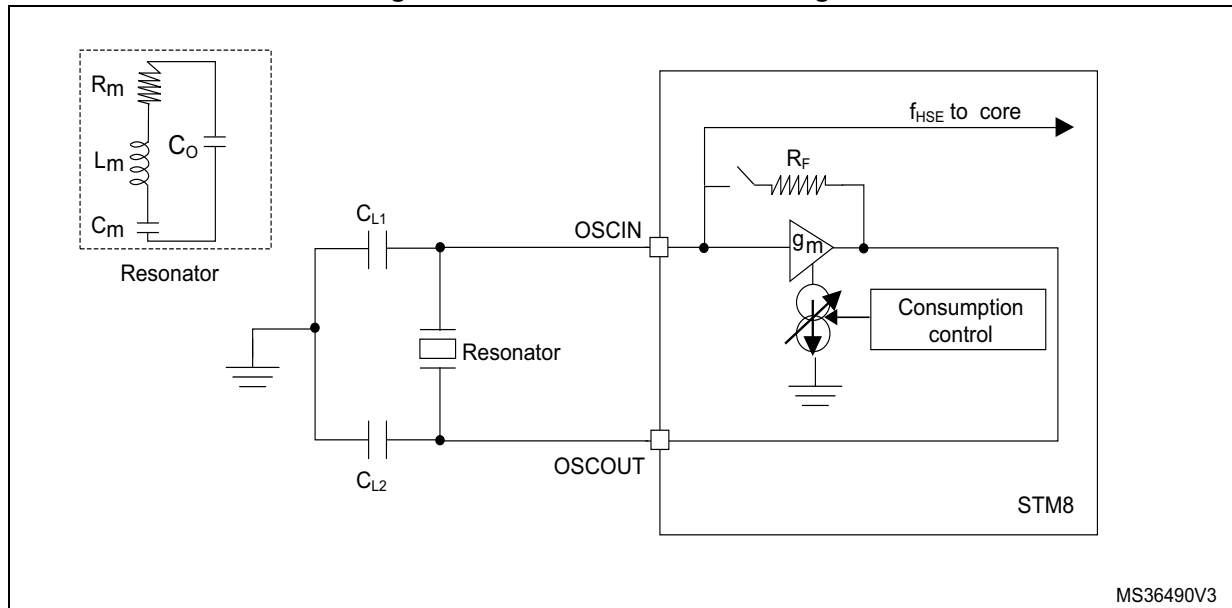
The HSE clock can be supplied with a 1 to 16 MHz crystal/ceramic resonator oscillator. All the information given in this paragraph is based on characterization results with specified typical external components. In the application, the resonator and the load capacitors have to be placed as close as possible to the oscillator pins in order to minimize output distortion and startup stabilization time. Refer to the crystal resonator manufacturer for more details (frequency, package, accuracy...).

Table 33. HSE oscillator characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{HSE}	External high speed oscillator frequency	-	1	-	16	MHz
R_F	Feedback resistor	-	-	220	-	k Ω
$C^{(1)}$	Recommended load capacitance ⁽²⁾	-	-	-	20	pF
$I_{DD(HSE)}$	HSE oscillator power consumption	C = 20 pF $f_{OSC} = 16$ MHz	-	-	6 (start up) 1.6 (stabilized) ⁽³⁾	mA
		C = 10 pF $f_{OSC} = 16$ MHz	-	-	6 (start up) 1.2 (stabilized) ⁽³⁾	
g_m	Oscillator transconductance	-	5	-	-	mA/V
$t_{SU(HSE)}^{(4)}$	Startup time	V_{DD} is stabilized	-	1	-	ms

1. C is approximately equivalent to 2 x crystal Cload.
2. The oscillator selection can be optimized in terms of supply current using a high quality resonator with small Rm value. Refer to crystal manufacturer for more details
3. Guaranteed by characterization results.
4. $t_{SU(HSE)}$ is the start-up time measured from the moment it is enabled (by software) to a stabilized 16 MHz oscillation is reached. This value is measured for a standard crystal resonator and it can vary significantly with the crystal manufacturer.

Figure 19. HSE oscillator circuit diagram



MS36490V3

HSE oscillator critical g_m equation

$$g_{m_{crit}} = (2 \times \pi \times f_{HSE})^2 \times R_m (2C_o + C)^2$$

R_m : Notional resistance (see crystal specification)

L_m : Notional inductance (see crystal specification)

C_m : Notional capacitance (see crystal specification)

C_o : Shunt capacitance (see crystal specification)

$C_{L1} = C_{L2} = C$: Grounded external capacitance

$g_m \gg g_{m_{crit}}$

10.3.5 Memory characteristics

RAM and hardware registers

Table 36. RAM and hardware registers

Symbol	Parameter	Conditions	Min	Unit
V_{RM}	Data retention mode ⁽¹⁾	Halt mode (or reset)	V_{IT-max} ⁽²⁾	V

1. Minimum supply voltage without losing data stored in RAM (in halt mode or under reset) or in hardware registers (only in halt mode). Guaranteed by design, not tested in production.

2. Refer to [Section 10.3: Operating conditions](#) for the value of V_{IT-max} .

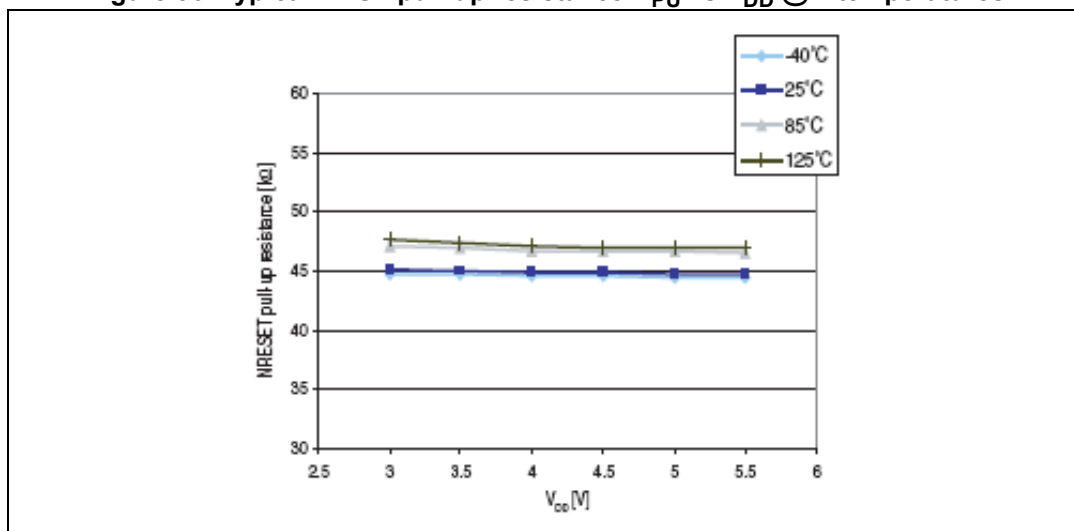
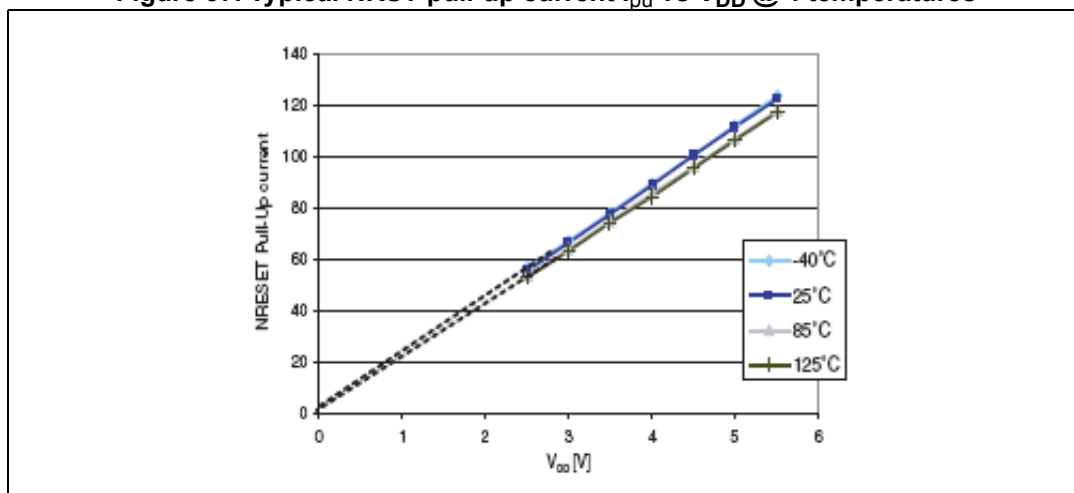
Flash program memory/data EEPROM memory

Table 37. Flash program memory/data EEPROM memory

Symbol	Parameter	Conditions	Min ⁽¹⁾	Typ	Max	Unit
V_{DD}	Operating voltage (all modes, execution/write/erase)	$f_{CPU} \leq 16 \text{ MHz}$	2.95	-	5.5	V
t_{prog}	Standard programming time (including erase) for byte/word/block (1 byte/4 byte/64 byte)	-	-	6	6.6	ms
	Fast programming time for 1 block (64 byte)	-	-	3	3.33	
t_{erase}	Erase time for 1 block (64 byte)	-	-	3	3.33	
N_{RW}	Erase/write cycles (program memory) ⁽²⁾	$T_A = +85^\circ\text{C}$	100k	-	-	cycle
	Erase/write cycles (data memory) ⁽²⁾	$T_A = +125^\circ\text{C}$	300k	1M	-	
t_{RET}	Data retention (program and data memory) after 10k erase/write cycles at $T_A = +55^\circ\text{C}$	$T_{RET} = 55^\circ\text{C}$	20	-	-	year
	Data retention (data memory) after 300k erase/write cycles at $T_A = +125^\circ\text{C}$	$T_{RET} = 85^\circ\text{C}$	1	-	-	
I_{DD}	Supply current (Flash programming or erasing for 1 to 128 byte)	-	-	2	-	mA

1. Guaranteed by characterization results.

2. The physical granularity of the memory is 4 byte, so cycling is performed on 4 byte even when a write/erase operation addresses a single byte.

Figure 36. Typical NRST pull-up resistance R_{PU} vs V_{DD} @ 4 temperaturesFigure 37. Typical NRST pull-up current I_{PU} vs V_{DD} @ 4 temperatures

The reset network shown in [Figure 38](#) protects the device against parasitic resets. The user must ensure that the level on the NRST pin can go below $V_{IL(NRST)}$ max (see [Table 42: NRST pin characteristics](#)), otherwise the reset is not taken into account internally.

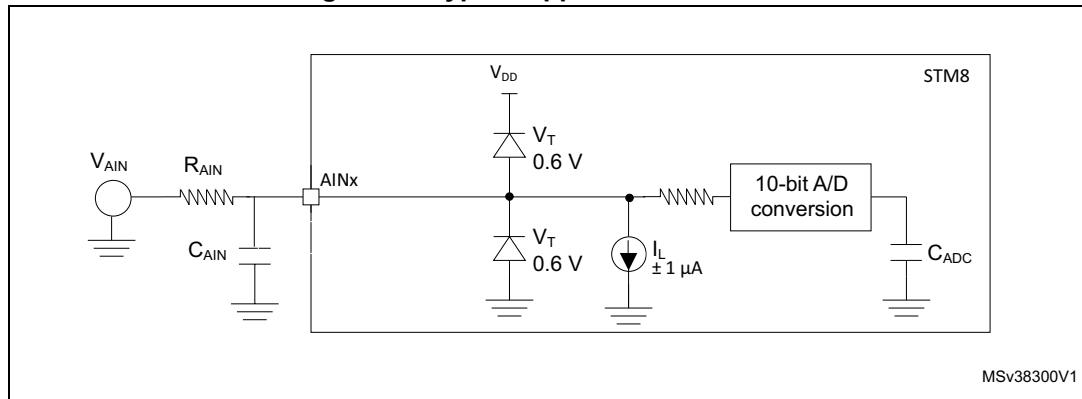
For power consumption sensitive applications, the external reset capacitor value can be reduced to limit the charge/discharge current. If NRST signal is used to reset external circuitry, attention must be taken to the charge/discharge time of the external capacitor to fulfill the external devices reset timing conditions. Minimum recommended capacity is 100 nF.

Table 43. SPI characteristics (continued)

Symbol	Parameter	Conditions ⁽¹⁾	Min	Max	Unit
$t_{r(SCK)}$ $t_{f(SCK)}$	SPI clock rise and fall time	Capacitive load: C = 30 pF	-	25	ns
$t_{su(NSS)}^{(2)}$	NSS setup time	Slave mode	$4 * t_{MASTER}$	-	
$t_{h(NSS)}^{(2)}$	NSS hold time	Slave mode	70	-	
$t_{w(SCKH)}^{(2)}$ $t_{w(SCKL)}^{(2)}$	SCK high and low time	Master mode	$t_{SCK}/2 - 15$	$t_{SCK}/2 + 15$	
$t_{su(MI)}^{(2)}$ $t_{su(SI)}^{(2)}$	Data input setup time	Master mode	5	-	
		Slave mode	5	-	
$t_{h(MI)}^{(2)}$ $t_{h(SI)}^{(2)}$	Data input hold time	Master mode	7	-	
		Slave mode	10	-	
$t_{a(SO)}^{(2)(3)}$	Data output access time	Slave mode	-	$3 * t_{MASTER}$	
$t_{dis(SO)}^{(2)(4)}$	Data output disable time	Slave mode	25	-	
$t_{v(SO)}^{(2)}$	Data output valid time	Slave mode (after enable edge)	-	65	
$t_{v(MO)}^{(2)}$	Data output valid time	Master mode (after enable edge)	-	30	
$t_{h(SO)}^{(2)}$	Data output hold time	Slave mode (after enable edge)	27	-	
$t_{h(MO)}^{(2)}$		Master mode (after enable edge)	11	-	

- Parameters are given by selecting 10 MHz I/O output frequency.
- Values based on design simulation and/or characterization results, and not tested in production.
- Min time is for the minimum time to drive the output and the max time is for the maximum time to validate the data.
- Min time is for the minimum time to invalidate the output and the max time is for the maximum time to put the data in Hi-Z.

Figure 44. Typical application with ADC



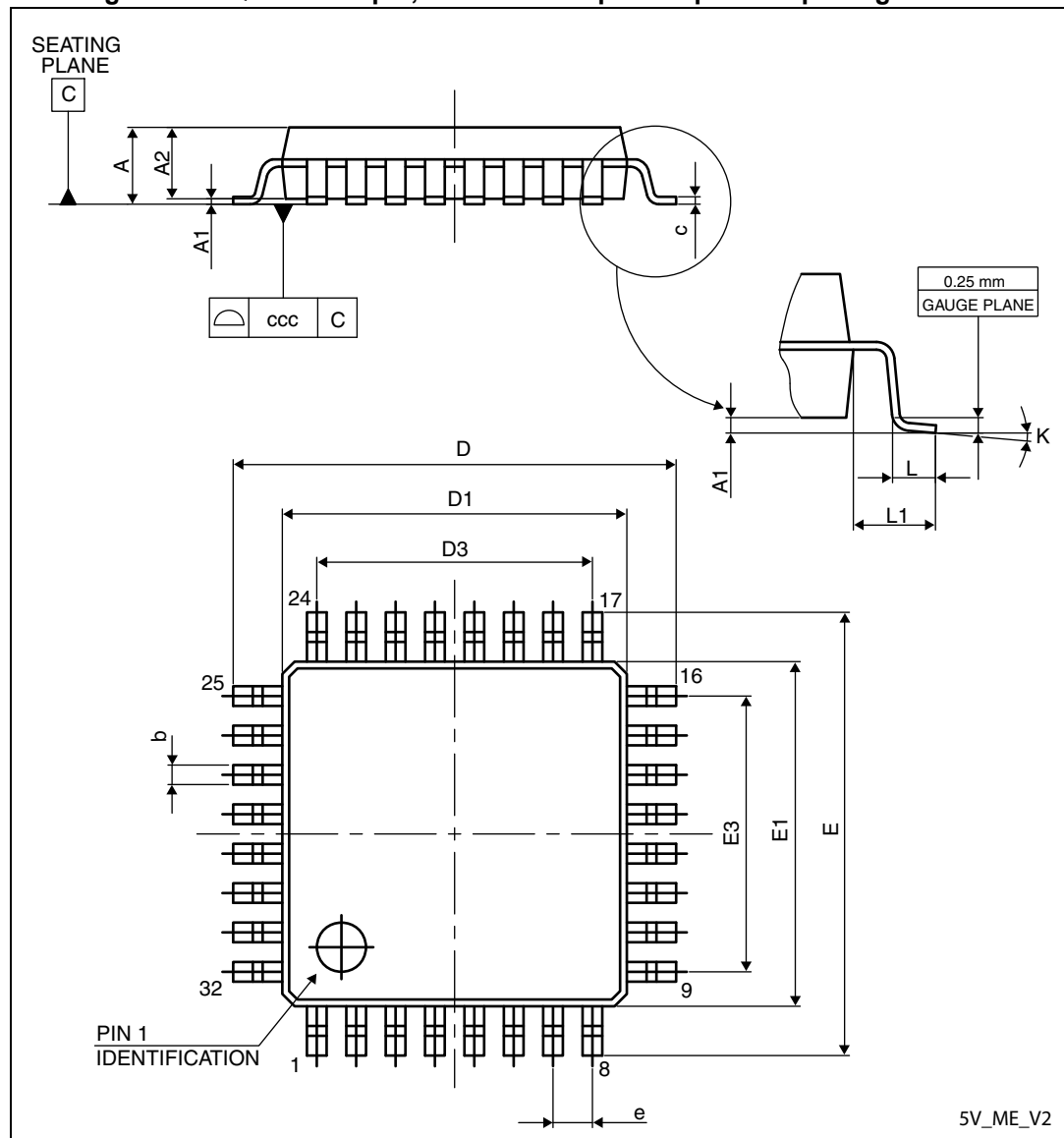
1. Legend: R_{AIN} = external resistance, C_{AIN} = capacitors, C_{smp} = internal sample and hold capacitor.

11 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

11.1 LQFP32 package information

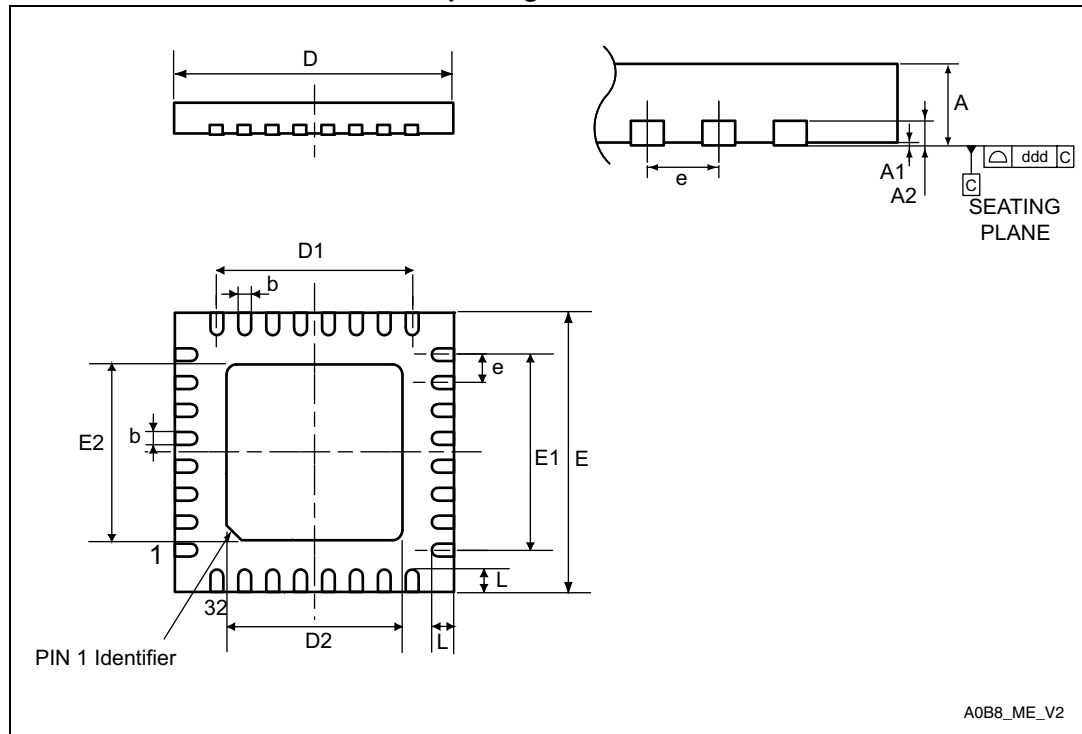
Figure 45. LQFP32 - 32-pin, 7 x 7 mm low-profile quad flat package outline



1. Drawing is not to scale.

11.2 UFQFPN32 package information

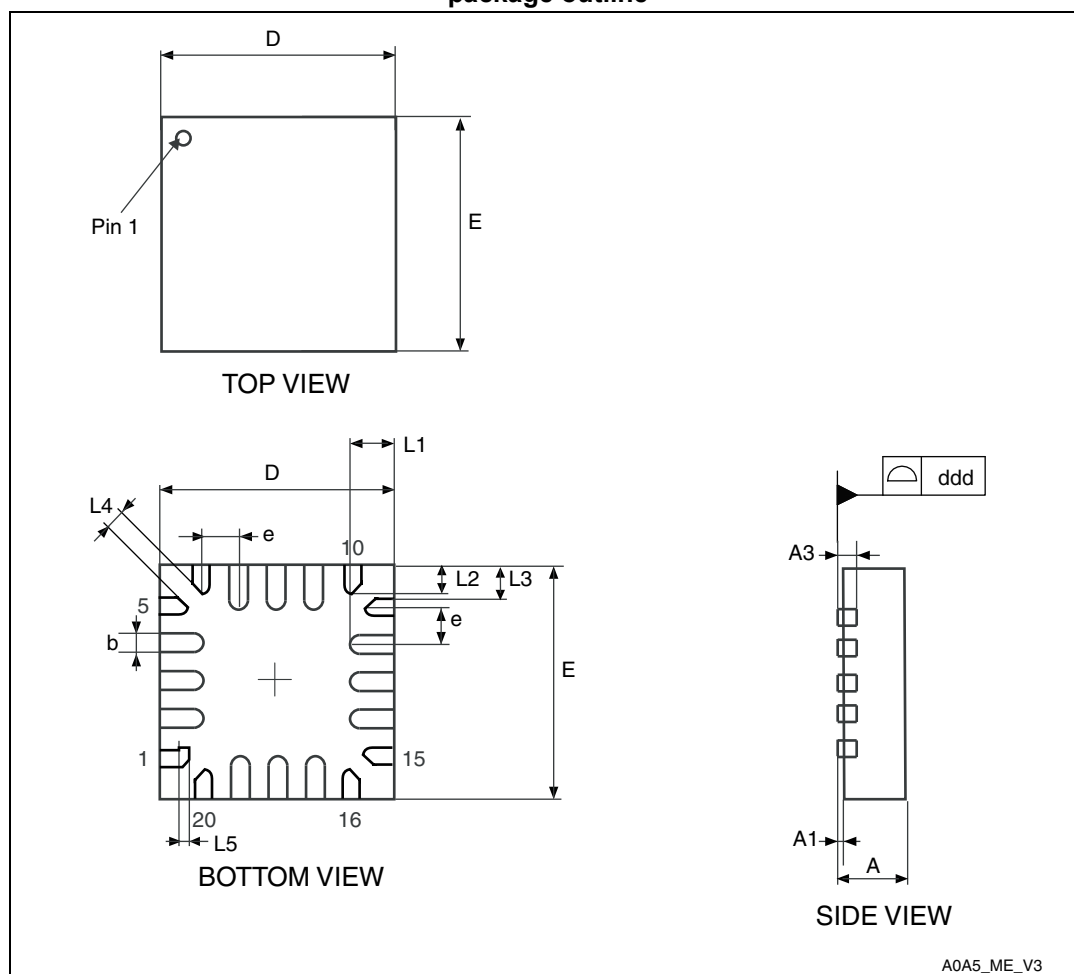
Figure 48. UFQFPN32 - 32-pin, 5x5 mm, 0.5 mm pitch ultra thin fine pitch quad flat package outline



1. Drawing is not to scale.
2. All leads/pads should be soldered to the PCB to improve the lead/pad solder joint life.
3. There is an exposed die pad on the underside of the UFQFPN package. It is recommended to connect and solder this backside pad to PCB ground.
4. Dimensions are in millimeters.

11.3 UFQFPN20 package information

Figure 51. UFQFPN20 - 20-lead, 3x3 mm, 0.5 mm pitch, ultra thin fine pitch quad flat package outline

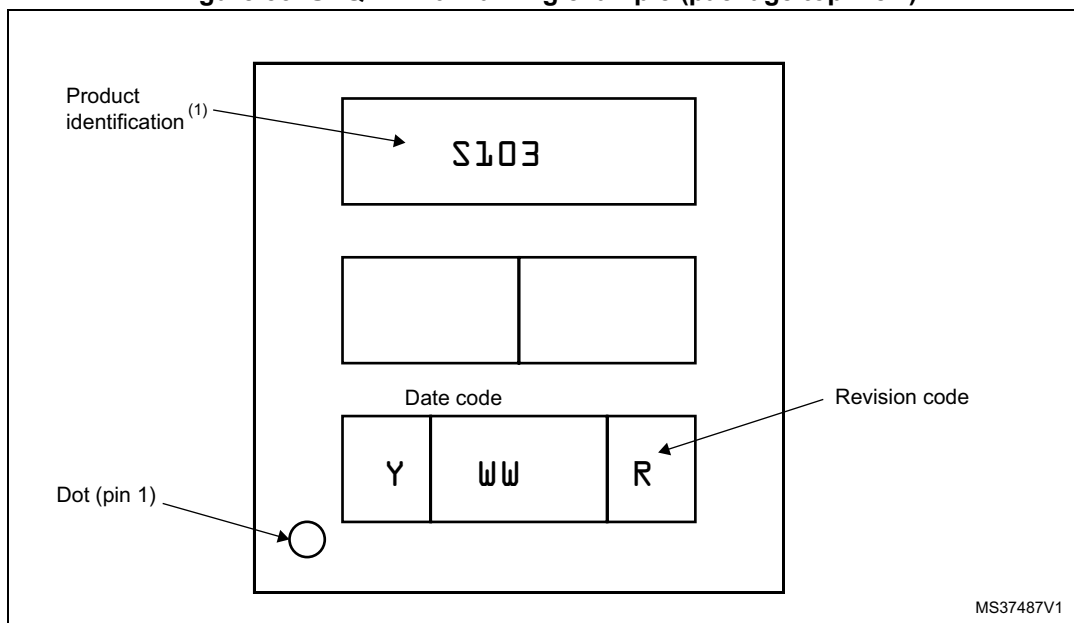


1. Drawing is not to scale.

Table 54. UFQFPN20 - 20-lead, 3x3 mm, 0.5 mm pitch, ultra thin fine pitch quad flat package mechanical data

Dim.	mm			inches ⁽¹⁾		
	Min	Typ	Max	Min	Typ	Max
A	0.500	0.550	0.600	0.0197	0.0217	0.0236
A1	0.000	0.020	0.050	0.0000	0.0008	0.0020
A3	-	0.152	-	-	0.060	-
D	2.900	3.000	3.100	0.1142	0.1181	0.1220
E	2.900	3.000	3.100	0.1142	0.1181	0.1220
L1	0.500	0.550	0.600	0.0197	0.0217	0.0236
L2	0.300	0.350	0.400	0.0118	0.0138	0.0157

Figure 53. UFQFPN20 marking example (package top view)



1. Parts marked as "ES", "E" or accompanied by an Engineering Sample notification letter, are not yet qualified and therefore not yet ready to be used in production and any consequences deriving from such usage will not be at ST charge. In no event, ST will be liable for any customer usage of these engineering samples in production. ST Quality has to be contacted prior to any decision to use these Engineering samples to run qualification activity.

Table 55. SDIP32 package mechanical data (continued)

Dim.	mm			inches ⁽¹⁾		
	Min	Typ	Max	Min	Typ	Max
eB	-	-	12.700	-	-	0.5000
L	2.540	3.048	3.810	0.1000	0.1200	0.1500

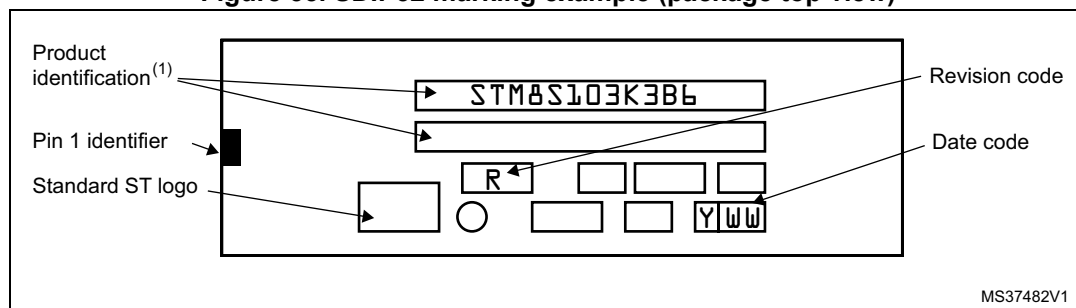
1. Values in inches are converted from mm and rounded to 4 decimal digits

Device marking

The following figure gives an example of topside marking orientation versus pin 1 identifier location.

Other optional marking or inset/upset marks, which identify the parts throughout supply chain operations, are not indicated below.

Figure 55. SDIP32 marking example (package top view)



1. Parts marked as "ES", "E" or accompanied by an Engineering Sample notification letter, are not yet qualified and therefore not yet ready to be used in production and any consequences deriving from such usage will not be at ST charge. In no event, ST will be liable for any customer usage of these engineering samples in production. ST Quality has to be contacted prior to any decision to use these Engineering samples to run qualification activity.

13 Ordering information

Figure 63. STM8S103F2/x3 access line ordering information scheme⁽¹⁾

Example:	STM8	S	103	K	3	T	6	TR
Product class STM8 microcontroller								
Family type S = Standard								
Sub-family type 10x = Access line 103 sub-family								
Pin count K = 32 pins F = 20 pins								
Program memory size 3 = 8 Kbytes 2 = 4 Kbytes								
Package type B = SDIP T = LQFP U = UFQFPN P = TSSOP M = SO								
Temperature range 3 = -40 to 125 °C 6 = -40 to 85 °C								
Package pitch Blank = 0.5 to 0.65 mm ⁽²⁾ C = 0.8 mm ⁽³⁾								
Packing No character = Tray or tube TR = Tape and reel								

1. A dedicated ordering information scheme will be released if, in the future, memory programming service (FastROM) is required. The letter "P" will be added after STM8S. Three unique letters identifying the customer application code will also be visible in the codification. Example: STM8SP103K3MACTR.
2. UFQFPN, TSSOP, and SO packages.
3. LQFP package.

14 STM8 development tools

Development tools for the STM8 microcontrollers include the full-featured STice emulation system supported by a complete software tool package including C compiler, assembler and integrated development environment with high-level language debugger. In addition, the STM8 is to be supported by a complete range of tools including starter kits, evaluation boards and a low-cost in-circuit debugger/programmer.

14.1 Emulation and in-circuit debugging tools

The STice emulation system offers a complete range of emulation and in-circuit debugging features on a platform that is designed for versatility and cost-effectiveness. In addition, STM8 application development is supported by a low-cost in-circuit debugger/programmer.

The STice is the fourth generation of full featured emulators from STMicroelectronics. It offers new advanced debugging capabilities including profiling and coverage to help detect and eliminate bottlenecks in application execution and dead code when fine tuning an application.

In addition, STice offers in-circuit debugging and programming of STM8 microcontrollers via the STM8 single wire interface module (SWIM), which allows non-intrusive debugging of an application while it runs on the target microcontroller.

For improved cost effectiveness, STice is based on a modular design that allows you to order exactly what you need to meet your development requirements and to adapt your emulation system to support existing and future ST microcontrollers.

14.1.1 STice key features

- Occurrence and time profiling and code coverage (new features),
- Advanced breakpoints with up to 4 levels of conditions,
- Data breakpoints,
- Program and data trace recording up to 128 KB records,
- Read/write on the fly of memory during emulation,
- In-circuit debugging/programming via SWIM protocol,
- 8-bit probe analyzer,
- 1 input and 2 output triggers,
- Power supply follower managing application voltages between 1.62 to 5.5 V,
- Modularity that allows you to specify the components you need to meet your development requirements and adapt to future requirements.
- Supported by free software tools that include integrated development environment (IDE), programming software interface and assembler for STM8.

14.3 Programming tools

During the development cycle, STice provides in-circuit programming of the STM8 Flash microcontroller on the application board via the SWIM protocol. Additional tools include a low-cost in-circuit programmer as well as ST socket boards, which provide dedicated programming platforms with sockets for the STM8 programming.

For production environments, programmers will include a complete range of gang and automated programming solutions from third-party tool developers already supplying programmers for the STM8 family.