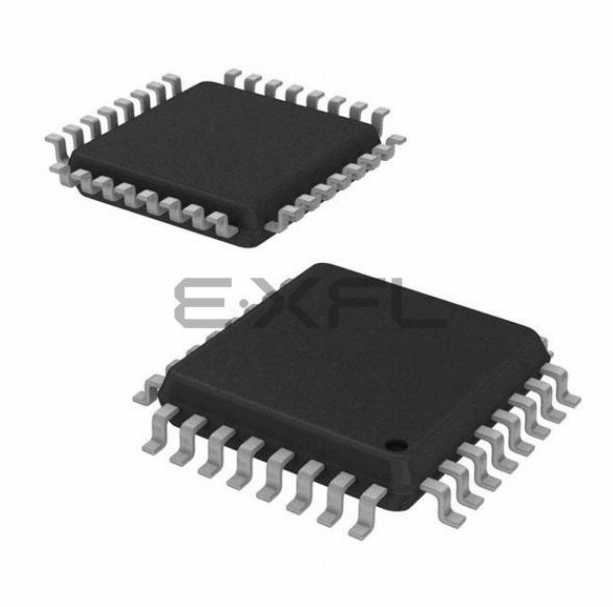

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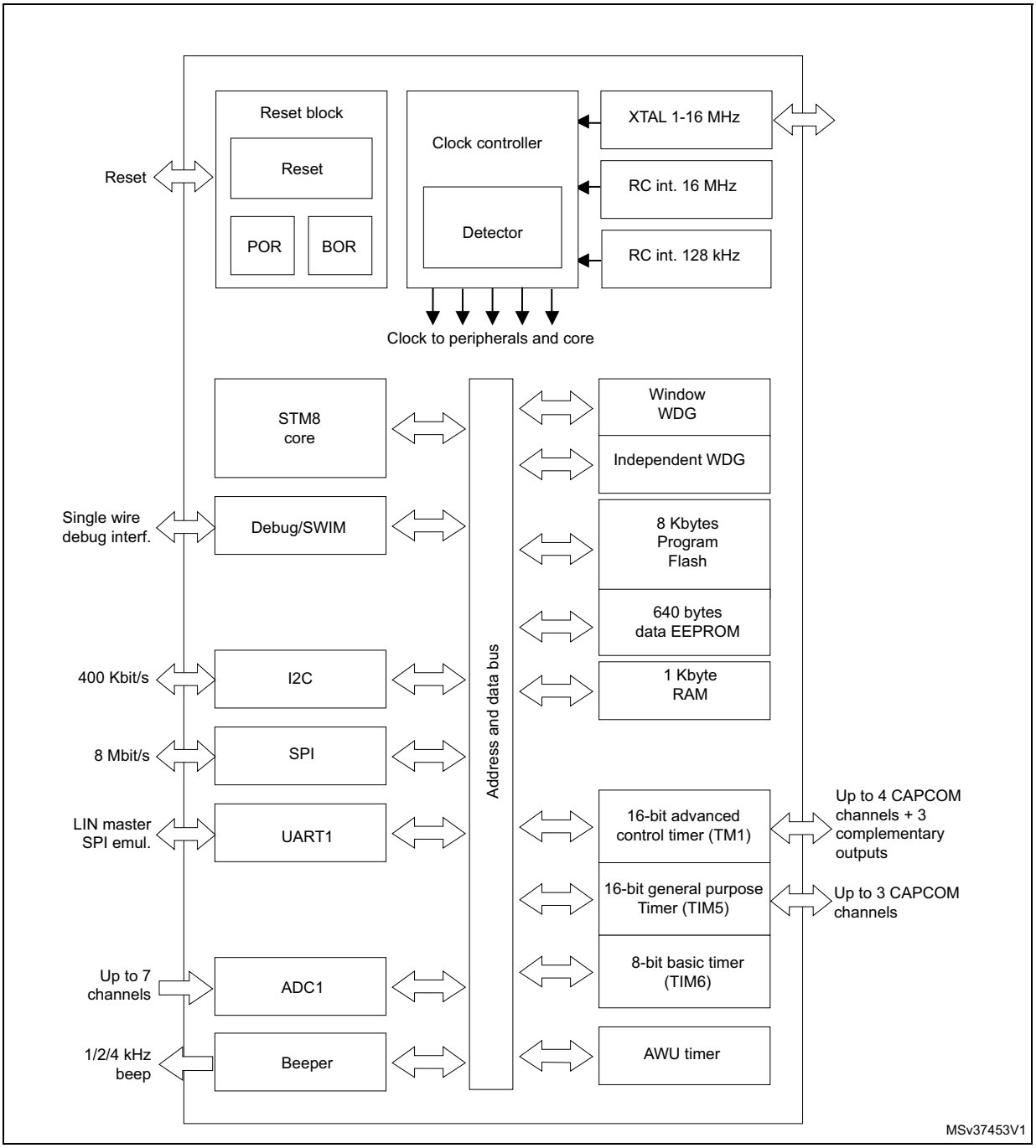
Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	STM8
Core Size	8-Bit
Speed	16MHz
Connectivity	I²C, 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 7x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	32-LQFP
Supplier Device Package	-
Purchase URL	https://www.e-xfl.com/product-detail/stmicroelectronics/stm8s903k3t6c

3 Block diagram

Figure 1. STM8S903K3/F3 block diagram



4.11 TIM5 - 16-bit general purpose timer

- 16-bit autoreload (AR) up-counter
- 15-bit prescaler adjustable to fixed power of 2 ratios 1…32768
- 3 individually configurable capture/compare channels
- PWM mode
- Interrupt sources: 3 x input capture/output compare, 1 x overflow/update
- Synchronization module to control the timer with external signals or to synchronize with TIM1 or TIM6

4.12 TIM6 - 8-bit basic timer

- 8-bit autoreload, adjustable prescaler ratio to any power of 2 from 1 to 128
- Clock source: CPU clock
- Interrupt source: 1 x overflow/update
- Synchronization module to control the timer with external signals or to synchronize with TIM1 or TIM5.

Table 3. TIM timer features

Timer	Counter size (bits)	Prescaler	Counting mode	CAPCOM channels	Complementary outputs	Ext. trigger	Timer synchronization/ chaining
TIM1	16	Any integer from 1 to 65536	Up/down	4	3	Yes	Yes
TIM5	16	Any power of 2 from 1 to 32768	Up	3	0	No	
TIM6	8	Any power of 2 from 1 to 128	Up	0	0	No	

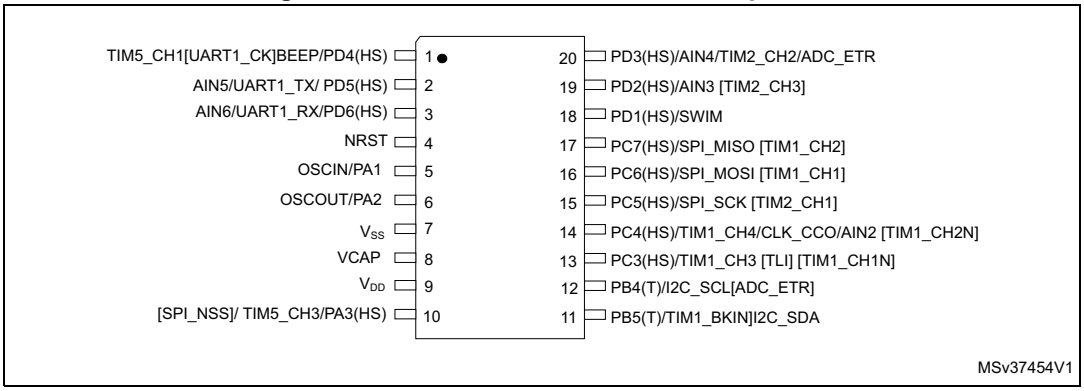
5 Pinouts and pin descriptions

Table 4. Legend/abbreviations for pinout 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.	

5.1 STM8S903F3 TSSOP20/SO20 pinout

Figure 3. STM8S903F3 TSSOP20/SO20 pinout



1. HS high sink capability.
2. (T) True open drain (P-buffer and protection diode to V_{DD} 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 6. STM8S903K3 UFQFPN32/LQFP32/SDIP32 pin descriptions (continued)

SDIP32	LQFP/ UFQFP32	Pin name	Type	Input			Output				Main function (after reset)	Default alternate function	Alternate function after remap [option bit]
				floating	wpu	Ext. interrupt	High sink(1)	Speed	OD	PP			
12	7	PA3/ TIM5_CH3 [SPI_NSS] [UART1_TX]	I/O	**X**	X	X	HS	O3	X	X	**Port A3**	Timer 5 channel 3	SPI master/ slave select [AFR1] /UART1 data transmit [AFR 1:0]
13	8	PF4 [UART1_RX]	I/O	**X**	X	-	-	O1	X	X	**Port F4**	-	UART1 data receive [AFR1:0]
14	9	PB7	I/O	**X**	X	X	-	O1	X	X	**Port B7**	-	-
15	10	PB6	I/O	**X**	X	X	-	O1	X	X	**Port B6**	-	-
16	11	PB5/ I2C_SDA [TIM1_BKIN]	I/O	**X**	-	X	-	O1	T (3)	-	**Port B5**	I2C data	Timer 1 - break input [AFR4]
17	12	PB4/ I2C_SCL [ADC_ETR]	I/O	**X**	-	X	-	O1	T	-	**Port B4**	I2C clock	ADC external trigger [AFR4]
18	13	PB3/ AIN3/TIM1_ETR	I/O	**X**	X	X	HS	O3	X	X	**Port B3**	Analog input 3/ Timer 1 external trigger	-
19	14	PB2/ AIN2/ TIM1_CH3N	I/O	**X**	X	X	HS	O3	X	X	**Port B2**	Analog input 2/ Timer 1 - inverted channel 3	-
20	15	PB1/ AIN1/ TIM1_CH2N	I/O	**X**	X	X	HS	O3	X	X	**Port B1**	Analog input 1/ Timer 1 - inverted channel 2	-
21	16	PB0/ AIN0/ TIM1_CH1N	I/O	**X**	X	X	HS	O3	X	X	**Port B0**	Analog input 0/ Timer 1 - inverted channel 1	-
22	17	PE5/ SPI_NSS [TIM1_CH1N]	I/O	**X**	X	X	HS	O3	X	X	Port E5	SPI master/slave select	Timer 1 - inverted channel 1 [AFR1:0]
23	18	PC1/ TIM1_CH1/ UART1_CK [TIM1_CH2N]	I/O	**X**	X	X	HS	O3	X	X	Port C1	Timer 1 - channel 1 UART1 clock	Timer 1 - inverted channel 2 [AFR1:0]

6.2 Register map

6.2.1 I/O port hardware register map

Table 7. I/O port hardware register map

Address	Block	Register label	Register name	Reset status
0x00 5000	Port A	PA_ODR	Port A data output latch register	0x00
0x00 5001		PA_IDR	Port A input pin value register	0xXX(1)
0x00 5002		PA_DDR	Port A data direction register	0x00
0x00 5003		PA_CR1	Port A control register 1	0x00
0x00 5004		PA_CR2	Port A control register 2	0x00
0x00 5005	Port B	PB_ODR	Port B data output latch register	0x00
0x00 5006		PB_IDR	Port B input pin value register	0xXX(1)
0x00 5007		PB_DDR	Port B data direction register	0x00
0x00 5008		PB_CR1	Port B control register 1	0x00
0x00 5009		PB_CR2	Port B control register 2	0x00
0x00 500A	Port C	PC_ODR	Port C data output latch register	0x00
0x00 500B		PB_IDR	Port C input pin value register	0xXX(1)
0x00 500C		PC_DDR	Port C data direction register	0x00
0x00 500D		PC_CR1	Port C control register 1	0x00
0x00 500E		PC_CR2	Port C control register 2	0x00
0x00 500F	Port D	PD_ODR	Port D data output latch register	0x00
0x00 5010		PD_IDR	Port D input pin value register	0xXX(1)
0x00 5011		PD_DDR	Port D data direction register	0x00
0x00 5012		PD_CR1	Port D control register 1	0x02
0x00 5013		PD_CR2	Port D control register 2	0x00
0x00 5014	Port E	PE_ODR	Port E data output latch register	0x00
0x00 5015		PE_IDR	Port E input pin value register	0xXX(1)
0x00 5016		PE_DDR	Port E data direction register	0x00
0x00 5017		PE_CR1	Port E control register 1	0x00
0x00 5018		PE_CR2	Port E control register 2	0x00
0x00 5019	Port F	PF_ODR	Port F data output latch register	0x00
0x00 501A		PF_IDR	Port F input pin value register	0xXX(1)
0x00 501B		PF_DDR	Port F data direction register	0x00
0x00 501C		PF_CR1	Port F control register 1	0x00
0x00 501D		PF_CR2	Port F control register 2	0x00

1. Depends on the external circuitry.

Table 8. General hardware register map (continued)

Address	Block	Register label	Register name	Reset status
0x00 5340	TIM6	TIM6_CR1	TIM6 control register 1	0x00
0x00 5341		TIM6_CR2	TIM6 control register 2	0x00
0x00 5342		TIM6_SMCR	TIM6 slave mode control register	0x00
0x00 5343		TIM6_IER	TIM6 interrupt enable register	0x00
0x00 5344		TIM6_SR	TIM6 status register	0x00
0x00 5345		TIM6_EGR	TIM6 event generation register	0x00
0x00 5346		TIM6_CNTR	TIM6 counter	0x00
0x00 5347		TIM6_PSCR	TIM6 prescaler register	0x00
0x00 5348		TIM6_ARR	TIM6 auto-reload register	0xFF
0x00 5349 to 0x00 53DF	Reserved area (153 byte)			
0x00 53E0 to 0x00 53F3	ADC1	ADC_DBxR	ADC data buffer registers	0x00
0x00 53F4 to 0x00 53FF	Reserved area (12 byte)			

2. Refer to STM8S903K3 pin descriptions.

Table 14. STM8S903F3 alternate function remapping bits [7:2] for 20-pin packages

Option byte no.	Description(1)
OPT2	**AFR7** Alternate function remapping option 7 0: AFR7 remapping option inactive: Default alternate functions.(2) 1: Port C3 alternate function = TIM1_CH1N; port C4 alternate function = TIM1_CH2N. **AFR6** Alternate function remapping option 6 Reserved. **AFR5** Alternate function remapping option 5 Reserved. **AFR4** Alternate function remapping option 4 0: AFR4 remapping option inactive: Default alternate functions.(2) 1: Port B4 alternate function = ADC_ETR; port B5 alternate function = TIM1_BKIN. **AFR3** Alternate function remapping option 3 0: AFR3 remapping option inactive: Default alternate function.(2) 1: Port C3 alternate function = TLI. **AFR2** Alternate function remapping option 2 Reserved.

1. Do not use more than one remapping option in the same port.
2. Refer to STM8S903K3 pin descriptions.

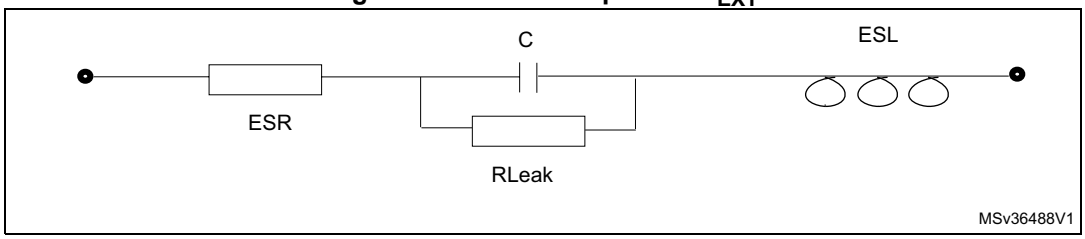
Table 15. STM8S903K3 alternate function remapping bits [1:0] for 32-pin packages

AFR1 option bit value	AFR0 option bit value	I/O port	Alternate function mapping
0	0	AFR1 and AFR0 remapping options inactive: Default alternate functions(1)	
0	1	PC5	TIM5_CH1
		PC6	TIM1_CH1
		PC7	TIM1_CH2
1	0	PA3	SPI_NSS
		PD2	TIM5_CH3

10.3.1 VCAP external capacitor

The stabilization for the main regulator is achieved by connecting an external capacitor C_{EXT} to the V_{CAP} pin. C_{EXT} is specified in *Table 21*. Care should be taken to limit the series inductance to less than 15 nH.

Figure 11. External capacitor C_{EXT}



1. ESR is the equivalent series resistance and ESL is the equivalent inductance.

10.3.2 Supply current characteristics

The current consumption is measured as illustrated in *Figure 9: Pin input voltage*.

Total supply current consumption in run mode

The MCU is placed under the following conditions:

- All I/O pins in input mode with a static value at V_{DD} or V_{SS} (no load)
- All peripherals are disabled (clock stopped by peripheral clock gating registers) except if explicitly mentioned.

Subject to general operating conditions for V_{DD} and T_A.

Table 23. Total current consumption with code execution in run mode at V_{DD} = 5 V

Symbol	Parameter	Conditions		Typ	Max(1)	Unit
$I_{DD(RUN)}$	Supply current in Run mode, code executed from RAM	$f_{CPU} = f_{MASTER}$ = 16 MHz	HSE crystal osc. (16 MHz)	2.3	-	mA
			HSE user ext. clock (16 MHz)	2	2.35	
			HSI RC osc. (16 MHz)	1.7	2	
		$f_{CPU} = f_{MASTER}$ /128 = 125 kHz	HSE user ext. clock (16 MHz)	0.86	-	
			HSI RC osc. (16 MHz)	0.7	0.87	
		$f_{CPU} = f_{MASTER}$ /128 = 15.625 kHz	HSI RC osc. (16 MHz/8)	0.46	0.58	
		$f_{CPU} = f_{MASTER}$ = 128 kHz	LSI RC osc. (128 kHz)	0.41	0.55	

Figure 16. Typ $I_{DD(WFI)}$ vs. f_{CPU} HSE external clock, V_{DD} = 5 V

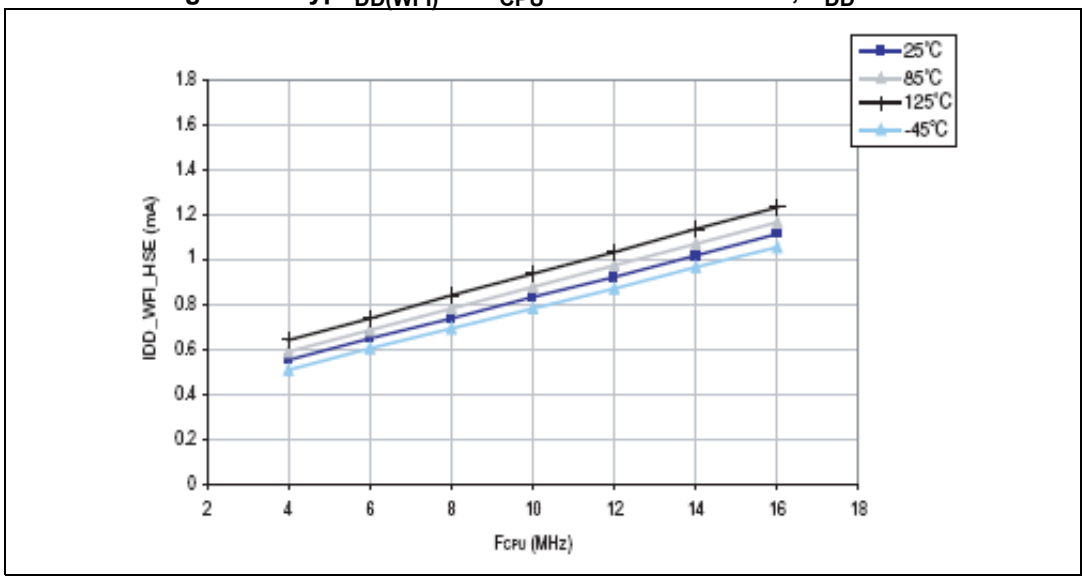


Figure 17. Typ $I_{DD(WFI)}$ vs. V_{DD} HSI RC osc., f_{CPU} = 16 MHz

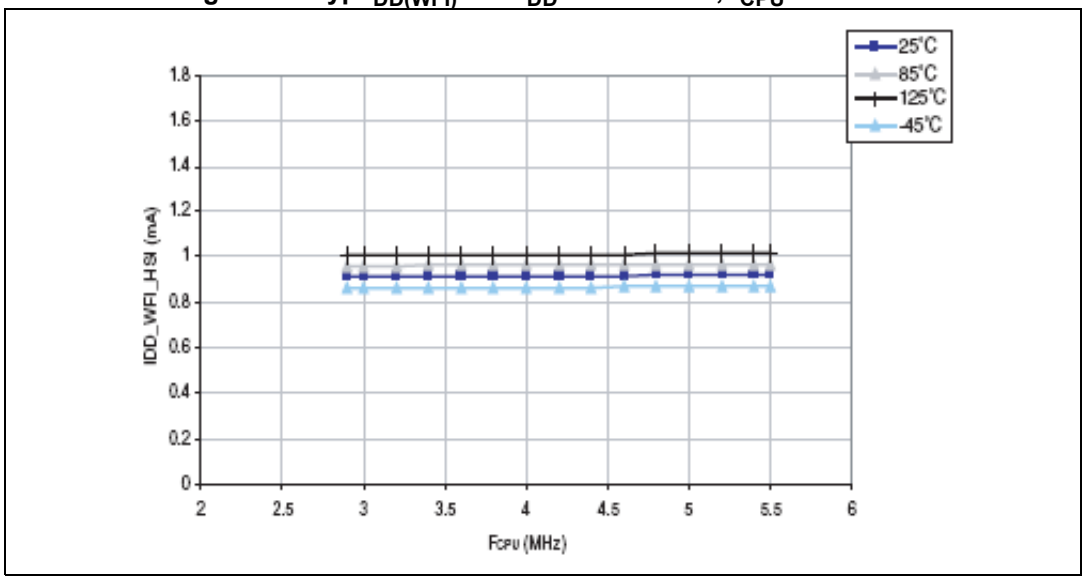
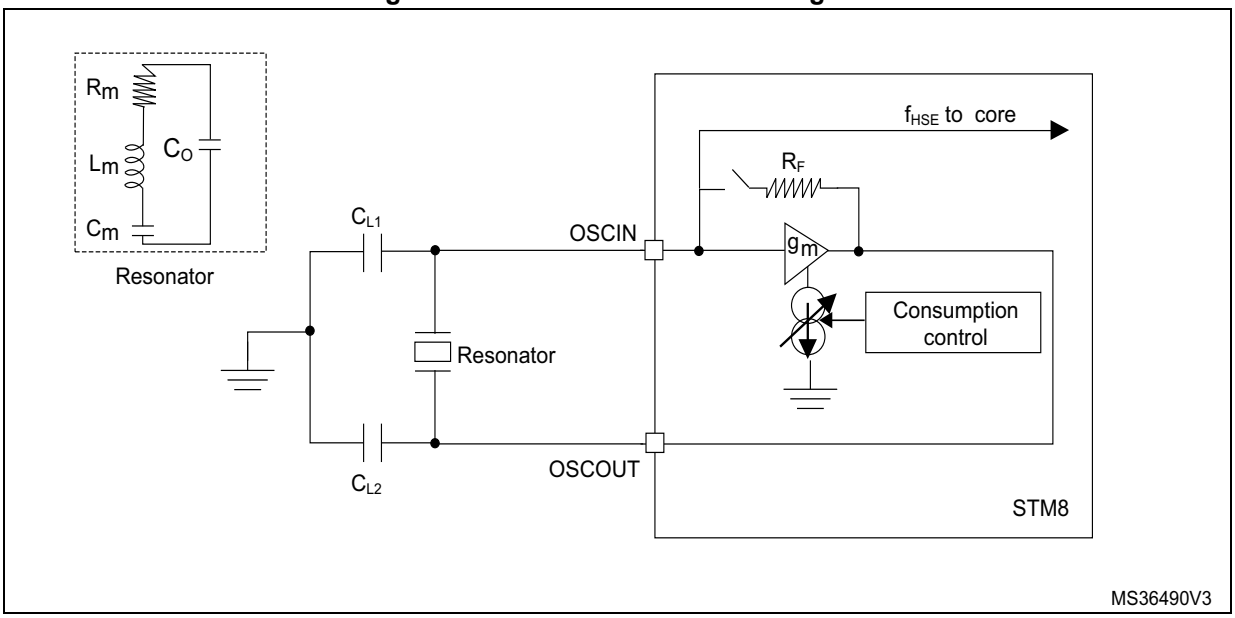


Figure 19. HSE oscillator circuit diagram



HSE oscillator critical g_m equation

$$g_{mcrit} = (2 \times \Pi \times f_{HSE})^2 \times R_m(2Co + C)^2$$

R_m: Notional resistance (see crystal specification)
L_m: Notional inductance (see crystal specification)
C_m: Notional capacitance (see crystal specification)
Co: Shunt capacitance (see crystal specification)
$C_{L1} = C_{L2} = C$: Grounded external capacitance
$g_m \gg g_{mcrit}$

Figure 31. Typ. V_{DD} - V_{OH} @ V_{DD} = 3.3 V (standard ports)

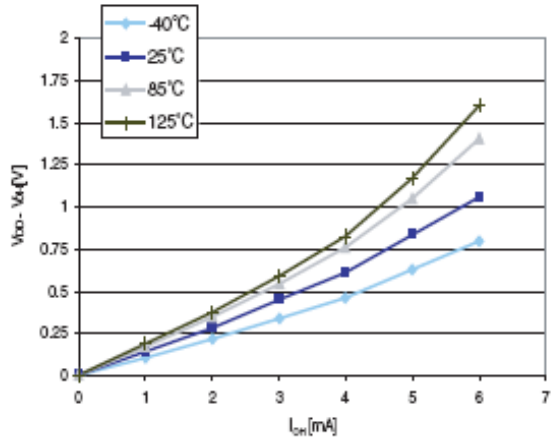


Figure 32. Typ. V_{DD} - V_{OH} @ V_{DD} = 5.0 V (standard ports)

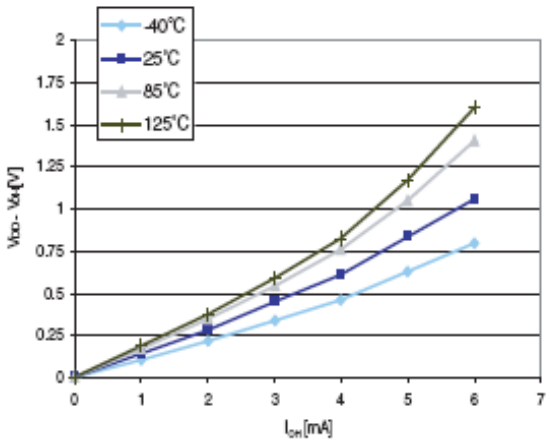


Figure 33. Typ. V_{DD} - V_{OH} @ V_{DD} = 3.3 V (high sink ports)

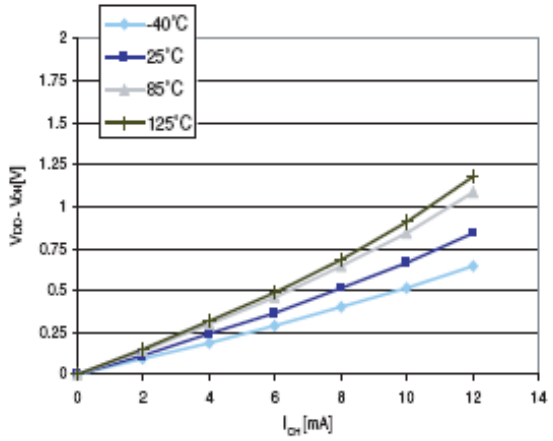
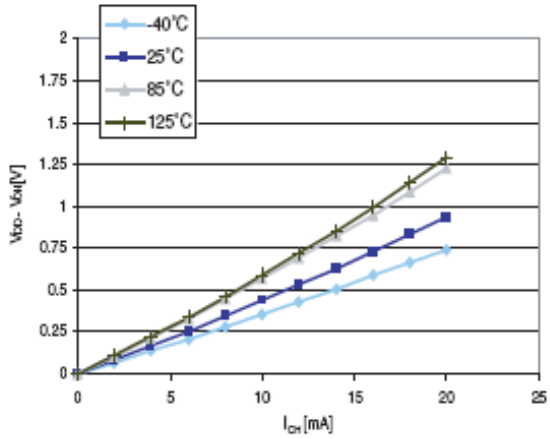


Figure 34. Typ. V_{DD} - V_{OH} @ V_{DD} = 5.0 V (high sink ports)



10.3.10 10-bit ADC characteristics

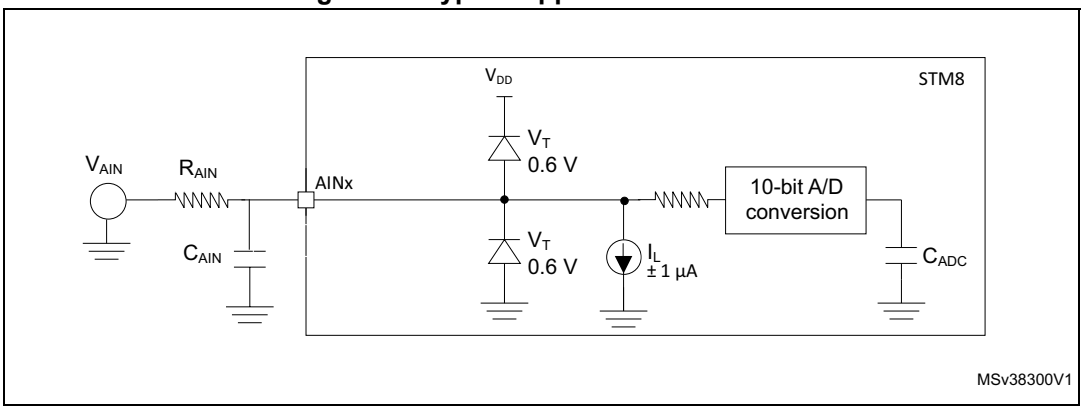
Subject to general operating conditions for V_{DDA}, f_{MASTER}, and T_A unless otherwise specified.

Table 47. ADC characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{ADC}	ADC clock frequency	V_{DD}= 2.95 to 5.5 V	1	-	4	MHz
		V_{DD}= 4.5 to 5.5 V	1	-	6	
V_{AIN}	Conversion voltage range(1)	-	V_{SS}	-	V_{DD}	V
V_{BGREF}	Internal bandgap reference voltage	V_{DD} = 2.95 to 5.5 V	1.19	1.22	1.25	V
C_{ADC}	Internal sample and hold capacitor	-	-	3	-	pF
t_S(1)	Minimum sampling time	f_{ADC} = 4 MHz	-	0.75	-	µs
		f_{ADC} = 6 MHz	-	0.5	-	
t_{STAB}	Wakeup time from standby	-	-	7.0	-	µs
t_{CONV}	Minimum total conversion time (including sampling time, 10-bit resolution)	f_{ADC} = 4 MHz	3.5			µs
		f_{ADC} = 6 MHz	2.33			µs
		-	14			$1/f_{ADC}$

1. During the sample time, the sampling capacitance, C_{AIN} (3 pF max), can be charged/discharged by the external source. The internal resistance of the analog source must allow the capacitance to reach its final voltage level within t_S. After the end of the sample time t_S, changes of the analog input voltage have no effect on the conversion result. Values for the sample clock t_S depend on programming.

Figure 44. Typical application with ADC



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

Electromagnetic interference (EMI)

Based on a simple application running on the product (toggling 2 LEDs through the I/O ports), the product is monitored in terms of emission. This emission test is in line with the norm IEC 61967-2 which specifies the board and the loading of each pin.

Table 51. EMI data

Symbol	Parameter	Conditions				Unit
		General conditions	Monitored frequency band	Max f_{CPU}(1)		
				16 MHz/ 8 MHz	16 MHz/ 16 MHz	
S_{EMI}	Peak level	V_{DD} = 5 V, T_A = 25 °C, LQFP32 package. Conforming to IEC 61967-2	0.1 MHz to 30 MHz	5	5	dBµV
			30 MHz to 130 MHz	4	5	
			130 MHz to 1 GHz	5	5	
	EMI level		EMI level	2.5	2.5	-

1. Guaranteed by characterization results.

Absolute maximum ratings (electrical sensitivity)

Based on two different tests (ESD, DLU and LU) using specific measurement methods, the product is stressed to determine its performance in terms of electrical sensitivity. For more details, refer to the application note AN1181.

Electrostatic discharge (ESD)

Electrostatic discharges (a positive then a negative pulse separated by 1 second) are applied to the pins of each sample according to each pin combination. The sample size depends on the number of supply pins in the device (3 parts x (n+1) supply pin). One model can be simulated: Human body model. This test conforms to the JESD22-A114A/A115A standard. For more details, refer to the application note AN1181.

Table 52. ESD absolute maximum ratings

Symbol	Ratings	Conditions	Class	Maximum value(1)	Unit
$V_{ESD(HBM)}$	Electrostatic discharge voltage (Human body model)	T_A = 25°C, conforming to JESD22-A114	A	4000	V
$V_{ESD(CDM)}$	Electrostatic discharge voltage (Charge device model)	T_A= 25°C, conforming to SD22-C101 LQFP32 package	IV	1000	

1. Guaranteed by characterization results

Static latch-up

Two complementary static tests are required on 10 parts to assess the latch-up performance.

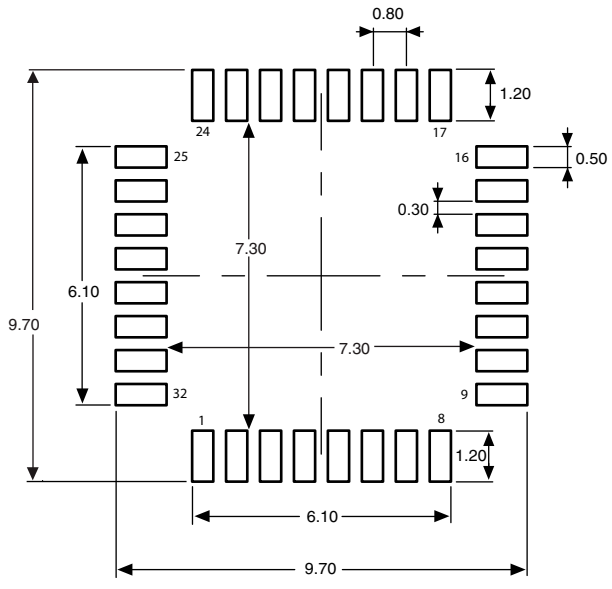
- A supply overvoltage (applied to each power supply pin), and
- A current injection (applied to each input, output and configurable I/O pin) are performed on each sample.

Table 54. LQFP32 - 32-pin, 7 x 7 mm low-profile quad flat package mechanical data

Symbol	millimeters			inches[1]		
	Min	Typ	Max	Min	Typ	Max
A	-	-	1.600	-	-	0.0630
A1	0.050	-	0.150	0.0020	-	0.0059
A2	1.350	1.400	1.450	0.0531	0.0551	0.0571
b	0.300	0.370	0.450	0.0118	0.0146	0.0177
c	0.090	-	0.200	0.0035	-	0.0079
D	8.800	9.000	9.200	0.3465	0.3543	0.3622
D1	6.800	7.000	7.200	0.2677	0.2756	0.2835
D3	-	5.600	-	-	0.2205	-
E	8.800	9.000	9.200	0.3465	0.3543	0.3622
E1	6.800	7.000	7.200	0.2677	0.2756	0.2835
E3	-	5.600	-	-	0.2205	-
e	-	0.800	-	-	0.0315	-
L	0.450	0.600	0.750	0.0177	0.0236	0.0295
L1	-	1.000	-	-	0.0394	-
k	0°	3.5°	7°	0°	3.5°	7°
ccc	-	-	0.100	-	-	0.0039

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

Figure 46. LQFP32 - 32-pin, 7 x 7 mm low-profile quad flat package recommended footprint



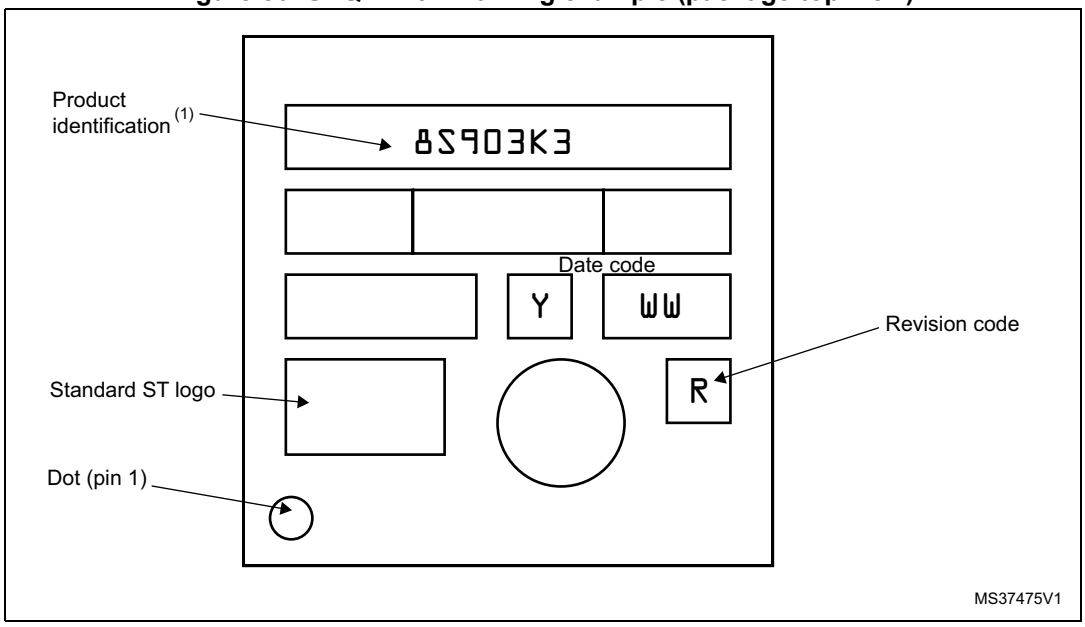
1. Dimensions are expressed in millimeters.

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 50. UFQFPN32 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 57. 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

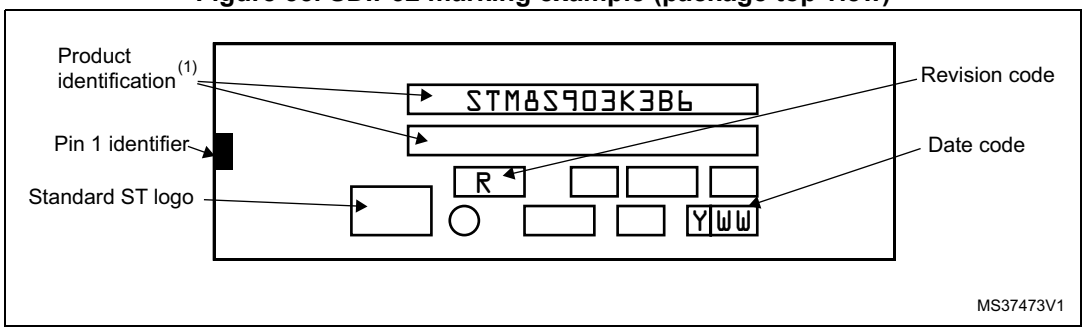
1. Values in inches are converted from mm and rounded to 4 decimal digits

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.

11.5 TSSOP20 package information

Figure 56. TSSOP20 package outline

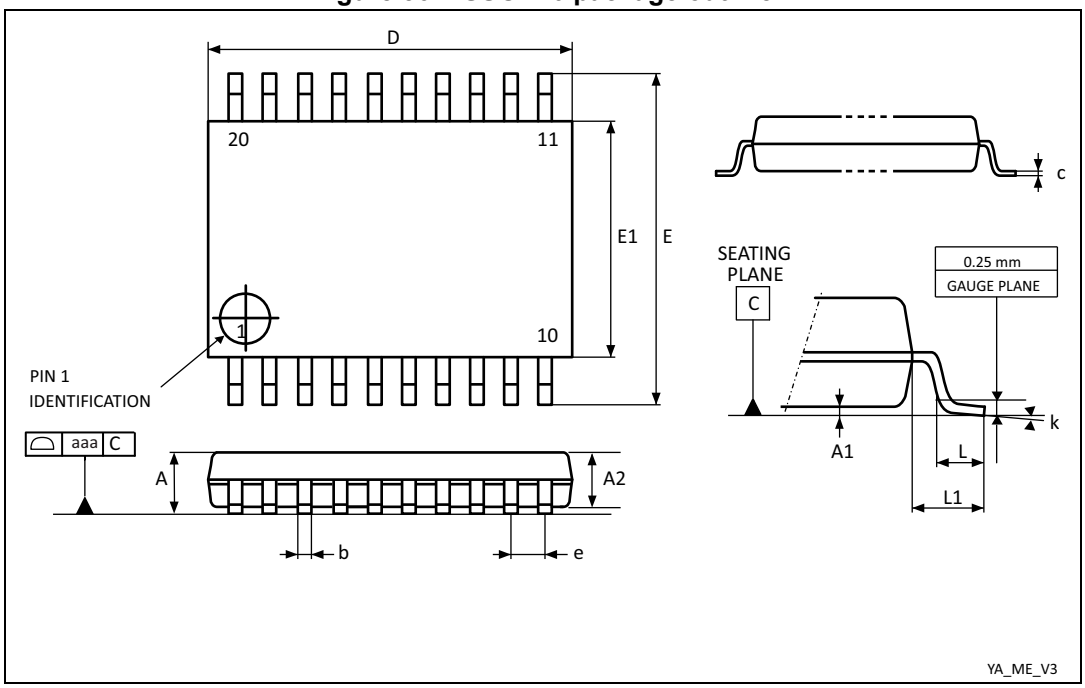


Table 58. TSSOP20 package mechanical data

Dim.	mm			inches[1]		
	Min	Typ	Max	Min	Typ	Max
A	-	-	1.200	-	-	0.0472
A1	0.050	-	0.150	0.0020	-	0.0059
A2	0.800	1.000	1.050	0.0315	0.0394	0.0413
b	0.190	-	0.300	0.0075	-	0.0118
c	0.090	-	0.200	0.0035	-	0.0079
D[2]	6.400	6.500	6.600	0.2520	0.2559	0.2598
E	6.200	6.400	6.600	0.2441	0.2520	0.2598
E1[3]	4.300	4.400	4.500	0.1693	0.1732	0.1772
e	-	0.650	-	-	0.0256	-
L	0.450	0.600	0.750	0.0177	0.0236	0.0295
L1	-	1.000	-	-	0.0394	-
k	0.0°	-	8.0°	0.0°	-	8.0°
aaa	-	-	0.100	-	-	0.0039

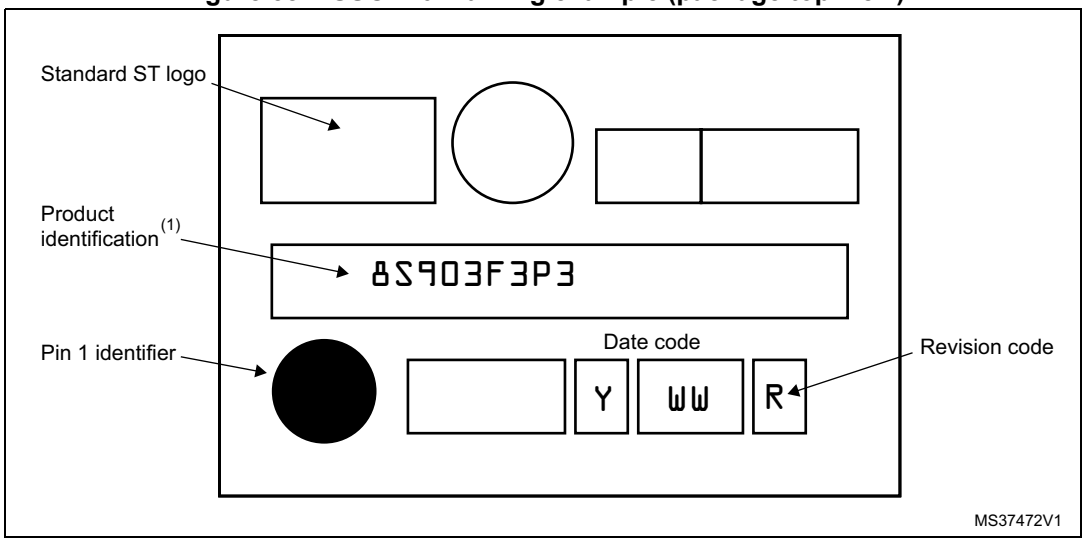
1. Values in inches are converted from mm and rounded to 4 decimal digits.
2. Dimension “D” does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15mm per side.

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.

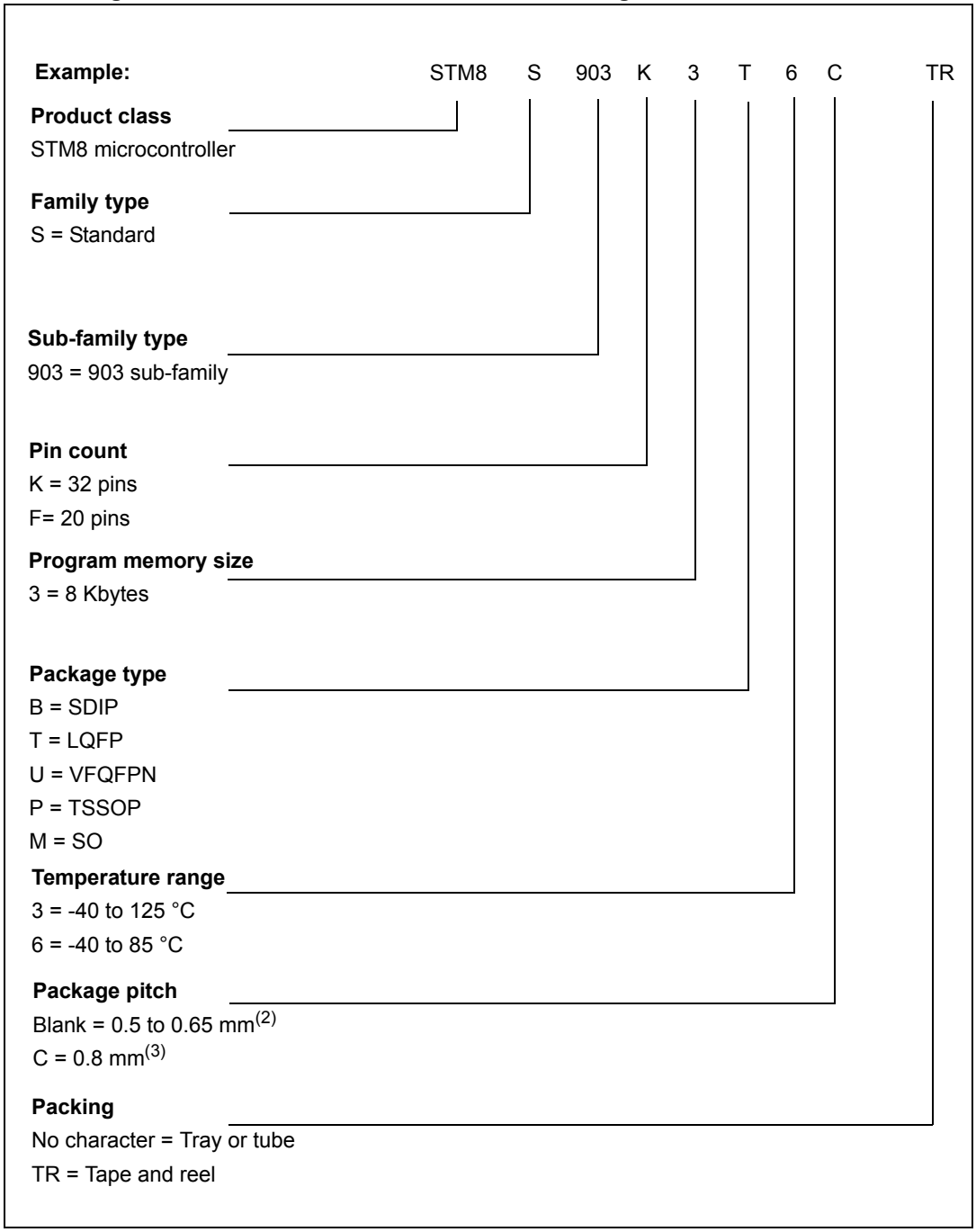
Figure 58. TSSOP20 marking example (package top view)



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. STM8S903K3/F3 access line ordering information scheme(1)



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: STM8SP903K3MACTR.
2. UFQFPN, TSSOP, and SO packages.
3. LQFP package.