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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	Obsolete
Core Processor	ARM7®
Core Size	32-Bit Single-Core
Speed	66MHz
Connectivity	HDLC, I²C, SmartCard, SPI, UART/USART, USB
Peripherals	PWM, WDT
Number of I/O	30
Program Memory Size	64KB (64K x 8 + 16K)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	16K x 8
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 4x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-LFBGA
Supplier Device Package	-
Purchase URL	https://www.e-xfl.com/product-detail/stmicroelectronics/str711fr0h6

Contents

List of figures

1 Introduction

This datasheet provides the STR71x pinout, ordering information, mechanical and electrical device characteristics.

For complete information on the STR71x microcontroller memory, registers and peripherals. please refer to the STR71x reference manual.

For information on programming, erasing and protection of the internal Flash memory please refer to the STR7 Flash programming reference manual.

For information on the ARM7TDMI core please refer to the ARM7TDMI technical reference manual.

Table 2. Device overview

Features	STR710 FZ1	STR710 FZ2	STR710 RZ	STR711 FR0	STR711 FR1	STR711 FR2	STR712 FR0	STR712 FR1	STR712 FR2	STR715 FRx
Flash - Kbytes	128+16	256+16	0	64+16	128+16	256+16	64+16	128+16	256+16	64+16
RAM - Kbytes	32	64	64	16	32	64	16	32	64	16
Peripheral Functions	CAN, EMI, USB, 48 I/Os			USB, 30 I/Os			CAN, 32 I/Os			32 I/Os
Operating Voltage	3.0 to 3.6 V									
Operating Temperature	-40 to +85°C or 0 to 70° C									
Packages	**T**=LQFP144 20 x 20 **H**=LFBGA144 10 x10			**T**=LQFP64 10 x10						

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2 Description

ARM® core with embedded Flash and RAM

The STR71x series is a family of ARM-powered 32-bit microcontrollers with embedded Flash and RAM. It combines the high performance ARM7TDMI CPU with an extensive range of peripheral functions and enhanced I/O capabilities. STR71xF devices have on-chip high-speed single voltage FLASH memory and high-speed RAM. STR710R devices have high-speed RAM but no internal Flash. The STR71x family has an embedded ARM core and is therefore compatible with all ARM tools and software.

Extensive tools support

STMicroelectronics' 32-bit, ARM core-based microcontrollers are supported by a complete range of high-end and low-cost development tools to meet the needs of application developers. This extensive line of hardware/software tools includes starter kits and complete development packages all tailored for ST's ARM core-based MCUs. The range of development packages includes third-party solutions that come complete with a graphical development environment and an in-circuit emulator/programmer featuring a JTAG application interface. These support a range of embedded operating systems (OS), while several royalty-free OSs are also available.

For more information, please refer to ST MCU site http://www.st.com/mcu

Realtime clock (RTC)

The RTC provides a set of continuously running counters driven by the 32 kHz external crystal. The RTC can be used as a general timebase or clock/calendar/alarm function. When the STR71x is in Standby mode the RTC can be kept running, powered by the low power voltage regulator and driven by the 32 kHz external crystal.

UARTs

The 4 UARTs allow full duplex, asynchronous, communications with external devices with independently programmable TX and RX baud rates up to 1.25 Mb/s.

Smartcard interface

UART1 is configurable to function either as a general purpose UART or as an asynchronous Smartcard interface as defined by ISO 7816-3. It includes Smartcard clock generation and provides support features for synchronous cards.

Buffered serial peripheral interfaces (BSPI)

Each of the two SPIs allow full duplex, synchronous communications with external devices, master or slave communication at up to 5.5 Mb/s in Master mode and 4 Mb/s in Slave mode.

I^2C interfaces

The two I^2C Interfaces provide multi-master and slave functions, support normal and fast I^2C mode (400 kHz) and 7 or 10-bit addressing modes.

One I^2C Interface is multiplexed with one SPI, so either 2xSPI+1x I^2C or 1xSPI+2x I^2C may be used at a time.

HDLC interface

The High Level Data Link Controller (HDLC) unit supports full duplex operation and NRZ, NRZI, FM0 or MANCHESTER protocols. It has an internal 8-bit baud rate generator.

A/D converter

The Analog to Digital Converter, converts in single channel or up to 4 channels in single-shot or round robin mode. Resolution is 12-bit with a sampling frequency of up to 1 kHz. The input voltage range is 0-2.5V.

Watchdog

The 16-bit Watchdog Timer protects the application against hardware or software failures and ensures recovery by generating a reset.

I/O ports

The 48 I/O ports are programmable as Inputs or Outputs.

External interrupts

Up to 14 external interrupts are available for application use or to wake up the application from STOP mode.

Figure 1. STR71x block diagram

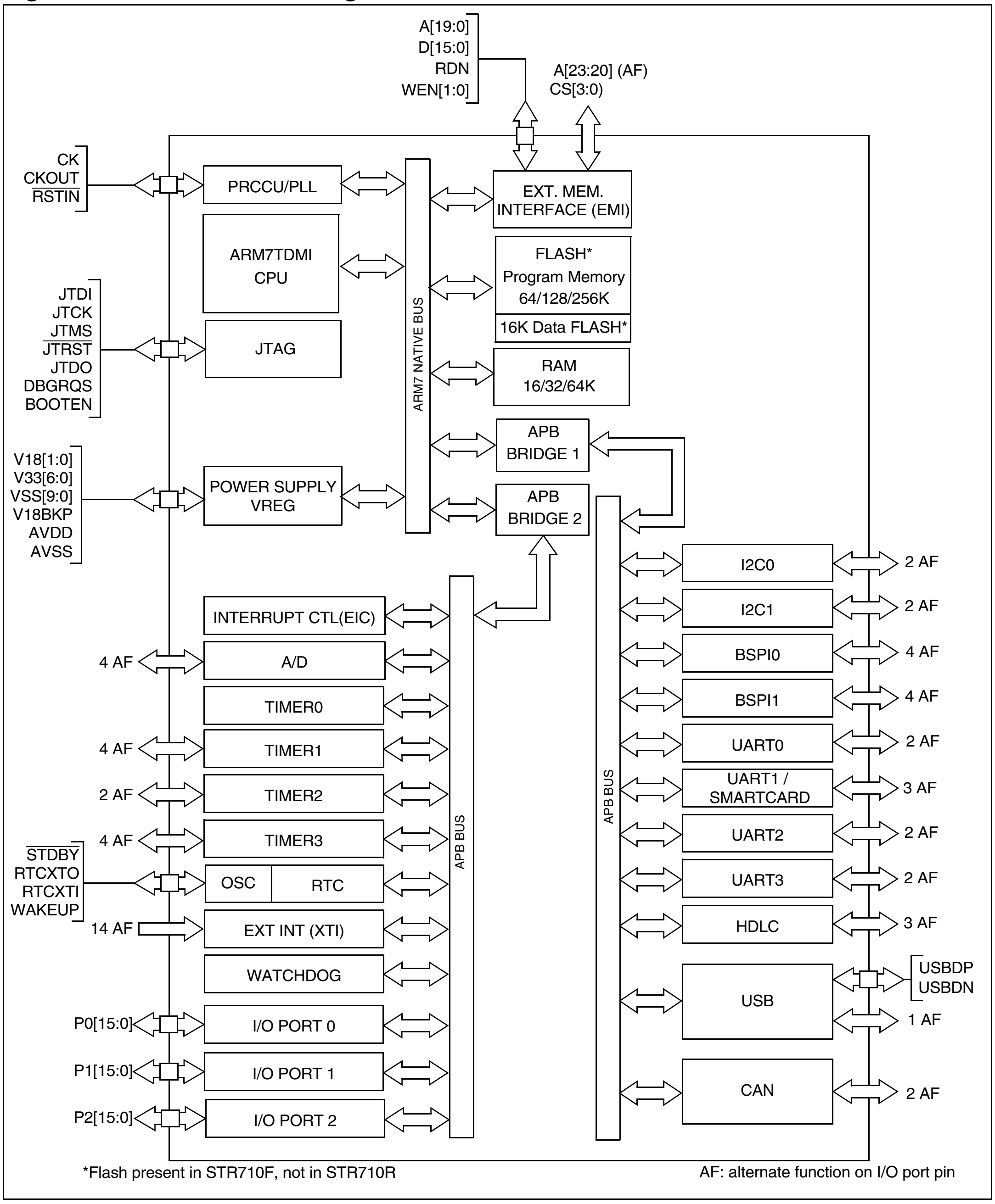


Table 3. STR710 BGA ball connections

	A	B	C	D	E	F	G	H	J	K	L	M
1	P0.10	P2.0	P2.1	VSS	P2.2	P2.6	BOOT EN	P2.12	P2.13	P2.15	JTDI	N.C.
2	VSS	RDn	P0.11	V33	P2.3	P2.8	P2.9	JTMS	JTRSTn	TEST	TEST	N.C.
3	V33	P0.9	P0.12	P0.13	P2.4	N.C.	P2.10	JTCK	NU	V33	N.C.	DBG RQS
4	P0.6	P0.7	P0.8	P0.14	P2.5	N.C.	P2.11	JTDO	CK	CKOUT	VSSIO-PLL	N.C.
5	A.19	WEn.1	WEn.0	P0.5	P2.7	VSS	P2.14	N.C.	RTCX-TO	RTCXTI	N.C.	P0.15
6	P0.3	A.15	A.16	A.17	A.18	V33	V18	N.C.	N.C.	V18BK P	VSS BKP	$\overline{STDBY}$
7	P0.2	P0.1	P0.4	VSS18	V18	A.14	D.12	D.1	D.0	nc	VSS18	$\overline{RSTIN}$
8	A.9	A.10	A.11	A.13	P0.0	A.0	D.11	P1.12/ CANTX	N.C.	AVSS	D.3	D.2
9	VSS	V33	A.5	A.6	V33	D.15	D.10	P1.8	D.9	P1.0	N.C.	N.C.
10	A.8	N.C.	P1.15	P1.13	VSS	D.14	USBDN	P1.7	D.8	P1.5	P1.1	D.4
11	A.7	N.C.	P1.14	P1.10	A.2	D.13	USBDP	VSS	D.5	P1.4	P1.3	AVDD
12	A.12	A.4	A.3	P1.9	A.1	P1.11/ CANRX	N.C.	V33IO-PLL	P1.6	D.7	D.6	P1.2

Legend / abbreviations for *Table 4*:

Type: I = input, O = output, S = supply, HiZ= high impedance,

In/Output level: C = CMOS $0.3V_{DD}/0.7V_{DD}$
C_T= CMOS $0.3V_{DD}/0.7V_{DD}$ with input trigger
T_T= TTL 0.8 V/2 V with input trigger
C/T = Programmable levels: CMOS $0.3V_{DD}/0.7V_{DD}$ or TTL 0.8 V / 2 V

Port and control configuration:

Input: pu/pd= software enabled internal pull-up or pull down
pu= in reset state, the internal 100kΩ weak pull-up is enabled.
pd = in reset state, the internal 100kΩ weak pull-down is enabled.

Output: OD = open drain (logic level)
PP = push-pull
T = true OD, (P-Buffer and protection diode to V_{DD} not implemented), 5 V tolerant.

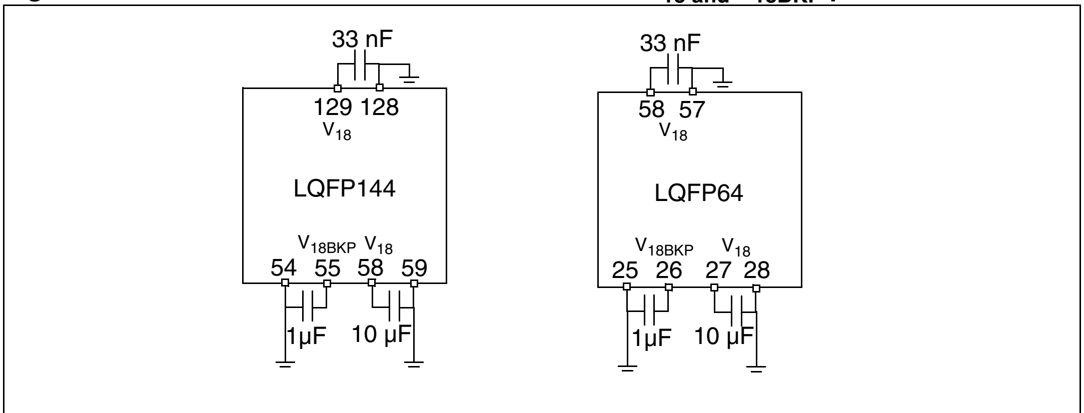
Table 5. STR711/STR712/STR715 pin description (continued)

Pin n°	Pin name	Type	Reset state1)	Input		Output			Active in Stdby	Main function (after reset)	Alternate function	
LQFP64				Input level	interrupt	Capability	OD	PP				
63	P0.8/U0.RX/U0.TX	I/O	pd	C_T	X	4mA	T			Port 0.8	UART0: Receive Data input	UART0: Transmit data output.
										Note: This pin may be used for single wire UART (half duplex) if programmed as Alternate Function Output. The pin will be tri-stated except when UART transmission is in progress		
64	P0.9/U0.TX/BOOT.0	I/O	pd	C_T		4mA	X	X		Port 0.9	Select Boot Configuration input	UART0: Transmit data output

1. The Reset configuration of the I/O Ports is IPUPD (input pull-up/pull down). Refer to *Table 6 on page 30*. The Port bit configuration at reset is PC0=1, PC1=1, PC2=0. The port data register bit (PD) value depends on the pu/pd column which specifies whether the pull-up or pull-down is enabled at reset
2. $V_{33IO-PLL}$ and V_{33} are internally connected. $V_{SSIO-PLL}$ and V_{SS} are internally connected.

3.5 External connections

Figure 5. Recommended external connection of V_{18} and V_{18BKP} pins



3.7 Memory mapping

Figure 6. Memory map

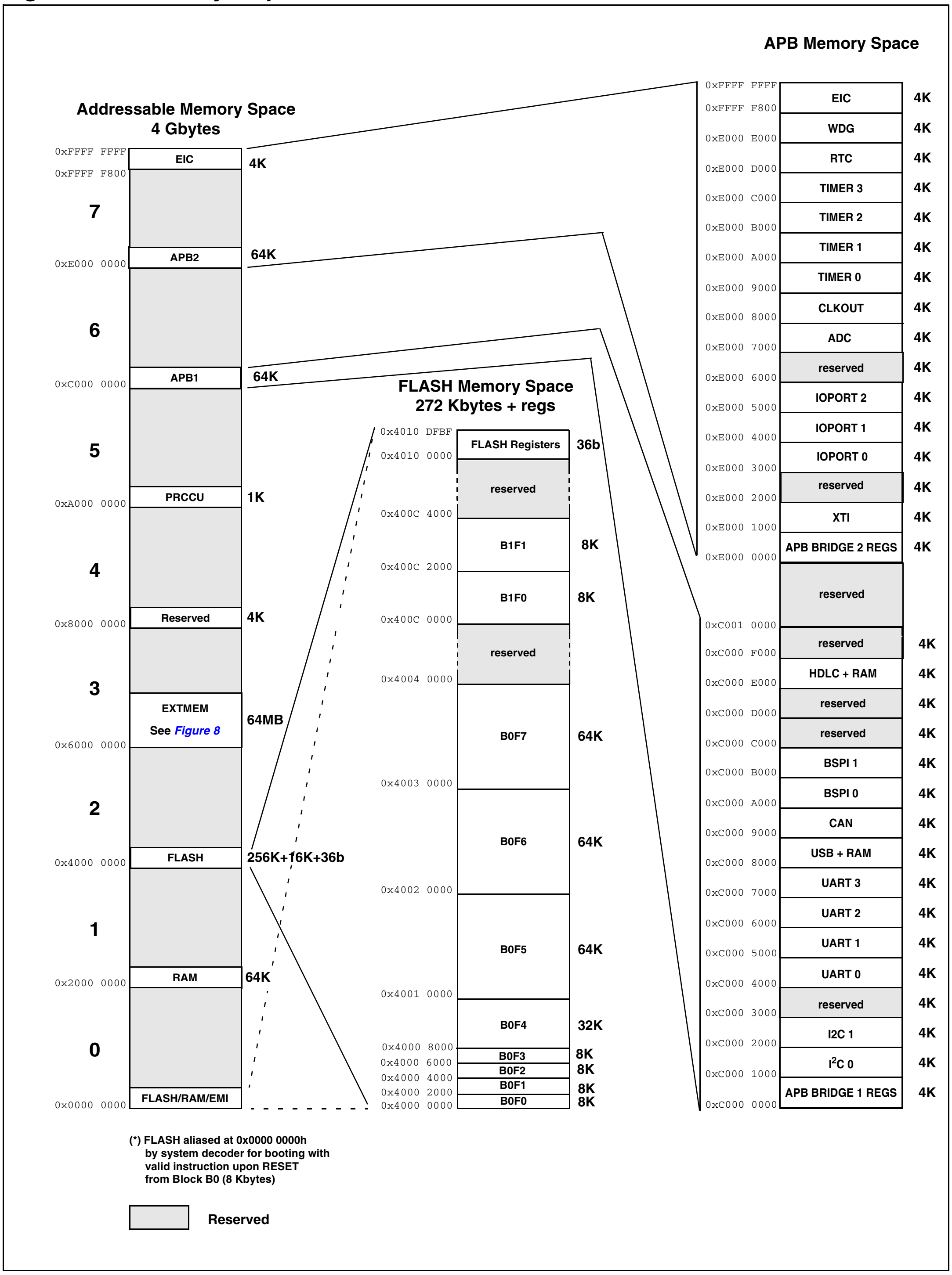


Figure 7. Mapping of Flash memory versions

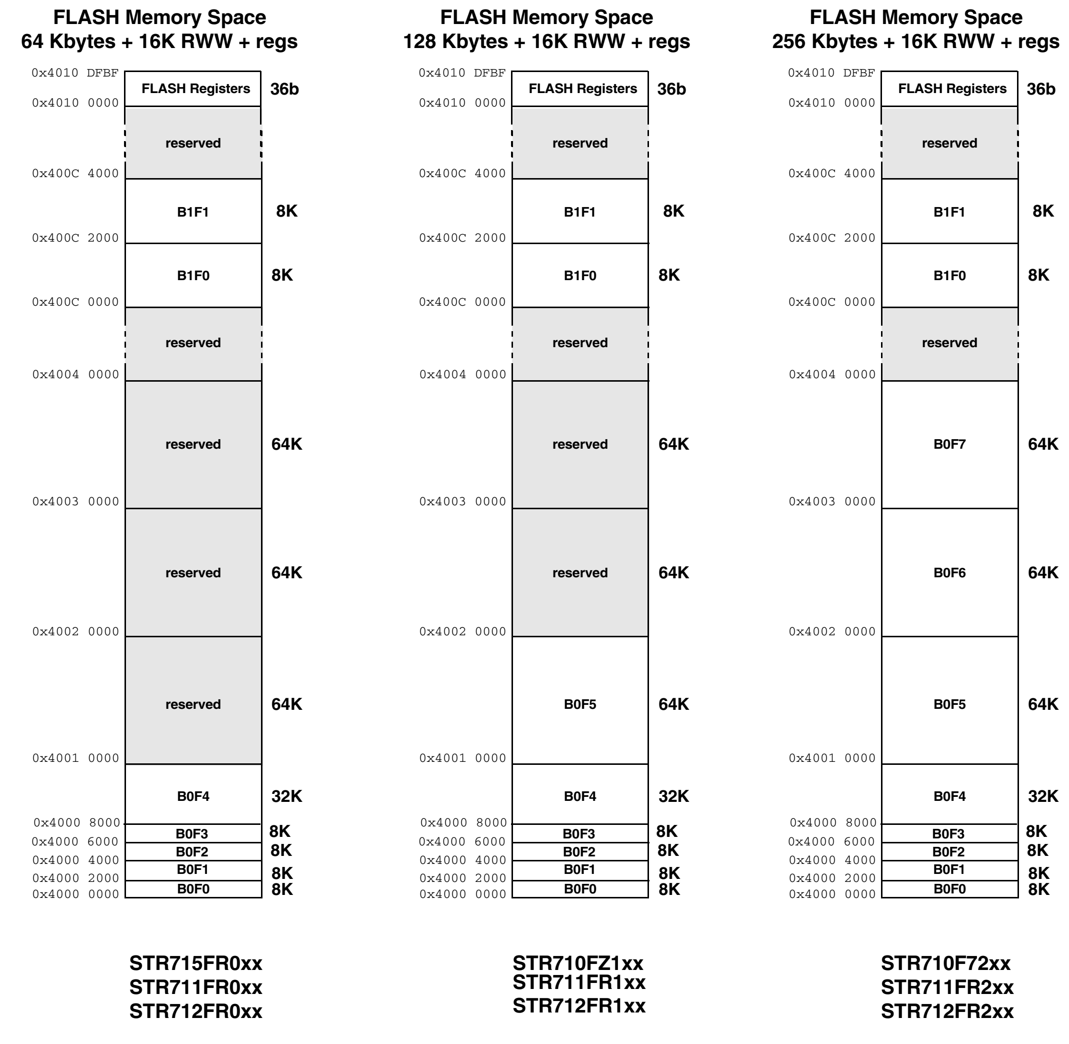


Table 7. RAM memory mapping

Part number	RAM size	Start address	End address
STR715FR0xx STR711FR0xx STR712FR0xx	16 Kbytes	0x2000 0000	0x2000 3FFF
STR710FZ1xx STR711FR1xx STR712FR1xx	32 Kbytes	0x2000 0000	0x2000 7FFF
STR710FR2xx STR710Rxx STR711FR2xx STR712FR2xx	64 Kbytes	0x2000 0000	0x2000 FFFF

4 Electrical parameters

4.1 Parameter conditions

Unless otherwise specified, all voltages are referred to V_{SS}.

4.1.1 Minimum and maximum values

Unless otherwise specified the minimum and maximum values are guaranteed in the worst conditions of ambient temperature, supply voltage and frequencies by tests in production on 100% of the devices with an ambient temperature at T_A=25°C and T_A=$T_A$max (given by the selected temperature range).

Data based on characterization results, design simulation and/or technology characteristics are indicated in the table footnotes and are not tested in production. Based on characterization, the minimum and maximum values refer to sample tests and represent the mean value plus or minus three times the standard deviation (mean±3Σ).

4.1.2 Typical values

Unless otherwise specified, typical data are based on T_A=25°C, V_{33}=3.3V (for the $3.0V \leq V_{33} \leq 3.6V$ voltage range) and V_{18}=1.8V. They are given only as design guidelines and are not tested.

Typical ADC accuracy values are determined by characterization of a batch of samples from a standard diffusion lot over the full temperature range, where 95% of the devices have an error less than or equal to the value indicated (mean±2Σ).

4.1.3 Typical curves

Unless otherwise specified, all typical curves are given only as design guidelines and are not tested.

4.1.4 Loading capacitor

The loading conditions used for pin parameter measurement are shown in *Figure 9*.

4.1.5 Pin input voltage

The input voltage measurement on a pin of the device is described in *Figure 10*.

Figure 9. Pin loading conditions

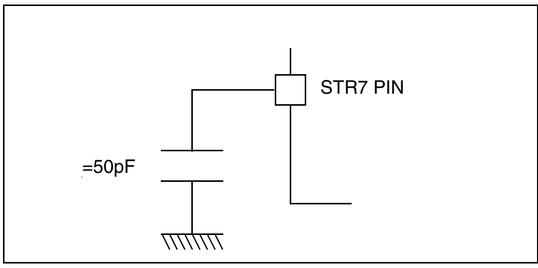
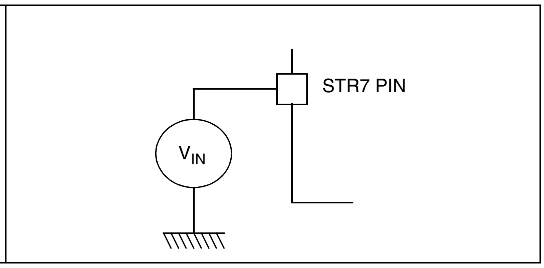


Figure 10. Pin input voltage



4.3.1 Supply current characteristics

The current consumption is measured as described in *Figure 9 on page 34* and *Figure 10 on page 34*.

Total current consumption

The MCU is placed under the following conditions:

- All I/O pins in input mode with a static value at V_{33} or V_{SS} (no load)
- All peripherals are disabled except if explicitly mentioned.
- Embedded Regulators are used to provide 1.8V (except if explicitly mentioned)

Subject to general operating conditions for V_{33}, and T_A.

Table 13. Total current consumption

<table>
<tr><th>Symbol</th><th>Parameter</th><th>Conditions</th><th>Typ 1)</th><th>Max 2)</th><th>Unit</th></tr>
<tr><td rowspan="4">I_{DD} 4)</td><td rowspan="2">Supply current in RUN mode</td><td>f_{MCLK}=66 MHz, RAM execution</td><td>73.6</td><td>100</td><td rowspan="2">mA</td></tr>
<tr><td>f_{MCLK}=32 MHz, Flash non-burst execution</td><td>49.3</td><td></td></tr>
<tr><td>Supply current in STOP mode</td><td>T_A=25°C</td><td>10</td><td>50 3)</td><td>µA</td></tr>
<tr><td>Supply current in STANDBY mode</td><td>OSC32K bypassed</td><td>12</td><td>30</td><td>µA</td></tr>
</table>

Notes:

1. Typical data are based on T_A=25°C, V_{33}=3.3V.
2. Data based on characterization results, tested in production at V_{33}, f_{MCLK} max. and T_A max.
3. Based on device characterisation, device power consumption in STOP mode at T_A 25°C is predicted to be 30µA or less in 99.730020% of parts.
4. The conditions for these consumption measurements are described in application note AN2100.

4.3.2 Clock and timing characteristics

External clock sources

Subject to general operating conditions for V_{33}, and T_A.

Table 16. CK external clock characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
f_{CK}	External clock source frequency		0		16.5	MHz
V_{CKH}	CK input pin high level voltage		$0.7xV_{33}$		V_{33}	V
V_{CKL}	CK input pin low level voltage		V_{SS}		$0.3xV_{33}$	
$t_{w(CK)}$ $t_{w(CK)}$	CK high or low time [1)]		25			ns
$t_{r(CK)}$ $t_{f(CK)}$	CK rise or fall time [1)]				20	
$C_{IN(CK)}$	CK input capacitance[1)]			5		pF
DuCy(XT1)	Duty cycle		40		60	%
I_L	CK Input leakage current	$V_{SS} \leq V_{IN} \leq V_{33}$			±1	µA

Notes:

1. Data based on design simulation and/or technology characteristics, not tested in production.

Figure 14. CK external clock source

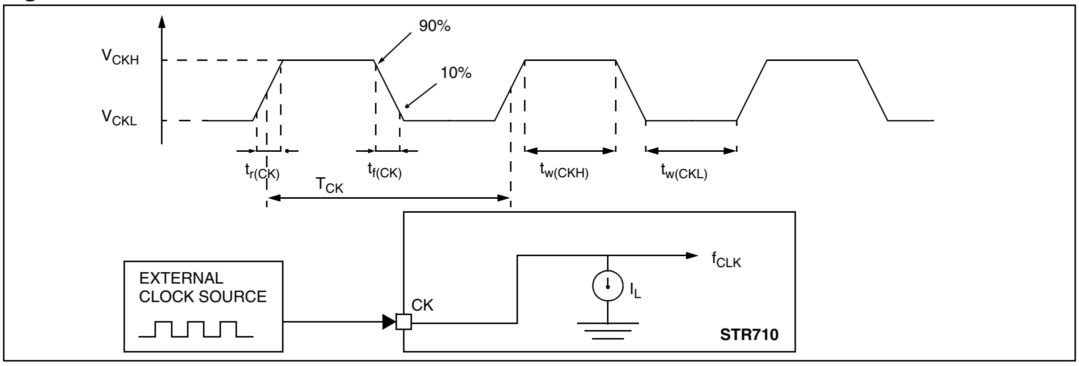


Table 19. PLL1 characteristics (continued)

Symbol	Parameter	Test conditions	Value			Unit
			Min	Typ	Max	
$\Delta t_{JITTER1}$	PLL jitter (peak to peak)	t_{PLL} = 4 MHz, MX[1:0]='11' Global Output division = 32 (Output Clock = 2 MHz)		0.7	2	ns

Table 20. PLL2 characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min	Typ	Max	
$f_{PLLCLK2}$	PLL multiplier output clock				140	MHz
f_{PLL2}	PLL input clock	FREF_RANGE = 0	1.5		3.0	MHz
		FREF_RANGE = 1	3.0		5	MHz
t_{LOCK2}	PLL lock time	FREF_RANGE = 0 Stable Input Clock Stable $V_{33IOPLL}$, V_{18}			300	µs
		FREF_RANGE = 1 Stable Input Clock Stable $V_{33IOPLL}$, V_{18}			600	µs
$\Delta t_{JITTER2}$	PLL jitter (peak to peak)	t_{PLL} = 4 MHz, MX[1:0]='11' Global Output division = 32 (Output Clock = 2 MHz)		0.7	2	ns

Table 21. Low-power mode wakeup timing

Symbol	Parameter	Typ	Unit
$t_{WULPWFI}$	Wakeup from LPWFI mode	26(1)	µs
t_{WUSTOP}	Wakeup from STOP mode	2048	CLK Cycles (2)
t_{WUSTBY}	Wakeup from STANDBY mode	2048 CLK Cycles + 8 CLK2 Cycles(3)	Cycles

1. Clock selected is CK2_16, Main VReg OFF and Flash in power-down
2. The CLK clock is derived from the external oscillator.
3. Refer to Figure 7. Reset General Timing in the STR71xF Reference Manual (UM0084)

4.3.5 I/O port pin characteristics

General characteristics

Subject to general operating conditions for V_{33} and T_A unless otherwise specified. All unused pins must be kept at a fixed voltage: using the output mode of the I/O for example or an external pull-up or pull-down resistor.

Table 27. I/O static characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IL}	Input low level voltage [1]	CMOS ports			$0.3V_{33}$	V
V_{IH}	Input high level voltage [1]		$0.7V_{33}$			
V_{hys}	Schmitt trigger voltage hysteresis [2]			0.8		V
V_{IL}	Input low level voltage [1]	P0.15 WAKEUP		0.9	0.8	V
V_{IH}	Input high level voltage [1]		2	1.35		
V_{hys}	Schmitt trigger voltage hysteresis [2]			0.4		V
V_{IL}	Input low level voltage [1]	TTL ports			0.8	V
V_{IH}	Input high level voltage [1]		2.0			
$I_{INJ(PIN)}$	Injected Current on any I/O pin				± 4	mA
$\Sigma I_{INJ(PIN)}$ [3]	Total injected current (sum of all I/O and control pins)				± 25	
I_{lkg}	Input leakage current [4]	$V_{SS} \le V_{IN} \le V_{33}$			±1	µA
R_{PU}	Weak pull-up equivalent resistor[5]	$V_{IN}=V_{SS}$	110	150	700	kΩ
R_{PD}	Weak pull-down equivalent resistor[5]	$V_{IN}=V_{33}$	110	150	700	kΩ
C_{IO}	I/O pin capacitance			5		pF

Notes:

1. Data based on characterization results, not tested in production.
2. Hysteresis voltage between Schmitt trigger switching levels. Based on characterization results, not tested.
3. When the current limitation is not possible, the V_{IN} absolute maximum rating must be respected, otherwise refer to $I_{INJ(PIN)}$ specification. A positive injection is induced by $V_{IN}>V_{33}$ while a negative injection is induced by $V_{IN}<V_{SS}$. Refer to *Section 4.2 on page 35* for more details.
4. Leakage could be higher than max. if negative current is injected on adjacent pins.
5. The R_{PU} pull-up and R_{PD} pull-down equivalent resistor are based on a resistive transistor (corresponding I_{PU} and I_{PD} current characteristics described in *Figure 18* to *Figure 19*).

Table 34. I2C characteristics

Symbol	Parameter	Standard mode I^2C		Fast mode I^2C[5]		Unit
		Min [1]	Max [1]	Min [1]	Max [1]	
$t_{w(SCLL)}$	SCL clock low time	4.7		1.3		µs
$t_{w(SCLH)}$	SCL clock high time	4.0		0.6		µs
$t_{su(SDA)}$	SDA setup time	250		100		ns
$t_{h(SDA)}$	SDA data hold time	0 [3]		0 [2]	900 [3]	ns
$t_{r(SDA)}$ $t_{r(SCL)}$	SDA and SCL rise time		1000	$20+0.1C_b$	300	ns
$t_{f(SDA)}$ $t_{f(SCL)}$	SDA and SCL fall time		300	$20+0.1C_b$	300	ns
$t_{h(STA)}$	START condition hold time	4.0		0.6		µs
$t_{su(STA)}$	Repeated START condition setup time	4.7		0.6		µs
$t_{su(STO)}$	STOP condition setup time	4.0		0.6		µs
$t_{w(STO:STA)}$	STOP to START condition time (bus free)	4.7		1.3		µs
C_b	Capacitive load for each bus line		400		400	pF

Notes:

1. Data based on standard I^2C protocol requirement, not tested in production.
2. The device must internally provide a hold time of at least 300 ns for the SDA signal in order to bridge the undefined region of the falling edge of SCL.
3. The maximum hold time $t_{h(SDA)}$ is not applicable.
4. Measurement points are done at CMOS levels: $0.3xV_{DD}$ and $0.7xV_{DD}$.
5. f_{PCLK1}, must be at least 8 MHz to achieve max fast I^2C speed (400 kHz).
6. The following table gives the values to be written in the I2CCCR register to obtain the required I^2C SCL line frequency.

Table 41. ADC accuracy with f_{PCLK2} = 20 MHz, f_{ADC}=10 MHz, AV_{DD}=3.3 V

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
ADC_DATA(0V)	Converted code when AIN=0V [1)]		2370		2565	Dec-imal code
ADC_DATA(2.5V)	Converted code when AIN=2.5V [1)]		1480		1680	
VCM	Center voltage of Sigma-Delta Modulator[1)]		1.23	1.25	1.30	V
TUE	Total unadjusted error	In this type of ADC, calibration is necessary to correct gain error and offset errors. Once calibrated, the TUE is limited to the ILE.				
$\lvert E_D \rvert$	Differential linearity error[1)]			1.96	2.19	LSB
$\lvert E_L \rvert$	Integral linearity error [1)]			2.36	3.95	

Data are based on characterisation and are not tested in production.

ADC Accuracy vs. Negative Injection Current

Injecting negative current on any of the standard (non-robust) analog input pins should be avoided as this significantly reduces the accuracy of the conversion being performed on another analog input. It is recommended to add a Schottky diode (pin to ground) to standard analog pins which may potentially inject negative current. The effect of negative injection current on robust pins is specified in *Section 4.3.5*.

Any positive injection current within the limits specified for $I_{INJ(PIN)}$ and $\Sigma I_{INJ(PIN)}$ in *Section 4.3.5* does not affect the ADC accuracy.

Analog power supply and reference pins

The AV_{DD} and AV_{SS} pins are the analog power supply of the A/D converter cell. They act as the high and low reference voltages for the conversion.

Separation of the digital and analog power pins allow board designers to improve A/D performance. Conversion accuracy can be impacted by voltage drops and noise in the event of heavily loaded or badly decoupled power supply lines (see*: General PCB design guidelines*).

General PCB design guidelines

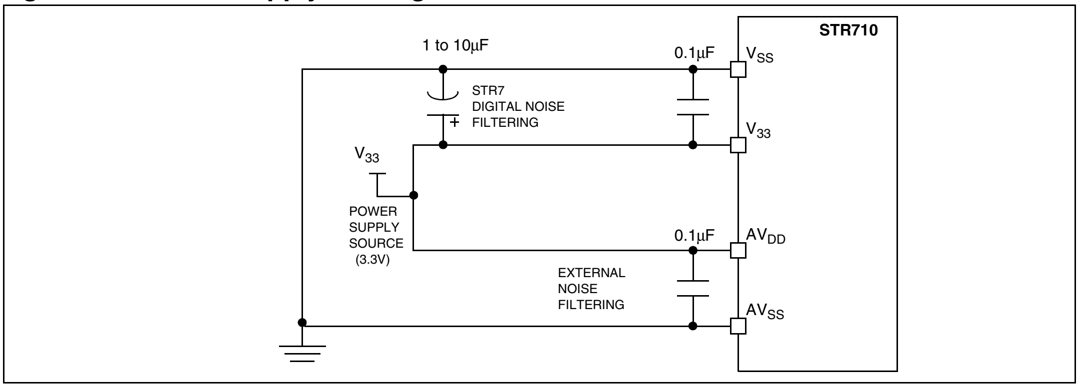
To obtain best results, some general design and layout rules should be followed when designing the application PCB to shield the noise-sensitive, analog physical interface from noise-generating CMOS logic signals.

- Use separate digital and analog planes. The analog ground plane should be connected to the digital ground plane via a single point on the PCB.
- Filter power to the analog power planes. It is recommended to connect capacitors, with good high frequency characteristics, between the power and ground lines, placing 0.1 µF and optionally, if needed 10 pF capacitors as close as possible to the STR7 power supply pins and a 1 to 10 µF capacitor close to the power source (see *Figure 39*).
- The analog and digital power supplies should be connected in a star network. Do not use a resistor, as AV_{DD} is used as a reference voltage by the A/D converter and any resistance would cause a voltage drop and a loss of accuracy.
- Properly place components and route the signal traces on the PCB to shield the analog inputs. Analog signals paths should run over the analog ground plane and be as short as possible. Isolate analog signals from digital signals that may switch while the analog inputs are being sampled by the A/D converter. Do not toggle digital outputs near the A/D input being converted.

Software filtering of spurious conversion results

For EMC performance reasons, it is recommended to filter A/D conversion outliers using software filtering techniques.

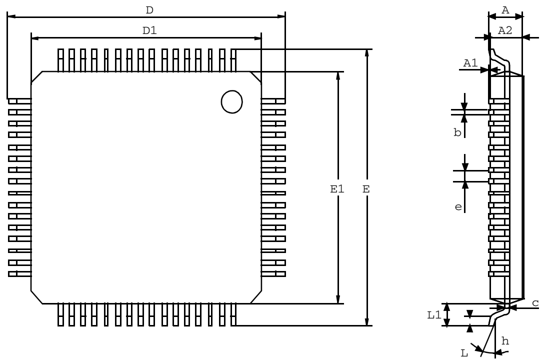
Figure 39. Power supply filtering



5 Package characteristics

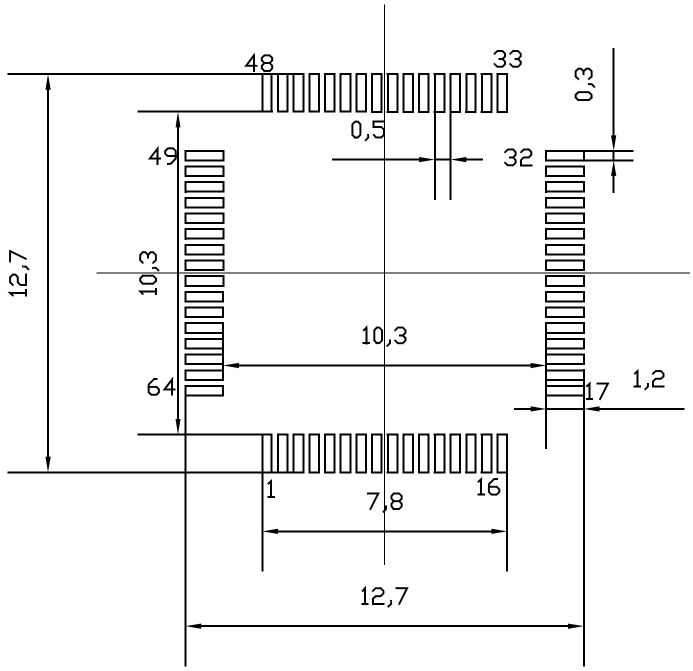
5.1 Package mechanical data

Figure 40. 64-Pin low profile quad flat package (10x10)



Dim.	mm			inches		
	Min	Typ	Max	Min	Typ	Max
A			1.60			0.063
A1	0.05		0.15	0.002		0.006
A2	1.35	1.40	1.45	0.053	0.055	0.057
b	0.17	0.22	0.27	0.007	0.009	0.011
c	0.09		0.20	0.004		0.008
D		12.00			0.472	
D1		10.00			0.394	
E		12.00			0.472	
E1		10.00			0.394	
e		0.50			0.020	
θ	0°	3.5°	7°	0°	3.5°	7°
L	0.45	0.60	0.75	0.018	0.024	0.030
L1		1.00			0.039	
	Number of Pins					
N	64					

Recommended footprint (dimensions in mm)



8 Known limitations

Description

If an IRQ or FIQ interrupt is pending and the Interrupt vector register (EIC_IVR) is not yet read, the HALT bit in the RCCU_SMR register can not be written. Therefore a software reset can not be generated.

Workaround

To generate a software reset when an IRQ or FIQ line is pending, either:

- reset the EIC peripheral by setting bit 14 in the APB2_SWRES register, or
- read the EIC_IVR register prior to generating a software reset.