

STM32 L1 Platform

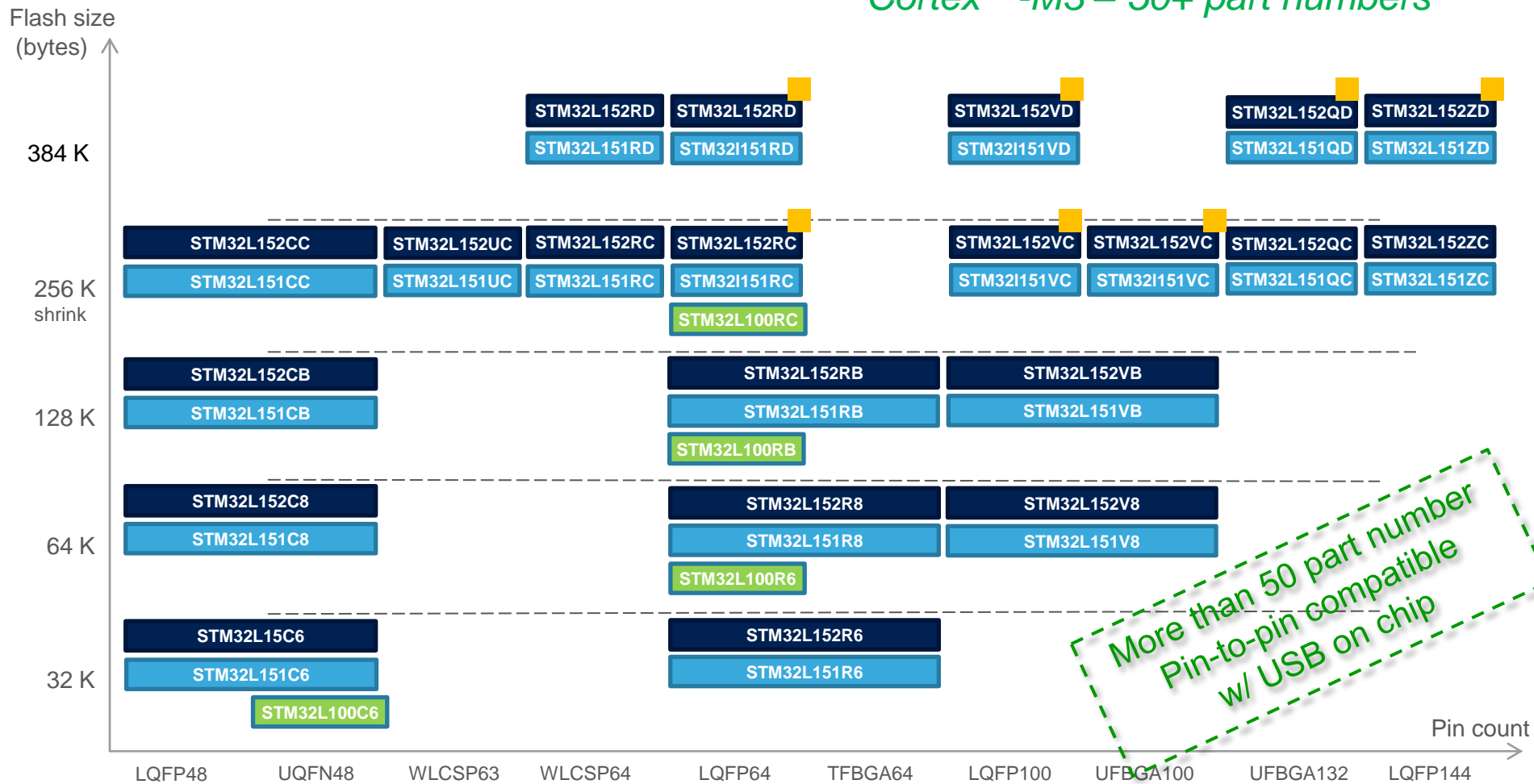
- Platform introduction





STM32L1x – portfolio

Cortex™-M3 – 50+ part numbers



More than 50 part number
Pin-to-pin compatible
w/ USB on chip

- STM32L151x = USB 2.0 FS + Analog 12-bit ADC & AC
- STM32L152x = STM32L151x + LCD
- STM32L100: USB2.0 + analog + LCD
- STM32L162x = STM32L152x + AES 128-bit





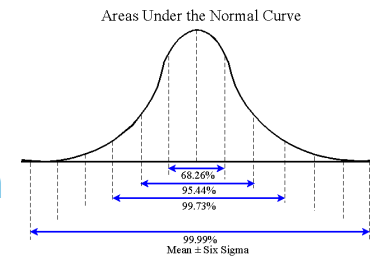
STM32L - Fact based documentation

- **STM32L Typical Values**

- Measured on a minimum of 10 000 parts
- Datasheet: The **average** value is given as Typical Value

- **STM32L Minimum and Maximum values**

- Min and Max (*for typical or hot*) are given at **6 sigma**
- **A 3 sigma** value will lead to 20% consumption value reduction



- **Check what is provided by STM32L competitors**

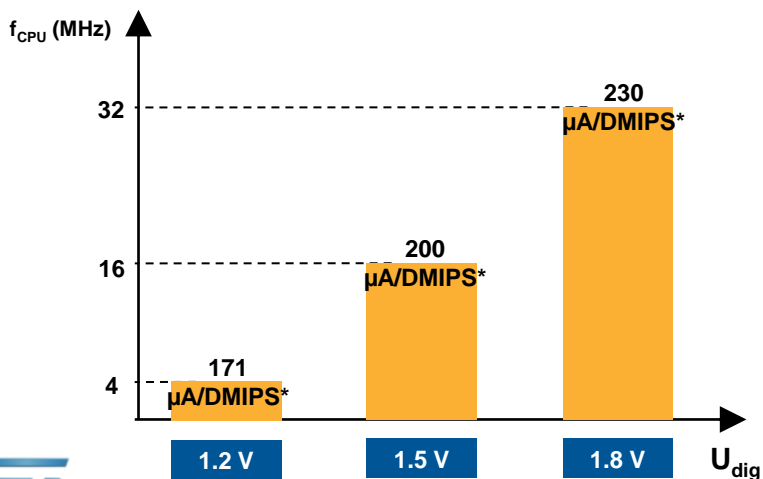
- Company 1 Typical: “These values are based on simulation. These values are not covered by test limits in production or characterization.”
- Company 2: “The typical data are based on TAMB=25°C and VDD=3.0 V, by simulation and/or technology characterization unless otherwise specified.”



Test your product in production for low power, do not rely on a few samples provided in development phase

- Very flexible clock system → Ultra-low-consumption
 - From 65KHz up to 32MHz (Internal PLL / Dynamic Voltage Scaling)
 - Run mode: from 50µA to 9.6mA → 285µA/MHz Flash (166µA/MHz Ram)
 - Low-power Run mode: from 9µA to 37µA (down 4.4µA in Low-power Sleep)
 - Additional 2 ultra-low-power-mode:
 - Stop mode: down to 500nA (1.2µA with RTC)
 - Standby mode: down: 300nA

• Dynamic Voltage scaling



• Safety

- Clock Security System
- Reset circuitry
- Unique ID
- Dual watchdog
- JTAG fuse
- Supply monitoring
- Memoru protection unit
- Anti tamper
 - Back-up clock
 - AES Encryption
 - Back-up register
- Flash & E² with ECC





STM32L an advanced MCU

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- Full functional at **32MHz** from **1.8V** to **3.6V** with **1.05 DMIPS/MHz**
1.65V to 3.6V with 1.25DMIPS/MHz
- An efficient Stop mode: **only 500nA**
 - Full Ram retention
 - 16 wakeup lines with < 8µs wakeup time
 - Wakeup from USART supported (no loss of 1st bit)
 - LCD + RTC available (**1.2µA**)
- An advanced RTC: **more than just a timer**
 - Calibration and sub-second counting
 - Time stamp in case of intrusion + Write protection HW calendar
- Memory robustness: **from automotive product (ECC)**
 - Working temp -40 C to 105 C
 - Cycling (85 C): 10K on Flash / 300K on EEPROM (1Million at 25 C)
 - Data retention: 30 years up to 85 C / 10 years up to 105 C
 - Flash retention and programming capability down to 1.65V

STM32L100 –Value Line

Objective

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- Divide by 2 the cost of non silicon items → reduce the overall cost by 25% with innovations in
 - **TEST**
 - Test reduction with massive parallel test techniques
 - **SUPPLY CHAIN**
 - Focus on high runners, Minimize part numbers to limit the cost of stocks
 - **PACKAGING**
 - Saturate a line with STM32L Value Line
- **OBJECTIVE ACHIEVED** – STM32L Value Line will cost ~25% less than the standard part



STM32L100 series introduction: Q1 13



STM32L15x vs. STM32L100

Quick spec overview

	STM32L15x				STM32L100			
Ratio Flash/RAM	32K/10K	64K/10K	128K/16K	256K/32K	32K/4K	64K/8K	128K/10K	256K/16K
FLASH	10K cycles / Retention 30y @ 85°C				1K cycles / Retention 20y @ 85°C			
Backup register	80 bytes				20 bytes			
VDD	1.65V - 3.6V				1.8V - 3.6V			
Temp	-45°C to 85°C/105°C				-40°C to 85°C			
Package	48pins	64pins			48pins	64pins		
EEPROM	4K	4K	4K	8K	2K	2K	2K	4K
	300K cycles				10K cycles			
HSI accuracy	+/-1% with TA= 25°C -4% to 3% with TA=-40°C to 85°C				+/-10% with TA=-40°C to 85°C			
MSI accuracy	+/-3% with TA= 0°C to 85°C				+/-10% with TA= 0°C to 85°C			
LCD	4x16	8x28			4x16	8x28		
USART	3	3	3	3	3	3	3	3
SPI	2	2	2	3	2	2	2	3
I2C	2	2	2	2	2	2	2	2
DAC	2	2	2	2	2			
Comparator	2	2	2	2	2			
Temp Sensor	1	1	1	1	No			
Touch Sense	28	28	28	36	No			
Unique ID	Yes				No			

ST process improvement

Optical shrink from 130nm to 110nm



Parameter	Previous	New	Performance Improvement
Run @ 32MHz	Depend on F_{CPU} from 1 MHz to 32 MHz*		From to 10% to 15%
STOP	650 nA	500 nA	23%
STOP + RTC	$V_{DD}=1.8V$ 1.6 μA	1.2 μA	25%
	$V_{DD}=3.6V$ 1.9 μA	1.4 μA	26%
STOP + RTC + LCD	4.8 μA	3.3 μA	31%
STANDBY	300 nA	270 nA	10%
STANDBY + RTC	$V_{DD}=1.8V$ 1.1 μA	0.9 μA	18%
	$V_{DD}=3.6V$ 1.3 μA	1.1 μA	15%



Datasheet available on ST Website NOW



Impact: 256KB flash consumption die = 128KB die one



STM32L1 – Huge Knowledge resources

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- Standard peripherals library (helps to start faster + tons of examples)
- Application Note:
 - [AN1015 Software techniques for improving microcontroller EMC performance](#)
 - [AN2548 Using the STM32L DMA controller](#)
 - [AN3193 STM32L15x ultralow power features overview](#)
 - [AN3216 Getting started with STM32L1xxx hardware development](#)
 - [AN3248 STM32L15xxx analog comparators](#)
 - [AN3300 STM32L1xx internal RC oscillator calibration](#)
 - [AN2592 How to achieve 32-bit timer resolution using the link system in STM32L microcontrollers](#)
 - [AN2668 Improving STM32L ADC resolution by oversampling](#)
 - [AN2739 How to use the STM32L1 microcontroller to play audio files with an external I²S audio codec](#)
 - [AN2812 Vocoder demonstration using a Speex audio codec on STM32L microcontrollers](#)
 - [AN2820 Driving bipolar stepper motors using a medium-density STM32L microcontroller](#)
 - [AN2821 Clock/calendar implementation on the STM32L microcontroller RTC](#)
 - [AN2834 How to get the best ADC accuracy in STM32L devices](#)
 - [AN2867 Oscillator design guide for ST microcontrollers](#)
 - [AN2869 Guidelines for designing touch sensing applications](#)
 - [AN2931 Implementing the ADPCM algorithm in high-density STM32L microcontrollers](#)
 - [AN2946 Solar-LED streetlight controller with 25 W LED lamp driver and 85 W battery charger based on the STM32L](#)
 - [AN3309 Clock configuration tool for STM32L microcontrollers](#)
 - [AN3310 STM32L1xx in-application programming using the USART](#)
 - [AN2953 How to migrate from the STM32L firmware library V2.0.3 to the STM32F10xxx standard peripheral library V3.0.0](#)

etc . . .



www.emcu.it



STM32 – Hardware dependent layer

Provider	Solution name	Model	Cost	Availability					
				F0	F1	F2	F4	L1	W
ST	Standard peripheral library and CMSIS DSP library⁵	Source	Free	Y	Y	Y	Y	Y	N
ST	Class B guidelines	Source ¹	Free	Y	Y	N ²	N ²	N ²	N
ST	Crypto library ³	Binaries	Free	N ²	Y	Y	Y	Y	N
ST	HAL library	Source	Free	N	N	N	N	N	Y ⁴

1/ Application note can be downloaded from ST web site. Software can be obtained on demand. Contact your local sales office.

2/ Can be ported.

3/ Subject to trade regulation, please contact our sales office.

4/ Part of ZigBee Simple MAC firmware. Please refer to the version [ZigBee](#) Middleware.

5/ DSP Library for STM32F4 only.



STM32 – RTOS / kernel (1/2)

Provider	Solution name	Model	Cost	Availability					
				F0	F1	F2	F4	L1	W
AVIX-RT	AVIX	Binaries	License	N	Y	Y	Y	Y	N
CMX	CMX-RTX	Source	License	Y	Y	Y	Y	Y	N
Chibios	ChibiOS/RT	Open source (GPL3) or Source	Free or License	Y	Y	Y	Y	Y	N
eCosCentric	eCosPro	Source ¹	License	N	Y	Y	Y	Y	N
eForce	µC3	Source	License	Y	Y	Y	Y	Y	N
Emcraft Systems	uCLinux	Open Source (GPL) ²	Free ²	N	N	Y	Y	N	N
EUROS	EUROSPlus	Binaries	License	N	Y	Y	Y	Y	N
Express Logic	ThreadX	Source	License	Y	Y	Y	Y	Y	N
FreeRTOS	FreeRTOS	Open source (modified GPL)	Free	Y	Y	Y	Y	Y	N
Green Hills	µ-velOSity	Source	License	Y	Y	Y	Y	Y	N
Keil/ARM	MDK-ARM RTX	Source	License	Y	Y	Y	Y	Y	N
Mentor	Nucleus Kernel	Source	License	N	Y	Y	Y	Y	N

1/ eCos is an open source kernel, a subset of eCosPro. eCosPro comes with TCP/IP stack, FAT, jFFS2, RAM and ROM FS

2/ uCLinux is open source, but this company proposes some ports on STM32. It requires some additional boards that they sell.

uCLinux can be much more than just a Kernel



STM32 – RTOS / kernel (2/2)

Provider	Solution name	Model	Cost	Availability					
				F0	F1	F2	F4	L1	W
Micrium	μC-OS	Source	License	Y	Y	Y	Y	Y	N
Micro Digital	SMX	Source	License	N	Y	Y	Y	Y	N
Quadros	RTXC Rtos	Source	License	Y	Y	Y	Y	Y	N
Rowebots	Unison	Source ¹	License	N	Y	Y	Y	Y	N
SEGGER	embOS	Source	License	Y	Y	Y	Y	Y	Y
SICS	Contiki	Open source (BSD)	Free	N	N	N	N	N	Y
High Integrity Systems	OpenRTOS²	Source	License	Y	Y	Y	Y	Y	N
High Integrity Systems	SafeRTOS³	Source	License	N ⁴	Y	N ⁴	N ⁴	N ⁴	N

1/ An Open Source version with less features is also available.

2/ OpenRTOS is FreeRTOS with commercial support

3/ SafeRTOS is OpenRTOS with Safety features and certificates

4/ Available on customer request. Please contact supplier



STM32 – File system (1/2)

Provider	Solution name	Model	Cost	Availability					
				F0	F1	F2	F4	L1	W
ChaN	FatFS	Open source (BSD)	Free	Y ³	Y ³	Y ³	Y ³	Y ³	N
CMX	CMX-FFS , CMX-FFS-FAT	Source	License	Y	Y	Y	Y	Y	N
eCosCentric	YAFFS (Nand), MMFS , JFFS2	Source	License ¹	N	Y	Y	Y	Y	N
Express Logic	FileX	Source	License	Y	Y	Y	Y	Y	N
EUROS	FMS	Binaries	License	N	Y	Y	Y	Y	N
HCC	SafeFAT , SafeFLASH , Safe-FTL , FAT16/32	Source	License	Y	Y	Y	Y	Y	N
Green Hills	µ-velOSity File System	Source	License	Y	Y	Y	Y	Y	N
Keil/ARM	MDK-ARM Flash	Source	License	Y	Y	Y	Y	Y	N
Mentor Embedded	Nucleus Storage	Source	License	N	Y	Y	Y	Y	N
Micrium	µC/FS	Source	License	Y	Y	Y	Y	Y	N
Micro Digital	smxFS	Source	License	N	Y	Y	Y	Y	N

1/ Free for non commercial usage.
2/ Available on customer request. Please contact supplier.
3/ FatFS ported on STM32 available on demos

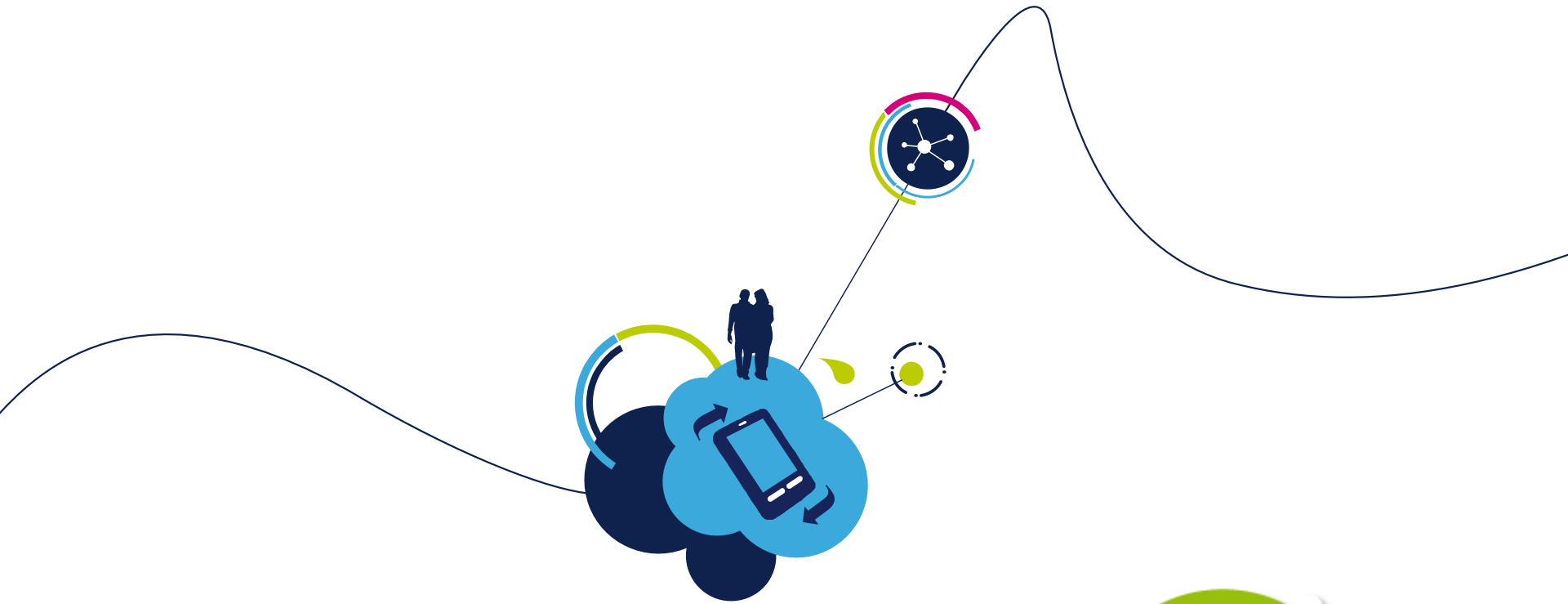




STM32 – File system (2/2)

Provider	Solution name	Model	Cost	Availability					
				F0	F1	F2	F4	L1	W
Quadros	RTXCfatfile	Source	License	Y	Y	Y	Y	N ¹	N
Rowebots	Unison FAT File System	Source	License	N	Y	Y	Y	Y	N
SEGGER	emFile	Source	License	Y	Y	Y	Y	Y	Y
SICS	Contiki/Coffee FS	Open source (BSD)	Free	N	N	N	N	N	Y

1/ Available on customer request. Please contact supplier.



STM32 Lx Platform

- Tools offer



April 2013

- Power Consumption Calculator (Plugging Micro-explorer)**

MicroExplorer 2013-01-22 - config01 - 6 steps.ioc*: STM32L151C(6-8-B)Tx

File Tools Windows Help

Pinout Power Consumption Calculator

Microcontroller Selection

Family: STM32L1
 SubFamily: STM32L151x6/8/B
 MCU: STM32L151C(6-8-B)Tx
 Part Number: STM32L151CB

Sequence

Step	Mode	Vcore	Memory	Oscillator	Frequency	CPU Frequ...	Peripherals	User's Co...	Average Cur...	Duration	DMIPS
1	RUN	Range1-High	FLASH	HSI PLL_ON	16.0 MHz	32.0 MHz	CRC	0 mA	9.432 mA	1 ms	33.6
2	RUN	Range2-Medium	FLASH	HSI PLL_OFF	16.0 MHz	16.0 MHz	DMA1	0 mA	4.16 mA	1 ms	16.8
3	SLEEP	Range1-High	FLASH	HSI PLL_ON	16.0 MHz	32.0 MHz	NULL	0 mA	2.3 mA	1 ms	0.0
4	STOP	NoRange	n/a	LSI RTC_ON...	37.0 kHz	0 Hz	COMP1 COMP2...	0 mA	357.46 µA	1 ms	0.0

Buttons: Load Sequence, Save Sequence, Delete Sequence

Buttons: Duplicate Step, Step Up, Step Down

6.0 ms
 4.608 mA
 28.0 DMIPS
 6 days and 7 hours

Graph: Average Current vs Time (ms)

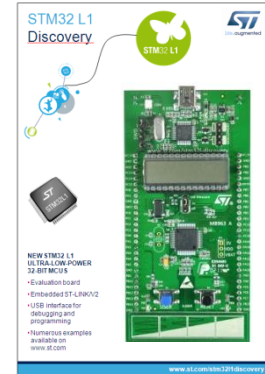
Sequence — Average Current

3: SLEEP, 4: STOP, 5: WU_FROM_STOP, 6: RUN

Step consumption: 4.16 mA
 Without IPs: 4.0 mA
 IPs part: 160.0 µA

OK Cancel

- **STM32L1 Discovery** low-cost evaluation kit
- **New** STM32L1 Discovery with 256K die shrink



- Evaluation board for full product feature evaluation



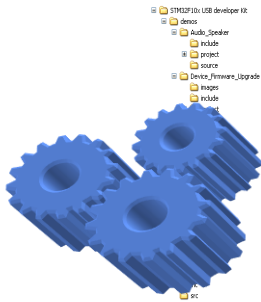
- Large choice of development IDE solutions



- STM32 standard peripheral libraries
 - C source code for easy implementation of all STM32 peripherals in any application

- STM32L touch-sensing library
 - Free source code touch-sensing library for easy implementation

- Class B: IEC 60335-1 approved self-diagnostic routines
 - ST's self-test-library software modules have been approved by the VDE



Standard peripheral library



life.augmented



USB device library



Touch-sense library



Self-test routines for EN/IEC 60335-1 Class B