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## Migrating from STM32L15/6xRC-A to STM32L15/6xRC and from STM32L15/6xVC-A to STM32L15/6xVC

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### Introduction

To ease the development of STM32 microcontroller applications, it is important to be able to smoothly replace one microcontroller type with another from the same product family. The purpose of this technical note is to help the users with the migration from an existing STM32L15/6xxC-A device to an STM32L15/6xxC device (only for devices in LQFP64 and LQFP100 packages: STM32L15/6xRC-A and STM32L15/6xVC-A). This document includes the relevant information for the users.

Prior to migrating an application, the users need to analyze the hardware migration, the peripheral migration and the firmware migration. To better understand the information included in this technical note, the users should be familiar with the STM32L1 microcontroller family.

For additional information, please refer to the STM32L100xx, STM32L151xx, STM32L152xx and STM32L162xx advanced ARM<sup>®</sup>-based 32-bit MCUs reference manual RM0038 in which STM32L15/6xxC-A and STM32L15/6xxC are 'Cat.3' devices, and to the STM32L15/6xxC datasheets. Documents are available for download from the company website at [www.st.com/stm32](http://www.st.com/stm32).

[Table 1](#) lists the STM32 microcontrollers concerned by this technical note.

**Table 1. Applicable products**

Type	Reference products
Microcontrollers	STM32L151RC, STM32L151VC STM32L151RC-A, STM32L151VC-A STM32L152RC, STM32L152VC STM32L152RC-A, STM32L152VC-A STM32L162RC, STM32L162VC STM32L162RC-A, STM32L162VC-A

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# 1 Codification/package changes

[Table 2](#) presents the list of references, part numbers and packages for the STM32L15/6xxC-A and STM32L15/6xxC products.

**Table 2. STM32L15/6xxC and STM32L15/6xxC-A codification summary**

Device description	Reference	Part number	Package
Up to: STM32L15/6x - 256KB Flash 32KB RAM	STM32L151RC-A STM32L152RC-A STM32L162RC-A STM32L151VC-A STM32L152VC-A STM32L162VC-A	STM32L151RCT6-A STM32L152RCT6-A STM32L162RCT6-A STM32L151VCT6-A STM32L152VCT6-A STM32L162VCT6-A	LQFP64, LQFP100
Up to: STM32L15/6x - 256KB Flash 32KB RAM	STM32L151RC STM32L152RC STM32L162RC STM32L151VC STM32L152VC STM32L162VC	STM32L151RCT6 STM32L152RCT6 STM32L162RCT6 STM32L151VCT6 STM32L152VCT6 STM32L162VCT6	LQFP64, LQFP100

The changes and similarities in the codification/packages in STM32L15/6xxC versus STM32L15/6xxC-A are the following:

- The related reference number does not end with -A,
- The packages are the same,
- The pinout is the same.

## 2 Hardware migration

The STM32L15/6xxC-A and STM32L15/6xxC devices are pin-to-pin compatible. All peripherals share the same pins. Both devices are produced in the same packages.

The transition from the STM32L15/6xxC-A device to the STM32L15/6xxC device is therefore very simple and devices can be replaced without any hardware changes on the application PCB.

### 3 Peripheral migration

[Table 3](#) lists the main product peripherals and system features for both product sets. The common peripherals are supported with the dedicated firmware library without any modification. The users can change the instance and all the related features (clock configuration, pin configuration, interrupt/DMA request).

The extended peripherals such as LCD rail decoupling and PCROP (Proprietary code read out protection) are fully backward compatible with no need to firmware update.

The main peripherals changes are described in [Section 3.1: Main peripherals/system changes](#). The changes which are also needed in the development tools configuration are described in [Section 4: Development tools adaptation](#).

[Table 3](#) presents the differences between STM32L15/6xxC-A and STM32L15/6xxC devices regarding the peripherals and system differences, as well as the impact to needed software changes. The differences are highlighted in gray.

**Table 3. STM32L15/6xxC and STM32L15/6xxC-A device differences**

Function	STM32L15/6xxC-A	STM32L15/6xxC	Behavior / impact to software
Core @ 32MHz	ARM® Cortex®-M3	ARM® Cortex®-M3	No change
Max DMIPS/MHz	1.25	1.25	No change
Flash [KB]	256	256	No change
RAM [KB]	32	32	No change
EEPROM [KB]	8	8	No change
Backup registers [B]	128	128	No change
Flash interface [bits]	64/32	64/32	No change
Bootloader	USART/USB	USART/USB	No change
DMA / channels	2 / 12ch	2 / 12ch	No change
USART	3	3	No change
SPI / I2S	3 / 2	3 / 2	No change
I2C	2	2	No change
USB 2.0	1 x FS	1 x FS	No change
LCD [seg x com]	8 x 40	8 x 40	No change
LCD rails decoupling	NO	YES	Better LCD contrast for larger displays (if used external LCD rails decoupling capacitors). If not used then no software change is required.
TIMER [32-bit/16-bit/Lite]	1/6/2	1/6/2	No change
IWDG/WWDG	1/1	1/1	No change

Table 3. STM32L15/6xxC and STM32L15/6xxC-A device differences (continued)

Function	STM32L15/6xxC-A	STM32L15/6xxC	Behavior / impact to software
Clock	HSI/HSE/LSI/LSE CSS on HSE/LSE	HSI/HSE/LSI/LSE CSS on HSE/LSE	No change
HSI/HSI clock trimming	+/- 1%	+/- 1%	No change
RTC version	RTC V2.0	RTC V2.0	No change
DAC	2	2	No change
ADC (total / fast channels)	1 (25 / 6)	1 (25 / 6)	No change
Comparator	2	2	No change
Touch sensing [channels]	23	23	No change
Temperature sensor	YES	YES	No change
Internal voltage reference	YES	YES	No change
Unique ID	YES	YES	No change
MCO	YES	YES	No change
PCROP	NO	YES	New memory protection feature implemented: Proprietary code read out protection (only its execution is allowed). If not used then no software change is needed (only added extension of existing protections).

*Note:* For additional information, please refer to the STM32L100xx, STM32L151xx, STM32L152xx and STM32L162xx advanced ARM<sup>®</sup>-based 32-bit MCUs reference manual RM0038 in which STM32L15/6xxC-A and STM32L15/6xxC are 'Cat.3' devices, and to the STM32L15/6xxC datasheets. Documents are available for download from the company website at [www.st.com/stm32](http://www.st.com/stm32).

### 3.1 Main peripherals/system changes

Some system properties and peripherals configuration were changed in the STM32L15/6xxC device. In the next are described those changes. The following sections describe these changes.

#### 3.1.1 LCD rails decoupling

The external decoupling capability of LCD rails was implemented to improve the LCD contrast (for example for large LCD displays with higher segments capacity). On STM32L15/6xxC devices, specific pins can be connected to external capacitors that maintain a stable LCD rail voltage while driving the LCD segments.

The backward compatibility is fulfilled, there is not need of any software change. To use the new feature, the dedicated pins must be configured as inputs and the external capacitors should be connected and the LCD\_CAPA[4:0] bits in the SYSCFG\_PMC register must be configured.

For more details about LCD rail decoupling please refer to the STM32L100xx, STM32L152xx and STM32L162xx advanced ARM<sup>®</sup>-based 32-bit MCUs reference manual RM0038 in which STM32L15/6xxC-A and STM32L15/6xxC are 'Cat.3' devices, and to the STM32L15/6xxC datasheets.

### 3.1.2 Proprietary code protection (PCROP)

The read protection of a given Flash area is implement in STM32L15/6xxC devices. The Flash area cannot be read by any access (including software), it can be only executed. It can be used as intellectual property read protection of proprietary third party code which can be executed on customer side.

The implementation of this proprietary code read out protection (PCROP) is backward compatible. To use the PCROP feature it is necessary to correctly program the added option bytes (SPRMOD and WRPx option bytes).

For additional information, please refer to the STM32L100xx, STM32L151xx, STM32L152xx and STM32L162xx advanced ARM<sup>®</sup>-based 32-bit MCUs reference manual RM0038 in which STM32L15/6xxC-A and STM32L15/6xxC are 'Cat.3' devices, and to the STM32L15/6xxC datasheets.

## 3.2 Device limitations, changes and/or updates

A new revision of errata sheet has been published for the STM32L15/6xxC devices. Several limitations that had been reported for the STM32L15/6xxC-A have been solved, while new limitations have been introduced. This section describes the changes in the device limitations.

Please refer to STM32L15/6xxC-A errata sheet and STM32L15/6xxC errata sheet for details on the device limitations.

### 3.2.1 Removed limitations

The following limitations that applied to STM32L15/6xxC-A devices do not apply to STM32L15/6xxC devices:

- Missing analog switch on GPIO PC10,
- Pull-up on PB7 when configured in analog mode,
- Injection from LCD\_SEG2, LCD\_SEG5, LCD\_SEG21 pins.

### 3.2.2 Newly introduced limitations

The following limitations which were not present in nor STM32L15/6xxC-A devices have been introduced for STM32L15/6xxC devices:

- The operational amplifier factory trimming value cannot be selected (manual initialization is required).
- Data EEPROM cycling is limited to 100 kcycles instead of 300 kcycles.
- ADC accuracy lowered.



## 4 Development tools adaptation

The changes in the device hardware have impacted the development tools. Following the change of device identifier (DEV\_ID) and some peripherals changes with the addition of new features, it has been necessary to upgrade the development tools as detailed hereafter.

1. DEV\_ID changes:
  - In STM32L15/6xxC-A devices, DEV\_ID=0x436
  - In STM32L15/6xxC devices, DEV\_ID=0x427
  - If the software or programming tool is using DEV\_ID[11:0] field (in DBGMCU\_IDCODE register) then the relevant changes must be applied in the software or tool.
2. Changes in the development tool configurations:
  - a) IAR - install the latest version or apply the patch provided by ST support team to support the new device, and change the device type in the configuration.
  - b) Keil - install the latest version that supports the new device, change the device type in the configuration, and change the ST link programming algorithm.
  - c) Others - install the latest version that supports the new device, and change the device type in the configuration.
3. STM32L1xx standard peripherals library update:

STM32L15/6xxC devices are supported in the latest version of STM32L1xx standard peripherals library. Make sure to use the latest version of STM32L1xx standard peripherals library to use the new peripheral features.

  - a) Define the macro STM32L1XX\_MDP and use it in the project *startup\_stm32l1xx\_mdp.s* file.
  - b) Rebuild the existing project with the new library so it can be run on STM32L15/6xxC devices.
4. Programming tools adaptation:

In the programming tool configurations (for example ST link with the related software) the device type must be changed to correctly program the new STM32L15/6xxC devices.

Use the latest ST Visual Programmer (STVP) or the latest ST-link utility which support the new devices (both are available at [www.st.com/stm32](http://www.st.com/stm32)).

## 5 Consumption comparison

The STM32L15/6xxC devices feature less dynamic consumption than the STM32L15/6xxC-A devices, due to the advanced manufacturing technology. The power consumptions in low-power modes are on similar levels.

[Table 4](#) shows the differences in power consumption between the devices in the various operating modes.

**Table 4. Consumption difference summary**

Parameters (all at $V_{DD}=3V$ )	STM32L15/6xxC-A	STM32L15/6xxC
Full speed from flash (32 MHz in HSI)	325 $\mu A/MHz$	257 $\mu A/MHz$
MSI clock from flash (4.2 MHz)	230 $\mu A/MHz$	185 $\mu A/MHz$
Low-power Run from RAM @ 32 kHz	12.5 $\mu A$	11.0 $\mu A$
Low-power sleep from RAM @ 32 kHz	6.1 $\mu A$	5.5 $\mu A$
Stop mode	476 nA	435 nA
Stop mode with RTC on LSI	1.35 $\mu A$	1.40 $\mu A$
Standby mode	305 nA	289 nA
Standby mode with RTC on LSI	1.16 $\mu A$	1.17 $\mu A$

## 6 Revision history

**Table 5. Document revision history**

Date	Revision	Changes
07-May-2014	1	Initial release.
17-Dec-2014	2	Updated <i>Table 3: STM32L15/6xxC and STM32L15/6xxC-A device differences</i> exchanging the second and third column titles.

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