D.2.2 STM32F4 series feature several V_{CORE} scales

The scale can be modified only when the PLL is OFF and when HSI or HSE is selected as system clock source.

- **Scale 1** (V12 voltage range limited to 1.26-1.40 V), default mode at reset

  HCLK frequency range = 144 MHz to 168 MHz (180 MHz with over-drive).

  This is the default mode at reset.

- **Scale 2** (V12 voltage range limited to 1.20 to 1.32 V)

  HCLK frequency range is up to 144 MHz (168 MHz with over-drive)

- **Scale 3** (V12 voltage range limited to 1.08 to 1.20 V), default mode when exiting Stop mode

  HCLK frequency ≤120 MHz.

The voltage scaling is adjusted to f_{HCLK} frequency as follows:

- **STM32F429x/39x MCUs**:
  - **Scale 1:** up to 168 MHz (up to 180 MHz with over-drive)
  - **Scale 2:** from 120 to 144 MHz (up to 168 MHz with over-drive)
  - **Scale 3:** up to 120 MHz.

- **STM32F401x MCUs**:

  No Scale 1
  - **Scale 2:** from 60 to 84 MHz
  - **Scale 3:** up to 60 MHz.

- **STM32F40x/41x MCUs**:
 - **Scale 1:** up to 168 MHz
  - **Scale 2:** up to 144 MHz

D.2.3 STM32L0 series feature 3 V_{CORE} ranges

- Range 1 (V_{DD} range limited to 1.71 to 3.6 V), with CPU running at a frequency up to 32 MHz
- Range 2 (full V_{DD} range), with a maximum CPU frequency of 16 MHz
- Range 3 (full V_{DD} range), with a maximum CPU frequency limited to 4.2 MHz.

Appendix E STM32Cube embedded software packages

Along with STM32CubeMX C code generator, embedded software packages are part of STM32Cube initiative (refer to *DB2164 databrief*): these packages include a low level hardware abstraction layer (HAL) that covers the microcontroller hardware, together with an extensive set of examples running on STMicroelectronics boards (see *Figure 203*). This set of components is highly portable across the STM32 series. The packages are fully compatible with STM32CubeMX generated C code.

Figure 203. STM32Cube Embedded Software package
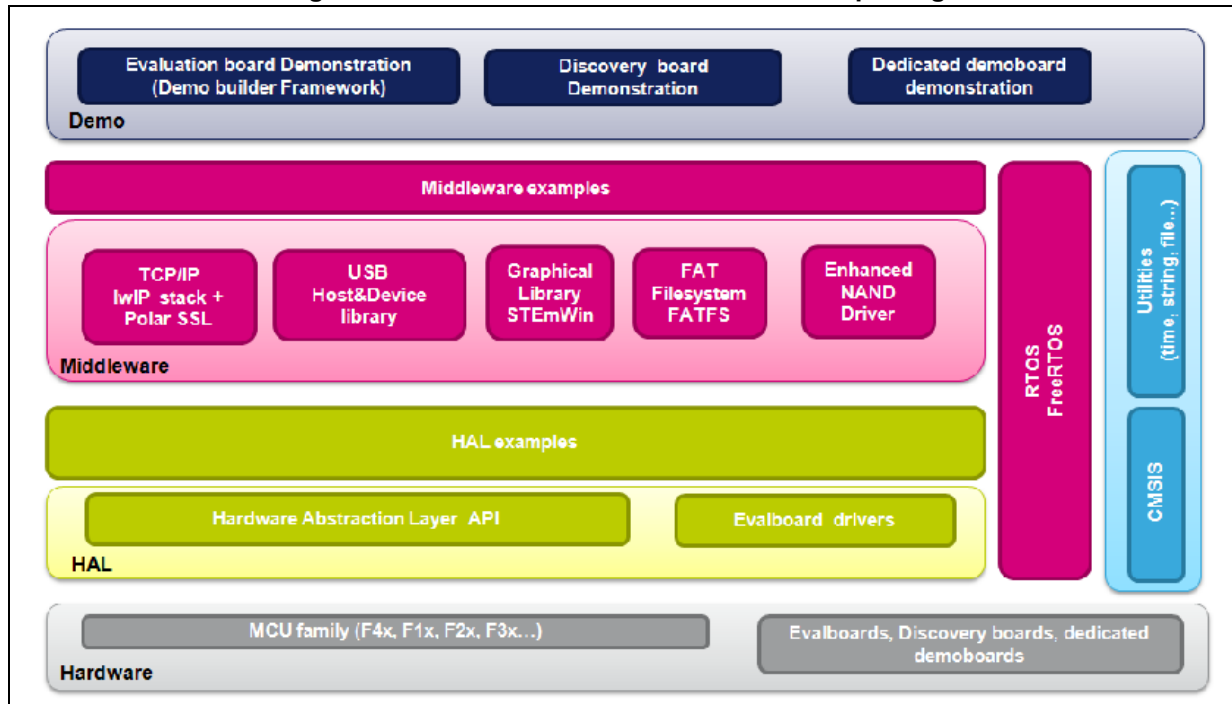
Note: *STM32CubeF0, STM32CubeF1, STM32CubeF2, STM32CubeF3, STM32CubeF4, STM32CubeL0 and STM32CubeL1 embedded software packages are available on st.com. They are based on STM32Cube release v1.1 (other series will be introduced progressively) and include the embedded software libraries used by STM32CubeMX for initialization C code generation.*

The user should use STM32CubeMX to generate the initialization C code and the examples provided in the package to get started with STM32 application development.

10   Revision history

Table 16. Document revision history

Date	Revision	Changes
17-Feb-2014	1	Initial release.
04-Apr-2014	2	Added support for STM32CubeF2 and STM32F2 series in cover page, *Section 2.2: Key features*, *Section 4.12.1: IP and Middleware Configuration window*, and *Appendix E: STM32Cube embedded software packages*. Updated *Section 6.1: Creating a new STM32CubeMX Project*, *Section 6.2: Configuring the MCU pinout*, *Section 6.6: Configuring the MCU initialization parameters*. Section "Generating GPIO initialization C code move to *Section 8: Tutorial 3- Generating GPIO initialization C code (STM32F1 series only)* and content updated. Added *Section 9.4: Why do I get the error "Java 7 update 45' when installing 'Java 7 update 45' or a more recent version of the JRE?*.
24-Apr-2014	3	Added support for STM32CubeL0 and STM32L0 series in cover page, *Section 2.2: Key features*, *Section 2.3: Rules and limitations* and *Section 4.12.1: IP and Middleware Configuration window* Added board selection in *Table 3: File menu functions*, *Section 4.4.3: Pinout menu* and *Section 4.2: New project window*. Updated *Table 5: Pinout menu*. Updated *Figure 92: Power Consumption Calculator default view* and added battery selection in *Section 4.14.1: Building a power consumption sequence*. Updated note in *Section 4.14: Power Consumption Calculator (PCC) view* Updated *Section 6.1: Creating a new STM32CubeMX Project*. Added *Section 9.5: Why does the RTC multiplexer remain inactive on the Clock tree view?*, *Section 9.6: How can I select LSE and HSE as clock source and change the frequency?*, and *Section 9.7: Why STM32CubeMX does not allow me to configure PC13, PC14, PC15 and PI8 as outputs when one of them is already configured as an output?*.

Table 16. Document revision history (continued)

Date	Revision	Changes
19-jun-2014	4	Added support for STM32CubeF0, STM32CubeF3, STM32F0 and STM32F3 series in cover page, *Section 2.2: Key features*, *Section 2.3: Rules and limitations*, Added board selection capability and pin locking capability in *Section 2.2: Key features*, *Table 2: Welcome page shortcuts*, *Section 4.2: New project window*, *Section 4.4: Toolbar and menus*, *Section 4.7: Set unused / Reset used GPIOs windows*, *Section 4.8: Project Settings window*, and *Section 4.11: Pinout view*. Added *Section 4.11.5: Pinning and labeling signals on pins*. Updated *Section 4.12: Configuration view* and *Section 4.13: Clock tree configuration view* and *Section 4.14: Power Consumption Calculator (PCC) view*. Updated *Figure 23: STM32CubeMX Main window upon MCU selection*, *Figure 38: Project Settings window*, *Figure 44: About window*, *Figure 45: STM32CubeMX Pinout view*, *Figure 46: Chip view*, *Figure 92: Power Consumption Calculator default view*, *Figure 93: Battery selection*, *Figure 94: Building a power consumption sequence*, *Figure 96: Power consumption sequence: new step default view*, *Figure 104: Power Consumption Calculator view after sequence building*, *Figure 105: Sequence table management functions*, *Figure 88: PCC Edit Step window*, *Figure 83: Power consumption sequence: new step configured (STM32F4 example)*, *Figure 102: ADC selected in Pinout view*, *Figure 103: PCC Step configuration window: ADC enabled using import pinout*, *Figure 107: Description of the Results area*, *Figure 108: Peripheral power consumption tooltip*, *Figure 173: Power Consumption Calculation example*, *Figure 155: Sequence table* and *Figure 156: Power Consumption Calculation results*. Updated *Figure 58: STM32CubeMX Configuration view* and *Figure 39: STM32CubeMX Configuration view - STM32F1 series* titles. Added STM32L1 in *Section 4.14: Power Consumption Calculator (PCC) view*. Removed Figure *Add a new step using the PCC panel* from *Section 8.1.1: Adding a step*. Removed Figure *Add a new step to the sequence* from *Section 4.14.2: Configuring a step in the power sequence*. Updated *Section 8.2: Reviewing results*. Updated appendix *B.3.4: FatFs* and *Appendix D: STM32 microcontrollers power consumption parameters*. Added Appendix *D.1.3: STM32L0 series* and *D.2.3: STM32L0 series feature 3 VCORE ranges*.

Table 16. Document revision history (continued)

Date	Revision	Changes
19-Sep-2014	5	Added support for STM32CubeL1 series in cover page, *Section 2.2: Key features*, *Section 2.3: Rules and limitations*, Updated *Section 3.2.3: Uninstalling STM32CubeMX standalone version*. Added off-line updates in *Section 3.5: Getting STM32Cube updates*, modified *Figure 16: New library Manager window*, and *Section 3.5.2: Downloading new libraries*. Updated *Section 4: STM32CubeMX User Interface* introduction, *Table 2: Welcome page shortcuts* and *Section 4.2: New project window*. Added *Figure 22: New Project window - board selector*. Updated *Figure 40: Project Settings Code Generator*. Modified step 3 in *Section 4.8: Project Settings window*. Updated *Figure 39: STM32CubeMX Configuration view - STM32F1 series*. Added STM32L1 in *Section 4.12.1: IP and Middleware Configuration window*. Updated *Figure 70: GPIO Configuration window - GPIO selection*; *Section 4.12.3: GPIO Configuration window* and *Figure 76: DMA MemToMem configuration*. Updated introduction of *Section 4.13: Clock tree configuration view*. Updated *Section 4.13.1: Clock tree configuration functions* and *Section 4.13.2: Recommendations*, *Section 4.14: Power Consumption Calculator (PCC) view*, *Figure 96: Power consumption sequence: new step default view*, *Figure 104: Power Consumption Calculator view after sequence building*, *Figure 83: Power consumption sequence: new step configured (STM32F4 example)*, and *Figure 103: PCC Step configuration window: ADC enabled using import pinout*. Added *Figure 106: Power Consumption: Peripherals Consumption Chart* and updated *Figure 108: Peripheral power consumption tooltip*. Updated *Section 4.14.4: Power sequence step parameters glossary*. Updated *Section 5: STM32CubeMX C Code generation overview*. Updated *Section 6.1: Creating a new STM32CubeMX Project* and *Section 6.2: Configuring the MCU pinout*. Added *Section 7: Tutorial 2 - Example of FatFs on an SD card using STM32429I-EVAL evaluation board* and updated *Section 8: Tutorial 3- Generating GPIO initialization C code (STM32F1 series only)*. Updated *Section 4.14.2: Configuring a step in the power sequence*.

Table 16. Document revision history (continued)

Date	Revision	Changes
19-Jan-2015	6	Complete project generation, power consumption calculation and clock tree configuration now available on all STM32 series. Updated *Section 2.2: Key features* and *Section 2.3: Rules and limitations*. Updated Eclipse IDEs in *Section 3.1.3: Software requirements*. Updated *Figure 12: Updater Settings window*, *Figure 16: New library Manager window* and *Figure 22: New Project window - board selector*, Updated *Section 4.8: Project Settings window* and *Section 4.9: Update Manager windows*. Updated *Figure 44: About window*. Removed Figure *STM32CubeMX Configuration view - STM32F1 series.* Updated *Table 9: STM32CubeMX Chip view - Icons and color scheme*. Updated *Section 4.12.1: IP and Middleware Configuration window*. Updated *Figure 74: Adding a new DMA request* and *Figure 76: DMA MemToMem configuration*. Updated *Section 4.13.1: Clock tree configuration functions*. Updated *Figure 93: Battery selection*, *Figure 94: Building a power consumption sequence*, *Figure 88: PCC Edit Step window*. Added *Section 5.2: Custom code generation*. Updated *Figure 126: Clock tree view* and *Figure 131: Configuration view*. Updated peripheral configuration sequence and *Figure 133: Timer 3 configuration window* in *Section 6.6.2: Configuring the peripherals* . Removed Tutorial 3: Generating GPIO initialization C code (STM32F1 series only). Updated *Figure 137: GPIO mode configuration*. Updated *Figure 173: Power Consumption Calculation example* and *Figure 155: Sequence table*. Updated Appendix *A.1: Block consistency*, *A.2: Block inter-dependency* and *A.3: One block = one peripheral mode*. Appendix *A.4: Block remapping (STM32F10x only)*: updated *Section : Example* . Appendix *A.6: Block shifting (only for STM32F10x and when "Keep Current Signals placement" is unchecked)*: updated *Section : Example* Updated Appendix *A.8: Mapping a function individually* . Updated Appendix *B.3.1: Overview*. Updated Appendix *D.1.3: STM32L0 series*.

Table 16. Document revision history (continued)

Date	Revision	Changes
19-Mar-2015	7	*Section 2.2: Key features*: removed *Pinout initialization C code generation for STM32F1 series* from; updated *Complete project generation*. Updated *Figure 16: New library Manager window*, *Figure 22: New Project window - board selector*. Updated IDE list in *Section 4.8: Project Settings window* and modified *Figure 38: Project Settings window*. Updated *Section 4.13.1: Clock tree configuration functions*. Updated *Figure 88: STM32F429xx Clock Tree configuration view*. *Section 4.14: Power Consumption Calculator (PCC) view*: added transition checker option. Updated *Figure 92: Power Consumption Calculator default view*, *Figure 93: Battery selection* and *Figure 94: Building a power consumption sequence*. Added *Figure 98: Enabling the transition checker option on an already configured sequence - all transitions valid*, *Figure 99: Enabling the transition checker option on an already configured sequence - at least one transition invalid* and *Figure 100: Transition checker option -show log*. Updated *Figure 104: Power Consumption Calculator view after sequence building*. Updated *Section : Managing sequence steps*, *Section : Managing the whole sequence (load, save and compare)*. Updated *Figure 88: PCC Edit Step window* and *Figure 107: Description of the Results area*. Updated *Figure 173: Power Consumption Calculation example*, *Figure 155: Sequence table*, *Figure 156: Power Consumption Calculation results* and *Figure 158: Power consumption results - IP consumption chart*. Updated Appendix *B.3.1: Overview* and *B.3.5: FreeRTOS*.
28-May-2015	8	Added *Section 3.2.2: Installing STM32CubeMX from command line* and *Section 3.4.2: Running STM32CubeMX in command-line mode*.
09-Jul-2015	9	Added STLM32F7 and STM32L4 microcontroller series. Added *Import project* feature. Added Import function in *Table 3: File menu functions*. Added *Section 4.6: Import Project window*. Updated *Figure 96: Power consumption sequence: new step default view*, *Figure 88: PCC Edit Step window*, *Figure 83: Power consumption sequence: new step configured (STM32F4 example)*, *Figure 103: PCC Step configuration window: ADC enabled using import pinout* and *Figure 108: Peripheral power consumption tooltip*. Updated command line to run STM32CubeMX in *Section 3.4.2: Running STM32CubeMX in command-line mode*. Updated note in *Section 4.12: Configuration view*. Added new clock tree configuration functions in *Section 4.13.1*. Updated *Figure 139: FatFs disabled*. Modified code example in Appendix *B.1: STM32CubeMX generated C code and user sections*. Updated Appendix *B.3.1: Overview*. Updated generated .h files in Appendix *B.3.4: FatFs*.

Table 16. Document revision history (continued)

Date	Revision	Changes
27-Aug-2015	10	Replace UM1742 by UM1940 in *Section : Reference documents*. Updated command line to run STM32CubeMX in command-line mode in *Section 3.4.2: Running STM32CubeMX in command-line mode*. Modified *Table 1: Command line summary*. Updated board selection in *Section 4.2: New project window*. Updated *Section 4.12: Configuration view* overview. Updated *Section 4.12.1: IP and Middleware Configuration window*, *Section 4.12.3: GPIO Configuration window* and *Section 4.12.4: DMA Configuration window*. Added *Section 4.12.2: User Constants configuration window*. Updated *Section 4.13: Clock tree configuration view* and added reserve path. Updated *Section 6.1: Creating a new STM32CubeMX Project*, *Section 6.5: Configuring the MCU Clock tree*, *Section 6.6: Configuring the MCU initialization parameters*, *Section 6.7.2: Downloading firmware package and generating the C code*, *Section 6.8: Building and updating the C code project*. Added *Section 6.9: Switching to another MCU*. Updated *Section 7: Tutorial 2 - Example of FatFs on an SD card using STM32429I-EVAL evaluation board* and replaced STM32F429I-EVAL by STM32429I-EVAL.
16-Oct-2015	11	Updated *Figure 16: New library Manager window* and *Section 3.5.4: Checking for updates*. Character string constant supported in *Section 4.12.2: User Constants configuration window*. Updated *Section 4.13: Clock tree configuration view*. Updated *Section 4.14: Power Consumption Calculator (PCC) view*. Modified *Figure 173: Power Consumption Calculation example*. Updated *Section 8: Tutorial 3- Using PCC to optimize the embedded application power consumption and more*. Added Eclipse Mars in *Section 3.1.3: Software requirements*
03-Dec-2015	12	Code generation options now supported by the Project settings menu. Updated *Section 3.1.3: Software requirements*. Added project settings in *Section 4.6: Import Project window*. Updated *Figure 30: Automatic project import*; modified *Manual project import* step and updated *Figure 31: Manual project import* and *Figure 32: Import Project menu - Try import with errors*; modified third step of the import sequence. Updated *Figure 89: Clock Tree configuration view with errors*. Added mxconstants.h in *Section 5.1: Standard STM32Cube code generation*. Updated *Figure 173: Power Consumption Calculation example* to *Figure 182: Step 10 optimization*. Updated *Figure 183: PCC Sequence results after optimizations*.

Table 16. Document revision history (continued)

Date	Revision	Changes
03-Feb-2016	13	Updated *Section 2.2: Key features*: – Information related to .ioc files. – Clock tree configuration – Automatic updates of STM32CubeMX and STM32Cube. Updated limitation related to STM32CubeMX C code generation in *Section 2.3: Rules and limitations*. Added Linux in *Section 3.1.1: Supported operating systems and architectures*. Updated Java Run Time Environment release number in *Section 3.1.3: Software requirements*. Updated *Section 3.2.1: Installing STM32CubeMX standalone version*, *Section 3.2.3: Uninstalling STM32CubeMX standalone version* and *Section 3.3.1: Downloading STM32CubeMX plug-in installation package*. Updated *Section 3.4.1: Running STM32CubeMX as standalone application*. Updated *Section 4.8: Project Settings window* and *Section 4.9: Update Manager windows*. Updated *Section 4.11.5: Pinning and labeling signals on pins*. Added *Section 4.11.6: Setting HAL timebase source* Updated *Figure 59: Configuration window tabs for GPIO, DMA and NVIC settings (STM32F4 series)*. Added note related to GPIO configuration in output mode in *Section 4.12.3: GPIO Configuration window*; updated *Figure 70: GPIO Configuration window - GPIO selection*. Modified *Figure 92: Power Consumption Calculator default view*, *Figure 94: Building a power consumption sequence*, *Figure 95: Step management functions*, *Figure 98: Enabling the transition checker option on an already configured sequence - all transitions valid*, *Figure 99: Enabling the transition checker option on an already configured sequence - at least one transition invalid*. Added import pinout button icon in *Section : Importing pinout*. Added *Section : Selecting/deselecting all peripherals*. Modified *Figure 104: Power Consumption Calculator view after sequence building*. Updated *Section : Managing the whole sequence (load, save and compare)*. Updated *Figure 107: Description of the Results area* and *Figure 108: Peripheral power consumption tooltip*. Updated *Figure 173: Power Consumption Calculation example* and *Figure 175: PCC Sequence table*. Updated *Section 5.2: Custom code generation*. Updated *Figure 118: Pinout view with MCUs selection* and *Figure 119: Pinout view without MCUs selection window* in *Section 6.1: Creating a new STM32CubeMX Project*. Updated *Section 6.6.2: Configuring the peripherals* . Updated *Figure 145: Project Settings and toolchain choice* and *Figure 146: Project Settings menu - Code Generator tab* in *Section 6.7.1: Setting project options*, and *Figure 147: Missing firmware package warning message* in *Section 6.7.2: Downloading firmware package and generating the C code*.

Table 16. Document revision history (continued)

Date	Revision	Changes
15-Mar-2016	14	Upgraded STM32CubeMX released number to 4.14.0. Added import of previously saved projects and generation of user files from templates in *Section 2.2: Key features*. Added MacOS in *Section 3.1.1: Supported operating systems and architectures*, *Section 3.2.1: Installing STM32CubeMX standalone version*, *Section 3.2.3: Uninstalling STM32CubeMX standalone version* and *Section 3.4.3: Running STM32CubeMX plug-in from Eclipse IDE*. Added command lines allowing the generation of user files from templates in *Section 3.4.2: Running STM32CubeMX in command-line mode*. Updated new library installation sequence in *Section 3.5.1: Updater configuration*. Updated *Figure 26: Pinout menus (Pinout tab selected)* and *Figure 27: Pinout menus (Pinout tab not selected)* in *Section 4.4.3: Pinout menu*. Modified *Table 6: Window menu*. Updated *Section 4.5: Output windows*. Updated *Figure 38: Project Settings window* and *Section 4.8.1: Project tab*. Updated *Figure 55: NVIC settings when using systick as HAL timebase, no FreeRTOS* and *Figure 56: NVIC settings when using FreeRTOS and SysTick as HAL timebase* in *Section 4.11.6: Setting HAL timebase source*. Updated *Figure 61: User Constants window* and *Figure 62: Extract of the generated mxconstants.h file* in *Section 4.12.2: User Constants configuration window*. *Section 4.12.3: GPIO Configuration window*: updated *Figure 71: GPIO Configuration window - displaying GPIO settings*, *Figure 72: GPIO configuration grouped by IP* and *Figure 73: Multiple Pins Configuration*. Updated *Section 4.12.5: NVIC Configuration window*.
18-May-2016	15	Import project function is no more limited to MCUs of the same series (see *Section 2.2: Key features*, *Section 4.4.1: File menu* and *Section 4.6: Import Project window*). Updated command lines in *Section 3.4.2: Running STM32CubeMX in command-line mode*. *Table 1: Command line summary*: modified all examples related to config comands as well as set dest_path <path> example. Added caution note for *Load Project* menu in *Table 3: File menu functions*. Updated *Generate Code* menu description in *Table 4: Project menu*. Updated *Set unused GPIOs* menu in *Table 5: Pinout menu*. Added case where FreeRTOS in enabled in *Section : Enabling interruptions using the NVIC tab view*. Added *Section 4.12.6: FreeRTOS middleware configuration view*. Updated Appendix *B.3.5: FreeRTOS* and *B.3.6: LwIP* .

IMPORTANT NOTICE – PLEASE READ CAREFULLY