

3 Boot modes

3.1 Boot configuration

The user can select the boot area through the boot configuration pin BOOT0 and bits nBOOT1, nBOOT_SEL, and nBOOT0 of the User option byte, as shown in the following table.

Table 9. Boot modes

Boot mode configuration					Selected boot area
BOOT_LOCK	nBOOT1 bit	BOOT0 pin	nBOOT_SEL bit	nBOOT0 bit	
0	x	0	0	x	Main flash memory ⁽¹⁾
0	1	1	0	x	System memory
0	0	1	0	x	Embedded SRAM
0	x	x	1	1	Main flash memory ⁽¹⁾
0	1	x	1	0	System memory
0	0	x	1	0	Embedded SRAM
1	x	x	x	x	Main flash memory

1. Boot forced to system memory when EMPTY flag in the FLASH access control register (FLASH_ACR) is set. See [Section 3.1.4: Empty check](#).

The boot mode configuration is latched after a reset. It is up to the user to set boot mode configuration related to the required boot mode. The boot mode configuration is also re-sampled when exiting Standby mode. Consequently, they must be kept in the required boot mode configuration in Standby mode. After this startup delay has elapsed, the CPU fetches the top-of-stack value from the address 0x0000 0000, then starts executing code from the address stored in the boot memory at 0x0000 0004.

Depending on the selected boot mode, main flash memory, system memory, or SRAM is accessible as follows:

- Boot from main flash memory: the main flash memory is aliased in the boot memory space (0x0000 0000), but still accessible from its original memory space (0x0800 0000). In other words, the flash memory contents can be accessed starting from address 0x0000 0000 or 0x0800 0000.
- Boot from system memory: the system memory is aliased in the boot memory space (0x0000 0000), but still accessible from its original memory space 0x1FFF0000.
- Boot from the embedded SRAM: the SRAM is aliased in the boot memory space (0x0000 0000), but it is still accessible from its original memory space (0x2000 0000).

Caution: BOOT0 pin shares the same GPIO with serial wire clock (SWCLK) that is used by the debugger to connect with the device, based on the fact that these functionalities can be considered almost completely disjoint. Nevertheless, to ensure system robustness, the STM32C0 series devices provide a hardware mechanism to force BOOT0 low (boot from user flash memory) if a debugger access is detected (and BOOT0 information is taken from the pin), in order to use SWCLK clock for debugger serial communications and at the same

time have a safe boot configuration for the device itself. This configuration is kept until the earliest power-on following the debugger access.

Caution: BOOT0 pin sampling is done on NRST (external reset) rising edge. Refer to NRST (external reset) description in [Section 6.1.2: System reset](#) for further details on how the PF2-NRST pin mode impacts the BOOT0 sampling.

3.1.1 Physical remap

Once the boot mode is selected, the application software can modify the memory accessible in the code area. This modification is performed by programming the MEM_MODE bits in the [SYSCFG configuration register 1 \(SYSCFG_CFGR1\)](#).

3.1.2 Embedded boot loader

The embedded bootloader is located in the system memory, programmed by ST during production. It is used to reprogram the flash memory using one of the following serial interfaces:

- USART
- I2C
- SPI (only on STM32C051xx, STM32C071xx, and STM32C091xx/92xx devices)
- USB DFU (only on STM32C071xx)
- FDCAN (only on STM32C092xx devices)

For further details, refer to the device data sheets and the application note AN2606.

Note: Some of the GPIOs are reconfigured from their high-Z state.

On STM32C092xx, the FDCAN_BL_CK[1:0] bitfield of the FLASH_OPTR register allows selecting FDCAN clock source.

3.1.3 Forcing boot from main flash memory

Setting the BOOT_LOCK bit forces the boot from a unique entry point in the main flash memory, regardless of the boot mode configuration pin, bits, and the EMPTY flag. See [Section 4.5.6: Forcing boot from main flash memory](#).

3.1.4 Empty check

Internal empty check flag (the EMPTY bit of the FLASH access control register FLASH_ACR) is implemented to allow easy programming of virgin devices by the boot loader. This flag is checked when the boot configuration defines the main flash memory as the target boot area and the BOOT_LOCK bit is not set. When the EMPTY flag is set, the device is considered empty and the system memory (bootloader) is selected instead of the main flash memory as a boot area, to allow the user to program the device. Refer to AN2606 for more details concerning the bootloader and GPIO configuration in the system memory boot mode (some of the GPIOs are reconfigured from the High-Z state).

The EMPTY flag is updated by hardware only during the loading of option bytes: it is set when the 64-bit content of the address 0x0800 0000 is read as 0xFFFF FFFF FFFF FFFF, otherwise it is cleared. It means that, after programming of a virgin device, a power-on reset or setting of the OBL_LAUNCH bit of the FLASH_CR register is required to clear the EMPTY flag (the system reset has no impact on this flag). The software can also modify the EMPTY flag directly in the FLASH_ACR register.

Note: If the device is programmed for the first time but the EMPTY flag is not updated, the device still selects system memory as a boot area after a system reset.