AT32 Bootloader Program Manual

Introduction

Bootloader program is stored in the boot memory of the microcontroller. It has been programmed before leaving factory. It is used to download application programs to the internal memory through peripheral interfaces such as UART, USB. These interfaces have their respective protocols, which can found on the corresponding protocol documents.

Applicable products:

Product series	AT32F403xx
	AT32F413xx
	AT32F415xx
	AT32F403Axx
	AT32F407xx
	AT32F421xx
	AT32F435xx
	AT32F437xx
	AT32F425xx
	AT32F423xx
	AT32L021xx
	AT32F405xx
	AT32F402xx
	AT32A403Axx
	AT32A423xx
	AT32M412xx
	AT32M416xx
	AT32F455xx
	AT32F456xx
	AT32F457xx
	AT32F422xx
	AT32F426xx
	AT32F011xx

	AT32F403Exx
	AT32F407Exx
	AT32F408xx
	AT32F406xx

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1 Bootloader mode

1.1 Enter Bootloader mode

Table 1 Bootloader mode

Part number	Conditions
AT32F403xx	BOOT0=1，BOOT1=0
AT32F413xx	BOOT0=1，BOOT1=0
AT32F415xx	BOOT0=1，BOOT1=0
AT32F403Axx	BOOT0=1，BOOT1=0，BTOPT=1
AT32F407xx	BOOT0=1，BOOT1=0，BTOPT=1
AT32F421xx	BOOT0=1，nBOOT1=1
AT32F435xx	BOOT0=1，BOOT1=0，BTOPT=1
AT32F437xx	BOOT0=1，BOOT1=0，BTOPT=1
AT32F425xx	BOOT0=1，nBOOT1=1
AT32F423xx	BOOT0=1，nBOOT1=1
AT32L021xx	BOOT0=1，nBOOT1=1
AT32F405xx	BOOT0=1，nBOOT1=1
AT32F402xx	BOOT0=1，nBOOT1=1
AT32A403Axx	BOOT0=1，BOOT1=0，BTOPT=1
AT32A423xx	BOOT0=1，nBOOT1=1
AT32M412xx	BOOT0=1，nBOOT1=1
AT32M416xx	BOOT0=1，nBOOT1=1
AT32F455xx	BOOT0=1，BOOT1=0
AT32F456xx	BOOT0=1，BOOT1=0
AT32F457xx	BOOT0=1，BOOT1=0
AT32F422xx	BOOT0=1，nBOOT1=1 Or nBOOT0_SW=0,nBOOT0=0, nBOOT1=1
AT32F426xx	BOOT0=1，nBOOT1=1 Or nBOOT0_SW=0,nBOOT0=0, nBOOT1=1
AT32F011xx	BOOT0=1，nBOOT1=1
AT32F403Exx	BOOT0=1，BOOT1=0，BTOPT=1
AT32F407Exx	BOOT0=1，BOOT1=0，BTOPT=1
AT32F408xx	BOOT0=1，nBOOT1=1
AT32F406xx	BOOT0=1，nBOOT1=1

Note: Refer to the particular datasheet for details on BOOT0 and BOOT1 pins.

Note: nBOOT0_SW, nBOOT0, nBOOT1 in the user system area can be modified by software. Refer to the particular reference manual for more information.

Note: BTOPT in the user system area corresponds to the device with Bank2. When BTOPT=0, it means booting from Bank 2.

In addition, by means of user code, it is possible to jump to boot memory to execute bootloader. But all peripherals must be reset prior to jumping, and all peripheral clocks, PLL, interrupts must be disabled, and pending interrupts must be cleared.

After entering a programming mode, the bootloader will no longer detect other programming modes. For example, if the bootloader supports UART1, UART2 and USB_DFU, when 0x7F on

UART1 is detected, the bootloader enters UART1 programming mode while disabling detection on UART2 and USB_DFU.

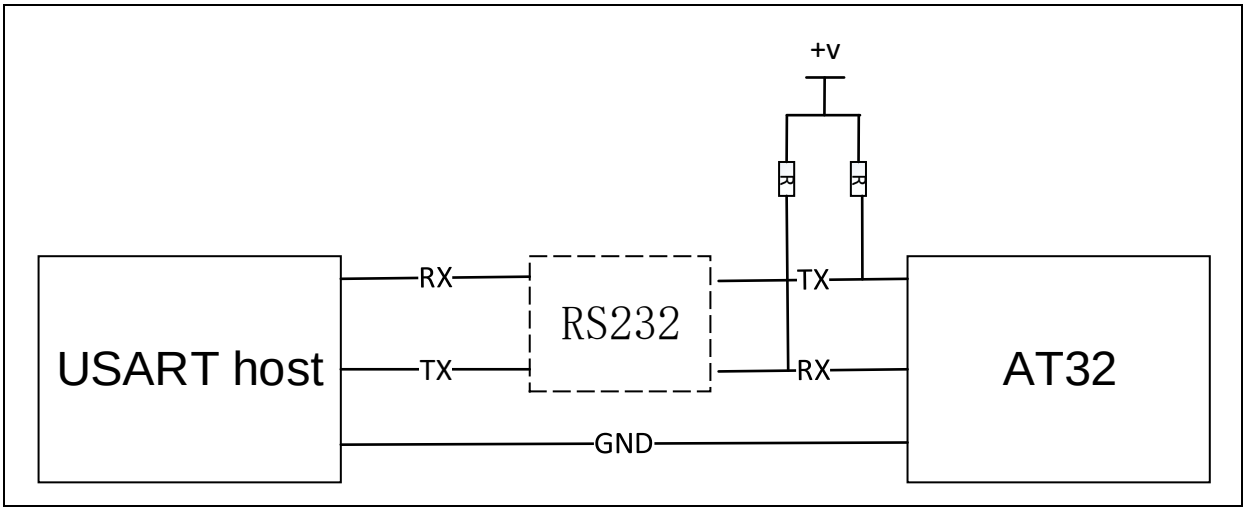
It should be noted that in the post- Bootloader detection phase, the unused RX(UART_RX, SPI_MOSI, CAN_RX, USB DP/DM) pins should be kept a fixed level (low or high). If these pins remain floating or have data transfer, this may cause false entry into these unused interfaces.

Note: It is recommended to start bootloader command 200ms after power on.

1.2 Hardware connection

To use USART bootloader program mode, the host must be connected to UARTx_RX and UARTx_TX.

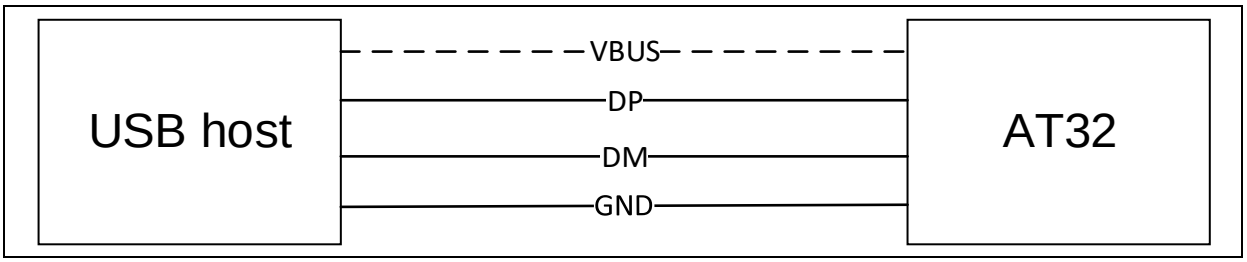
Figure 1 UART hardware connection block diagram



Note: +V typical value is 3.3 V, and R typical value is 100KOhm.

To use USB DFU, the MCU USB interface must be connected to USB host interface.

Figure 2 USB hardware connection block diagram

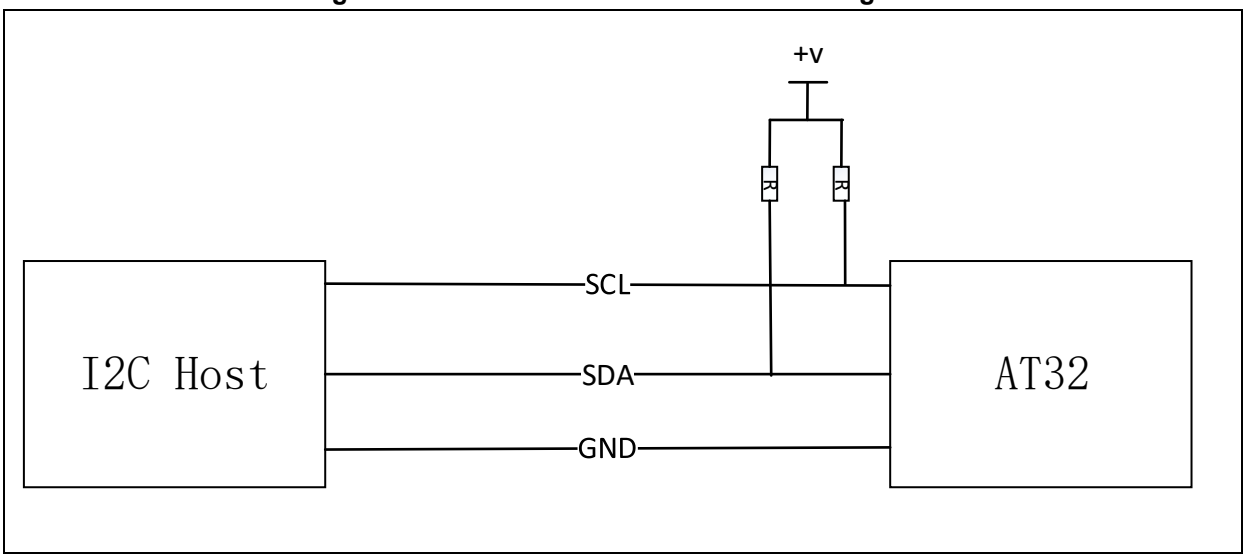


Note:

It is a good advice to keep unused peripheral RX interfaces (UART_RX, SPI_MOSI,CAN_RX) at a fixed level (high or low) when bootloader is being started. If these pins remain floating or have data transfer, this may cause false entry into these unused interfaces.

To enable I2C programming mode, the host must be connected to SCL and SDA pins of the I2C.

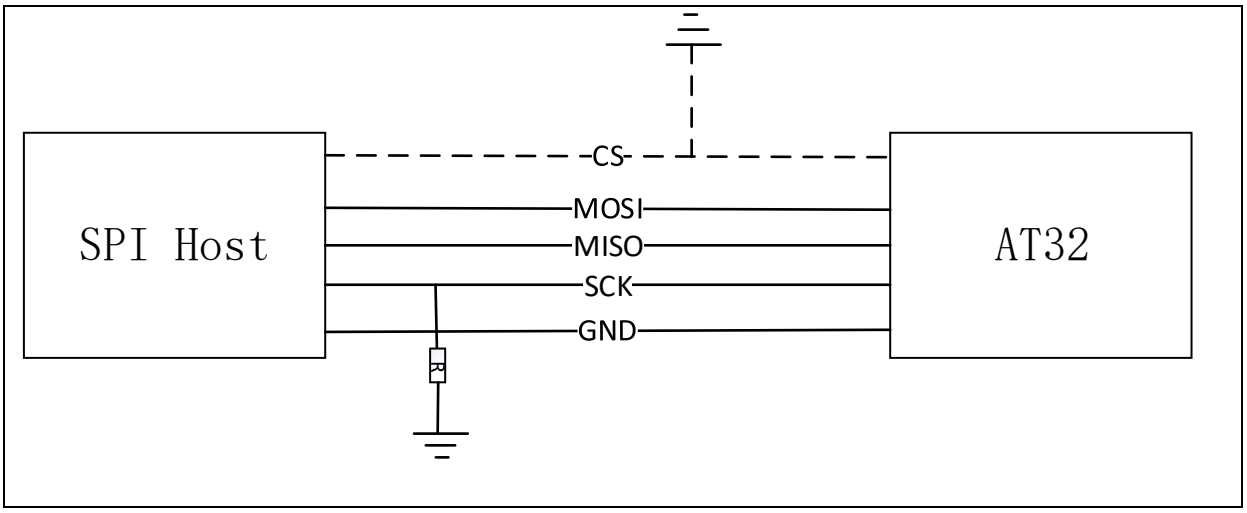
Figure 3 I2C hardware connection block diagram



Note: +V typical value is 3.3V. "R" value depends on the actual applications.

To enable SPI programming mode, the AT32 acts as a slave, and the host must be connected to MOSI, MISO, SCK and CS. The CS can also be grounded. The SCK pin is recommended to be connected to a pull-down resistor.

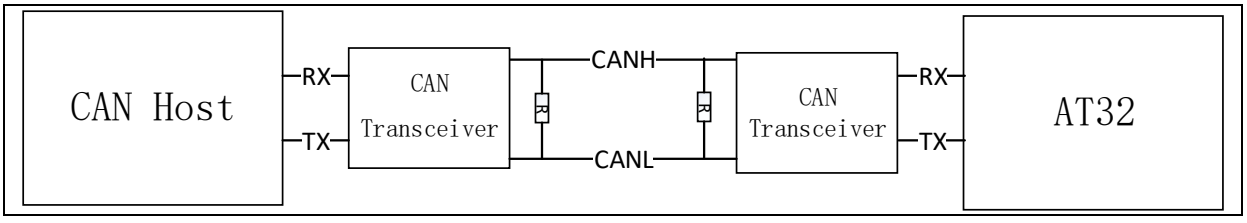
Figure 4 SPI hardware connection block diagram



Note: "R" typical value is 10KOhm, depending on the actual hardware. Dashed lines represent optional items

To enable CAN programming mode, the RX and TX of the CAN must be connected to the CAN transceiver.

Figure 5 CAN hardware connection block diagram



Note: "R" typical value is 120KOhm, depending on the actual hardware.

2 AT32F403xx Bootloader

AT32F403xx supports UART1, UART2 and USB_DFU.

2.1 Peripheral configuration

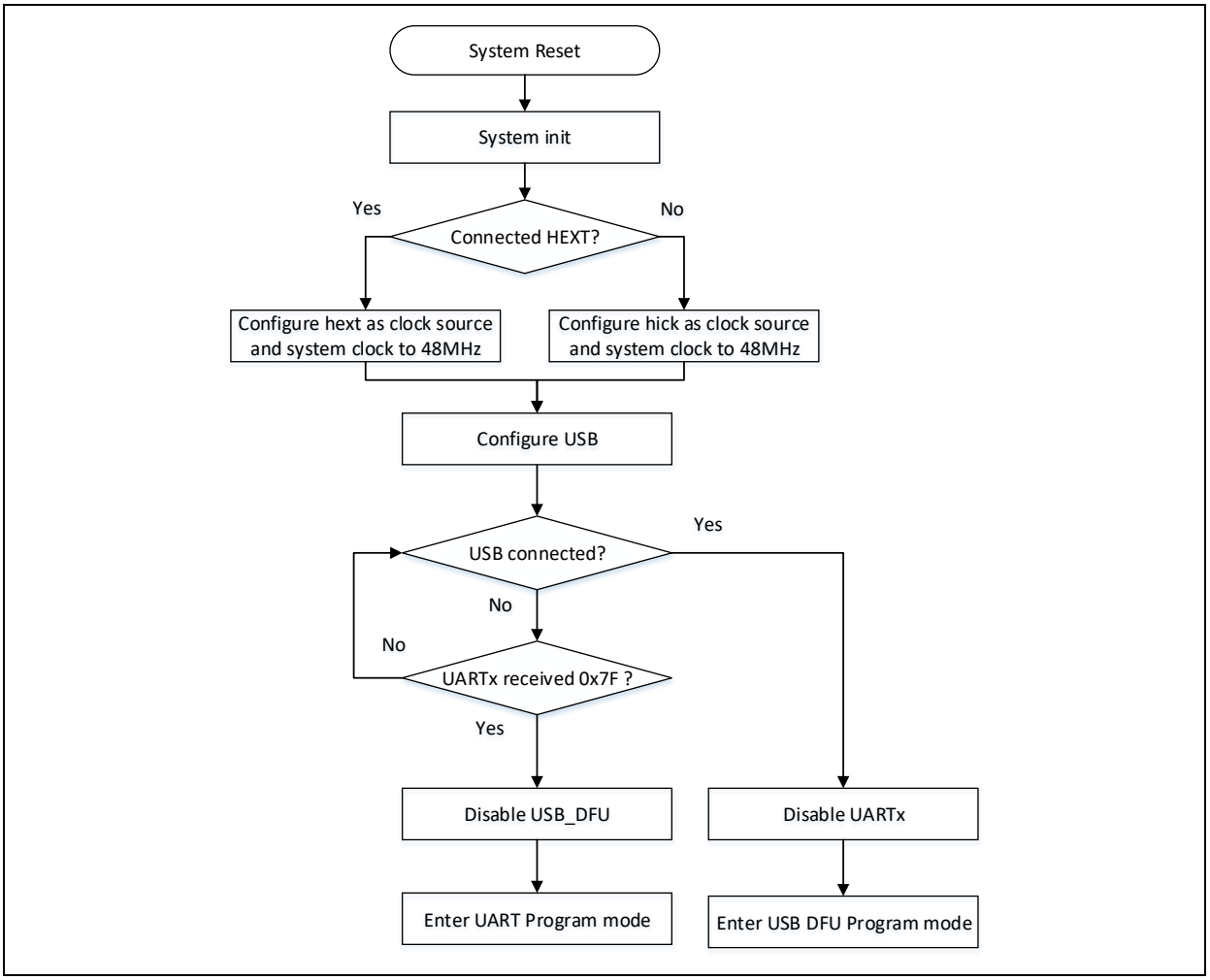
Table 2 AT32F403xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	AT32F403ZG,AT32F403VG	PD5:UART_TX PD6:UART_RX
	Other part numbers	PA2:UART_TX PA3:UART_RX
USB_DFU	All part numbers	PA11:USB_DM PA12:USB_DP

2.2 Program mode selection

If HEXT is connected, the Bootloader will check whether the current HEXT is able to configure system clock to 48 MHZ using PLL, if not, it will continue to use HICK as a clock source.

Figure 6 AT32F403xx program mode selection



3 AT32F413xx Bootloader

AT32F413xx supports UART1, UART2 and USB_DFU.

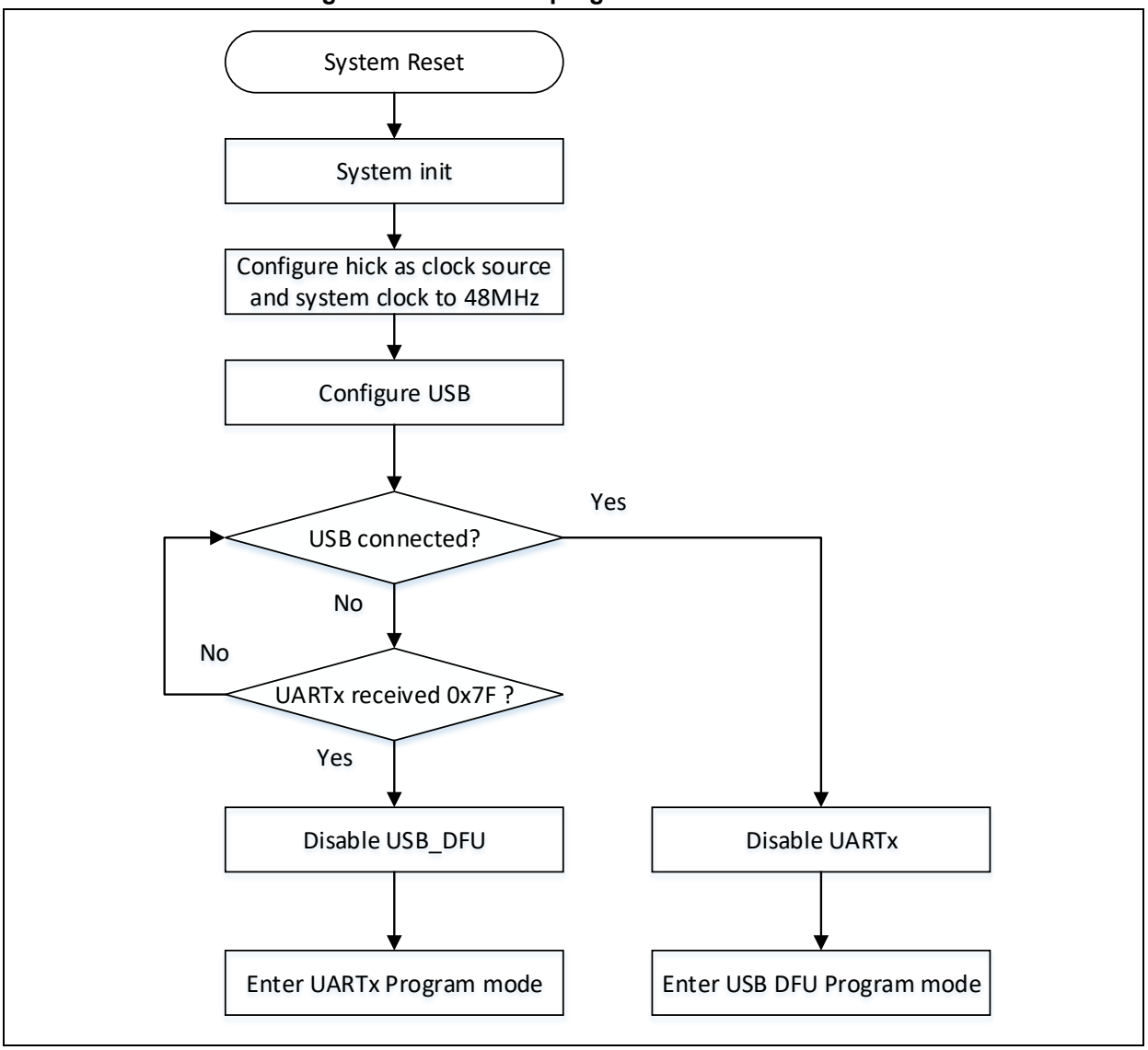
3.1 Peripheral configuration

Table 3 AT32F413xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX
USB_DFU	All part numbers	PA11:USB_DM PA12:USB_DP

3.2 Program mode selection

Figure 7 AT32F413xx program mode selection



4 AT32F415xx Bootloader

AT32F415xx supports UART1, UART2 and USB_OTG_DFU.

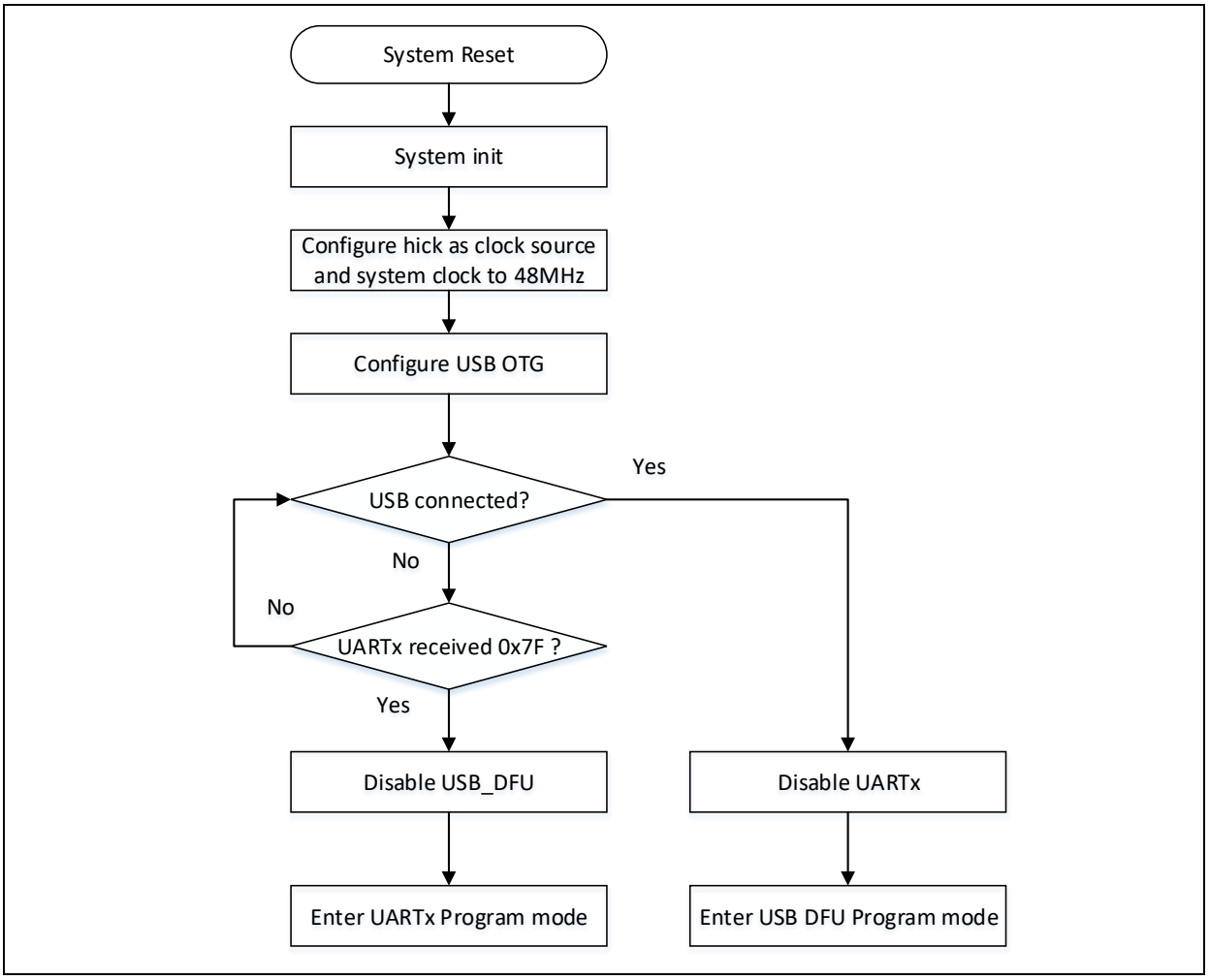
4.1 Peripheral configuration

Table 4 AT32F415xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX
USB_OTG_DFU	All part numbers	PA11:USB_DM PA12:USB_DP PA9:USB_VBUS

4.2 Program mode selection

Figure 8 AT32F415xx program mode selection



5 AT32F403Axx Bootloader

AT32F403Axx supports UART1, UART2 and USB_DFU.

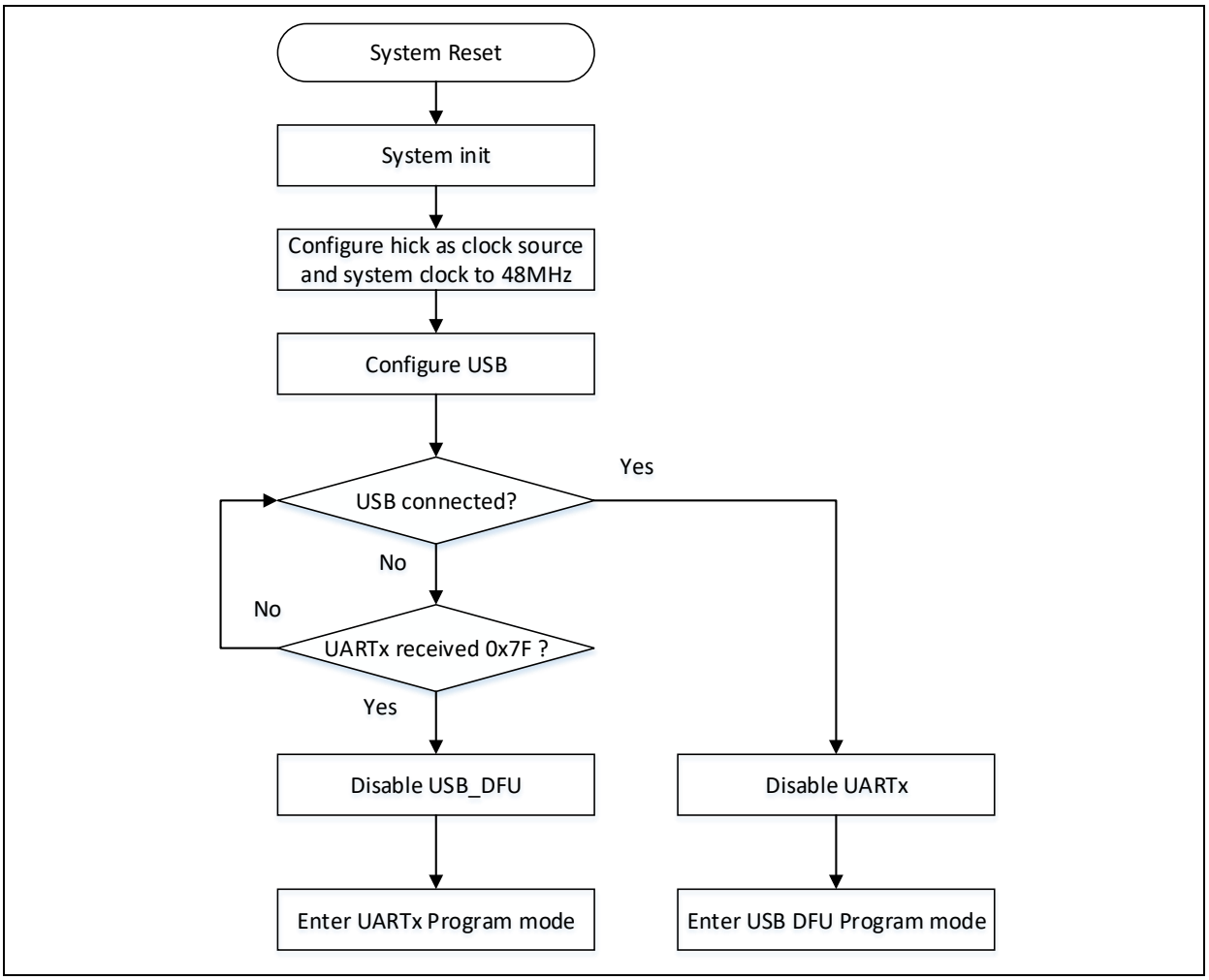
5.1 Peripheral configuration

Table 5 AT32F403Axx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	AT32F403AZG,AT32F403AVG	PD5:UART_TX PD6:UART_RX
	Others part numbers	PA2:UART_TX PA3:UART_RX
USB_DFU	All part numbers	PA11:USB_DM PA12:USB_DP

5.2 Program mode selection

Figure 9 AT32F403Axx program mode selection



6 AT32F407xx Bootloader

AT32F407xx supports UART1, UART2 and USB_DFU.

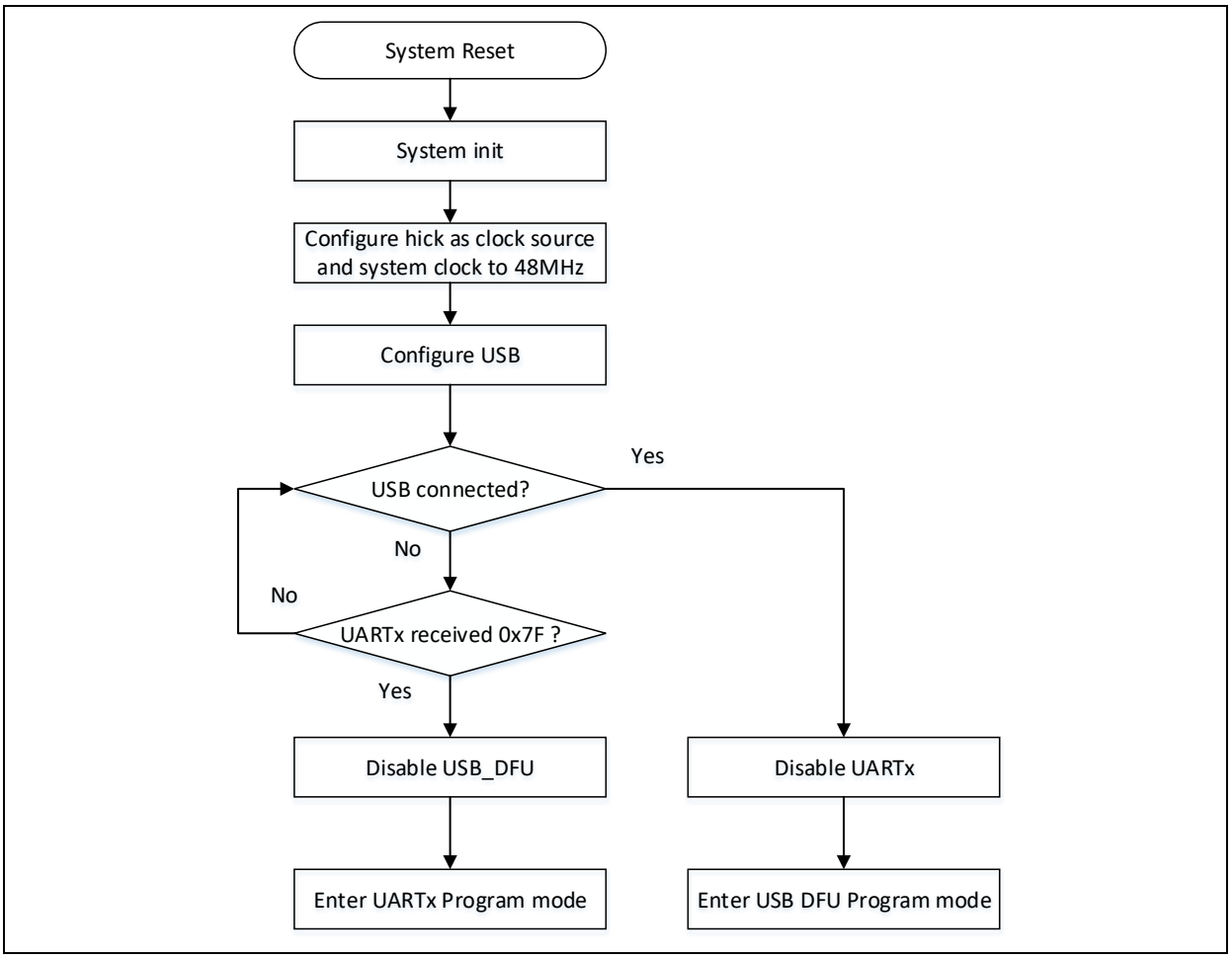
6.1 Peripheral configuration

Table 6 AT32F407xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	AT32F407ZG,AT32F407VG	PD5:UART_TX PD6:UART_RX
	Other part numbers	PA2:UART_TX PA3:UART_RX
USB_DFU	All part numbers	PA11:USB_DM PA12:USB_DP

6.2 Program mode selection

Figure 10 AT32F407xx program mode selection



7 AT32F421xx Bootloader

AT32F421xx supports UART1 and UART2.

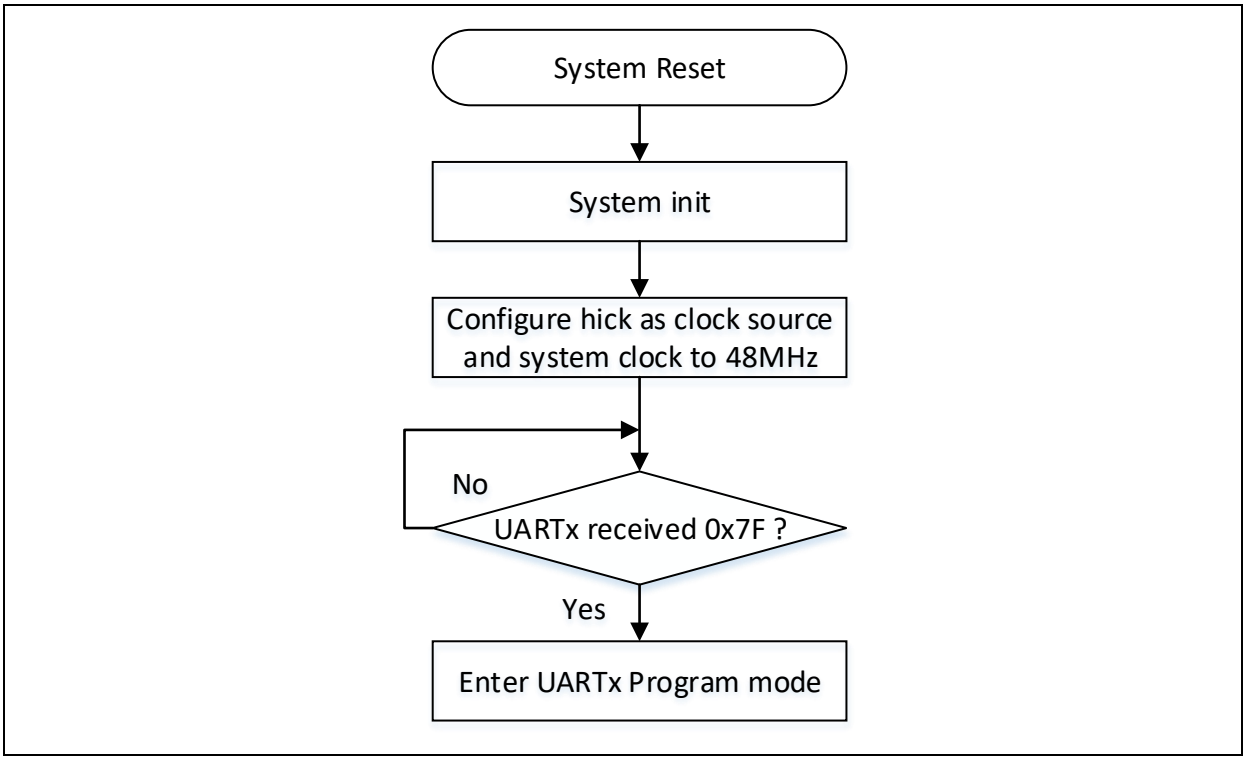
7.1 Peripheral configuration

Table 7 AT32F421xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX

7.2 Program mode selection

Figure 11 AT32F421xx program mode selection



8 AT32F435xx Bootloader

AT32F435xx supports UART1, UART2, UART3, USB_OTG1_DFU, and USB_OTG2_DFU.

8.1 Peripheral configuration

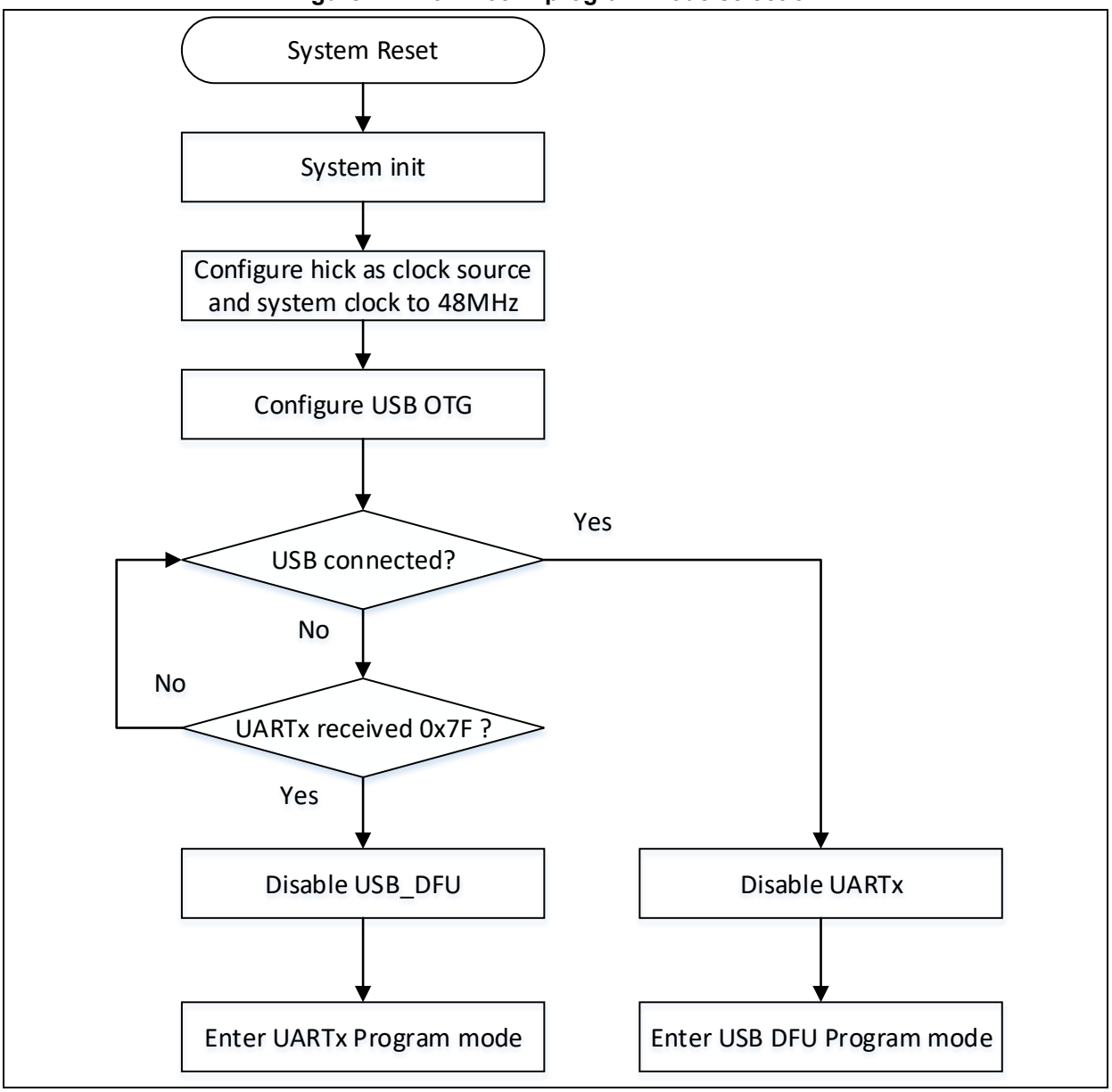
Table 8 AT32F435xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART1_TX PA10:UART1_RX
UART2	AT32F435ZxT7,AT32F435VxT7	PD5:UART2_TX PD6:UART2_RX
	Other part numbers	PA2:UART2_TX PA3:UART2_RX
UART3	AT32F435ZxT7,AT32F435VxT7, AT32F435RxT7	PC10: UART3_TX PC11: UART3_RX Or PB10: UART3_TX(1) PB11: UART3_RX(1)
	Other part numbers	PB10: UART3_TX PB11: UART3_RX
USB_OTG1_DFU	All part numbers	PA11:USB_DM PA12:USB_DP
USB_OTG2_DFU	All part numbers	PB14:USB_DM PB15:USB_DP

Note 1: PB10 and PB11 are available only in the USART3 of the silicon revision B of AT32F435ZxT7, AT32F435VxT7 and AT32F435RxT7.

8.2 Program mode selection

Figure 12 AT32F435xx program mode selection



9 AT32F437xx Bootloader

AT32F437xx supports UART1, UART2, UART3, USB_OTG1_DFU, and USB_OTG2_DFU.

9.1 Peripheral configuration

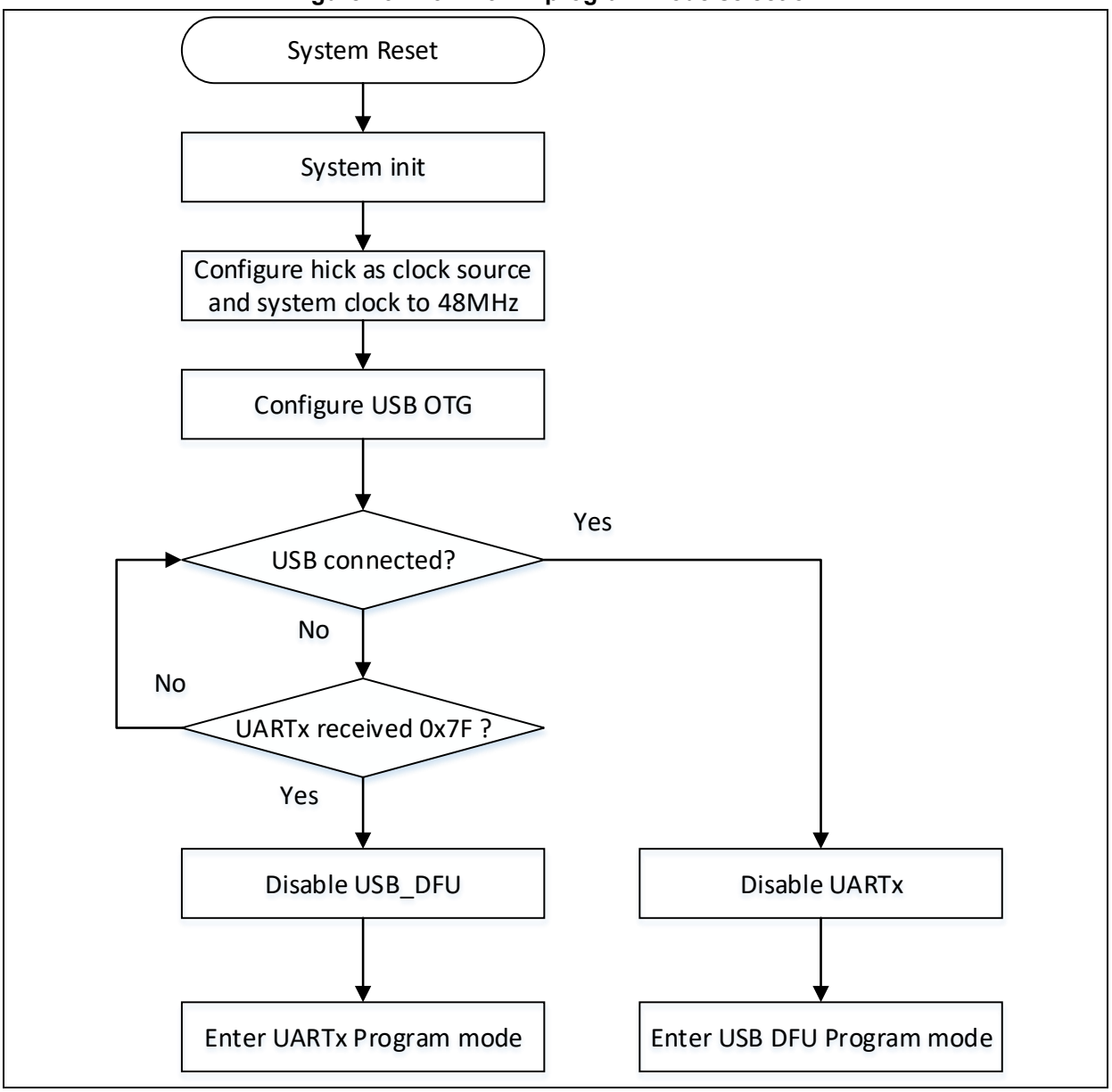
Table 9 AT32F437xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART1_TX PA10:UART1_RX
UART2	AT32F437ZxT7,AT32F437VxT7	PD5:UART2_TX PD6:UART2_RX
	Other part numbers	PA2:UART2_TX PA3:UART2_RX
UART3	AT32F437ZxT7,AT32F437VxT7, AT32F437RxT7	PC10: UART3_TX PC11: UART3_RX Or PB10: UART3_TX(1) PB11: UART3_RX(1)
	Other part numbers	PB10: UART3_TX PB11: UART3_RX
USB_OTG1_DFU	All part numbers	PA11:USB_DM PA12:USB_DP
USB_OTG2_DFU	All part numbers	PB14:USB_DM PB15:USB_DP

Note 1: PB10 and PB11 are available only in the USART3 of the silicon revision B of AT32F435ZxT7, AT32F435VxT7 and AT32F435RxT7.

9.2 Program mode selection

Figure 13 AT32F437xx program mode selection



10 AT32F425xx Bootloader

AT32F425xx supports UART1 and UART2.

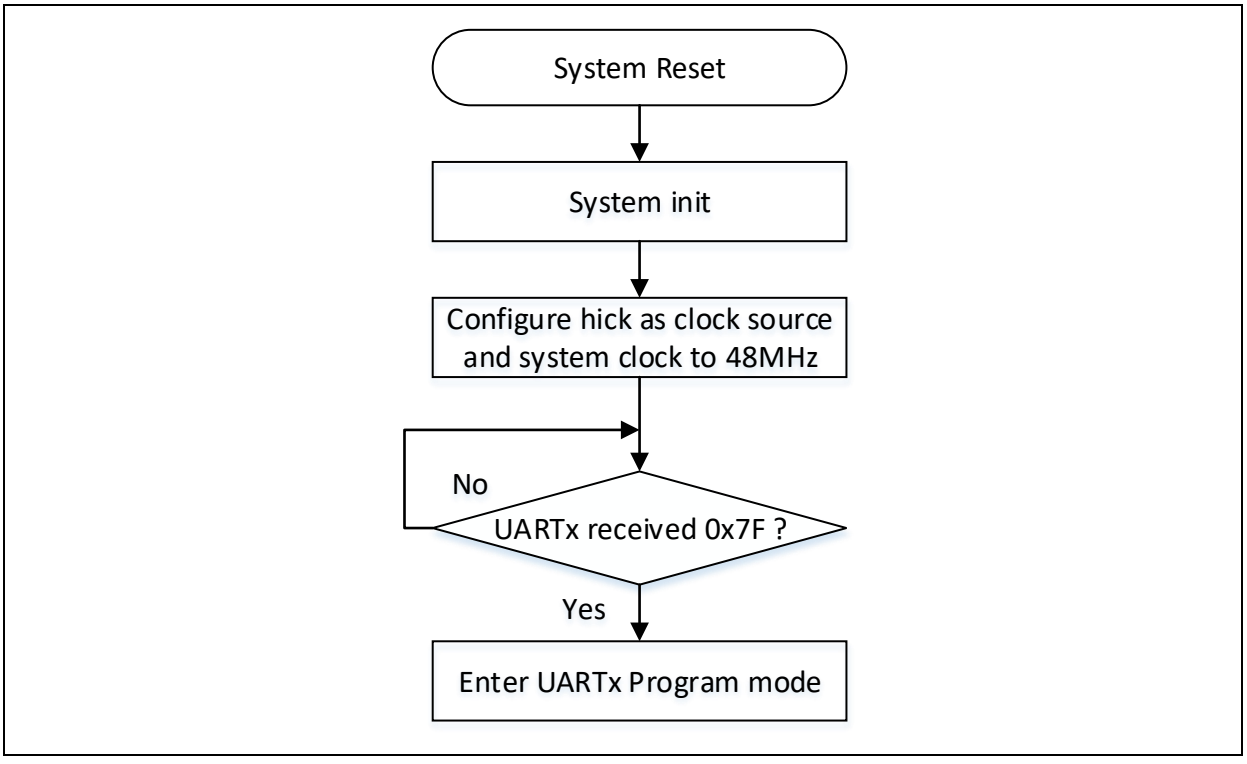
10.1 Peripheral configuration

Table 10 AT32F425xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX

10.2 Program mode selection

Figure 14 AT32F425xx program mode selection



11 AT32F423xx Bootloader

AT32F423xx supports UART1, UART2, UART3, USB_OTG_DFU.

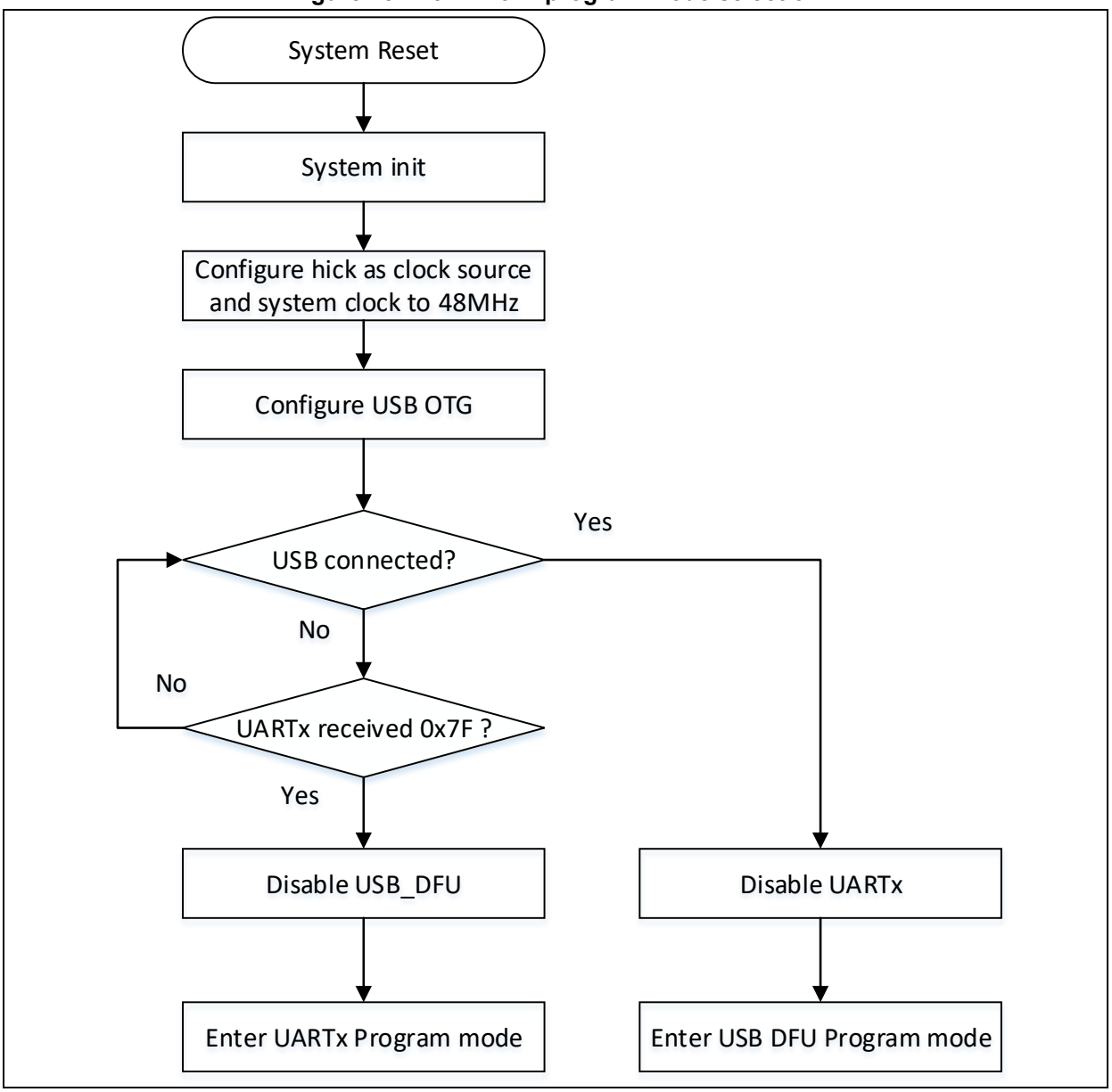
11.1 Peripheral configuration

Table 11 AT32F423xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART1_TX PA10:UART1_RX
UART2	AT32F423VxT7	PD5:UART2_TX PD6:UART2_RX
	Other part numbers	PA2:UART2_TX PA3:UART2_RX
UART3	AT32F423VxT7, AT32F423RxT7, AT32F423RxT7-7	PC10: UART3_TX PC11: UART3_RX Or PB10: UART3_TX PB11: UART3_RX
	AT32F423CxT7, AT32F423CxU7	PB10: UART3_TX PB11: UART3_RX
	Other part numbers	Not support
USB_OTG_DFU	All part numbers	PA11:USB_DM PA12:USB_DP

11.2 Program mode selection

Figure 15 AT32F423xx program mode selection



12 AT32L021xx Bootloader

AT32L021xx supports UART1 and UART2.

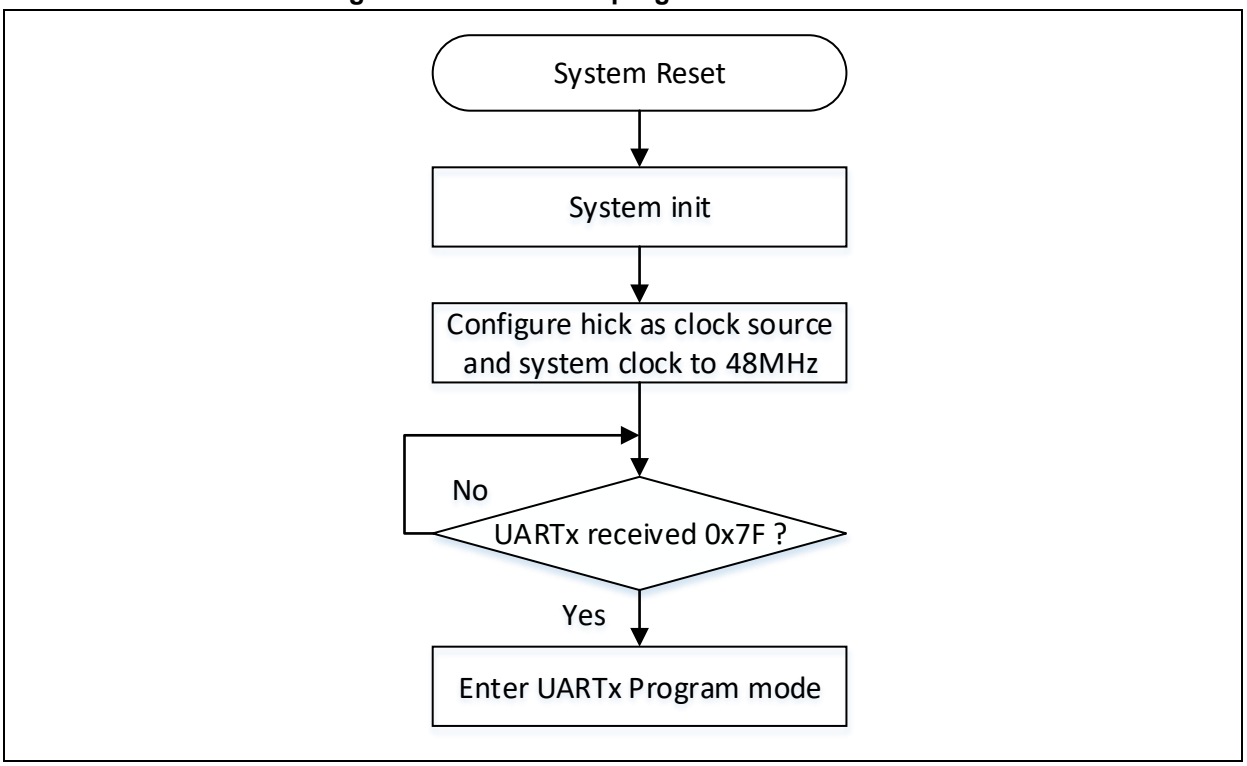
12.1 Peripheral configuration

Table 12 AT32L021 peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX

12.2 Program mode selection

Figure 16 AT32L021xx program mode selection



13 AT32F405xx Bootloader

The AT32F405xx supports UART1, UART2, UART3, OTGHS (Full Speed), OTGFS, I2C1, I2C2, I2C3, CAN1 and SPI1.

13.1 Peripheral configuration

Table 13 AT32F405xx peripheral configuration

Peripherals	Application products	Pins
UART1	AT32F405KxU7-4	Not support
	Other part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX
UART3	AT32F405RxT7 AT32F405RxT7-7	PC10:UART_TX PC11:UART_RX
	Other part numbers	Not support
OTGHS(1)	All part numbers	OTGHS_DM OTGHS_DP
OTGFS	All part numbers	PA11:OTGFS_DM PA12:OTGFS_DP
I2C1(2)	All part numbers	PB6:I2C_SCL PB7:I2C_SDA
I2C2(2)	AT32F405KxU7-4	Not support
	Other part numbers	PB10:I2C_SCL PB3:I2C_SDA
I2C3(2)	AT32F405KxU7-4	Not support
	Other part numbers	PA8:I2C_SCL PB4:I2C_SDA
CAN1(3)	AT32F405KxU7-4	Not support
	Other part numbers	PB8:CAN_RX PB9:CAN_TX
SPI1	All part numbers	PA4:SPI_CS PA5:SPI_SCK PA6:SPI_MISO PA7:SPI_MOSI

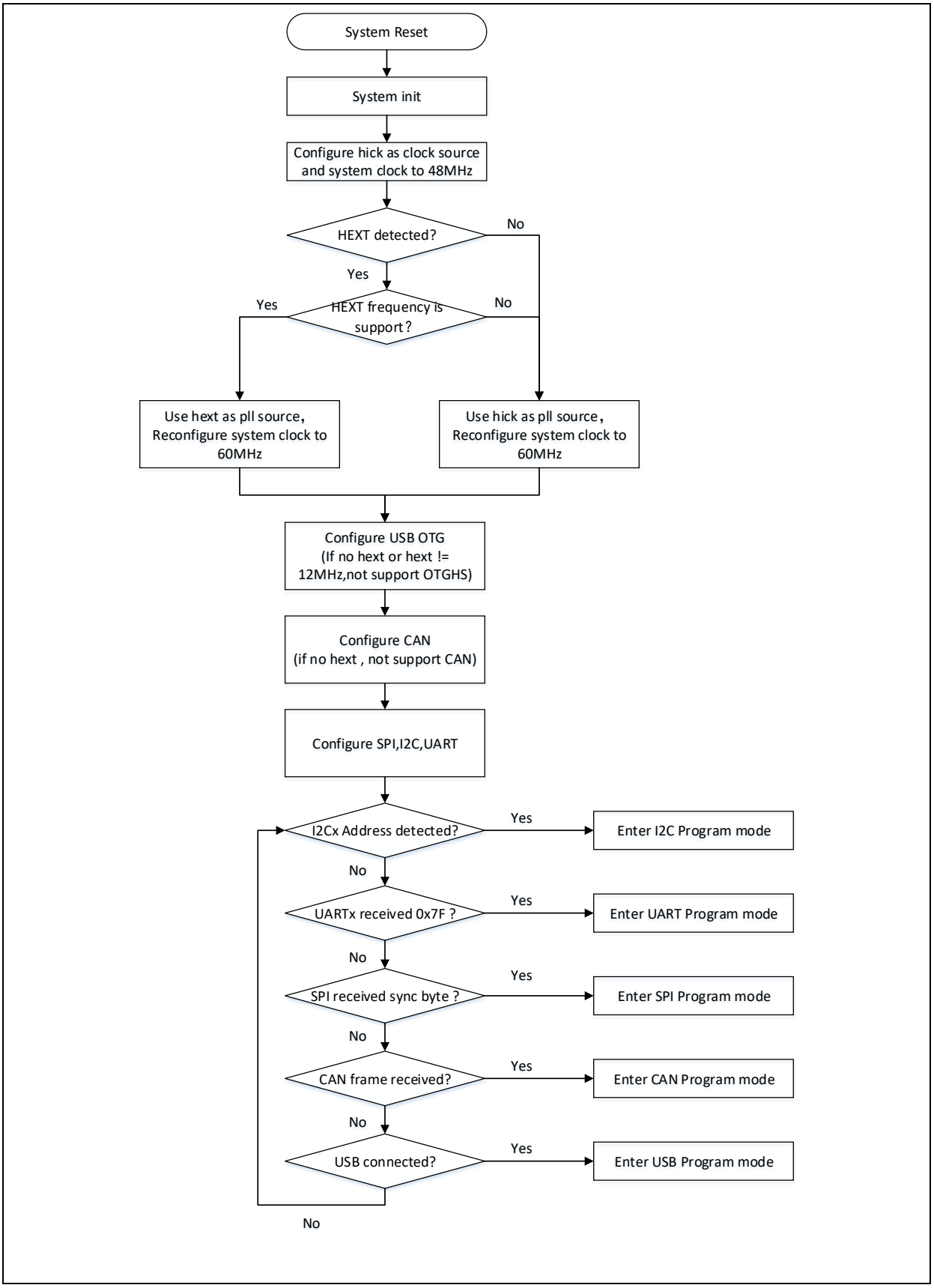
Note 1: to use OTGHS, an external 12MHz crystal is required.

Note 2: I2C uses the Slave 7-bit address 0b0011110x.

Note 3: to use CAN, an external crystal is required, and the supported frequencies are 4MHz, 6MHz, 8MHz, 12MHz, 14.7456MHz, 16MHz, 20MHz, 24MHz and 25MHz.

13.2 Program mode selection

Figure 17 AT32F405xx program mode selection



14 AT32F402xx Bootloader

The AT32F402xx supports UART1, UART2, UART3, OTGFS, I2C1, I2C2, I2C3, CAN1 and SPI1.

14.1 Peripheral configuration

Table 14 AT32F402xx peripheral configuration

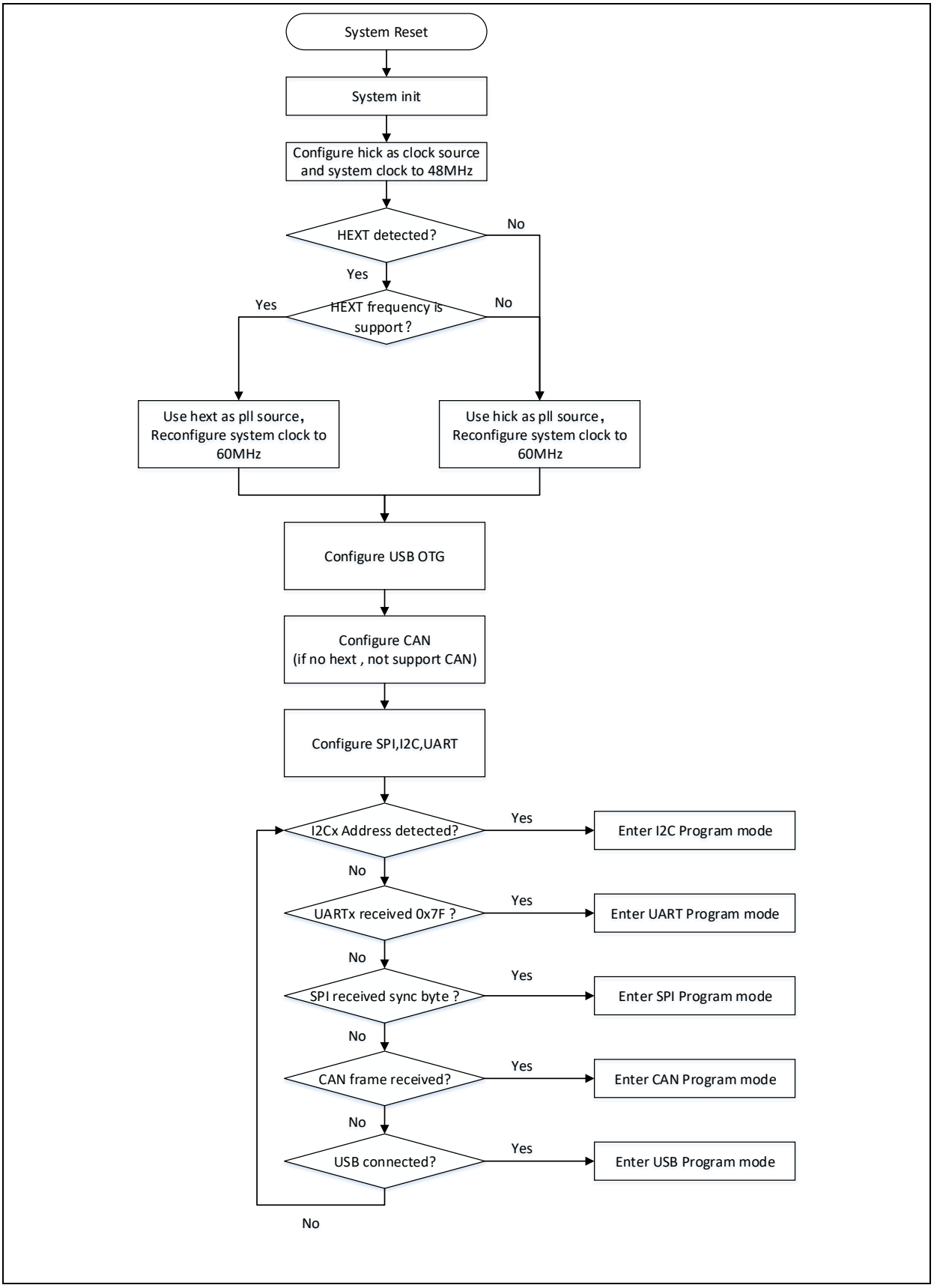
Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX
UART3	AT32F402RxT7 AT32F402RxT7-7	PC10:UART_TX PC11:UART_RX or PB10:UART_TX PB11:UART_RX
	AT32F402CxT7 AT32F402CxU7	PB10:UART_TX PB11:UART_RX
	Other part numbers	Not support
OTGFS	All part numbers	PA11:OTGFS_DM PA12:OTGFS_DP
I2C1(1)	All part numbers	PB6:I2C_SCL PB7:I2C_SDA
I2C2(1)	AT32F402KxU7-4	Not support
	Other part numbers	PB10:I2C_SCL PB3:I2C_SDA
I2C3(1)	All part numbers	PA8:I2C_SCL PB4:I2C_SDA
CAN1(2)	AT32F402KxU7-4	Not support
	Other part numbers	PB8:CAN_RX PB9:CAN_TX
SPI1	All part numbers	PA4:SPI_CS PA5:SPI_SCK PA6:SPI_MISO PA7:SPI_MOSI

Note 1: I2C uses the Slave 7-bit address 0b0011110x.

Note 2: to use CAN, an external crystal is required, and the supported frequencies are 4MHz, 6MHz, 8MHz, 12MHz, 14.7456MHz, 16MHz, 20MHz, 24MHz and 25MHz.

14.2 Program mode selection

Figure 18 AT32F402xx program mode selection



15 AT32A403Axx Bootloader

The AT32A403Axx supports UART1, UART2, and USB_DFU.

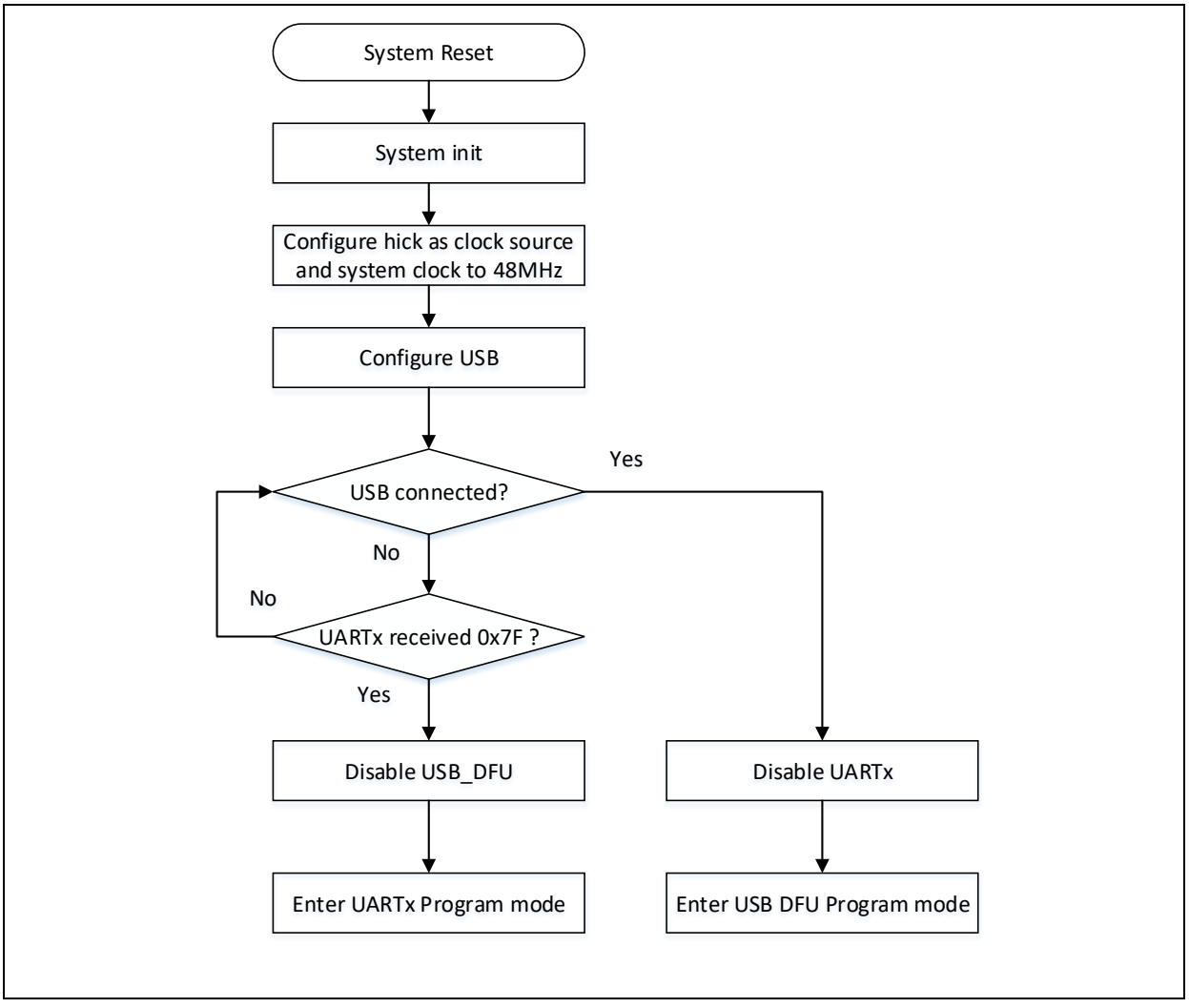
15.1 Peripheral configuration

Table 15 AT32A403Axx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	AT32A403AZG,AT32A403AVG	PD5:UART_TX PD6:UART_RX
	Other part numbers	PA2:UART_TX PA3:UART_RX
USB_DFU	All part numbers	PA11:USB_DM PA12:USB_DP

15.2 Program mode selection

Figure 19 AT32A403Axx program mode selection



16 AT32A423xx Bootloader

The AT32A423xx supports UART1, UART2, UART3, and USB_OTG_DFU.

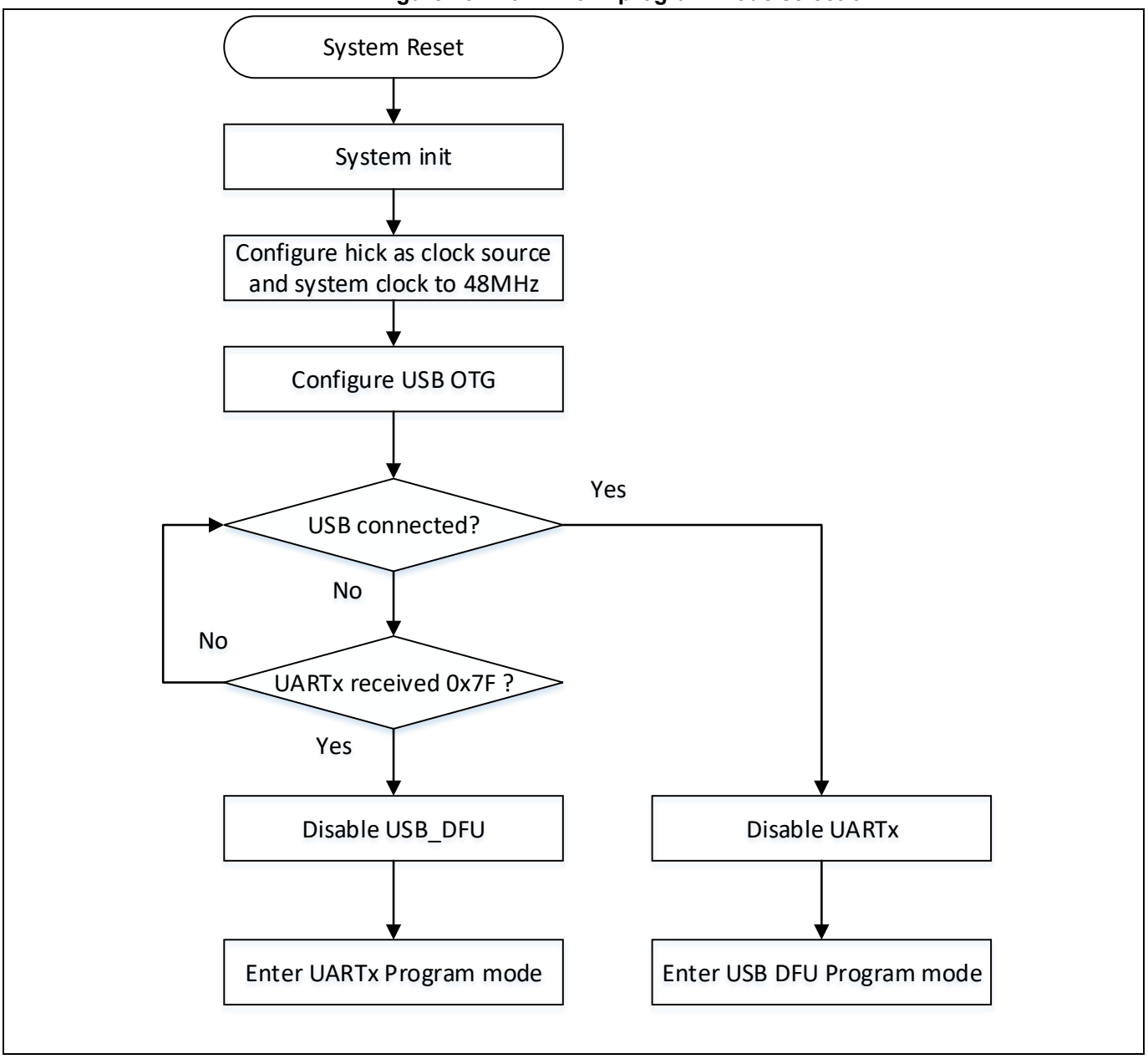
16.1 Peripheral configuration

Table 16 AT32A423xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART1_TX PA10:UART1_RX
UART2	AT32A423VxT7	PD5:UART2_TX PD6:UART2_RX
	Other part numbers	PA2:UART2_TX PA3:UART2_RX
UART3	AT32A423VxT7, AT32F423RxT7, AT32A423RxT7-7	PC10: UART3_TX PC11: UART3_RX or PB10: UART3_TX PB11: UART3_RX
	AT32A423CxT7, AT32A423CxU7	PB10: UART3_TX PB11: UART3_RX
	Other part numbers	Not support
USB_OTG_DFU	All part numbers	PA11:USB_DM PA12:USB_DP

16.2 Program mode selection

Figure 20 AT32A423xx program mode selection



17 AT32M412xx Bootloader

The AT32M412xx supports UART1, UART2, I2C1, I2C2, CAN1 and SPI1.

17.1 Peripheral configuration

Table 17 AT32M412xx peripheral configuration

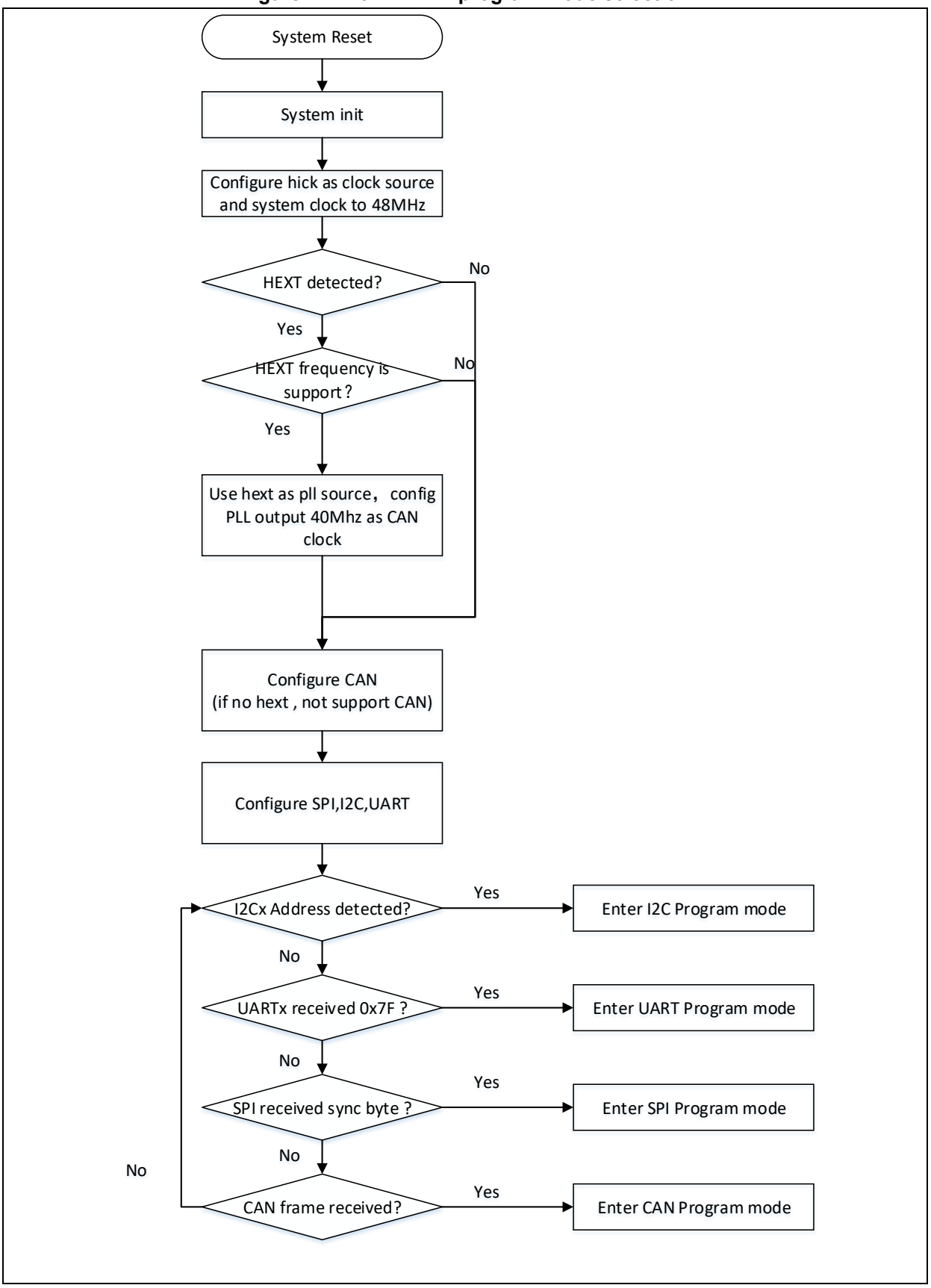
Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX
I2C1(1)	All part numbers	PB6:I2C_SCL PB7:I2C_SDA
I2C2(1)	AT32M412ExP7	Not support
	Other part numbers	PB10:I2C_SCL PB3:I2C_SDA
CAN1(2)	AT32M412KxT7，AT32M412KxU7	Not support
	Other part numbers	PB5:CAN_RX PB13:CAN_TX
SPI1	All part numbers	PA4:SPI_CS PA5:SPI_SCK PA6:SPI_MISO PA7:SPI_MOSI

Note 1: I2C uses the Slave 7-bit address 0b0011110x.

Note 2: to use CAN, an external crystal is required, and the supported frequencies are 4MHz, 6MHz, 8MHz, 12MHz, 14.7456MHz, 16MHz, 20MHz, 24MHz and 25MHz.

17.2 Program mode selection

Figure 21 AT32M412xx program mode selection



18 AT32M416xx Bootloader

The AT32M416xx supports UART1, UART2, I2C1, I2C2, CANFD and SPI1.

18.1 Peripheral configuration

Table 18 AT32M416xx peripheral configuration

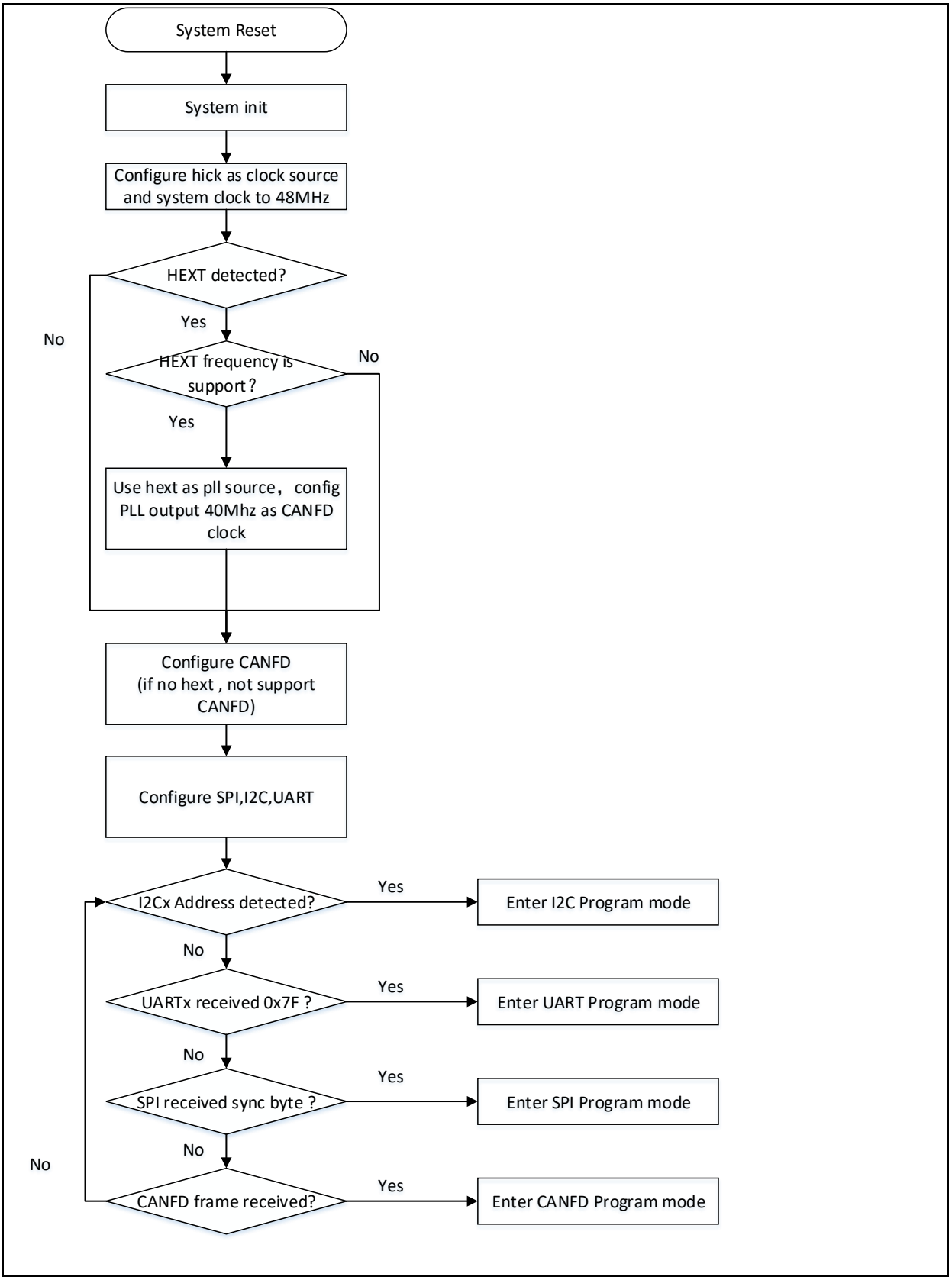
Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX
I2C1(1)	All part numbers	PB6:I2C_SCL PB7:I2C_SDA
I2C2(1)	AT32M416ExP7	Not support
	Other part numbers	PB10:I2C_SCL PB3:I2C_SDA
CANFD(2)	AT32M416KxT7，AT32M416KxU7	Not support
	Other part numbers	PB5:CANFD_RX PB13:CANFD_TX
SPI1	All part numbers	PA4:SPI_CS PA5:SPI_SCK PA6:SPI_MISO PA7:SPI_MOSI

Note 1: I2C uses the Slave 7-bit address 0b0011110x.

Note 2: to use CANFD, an external crystal is required, and the supported frequencies are 4MHz, 6MHz, 8MHz, 12MHz, 14.7456MHz, 16MHz, 20MHz, 24MHz and 25MHz.

18.2 Program mode selection

Figure 22 AT32M416xx program mode selection



19 AT32F455xx Bootloader

The AT32F455xx supports UART1, UART2, UART3, OTGFS, I2C1, I2C2, I2C3, CAN1, CAN2, SPI1 and SPI2.

19.1 Peripheral configuration

Table 19 AT32F455xx peripheral configuration

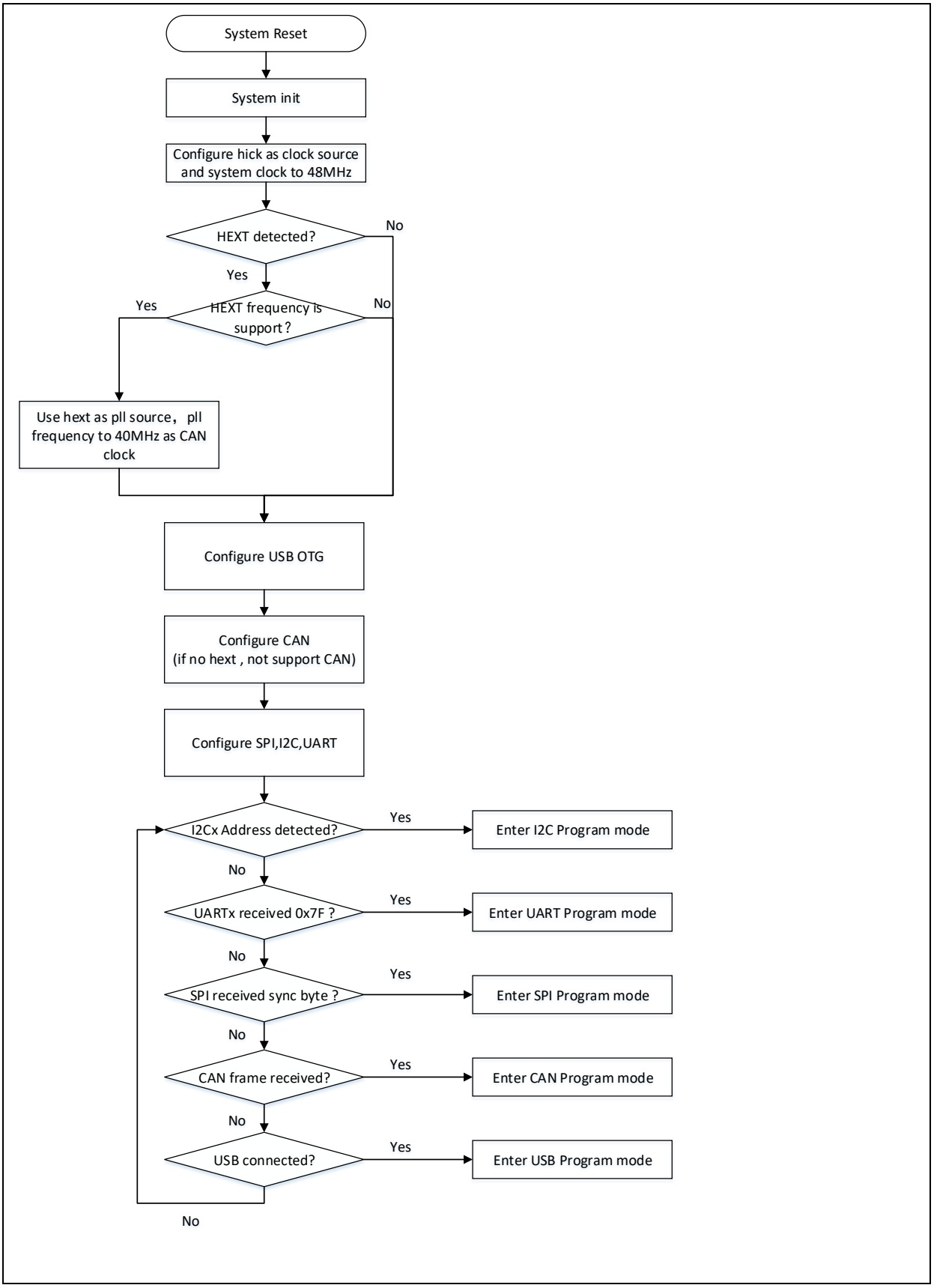
Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	AT32F455ZxT7，AT32F455VxT7	PD5：UART_TX PD6：UART_RX
	Other part numbers	PA2:UART_TX PA3:UART_RX
UART3	AT32F455ZxT7，AT32F455VxT7， AT32F455RxT7	PC10:UART_TX PC11:UART_RX Or PB10:UART_TX PB11:UART_RX
	Other part numbers	PB10:UART_TX PB11:UART_RX
OTGFS	All part numbers	PA11:OTGFS_DM PA12:OTGFS_DP
I2C1(1)	All part numbers	PB6:I2C_SCL PB7:I2C_SDA
I2C2(1)	All part numbers	PB10:I2C_SCL PB3:I2C_SDA
I2C3(1)	All part numbers	PA8:I2C_SCL PB4:I2C_SDA
CAN1(2)	AT32F455ZxT7，AT32F455VxT7	PD0:CAN_RX PD1:CAN_TX
	Other part numbers	PB8:CAN_RX PB9:CAN_TX
CAN2(2)	All part numbers	PB5:CAN_RX PB13:CAN_TX
SPI1	All part numbers	PA4:SPI_CS PA5:SPI_SCK PA6:SPI_MISO PA7:SPI_MOSI
SPI2	AT32F455ZxT7，AT32F455VxT7， AT32F455RxT7	PB12:SPI_CS PC7:SPI_SCK PC2:SPI_MISO PC3:SPI_MOSI
	Other part numbers	Not support

Note 1: I2C uses the Slave 7-bit address 0b0011110x.

Note 2: to use CAN, an external crystal is required, and the supported frequencies are 4MHz, 6MHz, 8MHz, 12MHz, 14.7456MHz, 16MHz, 20MHz, 24MHz and 25MHz.

19.2 Program mode selection

Figure 23 AT32F455xx program mode selection



20 AT32F456xx Bootloader

The AT32F456xx supports UART1, UART2, UART3, OTGFS, I2C1, I2C2, I2C3, CANFD1, CANFD2, SPI1 and SPI2.

20.1 Peripheral configuration

Table 20 AT32F456xx peripheral configuration

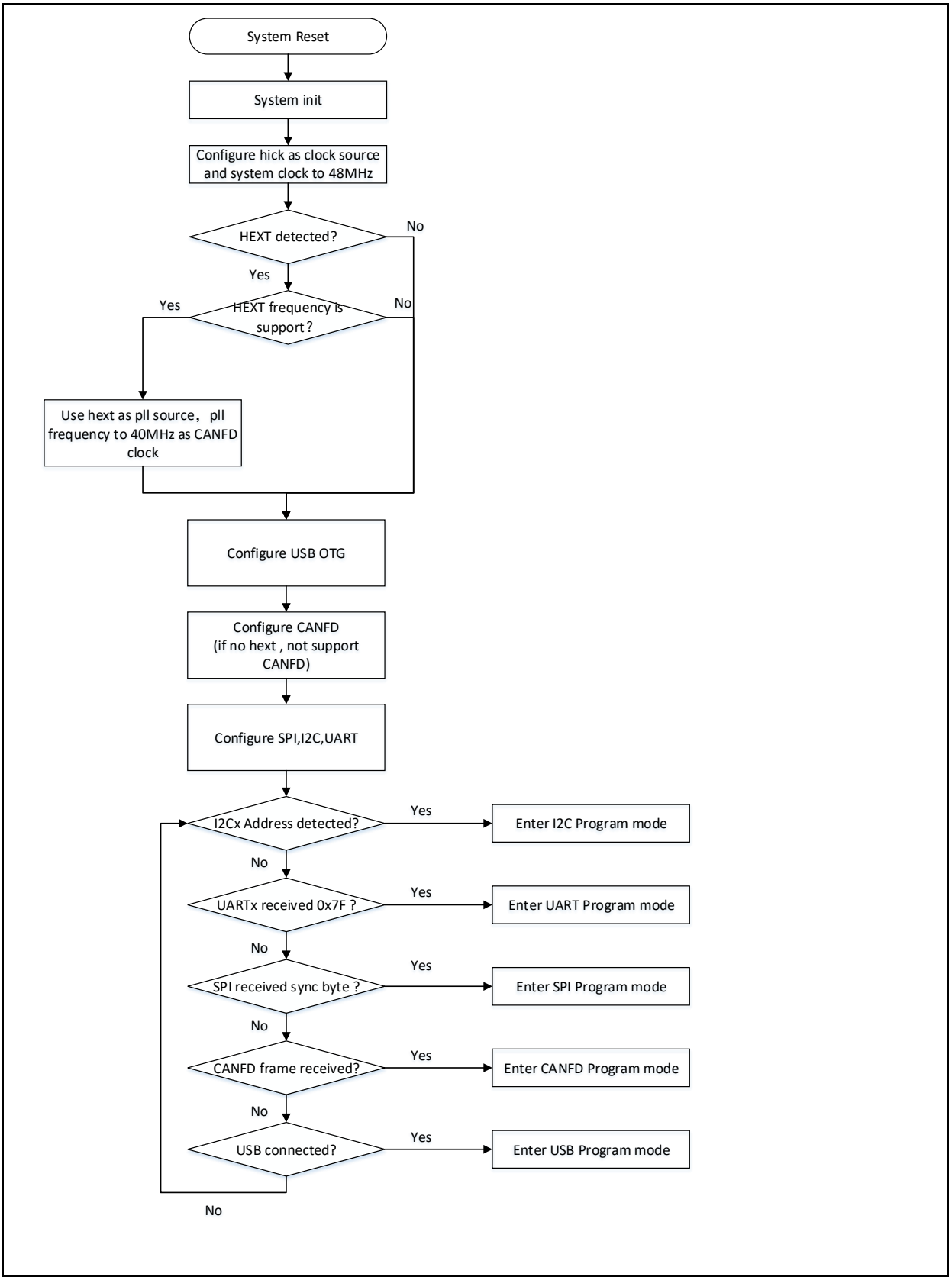
Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	AT32F456ZxT7，AT32F456VxT7	PD5：UART_TX PD6：UART_RX
	Other part numbers	PA2:UART_TX PA3:UART_RX
UART3	AT32F456ZxT7，AT32F456VxT7, AT32F456RxT7	PC10:UART_TX PC11:UART_RX Or PB10:UART_TX PB11:UART_RX
	Other part numbers	PB10:UART_TX PB11:UART_RX
OTGFS	All part numbers	PA11:OTGFS_DM PA12:OTGFS_DP
I2C1(1)	All part numbers	PB6:I2C_SCL PB7:I2C_SDA
I2C2(1)	All part numbers	PB10:I2C_SCL PB3:I2C_SDA
I2C3(1)	All part numbers	PA8:I2C_SCL PB4:I2C_SDA
CANFD1(2)	AT32F456ZxT7，AT32F456VxT7	PD0:CANFD_RX PD1:CANFD_TX
	Other part numbers	PB8:CANFD_RX PB9:CANFD_TX
CANFD2(2)	All part numbers	PB5:CANFD_RX PB13:CANFD_TX
SPI1	All part numbers	PA4:SPI_CS PA5:SPI_SCK PA6:SPI_MISO PA7:SPI_MOSI
SPI2	AT32F456ZxT7，AT32F456VxT7, AT32F456RxT7	PB12:SPI_CS PC7:SPI_SCK PC2:SPI_MISO PC3:SPI_MOSI
	Other part numbers	Not support

Note 1: I2C uses the Slave 7-bit address 0b0011110x.

Note 2: to use CANFD, an external crystal is required, and the supported frequencies are 4MHz, 6MHz, 8MHz, 12MHz, 14.7456MHz, 16MHz, 20MHz, 24MHz and 25MHz.

20.2 Program mode selection

Figure 24 AT32F456xx program mode selection



21 AT32F457xx Bootloader

The AT32F457xx supports UART1, UART2, UART3, OTGFS, I2C1, I2C2, I2C3, CAN1, CAN2, SPI1 and SPI2.

21.1 Peripheral configuration

Table 21 AT32F457xx peripheral configuration

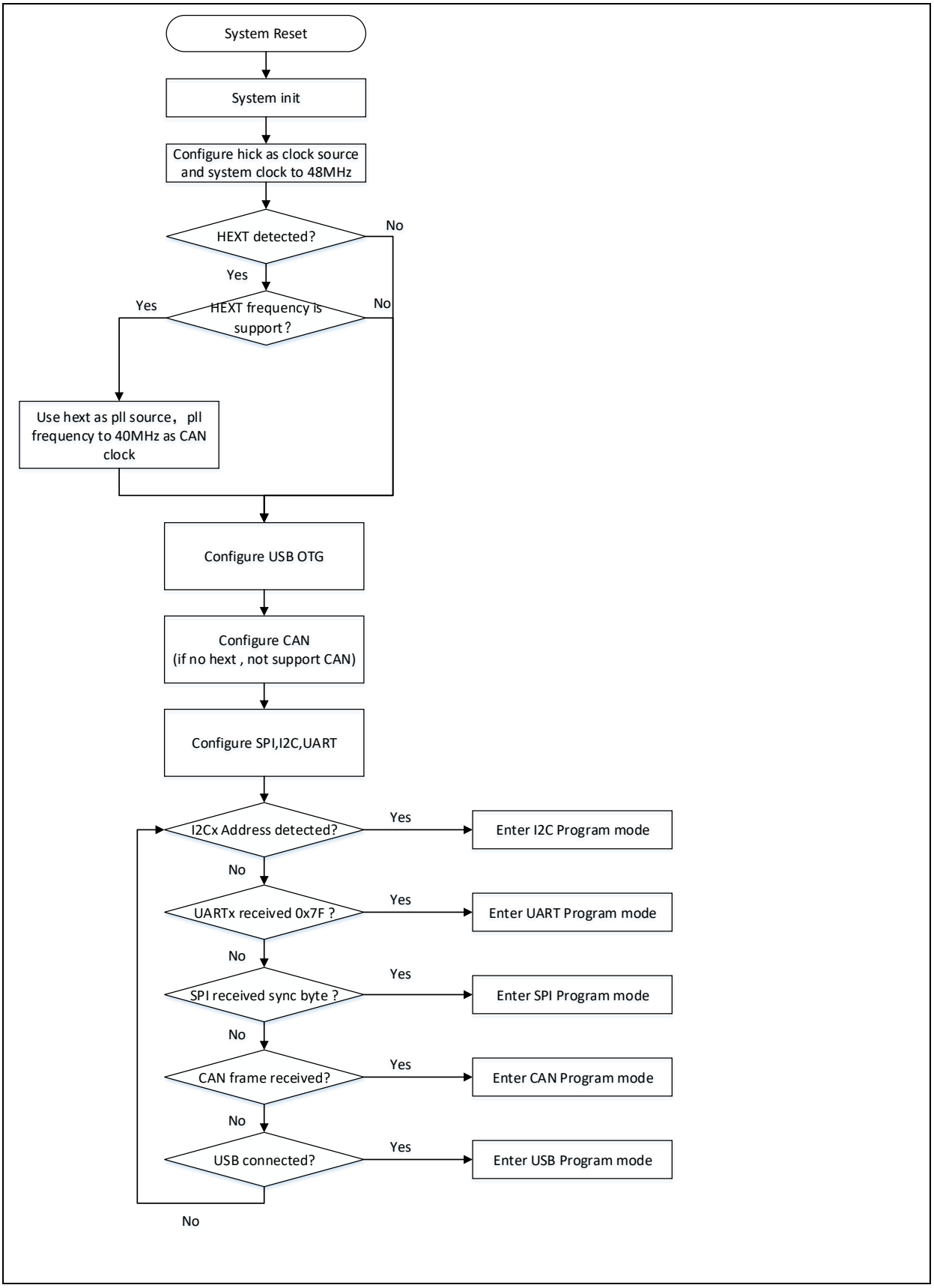
Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	AT32F457ZxT7，AT32F457VxT7	PD5：UART_TX PD6：UART_RX
	Other part numbers	PA2:UART_TX PA3:UART_RX
UART3	AT32F457ZxT7，AT32F457VxT7, AT32F457RxT7	PC10:UART_TX PC11:UART_RX or PB10:UART_TX PB11:UART_RX
	Other part numbers	PB10:UART_TX PB11:UART_RX
OTGFS	All part numbers	PA11:OTGFS_DM PA12:OTGFS_DP
I2C1(1)	All part numbers	PB6:I2C_SCL PB7:I2C_SDA
I2C2(1)	All part numbers	PB10:I2C_SCL PB3:I2C_SDA
I2C3(1)	All part numbers	PA8:I2C_SCL PB4:I2C_SDA
CAN1(2)	AT32F457ZxT7，AT32F457VxT7	PD0:CAN_RX PD1:CAN_TX
	Other part numbers	PB8:CAN_RX PB9:CAN_TX
CAN2(2)	All part numbers	PB5:CAN_RX PB13:CAN_TX
SPI1	All part numbers	PA4:SPI_CS PA5:SPI_SCK PA6:SPI_MISO PA7:SPI_MOSI
SPI2	AT32F457ZxT7，AT32F457VxT7, AT32F457RxT7	PB12:SPI_CS PC7:SPI_SCK PC2:SPI_MISO PC3:SPI_MOSI
	Other part numbers	Not support

Note 1: I2C uses the Slave 7-bit address 0b0011110x.

Note 2: to use CAN, an external crystal is required, and the supported frequencies are 4MHz, 6MHz, 8MHz, 12MHz, 14.7456MHz, 16MHz, 20MHz, 24MHz and 25MHz.

21.2 Program mode selection

Figure 25 AT32F457xx program mode selection



22 AT32F422xx Bootloader

The AT32F422xx supports UART1, UART2, I2C1, CAN1, and SPI1.

22.1 Peripheral configuration

Table 22 AT32F422xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX
I2C1(1)	AT32F422FxP7	Not support
	Other part numbers	PB6:I2C_SCL PB7:I2C_SDA
CAN1(2)	AT32F422GxP7，AT32F422FxP7	PA11:CAN_RX(3) PA12:CAN_TX(3)
	Other part numbers	PA11:CAN_RX PA12:CAN_TX
SPI1	All part numbers	PA4:SPI_CS PA5:SPI_SCK PA6:SPI_MISO PA7:SPI_MOSI

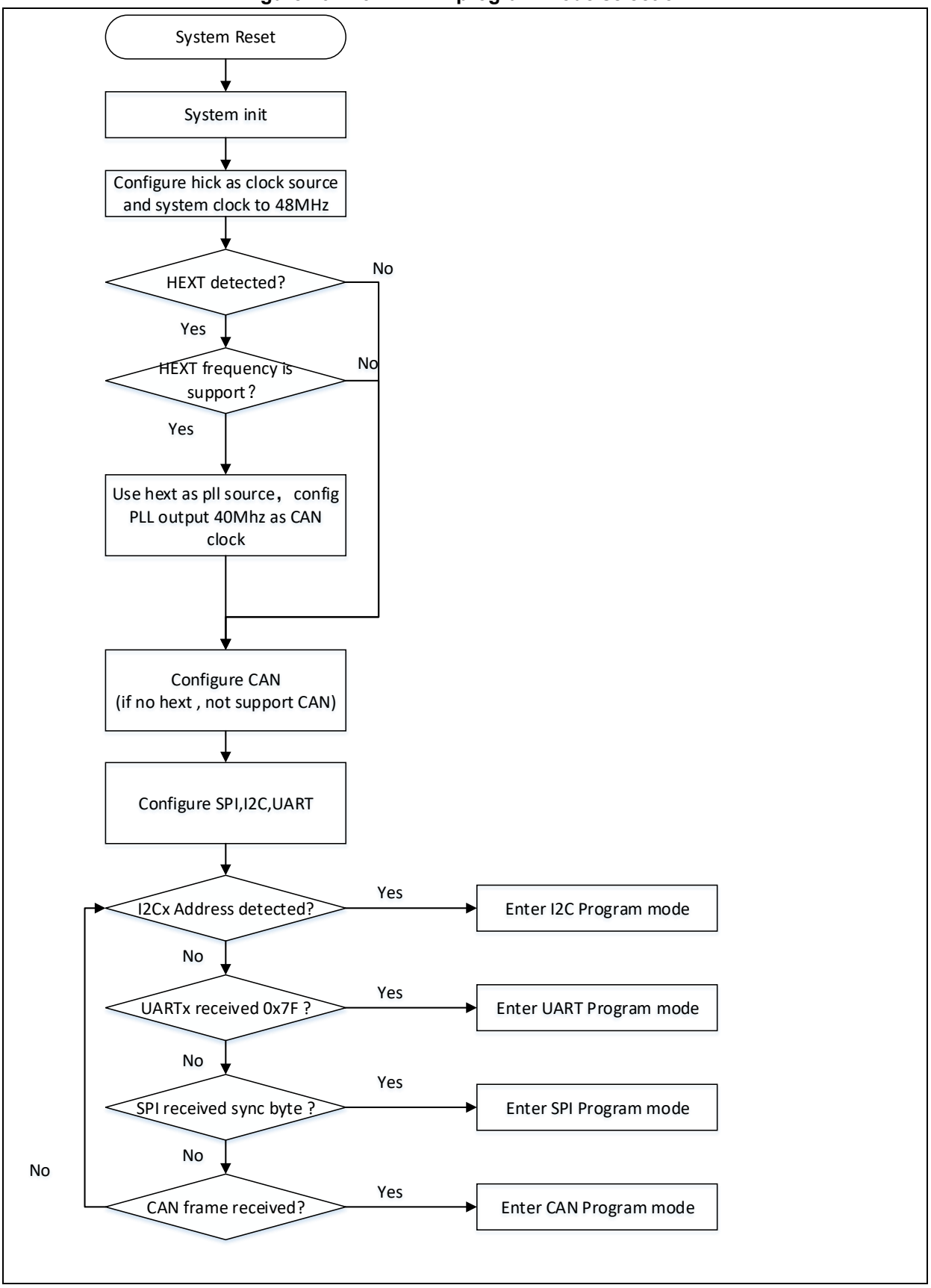
Note 1: I2C uses the Slave 7-bit address 0b0011110x.

Note 2: to use CAN, an external crystal is required, and the supported frequencies are 4MHz, 6MHz, 8MHz, 12MHz, 14.7456MHz, 16MHz, 20MHz, 24MHz and 25MHz.

Note 3: for AT32F422GxP7 and AT32F422FxP7, to use the CAN's PA11 and PA12, it is necessary to disable UART1 in the user data area. See the reference manual for details on this.

22.2 Program mode selection

Figure 26 AT32F422xx program mode selection



23 AT32F426xx Bootloader

The AT32F426xx supports UART1, UART2, I2C1, CANFD1, and SPI1.

23.1 Peripheral configuration

Table 23 AT32F426xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX
I2C1(1)	AT32F426FxP7	Not support
	Other part numbers	PB6:I2C_SCL PB7:I2C_SDA
CANFD1(2)	AT32F426GxP7，AT32F426FxP7	PA11:CANFD_RX(3) PA12:CANFD_TX(3)
	Other part numbers	PA11:CANFD_RX PA12:CANFD_TX
SPI1	All part numbers	PA4:SPI_CS PA5:SPI_SCK PA6:SPI_MISO PA7:SPI_MOSI

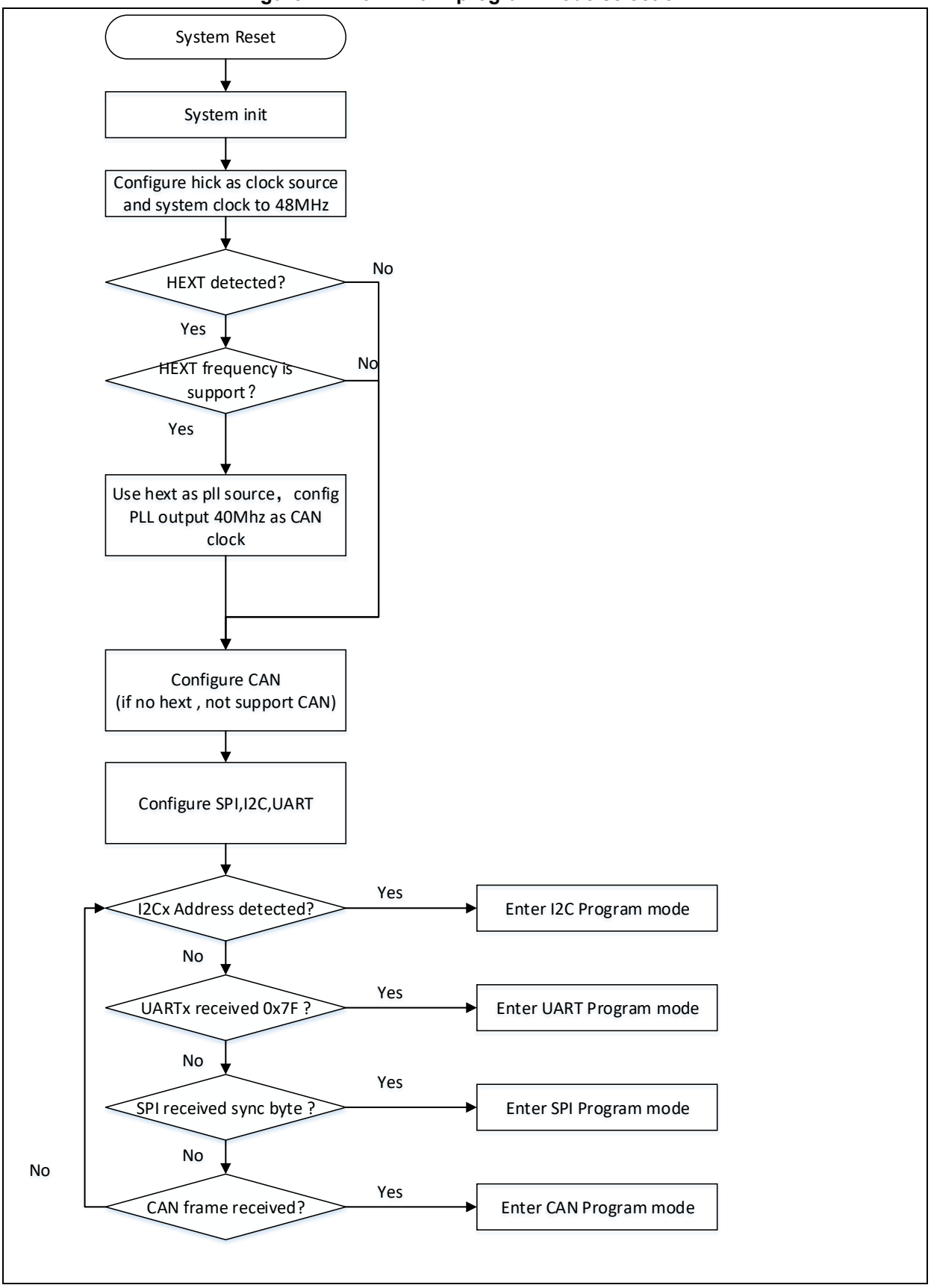
Note 1: I2C uses the Slave 7-bit address 0b0011110x.

Note 2: to use CAN, an external crystal is required, and the supported frequencies are 4MHz, 6MHz, 8MHz, 12MHz, 14.7456MHz, 16MHz, 20MHz, 24MHz and 25MHz.

Note 3: for AT32F426GxP7 and AT32F426FxP7, to use the CANFD's PA11 and PA12, it is necessary to disable UART1 in the user data area. See the reference manual for details on this.

23.2 Program mode selection

Figure 27 AT32F426xx program mode selection



24 AT32F011xx Bootloader

The AT32F011xx supports UART1, UART2.

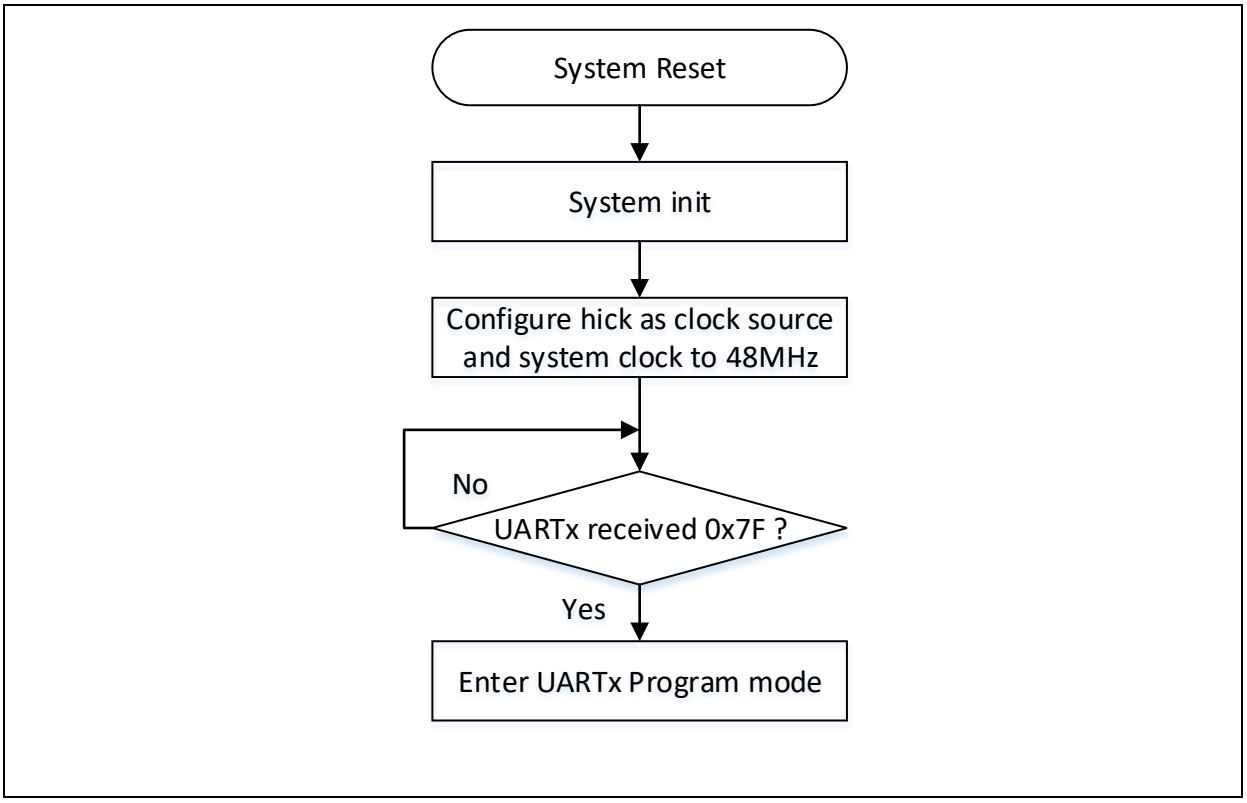
24.1 Peripheral configuration

Table 24 AT32F011xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX

24.2 Program mode selection

Figure 28 AT32F011xx program mode selection



25 AT32F403Exx Bootloader

The AT32F403Exx supports UART1, UART2 and USB_DFU.

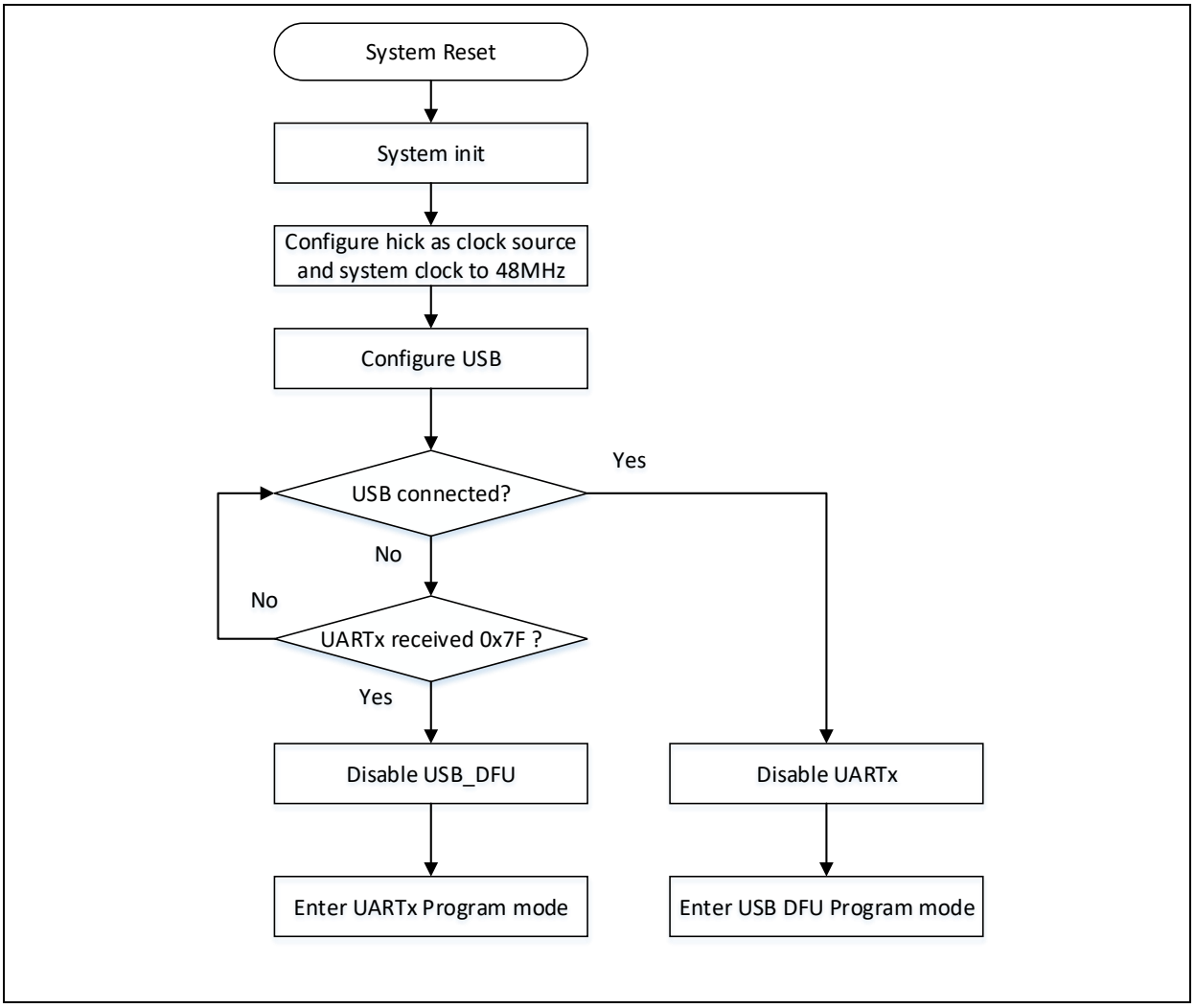
25.1 Peripheral configuration

Table 25 AT32F403Exx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	AT32F403EVP	PD5:UART_TX PD6:UART_RX
	Other part numbers	PA2:UART_TX PA3:UART_RX
USB_DFU	All part numbers	PA11:USB_DM PA12:USB_DP

25.2 Program mode selection

Figure 29 AT32F403Exx program mode selection



26 AT32F407Exx Bootloader

The AT32F407Exx supports UART1, UART2 and USB_DFU.

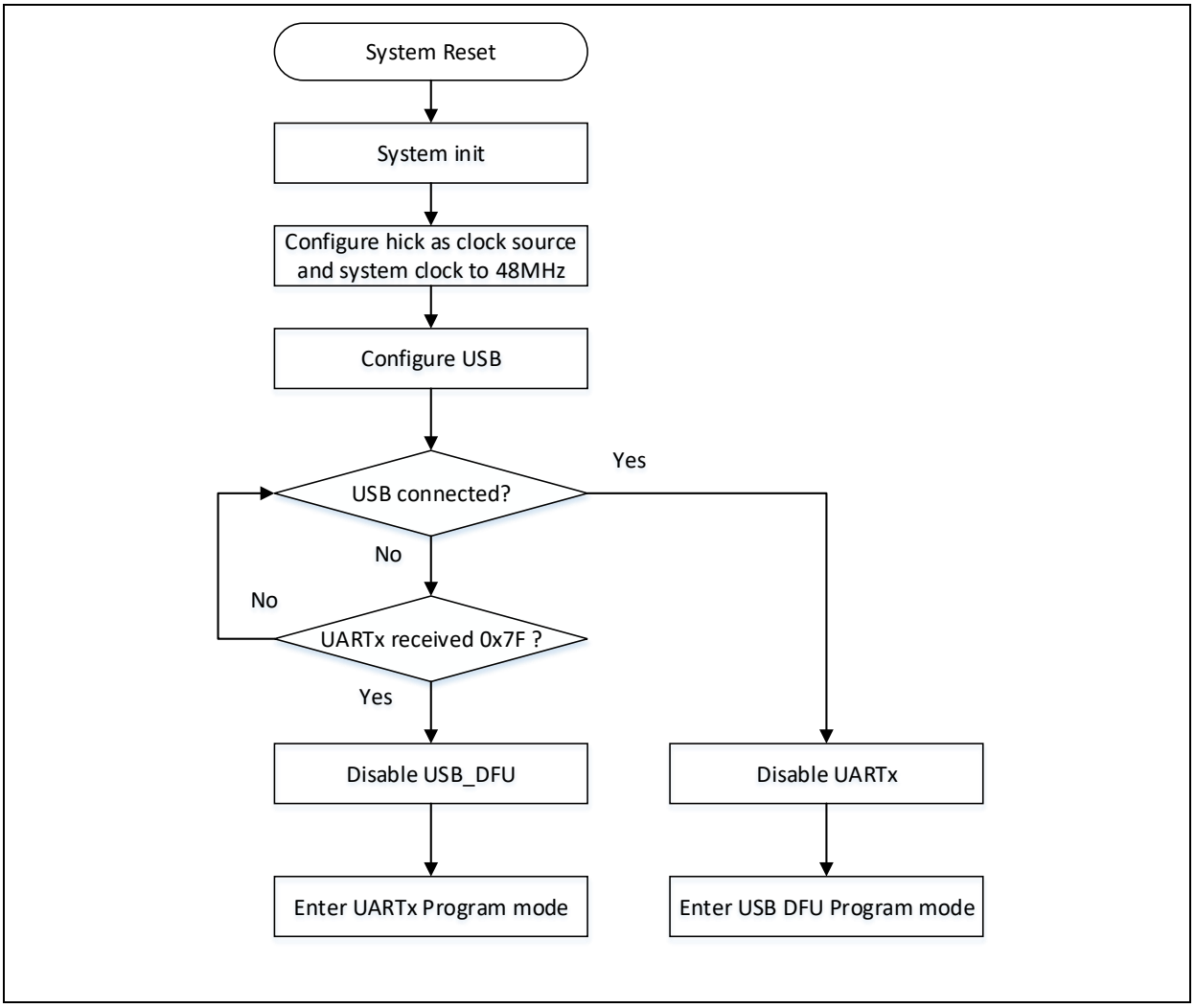
26.1 Peripheral configuration

Table 26 AT32F407Exx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	AT32F407EVP	PD5:UART_TX PD6:UART_RX
	Other part numbers	PA2:UART_TX PA3:UART_RX
USB_DFU	All part numbers	PA11:USB_DM PA12:USB_DP

26.2 Program mode selection

Figure 30 AT32F407Exx program mode selection



27 AT32F408xx Bootloader

The AT32F408xx supports UART1, UART2, UART3, OTGHS (Full Speed), I2C1, I2C2, I2C3 and SPI1.

27.1 Peripheral configuration

Table 27 AT32F408xx peripheral configuration

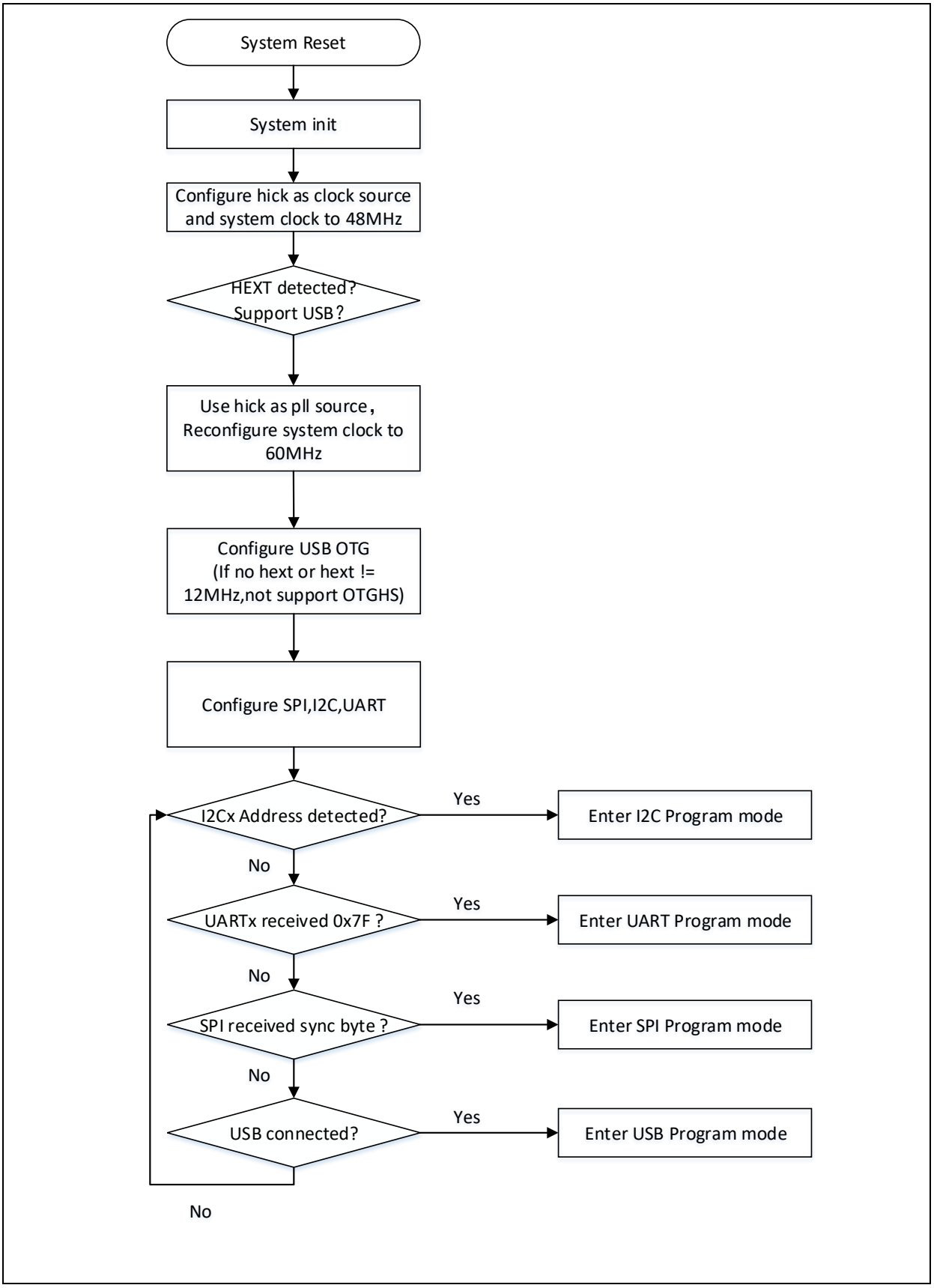
Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX
UART3	AT32F408RxT7-7 AT32F408RxT7-7R	PC10:UART_TX PC11:UART_RX
	Other part numbers	Not support
OTGHS(1)	All part numbers	OTGHS_DM OTGHS_DP
I2C1(2)	All part numbers	PB6:I2C_SCL PB7:I2C_SDA
I2C2(2)	All part numbers	PB10:I2C_SCL PB3:I2C_SDA
I2C3(2)	All part numbers	PA8:I2C_SCL PB4:I2C_SDA
SPI1	All part numbers	PA4:SPI_CS PA5:SPI_SCK PA6:SPI_MISO PA7:SPI_MOSI

Note 1: to use OTGHS, an external 12MH crystal is required,

Note 2: I2C uses the Slave 7-bit address 0b0011110x.

27.2 Program mode selection

Figure 31 AT32F408xx program mode selection



28 AT32F406xx Bootloader

The AT32F406xx supports UART1, UART2, UART3, I2C1, I2C2, I2C3 and SPI1.

28.1 Peripheral configuration

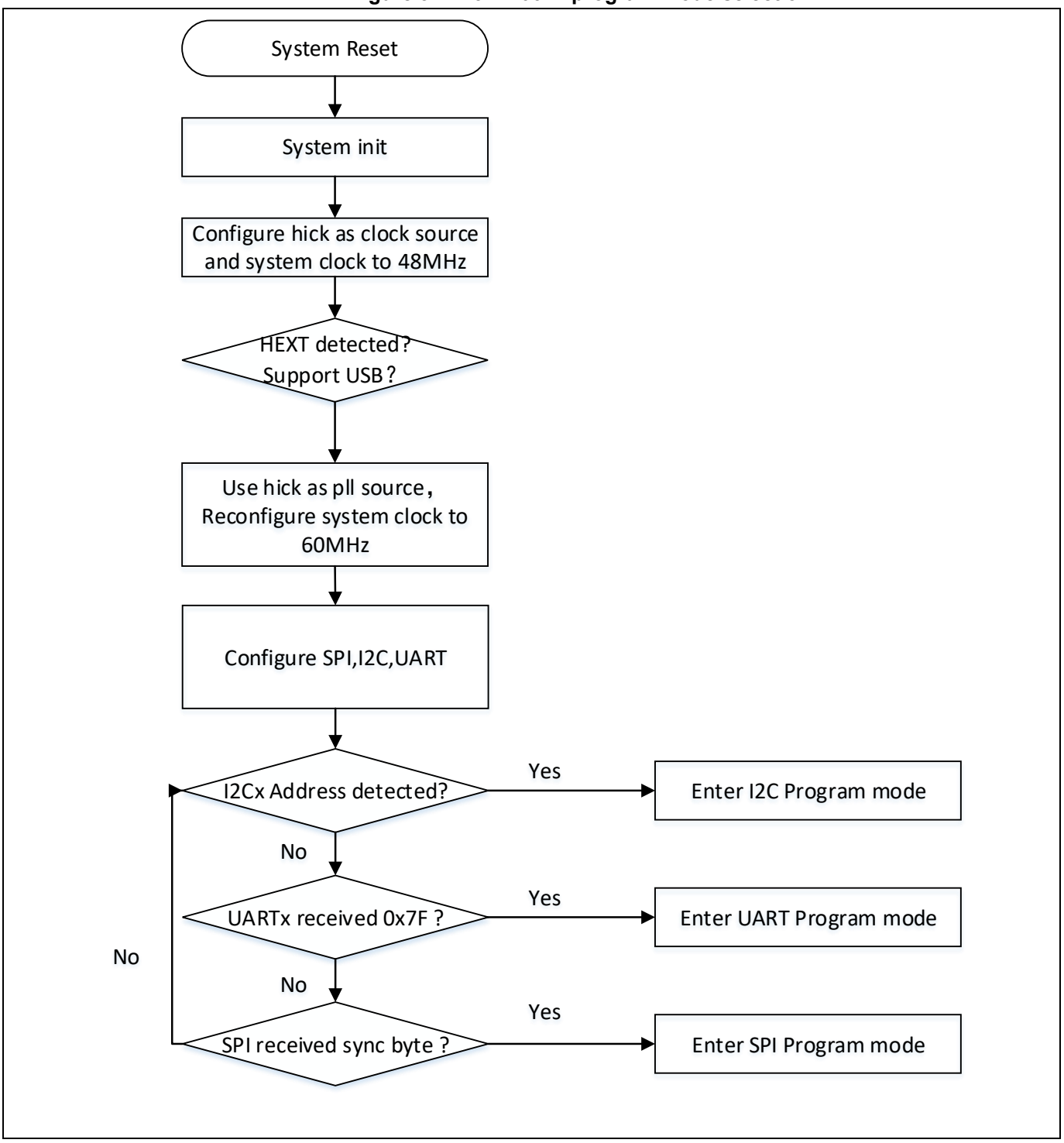
Table 28 AT32F406xx peripheral configuration

Peripherals	Application products	Pins
UART1	All part numbers	PA9:UART_TX PA10:UART_RX
UART2	All part numbers	PA2:UART_TX PA3:UART_RX
UART3	AT32F406RxT7-7 AT32F406RxT7-7R	PC10:UART_TX PC11:UART_RX
	AT32F406CxU7	PB10:UART_TX PB11:UART_RX
I2C1(2)	All part numbers	PB6:I2C_SCL PB7:I2C_SDA
I2C2(2)	All part numbers	PB10:I2C_SCL PB3:I2C_SDA
I2C3(2)	All part numbers	PA8:I2C_SCL PB4:I2C_SDA
SPI1	All part numbers	PA4:SPI_CS PA5:SPI_SCK PA6:SPI_MISO PA7:SPI_MOSI

Note 1: I2C uses the Slave 7-bit address 0b0011110x.

28.2 Program mode selection

Figure 32 AT32F406xx program mode selection



29 Revision history

Table 29 Document revision history

Date	Revision	Changes
2021.12.07	2.0.0	Initial release
2022.06.02	2.0.1	Updated the application products corresponding to UART2 and UART3 in *Table 9*.
2022.06.15	2.0.2	Updated the bootloader conditions corresponding to AT32F421xx and AT32F425xx in *Table 1.*
2023.01.05	2.0.3	1. Added AT32L021 series bootloader description 2. Added AT32F423 series bootloader description 3. Modified USART3 support for PB10 and PB11 on the version B of AT32F435/437, see *Table 8* and *Table 9.*
2023.06.30	2.0.4	1.Added AT32F405/402 series bootloader description 2. Added AT32A403A series bootloader description
2024.03.20	2.0.5	1.Added AT32A423 series bootloader description
2024.12.11	2.0.6	1. Added AT32M412 series bootloader description 2. Added AT32M416 series bootloader description 3. Added AT32F455/456/457 series bootloader description
2025.05.20	2.0.7	1. Added AT32F422 series bootloader description 2. Added AT32F426 series bootloader description
2025.08.05	2.0.8	1. Added AT32F011 series bootloader description
2026.01.26	2.0.9	1. Added AT32F403E series bootloader description 2. Added AT32F407E series bootloader description
2026.06.01	2.1.0	1. Added AT32F408 series bootloader description 2. Added AT32F406 series bootloader description

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