Tema3

Entrada/Salida en Procesador Cortex M3

Indice

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3.1 Chip LPC1768

◆LPC1768

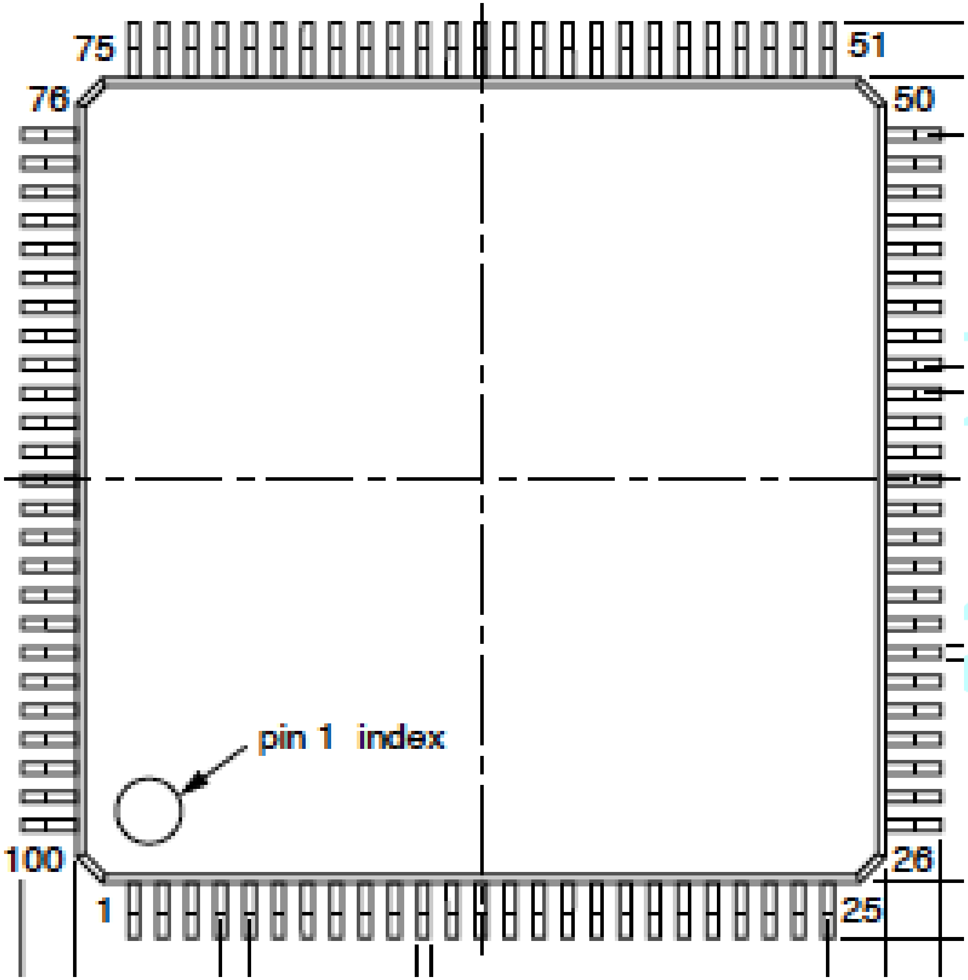
- **Trabaja a una frecuencia de CPU de hasta 100 MHz.**
- **La CPU Cortex-M3 incorpora pipeline de 3-estados y usa arquitectura Harvard con bus de datos e instrucciones separados, además incorpora un tercer bus para comunicación con los periféricos.**
- **El LPC17xx incluye los siguientes periféricos:**
  - Hasta 512 kB de memoria flash.
  - Hasta 64 kB de memoria de datos.
  - Ethernet MAC.
  - USB interfase.
  - Un controlador de DMA de 8 canales.
  - 4 UARTs.
  - 2 canales CAN, 2 controladores SSP, y un SPI interfase.
  - 3 I2C interfaces.
  - I2S interfase.

3.1 Chip LPC1768

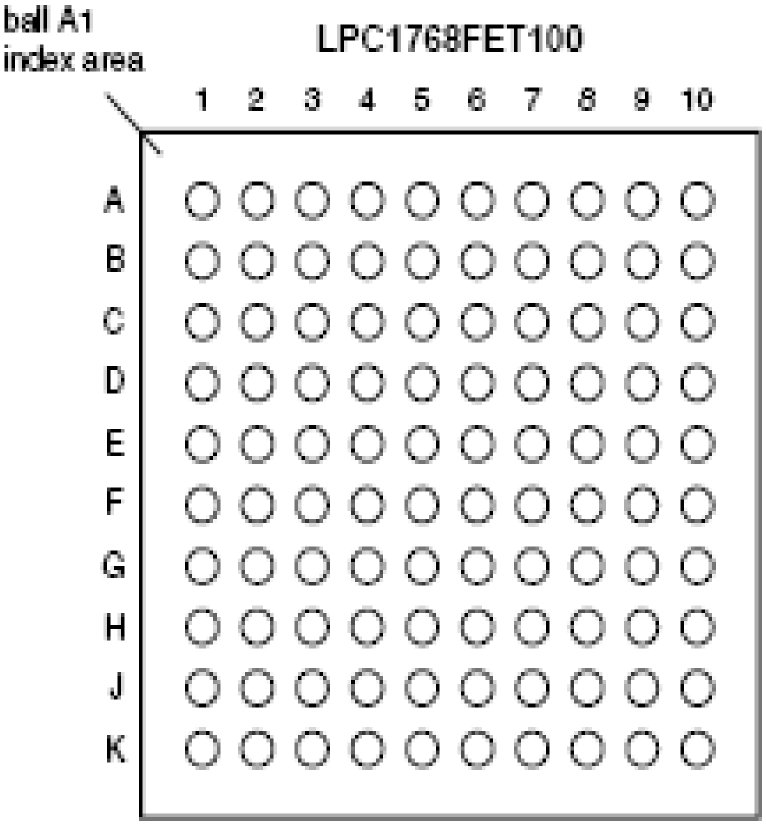
◆LPC1768

- **El LPC17xx incluye los siguientes periféricos:**
  - Un ADC de 12 bits y 8 canales de entrada y un DAC de 10-bit.
  - 4 timers de propósito general.
  - 6 salidas de PWM.
  - Un reloj de tiempo real de bajo consumo con batería separada.
  - Hasta 70 pines de entrada/salida de propósito general.
- **Los pines de entrada/salida se organizan en 5 puertos.**
- **Se comercializa en dos tipos de encapsulado: LQFP100 y TFBGA100**

3.1 Chip LPC1768


75
51
76
50
pin 1 index
100
26
1
25

3.1 Chip LPC1768


ball A1
index area
LPC1768FET100
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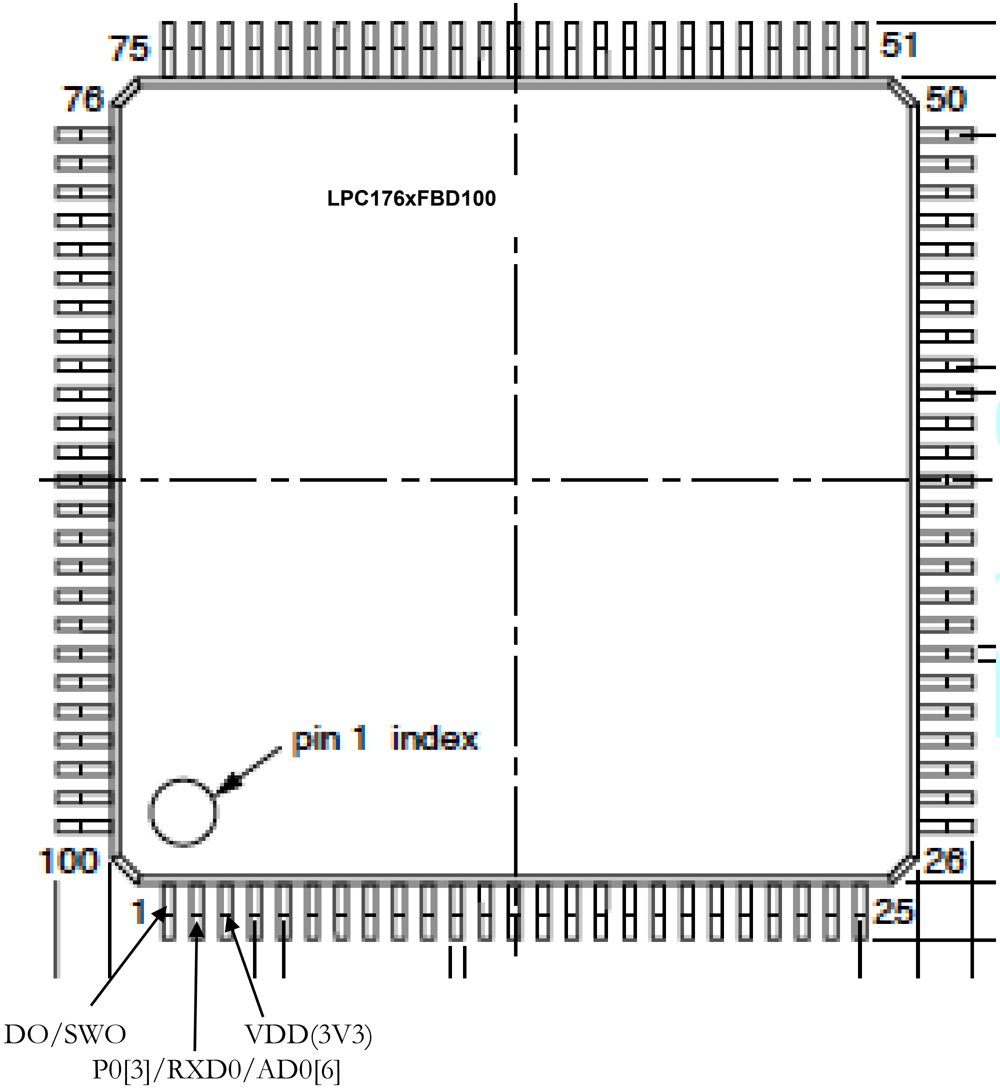
3.1 Chip LPC1768


75
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LPC176xFBD100
pin 1 index
100
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1
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DO/SWO
VDD(3V3)
P0[3]/RXD0/AD0[6]

3.2 Selección de Funcion de Pin

Registro PINSEL

- Permite seleccionar la funcionalidad de cada pin.
- Dos bits por pin.

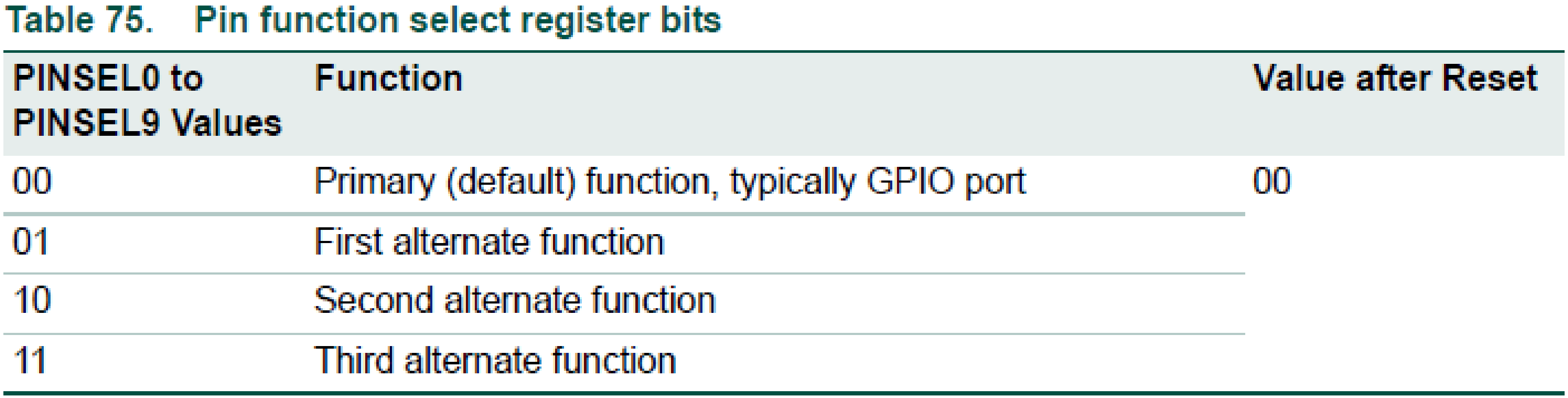


Table 75. Pin function select register bits

PINSEL0 to PINSEL9 Values	Function	Value after Reset
00	Primary (default) function, typically GPIO port	00
01	First alternate function	
10	Second alternate function	
11	Third alternate function	

3.2 Selección de Funcion de Pin

◆Registro PINSEL

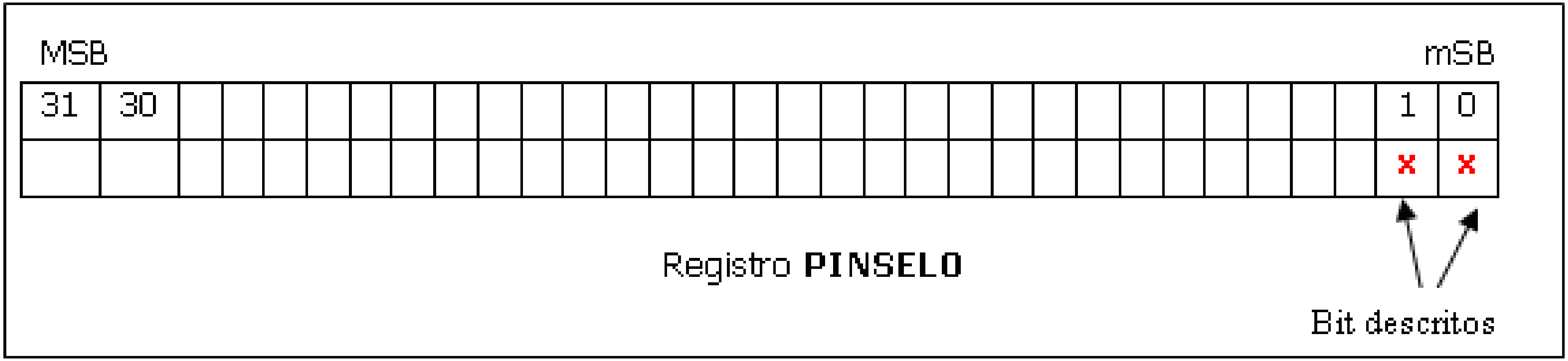


Table 79. Pin function select register 0 (PINSEL0 - address 0x4002 C000) bit description

PINSEL0	Pin name	Function when 00	Function when 01	Function when 10	Function when 11	Reset value
1:0	P0.0	GPIO Port 0.0	RD1	TXD3	SDA1	00
3:2	P0.1	GPIO Port 0.1	TD1	RXD3	SCL1	00
5:4	P0.2	GPIO Port 0.2	TXD0	AD0.7	Reserved	00
:	:				:	:
23:22	P0.11	GPIO Port 0.11	RXD2	SCL2	MAT3.1	00
29:24	-	Reserved	Reserved	Reserved	Reserved	0
31:30	P0.15	GPIO Port 0.15	TXD1	SCK0	SCK	00

3.2 Selección de Funcion de Pin

- **Registro PINMODE**
  - **Permite seleccionar la configuracion electrica de cada pin.**

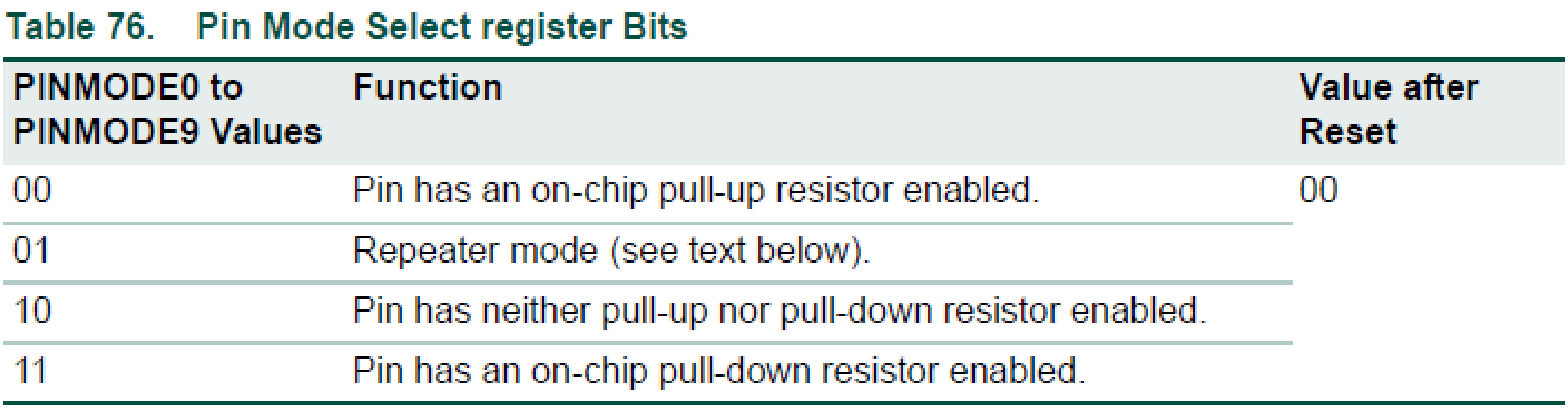


Table 76. Pin Mode Select register Bits

PINMODE0 to PINMODE9 Values	Function	Value after Reset
00	Pin has an on-chip pull-up resistor enabled.	00
01	Repeater mode (see text below).	
10	Pin has neither pull-up nor pull-down resistor enabled.	
11	Pin has an on-chip pull-down resistor enabled.	

3.2 Selección de Funcion de Pin

- **Register PINMODE_OD**
  - **Permite seleccionar la configuracion electrica de cada pin.**

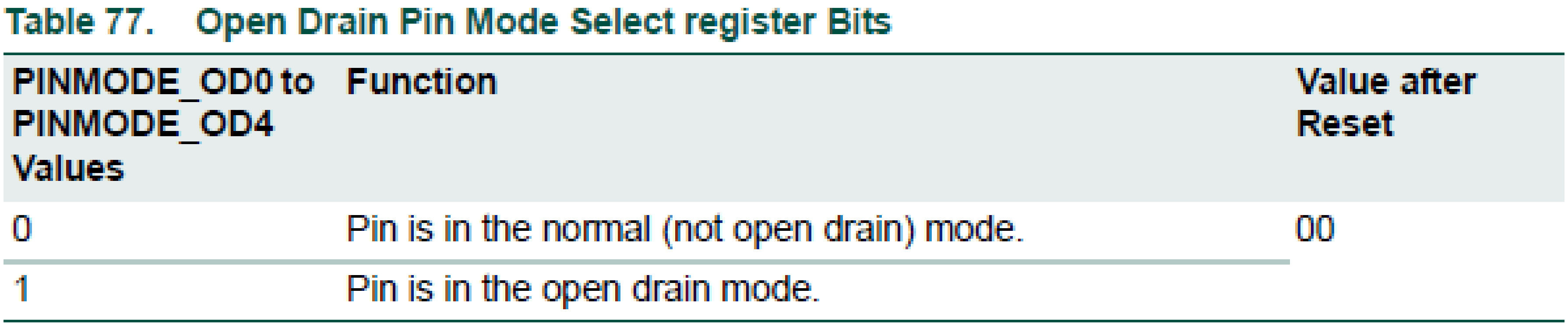


Table 77. Open Drain Pin Mode Select register Bits

PINMODE_OD0 to PINMODE_OD4 Values	Function	Value after Reset
0	Pin is in the normal (not open drain) mode.	00
1	Pin is in the open drain mode.	

3.3 Registros de Configuracion de GPIO

- **Entradas/Salidas de Propósito General (General Porpouse Inputs Outputs, GPIOs)**
  - **5 puertos**

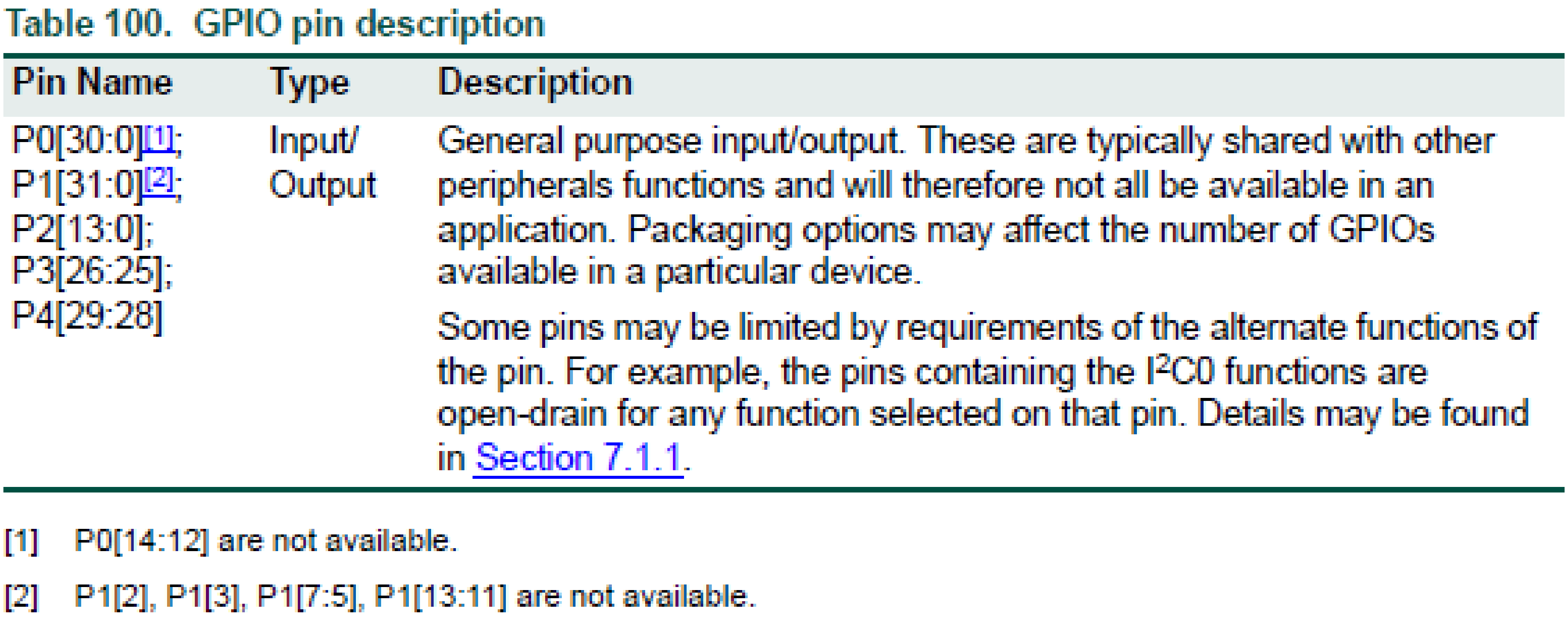


Table 100. GPIO pin description

Pin Name	Type	Description
P0[30:0][1]; P1[31:0][2]; P2[13:0]; P3[26:25]; P4[29:28]	Input/ Output	General purpose input/output. These are typically shared with other peripherals functions and will therefore not all be available in an application. Packaging options may affect the number of GPIOs available in a particular device. Some pins may be limited by requirements of the alternate functions of the pin. For example, the pins containing the I^{2}C0 functions are open-drain for any function selected on that pin. Details may be found in Section 7.1.1.

[1] P0[14:12] are not available.

[2] P1[2], P1[3], P1[7:5], P1[13:11] are not available.

3.3 Registros de Configuracion de GPIO

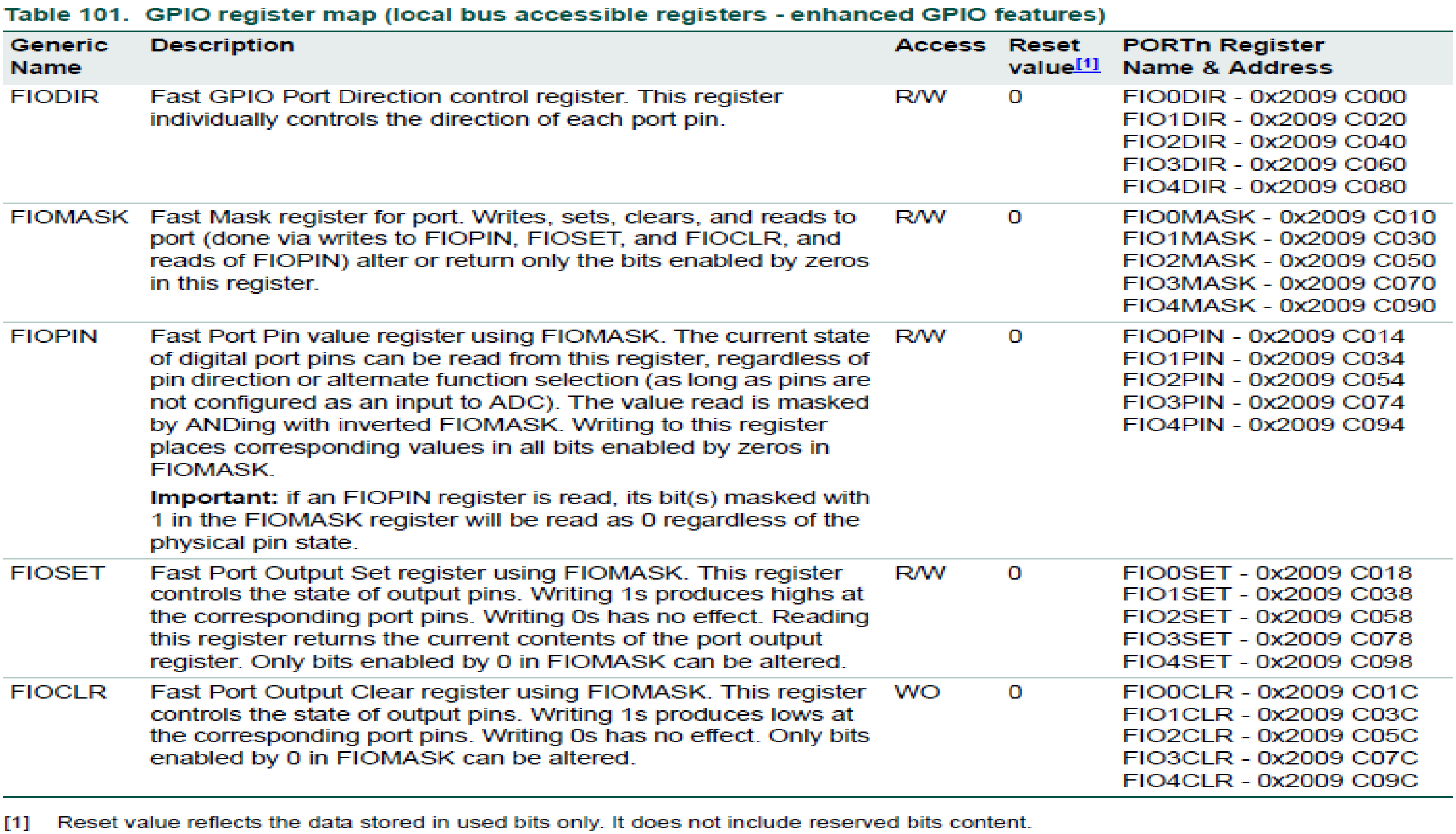


Table 101. GPIO register map (local bus accessible registers - enhanced GPIO features)

Generic Name	Description	Access	Reset value[1]	PORTn Register Name & Address
FIODIR	Fast GPIO Port Direction control register. This register individually controls the direction of each port pin.	R/W	0	FIO0DIR - 0x2009 C000 FIO1DIR - 0x2009 C020 FIO2DIR - 0x2009 C040 FIO3DIR - 0x2009 C060 FIO4DIR - 0x2009 C080
FIOMASK	Fast Mask register for port. Writes, sets, clears, and reads to port (done via writes to FIOPIN, FIOSET, and FIOCLR, and reads of FIOPIN) alter or return only the bits enabled by zeros in this register.	R/W	0	FIO0MASK - 0x2009 C010 FIO1MASK - 0x2009 C030 FIO2MASK - 0x2009 C050 FIO3MASK - 0x2009 C070 FIO4MASK - 0x2009 C090
FIOPIN	Fast Port Pin value register using FIOMASK. The current state of digital port pins can be read from this register, regardless of pin direction or alternate function selection (as long as pins are not configured as an input to ADC). The value read is masked by ANDing with inverted FIOMASK. Writing to this register places corresponding values in all bits enabled by zeros in FIOMASK. **Important:** if an FIOPIN register is read, its bit(s) masked with 1 in the FIOMASK register will be read as 0 regardless of the physical pin state.	R/W	0	FIO0PIN - 0x2009 C014 FIO1PIN - 0x2009 C034 FIO2PIN - 0x2009 C054 FIO3PIN - 0x2009 C074 FIO4PIN - 0x2009 C094
FIOSET	Fast Port Output Set register using FIOMASK. This register controls the state of output pins. Writing 1s produces highs at the corresponding port pins. Writing 0s has no effect. Reading this register returns the current contents of the port output register. Only bits enabled by 0 in FIOMASK can be altered.	R/W	0	FIO0SET - 0x2009 C018 FIO1SET - 0x2009 C038 FIO2SET - 0x2009 C058 FIO3SET - 0x2009 C078 FIO4SET - 0x2009 C098
FIOCLR	Fast Port Output Clear register using FIOMASK. This register controls the state of output pins. Writing 1s produces lows at the corresponding port pins. Writing 0s has no effect. Only bits enabled by 0 in FIOMASK can be altered.	WO	0	FIO0CLR - 0x2009 C01C FIO1CLR - 0x2009 C03C FIO2CLR - 0x2009 C05C FIO3CLR - 0x2009 C07C FIO4CLR - 0x2009 C09C

[1] Reset value reflects the data stored in used bits only. It does not include reserved bits content.

3.3 Registros de Configuracion de GPIO

Registro FIODIR

- Permite definir la direccion de la comunicación.
- Se puede acceder al registro en tamaño word, half-word or byte

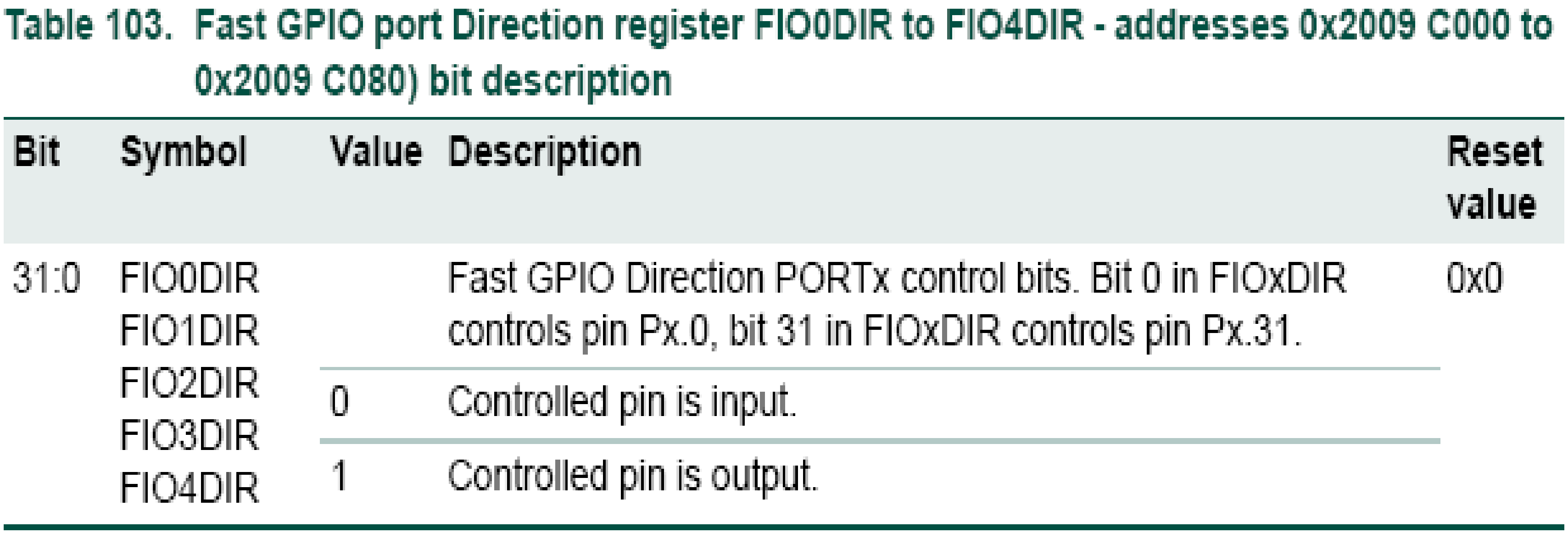


Table 103. Fast GPIO port Direction register FIO0DIR to FIO4DIR - addresses 0x2009 C000 to 0x2009 C080) bit description

Bit	Symbol	Value	Description	Reset value
31:0	FIO0DIR FIO1DIR FIO2DIR FIO3DIR FIO4DIR		Fast GPIO Direction PORTx control bits. Bit 0 in FIOxDIR controls pin Px.0, bit 31 in FIOxDIR controls pin Px.31.	0x0
		0	Controlled pin is input.	
		1	Controlled pin is output.	

3.3 Registros de Configuracion de GPIO

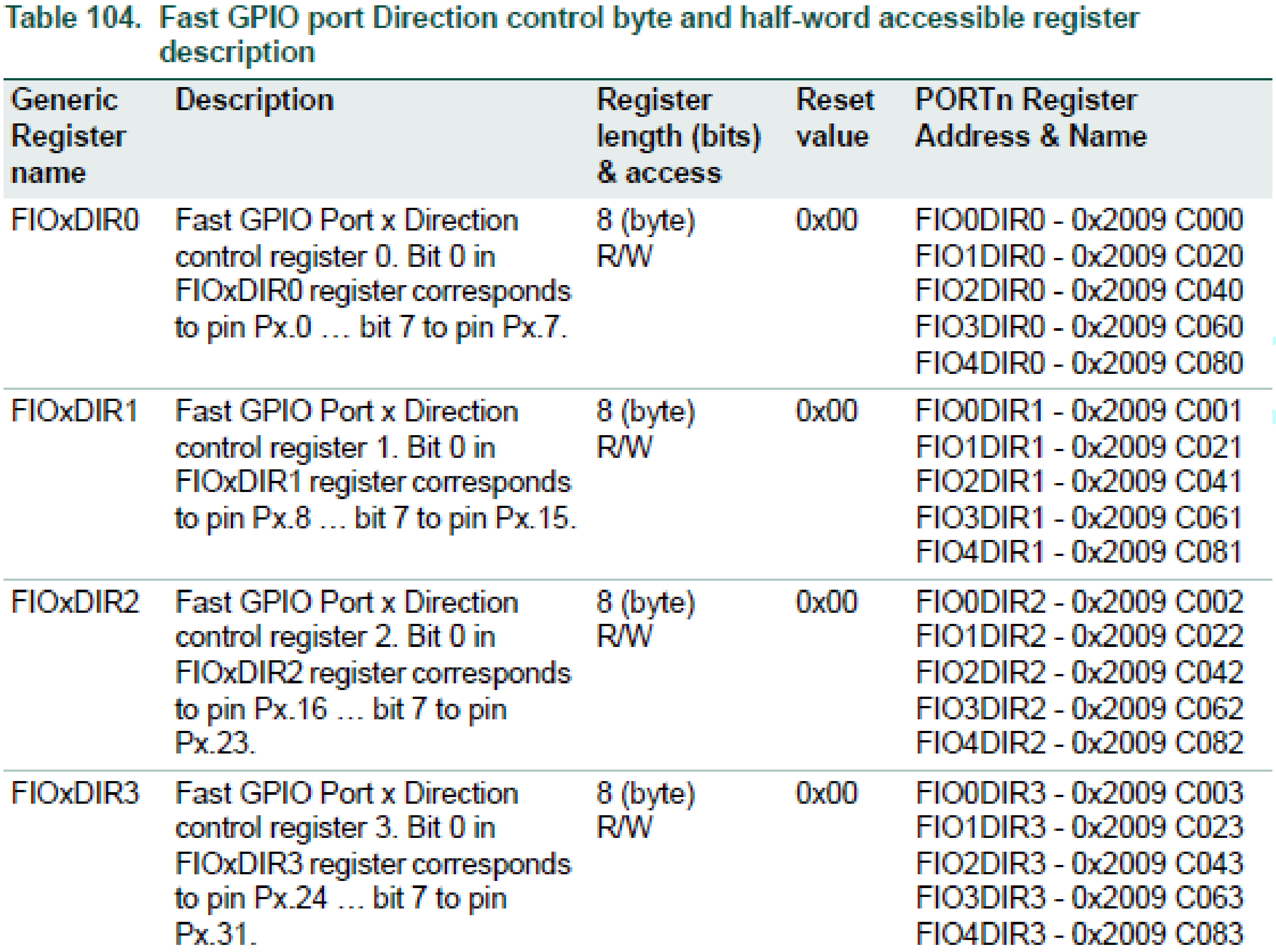
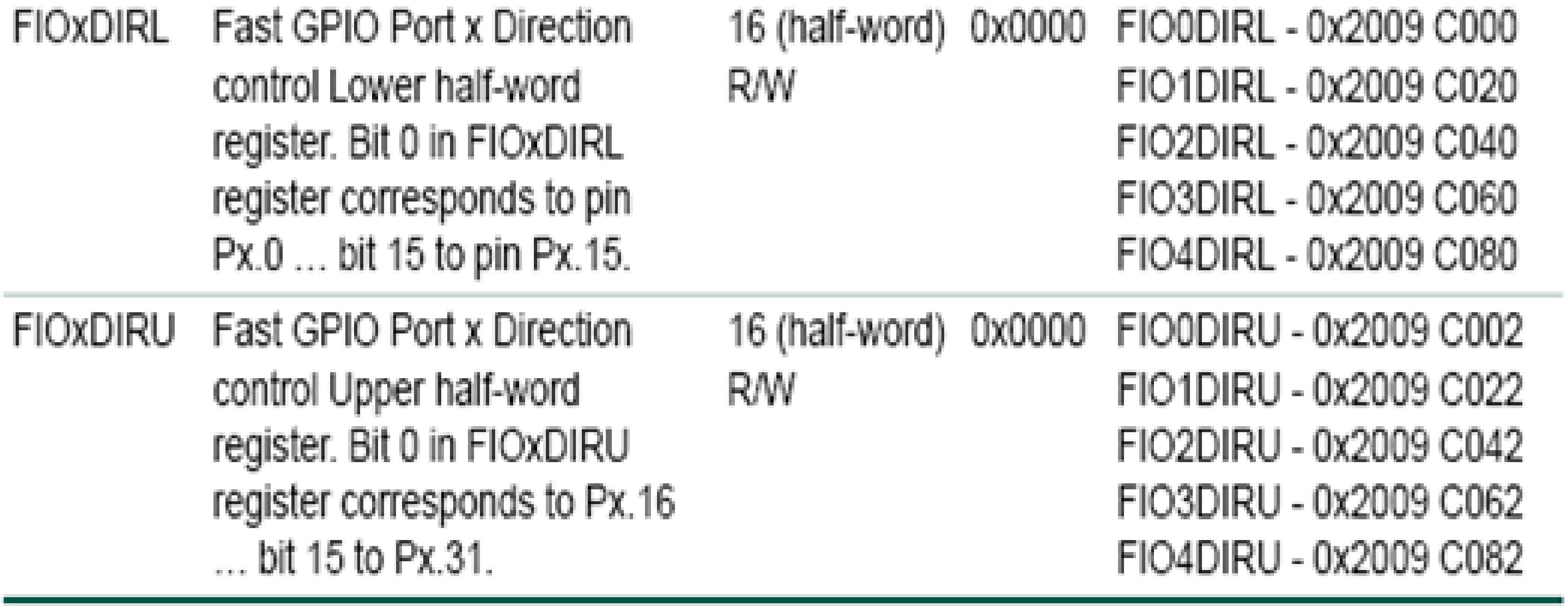


Table 104. Fast GPIO port Direction control byte and half-word accessible register description

Generic Register name	Description	Register length (bits) & access	Reset value	PORTn Register Address & Name
FIOxDIR0	Fast GPIO Port x Direction control register 0. Bit 0 in FIOxDIR0 register corresponds to pin Px.0 … bit 7 to pin Px.7.	8 (byte) R/W	0x00	FIO0DIR0 - 0x2009 C000 FIO1DIR0 - 0x2009 C020 FIO2DIR0 - 0x2009 C040 FIO3DIR0 - 0x2009 C060 FIO4DIR0 - 0x2009 C080
FIOxDIR1	Fast GPIO Port x Direction control register 1. Bit 0 in FIOxDIR1 register corresponds to pin Px.8 … bit 7 to pin Px.15.	8 (byte) R/W	0x00	FIO0DIR1 - 0x2009 C001 FIO1DIR1 - 0x2009 C021 FIO2DIR1 - 0x2009 C041 FIO3DIR1 - 0x2009 C061 FIO4DIR1 - 0x2009 C081
FIOxDIR2	Fast GPIO Port x Direction control register 2. Bit 0 in FIOxDIR2 register corresponds to pin Px.16 … bit 7 to pin Px.23.	8 (byte) R/W	0x00	FIO0DIR2 - 0x2009 C002 FIO1DIR2 - 0x2009 C022 FIO2DIR2 - 0x2009 C042 FIO3DIR2 - 0x2009 C062 FIO4DIR2 - 0x2009 C082
FIOxDIR3	Fast GPIO Port x Direction control register 3. Bit 0 in FIOxDIR3 register corresponds to pin Px.24 … bit 7 to pin Px.31.	8 (byte) R/W	0x00	FIO0DIR3 - 0x2009 C003 FIO1DIR3 - 0x2009 C023 FIO2DIR3 - 0x2009 C043 FIO3DIR3 - 0x2009 C063 FIO4DIR3 - 0x2009 C083

3.3 Registros de Configuracion de GPIO



FIOxDIRL	Fast GPIO Port x Direction control Lower half-word register. Bit 0 in FIOxDIRL register corresponds to pin Px.0 … bit 15 to pin Px.15.	16 (half-word) R/W	0x0000	FIO0DIRL - 0x2009 C000 FIO1DIRL - 0x2009 C020 FIO2DIRL - 0x2009 C040 FIO3DIRL - 0x2009 C060 FIO4DIRL - 0x2009 C080
FIOxDIRU	Fast GPIO Port x Direction control Upper half-word register. Bit 0 in FIOxDIRU register corresponds to Px.16 … bit 15 to Px.31.	16 (half-word) R/W	0x0000	FIO0DIRU - 0x2009 C002 FIO1DIRU - 0x2009 C022 FIO2DIRU - 0x2009 C042 FIO3DIRU - 0x2009 C062 FIO4DIRU - 0x2009 C082

3.3 Registros de Configuracion de GPIO

◆ Registro FIOPIN.

- **Podemos obtener el valor digital de cada pin leyendo este registro**
- **Podemos establecer el valor electrico de un pin escribiendo en este registro**
- **Depende del valor del registro FIOMASK**

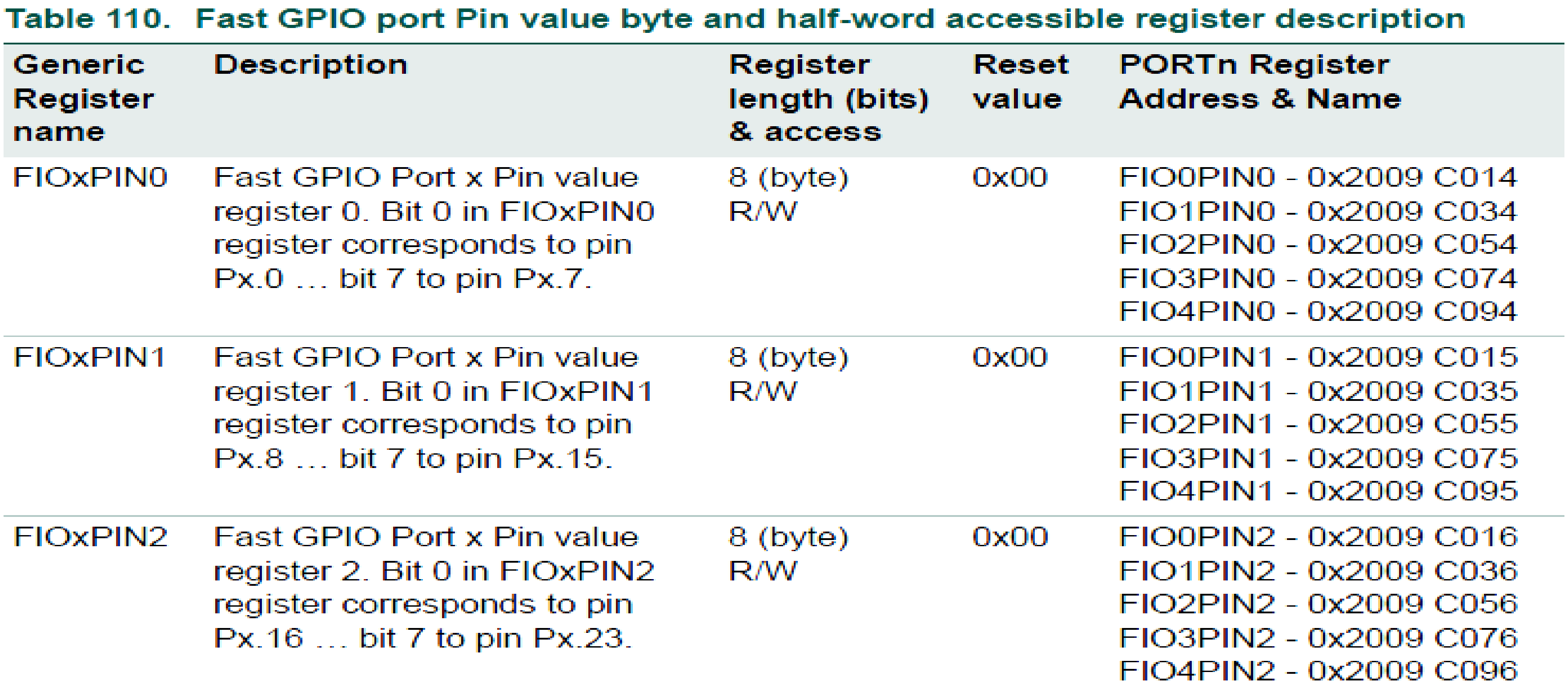


Table 110. Fast GPIO port Pin value byte and half-word accessible register description

Generic Register name	Description	Register length (bits) & access	Reset value	PORTn Register Address & Name
FIOxPIN0	Fast GPIO Port x Pin value register 0. Bit 0 in FIOxPIN0 register corresponds to pin Px.0 … bit 7 to pin Px.7.	8 (byte) R/W	0x00	FIO0PIN0 - 0x2009 C014 FIO1PIN0 - 0x2009 C034 FIO2PIN0 - 0x2009 C054 FIO3PIN0 - 0x2009 C074 FIO4PIN0 - 0x2009 C094
FIOxPIN1	Fast GPIO Port x Pin value register 1. Bit 0 in FIOxPIN1 register corresponds to pin Px.8 … bit 7 to pin Px.15.	8 (byte) R/W	0x00	FIO0PIN1 - 0x2009 C015 FIO1PIN1 - 0x2009 C035 FIO2PIN1 - 0x2009 C055 FIO3PIN1 - 0x2009 C075 FIO4PIN1 - 0x2009 C095
FIOxPIN2	Fast GPIO Port x Pin value register 2. Bit 0 in FIOxPIN2 register corresponds to pin Px.16 … bit 7 to pin Px.23.	8 (byte) R/W	0x00	FIO0PIN2 - 0x2009 C016 FIO1PIN2 - 0x2009 C036 FIO2PIN2 - 0x2009 C056 FIO3PIN2 - 0x2009 C076 FIO4PIN2 - 0x2009 C096

3.3 Registros de Configuracion de GPIO

◆Registro FIOSET

- Permite escribir un ‘1’ en el pin

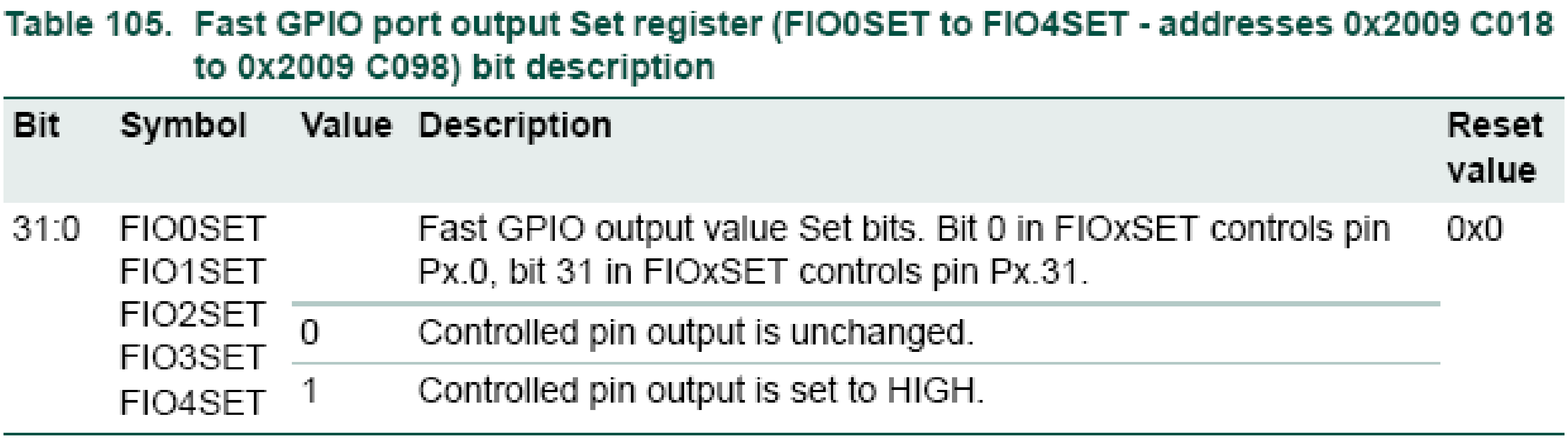


Table 105. Fast GPIO port output Set register (FIO0SET to FIO4SET - addresses 0x2009 C018 to 0x2009 C098) bit description

Bit	Symbol	Value	Description	Reset value
31:0	FIO0SET FIO1SET FIO2SET FIO3SET FIO4SET		Fast GPIO output value Set bits. Bit 0 in FIOxSET controls pin Px.0, bit 31 in FIOxSET controls pin Px.31.	0x0
		0	Controlled pin output is unchanged.	
		1	Controlled pin output is set to HIGH.	

3.3 Registros de Configuracion de GPIO

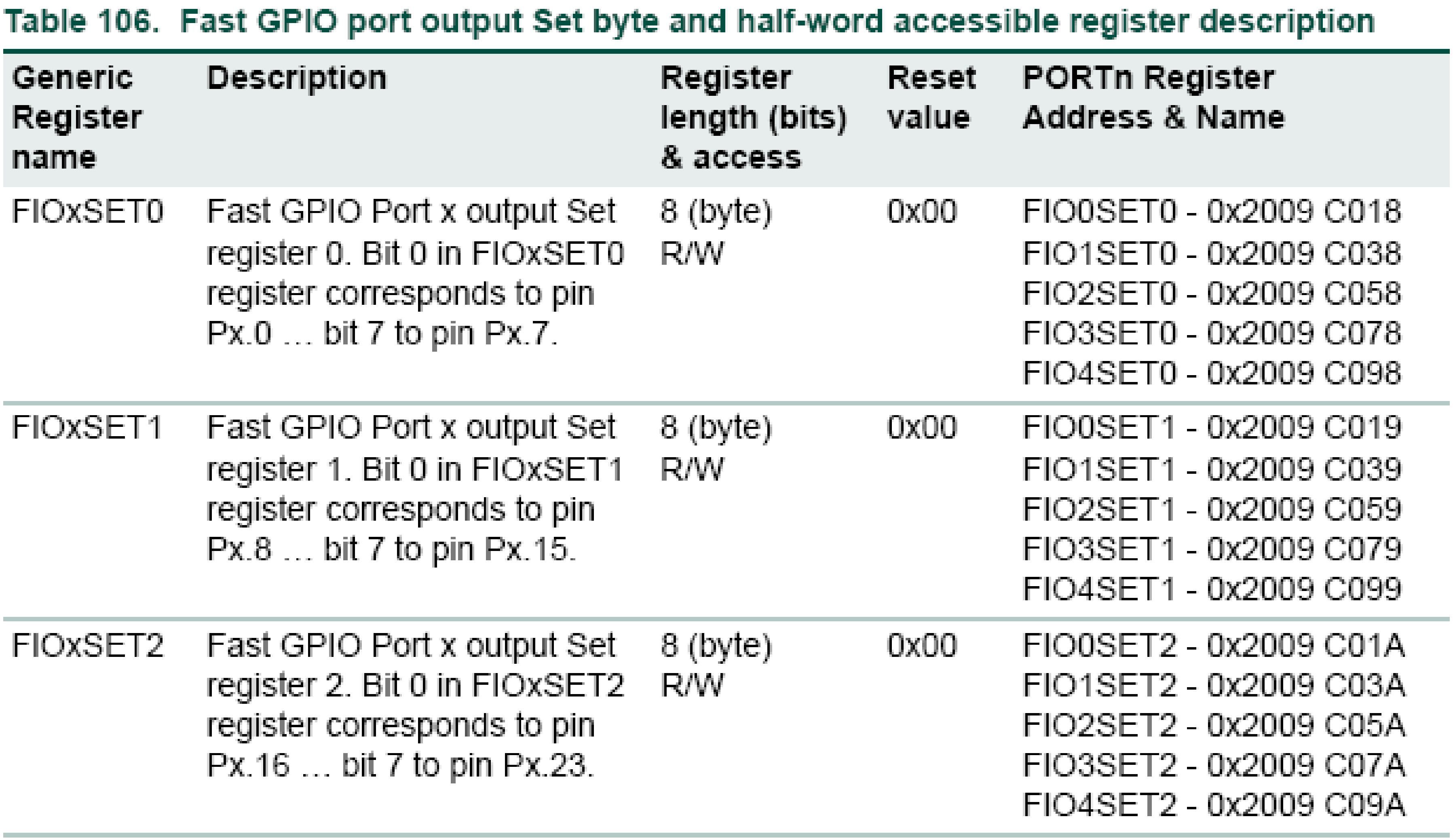
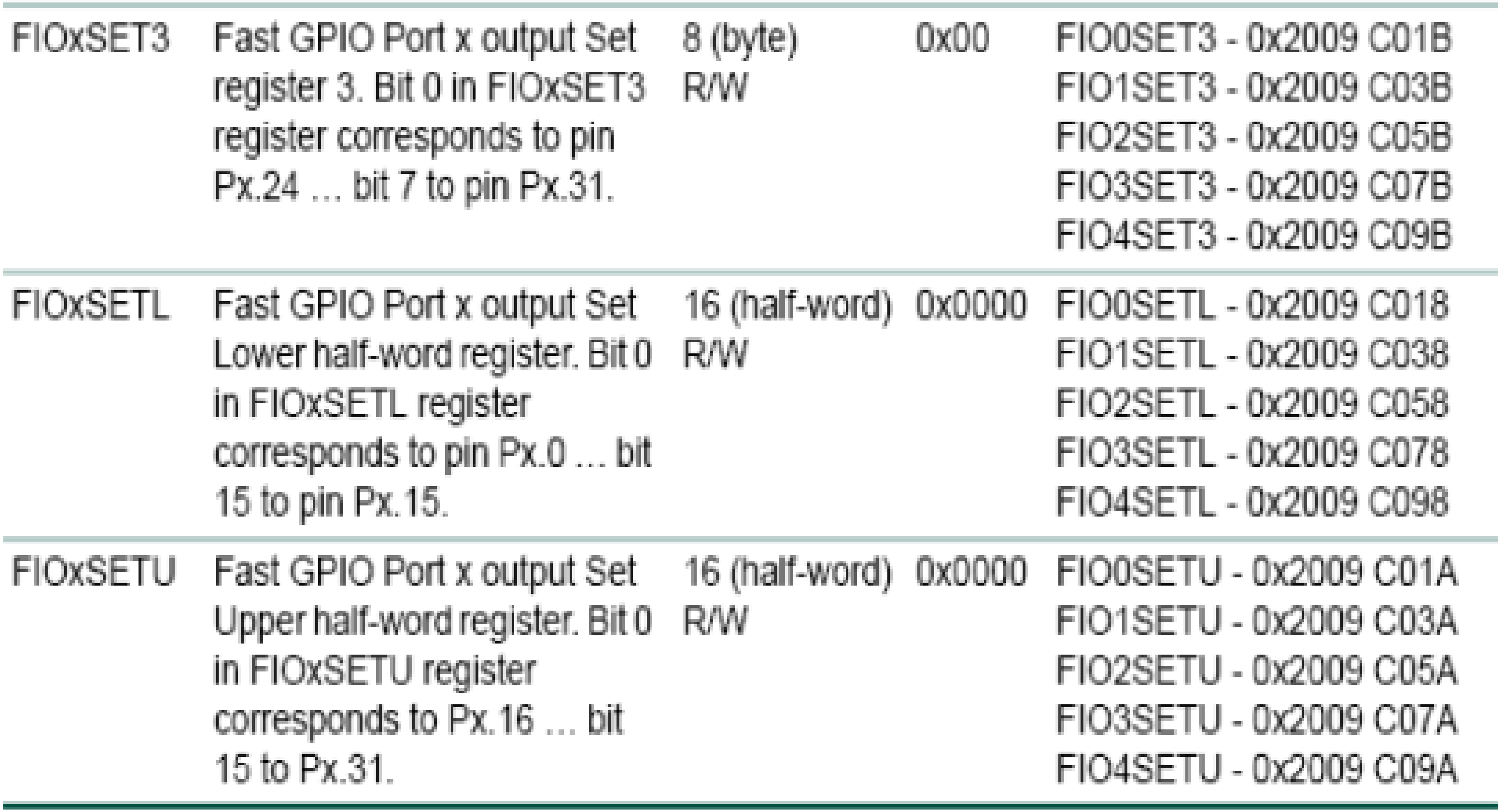


Table 106. Fast GPIO port output Set byte and half-word accessible register description

Generic Register name	Description	Register length (bits) & access	Reset value	PORTn Register Address & Name
FIOxSET0	Fast GPIO Port x output Set register 0. Bit 0 in FIOxSET0 register corresponds to pin Px.0 … bit 7 to pin Px.7.	8 (byte) R/W	0x00	FIO0SET0 - 0x2009 C018 FIO1SET0 - 0x2009 C038 FIO2SET0 - 0x2009 C058 FIO3SET0 - 0x2009 C078 FIO4SET0 - 0x2009 C098
FIOxSET1	Fast GPIO Port x output Set register 1. Bit 0 in FIOxSET1 register corresponds to pin Px.8 … bit 7 to pin Px.15.	8 (byte) R/W	0x00	FIO0SET1 - 0x2009 C019 FIO1SET1 - 0x2009 C039 FIO2SET1 - 0x2009 C059 FIO3SET1 - 0x2009 C079 FIO4SET1 - 0x2009 C099
FIOxSET2	Fast GPIO Port x output Set register 2. Bit 0 in FIOxSET2 register corresponds to pin Px.16 … bit 7 to pin Px.23.	8 (byte) R/W	0x00	FIO0SET2 - 0x2009 C01A FIO1SET2 - 0x2009 C03A FIO2SET2 - 0x2009 C05A FIO3SET2 - 0x2009 C07A FIO4SET2 - 0x2009 C09A

3.3 Registros de Configuracion de GPIO



FIOxSET3	Fast GPIO Port x output Set register 3. Bit 0 in FIOxSET3 register corresponds to pin Px.24 … bit 7 to pin Px.31.	8 (byte) R/W	0x00	FIO0SET3 - 0x2009 C01B FIO1SET3 - 0x2009 C03B FIO2SET3 - 0x2009 C05B FIO3SET3 - 0x2009 C07B FIO4SET3 - 0x2009 C09B
FIOxSETL	Fast GPIO Port x output Set Lower half-word register. Bit 0 in FIOxSETL register corresponds to pin Px.0 … bit 15 to pin Px.15.	16 (half-word) R/W	0x0000	FIO0SETL - 0x2009 C018 FIO1SETL - 0x2009 C038 FIO2SETL - 0x2009 C058 FIO3SETL - 0x2009 C078 FIO4SETL - 0x2009 C098
FIOxSETU	Fast GPIO Port x output Set Upper half-word register. Bit 0 in FIOxSETU register corresponds to Px.16 … bit 15 to Px.31.	16 (half-word) R/W	0x0000	FIO0SETU - 0x2009 C01A FIO1SETU - 0x2009 C03A FIO2SETU - 0x2009 C05A FIO3SETU - 0x2009 C07A FIO4SETU - 0x2009 C09A

3.3 Registros de Configuracion de GPIO

◆Registro FIOCLR

- Permite escribir un ‘0’ en el pin

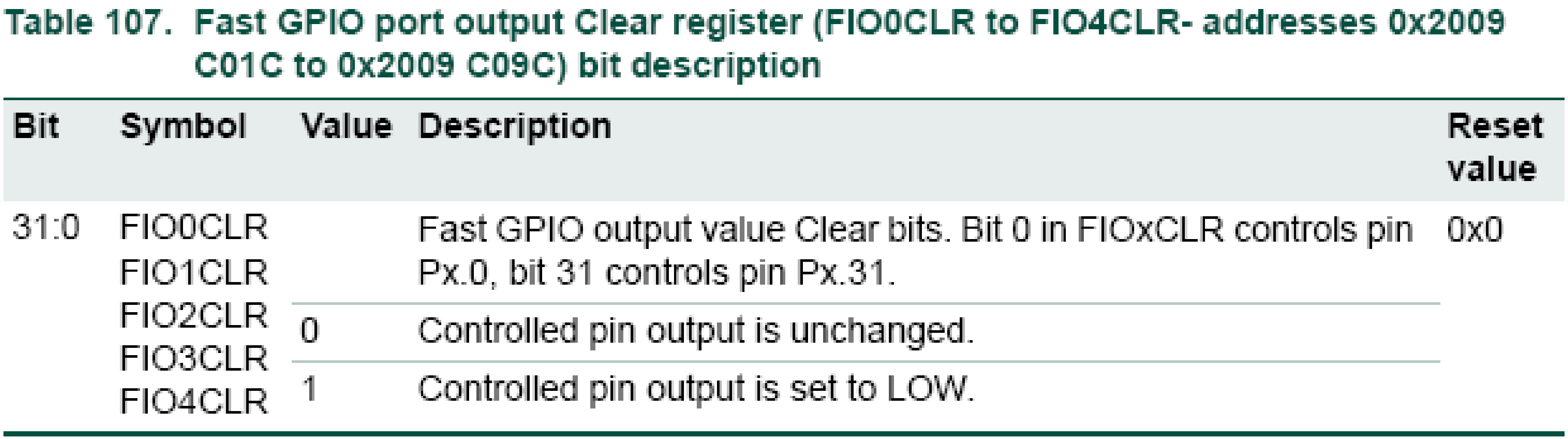


Table 107. Fast GPIO port output Clear register (FIO0CLR to FIO4CLR- addresses 0x2009 C01C to 0x2009 C09C) bit description

Bit	Symbol	Value	Description	Reset value
31:0	FIO0CLR FIO1CLR FIO2CLR FIO3CLR FIO4CLR		Fast GPIO output value Clear bits. Bit 0 in FIOxCLR controls pin Px.0, bit 31 controls pin Px.31.	0x0
		0	Controlled pin output is unchanged.	
		1	Controlled pin output is set to LOW.	

3.3 Registros de Configuracion de GPIO

◆Registro FIOCLR

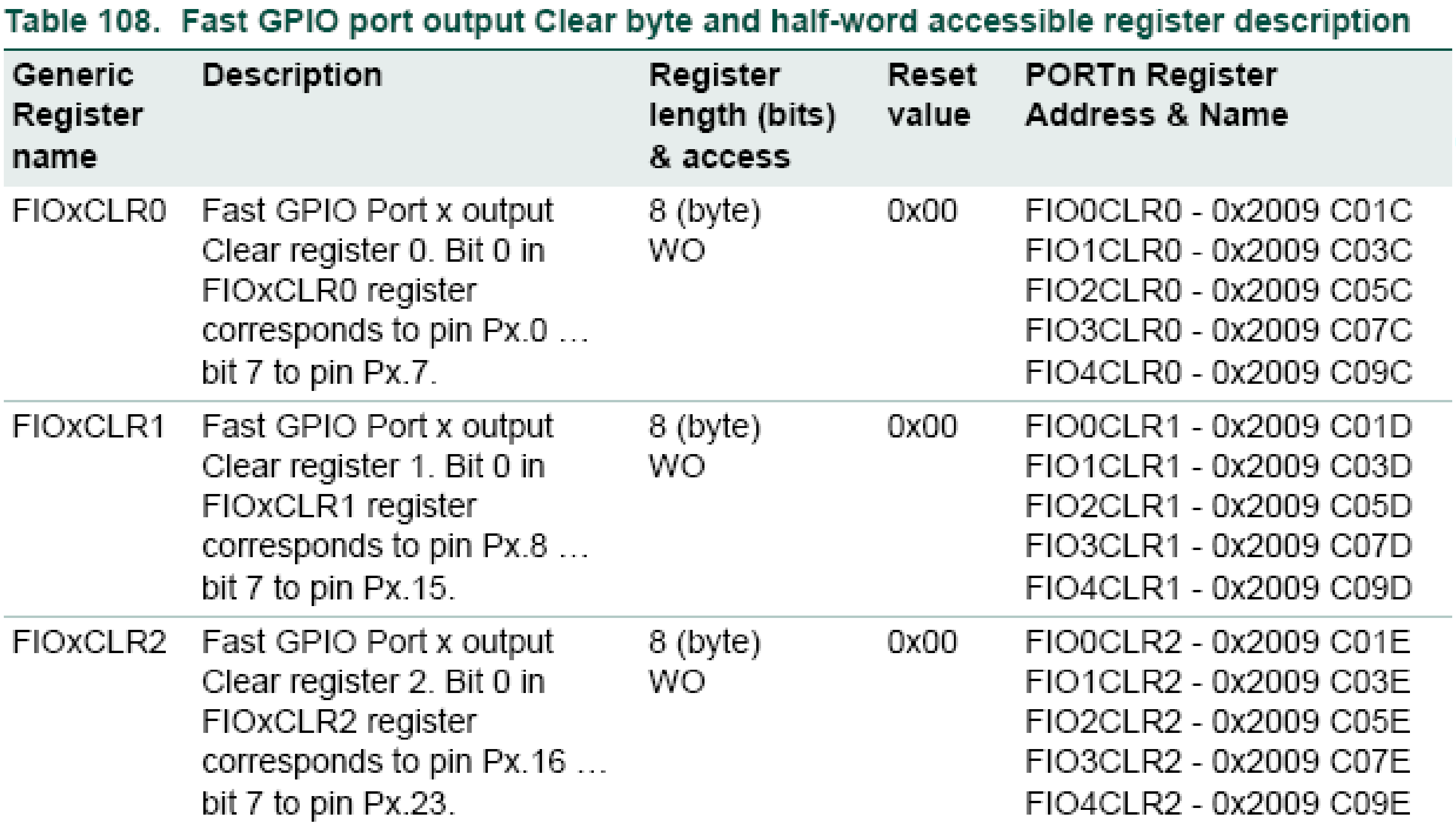
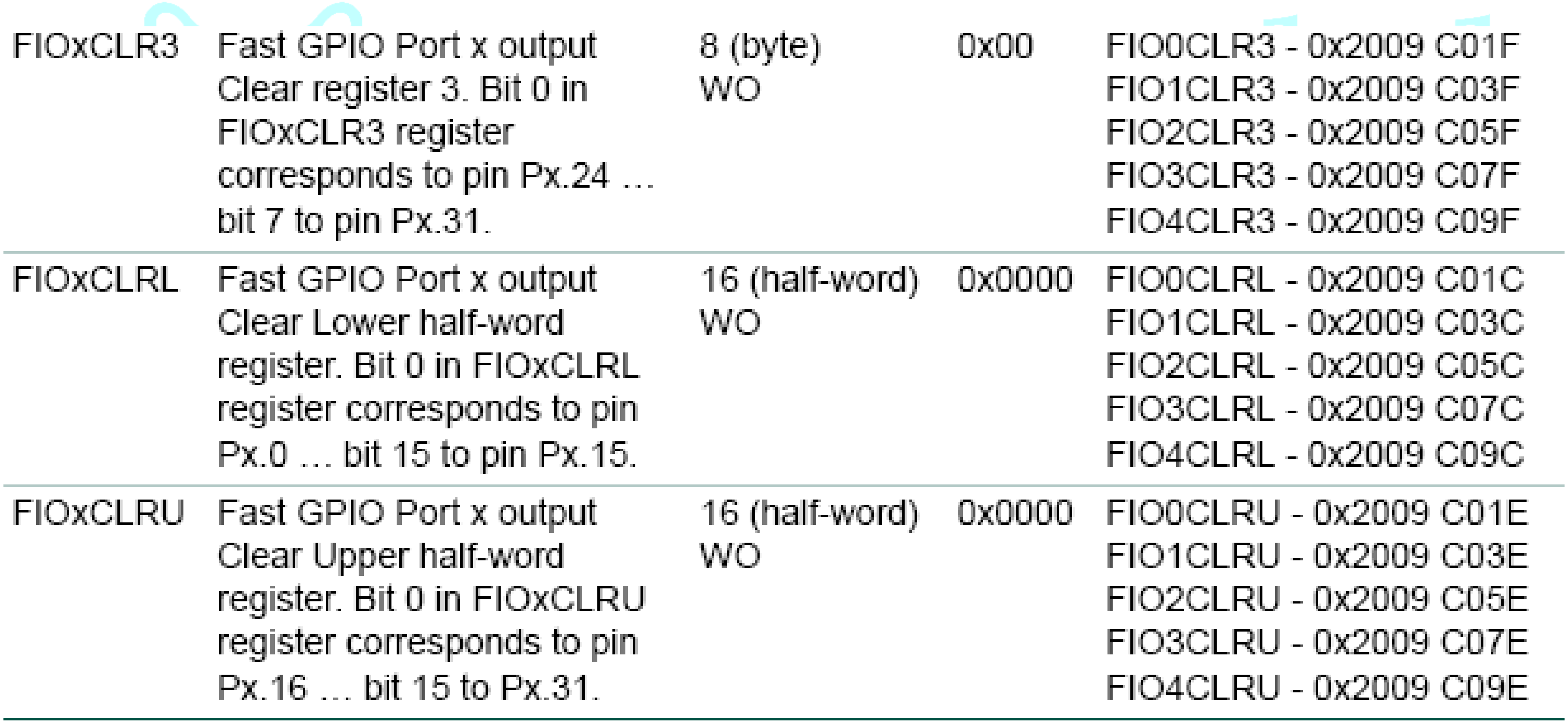


Table 108. Fast GPIO port output Clear byte and half-word accessible register description

Generic Register name	Description	Register length (bits) & access	Reset value	PORTn Register Address & Name
FIOxCLR0	Fast GPIO Port x output Clear register 0. Bit 0 in FIOxCLR0 register corresponds to pin Px.0 … bit 7 to pin Px.7.	8 (byte) WO	0x00	FIO0CLR0 - 0x2009 C01C FIO1CLR0 - 0x2009 C03C FIO2CLR0 - 0x2009 C05C FIO3CLR0 - 0x2009 C07C FIO4CLR0 - 0x2009 C09C
FIOxCLR1	Fast GPIO Port x output Clear register 1. Bit 0 in FIOxCLR1 register corresponds to pin Px.8 … bit 7 to pin Px.15.	8 (byte) WO	0x00	FIO0CLR1 - 0x2009 C01D FIO1CLR1 - 0x2009 C03D FIO2CLR1 - 0x2009 C05D FIO3CLR1 - 0x2009 C07D FIO4CLR1 - 0x2009 C09D
FIOxCLR2	Fast GPIO Port x output Clear register 2. Bit 0 in FIOxCLR2 register corresponds to pin Px.16 … bit 7 to pin Px.23.	8 (byte) WO	0x00	FIO0CLR2 - 0x2009 C01E FIO1CLR2 - 0x2009 C03E FIO2CLR2 - 0x2009 C05E FIO3CLR2 - 0x2009 C07E FIO4CLR2 - 0x2009 C09E

3.3 Registros de Configuracion de GPIO

◆Registro FIOCLR



FIOxCLR3	Fast GPIO Port x output Clear register 3. Bit 0 in FIOxCLR3 register corresponds to pin Px.24 … bit 7 to pin Px.31.	8 (byte) WO	0x00	FIO0CLR3 - 0x2009 C01F FIO1CLR3 - 0x2009 C03F FIO2CLR3 - 0x2009 C05F FIO3CLR3 - 0x2009 C07F FIO4CLR3 - 0x2009 C09F
FIOxCLRL	Fast GPIO Port x output Clear Lower half-word register. Bit 0 in FIOxCLRL register corresponds to pin Px.0 … bit 15 to pin Px.15.	16 (half-word) WO	0x0000	FIO0CLRL - 0x2009 C01C FIO1CLRL - 0x2009 C03C FIO2CLRL - 0x2009 C05C FIO3CLRL - 0x2009 C07C FIO4CLRL - 0x2009 C09C
FIOxCLRU	Fast GPIO Port x output Clear Upper half-word register. Bit 0 in FIOxCLRU register corresponds to pin Px.16 … bit 15 to Px.31.	16 (half-word) WO	0x0000	FIO0CLRU - 0x2009 C01E FIO1CLRU - 0x2009 C03E FIO2CLRU - 0x2009 C05E FIO3CLRU - 0x2009 C07E FIO4CLRU - 0x2009 C09E

3.3 Registros de Configuracion de GPIO

◆Registro FIOMASK

- **Permite habilitar o deshabilitar las operaciones de lectura/escritura en el pin cuando se accede mediante los registros FIOPIN, FIOSET or FIOCLR.**

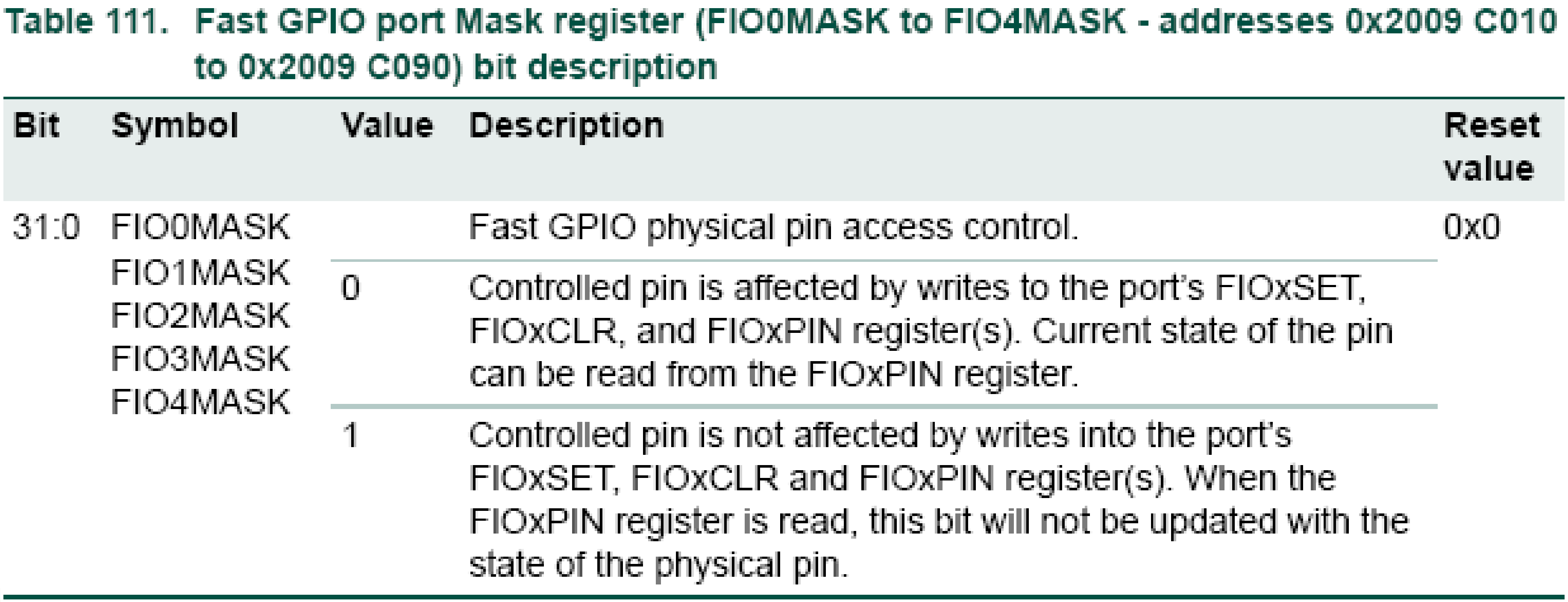


Table 111. Fast GPIO port Mask register (FIO0MASK to FIO4MASK - addresses 0x2009 C010 to 0x2009 C090) bit description

Bit	Symbol	Value	Description	Reset value
31:0	FIO0MASK FIO1MASK FIO2MASK FIO3MASK FIO4MASK		Fast GPIO physical pin access control.	0x0
		0	Controlled pin is affected by writes to the port's FIOxSET, FIOxCLR, and FIOxPIN register(s). Current state of the pin can be read from the FIOxPIN register.	
		1	Controlled pin is not affected by writes into the port's FIOxSET, FIOxCLR and FIOxPIN register(s). When the FIOxPIN register is read, this bit will not be updated with the state of the physical pin.	