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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Obsolete
Core Processor	HCS12X
Core Size	16-Bit
Speed	80MHz
Connectivity	EBI/EMI, I²C, IrDA, LINbus, SCI, SPI
Peripherals	LVD, POR, PWM, WDT
Number of I/O	119
Program Memory Size	256KB (256K x 8)
Program Memory Type	FLASH
EEPROM Size	4K x 8
RAM Size	16K x 8
Voltage - Supply (Vcc/Vdd)	2.35V ~ 5.5V
Data Converters	A/D 24x10b
Oscillator Type	External
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	144-LQFP
Supplier Device Package	144-LQFP (20x20)
Purchase URL	https://www.e-xfl.com/pro/item?MUrl=&PartUrl=mc9s12xa256cag

Chapter 1 Device Overview MC9S12XD-Family describes pinouts, detailed pin description , interrupts and register map of the cover part MC9S12XDP512 (maskset L15Y). For availability of the modules on other members of the S12XA, S12XB and S12XD families please refer to Appendix E Derivative Differences. For pinout explanations of the different parts refer to E.7 Pinout explanations:. For a list of available partnames /masksets refer to Table 1-6.

Figure 1-6. XGATE Global Address Mapping

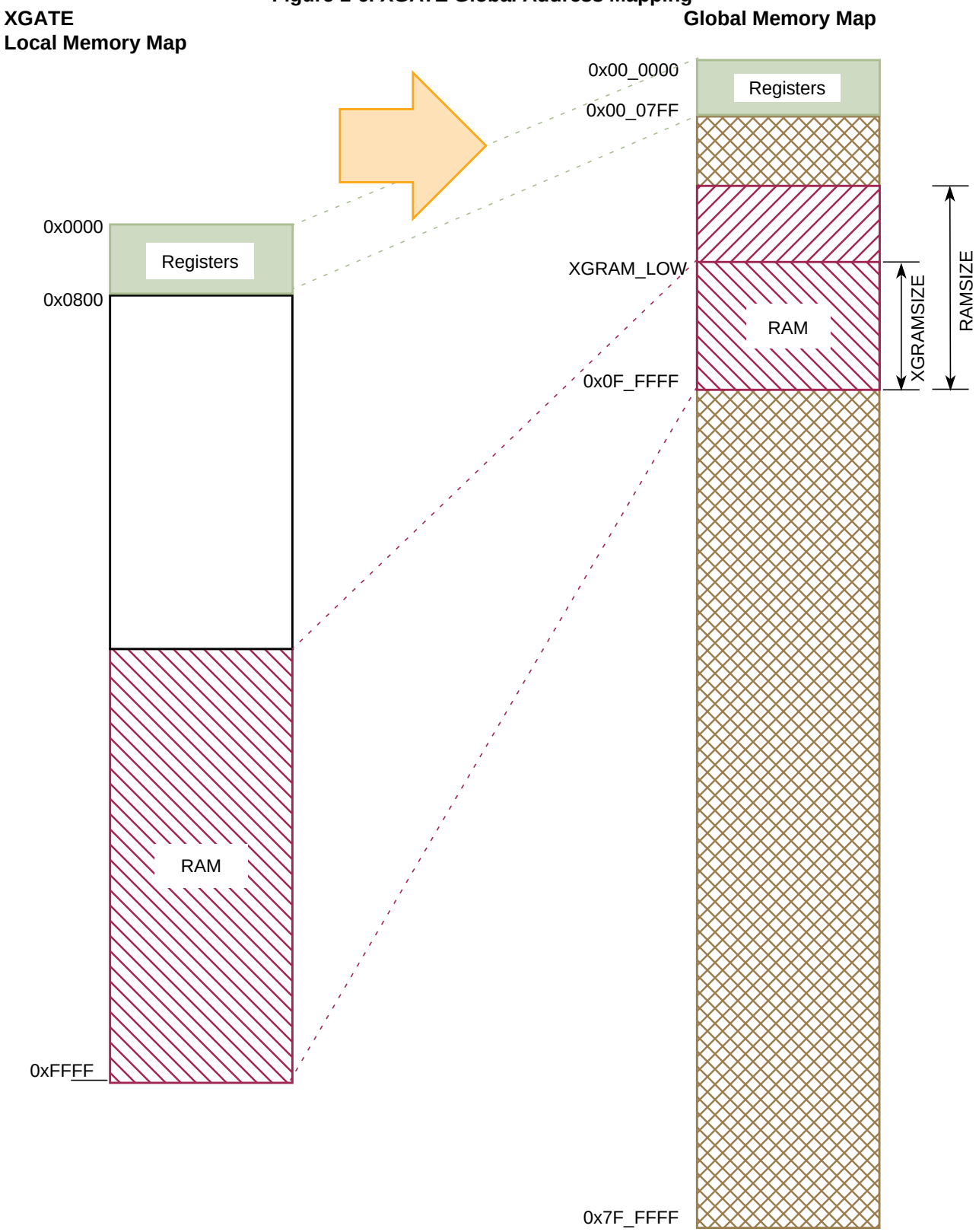

Table 4-13. Clock Prescaler Values

Prescale Value	Total Divisor Value	Max. Bus Clock[1]	Min. Bus Clock[2]
00000	Divide by 2	4 MHz	1 MHz
00001	Divide by 4	8 MHz	2 MHz
00010	Divide by 6	12 MHz	3 MHz
00011	Divide by 8	16 MHz	4 MHz
00100	Divide by 10	20 MHz	5 MHz
00101	Divide by 12	24 MHz	6 MHz
00110	Divide by 14	28 MHz	7 MHz
00111	Divide by 16	32 MHz	8 MHz
01000	Divide by 18	36 MHz	9 MHz
01001	Divide by 20	40 MHz	10 MHz
01010	Divide by 22	44 MHz	11 MHz
01011	Divide by 24	48 MHz	12 MHz
01100	Divide by 26	52 MHz	13 MHz
01101	Divide by 28	56 MHz	14 MHz
01110	Divide by 30	60 MHz	15 MHz
01111	Divide by 32	64 MHz	16 MHz
10000	Divide by 34	68 MHz	17 MHz
10001	Divide by 36	72 MHz	18 MHz
10010	Divide by 38	76 MHz	19 MHz
10011	Divide by 40	80 MHz	20 MHz
10100	Divide by 42	84 MHz	21 MHz
10101	Divide by 44	88 MHz	22 MHz
10110	Divide by 46	92 MHz	23 MHz
10111	Divide by 48	96 MHz	24 MHz
11000	Divide by 50	100 MHz	25 MHz
11001	Divide by 52	104 MHz	26 MHz
11010	Divide by 54	108 MHz	27 MHz
11011	Divide by 56	112 MHz	28 MHz
11100	Divide by 58	116 MHz	29 MHz
11101	Divide by 60	120 MHz	30 MHz
11110	Divide by 62	124 MHz	31 MHz
11111	Divide by 64	128 MHz	32 MHz

1 Maximum ATD conversion clock frequency is 2 MHz. The maximum allowed bus clock frequency is shown in this column.

2 Minimum ATD conversion clock frequency is 500 kHz. The minimum allowed bus clock frequency is shown in this column.

Register Name		Bit 7	6	5	4	3	2	1	Bit 0
ATDD47H	10-BIT	0	0	0	0	0	0	BIT 9 MSB	BIT 8
	8-BIT	0	0	0	0	0	0	0	0
	W								
ATDD47L	10-BIT	BIT 7 BIT 7 MSB	BIT 6 BIT 6	BIT 5 BIT 5	BIT 4 BIT 4	BIT 3 BIT 3	BIT 2 BIT 2	BIT 1 BIT 1	BIT 0 BIT 0
	8-BIT								

= Unimplemented or Reserved

Figure 5-2. ATD Register Summary (Sheet 5 of 5)

5.3.2.1 ATD Control Register 0 (ATDCTL0)

Writes to this register will abort current conversion sequence but will not start a new sequence.

	7	6	5	4	3	2	1	0
R	0	0	0	0	0	WRAP2	WRAP1	WRAP0
W								
Reset	0	0	0	0	0	1	1	1

= Unimplemented or Reserved

Figure 5-3. ATD Control Register 0 (ATDCTL0)

Read: Anytime

Write: Anytime

Table 5-1. ATDCTL0 Field Descriptions

Field	Description
2–0 WRAP[2:0]	**Wrap Around Channel Select Bits** — These bits determine the channel for wrap around when doing multi-channel conversions. The coding is summarized in Table 5-2.

Table 5-2. Multi-Channel Wrap Around Coding

WRAP2	WRAP1	WRAP0	Multiple Channel Conversions (MULT = 1) Wrap Around to AN0 after Converting
0	0	0	Reserved
0	0	1	AN1
0	1	0	AN2
0	1	1	AN3
1	0	0	AN4
1	0	1	AN5
1	1	0	AN6
1	1	1	AN7

5.3.2.8 Reserved Register (ATDTEST0)

	7	6	5	4	3	2	1	0
R	U	U	U	U	U	U	U	U
W								
Reset	1	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 5-10. Reserved Register (ATDTEST0)

Read: Anytime, returns unpredictable values

Write: Anytime in special modes, unimplemented in normal modes

NOTE

Writing to this register when in special modes can alter functionality.

5.3.2.9 ATD Test Register 1 (ATDTEST1)

This register contains the SC bit used to enable special channel conversions.

	7	6	5	4	3	2	1	0
R	U	U	0	0	0	0	0	SC
W								
Reset	0	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 5-11. ATD Test Register 1 (ATDTEST1)

Read: Anytime, returns unpredictable values for Bit7 and Bit6

Write: Anytime

Table 5-18. ATDTEST1 Field Descriptions

Field	Description
0 SC	**Special Channel Conversion Bit** — If this bit is set, then special channel conversion can be selected using CC, CB and CA of ATDCTL5. Table 5-19 lists the coding. 0 Special channel conversions disabled 1 Special channel conversions enabled **Note:** Always write remaining bits of ATDTEST1 (Bit7 to Bit1) zero when writing SC bit. Not doing so might result in unpredictable ATD behavior.

Table 5-19. Special Channel Select Coding

SC	CC	CB	CA	Analog Input Channel
1	0	X	X	Reserved
1	1	0	0	V_{RH}
1	1	0	1	V_{RL}
1	1	1	0	$(V_{RH}+V_{RL}) / 2$
1	1	1	1	Reserved

BLT Branch if Lower than Zero BLT

Operation

If N ^ V = 1, then PC + $0002 + (REL9 << 1) ⇒ PC

Branch instruction to compare signed numbers.

Branch if RS1 < RS2:

```
SUB     R0,RS1,RS2
BLT     REL9
```

CCR Effects

N	Z	V	C
—	—	—	—

N: Not affected.
Z: Not affected.
V: Not affected.
C: Not affected.

Code and CPU Cycles

Source Form	Address Mode	Machine Code								Cycles
BLT REL9	REL9	0	0	1	1	0	1	1	REL9	PP/P

	7	6	5	4	3	2	1	0
R W	Bit 7	6	5	4	3	2	1	Bit 0
Reset	0	0	0	0	0	0	0	0

Figure 8-11. PWM Scale A Register (PWMSCLA)

Read: Anytime

Write: Anytime (causes the scale counter to load the PWMSCLA value)

8.3.2.10 PWM Scale B Register (PWMSCLB)

PWMSCLB is the programmable scale value used in scaling clock B to generate clock SB. Clock SB is generated by taking clock B, dividing it by the value in the PWMSCLB register and dividing that by two.

Clock SB = Clock B / (2 * PWMSCLB)

NOTE

When PWMSCLB = $00, PWMSCLB value is considered a full scale value of 256. Clock B is thus divided by 512.

Any value written to this register will cause the scale counter to load the new scale value (PWMSCLB).

	7	6	5	4	3	2	1	0
R W	Bit 7	6	5	4	3	2	1	Bit 0
Reset	0	0	0	0	0	0	0	0

Figure 8-12. PWM Scale B Register (PWMSCLB)

Read: Anytime

Write: Anytime (causes the scale counter to load the PWMSCLB value).

8.3.2.11 Reserved Registers (PWMSCNTx)

The registers PWMSCNTA and PWMSCNTB are reserved for factory testing of the PWM module and are not available in normal modes.

	7	6	5	4	3	2	1	0
R	0	0	0	0	0	0	0	0
W								
Reset	0	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 8-13. Reserved Registers (PWMSCNTx)

Read: Always read $00 in normal modes

Write: Unimplemented in normal modes

12.4.1 Master Mode

The SPI operates in master mode when the MSTR bit is set. Only a master SPI module can initiate transmissions. A transmission begins by writing to the master SPI data register. If the shift register is empty, the byte immediately transfers to the shift register. The byte begins shifting out on the MOSI pin under the control of the serial clock.

- Serial clock

  The SPR2, SPR1, and SPR0 baud rate selection bits, in conjunction with the SPPR2, SPPR1, and SPPR0 baud rate preselection bits in the SPI baud rate register, control the baud rate generator and determine the speed of the transmission. The SCK pin is the SPI clock output. Through the SCK pin, the baud rate generator of the master controls the shift register of the slave peripheral.
- MOSI, MISO pin

  In master mode, the function of the serial data output pin (MOSI) and the serial data input pin (MISO) is determined by the SPC0 and BIDIROE control bits.
- $\overline{SS}$ pin

  If MODFEN and SSOE are set, the $\overline{SS}$ pin is configured as slave select output. The $\overline{SS}$ output becomes low during each transmission and is high when the SPI is in idle state.

  If MODFEN is set and SSOE is cleared, the $\overline{SS}$ pin is configured as input for detecting mode fault error. If the $\overline{SS}$ input becomes low this indicates a mode fault error where another master tries to drive the MOSI and SCK lines. In this case, the SPI immediately switches to slave mode, by clearing the MSTR bit and also disables the slave output buffer MISO (or SISO in bidirectional mode). So the result is that all outputs are disabled and SCK, MOSI, and MISO are inputs. If a transmission is in progress when the mode fault occurs, the transmission is aborted and the SPI is forced into idle state.

  This mode fault error also sets the mode fault (MODF) flag in the SPI status register (SPISR). If the SPI interrupt enable bit (SPIE) is set when the MODF flag becomes set, then an SPI interrupt sequence is also requested.

  When a write to the SPI data register in the master occurs, there is a half SCK-cycle delay. After the delay, SCK is started within the master. The rest of the transfer operation differs slightly, depending on the clock format specified by the SPI clock phase bit, CPHA, in SPI control register 1 (see Section 12.4.3, “Transmission Formats”).

NOTE

A change of the bits CPOL, CPHA, SSOE, LSBFE, MODFEN, SPC0, or BIDIROE with SPC0 set, SPPR2-SPPR0 and SPR2-SPR0 in master mode will abort a transmission in progress and force the SPI into idle state. The remote slave cannot detect this, therefore the master must ensure that the remote slave is returned to idle state.

Register Name		Bit 7	6	5	4	3	2	1	Bit 0
PITLD1 (Low)	R	PLD7	PLD6	PLD5	PLD4	PLD3	PLD2	PLD1	PLD0
	W								
PITCNT1 (High)	R	PCNT15	PCNT14	PCNT13	PCNT12	PCNT11	PCNT10	PCNT9	PCNT8
	W								
PITCNT1 (Low)	R	PCNT7	PCNT6	PCNT5	PCNT4	PCNT3	PCNT2	PCNT1	PCNT0
	W								
PITLD2 (High)	R	PLD15	PLD14	PLD13	PLD12	PLD11	PLD10	PLD9	PLD8
	W								
PITLD2 (Low)	R	PLD7	PLD6	PLD5	PLD4	PLD3	PLD2	PLD1	PLD0
	W								
PITCNT2 (High)	R	PCNT15	PCNT14	PCNT13	PCNT12	PCNT11	PCNT10	PCNT9	PCNT8
	W								
PITCNT2 (Low)	R	PCNT7	PCNT6	PCNT5	PCNT4	PCNT3	PCNT2	PCNT1	PCNT0
	W								
PITLD3 (High)	R	PLD15	PLD14	PLD13	PLD12	PLD11	PLD10	PLD9	PLD8
	W								
PITLD3 (Low)	R	PLD7	PLD6	PLD5	PLD4	PLD3	PLD2	PLD1	PLD0
	W								
PITCNT3 (High)	R	PCNT15	PCNT14	PCNT13	PCNT12	PCNT11	PCNT10	PCNT9	PCNT8
	W								
PITCNT3 (Low)	R	PCNT7	PCNT6	PCNT5	PCNT4	PCNT3	PCNT2	PCNT1	PCNT0
	W								

= Unimplemented or Reserved

Figure 13-2. PIT Register Summary (Sheet 2 of 2)

14.3.2.6 Reserved 06

The Reserved 06 is reserved for test purposes.

	7	6	5	4	3	2	1	0
R	0	0	0	0	0	0	0	0
W								
Reset	0	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 14-8. Reserved 06

14.3.2.7 Reserved 07

The Reserved 07 is reserved for test purposes.

	7	6	5	4	3	2	1	0
R	0	0	0	0	0	0	0	0
W								
Reset	0	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 14-9. Reserved 07

14.4 Functional Description

14.4.1 General

Module VREG_3V3 is a voltage regulator, as depicted in Figure 14-1. The regulator functional elements are the regulator core (REG), a low-voltage detect module (LVD), a control block (CTRL), a power-on reset module (POR), and a low-voltage reset module (LVR).

14.4.2 Regulator Core (REG)

Respectively its regulator core has two parallel, independent regulation loops (REG1 and REG2) that differ only in the amount of current that can be delivered.

The regulator is a linear regulator with a bandgap reference when operated in Full Performance Mode. It acts as a voltage clamp in Reduced Power Mode. All load currents flow from input V_{DDR} to V_{SS} or V_{SSPLL}. The reference circuits are supplied by V_{DDA} and V_{SSA}.

14.4.2.1 Full Performance Mode

In Full Performance Mode, the output voltage is compared with a reference voltage by an operational amplifier. The amplified input voltage difference drives the gate of an output transistor.

within a few percent of the actual target speed and the communication protocol can easily tolerate speed errors of several percent.

As soon as the SYNC request is detected by the target, any partially received command or bit retrieved is discarded. This is referred to as a soft-reset, equivalent to a time-out in the serial communication. After the SYNC response, the target will consider the next negative edge (issued by the host) as the start of a new BDM command or the start of new SYNC request.

Another use of the SYNC command pulse is to abort a pending ACK pulse. The behavior is exactly the same as in a regular SYNC command. Note that one of the possible causes for a command to not be acknowledged by the target is a host-target synchronization problem. In this case, the command may not have been understood by the target and so an ACK response pulse will not be issued.

15.4.10 Instruction Tracing

When a TRACE1 command is issued to the BDM in active BDM, the CPU exits the standard BDM firmware and executes a single instruction in the user code. Once this has occurred, the CPU is forced to return to the standard BDM firmware and the BDM is active and ready to receive a new command. If the TRACE1 command is issued again, the next user instruction will be executed. This facilitates stepping or tracing through the user code one instruction at a time.

If an interrupt is pending when a TRACE1 command is issued, the interrupt stacking operation occurs but no user instruction is executed. Once back in standard BDM firmware execution, the program counter points to the first instruction in the interrupt service routine.

Be aware when tracing through the user code that the execution of the user code is done step by step but all peripherals are free running. Hence possible timing relations between CPU code execution and occurrence of events of other peripherals no longer exist.

Do not trace the CPU instruction BGND used for soft breakpoints. Tracing the BGND instruction will result in a return address pointing to BDM firmware address space.

When tracing through user code which contains stop or wait instructions the following will happen when the stop or wait instruction is traced:

The CPU enters stop or wait mode and the TRACE1 command can not be finished before leaving the low power mode. This is the case because BDM active mode can not be entered after CPU executed the stop instruction. However all BDM hardware commands except the BACKGROUND command are operational after tracing a stop or wait instruction and still being in stop or wait mode. If system stop mode is entered (all bus masters are in stop mode) no BDM command is operational.

As soon as stop or wait mode is exited the CPU enters BDM active mode and the saved PC value points to the entry of the corresponding interrupt service routine.

In case the handshake feature is enabled the corresponding ACK pulse of the TRACE1 command will be discarded when tracing a stop or wait instruction. Hence there is no ACK pulse when BDM active mode is entered as part of the TRACE1 command after CPU exited from stop or wait mode. All valid commands sent during CPU being in stop or wait mode or after CPU exited from stop or wait mode will have an ACK pulse. The handshake feature becomes disabled only when system

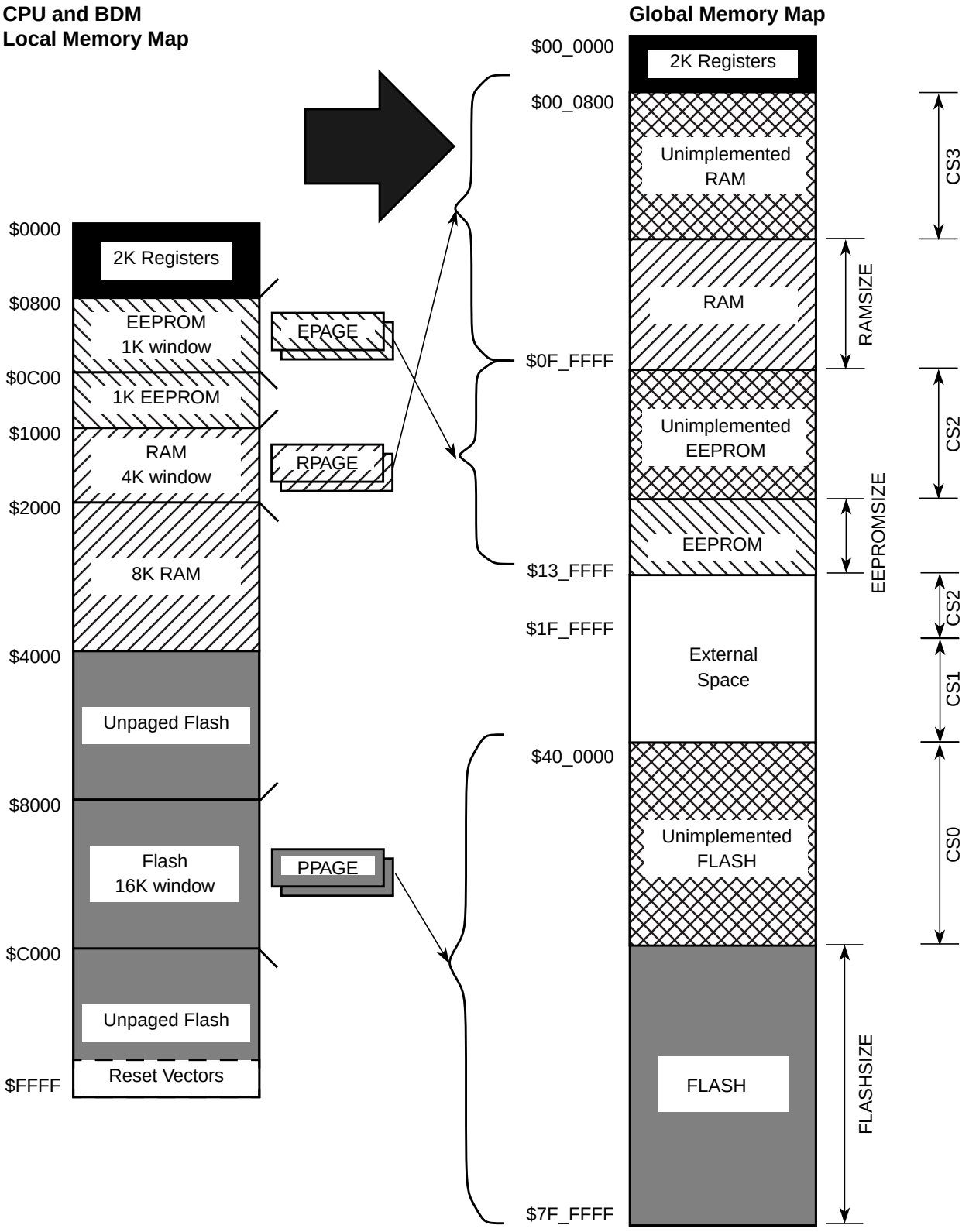

Figure 17-23. Local to Implemented Global Address Mapping (Without GPAGE)

18.3.2.3 Global Page Index Register (GPAGE)

Address: 0x0010

	7	6	5	4	3	2	1	0
R	0	GP6	GP5	GP4	GP3	GP2	GP1	GP0
W								
Reset	0	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 18-6. Global Page Index Register (GPAGE)

Read: Anytime

Write: Anytime

The global page index register is used to construct a 23 bit address in the global map format. It is only used when the CPU is executing a global instruction (GLDAA, GLDAB, GLDD, GLDS, GLDX, GLDY,GSTAA, GSTAB, GSTD, GSTS, GSTX, GSTY) (see CPU Block Guide). The generated global address is the result of concatenation of the CPU local address [15:0] with the GPAGE register [22:16] (see Figure 18-7).

CAUTION

XGATE write access to this register during an CPU access which makes use of this register could lead to unexpected results.

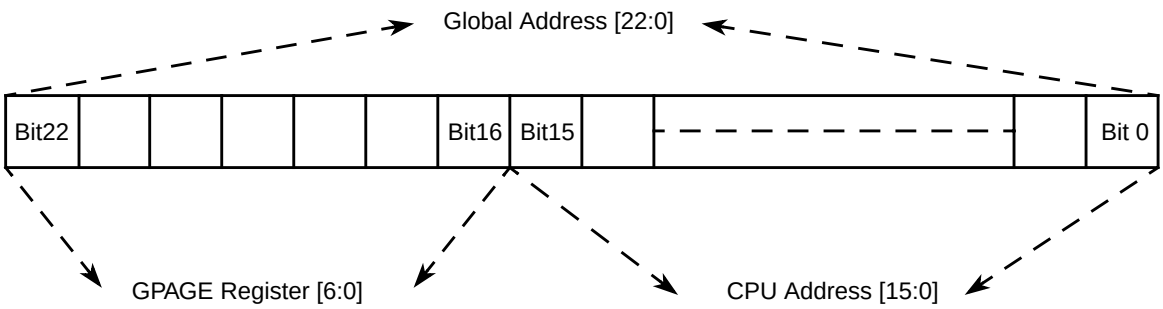

Figure 18-7. GPAGE Address Mapping

Table 18-8. GPAGE Field Descriptions

Field	Description
6–0 GP[6:0]	**Global Page Index Bits 6–0** — These page index bits are used to select which of the 128 64-kilobyte pages is to be accessed.

Example 18-1. This example demonstrates usage of the GPAGE register

```
LDX     #0x5000          ;Set GPAGE offset to the value of 0x5000
MOVB    #0x14, GPAGE     ;Initialize GPAGE register with the value of 0x14
GLDAA   X                ;Load Accu A from the global address 0x14_5000
```

20.3.2.7.3 Debug State Control Register 3 (DBGSCR3)

Address: 0x0027

	7	6	5	4	3	2	1	0
R	0	0	0	0	SC3	SC2	SC1	SC0
W								
Reset	0	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 20-11. Debug State Control Register 3 (DBGSCR3)

Read: Anytime

Write: Anytime when S12XDBG not armed.

This register is visible at 0x0027 only with COMRV[1:0] = 10. The state control register three selects the targeted next state whilst in State3. The matches refer to the match channels of the comparator match control logic as depicted in Figure 20-1 and described in Section 20.3.2.8.1". Comparators must be enabled by setting the comparator enable bit in the associated DBGXCTL control register.

Table 20-24. DBGSCR3 Field Descriptions

Field	Description
3–0 SC[3:0]	These bits select the targeted next state whilst in State3, based upon the match event.

Table 20-25. State3 — Sequencer Next State Selection

SC[3:0]	Description
0000	Any match triggers to state1
0001	Any match triggers to state2
0010	Any match triggers to Final State
0011	Match0 triggers to State1..... Other matches have no effect
0100	Match0 triggers to State2..... Other matches have no effect
0101	Match0 triggers to Final State.....Match1 triggers to State1
0110	Match1 triggers to State1..... Other matches have no effect
0111	Match1 triggers to State2..... Other matches have no effect
1000	Match1 triggers to Final State..... Other matches have no effect
1001	Match2 triggers to State2..... Match0 triggers to Final State..... Other matches have no effect
1010	Match1 triggers to State1..... Match3 triggers to State2..... Other matches have no effect
1011	Match3 triggers to State2..... Match1 triggers to Final State..... Other matches have no effect
1100	Match2 triggers to Final State..... Other matches have no effect
1101	Match3 triggers to Final State..... Other matches have no effect
1110	Reserved
1111	Reserved

The trigger priorities described in Table 20-38 dictate that in the case of simultaneous matches, the match on the lower channel number (0,1,2,3) has priority. The SC[3:0] encoding ensures that a match leading to final state has priority over all other matches.

Register Name		Bit 7	6	5	4	3	2	1	Bit 0
PTIP	R	PTIP7	PTIP6	PTIP5	PTIP4	PTIP3	PTIP2	PTIP1	PTIP0
	W								
DDRP	R	DDRP7	DDRP6	DDRP5	DDRP4	DDRP3	DDRP2	DDRP1	DDRP0
	W								
RDRP	R	RDRP7	RDRP6	RDRP5	RDRP4	RDRP3	RDRP2	RDRP1	RDRP0
	W								
PERP	R	PERP7	PERP6	PERP5	PERP4	PERP3	PERP2	PERP1	PERP0
	W								
PPSP	R	PPSP7	PPSP6	PPSP5	PPSP4	PPSP3	PPSP2	PPSP1	PPSP0
	W								
PIEP	R	PIEP7	PIEP6	PIEP5	PIEP4	PIEP3	PIEP2	PIEP1	PIEP0
	W								
PIFP	R	PIFP7	PIFP6	PIFP5	PIFP4	PIFP3	PIFP2	PIFP1	PIFP0
	W								
PTH	R	PTH7	PTH6	PTH5	PTH4	PTH3	PTH2	PTH1	PTH0
	W								
PTIH	R	PTIH7	PTIH6	PTIH5	PTIH4	PTIH3	PTIH2	PTIH1	PTIH0
	W								
DDRH	R	DDRH7	DDRH6	DDRH5	DDRH4	DDRH3	DDRH2	DDRH1	DDRH0
	W								
RDRH	R	RDRH7	RDRH6	RDRH5	RDRH4	RDRH3	RDRH2	RDRH1	RDRH0
	W								
PERH	R	PERH7	PERH6	PERH5	PERH4	PERH3	PERH2	PERH1	PERH0
	W								
PPSH	R	PPSH7	PPSH6	PPSH5	PPSH4	PPSH3	PPSH2	PPSH1	PPSH0
	W								
PIEH	R	PIEH7	PIEH6	PIEH5	PIEH4	PIEH3	PIEH2	PIEH1	PIEH0
	W								
PIFH	R	PIFH7	PIFH6	PIFH5	PIFH4	PIFH3	PIFH2	PIFH1	PIFH0
	W								

= Unimplemented or Reserved

Figure 24-2. PIM Register Summary (Sheet 5 of 7)

Table 24-60. Register Availability per Port[1]

Port	Data	Data Direction	Input	Reduced Drive	Pull Enable	Polarity Select	Wired-OR Mode	Interrupt Enable	Interrupt Flag
J	yes	yes	yes	yes	yes	yes	—	yes	yes
AD1	yes	yes	—	yes	yes	—	—	—	—

1. Each cell represents one register with individual configuration bits

24.0.6 Registers

24.0.6.1 Data Register

This register holds the value driven out to the pin if the pin is used as a general purpose I/O.

Writing to this register has only an effect on the pin if the pin is used as general purpose output. When reading this address, the buffered state of the pin is returned if the associated data direction register bit is set to “0”.

If the data direction register bits are set to logic level “1”, the contents of the data register is returned. This is independent of any other configuration (Figure 24-68).

24.0.6.2 Input Register

This is a read-only register and always returns the buffered state of the pin (Figure 24-68).

24.0.6.3 Data Direction Register

This register defines whether the pin is used as an input or an output.

If a peripheral module controls the pin the contents of the data direction register is ignored (Figure 24-68).

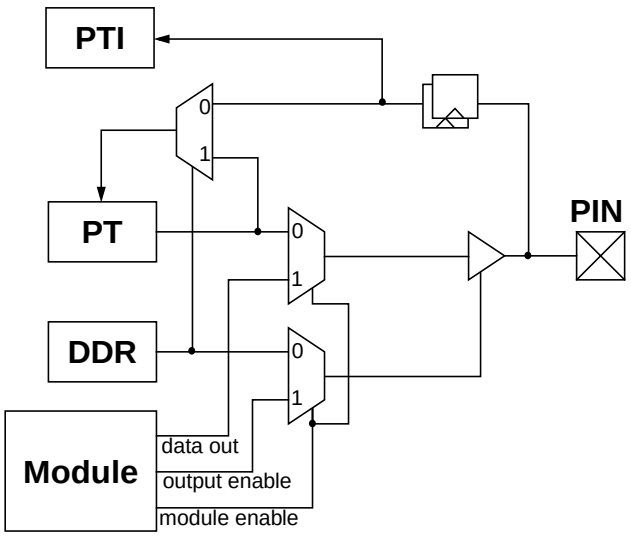

Figure 24-68. Illustration of I/O Pin Functionality

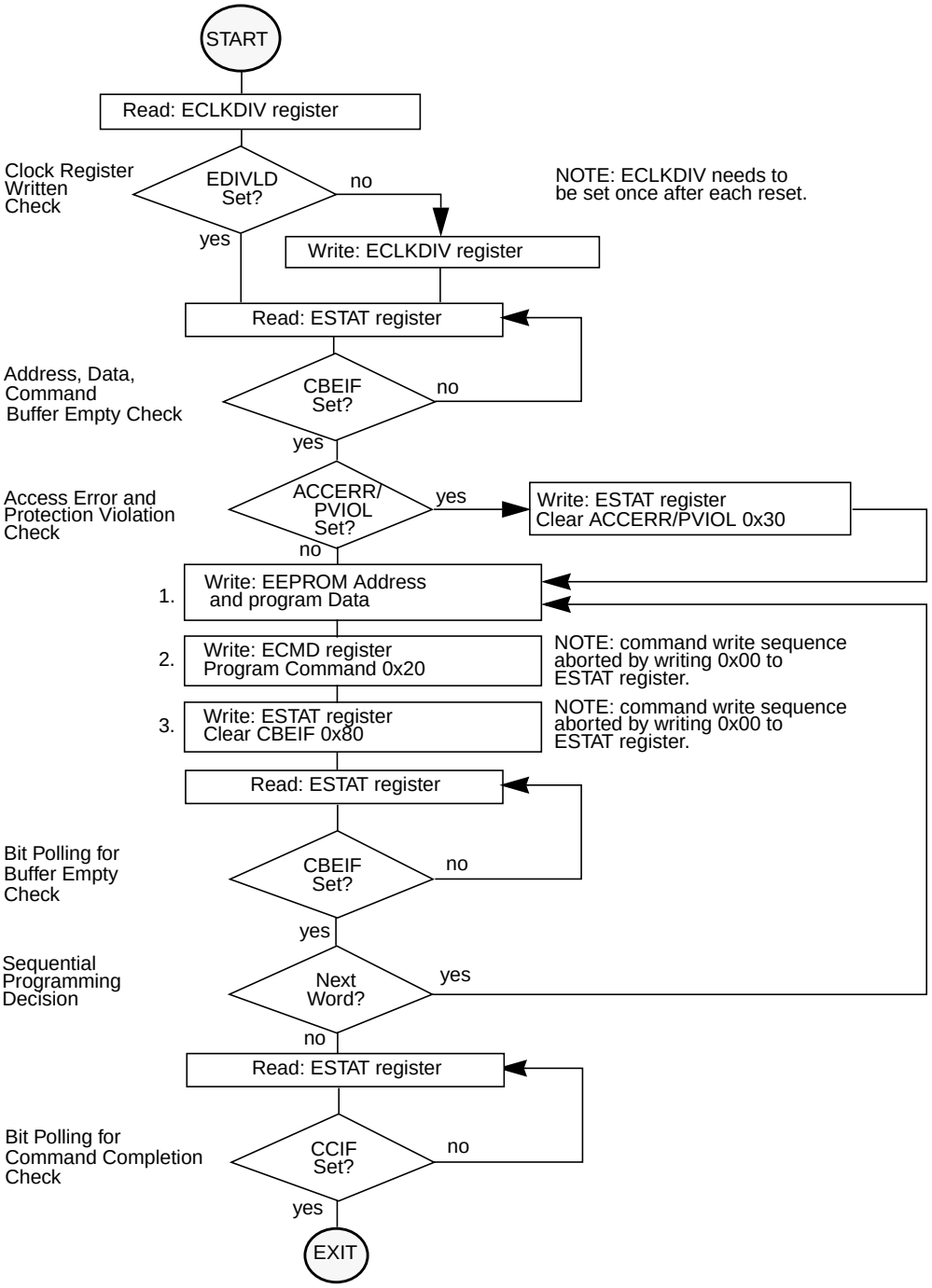

Figure 25-19. Example Program Command Flow

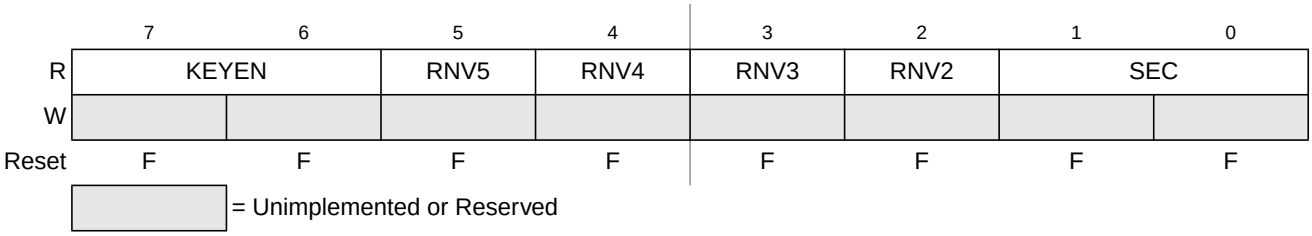

Figure 29-5. Flash Security Register (FSEC)

All bits in the FSEC register are readable but are not writable.

The FSEC register is loaded from the Flash Configuration Field at address 0x7F_FF0F during the reset sequence, indicated by F in Figure 29-5.

Table 29-3. FSEC Field Descriptions

Field	Description
7:6 KEYEN[1:0]	**Backdoor Key Security Enable Bits** — The KEYEN[1:0] bits define the enabling of backdoor key access to the Flash module as shown in Table 29-4.
5:2 RNV[5:2]	**Reserved Nonvolatile Bits** — The RNV[5:2] bits should remain in the erased state for future enhancements.
1:0 SEC[1:0]	**Flash Security Bits** — The SEC[1:0] bits define the security state of the MCU as shown in Table 29-5. If the Flash module is unsecured using backdoor key access, the SEC[1:0] bits are forced to 1:0.

Table 29-4. Flash KEYEN States

KEYEN[1:0]	Status of Backdoor Key Access
00	DISABLED
01[1]	DISABLED
10	ENABLED
11	DISABLED

1 Preferred KEYEN state to disable Backdoor Key Access.

Table 29-5. Flash Security States

SEC[1:0]	Status of Security
00	SECURED
01[1]	SECURED
10	UNSECURED
11	SECURED

1 Preferred SEC state to set MCU to secured state.

The security function in the Flash module is described in Section 29.6, “Flash Module Security”.

29.3.2.3 Flash Test Mode Register (FTSTMOD)

The FTSTMOD register is used to control Flash test features.

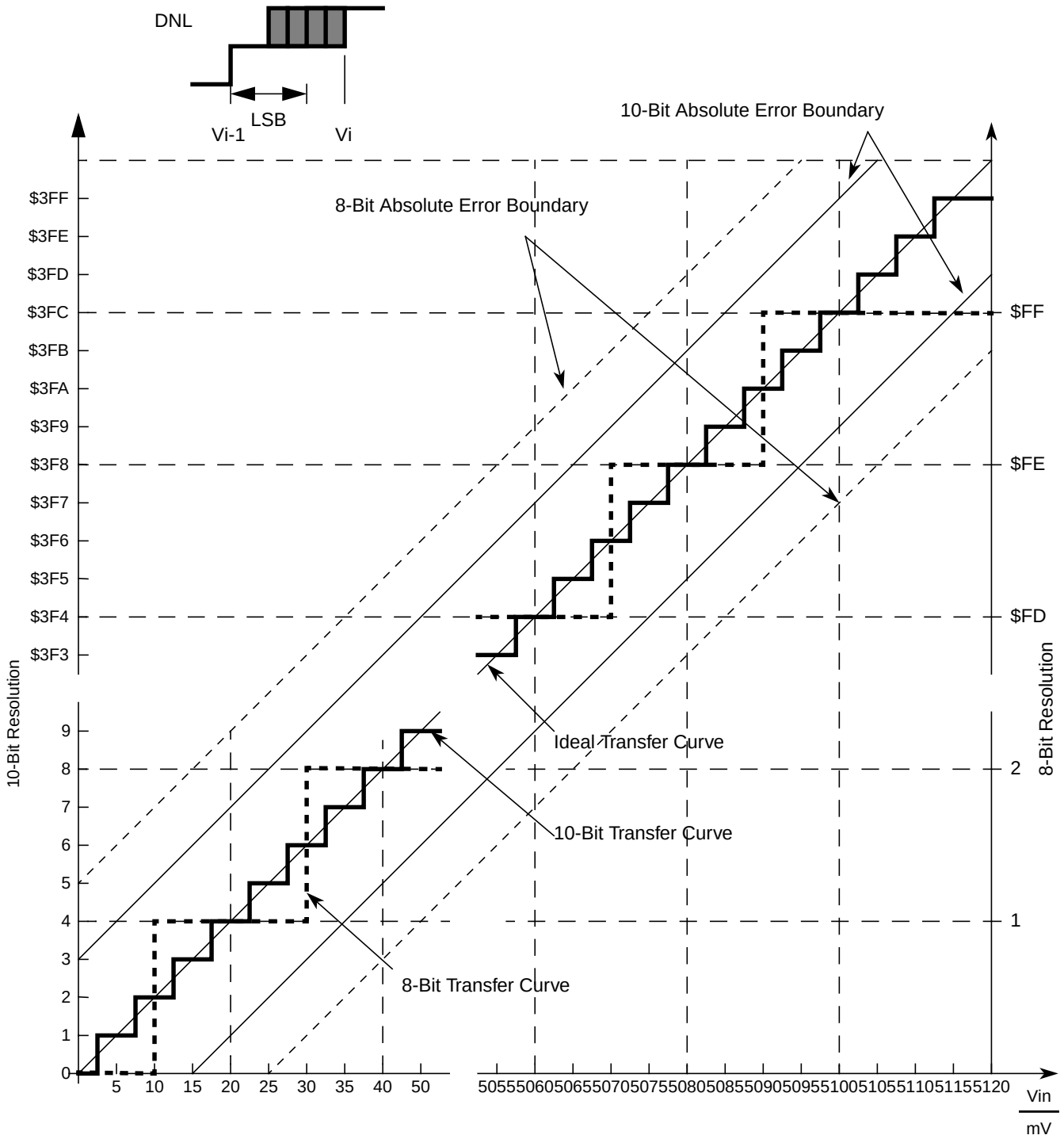

Figure A-1. ATD Accuracy Definitions

NOTE

Figure A-1 shows only definitions, for specification values refer to Table A-15.