

13 Direct memory access controller (DMA)

Low-density devices are STM32F101xx, STM32F102xx and STM32F103xx microcontrollers where the Flash memory density ranges between 16 and 32 Kbytes.

Medium-density devices are STM32F101xx, STM32F102xx and STM32F103xx microcontrollers where the Flash memory density ranges between 64 and 128 Kbytes.

High-density devices are STM32F101xx and STM32F103xx microcontrollers where the Flash memory density ranges between 256 and 512 Kbytes.

XL-density devices are STM32F101xx and STM32F103xx microcontrollers where the Flash memory density ranges between 768 Kbytes and 1 Mbyte.

Connectivity line devices are STM32F105xx and STM32F107xx microcontrollers.

This section applies to the whole STM32F10xxx family, unless otherwise specified.

13.1 DMA introduction

Direct memory access (DMA) is used in order to provide high-speed data transfer between peripherals and memory as well as memory to memory. Data can be quickly moved by DMA without any CPU actions. This keeps CPU resources free for other operations.

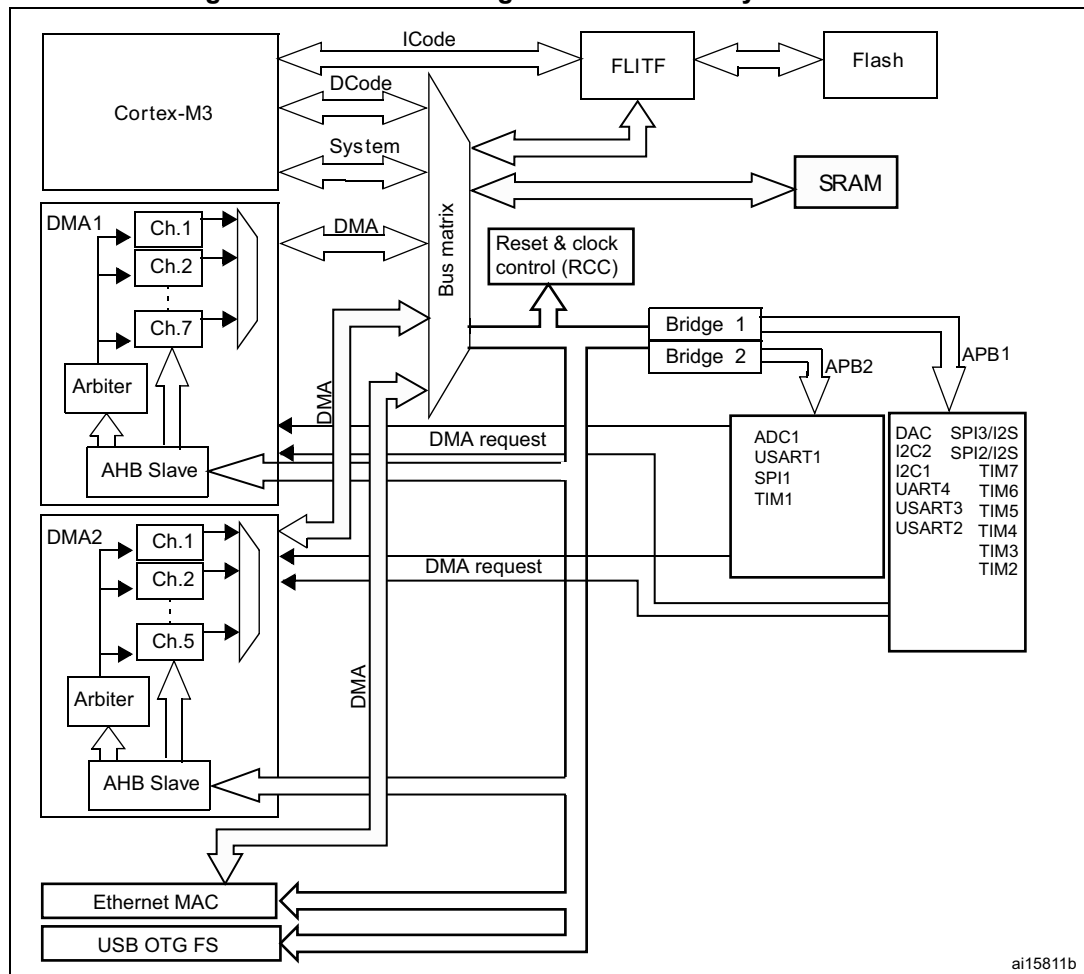
The two DMA controllers have 12 channels in total (7 for DMA1 and 5 for DMA2), each dedicated to managing memory access requests from one or more peripherals. It has an arbiter for handling the priority between DMA requests.

13.2 DMA main features

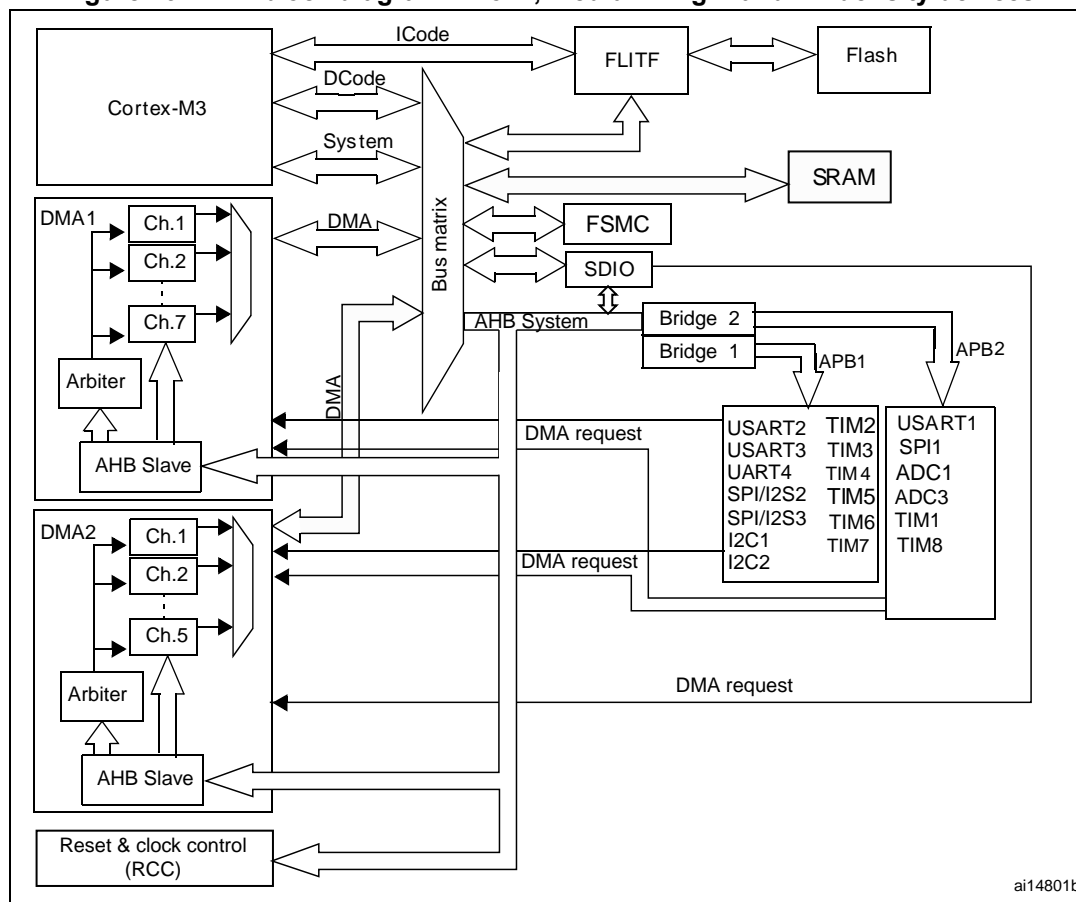
- 12 independently configurable channels (requests): 7 for DMA1 and 5 for DMA2
- Each of the 12 channels is connected to dedicated hardware DMA requests, software trigger is also supported on each channel. This configuration is done by software.
- Priorities between requests from channels of one DMA are software programmable (4 levels consisting of *very high*, *high*, *medium*, *low*) or hardware in case of equality (request 1 has priority over request 2, etc.)
- Independent source and destination transfer size (byte, half word, word), emulating packing and unpacking. Source/destination addresses must be aligned on the data size.
- Support for circular buffer management
- 3 event flags (DMA Half Transfer, DMA Transfer complete and DMA Transfer Error) logically ORed together in a single interrupt request for each channel
- Memory-to-memory transfer
- Peripheral-to-memory and memory-to-peripheral, and peripheral-to-peripheral transfers
- Access to Flash, SRAM, APB1, APB2 and AHB peripherals as source and destination
- Programmable number of data to be transferred: up to 65536

The block diagram is shown in [Figure 48](#).

Figure 48. DMA block diagram in connectivity line devices



ai15811b

Figure 49. DMA block diagram in low-, medium- high- and XL-density devices

1. The DMA2 controller is available only in high-density and XL-density devices.
1. ADC3, SPI/I2S3, UART4, SDIO, TIM5, TIM6, DAC, TIM7, TIM8 DMA requests are available only in high-density devices

13.3 DMA functional description

The DMA controller performs direct memory transfer by sharing the system bus with the Cortex[®]-M3 core. The DMA request may stop the CPU access to the system bus for some bus cycles, when the CPU and DMA are targeting the same destination (memory or peripheral). The bus matrix implements round-robin scheduling, thus ensuring at least half of the system bus bandwidth (both to memory and peripheral) for the CPU.

13.3.1 DMA transactions

After an event, the peripheral sends a request signal to the DMA Controller. The DMA controller serves the request depending on the channel priorities. As soon as the DMA Controller accesses the peripheral, an Acknowledge is sent to the peripheral by the DMA Controller. The peripheral releases its request as soon as it gets the Acknowledge from the DMA Controller. Once the request is deasserted by the peripheral, the DMA Controller release the Acknowledge. If there are more requests, the peripheral can initiate the next transaction.

In summary, each DMA transfer consists of three operations:

- The loading of data from the peripheral data register or a location in memory addressed through an internal current peripheral/memory address register. The start address used for the first transfer is the base peripheral/memory address programmed in the DMA_CPARx or DMA_CMARx register
- The storage of the data loaded to the peripheral data register or a location in memory addressed through an internal current peripheral/memory address register. The start address used for the first transfer is the base peripheral/memory address programmed in the DMA_CPARx or DMA_CMARx register
- The post-decrementing of the DMA_CNDTRx register, which contains the number of transactions that have still to be performed.

13.3.2 Arbiter

The arbiter manages the channel requests based on their priority and launches the peripheral/memory access sequences.

The priorities are managed in two stages:

- Software: each channel priority can be configured in the DMA_CCRx register. There are four levels:
 - Very high priority
 - High priority
 - Medium priority
 - Low priority
- Hardware: if 2 requests have the same software priority level, the channel with the lowest number will get priority versus the channel with the highest number. For example, channel 2 gets priority over channel 4.

Note: In high-density, XL-density and connectivity line devices, the DMA1 controller has priority over the DMA2 controller.

13.3.3 DMA channels

Each channel can handle DMA transfer between a peripheral register located at a fixed address and a memory address. The amount of data to be transferred (up to 65535) is programmable. The register which contains the amount of data items to be transferred is decremented after each transaction.

Programmable data sizes

Transfer data sizes of the peripheral and memory are fully programmable through the PSIZE and MSIZE bits in the DMA_CCRx register.

Pointer incrementation

Peripheral and memory pointers can optionally be automatically post-incremented after each transaction depending on the PINC and MINC bits in the DMA_CCRx register. If incremented mode is enabled, the address of the next transfer will be the address of the previous one incremented by 1, 2 or 4 depending on the chosen data size. The first transfer address is the one programmed in the DMA_CPARx/DMA_CMARx registers. During transfer operations, these registers keep the initially programmed value. The current

transfer addresses (in the current internal peripheral/memory address register) are not accessible by software.

If the channel is configured in noncircular mode, no DMA request is served after the last transfer (that is once the number of data items to be transferred has reached zero). In order to reload a new number of data items to be transferred into the DMA_CNDTRx register, the DMA channel must be disabled.

Note: If a DMA channel is disabled, the DMA registers are not reset. The DMA channel registers (DMA_CCRx, DMA_CPARx and DMA_CMARx) retain the initial values programmed during the channel configuration phase.

In circular mode, after the last transfer, the DMA_CNDTRx register is automatically reloaded with the initially programmed value. The current internal address registers are reloaded with the base address values from the DMA_CPARx/DMA_CMARx registers.

Channel configuration procedure

The following sequence should be followed to configure a DMA channelx (where x is the channel number).

1. Set the peripheral register address in the DMA_CPARx register. The data will be moved from/ to this address to/ from the memory after the peripheral event.
2. Set the memory address in the DMA_CMARx register. The data will be written to or read from this memory after the peripheral event.
3. Configure the total number of data to be transferred in the DMA_CNDTRx register. After each peripheral event, this value will be decremented.
4. Configure the channel priority using the PL[1:0] bits in the DMA_CCRx register
5. Configure data transfer direction, circular mode, peripheral & memory incremented mode, peripheral & memory data size, and interrupt after half and/or full transfer in the DMA_CCRx register
6. Activate the channel by setting the ENABLE bit in the DMA_CCRx register.

As soon as the channel is enabled, it can serve any DMA request from the peripheral connected on the channel.

Once half of the bytes are transferred, the half-transfer flag (HTIF) is set and an interrupt is generated if the Half-Transfer Interrupt Enable bit (HTIE) is set. At the end of the transfer, the Transfer Complete Flag (TCIF) is set and an interrupt is generated if the Transfer Complete Interrupt Enable bit (TCIE) is set.

Circular mode

Circular mode is available to handle circular buffers and continuous data flows (e.g. ADC scan mode). This feature can be enabled using the CIRC bit in the DMA_CCRx register. When circular mode is activated, the number of data to be transferred is automatically reloaded with the initial value programmed during the channel configuration phase, and the DMA requests continue to be served.

Memory-to-memory mode

The DMA channels can also work without being triggered by a request from a peripheral. This mode is called Memory to Memory mode.

If the MEM2MEM bit in the DMA_CCRx register is set, then the channel initiates transfers as soon as it is enabled by software by setting the Enable bit (EN) in the DMA_CCRx

register. The transfer stops once the DMA_CNDTRx register reaches zero. Memory to Memory mode may not be used at the same time as Circular mode.

13.3.4 Programmable data width, data alignment and endians

When PSIZE and MSIZE are not equal, the DMA performs some data alignments as described in [Table 76](#).

Table 76. Programmable data width and endian behavior (when bits PINC = MINC = 1)

Source port width	Destination port width	Number of data items to transfer (NDT)	Source content: address / data	Transfer operations	Destination content: address / data
8	8	4	@0x0 / B0 @0x1 / B1 @0x2 / B2 @0x3 / B3	1: READ B0[7:0] @0x0 then WRITE B0[7:0] @0x0 2: READ B1[7:0] @0x1 then WRITE B1[7:0] @0x1 3: READ B2[7:0] @0x2 then WRITE B2[7:0] @0x2 4: READ B3[7:0] @0x3 then WRITE B3[7:0] @0x3	@0x0 / B0 @0x1 / B1 @0x2 / B2 @0x3 / B3
8	16	4	@0x0 / B0 @0x1 / B1 @0x2 / B2 @0x3 / B3	1: READ B0[7:0] @0x0 then WRITE 00B0[15:0] @0x0 2: READ B1[7:0] @0x1 then WRITE 00B1[15:0] @0x2 3: READ B2[7:0] @0x2 then WRITE 00B2[15:0] @0x4 4: READ B3[7:0] @0x3 then WRITE 00B3[15:0] @0x6	@0x0 / 00B0 @0x2 / 00B1 @0x4 / 00B2 @0x6 / 00B3
8	32	4	@0x0 / B0 @0x1 / B1 @0x2 / B2 @0x3 / B3	1: READ B0[7:0] @0x0 then WRITE 000000B0[31:0] @0x0 2: READ B1[7:0] @0x1 then WRITE 000000B1[31:0] @0x4 3: READ B2[7:0] @0x2 then WRITE 000000B2[31:0] @0x8 4: READ B3[7:0] @0x3 then WRITE 000000B3[31:0] @0xC	@0x0 / 000000B0 @0x4 / 000000B1 @0x8 / 000000B2 @0xC / 000000B3
16	8	4	@0x0 / B1B0 @0x2 / B3B2 @0x4 / B5B4 @0x6 / B7B6	1: READ B1B0[15:0] @0x0 then WRITE B0[7:0] @0x0 2: READ B3B2[15:0] @0x2 then WRITE B2[7:0] @0x1 3: READ B5B4[15:0] @0x4 then WRITE B4[7:0] @0x2 4: READ B7B6[15:0] @0x6 then WRITE B6[7:0] @0x3	@0x0 / B0 @0x2 / B2 @0x4 / B4 @0x6 / B6
16	16	4	@0x0 / B1B0 @0x2 / B3B2 @0x4 / B5B4 @0x6 / B7B6	1: READ B1B0[15:0] @0x0 then WRITE B1B0[15:0] @0x0 2: READ B3B2[15:0] @0x2 then WRITE B3B2[15:0] @0x2 3: READ B5B4[15:0] @0x4 then WRITE B5B4[15:0] @0x4 4: READ B7B6[15:0] @0x6 then WRITE B7B6[15:0] @0x6	@0x0 / B1B0 @0x2 / B3B2 @0x4 / B5B4 @0x6 / B7B6
16	32	4	@0x0 / B1B0 @0x2 / B3B2 @0x4 / B5B4 @0x6 / B7B6	1: READ B1B0[15:0] @0x0 then WRITE 0000B1B0[31:0] @0x0 2: READ B3B2[15:0] @0x2 then WRITE 0000B3B2[31:0] @0x4 3: READ B5B4[15:0] @0x4 then WRITE 0000B5B4[31:0] @0x8 4: READ B7B6[15:0] @0x6 then WRITE 0000B7B6[31:0] @0xC	@0x0 / 0000B1B0 @0x4 / 0000B3B2 @0x8 / 0000B5B4 @0xC / 0000B7B6
32	8	4	@0x0 / B3B2B1B0 @0x4 / B7B6B5B4 @0x8 / BBBAB9B8 @0xC / BFBEBDBC	1: READ B3B2B1B0[31:0] @0x0 then WRITE B0[7:0] @0x0 2: READ B7B6B5B4[31:0] @0x4 then WRITE B4[7:0] @0x1 3: READ BBBAB9B8[31:0] @0x8 then WRITE B8[7:0] @0x2 4: READ BFBEBDBC[31:0] @0xC then WRITE BC[7:0] @0x3	@0x0 / B0 @0x1 / B4 @0x2 / B8 @0x3 / BC
32	16	4	@0x0 / B3B2B1B0 @0x4 / B7B6B5B4 @0x8 / BBBAB9B8 @0xC / BFBEBDBC	1: READ B3B2B1B0[31:0] @0x0 then WRITE B1B0[7:0] @0x0 2: READ B7B6B5B4[31:0] @0x4 then WRITE B5B4[7:0] @0x1 3: READ BBBAB9B8[31:0] @0x8 then WRITE B9B8[7:0] @0x2 4: READ BFBEBDBC[31:0] @0xC then WRITE BDBC[7:0] @0x3	@0x0 / B1B0 @0x2 / B5B4 @0x4 / B9B8 @0x6 / BDBC
32	32	4	@0x0 / B3B2B1B0 @0x4 / B7B6B5B4 @0x8 / BBBAB9B8 @0xC / BFBEBDBC	1: READ B3B2B1B0[31:0] @0x0 then WRITE B3B2B1B0[31:0] @0x0 2: READ B7B6B5B4[31:0] @0x4 then WRITE B7B6B5B4[31:0] @0x4 3: READ BBBAB9B8[31:0] @0x8 then WRITE BBBAB9B8[31:0] @0x8 4: READ BFBEBDBC[31:0] @0xC then WRITE BFBEBDBC[31:0] @0xC	@0x0 / B3B2B1B0 @0x4 / B7B6B5B4 @0x8 / BBBAB9B8 @0xC / BFBEBDBC

Addressing an AHB peripheral that does not support byte or halfword write operations

When the DMA initiates an AHB byte or halfword write operation, the data are duplicated on the unused lanes of the HWDATA[31:0] bus. So when the used AHB slave peripheral does not support byte or halfword write operations (when HSIZE is not used by the peripheral)

and does not generate any error, the DMA writes the 32 HWDATA bits as shown in the two examples below:

- To write the halfword “0xABCD”, the DMA sets the HWDATA bus to “0xABCDABCD” with HSIZE = HalfWord
- To write the byte “0xAB”, the DMA sets the HWDATA bus to “0xABABABAB” with HSIZE = Byte

Assuming that the AHB/APB bridge is an AHB 32-bit slave peripheral that does not take the HSIZE data into account, it will transform any AHB byte or halfword operation into a 32-bit APB operation in the following manner:

- an AHB byte write operation of the data “0xB0” to 0x0 (or to 0x1, 0x2 or 0x3) will be converted to an APB word write operation of the data “0xB0B0B0B0” to 0x0
- an AHB halfword write operation of the data “0xB1B0” to 0x0 (or to 0x2) will be converted to an APB word write operation of the data “0xB1B0B1B0” to 0x0

For instance, to write the APB backup registers (16-bit registers aligned to a 32-bit address boundary), the memory source size (MSIZE) must be configured to “16-bit” and the peripheral destination size (PSIZE) to “32-bit”.

13.3.5 Error management

A DMA transfer error can be generated by reading from or writing to a reserved address space. When a DMA transfer error occurs during a DMA read or a write access, the faulty channel is automatically disabled through a hardware clear of its EN bit in the corresponding Channel configuration register (DMA_CCRx). The channel's transfer error interrupt flag (TEIF) in the DMA_IFR register is set and an interrupt is generated if the transfer error interrupt enable bit (TEIE) in the DMA_CCRx register is set.

13.3.6 Interrupts

An interrupt can be produced on a Half-transfer, Transfer complete or Transfer error for each DMA channel. Separate interrupt enable bits are available for flexibility.

Table 77. DMA interrupt requests

Interrupt event	Event flag	Enable Control bit
Half-transfer	HTIF	HTIE
Transfer complete	TCIF	TCIE
Transfer error	TEIF	TEIE

Note: In high-density and XL-density devices, DMA2 Channel4 and DMA2 Channel5 interrupts are mapped onto the same interrupt vector. In connectivity line devices, DMA2 Channel4 and DMA2 Channel5 interrupts have separate interrupt vectors. All other DMA1 and DMA2 Channel interrupts have their own interrupt vector.

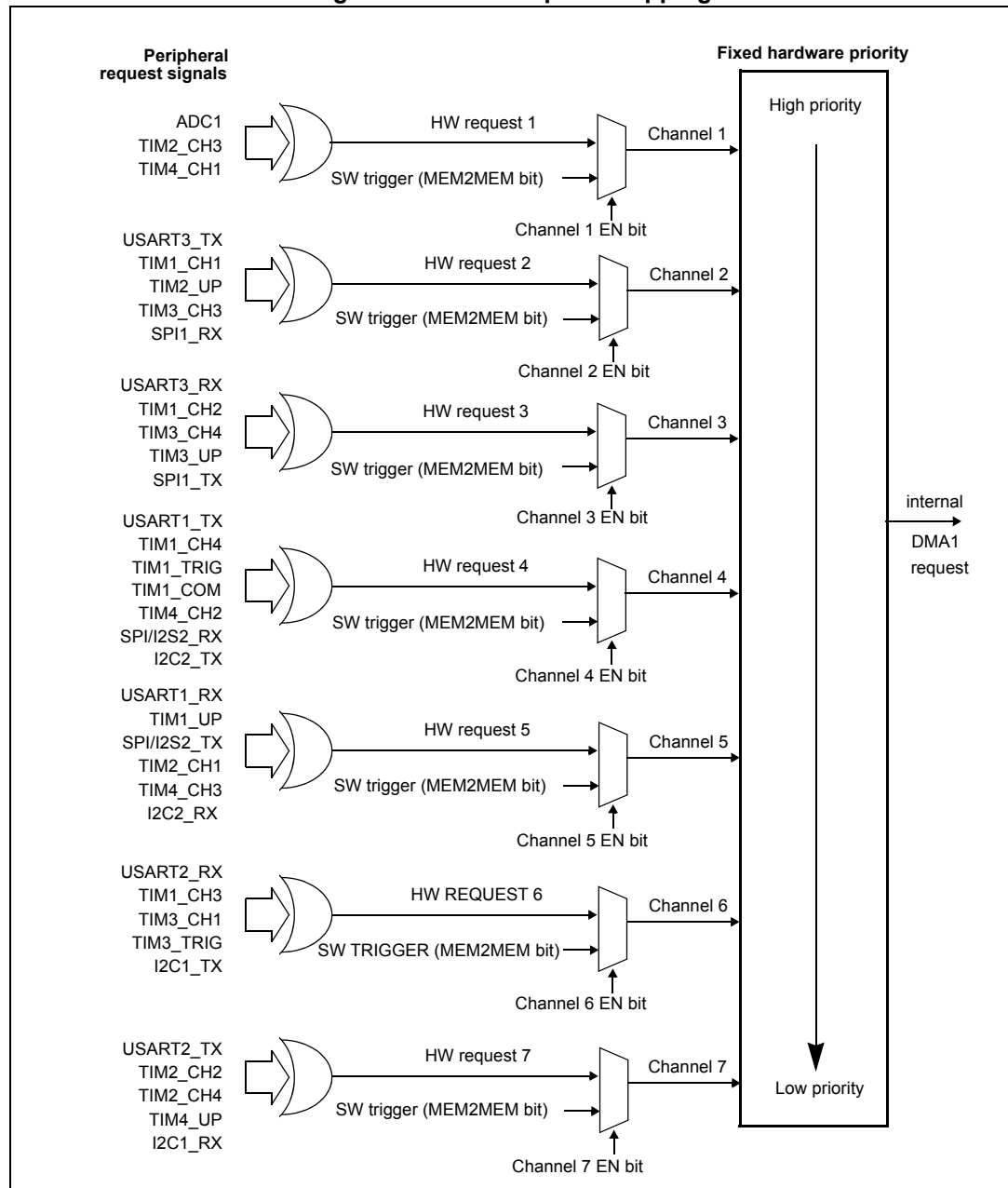
13.3.7 DMA request mapping

DMA1 controller

The 7 requests from the peripherals (TIMx[1,2,3,4], ADC1, SPI1, SPI/I2S2, I2Cx[1,2] and USARTx[1,2,3]) are simply logically ORed before entering the DMA1, this means that only one request must be enabled at a time. Refer to [Figure 50](#).

The peripheral DMA requests can be independently activated/de-activated by programming the DMA control bit in the registers of the corresponding peripheral.

Figure 50. DMA1 request mapping



[Table 78](#) lists the DMA requests for each channel.

Table 78. Summary of DMA1 requests for each channel

Peripherals	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7
ADC1	ADC1	-	-	-	-	-	-
SPI/I ² S	-	SPI1_RX	SPI1_TX	SPI2/I2S2_RX	SPI2/I2S2_TX	-	-
USART	-	USART3_TX	USART3_RX	USART1_TX	USART1_RX	USART2_RX	USART2_TX
I ² C	-	-	-	I2C2_TX	I2C2_RX	I2C1_TX	I2C1_RX
TIM1	-	TIM1_CH1	-	TIM1_CH4 TIM1_TRIG TIM1_COM	TIM1_UP	TIM1_CH3	-
TIM2	TIM2_CH3	TIM2_UP	-	-	TIM2_CH1	-	TIM2_CH2 TIM2_CH4
TIM3	-	TIM3_CH3	TIM3_CH4 TIM3_UP	-	-	TIM3_CH1 TIM3_TRIG	-
TIM4	TIM4_CH1	-	-	TIM4_CH2	TIM4_CH3	-	TIM4_UP

DMA2 controller

The five requests from the peripherals (TIMx[5,6,7,8], ADC3, SPI/I2S3, UART4, DAC_Channel[1,2] and SDIO) are simply logically ORed before entering the DMA2, this means that only one request must be enabled at a time. Refer to [Figure 51](#).

The peripheral DMA requests can be independently activated/de-activated by programming the DMA control bit in the registers of the corresponding peripheral.

Note: *The DMA2 controller and its relative requests are available only in high-density, XL-density and connectivity line devices.*

Figure 51. DMA2 request mapping

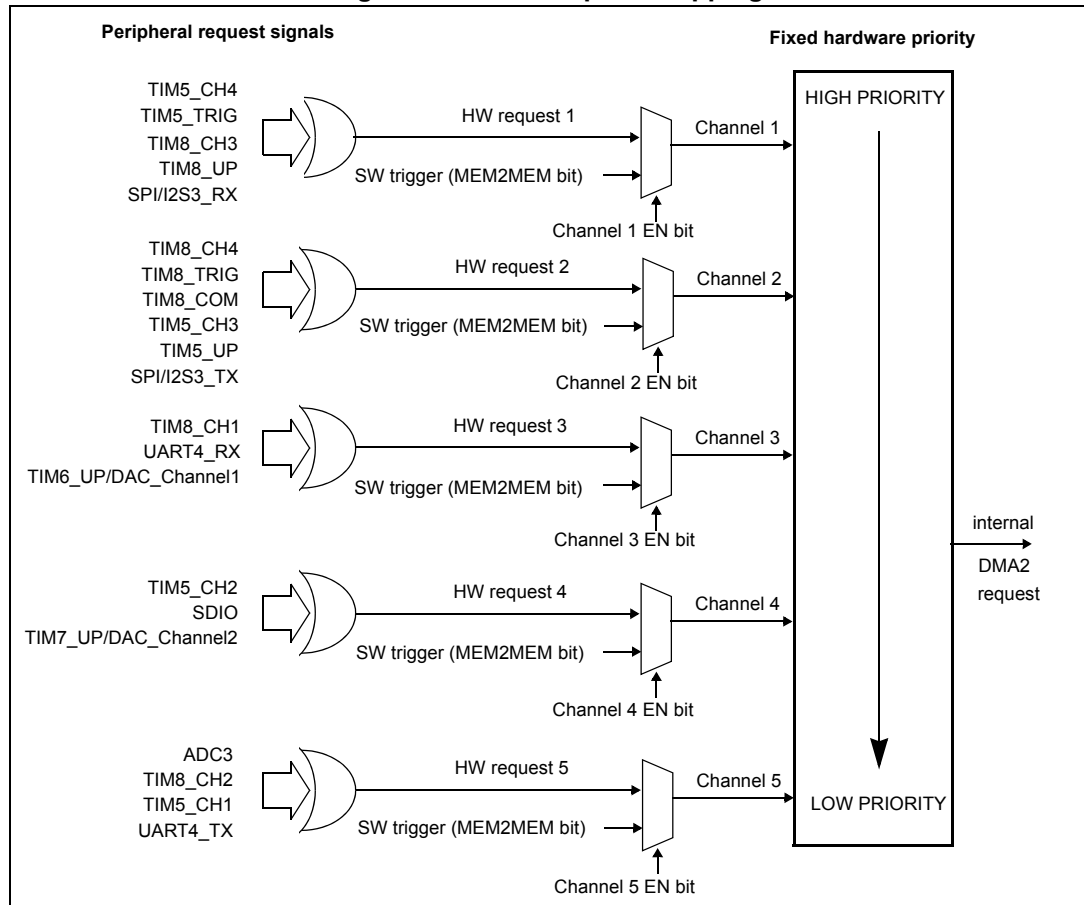


Table 79 lists the DMA2 requests for each channel.

Table 79. Summary of DMA2 requests for each channel

Peripherals	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5
ADC3 ⁽¹⁾	-	-	-	-	ADC3
SPI/I2S3	SPI/I2S3_RX	SPI/I2S3_TX	-	-	-
UART4	-	-	UART4_RX	-	UART4_TX
SDIO ⁽¹⁾	-	-	-	SDIO	-
TIM5	TIM5_CH4 TIM5_TRIG	TIM5_CH3 TIM5_UP	-	TIM5_CH2	TIM5_CH1
TIM6/ DAC_Channel1	-	-	TIM6_UP/ DAC_Channel1	-	-
TIM7	-	-	-	TIM7_UP/ DAC_Channel2	-
TIM8	TIM8_CH3 TIM8_UP	TIM8_CH4 TIM8_TRIG TIM8_COM	TIM8_CH1	-	TIM8_CH2

1. ADC3, SDIO and TIM8 DMA requests are available only in high-density and XL-density devices.

13.4 DMA registers

Refer to [Section 2.2 on page 45](#) for a list of abbreviations used in register descriptions.

Note: *In the following registers, all bits related to channel6 and channel7 are not relevant for DMA2 since it has only 5 channels.*

The peripheral registers can be accessed by bytes (8-bit), half-words (16-bit) or words (32-bit).

13.4.1 DMA interrupt status register (DMA_ISR)

Address offset: 0x00

Reset value: 0x0000 0000

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Reserved				TEIF7	HTIF7	TCIF7	GIF7	TEIF6	HTIF6	TCIF6	GIF6	TEIF5	HTIF5	TCIF5	GIF5
				r	r	r	r	r	r	r	r	r	r	r	r
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TEIF4	HTIF4	TCIF4	GIF4	TEIF3	HTIF3	TCIF3	GIF3	TEIF2	HTIF2	TCIF2	GIF2	TEIF1	HTIF1	TCIF1	GIF1
r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r

Bits 31:28 Reserved, must be kept at reset value.

Bits 27, 23, 19, 15, **TEIFx**: Channel x transfer error flag (x = 1 ..7)

11, 7, 3 This bit is set by hardware. It is cleared by software writing 1 to the corresponding bit in the DMA_IFCR register.

0: No transfer error (TE) on channel x

1: A transfer error (TE) occurred on channel x

Bits 26, 22, 18, 14, **HTIFx**: Channel x half transfer flag (x = 1 ..7)

10, 6, 2 This bit is set by hardware. It is cleared by software writing 1 to the corresponding bit in the DMA_IFCR register.

0: No half transfer (HT) event on channel x

1: A half transfer (HT) event occurred on channel x

Bits 25, 21, 17, 13, **TCIFx**: Channel x transfer complete flag (x = 1 ..7)

9, 5, 1 This bit is set by hardware. It is cleared by software writing 1 to the corresponding bit in the DMA_IFCR register.

0: No transfer complete (TC) event on channel x

1: A transfer complete (TC) event occurred on channel x

Bits 24, 20, 16, 12, **GIFx**: Channel x global interrupt flag (x = 1 ..7)

8, 4, 0 This bit is set by hardware. It is cleared by software writing 1 to the corresponding bit in the DMA_IFCR register.

0: No TE, HT or TC event on channel x

1: A TE, HT or TC event occurred on channel x

13.4.2 DMA interrupt flag clear register (DMA_IFCR)

Address offset: 0x04

Reset value: 0x0000 0000

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Reserved				CTEIF 7	CHTIF 7	CTCIF7	CGIF7	CTEIF6	CHTIF6	CTCIF6	CGIF6	CTEIF5	CHTIF5	CTCIF5	CGIF5
				w	w	w	w	w	w	w	w	w	w	w	w
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CTEIF 4	CHTIF 4	CTCIF 4	CGIF4	CTEIF 3	CHTIF 3	CTCIF3	CGIF3	CTEIF2	CHTIF2	CTCIF2	CGIF2	CTEIF1	CHTIF1	CTCIF1	CGIF1
w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w

Bits 31:28 Reserved, must be kept at reset value.

Bits 27, 23, 19, 15, **CTEIFx**: Channel x transfer error clear (x = 1 ..7)

11, 7, 3 This bit is set and cleared by software.

0: No effect

1: Clears the corresponding TEIF flag in the DMA_ISR register

Bits 26, 22, 18, 14, **CHTIFx**: Channel x half transfer clear (x = 1 ..7)

10, 6, 2 This bit is set and cleared by software.

0: No effect

1: Clears the corresponding HTIF flag in the DMA_ISR register

Bits 25, 21, 17, 13, **CTCIFx**: Channel x transfer complete clear (x = 1 ..7)

9, 5, 1 This bit is set and cleared by software.

0: No effect

1: Clears the corresponding TCIF flag in the DMA_ISR register

Bits 24, 20, 16, 12, **CGIFx**: Channel x global interrupt clear (x = 1 ..7)

8, 4, 0 This bit is set and cleared by software.

0: No effect

1: Clears the GIF, TEIF, HTIF and TCIF flags in the DMA_ISR register

13.4.3 DMA channel x configuration register (DMA_CCRx) (x = 1..7, where x = channel number)

Address offset: 0x08 + 0d20 × (channel number – 1)

Reset value: 0x0000 0000

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Reserved															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Res.	MEM2 MEM	PL[1:0]		MSIZE[1:0]		PSIZE[1:0]		MINC	PINC	CIRC	DIR	TEIE	HTIE	TCIE	EN
	rw	rw	rw	rw	rw	rw	rw	rw	rw	rw	rw	rw	rw	rw	rw

Bits 31:15 Reserved, must be kept at reset value.

Bit 14 **MEM2MEM**: Memory to memory mode

This bit is set and cleared by software.

0: Memory to memory mode disabled

1: Memory to memory mode enabled

Bits 13:12 **PL[1:0]**: Channel priority level

These bits are set and cleared by software.

00: Low

01: Medium

10: High

11: Very high

Bits 11:10 **MSIZE[1:0]**: Memory size

These bits are set and cleared by software.

00: 8-bits

01: 16-bits

10: 32-bits

11: Reserved

Bits 9:8 **PSIZE[1:0]**: Peripheral size

These bits are set and cleared by software.

00: 8-bits

01: 16-bits

10: 32-bits

11: Reserved

Bit 7 **MINC**: Memory increment mode

This bit is set and cleared by software.

0: Memory increment mode disabled

1: Memory increment mode enabled

Bit 6 **PINC**: Peripheral increment mode

This bit is set and cleared by software.

0: Peripheral increment mode disabled

1: Peripheral increment mode enabled

Bit 5 **CIRC**: Circular mode

This bit is set and cleared by software.

0: Circular mode disabled

1: Circular mode enabled

- Bit 4 **DIR**: Data transfer direction
This bit is set and cleared by software.
0: Read from peripheral
1: Read from memory
- Bit 3 **TEIE**: Transfer error interrupt enable
This bit is set and cleared by software.
0: TE interrupt disabled
1: TE interrupt enabled
- Bit 2 **HTIE**: Half transfer interrupt enable
This bit is set and cleared by software.
0: HT interrupt disabled
1: HT interrupt enabled
- Bit 1 **TCIE**: Transfer complete interrupt enable
This bit is set and cleared by software.
0: TC interrupt disabled
1: TC interrupt enabled
- Bit 0 **EN**: Channel enable
This bit is set and cleared by software.
0: Channel disabled
1: Channel enabled

13.4.4 DMA channel x number of data register (DMA_CNDTRx) (x = 1..7, where x = channel number)

Address offset: $0x0C + 0d20 \times (\text{channel number} - 1)$

Reset value: 0x0000 0000

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Reserved															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
NDT															
rw	rw	rw	rw	rw	rw	rw	rw	rw	rw	rw	rw	rw	rw	rw	rw

Bits 31:16 Reserved, must be kept at reset value.

Bits 15:0 **NDT[15:0]**: Number of data to transfer

Number of data to be transferred (0 up to 65535). This register can only be written when the channel is disabled. Once the channel is enabled, this register is read-only, indicating the remaining bytes to be transmitted. This register decrements after each DMA transfer. Once the transfer is completed, this register can either stay at zero or be reloaded automatically by the value previously programmed if the channel is configured in auto-reload mode.

If this register is zero, no transaction can be served whether the channel is enabled or not.

13.4.5 DMA channel x peripheral address register (DMA_CPARx) (x = 1..7, where x = channel number)

Address offset: $0x10 + 0d20 \times (\text{channel number} - 1)$

Reset value: 0x0000 0000

This register must *not* be written when the channel is enabled.

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
PA																															
rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW

Bits 31:0 **PA[31:0]**: Peripheral address

Base address of the peripheral data register from/to which the data will be read/written.

When PSIZE is 01 (16-bit), the PA[0] bit is ignored. Access is automatically aligned to a half-word address.

When PSIZE is 10 (32-bit), PA[1:0] are ignored. Access is automatically aligned to a word address.

13.4.6 DMA channel x memory address register (DMA_CMARx) (x = 1..7, where x = channel number)

Address offset: $0x14 + 0d20 \times (\text{channel number} - 1)$

Reset value: 0x0000 0000

This register must *not* be written when the channel is enabled.

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MA																															
rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW	rW

Bits 31:0 **MA[31:0]**: Memory address

Base address of the memory area from/to which the data will be read/written.

When MSIZE is 01 (16-bit), the MA[0] bit is ignored. Access is automatically aligned to a half-word address.

When MSIZE is 10 (32-bit), MA[1:0] are ignored. Access is automatically aligned to a word address.

13.4.7 DMA register map

The following table gives the DMA register map and the reset values.

Table 80. DMA register map and reset values

Offset	Register	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
0x000	DMA_ISR	Reserved				TEIF7	HTIF7	TCIF7	GIF7	TEIF6	HTIF6	TCIF6	GIF6	TEIF5	HTIF5	TCIF5	GIF5	TEIF4	HTIF4	TCIF4	GIF4	TEIF3	HTIF3	TCIF3	GIF3	TEIF2	HTIF2	TCIF2	GIF2	TEIF1	HTIF1	TCIF1	GIF1	
	Reset value					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0x004	DMA_IFCR	Reserved				CTEIF7	CHTIF7	CTCIF7	CGIF7	CTEIF6	CHTIF6	CTCIF6	CGIF6	CTEIF5	CHTIF5	CTCIF5	CGIF5	CTEIF4	CHTIF4	CTCIF4	CGIF4	CTEIF3	CHTIF3	CTCIF3	CGIF3	CTEIF2	CHTIF2	CTCIF2	CGIF2	CTEIF1	CHTIF1	CTCIF1	CGIF1	
	Reset value					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0x008	DMA_CCR1	Reserved																MEM2MEM	PL [1:0]	M SIZE [1:0]		PSIZE [1:0]		MINC	PINC	CIRC	DIR	TEIE	HTIE	TCIE	EN			
	Reset value																															0	0	0
0x00C	DMA_CNDTR1	Reserved																NDT[15:0]																
	Reset value																	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0x010	DMA_CPAR1	PA[31:0]																																
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0x014	DMA_CMAR1	MA[31:0]																																
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0x018	Reserved																																	
0x01C	DMA_CCR2	Reserved																MEM2MEM	PL [1:0]	M SIZE [1:0]		PSIZE [1:0]		MINC	PINC	CIRC	DIR	TEIE	HTIE	TCIE	EN			
	Reset value																															0	0	0
0x020	DMA_CNDTR2	Reserved																NDT[15:0]																
	Reset value																	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0x024	DMA_CPAR2	PA[31:0]																																
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0x028	DMA_CMAR2	MA[31:0]																																
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0x02C	Reserved																																	
0x030	DMA_CCR3	Reserved																MEM2MEM	PL [1:0]	M SIZE [1:0]		PSIZE [1:0]		MINC	PINC	CIRC	DIR	TEIE	HTIE	TCIE	EN			
	Reset value																															0	0	0
0x034	DMA_CNDTR3	Reserved																NDT[15:0]																
	Reset value																	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0x038	DMA_CPAR3	PA[31:0]																																
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0x03C	DMA_CMAR3	MA[31:0]																																
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0x040	Reserved																																	

Table 80. DMA register map and reset values (continued)

Offset	Register	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0				
0x044	DMA_CCR4	Reserved																MEM2MEM	PL [1:0]		M SIZE [1:0]		PSIZE [1:0]		MINC	PINC	CIRC	DIR	TEIE	HTIE	TCIE	EN					
	Reset value																	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
0x048	DMA_CNDTR4	Reserved																NDT[15:0]																			
	Reset value																	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0x04C	DMA_CPAR4	PA[31:0]																																			
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
0x050	DMA_CMAR4	MA[31:0]																																			
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
0x054	Reserved																																				
0x058	DMA_CCR5	Reserved																MEM2MEM	PL [1:0]		M SIZE [1:0]		PSIZE [1:0]		MINC	PINC	CIRC	DIR	TEIE	HTIE	TCIE	EN					
	Reset value																	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0x05C	DMA_CNDTR5	Reserved																NDT[15:0]																			
	Reset value																	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0x060	DMA_CPAR5	PA[31:0]																																			
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
0x064	DMA_CMAR5	MA[31:0]																																			
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
0x068	Reserved																																				
0x06C	DMA_CCR6	Reserved																MEM2MEM	PL [1:0]		M SIZE [1:0]		PSIZE [1:0]		MINC	PINC	CIRC	DIR	TEIE	HTIE	TCIE	EN					
	Reset value																	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0x070	DMA_CNDTR6	Reserved																NDT[15:0]																			
	Reset value																	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0x074	DMA_CPAR6	PA[31:0]																																			
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
0x078	DMA_CMAR6	MA[31:0]																																			
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
0x07C	Reserved																																				
0x080	DMA_CCR7	Reserved																MEM2MEM	PL [1:0]		M SIZE [1:0]		PSIZE [1:0]		MINC	PINC	CIRC	DIR	TEIE	HTIE	TCIE	EN					
	Reset value																	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0x084	DMA_CNDTR7	Reserved																NDT[15:0]																			
	Reset value																	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0x088	DMA_CPAR7	PA[31:0]																																			
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				

Table 80. DMA register map and reset values (continued)

Offset	Register	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x08C	DMA_CMAR7	MA[31:0]																															
	Reset value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0x090	Reserved																																

Refer to [Table 3 on page 50](#) for the register boundary addresses.