MCF5307 Device Errata

This document identifies implementation differences between particular versions of the MCF5307 processor and the description of the MCF5307 processor contained in the MCF5307 User's Manual. Please check the WWW at http://www.motorola.com/ColdFire for the latest updates. This errata lists any processor differences from the following documents:

- MCF5307 User's Manual
- MCF5307 User's Manual Mask Set Addendum
- ColdFire Microprocessor Family Programmer's Reference Manual

This document applies to the following mask sets: 0H55J, 1H55J, 1J20C, and 2J20C. Designers can differentiate whether they have a xH55J mask set or xJ20C mask set by reading the IDCODE register in the JTAG module of the MCF5307.

The IDCODE register shown in Table 1 will be identical between mask sets except for the version number. For an xH55J mask, idcode[31:28]=version no.= 0000, while for an xJ20C mask, idcode[31:28]=version no.=0001. All other bits remain the same.

Table 1. MCF5307 IDCODE Register

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
x	x	x	x	0	1	0	0	1	1	0	0	0	0	0	0
Version No.				Design Center= ColdFire						Device No.					
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	1	1	0	0	0	0	0	0	0	1	1	1	0	1
Device No.				JEDEC No.											-

Table 2. Summary of MCF5307 Errata

Errata ID	Module Affected	Date Errata Added	Applicable Mask Set				Errata Title
			0H55J	1H55J	1J20C	2J20C	
1	External Bus	01/18/1999	Yes	Yes			TS Asserts Before Tri-stating During External Master Arbitration
2	External Bus	01/18/1999	Yes	Yes			TA Asserts for an Extra Clock During an External Master Burst-line Write
3	External Bus	01/18/1999	Yes	Yes			MBAR Reads Execute an External Bus Cycle
4	External Bus	01/18/1999	Yes	Yes			Added Latency During External Master Access of On-chip Peripherals
5	Core	01/18/1999	Yes	Yes			CPUSHL Instruction Fails to Push if CACR[31] = 0
6	Core	01/18/1999	Yes	Yes			Contents of Line-fill Buffer Lost During Warm Reset
7	Debug	01/18/1999	Yes	Yes			Misaligned WDDATA Operands Not Captured
8	Debug	01/18/1999	Yes	Yes			CCR Corrupted During Misaligned Memory-to-Memory MOVE.L while Capturing Operands for DDATA
9	Debug	01/18/1999	Yes	Yes			Unexpected Data Breakpoint Trigger
10	DRAMC	01/18/1999	Yes	Yes			RAS[1:0] Negation during Page-mode Access in Asynchronous DRAM Mode
11	SIM	01/18/1999	Yes	Yes			SWT Servicing Sequence Fails
12	Elec. Specs	01/18/1999	Yes	Yes	Yes	Yes	DC Parametric Modifications
13	Elec. Specs	01/18/1999	Yes	Yes	See Errata #26	See Errata #26	AC Timing Modifications for the xH55J Mask
14	DMA	01/18/1999	Yes	Yes			Direct Memory Access Controller (DMA) Cycle Steal Mode Misoperation
15	DRAMC	01/18/1999	Yes	Yes			SDRAM Edgeselect Mode
16	Cache	04/09/1999	Yes	Yes			Incorrect Behavior of Burst-write MOVEM after Read Cache Miss

Table 2. Summary of MCF5307 Errata (continued)

Errata ID	Module Affected	Date Errata Added	Applicable Mask Set				Errata Title
			0H55J	1H55J	1J20C	2J20C	
17	several	04/09/1999	Yes	Yes			Bogus Write-protect Faults for some MOVEM or CPUSHL Instructions
18	Core	04/09/1999	Yes	Yes			Incorrect Branch Target Instruction Fetches
19	Core	04/09/1999	Yes	Yes			Problem Involving Undetected Level 7 Interrupt
20	Core	04/09/1999	Yes	Yes	Yes	Yes	Longword Aligned Fetch Containing Illegal Opcode (Upper 16-bits) plus Bxx.b Opcode (lower 16-bits) Generates Bogus Fetch Address
21	Debug	04/09/1999	Yes	Yes			Correct Operation of Debug_RevB “syncPC” Command is Sequence-dependent
22	SIM	04/09/1999	Yes	Yes	Yes	Yes	Spurious Interrupt Generated when Masked IMR Interrupt is Taken
23	DRAMC	04/09/1999	Yes	Yes	Yes	Yes	External Master Termination is Not Always Correct when Using SDRAM Controller
24	DMA	04/09/1999	Yes	Yes			Source Address Increment Bit for DMA Channels does Not Increment Properly
25	DMA	08/18/1999	Yes	Yes	Yes		When Using Multiple DMA Channels, a Write by a DMA Channel Could Get Lost if a Higher Priority DMA Channel Requests the Internal Bus Simultaneously.
26	Elec. Specs	09/17/1999	See Errata #13	See Errata #13	Yes	Yes	AC Timing Modifications for xJ20C Mask
27	MAC	05/24/2000			Yes	Yes	MAC Fractional –1 * –1 Overflow Detection Erratic
28	Debug	05/24/2000	Yes	Yes	Yes	Yes	Data Inversion Triggers are Incorrect for Word and Longword Accesses
29	Debug	05/24/2000	Yes	Yes	Yes	Yes	Second-level Breakpoint Trigger Missed if it Occurs on the Cycle Immediately after Assertion of First-level Trigger
30	DMA	05/24/2000	Yes	Yes	Yes	Yes	DMA Writes to UART Cause Transmission Errors
31	DMA	05/24/2000	Yes	Yes	Yes	Yes	DMA Single-Address Access Mode and Cycle-steal Mode do Not Work Together
32	DMA arbiter	05/24/2000	Yes	Yes	Yes	Yes	DMA Channel Arbiter Hangs in Round-robin Mode
33	Debug	05/24/2000	Yes	Yes	Yes	Yes	Processor Status Reporting Anomaly during Debug Exception Processing
34	Debug	05/24/2000	Yes	Yes	Yes	Yes	Forcing Emulator Mode from Reset by Asserting CSR[13] does Not Work
35	SIM	01/22/04	Yes	Yes	Yes	Yes	Corrupted Return PC in Exception Stack Frame
36	Debug	08/02/04	Yes	Yes	Yes	Yes	Incorrect debug interrupts triggered

1 $\overline{\text{TS}}$ Asserts Before Tri-stating During External Master Arbitration

1.1 Description

This errata applies only when using an external master and the EARBCTRL control bit of the Default Bus master Register (MPARK) is cleared. If the EARBCTRL control bit is cleared, (allowing slave bus cycles without arbitrating for the external bus) and bus grant ($\overline{\text{BG}}$) negates at the initiation of a slave bus cycle, $\overline{\text{TS}}$ may be asserted and may not be negated prior to the 5307 tri-stating and releasing the bus. This leaves the $\overline{\text{TS}}$ signal asserted for the external master or control logic.

1.2 Workaround

- No external master in the system.
- If there is an external master other than the 5307, the EARBCTRL bit must be set, requiring arbitration for the external bus prior to initiation of slave bus cycles.
- Provide an external pull-up on the $\overline{\text{TS}}$ signal to negate $\overline{\text{TS}}$ after the 5307 releases the bus.

MASKS: 0H55J, 1H55J01/18/1999

2 $\overline{\text{TA}}$ Asserts for an Extra Clock During an External Master Burst-line Write

2.1 Description

This errata applies only when using an external master with the MCF5307. If the external master is either executing a line write burst to internal MCF5307 peripherals or if the external master is using the MCF5307 control signals to execute a line write burst cycle, then during the last transfer of either of these two scenarios, the transfer acknowledge ($\overline{\text{TA}}$) signal may be erroneously asserted for two cycles.

2.2 Workaround

- No external master in the system.
- If there is an external master other than the 5307, do not allow the external master to do burst line writes to slave bus modules.

MASKS: 0H55J, 1H55J01/18/1999

3 MBAR Reads Execute an External Bus Cycle

3.1 Description

A read of the MBAR register causes the execution of an external bus cycle which could result in an external bus lock up while waiting for a $\overline{\text{TA}}$ termination signal.

3.2 Workaround

- Do not allow reads from the MBAR address.

MASKS: 0H55J, 1H55J1/18/1999

4 Added Latency During External Master Access of On-chip Peripherals

4.1 Description

This is only an issue when there is an external bus master accessing 5307 on-chip peripherals or when an on-chip alternate master is used when the SHOWDATA and EARBCTRL bit in the MPARK register is set to 1. For the external master scenario, this bug only affects performance, not functionality. On the initial bus cycle of a transfer by an external master to/from a 5307 peripheral, an extra cycle of latency is present in the response of the 5307 ($\overline{\text{TA}}$ and data[31:0]). When using the on-chip DMA, during an internal peripheral fetch followed by a DMA cycle, this added TA latency can cause DMA cycle to be erroneously terminated.

4.2 Workaround

- The current timing should not cause any functional problems.

MASKS: 0H55J, 1H55J1/18/1999

5 CPUSHL Instruction Fails to Push if CACR[31] = 0

5.1 Description

The CPUSHL instruction should force a cache line push at the specified cache address for modified data, regardless of the state of the cache enable defined in CACR[31]. In the current implementation, the CPUSHL operates correctly only if the cache is enabled, that is, CACR[31] = 1.

5.2 Workaround

- Guarantee that CACR[31] = 1 whenever a CPUSHL instruction is executed.

MASKS: 0H55J, 1H55J1/18/1999

6 Contents of Line-fill Buffer Lost During Warm Reset

6.1 Description

If a “warm reset” occurs while the Version 3 ColdFire processor core is operating, the documentation indicates that the cache contents are to be unaffected. With this errata, the occurrence of any reset causes the line fill buffer to be marked as invalid. Thus, if the line fill buffer contained valid data at the time of a warm reset, the initial state of the buffer after reset is empty, causing loss of the previous contents.

6.2 Workaround

- If the cache state is required to be consistent with across warm resets, it is necessary to flush the cache contents before the occurrence of the warm reset.

MASKS: 0H55J, 1H55J1/18/1999

7 Misaligned WDDATA Operands Not Captured

7.1 Description

Operands referenced by WDDATA instructions must be aligned on either 0-modulo-2 addresses or 0-modulo-4 addresses. Any other misaligned operand reference will cause the operand not to be captured by the WDDATA instruction.

7.2 Workaround

- Guarantee that all operands referenced by WDDATA instructions are aligned, that is, 16-bit references on 0-modulo-2 addresses and 32-bit references on 0-modulo-4 addresses.

MASKS: 0H55J, 1H55J1/18/1999

8 CCR Corrupted During Misaligned Memory-to-Memory MOVE.L while Capturing Operands for DDATA

8.1 Description

During the execution of certain 32-bit memory-to-memory move instructions with a misaligned source operand, there is a possibility that the Condition Code Register (CCR) may be incorrectly loaded if the processor's operand Execution pipeline is stalled for one or more cycles by the Debug Data module after the source operand access is completed. This failure can only occur if the debug unit's Configuration/Status Register is set to capture operand reads and/or writes for display on the DDATA output port.

8.2 Workaround

There are several potential workarounds to this problem:

- Do not enable operand capture and display on the DDATA outputs.
- If capturing operands for DDATA, guarantee that all memory-to-memory move instructions reference aligned operands.
- If capturing operands for DDATA, proceed any misaligned memory-to-memory move with a NOP instruction to provide pipeline synchronization.

MASKS: 0H55J, 1H55J1/18/1999

9 Unexpected Data Breakpoint Trigger

9.1 Description

If a data breakpoint monitoring multiple word and byte values is configured, there is a possibility that the breakpoint may falsely trigger. As an example, if the breakpoint hardware is configured to monitor for a certain byte value within a range of addresses, a byte reference is made and the data breakpoint value is present on the data bus, but in a different byte lane, a false trigger could be generated. The logic to fully qualify the reference size and the appropriate bytes of the data bus is incorrect.

Note: this bug does NOT affect the ability to configure a breakpoint of a certain data value at a certain address. The false trigger can only occur when multiple bits in the following fields of the Trigger Definition Register are asserted:

- if multiple bits of TDR[27:26] are set, and a level 2 trigger is enabled;
- if multiple bits of TDR[25:22] are set, and a level 2 trigger is enabled;
- if multiple bits of TDR[11:10] are set, and a level 1 trigger is enabled;

- if multiple bits of TDR[9:6] are set, and a level 1 trigger is enabled, then a false trigger may occur.

9.2 Workaround

- Restrict the use of the data breakpoint to only a single operand, and enable only a single bit in the TDR appropriate for the operand size and location on the data bus.

MASKS: 0H55J, 1H55J1/18/1999

10 $\overline{\text{RAS[1:0]}}$ Negation during Page-mode Access in Asynchronous DRAM Mode

10.1 Description

The DRAMC output $\overline{\text{RAS[1:0]}}$ signals negate during page mode accesses. This only happens in the "Asynchronous" DRAM page mode. The estimated effect of the Asynchronous DRAM being restricted to no page mode by considering the degradation of going from a 4-2-2-2 memory access to a 4-4-4-4 memory access.

10.2 Workaround

- 1. Do not use page mode for Asynchronous DRAM's.
- 2. Use Synchronous DRAM's.

MASKS: 0H55J, 1H55J1/18/1999

11 SWT Servicing Sequence Fails

11.1 Description

If the SWE bit in the SYPCR is enabled, the SWT requires the periodic execution of a software watchdog servicing sequence. The documentation indicates that the SWT service sequence consists of writing $55 to the SWSR followed by writing $AA to the SWSR. However, this service routine fails to reset the SWT counter.

11.2 Workaround

- No workarounds available.

MASKS: 0H55J, 1H55J1/18/1999

12 DC Parametric Modifications

12.1 Description

The following signals provide I_{OL}/I_{OH} levels reduced from the published levels.

- DATA[31:0], ADDR[23:0], PP[15:0], $\overline{\text{TS}}$, $\overline{\text{TA}}$, SIZE[1:0], R/$\overline{\text{W}}$, $\overline{\text{BR}}$, $\overline{\text{BD}}$, $\overline{\text{RSTO}}$, $\overline{\text{AS}}$, $\overline{\text{CS}}$[7:0], $\overline{\text{BE}}$[3:0], $\overline{\text{OE}}$, PSTCLK, PST[3:0], DDATA[3:0], DSO, TOUT[1:0], SCL, SDA, RTS[1:0], and TXD[1:0] provide I_{OH} = 6 mA at V_{OH} = 2.4 V and I_{OL} = 6 mA at V_{OL} = 0.5 V.
- BCLKO, $\overline{\text{RAS}}$[1:0], $\overline{\text{CAS}}$[3:0], $\overline{\text{DRAMW}}$, SCKE, $\overline{\text{SRAS}}$, and $\overline{\text{SCAS}}$ provide I_{OH} = 12 mA at V_{OH} = 2.4 V and I_{OL} = 12 mA at V_{OL} = 0.5 V.

12.2 Workaround

- Not Applicable

MASKS: 0H55J, 1H55J, 1J20C, 2J20C1/18/1999

13 AC Timing Modifications for the xH55J Mask

13.1 Description

For details on the AC timing modifications for the xJ20C mask see Errata #26.

- Spec D2 (output hold) must be decreased to –4.0 nsec all frequencies.
- Specs T5/U6/U8/M13/P4 (output holds) must be decreased to 0.0 nsec for all frequencies.
- Spec B11 (output hold) for $\overline{\text{RSTO}}$, DATA[31:0], $\overline{\text{TS}}$, $\overline{\text{BR}}$, $\overline{\text{BD}}$, ADDR[23:0], PP[15:0], R/$\overline{\text{W}}$, SIZE[1:0],$\overline{\text{TA}}$, must be decreased to 0.0 nsec for all frequencies.
- Spec B11a (output hold) for $\overline{\text{RAS}}$[1:0], $\overline{\text{CAS}}$[3:0], $\overline{\text{DRAMW}}$, SCKE, $\overline{\text{SRAS}}$, $\overline{\text{SCAS}}$ must be decreased to –1.0 nsec for all frequencies.
- Spec B14 (output hold) for $\overline{\text{AS}}$, $\overline{\text{CS}}$[7:0], $\overline{\text{BE}}$[3:0], $\overline{\text{OE}}$ must be decreased to 1.5 nsec for all frequencies.
- Spec B14a (output hold) for $\overline{\text{RAS}}$[1:0], $\overline{\text{CAS}}$[3:0], $\overline{\text{DRAMW}}$, SCKE, $\overline{\text{SRAS}}$, $\overline{\text{SCAS}}$ must be decreased to 0.5 nsec for all frequencies.
- Spec B14b (output hold) for DATA[31:0], ADDR[23:0], PP[15:8] must be decreased to 0.0 nsec for all frequencies.

13.2 Workaround

- The negative edge of pstclk can be used to sample the PST[3:0], DDATA[3:0] due to the negative hold time spec D2.

- The negative hold time spec B11a, can be adjusted by tying BCLKO to EDGESEL with as short a trace as possible. This will give you ~2.5 ns of delay between EDGESEL input and BCLKO output (through the input/outputpads). Thus, the interface signals to SDRAM will have a hold time of -1.0 ns + ~2.5 ns = ~1.5 ns. See Section 11.4.7 of the MCF5307 User's Manual and the workaround for Errata 15 for more information.

MASKS: 0H55J, 1H55J1/18/1999

14 Direct Memory Access Controller (DMA) Cycle Steal Mode Misoperation

14.1 Description

When the Cycle Steal (CS) mode is set in DCR, the DMA controller module does not operate properly if multiple channels are active. In other words, when CS is set, it does not do a single read/write transfer. For example, if DMA channel 1 is set to Cycle Steal mode, and the first request for DMA channel 1 has already occurred, and then a second DMA channel is started, DMA channel 1 will completely transfer the number of bytes programmed in the BCR instead of a single transfer, thus ignoring the setting of the Cycle Steal mode bit.

14.2 Workarounds

- The only guaranteed way for Cycle Steal mode to work correctly is to use only the lowest priority channel in Cycle Steal mode.

MASKS: 0H55J, 1H55J1/18/1999

15 SDRAM Edgeselect Mode

15.1 Description

When the 5307 core or DMA modules start a new bus cycle during the PALL command an EDGESEL bug can occur. When EDGESEL is tied high, the new bus cycle will not appear on the external bus pins until after the PALL cycle has run. The problem will show up when EDGESEL is tied to a delayed BCLK0 or tied low. This extends the PALL command past the rising BCLK0 edge which is starting the next bus cycle. The next bus cycle will cause the address bus to be updated on the rising edge of the internal clock and not provide the output hold time that the EDGESEL signal should give.

15.2 Workaround

The following are three different possible solutions:

- Only use one bank for all SDRAM’s in system.

- Latch all Bank Select outputs of the MCF5307 for all SDRAM bus cycles except hold the Bank Selects during SDRAM precharge cycles.
- Tying EDGESEL high is the easiest workaround, however this solution conflicts with the workaround for Errata 13. A workaround that will solve both issues is to keep the SDRAM CLK in phase with the BCLKO signal and tie EDGESEL to BCLKO with as short a trace as possible. This can be done by driving the SDRAM CLK with a clock driver that uses an internal PLL to follow the input clock and adjusts to give zero output skew. Refer to Errata 13 for related information on this workaround.

MASKS: 0H55J, 1H55J1/18/1999

16 Incorrect Behavior of Burst-write MOVEM after Read Cache Miss

16.1 Description

This failure involves a very complex sequence of internal memory bus accesses involving the unified cache and external bus line writes. The error occurs when the cache is programmed to enable write-through mode and the store buffer is enabled. The failing sequence involves the following conditions:

1. An operand read at offset 0x4 within a given line generates a cache miss
2. A subsequent MOVEM store instruction generates a line write beginning at offset 0x0 to the same line address which caused the previous miss

   If the processor is operating in store-though mode, there is possibility that the first MOVEM write cycle will begin one cycle to early at the same time the cache miss read is completing. The exact failure is very timing dependent and requires bus termination on the last longword for the cache read miss to exactly coincide with the initiation of the MOVEM write address phase. Additionally, the failure only occurs when the first two MOVEM write bus terminations occur on consecutive cycles (bursting). Thus, the failure occurs only when there are three consecutive bus terminations:

```
Cycle i         Bus termination for last longword of read miss
Cycle i+1       Bus termination for the first MOVEM write
Cycle i+2       Bus termination for the second MOVEM write
```

   The error is manifested as incorrect write data during the MOVEM, with the write operand for address 0x0 incorrectly stored at address 0x4 of the given line.

16.2 Workaround

- Operate the processor only in copyback mode.
- If the processor is operating in write-through mode with the store buffer enabled, then precede every potential write MOVEM instruction with a NOP to synchronize the processor.

MASKS: 0H55J, 1H55J4/09/1999

17 Bogus Write-protect Faults for some MOVEM or CPUSHL Instructions

17.1 Description

The assignment of the write-protect attribute (bit programmed in cache access control registers (ACR), chip select mask registers (CSMRs), and DRAM mask registers (DMRs) to a memory region may incorrectly generate an access error exception (write-protect fault). There are three specific conditions when these bogus write-protect faults may be generated:

1. If a memory-to-memory MOVE instruction is executed where the source operand space is write-protected and the destination address is unprotected, an incorrect write-protect fault may be reported as a result of the attempted write to the destination. The write to the destination does not occur in this case.
2. If a MOVEM instruction which loads registers from a write-protected memory space is executed and is immediately followed by an instruction which performs an operand write to a non-protected memory space, an incorrect write-protect fault may be generated in response to the attempted write. That is, the operand write is not performed.
3. If a CPUSHL instruction is executed using an effective address which corresponds to a write-protected memory space, an incorrect write-protect fault is generated. The effective address associated with the CPUSHL instruction is defined as the specific cache address to select an entry to be pushed and optionally cleared. If this cache address is equivalent to a memory address in a write-protected space, the incorrect exception is generated and the cache entry unaffected.

17.2 Workaround

- Do not use write-protection for any address space, OR only assign this attribute to instruction spaces that will never be accessed by operand references.
- Another option is to not allow write-protect spaces to be read by memory-to-memory MOVE or MOVEM instructions. For the #3 issue listed in the description, do not execute any CPUSHL instruction where the effective address appears as a memory-protected address. Or simply disable the write-protect attribute temporarily before the execution of an CPUSHL instruction.

MASKS: 0H55J, 1H55J4/09/1999

18 Incorrect Branch Target Instruction Fetches

18.1 Description

In as situation where a code segment ends with a subroutine return instruction (RTS), the Instruction Fetch Pipeline will continue to prefetch sequentially past this code in accordance with normal pre-fetch rules. However, if a subsequent bit pattern appears as one of the change-of-flow instructions (that is, has the same opcode as BRA, BSR, Bcc, JMP, JSR even though it is not an instruction), the branch acceleration mechanism calculates the target instruction address and switches the prefetch stream to that address. Consider the following example:

```
X-2:    rts             #end of code section
X+0:    4ef9 xxxx       #unknown contents appearing as “jmp xxxx_yyyy.l”
X+4:    yyyy ....
```

After the fetch of the RTS instruction, the next sequential access reads a bit pattern that appears to the Instruction Fetch Pipeline as a “JMP xxxx_yyyy” and redirects the prefetch to this new location. It is important to note that the processor always continues to execute the instruction stream correctly, processing the RTS instruction properly and discarding the prefetched contents of the instruction buffer. However, if the prefetch location includes non-existent memory regions, or if there are peripheral spaces that can be referenced by operand access only, the incorrect prefetch access can cause access errors or cause the system to hang.

18.2 Workaround

- At boundaries between code and data sections, the insertion of a special piece of code guarantees the prefetch mechanism cannot advance past the given location. Specifically, the following code guarantees the prefetch mechanism never accesses beyond the last text address:

```
60fe label:     bra.b   label
4afc            illegal
4afc            illegal
4afc            illegal
4afc            illegal
4afc            illegal
```

MASKS: 0H55J, 1H55J4/09/1999

19 Problem Involving Undetected Level 7 Interrupt

19.1 Description

There is a problem involving the execution of a MOVE to SR or RTE instruction which may cause the assertion of a level 7 interrupt request to be undetected by the processor (i.e. the core never responds with a level 7 interrupt exception).

Level 7 interrupts are treated differently than all other interrupts since they are viewed as being edge-sensitive (versus level-sensitive). Consequently, the processor has special logic to recognize the high-to-low assertion edge of the active-low interrupt 7 request. The error involves a very small window of time where the assertion of a level 7 interrupt request, in conjunction with the execution of certain variations of the MOVE to SR or RTE instructions, may incorrectly set a control state inhibiting the processing of this interrupt request.

In particular, the problem exists only when the execution of the MOVE to SR or RTE instruction loads a value of “7” into the 3-bit interrupt mask level of the status register. For all other interrupt mask values the failure cannot occur.

It should also be noted that the typical level 7 interrupt service routine, where the interrupt request is negated before the RTE is executed, would never encounter this problem.

19.2 Workaround

For the MOVE to SR or RTE instructions, load an operand of “6” into the 3-bit interrupt mask of the status register to mask interrupt levels 1-6. The use of this new interrupt mask level does not effect the ability to inhibit interrupts, since values of 6 or 7 both mask levels 1-6. A level 7 interrupt service routine would need to load an operand of “7” into the interrupt mask until the level 7 interrupt source is negated, otherwise another level 7 interrupt would be generated if the interrupt mask is lowered and the level 7 request is still present.

MASKS: 0H55J, 1H55J4/09/1999

20 Longword Aligned Fetch Containing Illegal Opcode (Upper 16-bits) plus Bxx.b Opcode (lower 16-bits) Generates Bogus Fetch Address

20.1 Description

If the upper 16-bits of a longword aligned fetch location contain an unknown (illegal) opcode while the lower 16 bits contain a Bxx.B opcode (where Bxx = BRA, BSR, Bcc) an incorrect re-direction of the prefetch stream to an improper target location will occur. An example of this could seen in the following code:

```
        mov.l   (4,%pc,%d0.l*4), %a0

        jmp     (%a0)

label:

        long    label1

        long    label2
```

In this case, the code would disassemble to:

```
X-6:    207b 0c04       #mov.l

X-2:    4ed0            #jmp

X+0:    wxyz 6040       #pointer to label1 (example)
```

```
X+4:    .... .....      #pointer to label2
```

In this example, you can see that after the JMP instruction the label pointer disassembles to what looks like an unknown opcode (wxyz = any unknown opcode) followed by a 16-bit opcode that looks like a Bxx.B opcode, but actually isn’t. In this case, the branch acceleration logic would calculate the target address and begin prefetching at X + $44. This will especially cause a problem if the address that the acceleration logic jumps to an offset range that doesn’t exist which would result in an illegal access. More specifically, if the 8-bit displacement that was decoded in the look-alike Bxx.b instruction branched to an offset (-128 byte to +128 byte) that no chip-select was programmed to or where no memory existed, then the bus cycle would hang. However, if the offset was within a chip-select or memory range, then although the branch would be to an improper address location, the error would eventually be recovered when the JMP instruction (at X-2) was executed in the Operand Execution Pipeline.

20.2 Workaround

- If there is a 128-byte space at the beginning and end of any code sections that might be affected by this sequence, the calculation of the bogus target address should not impact system operation.
- The assembly language for label or case statements as defined above can also be modified to guarantee the problem does not occur. The use of the ILLEGAL opcode prior to the table of addresses would prevent improper code re-direction. Note that the ColdFire ISA ILLEGAL opcode is different than the unknown, illegal opcodes referenced above. An example of the ILLEGAL opcode in a program is as follows:

```
        mov.l   (6,%pc,%d0.l*4),%a0     # offset changed to “6”
        jmp     (%a0)
        illegal                         # added instruction as workaround
label:
        long    label1
        long    label2
```

MASKS: 0H55J, 1H55J, 1J20C, 2J20C4/09/1999

21 Correct Operation of Debug_RevB “syncPC” Command is Sequence-dependent

21.1 Description

With the introduction of the Revision B debug functionality, a new BDM command named “syncPC” was added. This command is serially sent to the debug module, which then signals the processor. The processor responds by forcing an instruction fetch at an appropriate sample point and signaling the Pst/Ddata module to capture this PC and display it on the DDATA bus. This command was added as a less obtrusive means of determining the current PC compared to the more traditional {halt the CPU, read the PC, restart the

CPU} sequence, and is used by emulators to guarantee at least one PC address is contained within the trace memory to recreate the dynamic instruction stream via post-processing.

If the processor is executing a series of standard 1-cycle instructions or multi-cycle instructions that do not perform operand memory reads, the arrival of the syncPC command may cause a control state signaling a “pending” syncPC operation to be set. If the subsequent instruction stream continues to be the same types of instructions (standard 1-cycle opcodes or multi-cycle, non-operand-read opcodes), this state is never exited, effectively causing the command to be lost. It should be noted that the execution of any multi-cycle pipeline operations (for example, any instruction with an operand read, any pipeline cancels due to wrong-way conditional branches) results in the correct behavior. It is only the “infinite” execution of a series of standard 1-cycle or non-operand-read instructions where the problem is observed.

21.2 Workaround

- If a code sequence contains any instructions which perform operand read or wrong-way conditional branches, the arrival of the syncPC command is processed correctly.
- As another option, the emulator can configure the assertion of the BKPT pin to generate a debug interrupt. Instead of initiating a syncPC BDM command, this input pin can be asserted to force a debug interrupt exception. This approach will require the user to include a “null” exception handler containing only a RTE instruction with the appropriate exception vector. The processing of this debug interrupt provides two PC values to the emulator: one pointing to the debug exception handler, and the one at the application PC at the time of the interrupt.

MASKS: 0H55J, 1H55J4/09/1999

22 Spurious Interrupt Generated when Masked IMR Interrupt is Taken

22.1 Description

If an interrupt source is being masked in the interrupt controller mask register (IMR) while the mask register in the status register is set lower, and at that same moment an interrupt from that source is generated, a spurious interrupt may occur. This is because by the time the status register acknowledges this interrupt, the mask will be enabled in the IMR. Since no internal interrupts are pending, an external interrupt acknowledge cycle will occur with no termination. This causes a spurious interrupt.

22.2 Workaround

- For interrupts sources with levels 1-6, first write a higher level interrupt mask to the status register, before setting the IMR. After the IMR is set, return the interrupt mask in the status register to its previous value.
- For, level 7 interrupt sources, do not mask a level 7 interrupt in the IMR.

MASKS: 0H55J, 1H55J, 1J20C, 2J20C4/09/1999

23 External Master Termination is Not Always Correct when Using SDRAM Controller

23.1 Description

When an external master is accessing SDRAM using the MCF5307 SDRAM Controller, external termination is not always correct. This termination will come early for write cycles and be missing for back-to-back read cycles which look like burst cycles to the SDRAM.

The $\overline{\text{TA}}$ output from the MCF5307 does not assert properly when an external master is accessing SDRAM address space. For back-to-back reads from the same page, only the first read and last read will be terminated. For a write cycle by an external master, the $\overline{\text{TA}}$ asserts 1 bus clock early for all CASL[1:0] encodings.

23.2 Workarounds:

- Disallow external master access to SDRAM using the MCF5307 DRAM controller.
- Provide external termination for SDRAM bus cycles by an external master.

MASKS: 0H55J, 1H55J, 1J20C, 2J20C4/09/1999

24 Source Address Increment Bit for DMA Channels does Not Increment Properly

24.1 Description

If multiple internal DMA channels are being used and one channel is programmed to increment its source address register (SAR) while the other is not, the source address may not increment correctly on arbitration boundaries.

For example, DMA channel 1's SAR may be programmed to increment source addresses and channel 2's SAR may be programmed not to increment source addresses. If channel 2 initiates a DMA request while channel 1 is doing a transfer, when channel 2 is arbitrated the bus, it's SAR WILL increment after the first transfer when it is NOT supposed be incrementing. This could cause complications if channel 2 was being used as a FIFO. Furthermore, if channel 1 is programmed not to increment its SAR and channel 2 is programmed to increment its SAR, the opposite effect will take place. If channel 2 initiates a DMA request while channel 1 is doing a transfer, when channel 2 arbitrates the bus, it's SAR will NOT increment when it is suppose to. This would cause a duplicate write in the same address location to take place.

24.2 Workaround

- Guarantee no multiple concurrent requests

- Make all channels have identical incrementing schemes (that is, all enabled to increment, or all enabled not to increment).

MASKS: 0H55J, 1H55J4/09/1999

25 When Using Multiple DMA Channels, a Write by a DMA Channel Could Get Lost if a Higher Priority DMA Channel Requests the Internal Bus Simultaneously.

25.1 Description

When two DMA channels with different access priorities request the internal bus simultaneously, the write access of the lower-priority channel is lost. This results in a read access by the lower priority channel with the address equal to the value of its source address register (SAR). The second and third accesses are a read and write by the higher priority channel. There is no fourth access; the write by the lower priority channel is lost.

If the lower-priority channel is using the external request signal and is in cycle steal mode, subsequent external requests are never serviced.

25.2 Workaround

- The DMA start bits can be set with writes by the processor. This means not to set the external DMA request bit DCR[EEXT].
- If multiple DMA channels must be used concurrently, then enforce sequential access by using the external DMA request.

MASKS: 0H55J, 1H55J, 1J20C08/18/1999

26 AC Timing Modifications for xJ20C Mask

26.1 Description

For details on the AC timing modifications for the xH55J mask see Errata #13.

The following applies to the xJ20C masks:

- Spec D2 (output hold) must be decreased to -1.5 nsec for all frequencies.
- Specs T5/U6/U8 (output holds) must be decreased to 1.5 nsec for all frequencies.
- Spec B11/P4 (output hold) for $\overline{\text{RSTO}}$, DATA[31:0], $\overline{\text{TS}}$, $\overline{\text{BR}}$, $\overline{\text{BD}}$, ADDR[23:0], PP[15:0], R/$\overline{\text{W}}$, SIZE[1:0],$\overline{\text{TA}}$, must be decreased to 1.0 nsec for all frequencies.

- Spec B11a (output hold) for $\overline{\text{RAS}}$[1:0], $\overline{\text{CAS}}$[3:0], $\overline{\text{DRAMW}}$, SCKE, $\overline{\text{SRAS}}$, $\overline{\text{SCAS}}$ must be decreased to 0.5 nsec for all frequencies.
- Spec D1 (output hold) must be increased to 7.5 nsec for all frequencies.

A summary of all the different mask timings is included in the Table 3 below.

Table 3. AC Timing Table

Name	User Manual Value (nsec)	0H55J	1H55J	1J20C	2J20C
D2	2.0	-4.0	-4.0	-1.5	-1.5
T5	2.0	0.0	0.0	1.5	1.5
U6	2.0	0.0	0.0	1.5	1.5
U8	2.0	0.0	0.0	1.5	1.5
M13	2.0	0.0	0.0	2.0	2.0
P4	2.0	0.0	0.0	1.0	1.0
B11	2.0	0.0	0.0	1.0	1.0
B11a	2.0	-1.0	-1.0	0.5	0.5
B14	2.0	1.5	1.5	2.0	2.0
B14a	2.0	0.5	0.5	2.0	2.0
B14b	2.0	0.0	0.0	2.0	2.0
D1	5.5	5.5	5.5	7.5	7.5

26.2 Workaround

- The negative edge of pstclk can be used to sample the PST[3:0], DDATA[3:0] due to the negative hold time specification for D2.

MASKS: 1J20C, 2J20C09/17/1999

27 MAC Fractional –1 * –1 Overflow Detection Erratic

27.1 Description

In fractional mode, 32-bit results in the range [-1,+1) are generated in the accumulator of the MAC unit. The bracket indicates that -1 is included and the parenthesis indicates that +1 is not. The product itself of two inputs will always fall in this range except in the case of -1 5 -1 yielding +1. The +1 product is handled as though no overflow has occurred and added to the accumulator. Only if the accumulator is initially non-negative will overflow be signalled by setting the V condition code bit in the MACSR, and by saturating the accumulator if the OMC bit (saturation mode) is set. If the product is to be subtracted from the accumulator (MSAC instruction) then overflow will occur if the accumulator is initially negative.

There is an error in the detection of the overflow in the special case when the two 16-bit operands are obtained from different halves of CPU registers. There is no problem with MAC instructions with 32-bit operands or with MAC instructions with both 16-bit operands residing in the lower halves or both in the upper halves of CPU registers. The execution of the following instructions may result in an erroneous V (overflow) bit state if both operands = -1 (8000 hexadecimal):

```
mac.w   Rx:u,Ry:l
mac.w   Rx:l,Ry:u
msac.w  Rx:u,Ry:l
msac.w  Rx:l,Ry:u
```

If saturation mode is not enabled, only the setting of the V bit may be in error. If saturation mode is enabled, the result in the accumulator may also be wrong.

27.2 Software Workarounds

If 16-bit operands MAC instruction operands are being used from different halves of different CPU registers (y != x), and if the V bit is being checked or if the MAC unit is operating in saturation mode, then any of the above instructions can be replaced with a three instruction sequence. For instance, the following instruction:

```
mac.w   Rx:u,Ry:l
```

can be replaced with the following equivalent sequence:

```
swap    Rx
mac.w   Rx:l,Ry:l
swap    Rx
```

And the instruction:

```
mac.w   Rx:l,Ry:u
```

can be replaced with:

```
swap    Rx
mac.w   Rx:u,Ry:u
swap    Rx
```

Of course, the second swap instruction in each case should be removed if the MAC instruction specifies a memory operand that is to be loaded into the Rx register.

Similar sequences can be substituted for the two failing MSAC.W instructions.

The case for 16-bit operands from different halves of the same CPU register (y == x) is slightly more complicated. The instruction:

```
mac.w   Rx:u,Rx:l
```

can be replaced with:

```
     cmp.lx,&0x80008000
     bne.blabel1
     mac.wRx:l,Rx:l
     bra.blabel2
```

```
label1:

      mac.wRx:u,Rx:l

label2:
```

Similar sequences can be used for the other failing instructions.

MASKS: 1J20C, 2J20C05/24/2000

28 Data Inversion Triggers are Incorrect for Word and Longword Accesses

28.1 Description

The 5307 allows debug breakpoint triggers to be set on PC, and/or address, and optionally data compares. The trigger definition register (TDR), and extended trigger definition register (XTDR) register in the 5307, configures the breakpoint logic. In particular, TDR/XTDR[12:5] configures a data breakpoint. TDR/XTDR[12:6] configures the size of the data to be compared to the data breakpoint register DBR (and/or DBR1 in MCF5307) data value. Data breakpoints can be configured for byte-, word- or longword reference sizes. However, the data inversion bit, TDR/XTDR[5], does not work as advertised. When asserted, this bit is specified to enable data breakpoints to trigger for any access which does not match the specified data value. The data inversion feature works correctly for byte-size accesses, but is incorrect for 16- and 32-bit references. There are scenarios where triggers should occur, but don't, for 16- and 32-bit references.

28.2 Software Workaround

Do not use data inversion triggers/do not set TDR/XTDR[5] for word or longword breakpoints.

MASKS: 0H55J, 1H55J, 1J20C, 2J20C05/24/2000

29 Second-level Breakpoint Trigger Missed if it Occurs on the Cycle Immediately after Assertion of First-level Trigger

29.1 Description

The 5307 allows debug breakpoint triggers to be set correlating to PC, and/or address, and optionally data compares. The configuration/status register bits, CSR[31–28], report breakpoint status, as follows:

- 0000 = No breakpoints enabled
- 0010 = Waiting for level 1 breakpoint
- 0100 = Level 1 breakpoint triggered

- 1010 = Waiting for level 2 breakpoint
- 1100 = Level 2 breakpoint triggered

A two-level breakpoint configuration means that the breakpoint cannot occur until the first-level trigger has been matched and then after that the second-level trigger matches.

A boundary condition bug exists for a two-level breakpoint configuration:

If a two-level breakpoint is configured, with both trigger conditions occurring in adjacent processor clock cycles, the second level trigger is missed and the trigger state incorrectly remains in the "waiting for trigger 2" state.

29.2 Software Workaround

Do not configure a two-level breakpoint; instead, configure two separate one-level breakpoints.

MASKS: 0H55J, 1H55J, 1J20C, 2J20C05/24/2000

30 DMA Writes to UART Cause Transmission Errors

30.1 Description

DMA transfers from memory to the UART do not work properly. The DMA module configured for DMA transfers to the UART:

DCR = 0x6052

Table 4. DCR = 0x6052

Bits	Name	Setting	Description
15	INT	0	No interrupt is generated at the completion of a transfer
14	EEXT	1	Enable external request
13	CS	1	Enable cycle steal
12	AA	0	No accesses are auto-aligned
11–9	BWC	000	DMA has priority
8	SAA	0	Dual address mode
7	S_RW	0	Not valid when SAA=0
6	SINC	1	Source address increments
5–4	SSIZE	01	Size of source bus cycle = byte
3	DINC	0	Destination address does not increment
2–1	DSIZE	01	Size of destination bus cycle = byte
0	START	0	The UART $\overline{\text{DREQ}}$ kicks off the DMA transfer

The UART is configured to assert an internal interrupt when the transmitter is ready (UIMR = 0x01 and UISR = 0x01). $\overline{\text{DREQ}}$ is connected internally to the UART interrupt pin. When the UART asserts an internal interrupt, the DMA initiates a single read/write cycle. The problem stems from $\overline{\text{DREQ}}$ not being negated fast enough thus allowing a second DMA transfer right after the first when the transmit buffer (UTB) of the UART isn't ready yet.

If the first byte hasn't been completely transmitted and the UTB (transmitter buffer) is still full, the second byte transfer has nowhere to go and is discarded. For example if a string = “0123456789” is transferred via the DMA to the transmit buffer of the UART, the UTB receives only “0248” and consequently only 0248 is sent out of the UART.

30.2 Software Workaround

Use the CPU to write to the UART transmitter buffer.

MASKS: 0H55J, 1H55J, 1J20C, 2J20C05/24/2000

31 DMA Single-Address Access Mode and Cycle-steal Mode do Not Work Together

31.1 Description

An enabled DMA channel performing a single address access and a cycle steal, interprets a request for another channel as a request for itself, performing an errant access. The intended access does occur after the errant access.

31.2 Software Workaround

Don't use single address access mode in cycle-steal mode.

MASKS: 0H55J, 1H55J, 1J20C, 2J20C05/24/2000

32 DMA Channel Arbiter Hangs in Round-robin Mode

32.1 Description

In the following scenario, the DMA channel arbiter may hang:

- Round-robin mode (MPARK[PARK] = 00)
- DCR[BWC] = 000
- Simultaneous access by DMA and core while the arbiter is selecting the external master (master 0).

When the bus grant is removed or when the SDRAM is performing a PAL (precharge), a hold is asserted to the arbiter, putting it in a park on external master mode. When the hold is removed, if both core and

DMA want the bus and DCR[BWC] is set to have priority, the arbiter hangs, causing the external bus to hang.

32.2 Software Workaround

- Set PARK = 01 (park on ColdFire core) or 10 (park on DMA).
- Set BWC bits ≠ 000.

MASKS: 0H55J, 1H55J, 1J20C, 2J20C05/24/2000

33 Processor Status Reporting Anomaly during Debug Exception Processing

33.1 Description

If the ColdFire debug module is configured to generate a debug interrupt exception in response to a breakpoint trigger, the processor responds by taking a special exception. While processing this exception, the debug module is supposed to output a contiguous stream of PST[3:0] = 0xD values until the exception completes and control is passed to the instruction defined by the interrupt vector. This change-of-flow is signaled by PST[3:0] = 0x5, which marks the end of the exception processing. The only allowable deviations to the PST[3:0] = 0xD stream are operand markers (PST[3:0] = 0xB) associated with operand captures during the writing of the exception stack frame.

If operand writes are being captured, there is the possibility that the stream of PST[3:0] = 0xD values is non-contiguous, with PST[3:0] = 0x0 values incorrectly inserted into the output stream.

It is important to note that the processor's operation is perfectly correct throughout this sequence; it is the potential occurrence of extraneous PST[3:0] = 0x0 values that is the error.

33.2 Software Workaround

- Disable the capturing of operand writes if debug interrupts are enabled,
- Simply ignore PST[3:0] = 0x0 values occurring during a debug interrupt. Let the debug interrupt exception processing be defined from the initial PST[3:0] = 0xD until PST[3:0] = 0x5.

MASKS: 0H55J, 1H55J, 1J20C, 2J20C05/24/2000

34 Forcing Emulator Mode from Reset by Asserting CSR[13] does Not Work

34.1 Description

The ColdFire debug architecture defines a control bit in the Configuration/Status Register (CSR) which specifies the processor should begin execution in emulator mode. After reset is negated, the processor samples for certain conditions (for example, the assertion of the breakpoint input signal) before beginning reset exception processing. A typical sequence may involve the assertion of the breakpoint signal immediately after the negation of reset, followed by a BDM-controlled initiation of the microprocessor and/or system. Once the BDM "go" command is received, the processor continues with reset exception processing.

If bit 13 of the CSR is set during this initialization sequence, the processor is supposed to begin the reset exception processing in emulator mode. Unfortunately in all ColdFire core designs, the assertion of CSR[13] in this type of sequence does *not* force entry in emulator mode.

34.2 Software Workaround

Do not set bit 13 of the debug module's Configuration/Status Register. The quickest entry into emulator mode after reset is created with the following sequence:

1. While in the BDM initiation sequence, program a debug breakpoint trigger event by an operand reference to address 0x0 or 0x4. As part of this sequence, the debug interrupt vector must also be initialized to the same address as the initial PC defined at address 4.
2. When the BDM "go" command is received by the processor, the reset exception processing fetches the longwords at addresses 0 and 4 in "normal mode" and then a debug interrupt is immediately generated before the first instruction is executed.
3. Execution continues in emulator mode.

MASKS: 0H55J, 1H55J, 1J20C, 2J20C05/24/2000

35 Corrupted Return PC in Exception Stack Frame

35.1 Description

When processing an autovectored interrupt an error can occur that causes 0xFFFFFFFF to be written as the return PC value in the exception stack frame. The problem is caused by a conflict between an internal autovector access and a chip select mapped to the IACK address space (0xFFFFXXXX).

35.2 Workaround

- Set the C/I bit in the chip select mask register (CSMR) for the chip select that is mapped to 0xFFFFXXXX. This will prevent the chip select from asserting for IACK accesses.

- Remap the chip select to a different address range.
- Use external logic to provide external vectors for all interrupts instead of autovectoring.

MASKS: 0H55J, 1H55J, 1J20C, 2J20C01/22/04

36 Incorrect Debug Interrupts Triggered

36.1 Description

Extraneous PC breakpoint debug interrupts (vector 13) may occur when the RTE instruction is executed at the end of a PC breakpoint debug interrupt service routine. PC breakpoint debug interrupts are enabled based on the settings of the PBR and PMR registers when the TDR[TRC] is set to 10. When the RTE instruction is executed at the end of the interrupt service routine, extra debug interrupts may occur.

36.2 Workaround

In the debug interrupt service routine:

1. Clear the TDR
2. Once cleared, the TDR can be reprogrammed with the original value
3. Execute the return from exception (RTE)

MASKS: 0H55J, 1H55J, 1J20C, 2J20C08/02/04

37 Revision History

Table 5 is a revision history for this document.

Table 5. MCF5307 Processor Errata Change HIstory

Revision	Date	Change History
Rev 1.0	04/9/1999	Initial Errata.
Rev 1.1	04/21/1999	Edit - Errata #4.
Rev 2.0	06/17/1999	Add - 1J20C Mask.
Rev 2.1	08/18/1999	Add - Errata #25.
Rev 2.2	09/01/1999	Documentation Fix: • Include description for Errata #23.
Rev 3.0	09/17/1999	Add - 2J20C Mask. Add - Errata #26.
Rev 3.1	12/10/1999	Edited - Errata #13 Workaround. Edited - Errata #15 Workaround.
Rev 4.0	05/23/2000	Add - Errata #27 - #34
Rev 4.1	01/22/04	Add - Errata #35
Rev 4.2	08/0204	Add - Errata #36

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Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
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+1-800-521-6274 or +1-480-768-2130
support@freescale.com

Europe, Middle East, and Africa:
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Technical Information Center
Schatzbogen 7
81829 Muenchen, Germany
+44 1296 380 456 (English)
+46 8 52200080 (English)
+49 89 92103 559 (German)
+33 1 69 35 48 48 (French)
support@freescale.com

Japan:
Freescale Semiconductor Japan Ltd.
Technical Information Center
3-20-1, Minami-Azabu, Minato-ku
Tokyo 106-0047, Japan
0120 191014 or +81 3 3440 3569
support.japan@freescale.com

Asia/Pacific:
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