



Silicon Anomaly List

ADSP-21369

ABOUT ADSP-21369 SILICON ANOMALIES

These anomalies represent the currently known differences between revisions of the SHARC ADSP-21369 product(s) and the functionality specified in the ADSP-21369 data sheet(s) and the Hardware Reference book(s).

SILICON REVISIONS

A silicon revision number with the form "-x.x" is branded on all parts (see the data sheet for information on reading part branding). The silicon revision can also be electronically read by reading the **REVPID** register either via JTAG or DSP code.

The following DSP code can be used to read the register:

```
<UREG> = REVPID;
```

Silicon REVISION	REVPID[7:4]
0.2	0010
0.1	0001
0.0	0000

ANOMALY LIST REVISION HISTORY

The following revision history lists the anomaly list revisions and major changes for each anomaly list revision.

Date	Anomaly List Revision	Data Sheet Revision	Additions and Changes
01/20/2009	F	D	Added anomaly: 08000026
03/16/2007	E	A	Modified anomalies: 08000001, 08000014, 08000015, 08000016, 08000017, 08000018, 08000019, 08000020, 08000024
01/05/2007	D	A	Added anomaly: 08000024 Modified anomaly: 08000020
08/14/2006	C	A	Added anomalies: 08000018, 08000019, 08000020 Modified anomalies: 08000014, 08000017
03/21/2006	B	PrB	Added anomalies: 08000014, 08000015, 08000016, 08000017 Modified anomalies: 08000002, 08000006
08/10/2005	A	PrB	Initial release

NR003114F

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

SUMMARY OF SILICON ANOMALIES

The following table provides a summary of ADSP-21369 anomalies and the applicable silicon revision(s) for each anomaly.

No.	ID	Description	0.0	0.1	0.2
1	08000001	Core Stall not executed properly	x	x	x
2	08000002	Memory write operations can fail under certain conditions while DMA to internal memory is in progress	x	.	.
3	08000006	tDCAD specification violated	x	.	.
4	08000014	Instruction fetch fails when there is a CORE-DMA conflict coupled with an external memory access	x	x	.
5	08000015	Elevated core voltage needed for operation above 266 MHz	x	x	.
6	08000016	SPI DMA issue when using SPIBAUD=2	x	x	x
7	08000017	166MHz SDRAM operation violates tSSDAT specification	x	x	.
8	08000018	TCK can effect external PM bus accesses under certain circumstances	x	x	.
9	08000019	PDAP must use DAI pins, external port pins not available for PDAP data	x	x	x
10	08000020	Input Shift Register Anomaly in ASRCs (Asynchronous Sample Rate Converters) impacts Daisy-Chained TDM mode	x	x	.
11	08000024	Parallel EPROM/FLASH boot following a Hard (Hot) Reset may fail if issued in the middle of external SDRAM reads	x	x	x
12	08000026	Incorrect Popping of stacks possible when exiting IRQx/Timer Interrupts with DB modifiers	x	x	x

Key: x = anomaly exists in revision
 . = Not applicable

DETAILED LIST OF SILICON ANOMALIES

The following list details all known silicon anomalies for the ADSP-21369 including a description, workaround, and identification of applicable silicon revisions.

1. 08000001 - Core Stall not executed properly:

DESCRIPTION:

Under certain specific conditions outlined below, one type of core stall that is normally incurred does not get executed. In certain cases this can cause unexpected code operation.

PCSTK load & RTS combination:

When PCSTK is loaded, and an RTS is executed immediately afterward, there is a stall as the return waits for a writeback of PCSTK before the return.

Example:

```
[1] PCSTK = DM(I0,M0);  
[2] RTS;
```

Anomalous behavior:

If: The memory access in instruction 1 is to a memory-mapped IOP register.

-OR-

DMA is simultaneously accessing the same bank as the memory access in instruction 1.

Then: Stall does not occur, and this results in the RTS vectoring to some unknown location instead of the value from PCSTK.

WORKAROUND:

Add a nop between instructions 1 and 2.

APPLIES TO REVISION(S):

0.0, 0.1, 0.2

2. 08000002 - Memory write operations can fail under certain conditions while DMA to internal memory is in progress:

DESCRIPTION:

If an instruction modifies a register and the same register is the source to a memory write, and a DMA happens to the same block as the memory write in the next cycle, under the following conditions, the modified value of the register is written to memory instead of the old one.

Examples of instructions that modify a register and the same register's contents are written to memory are:

1. `R0 = R1-R2, DM(I0,M0) = R0; // The memory access can be either DM/PM`
2. `DM(I0,M0) = R0, R0 = PM(I8,M8);`

The conditions under which we see the issue are:

1. The failing instruction is the first instruction in a 1,2, or 4 instructions long loop.

Example:

```
lcntr = 8, do (pc,1) until lce;
DM(I0,M0) = R0, R0 = PM(I8,M8); //and DMA occurs in next cycle.
// The new value of R0 (fetched through PM) is written into DM memory
lcntr=0x7, do ST2_IN_BFLY_T2 until lce; //2 instr long loop
f4=f2+f4, dm(i3,m6)=r0, r0=pm(i11,m11);
ST2_IN_BFLY_T2: f4=pass f2, dm(i4,m6)=r4, r2=pm(i11,m11);
```

2. When the compute of the failing instruction generates both the operands of multiplier in the next instruction.

Example:

```
F0=F0+F4, F1=F0-F4, DM(I0,M0) = R1; // and DMA occurs in next cycle.
// The new value of R1 (output of compute) is written into DM memory
F4=F0*F1;
```

3. When the failing instruction is followed by a conditional branch and any of the following two happens:

- a. A compute in the failing instruction affects the condition of the branch.

Example:

```
F0=F0+F4, PM(I10,M10) = R0; // and DMA occurs in next cycle.
//The new value of R0 (output of compute) is written into PM memory
IF EQ JUMP(PC,0x12);
```

- b. A compute in the instruction preceding the failing instruction affects the condition of branch.

Example:

```
F0=F0+F4;
DM(I0,M0) = R0, R0 = PM(I8,M8); // and DMA occurs in next cycle.
//The new value of R0 (fetched through PM) is written into DM memory
IF EQ JUMP(PC,0x12);
```

4. When the failing instruction contains a floating point multiplication and is followed by compute operation involving any fixed-point operand register executing in ALU or shifter.

Example:

```
F0=F0*F4, DM(I0,M0) = R0;
F5=FLOAT R1; //The new value of R0 (output of multiply) is written into PM memory
```

WORKAROUND:

Move DMA to another block of memory, OR:

1. For case 1, unroll the loop to make the loop length more than 4.

2. For case 2, 3a, 3b and 4 insert an unrelated instruction between the failing instruction and the instruction following it.

APPLIES TO REVISION(S):

0.0

3. 08000006 - tDCAD specification violated:

DESCRIPTION:

When using the SDRAM Controller with a 166 MHz SDCLK, the SDRAM Controller specification tDCAD (Data delay after SDCLK) is violated on specific data pins for the first access only. It is specified as 4.0 ns max, and may increase to as much as 6.0 ns. This could cause a spec violation for the SDRAM. This violation has not been seen to cause any SDRAM access failures.

WORKAROUND:

None.

APPLIES TO REVISION(S):

0.0

4. 0800014 - Instruction fetch fails when there is a CORE-DMA conflict coupled with an external memory access:

DESCRIPTION:

Instruction fetch may fail under certain conditions:

An instruction fetch may fail if following combination of external accesses, instruction pipeline stall & DMA block conflict occurs. The failure happens only if all three conditions mentioned below are met:

1. Two instructions executing consecutively make data accesses to/from external memory.
2. When the processor core is being stalled for the first access, there is another stall generated at the same time. The later stall can be any of the stalls mentioned in "PROGRAM SEQUENCER" chapter of "ADSP-2136x SHARC Processor- Programming Reference" (pages 3-11 through 3-26 in Revision 1.0, November 2005), with two exceptions:
 - a) Stalls due to any of the DAG register (index, modifier etc.) dependencies.
 - b) Stalls generated by emulator.

An instruction making an external data access may get stalled when it is in "address" stage of the instruction pipeline, in order to wait until the external memory device acknowledges the access completion. For details on other stalls, refer to the Programming Reference mentioned above.

3. An internal memory block conflict happens between a DMA and instruction fetch of the 3rd instruction following the last external access instruction. This instruction fetch fails, leading to corruption of the corresponding opcode and in turn producing unpredictable results.

For example, consider following sequences of instructions:

- a) Multiplier dependency stall:

```
I1: r12=r5+r4, r0=dm(ext1);
I2: r12=r12*r12, r1=dm(ext2);
I3: <any_instruction>;
I4: <any_instruction>;
I5: <any_instruction>;
```

Here, I1 and I2 are consecutive instructions which perform external memory accesses. Both of them get stalled in their "address" stages in the pipeline due to extra time required for external accesses. When I1 is being stalled, there is another core generated dependency stall happening at the same time. This stall is due to both operands of multiplier in I2 (i.e. R12) depend upon execution of I1 where R12 is getting written. When both these stalls vanish, the pipeline moves ahead where instruction fetch of I5 begins. While I5 is in "fetch1" stage, if there happens to be a DMA to the same block of internal memory where the code is residing, then an internal memory block conflict occurs. Therefore, due to this anomaly, the instruction fetch of I5 fails due to its opcode getting corrupted.

- b) The above accesses inside a loop:

```
lcntr = 100 , do (PC,3) until lce;
I1: r12=r5+r4, r0=dm(ext1);
I2: r12=r12*r12, r1=dm(ext2);
I3: <any_instruction>;
```

Here too, the problem will occur as per the same reasoning. The difference is that instead of I5, I2 of the 2nd loop iteration fails.

- c) Conditional branch dependency on compute:

```
I1: R0=R5+R8,R2 = DM(I0,M0) ;
I2: IF eq JUMP (pc, 3), ELSE R1=DM(I5,M5);
I3: <any_instruction>;
I4: <any_instruction>;
I5: <any_instruction>;
```

In this case processor core creates a stall due to an another reason, i.e. conditional jump in I2 depending on compute in I1. Fetch of I5 will fail.

Examples of DAG dependency stalls which will NOT have any problems:

```
a)
I0:    I5 = buffer1; // buffer1 in external memory.
I1:    r12=r5+r4,    r0=DM(I0,M1);
I2:    R1 = DM(I5,M5);

b)
I0:    R2=R3-R4
I1:    IF EQ DM(I1,M1) = R15;
I2:    R0 = DM(I1,M2);
```

WORKAROUND:

1. Place code and DMA data in different blocks of internal memory.
2. Separate two instructions making external memory accesses by adding a NOP instruction between them. Any other instructions which do not access external memory can also be used instead of NOP. Note that using this workaround will result in degradation of data throughput to/from external accesses, resulting in slower execution of the code.

APPLIES TO REVISION(S):

0.0, 0.1

5. 08000015 - Elevated core voltage needed for operation above 266 MHz:

DESCRIPTION:

A memory speed path in the internal memory of revision 0.0 and 0.1 material limits the speed at which the memory can be used at the nominal core voltage. This results in a need to raise the core voltage supply. This issue only effects operation above 266 MHz in 0.0 and 0.1 revision silicon. The 266 MHz products in the MQFP package are not effected and should be operated at their datasheet-specified voltages.

Functional testing of 0.2 revision material has shown that this issue has been fixed. While datasheet timing requirements and characteristics for 0.2 silicon are currently being characterized at 1.2v nominal core voltage, revision 0.2 material may be operated at Vddint of 1.2v +/-5% . Note that operation at 400 MHz in all revisions will still require a 1.3v +/-5% Vddint.

The ADSP-21367/8/9 datasheet will be revised to include the updated timing information at 1.2v nominal and 333 MHz core clock rate.

WORKAROUND:

1. If using revision 0.0 or 0.1 silicon at or above 333 MHz, adjust the vddINT voltage to 1.3 volts (+/-5%)

APPLIES TO REVISION(S):

0.0, 0.1

6. 08000016 - SPI DMA issue when using SPIBAUD=2:

DESCRIPTION:

When using the SPI peripheral in DMA master receive mode, when the SPI is programmed for back to back DMA access, and when the SPI port is used without being disabled in between the accesses, the SPI can generate an extra clock for a 32bit word even after the FIFO and the receive buffer are full. This extra clock can cause a receive buffer overflow error which will result in a 32bit word getting lost. This occurs only with SPIBAUD=2 setting.

WORKAROUND:

1) Do not disable DMA between back to back DMA access.

-OR-

2) If DMA must be disabled between back to back access, disable SPI as well and before reenabling the SPI clear the FIFO and the receive buffer and then enable SPI and then configure the DMA descriptors and enable the DMA.

APPLIES TO REVISION(S):

0.0, 0.1, 0.2

7. 08000017 - 166MHz SDRAM operation violates tSSDAT specification:

DESCRIPTION:

While SDRAM operations up to a 133 MHz SDCLK rate work correctly, due to a timing issue, the SDRAM controller's tSSDAT timing requirement does not adequately correlate with the SDRAM's setup time characteristic (tAC in many SDRAM vendor's specifications) when used at a 166 MHz SDCLK rate. This issue only exists at the 166 MHz SDCLK rate. Using the SDRAM controller at a 166 MHz SDCLK rate could result in incorrect data accesses.

WORKAROUND:

Use the SDRAM controller at the 133 MHz rate.

APPLIES TO REVISION(S):

0.0, 0.1

8. 08000018 - TCK can effect external PM bus accesses under certain circumstances:

DESCRIPTION:

In some processors, it is possible to experience an issue with External Memory accesses using the PM data bus while TCK is being driven. In some cases the address value driven may change inappropriately. This issue effects PM bus accesses to external memory only, and is dependent on the TCK jtag input being driven. No issues have been observed while TCK is inactive. TCK is typically only driven by an In-Circuit-Emulator or a boundary-scan controller. During normal non-debug operation of the processor, TCK is not driven, and so this issue can easily be avoided.

WORKAROUND:

During normal processor operation, without an emulator or boundary-scan controller in use, the TCK input is not driven, and this issue will not appear. In scenarios where the processor application is being debugged with an emulator, or a boundary-scan controller is active (driving TCK), and an PM bus write to external space is observed to be incorrect, use the DM bus to execute the external write. Note that this is only necessary during debug, as this issue has not been observed while TCK is inactive.

APPLIES TO REVISION(S):

0.0, 0.1

9. 0800019 - PDAP must use DAI pins, external port pins not available for PDAP data:

DESCRIPTION:

The SHARC user has the choice of using the PDAP input by either routing the PDAP DATA signals over the External Port Data pins or using the SRU to route these signals to DAI pins. Due to a silicon issue, the PDAP MUST have its data signals routed to DAI pins via the SRU, and CANNOT be used with its data signals using the External Port Data pins. This issue does not effect other External Port or SDRAM usage. It is a restriction on PDAP usage only.

WORKAROUND:

None.

APPLIES TO REVISION(S):

0.0, 0.1, 0.2

have any data shift. At the output end, three MSBs will be lost for the channels 1 and 2, two MSBs will be lost for the channels 3 and 4 and one MSB will be lost for the channels 5 and 6.

For the set of the following 8-channel input data,

```
0xF1111100    0xF1111100    // Channels 1 and 2
0xF1111100    0xF1111100    // Channels 3 and 4
0xF1111100    0xF1111100    // Channels 5 and 6
0xF1111100    0xF1111100    // Channels 7 and 8
```

The output data will be as follows,

```
0x888888FF    0x888888FF    //3-bit left shift and 3 MSBs are lost
0xC44444FF    0xC44444FF    //2-bit left shift and 2 MSBs are lost
0xE22222FF    0xE22222FF    //1-bit left shift and one MSB is lost
0xF11111FF    0xF11111FF
```

In the above output data the 8-LSBs of each word has the ratio information.

For a TDM daisy chain in NON-BYPASS mode, the output of the TDM Daisy chain will be corrupted completely because of the MSB bit loss in each ASRC in the chain.

WORKAROUND:

The workaround for this anomaly must be carried out in software only on the device providing input data to the ASRCs in TDM daisy chain mode. It can not be implemented on the output data from the ASRCs. The workaround implementation in software adds some core MIPS to the application. For devices like ADCs/CODECs, the workaround may not be implemented directly. For such systems, two serial ports of the SHARC should be dedicated for this purpose. One serial port should be used for receiving the data from the ADC/CODEC and the other one should be used for transmitting the modified input data to the ASRC.

When the ASRCs are used in TDM daisy chain mode, only the 24-MSBs of the input 32-bit data is used and the 8-LSBs are not used by the ASRC. The anomaly can be worked around by shifting the 24-MSBs of the data to the 8-LSBs as follows:

1. Right shift the input data for channels 1 and 2 by three bits. Now the 24-MSBs which has the data are placed in the bits from 28 - 5.
2. Right shift the input data for channels 3 and 4 by two bits. Now the 24-MSBs which has the data are placed in the bits from 29 - 6.
3. Right shift the input data for channels 5 and 6 by one bit. Now the 24-MSBs which has the data are placed in the bits from 30 - 7.
4. The input data for channels 7 and 8 need not be modified.

When the modified input data is provided to the TDM daisy chain, one MSB of the modified data will be lost at each ASRC in the chain due to the anomaly. Since the 24-MSBs which has the data is shifted to the LSBs of the input, the actual MSB is not lost at each ASRC in the chain. Because of the anomaly the data will be shifted left by the ASRC and received correctly at the output end.

This workaround is applicable for both the BYPASS and NON-BYPASS mode of the ASRC. In both the cases the 24-bit audio data will be preserved and there will be no loss of resolution. The workaround also has no impact on the matched phase mode of the ASRC TDM daisy chain mode, since the phase information lies only in the 8-LSBs of the output SRC shift registers which are not affected by this anomaly.

For the set of the following 8-channel actual input data,

```
0xF1111100 0xF1111100 // Channels 1 and 2
0xF1111100 0xF1111100 // Channels 3 and 4
0xF1111100 0xF1111100 // Channels 5 and 6
0xF1111100 0xF1111100 // Channels 7 and 8
```

The data modified according to the workaround will be as follows:

```
0xFE222220 0xFE222220 // Channels 1 and 2 with three bit right shift
0xFC444440 0xFC444440 // Channels 3 and 4 with two bit right shift
```

```
0xF8888880 0xF8888880 // Channels 5 and 6 with one bit right shift  
0xF1111100 0xF1111100 // Channels 7 and 8
```

The data at the output end will be as follows for the BYPASS mode:

```
0xF11111FF 0xF11111FF // Channels 1 and 2  
0xF11111FF 0xF11111FF // Channels 3 and 4  
0xF11111FF 0xF11111FF // Channels 5 and 6  
0xF11111FF 0xF11111FF // Channels 7 and 8
```

APPLIES TO REVISION(S):

0.0, 0.1

11. 08000024 - Parallel EPROM/FLASH boot following a Hard (Hot) Reset may fail if issued in the middle of external SDRAM reads:

DESCRIPTION:

If the SHARC processor is in the process of fetching data from external SDRAM memory, initiating a Hard (hot) reset during this process may cause the SDRAM device to continue to drive the data bus during the entire duration of /RESET being asserted, and also failing to relinquish the external data bus even when the DSP comes out of /RESET.

If the DSP had been configured to boot via parallel external FLASH or EPROM (which shares part of the same data bus with the external SDRAM), the resulting bus contention on the external data bus between the DSP trying to boot from the FLASH memory and the SDRAM continuing to drive the data bus causes incorrect boot data to be loaded in, and the booting operation fails. Once the above state is hit, subsequent DSP Resets will not correct the situation. A power-cycling sequence is required to recover from this state.

If a microcontroller or host processor controls the /RESET pin of the SHARC, a simple communication protocol between the microcontroller/host processor and the DSP that ensures that any DMA transfer/external data fetch is completed before /RESET is asserted will avoid this problem.

Note that the probability of encountering this problem is greatly reduced during normal mode of DSP operation, i.e.,

- when the cache is enabled (CADIS bit of the MODE2 register is not set)
- if Bit 31 of the SDCTL register (NO_BSTOP bit) is set to disable burst-mode accesses from the SDRAM.

The above conditions reduce the probability of encountering this problem, but are not suggested as workarounds. For this, please refer to the techniques listed in the workaround section.

This anomaly is not observed during writes to SDRAM memory. It is only seen on reads from external SDRAM. The anomaly is also not observed during other Reset scenarios such as Power-on Reset, or software Reset.

WORKAROUND:

Software:

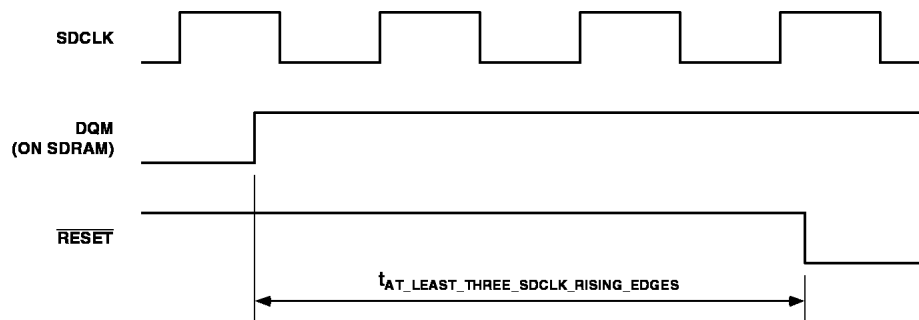
Configure the DSP to boot via SPI port (master or slave) and perform the following sequence within the loader kernel:

- Initialize the SDCTL and SDRRC registers to the appropriate values
- Perform a dummy read access of external SDRAM memory.

This has the effect of resetting and re-initializing the states of the SDRAM controller as well as that of the external SDRAM memory, and avoid hitting the problem state.

Hardware:

Providing an external delay of at least 3 SDCLK clock cycles between the SDRAM's DQM signal and the /RESET_IN to the DSP will also cause the problem to be avoided (see attached Figure).



APPLIES TO REVISION(S):

0.0, 0.1, 0.2

12. 0800026 - Incorrect Popping of stacks possible when exiting IRQx/Timer Interrupts with DB modifiers:**DESCRIPTION:**

If a delayed branch modifier (DB) is used to return from the interrupt service routines of any of IRQx (hardware) or timer interrupts, the automatic popping of ASTATx/ASTATy/MODE1 registers from the status stack may go wrong.

The specific instructions affected by this anomaly are "RTI (DB);" and "JUMP (CI) (DB);"

This anomaly affects only IRQx and Timer Interrupts as these are the only interrupts that cause the sequencer to push an entry onto the status stack.

WORKAROUND:

Do not use (DB) modifiers in instructions exiting IRQx or Timer ISRs. Instructions in the delay slots should be moved to a location prior to the branch.

APPLIES TO REVISION(S):

0.0, 0.1, 0.2