# Rules of PCM placement

TEC/NOT/035

This paper outlines some useful rules for PCM placement. This paper describes rules about slow read rates, interleaving threads, minimum word size, master/slave operation and multiple PCM streams.

The following topics are discussed:



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**NOTE:** PCM Placer software utility follows "0.2 Rule 1: Bus monitors - do not interleave threads from the same module" on page 1 and "0.3 Rule 2: Master/slave operation" on page 1. We recommend using PCM Placer if multiple PCMs are used or if the bit-rate is higher than 6 Mbps.

## 19.1 Rule 1: Bus monitors - do not interleave threads from the same module

Bus monitor modules need to read all required parameters from a particular MIL-STD-1553 message at once. It takes time to transfer all these over the Acra KAM-500 backplane. For best results, place parameters from a single MIL-STD-1553 message adjacent to each other, in ascending order, in the same minor frame.

Table 19-1: Threads example on a PCM frame

| | | | | | | |
|---|---|---|---|---|---|---|
| MSG_0_1_D0 | MSG_0_1_D1 | MSG_0_1_thi | MSG_0_2_D3 | MSG_0_2_D23 | MSG_0_2_tlo | Syncword |
| | | | MSG_0_2_D3 | MSG_0_2_D23 | MSG_0_2_tlo | Syncword |
| MSG_0_1_D0 | MSG_0_1_D1 | MSG_0_1_thi | MSG_0_2_D3 | MSG_0_2_D23 | MSG_0_2_tlo | Syncword |
| | | | MSG_0_2_D3 | MSG_0_2_D23 | MSG_0_2_tlo | Syncword |

## 19.2 Rule 2: Master/slave operation

We recommend placing parameters from slaves later in the frame.

When placing parameters in the master PCM stream, time must be allowed to transmit a parameter from a slave to the master.

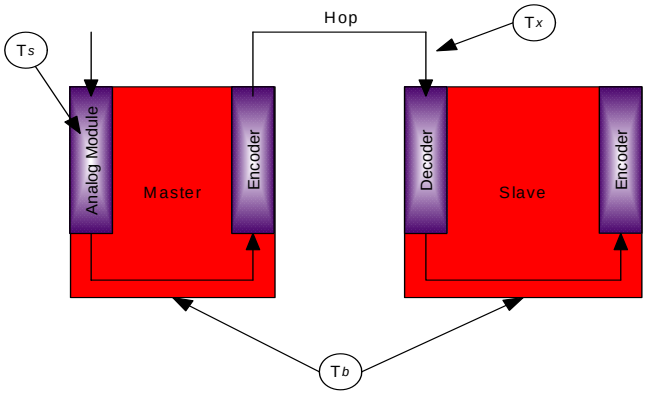


*Figure 19-1: Elements contributing to the delays encountered in a signal as it moves through an Acra KAM-500 chassis*

See "Types of delays" on page 2 for further details.

## 19.3 Rule 3: Minimum word size

The minimum word transmit time is 500 ns for the KAD/BCU/101. Therefore at 16Mbps the minimum word size is 8 bits (16 Mbps x 500 ns = 8 bits).

See “Table 19-3: Minimum word transmit time per encoder module” on page 3 for a list of the minimum word sizes per encoder module.

## 19.4 Rule 4: Multiple PCM streams - acquisition cycles must agree

### 19.4.1 Rule 4.1

All the major frames of the PCM streams must fit into the acquisition cycle, so the rule is:

(BitsPerMajorFrame1) / (BitRate1) = N* (BitsPerMajorFrame2) / (BitRate2)

with N being an integer.

### 19.4.2 Rule 4.2

If the same parameter is on two different PCM streams you must place them at the same time position.

For example, P1 stream 1 at 16 bits fixed transmission wordIndex = 8, FrameIndex = 0, BitRate = 2 Mbps.

P1 stream 2 at 16 bits fixed transmission wordIndex = 4, FrameIndex = 0, BitRate = 4 Mbps.

## 19.5 Rule 5: Read delay after start of acquisition cycle

Some older modules such as KAD/ADC/009/S1 or KAD/ADC/006 cannot be read for 16 µs after the start of an acquisition cycle while accessing setup information.

For example, at 8 Mbps the parameter must be transmitted after bit 128 (8 Mbps x 16 µs = 128 bits).

See Table 19-4 on page 3 describing the read delay per module.

## 19.6 Rule 6: Slow read rate

Older modules can be read at 500 ksps, in other words a gap of 2 µs is required. So if data is read from one of these modules only, 500 ksps is the maximum sampling rate available.

However during that gap, data can be read from other modules. This is called interleaving reads. An example of interleaving is displayed in the following table.

In order to allow and support interleaving, it helps to try to place parameters from the same sampling groups in different slots consecutively in the PCM stream.

Table 19-2: Interleaving example on a PCM frame

| | | | | | | |
|---|---|---|---|---|---|---|
| ADC_J3_Ch0 | ADC_J4_Ch0 | ADC_J5Ch0 | ADC_J3Ch1 | ADC_J4Ch1 | ADC_J5Ch1 | Syncword |
| ADC_J3_Ch0 | ADC_J4_Ch0 | ADC_J5Ch0 | | | | Syncword |
| ADC_J3_Ch0 | ADC_J4_Ch0 | ADC_J5Ch0 | ADC_J3Ch1 | ADC_J4Ch1 | ADC_J5Ch1 | Syncword |
| ADC_J3_Ch0 | ADC_J4_Ch0 | ADC_J5Ch0 | | | | Syncword |

See Table 19-5 on page 3 for a list of the worst-case read rates per module.

## 19.7 Appendix

### 19.7.1 Types of delays

Considering Figure 19-1 on page 1, there are three types of delay which are described as follows:

$T_S$ – The sourcing delay due to filter characteristics. This delay is dependent on the type of source module, the sample rate and module configuration.

$T_b$ – A delay associated with transferring the data over the backplane of a chassis. This delay is constant for all chassis.

$T_x$ – A delay associated with transferring a sample via PCM from chassis to chassis. This delay varies from link to link depending on the bit-rate used to transfer the data and the amount of data sent.

Table 19-3: Minimum word transmit time per encoder module

| Module | Minimum word transmit time (µs) |
|---|---|
| KAD/ENC/106 (no PMF) | 0.375 |
| KAD/BCU/101 | 0.5 |
| KAD/BCU/001 | 1 |
| KAD/ENC/005/B | 1 |
| KAD/ENC/004 | 0.5 |
| KAD/ENC/005 | 0.5 |

Table 19-4: Read delay per module

| Module | Read delay (µs) |
|---|---|
| KAD/MDC/001 | 3289 |
| KAD/SDI/001 | 2000 |
| KAD/ADC/001 | 72 |
| KAD/ADC/009 | 16 |
| KAD/ADC/019 | 16 |
| KAD/ADC/005 | 16 |
| KAD/ADC/006 | 16 |
| KAD/CDC/001 | 16 |
| KAD/LDC/001 | 16 |

Table 19-5: Worst-case read rates per module

| Module | Read rate (µs) |
|---|---|
| KAD/ADC/003 | 2.5 |
| KAD/ADC/009 | 1.75 |
| KAD/ADC/019 | 1.75 |
| KAD/ADC/005 | 1.75 |
| KAD/ADC/006 | 1.75 |
| KAD/CDC/001 | 1.75 |
| KAD/LDC/001 | 1.75 |
| KAD/ADC/001 | 1 |

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