Scaler Problems
SCALE32 module

S. Wood

4/30/2020

Symptom

Peter Bosted observed in some of his report files:

```
SHMS_pEL_REAL   :    4526475935.000000 [ 2204.893 kHz ]
```

More typically this is seen:

```
SHMS_pEL_REAL   :    430518965 [ 237.815 kHz ]
```

Note that: $4526475935.000000 > 2^{32}$

THcScalerEvtHandler.cxx:

```
if(scaldata < scal_prev_read[nscal]) {
        scal_overflows[nscal]++;
}
```

scal_prev_read[nscal]	136703393	10000010010111101101101000 01
scaldata	136575034	10000010001111111000001110 10

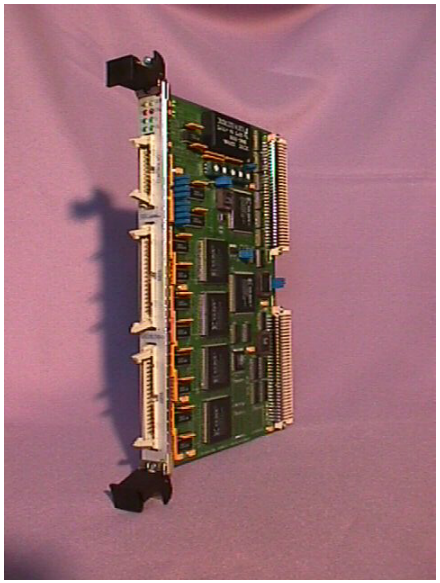
Scalers in Hall C DAQ

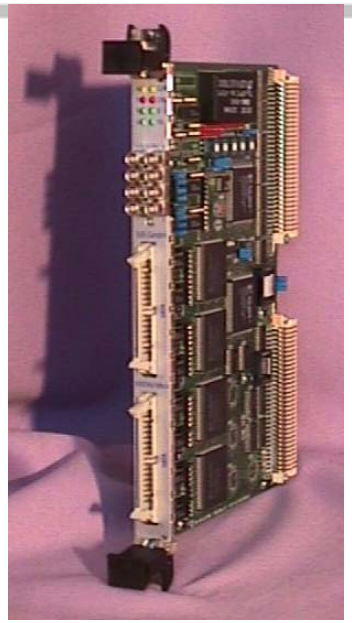
Most Hall C scalers are Struck SIS3801 32 scalers.

Some are Saclay SCALE32 modules from G0 experiment. (HMS slots 11&12, SHMS slots 12&13)

G0 discovered bitflip problems with SCALE32 modules. Problem was completely resolved by insuring that inputs (things you are trying to scale) have wide enough (> 10ns) pulse widths.

I chose to use these modules (probably a mistake), keeping inputs wide.





Detecting problems

```
if(scaldata < scal_prev_read[nscal]) {
    if((scal_prev_read[nscal]-scaldata) < kMaxUInt/2) {
        cout << "Overflow " … << endl;
    }
    scal_overflows[nscal]++;
}
```

Replayed 50 random SIDIS runs.

SHMS Slot 12, channel 16 (pSTOF) is bad often for some runs. Excluding this channel, 23 incidents in 50 runs.

HMS slot	chan	name
12	0	S1X
12	1	S1Y
12	2	S2X
12	3	S2Y

SHMS slot	chan	name
12	16	pSTOF
12	20	pEL_REAL
13	0	S1X
13	1	S1Y
13	2	S2X
13	3	S2Y

How bad is this?

1. No one has complained until now.

2. 1MHz clock and BCM signals seem OK.

3. pSTOF and pEL_REAL are duplicated in HMS scaler crate for coincidence runs. (Doesn't help for SHMS singles runs, if those scalers are important.)

4. Only limited range of runs scanned (runs 2062-8690 from SIDIS)

What to do about it

Future data taking:

1. Discontinue use of SCALE32 (ultimate goal)
2. Use SCALE32 only for individual PMT scalers.
3. Check and increase widths of problematic channels

Existing data:

1. Modify Scaler analysis to flag problematic channels (easy)
   Fully understand extent of issue
2. Modify Scaler analysis to fix scaler counts for problematic channels.
   (probably not possible is a systematic way)
3. For channels important to cross section, fix on a case by case basis.
   (Replace bad scaler read with average rate)
4. For coincidence runs, use use HMS duplicate of pTOF and pEL_REAL