

LumiCal boards calibration

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1 Bug in existing gain commands

There is a bug in gain names on LumiCal daq board.
Commands to change the gains are as follows:

```
FE.PREAMP.GAIN HIGH/LOW  
FE.SHP.GAIN HIGH/LOW
```

Unfortunately, the command `FE.PREAMP.GAIN` changes the **shaper** gain, and, respectively, the command `FE.SHP.GAIN` changes the **preamplifier** gain.

This document uses correct gain names where "Preamp" means preamplifier and "Shp" means shaper. Keeping this term the testbeam logbook should be corrected as follows.

Starting from **Fcal run 182** the gain was lowered using commands listed below:

```
FE.PREAMP.GAIN LOW  
FE.SHP.GAIN HIGH
```

In reality, doing this we set:

- gain of **preamplifier** to **high**,
- gain of **shaper** to **low**.

2 ASIC gain info

Each Front-end ASIC has two groups of four channels each with different gains. Channels 0-3 are the "R feedback" type with lower gain and channels 4-7 are the "MOS feedback" type with higher gain. The gain differences occurs only when preamplifier is in high gain mode.

From the readout board point of view, the channels are grouped as follows:

- "MOS feedback" - higher gain - channels 0-3, 8-11, 16-19, 24-27
- "R feedback" - lower gain - channels 4-7, 12-15, 20-23, 28-31

3 Readout boards calibration

Table 1: "R feedback", channels 4-7, 12-15, 20-23, 28-31

Board	Gain [LSB/pC]	Gain std. dev. [LSB/pC]	Offset [LSB]	Offset std. dev [LSB]
Preamp HIGH, Shp HIGH				
ID63	7657.32	36.75	2.30	1.41
ID64	7671.75	30.52	2.26	1.17
ID67	7433.64	56.53	5.58	2.17
ID76	6878.87	14.65	3.46	0.56
Preamp HIGH, Shp LOW				
ID63	1446.89	5.56	2.17	1.23
ID64	1479.66	4.13	2.57	0.91
ID67	1452.13	10.08	5.02	2.23
ID76	1257.58	2.97	2.14	0.65
Preamp LOW, Shp HIGH				
ID63	417.22	2.26	3.00	1.54
ID64	426.64	1.94	3.04	1.31
ID67	413.30	2.96	5.48	2.01
ID76	415.31	5.20	3.02	3.52
Preamp LOW, Shp LOW				
ID63	73.48	0.34	0.64	0.43
ID64	74.90	0.31	0.75	0.39
ID67	74.70	0.35	0.60	0.44
ID76	75.08	0.60	-0.28	0.75

Table 2: "MOS feedback", channels 0-3, 8-11, 16-19, 24-27

Board	Gain [LSB/pC]	Gain std. dev. [LSB/pC]	Offset [LSB]	Offset std. dev [LSB]
Preamp HIGH, Shp HIGH				
ID63	15999.99	116.46	6.78	2.47
ID64	16085.90	493.12	9.53	10.46
ID67	15067.96	419.20	17.16	8.89
ID76	14361.89	156.42	7.53	3.32
Preamp HIGH, Shp LOW				
ID63	3007.30	24.75	5.28	2.63
ID64	3066.87	16.68	6.03	1.77
ID67	3015.98	38.56	7.26	4.09
ID76	2637.23	6.67	2.84	0.71
Preamp LOW, Shp HIGH				
ID63	419.28	2.21	3.17	1.50
ID64	428.48	1.90	3.06	1.29
ID67	415.32	3.10	5.66	2.11
ID76	417.76	5.06	2.77	3.43
Preamp LOW, Shp LOW				
ID63	73.79	0.32	0.69	0.41
ID64	75.18	0.28	0.76	0.35
ID67	74.92	0.36	0.60	0.45
ID76	75.45	0.54	-0.28	0.68

4 Overall gain comparison

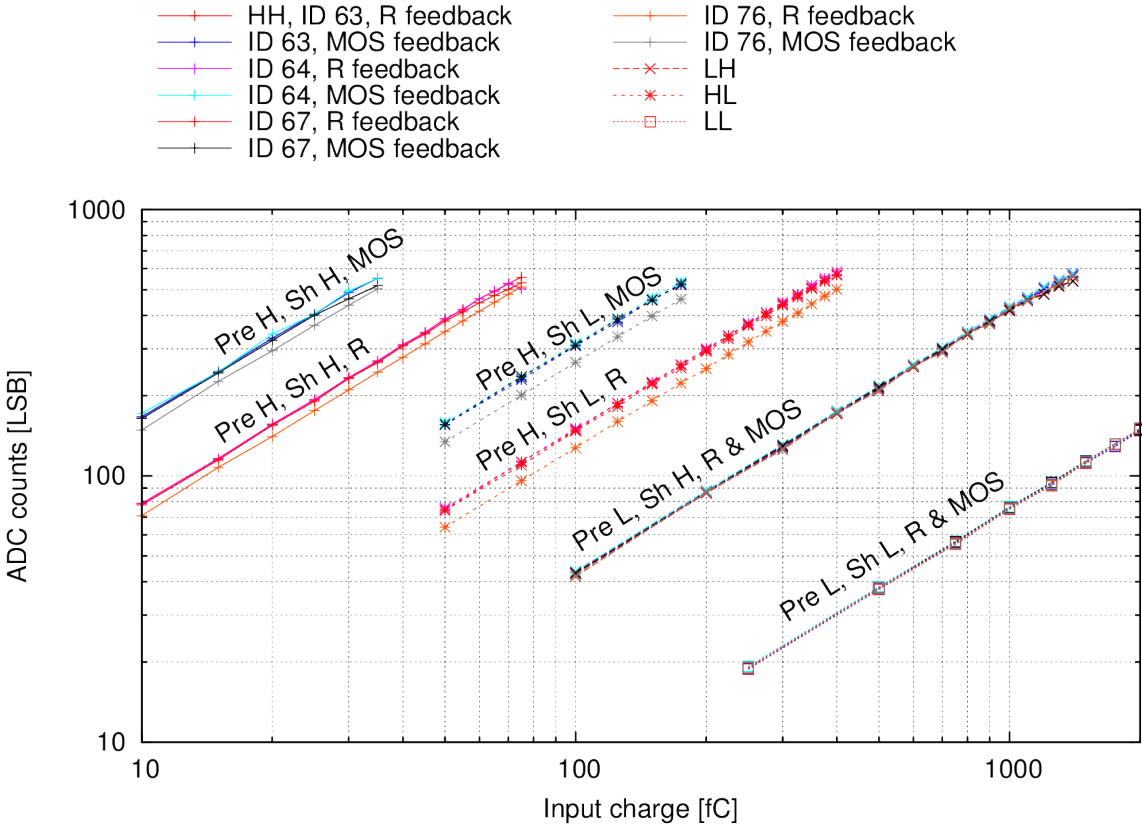


Figure 1: All modes, all boards

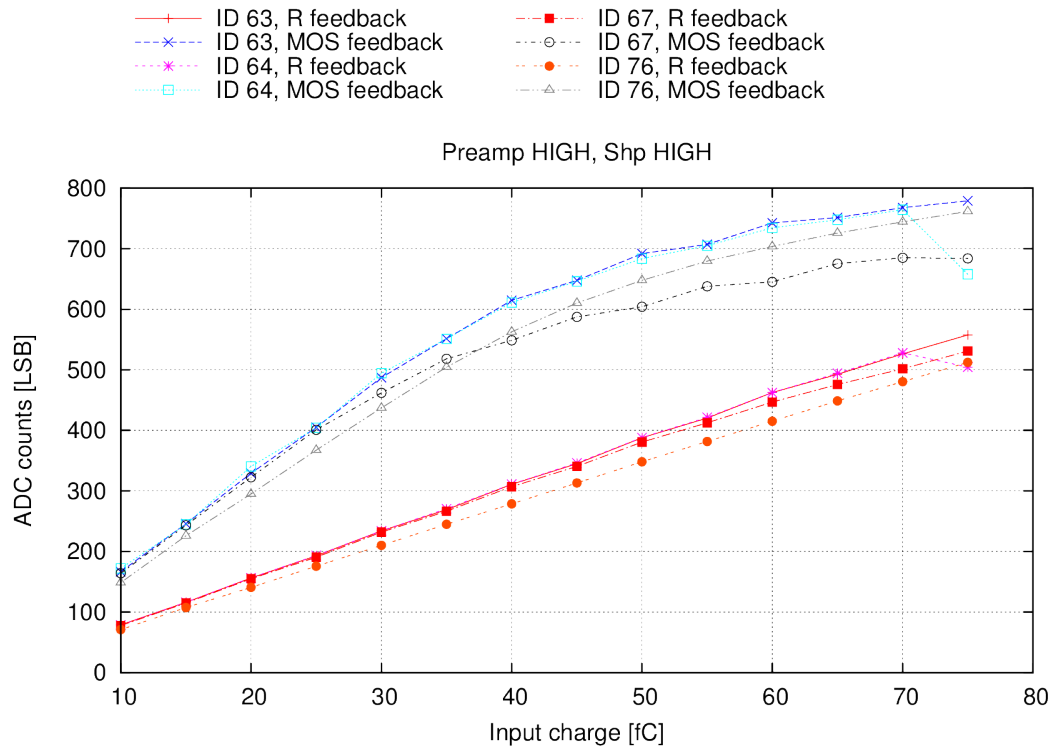


Figure 2: Preamp HIGH, Shp HIGH, all boards

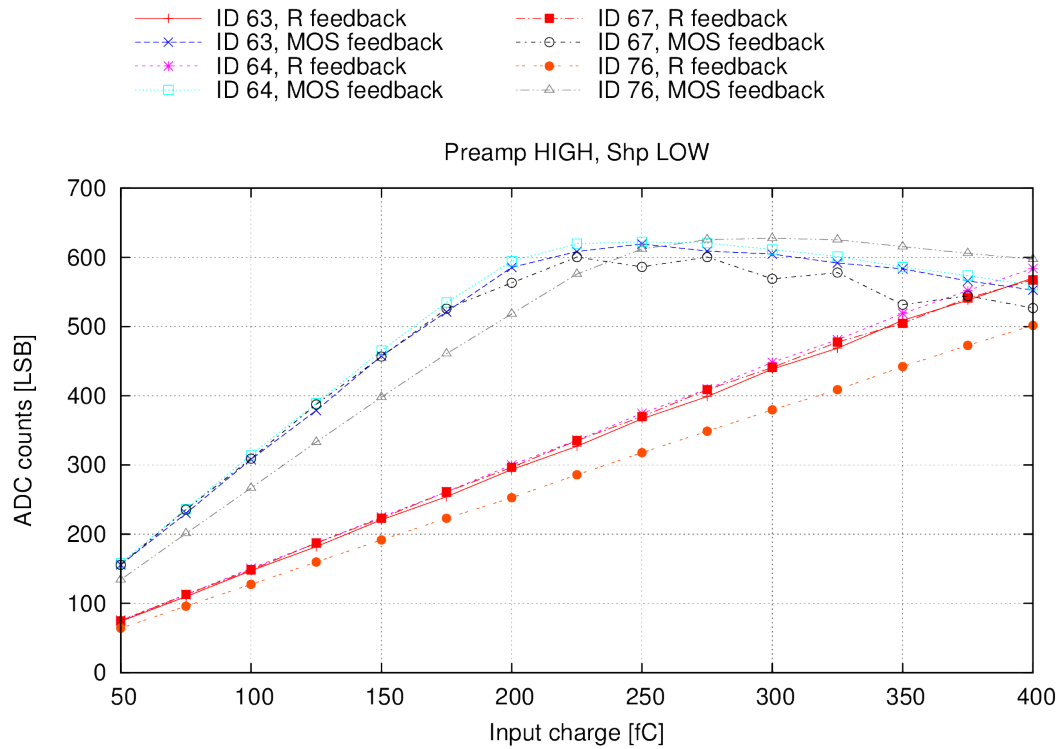


Figure 3: Preamp HIGH, Shp LOW, all boards

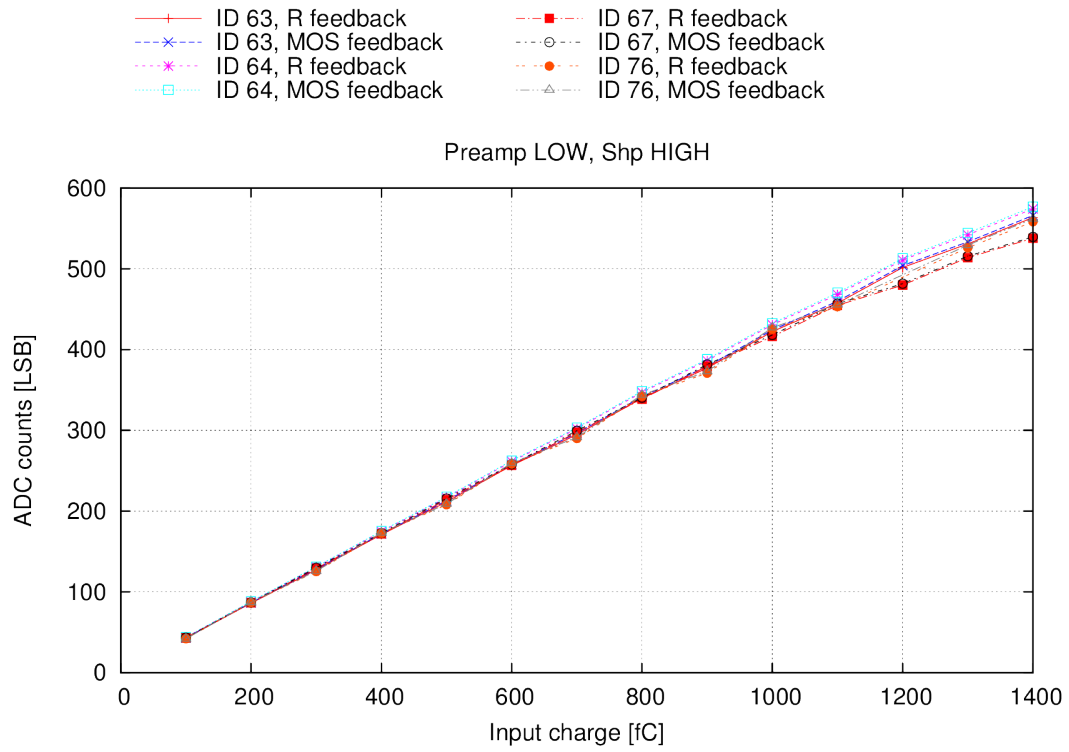


Figure 4: Preamp LOW, Shp HIGH, all boards

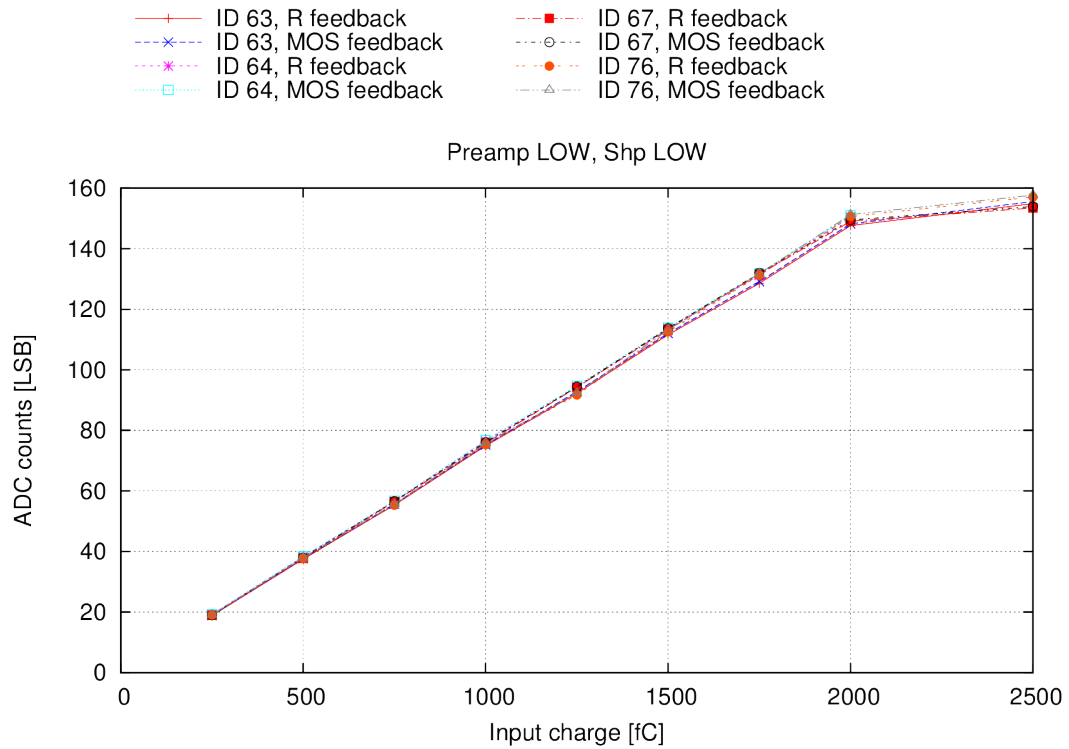


Figure 5: Preamp LOW, Shp LOW, all boards

5 Detail gain information

5.1 Board ID63

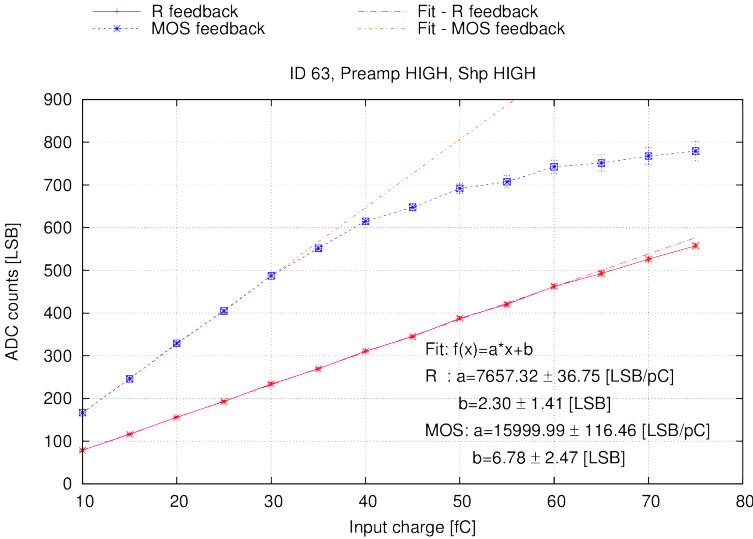


Figure 6: Preamp HIGH, Shp HIGH, board ID63

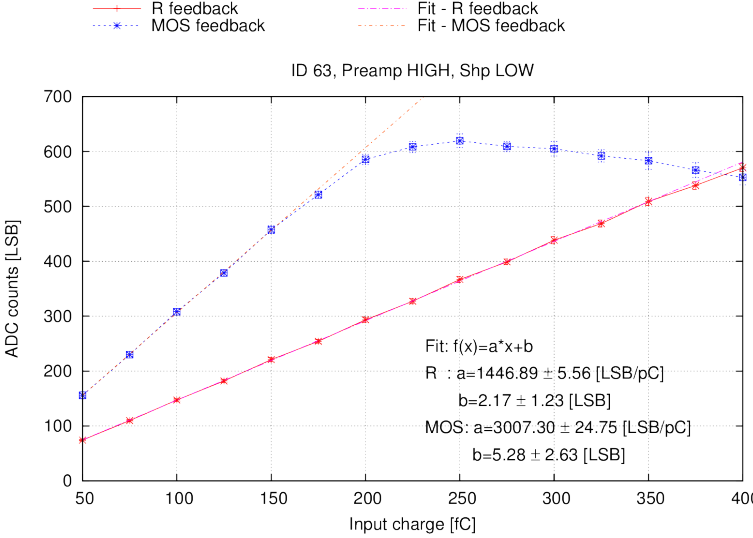


Figure 7: Preamp HIGH, Shp LOW, board ID63

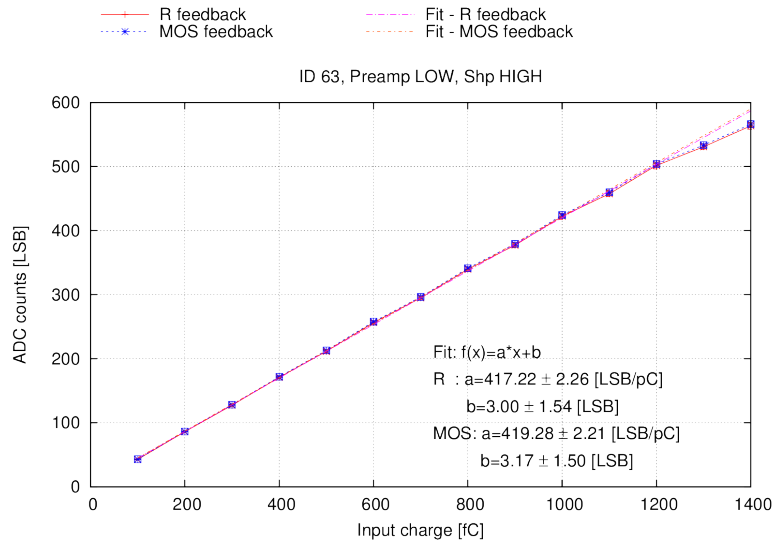


Figure 8: Preamp LOW, Shp HIGH, board ID63

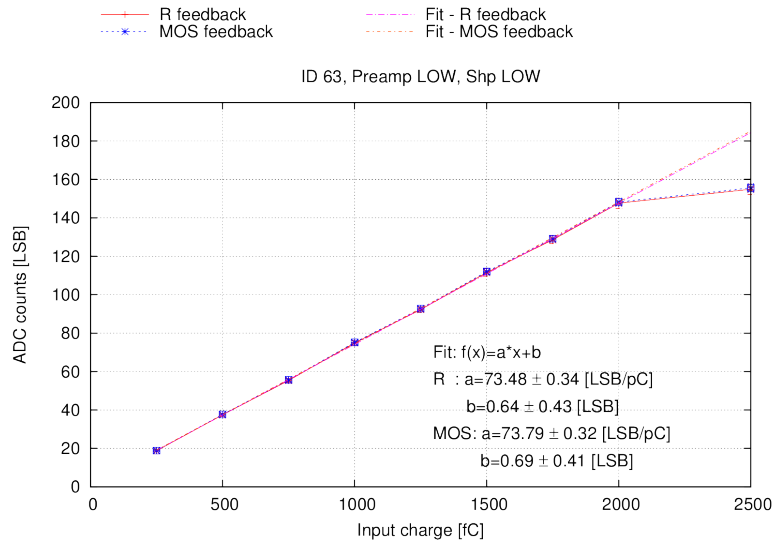


Figure 9: Preamp LOW, Shp LOW, board ID63

5.2 Board ID64

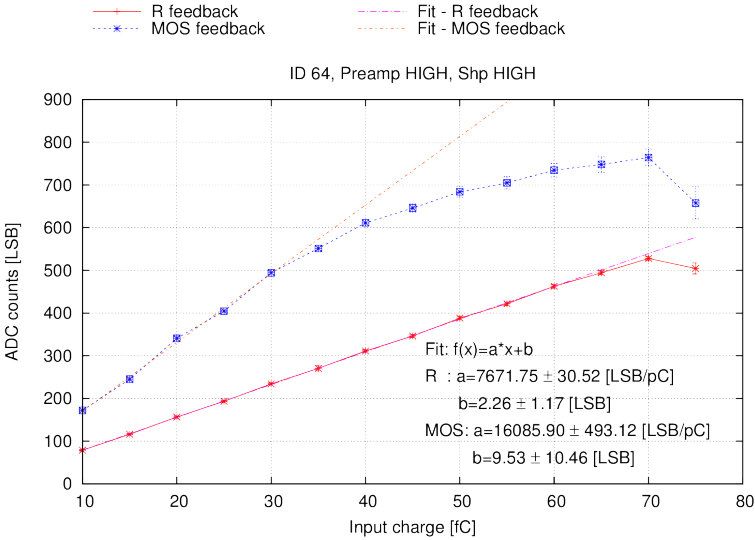


Figure 10: Preamp HIGH, Shp HIGH, board ID64

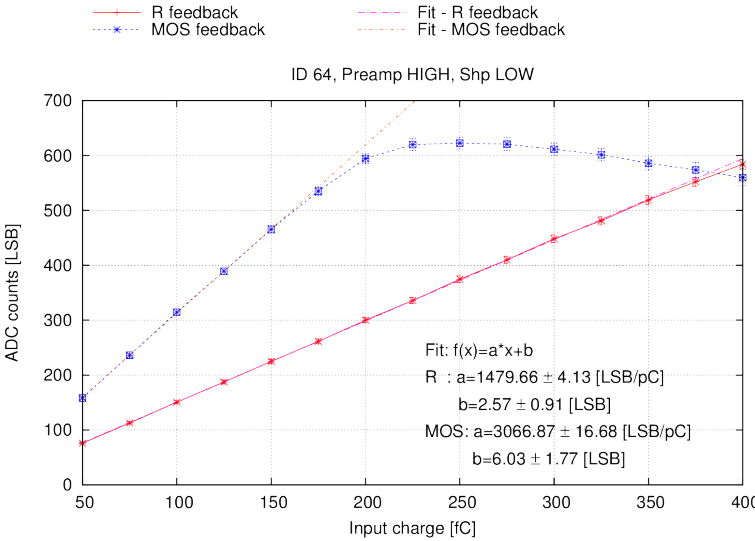


Figure 11: Preamp HIGH, Shp LOW, board ID64

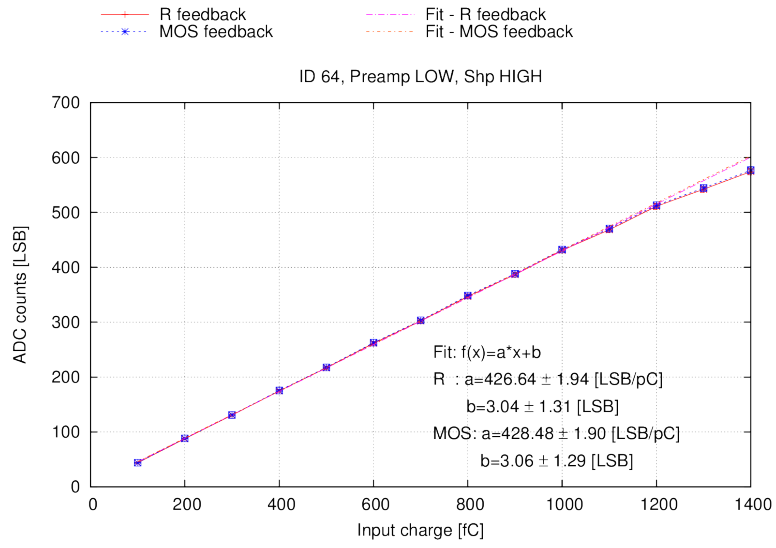


Figure 12: Preamp LOW, Shp HIGH, board ID64

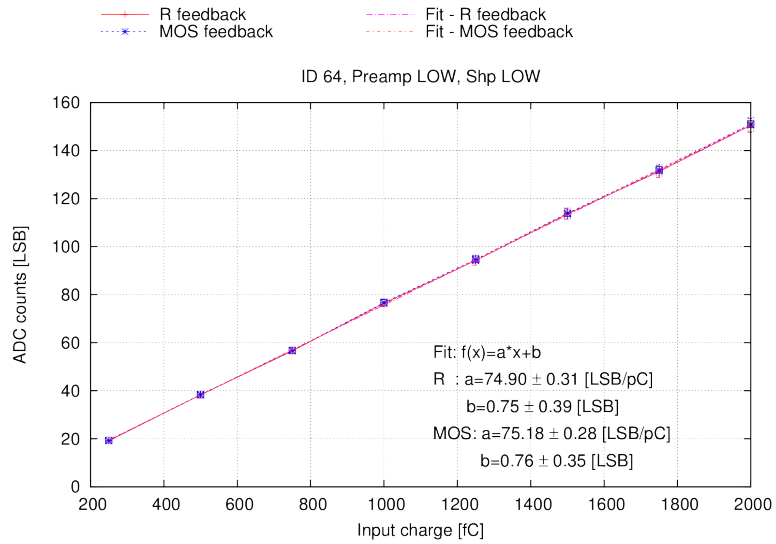


Figure 13: Preamp LOW, Shp LOW, board ID64

5.3 Board ID67

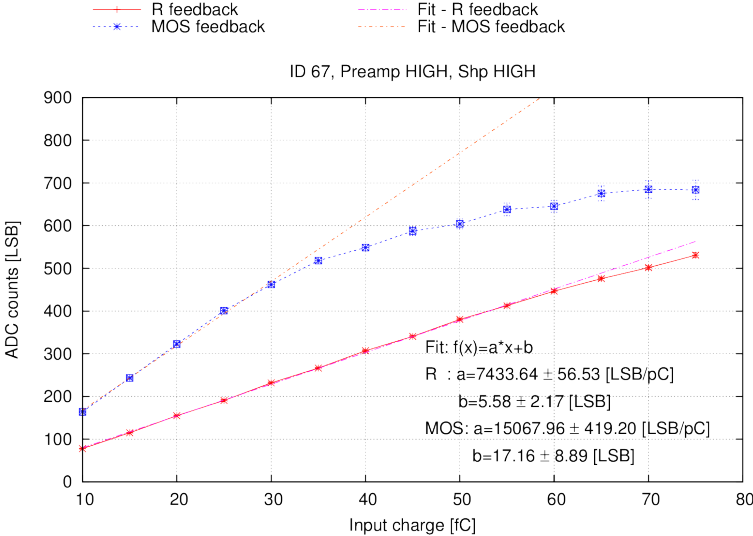


Figure 14: Preamp HIGH, Shp HIGH, board ID67

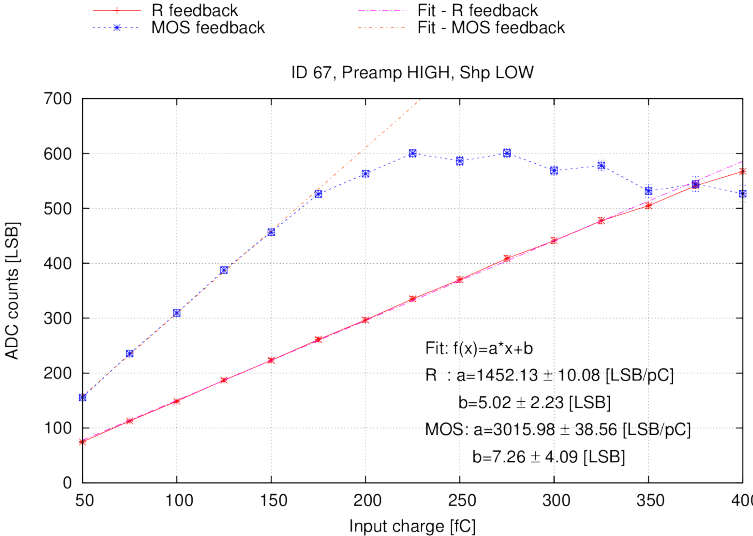


Figure 15: Preamp HIGH, Shp LOW, board ID67

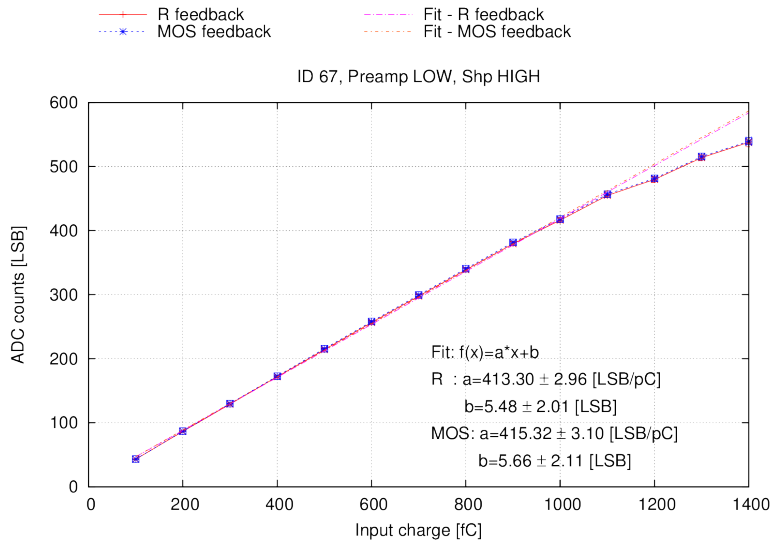


Figure 16: Preamp LOW, Shp HIGH, board ID67

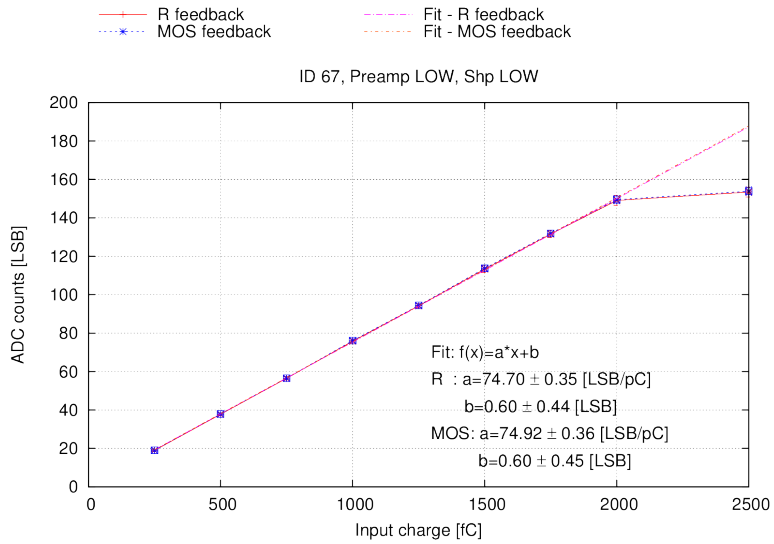


Figure 17: Preamp LOW, Shp LOW, board ID67

5.4 Board ID76

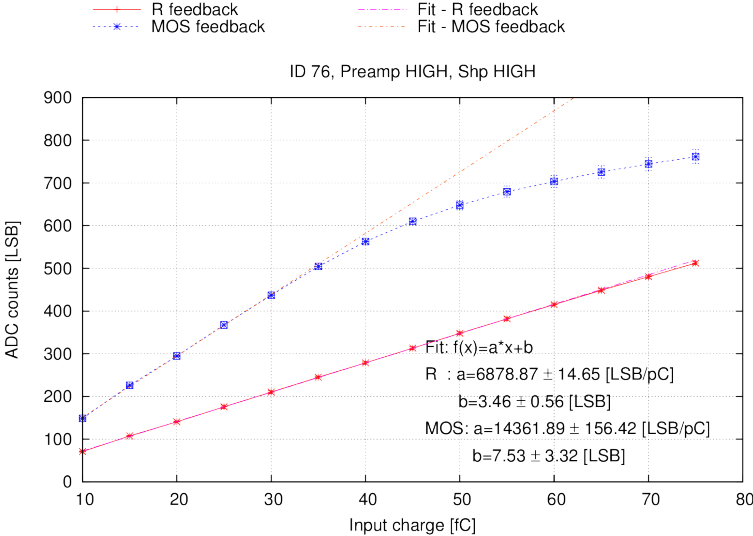


Figure 18: Preamp HIGH, Shp HIGH, board ID76

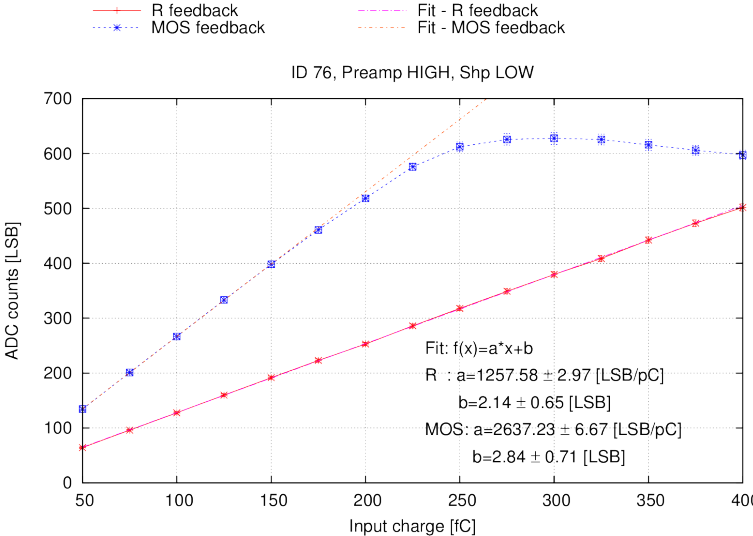


Figure 19: Preamp HIGH, Shp LOW, board ID76

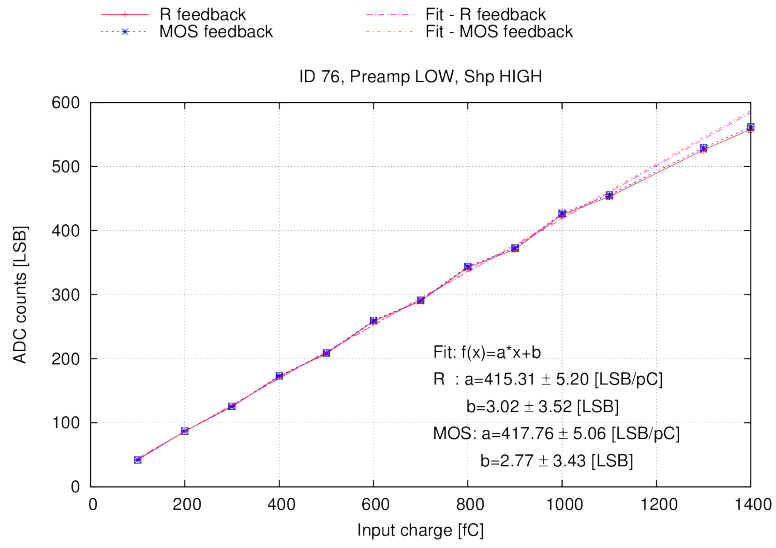


Figure 20: Preamp LOW, Shp HIGH, board ID76

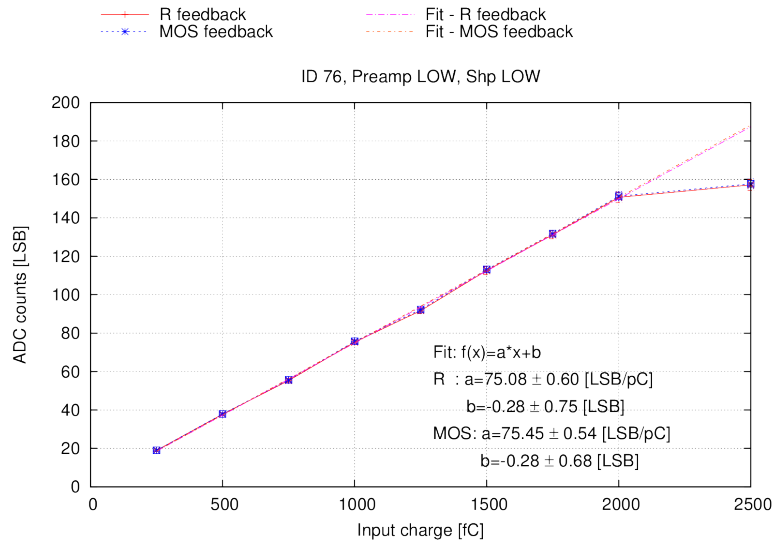


Figure 21: Preamp LOW, Shp LOW, board ID76