RSI Technical Note 048

Interpreting the Results of Calibrate All

Evan Cervelli

Rolf Lueck

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Rockland Scientific International Inc.
520 Dupplin Rd
Victoria, BC, CANADA, V8Z 1C1
www.rocklandscientific.com

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1 Introduction

The Calibrate All function is a tool embedded in the Data Acquisition Software found on Rockland Scientific instrumentation for both internally recording and real-time instruments. The Calibrate All function can be used to assess the health of an instrument's electronics and, in some cases, the microstructure probes installed in the instrument. The Calibrate All function does Not calibrate the instrument or sensors, it is named as such because it is used by Rockland Scientific during the calibration of the instrument electronics at the time of production. This document provides a guide to interpreting the results of the Calibrate All function for common instrument channels found on standard Rockland Instruments; channels associated with uncommon and custom sensors are not discussed in this document.

1.1 Issuing the Calibrate All command

1.1.1 ODAS5IR Internally Recording

Once you have connected to the instrument via Motocross software type the following:

```
odas5ir -c all
```

For more information on ODAS5IR software and Instrument communication please refer to the ODAS5-IR User Guide.

1.1.2 ODAS-RT Real Time

Once you have connected to the real time instrument via ODAS-RT software, navigate to the 'calibrate' tab. Press the 'calibrate' button.

For more information on ODAS-RT software and Instrument communication please refer to the ODAS-RT User Guide.

1.2 Variation in the Results

It is important to understand that Rockland Scientific electronics and sensors are extremely sensitive. The results of the Calibrate All test (as well as standard Electronics Bench Tests) may vary due to local electromagnetic radiation and mechanical vibrations. Electromagnetic radiation sources include, but are not limited to, AC electrical systems, lighting, televisions etc. See the instrument manual for recommendtaions for shielding your instrument from electromagnetic radiation. Mechanical vibrations may occur from collegues walking down the hall outside the room, fans, appliances etc. See instrument manual for reccomendations for mechanically isolating your instrument. Table 2 lists expected results from tests performed in a laboratory with minimal sources of electromagnetic radiation and mechanical vibrations. It is important to consider the local conditions when performing the Calibrate All Test. Results from the Calibrate All test performed on a MicroRider on a glider on the surface during a deployment at sea may vary depending on the local sea state.

It is important to remember that the expected values discussed in this document are for reference only. Values may vary due to multiple factors.

1.3 Channel Reference

Table 1 lists the channels that may appear on a Rockland Instrumentation. Please note that some channels will only appear on specific Rockland Instrumentation; for a list of channels specific to your instrument check the instrument `setup.cfg` file. More information available in the ODAS5IR User Guide and Instrument Manuals.

ID	Name	Signal
0	gnd	pseudo-ground
1	Ax	piezo-accelerometer sensitive to x axis
2	Ay	piezo-accelerometer sensitive to y axis
4	T1	Thermistor 1
5	T1_dT1	Thermistor 1 with pre-emphasis
6	T2	Thermistor 2
7	T2_dT2	Thermistor 2 with pre-emphasis
8	sh1	Shear Probe 1
9	sh2	Shear Probe 2
10	P	Pressure
11	P_dP	Pressure with pre-emphasis
12	PV	Voltage on pressure transducer
15	EMC_Cur	EMC drive current reference signal for EM noise removal
32	V_bat	Power Supply Voltage divided by 10
40	Incl_Y	y-inclinometer (pitch)
41	Incl_X	x-inclinometer (roll)
42	Incl_T	Inclinometer temperature
48, 49	JAC_C	JAC conductivity sensor (two channels, voltage and current)
50	JAC_T	JAC thermometer
52	Chlorophyll	JAC fluorometer
53	Turbidity	JAC backscatter sensor
64	C	Micro Conductivity
65	C_dC	Micro Conductivity with pre-emphasis
144	U_EM	JAC Electromagnetic Velocity Digital output
255	Sp_char	Special Character, 7FF0H

Table 1: Channel Reference

2 Interpreting Results from Calibrate All

The values displayed in the Calibrate All results are measured in raw counts. Rockland equipment uses a 16 bit system therefore the range of possible raw counts is limited to ±32768 counts. Raw counts can be converted to physical units using the function `convert_odas` available in the ODAS MatLab Library, or manually using the equations listed in the ODAS MatLab Library. This is very useful for T1, T1_dT1, T1, T2_dT2, P, P_dP, S1, S2, C1, C1_dC1, V_Bat, Incl_X, Incl_Y, Incl_T.

There are two common conditions when interprtation of the Calibrate All test is useful. The first case is when the instrument is in the laboratory with test probes installed; the results of this test will provide insight into the health of the instrument electronics. Table 2 provides a description of expected results from each channel when the instrument is on the bench with test probes installed.

The second case is when a Rockland instrument such as a MicroRider is deployed at sea on a platform such as a glider. Some glider systems allow for direct communication with the MicroRider while the glider is at the surface. In this scenario the results can provide insight into the health of the instrument electronics and the microstructure probes installed in the instrument. Table 3 provides a description of expected results from each channel when the instrument is deployed at sea, integrated into a glider system.

2.1 Calibrate All with Test Probes

ID	Name	Expected Signal
0	gnd	Expect min and max values between 0 and ±10 counts. Expect mean ±10 counts, stdev < +1.
1	Ax	Values will reflect local vibrations. Ax values are expected to be larger than Ay.
2	Ay	Values will reflect local vibrations. Ay values are expected to be smaller than Ax.
4	T1	Expect min, max and mean < ±500 counts; stdev < +1. High counts may indicate corrosion on SMC cable.
5	T1_dT1	Expect min, max and mean < ±500 counts and stdev < +10. Stdev will always be higher than T1.
6	T2	Expect min, max and mean to be < ±500 counts and stdev < +1.
7	T2_dT2	Expect min, max and mean to be < ±500 counts and stdev < +10. Stdev will always be higher than T2.
8	Sh1	Expect min, max and mean to be < ±10 counts and stdev < +5 counts. Higher counts may indicate corrosion on SMC Cables. Expect higher counts when unshielded.
9	Sh2	Expect min, max and mean to be < ±10 counts and stdev < +5 counts. Higher counts may indicate corrosion on SMC Cables. Expect higher counts when unshielded.
10	P	Expect min, max and mean to be < ±250 counts and stdev < +1 counts. Very high counts may indicate broken pressure sensor.
11	P_dP	Expect min, max and mean to be < ±500 counts and stdev < +5 counts. Stdev will always be higher than P.
12	PV	Expect min, max and mean to be < ±2000 counts and stdev < +100 counts.
15	EMC_Cur	Expect min, max and mean to be < ±15000 counts and stdev < +10000 counts.
32	V_Bat	Expected stdev < +10 counts (For min, max and mean: +16000 counts = 10 V, +26000 counts = 16.25 V, see equation in ODAS MatLab Library User Guide.)
40	Incl_X	Counts proportional to the inclination around the x axis, expect stdev < +1, higher if instrument is moving. 1 degree equals 40 counts.
41	Incl_Y	Counts proportional to the inclination around the y axis, expect stdev < +1, higher if instrument is moving. 1 degree equals 40 counts.
42	Incl_T	Counts proportional to the temperature insided the instrument, expect stdev < +1
48	JAC_C	Counts are irrelevant in air. JAC-C voltage, expect min, max and mean to be < +28000 counts and stdev < +10 counts in air.
49	JAC_C	Counts are irrelevant in air. JAC Current, expect min, max and mean to be < +25 counts and stdev < +1 counts in air.
50	JAC_T	Counts proportional to the air temperature, expect min, max and mean to be < +32768 counts
52	Chlorophyll	Expect min, max and mean to be < +1500 counts and stdev < +20 counts. May change if objects are near sensor, displays DATA FIFO EMPTY if sensor is covered
53	Turbidity	Expect min, max and mean to be < +7000 counts and stdev < +20 counts. May change if objects are near sensor, displays DATA FIFO EMPTY if sensor is covered
64	C1	Expect min, max and mean to be > −7000 counts and stdev < +1 counts.
65	C1_dC1	Expect min, max and mean to be > −7000 counts and stdev < +25 counts. Stdev will always be higher than C1.
144	U_EM	Expect min, max and mean to be < +3000 counts and stdev < +250 counts in air.
255	Sp_char	Special Character, 7FF0H, expect min, max and mean to ALWAYS be +32752 counts and stdev = 0 counts.

Table 2: Expected Calibrate All Results with Test Probes

2.2 Calibrate all from a Glider at Sea

ID	Name	Expected Signal
0	gnd	Expect min and max values between 0 and ±10 counts. Expect mean ±10 counts, stdev < +1.
1	Ax	Values will reflect local vibrations. Expect larger numbers up to 32768 as surface conditions get worse (waves) or if glider is running pump etc. Ax values are expected to be larger than Ay.
2	Ay	Values will reflect local vibrations. Expect larger numbers up to 32768 as surface conditions get worse (waves) or if glider is running pump etc. Ay values are expected to be smaller than Ax.
4	T1	Monitor for change. +/-10000 count range for oceanographic conditions (aprox -2C to +38C) . The signal is 500 counts per C. The values increase with increasing temperature. A large departure from expectations suggests a crack in the glass coating, a leak into the probe, or (heavens forbid) that water is in the nose cone. A systematic shift with time indicates the same possible phenomena.
5	T1_dT1	The standard deviation of the thermistor channel with pre-emphasis gives you corroboration of any failure symptoms displayed by the T1 channel. It indicates the intensity of the fluctuations. This statistic is a bit harder to interpret, but basically a wide range on the thermistor channel with pre-emphasis is a bad sign. A wide range is more than 5000 counts, and indicates that there is one of the three possible failures listed above.
6	T2	Same as T1.
7	T2_dT2	Same as T1_dT1
8	Sh1	Velocity derivative from shear probe 1. Difficult to interpret when on surface. Very large numbers near 32768 are not a good sign, but could simply be from high seas. Need to check MicroRider Proglet Verbose Output from mid-profile to assess shear probe health: For the shear probes, the mean is of little value because the expectation is zero. Even a completely broken shear probe will have a mean of near zero. Only the standard deviation is useful. A broken probe will have a large standard deviation, more than 1000 counts. You will also get a large standard deviation if you have snagged seaweed, jelly fish, or hit zooplankton, also if you are bouncing around on a rough sea surface, but these will be transient. Persistently high values are a bad sign.
9	Sh2	Same as Sh1
10	P	Expect min, max and mean to be < ±250 counts and stdev < +1 counts. Very high counts may indicate broken pressure sensor.
11	P_dP	Expect min, max and mean to be < ±500 counts and stdev < +5 counts. Stdev will always be higher than P.
12	PV	Expect min, max and mean to be < ±2000 counts and stdev < +100 counts.
15	EMC_Cur	Expect min, max and mean to be < ±15000 counts and stdev < +10000 counts.
32	V_Bat	Expected stdev < +10 counts (For min, max and mean: +16000 counts = 10 V, +26000 counts = 16.25 V, see equation in ODAS MatLab Library User Guide.)
40	Incl_X	Counts proportional to the inclination around the x axis, expect stdev < +1, higher if instrument is moving. 1 degree equals 40 counts.
41	Incl_Y	Counts proportional to the inclination around the y axis, expect stdev < +1, higher if instrument is moving. 1 degree equals 40 counts.
42	Incl_T	Counts proportional to the temperature insided the instrument, expect stdev < +1.
144	U_EM	Expect min, max and mean to be < +3000 counts and stdev < +250 counts in air.
255	Sp_char	Special Character, 7FF0H, expect min, max and mean to ALWAYS be +32752 counts and stdev = 0 counts.

Table 3: Expected Calibrate All Results from a Glider at Sea

2.3 Mid-profile Verbose Output Statistics

On some glider systems the verbose output from the mircorider can be recorded by the glider and sent back to land. The verbose output includes mid-profile mean (record average) and the 'pseudo-standard deviation' (mean absolute deviation) from the microstructure probes. Pseudo-standard deviation can be interpretted similarly to standard deviation. Pseudo-standard deviation is used because it is easer to compute, but is typically 10% smaller in value than standard deviation. Channel statistics from mid-profile are better for assessing probe health than when the probes are on the surface. The health of shear probes can only truely be assessed from mid-profile channel statistics. Below is a discussion of interpretting mean and pseudo-standard deviation from mid-profile probe statistics. For more information see Technical Note 044.

What can one tell about the sensors from a record average and a record pseudo standard deviation?

For the FP07 thermistors, the record average can be converted into physical units and this should give a reasonable estimate of the temperature, which you can compare to your expectations for the environment. Basically, the average thermistor output is in the +/- 10000 count range for oceanographic conditions. The signal is aproximately 500 counts per degree Celcius. The raw count values increase with increasing temperature. A large departure from expectations suggests a crack in the glass coating, a leak into the probe, or (heavens forbid) that water is in the nose cone. A systematic shift with time indicates the same possible phenomena.

The standard deviation of the thermistor channel with pre-emphasis gives you corroboration of any failure symptoms displayed by the record average values. It indicates the intensity of the fluctuations. This statistic is a bit harder to interpret, but basically a wide range on the thermistor channel with pre-emphasis is a bad sign. A wide range is more than 5000 counts, and indicates that there is one of the three possible failures listed above.

For the shear probes, the record average is of little value because the expectation is zero. Even a completely broken shear probe will have a record average of near zero. Thus, only the standard deviation is useful. A broken probe will have a large standard deviation, more than 1000 counts. You will also get a large standard deviation if you have snagged seaweed, jelly fish, or hit zooplankton, also if you are bouncing around on a rough sea surface, but these will be transient. Persistently high values are a bad sign.

3 Examples of Calibrate All Results

Below are examples of calibrate all results from a glider on deck with probes installed, a glider on the surface with probes installed, a glider on the surface after suffering damage to all four microstructure probes. Full discussion of how to interpret the calibrate all statistics are not included in this document. Glider MicroRider users are welcome to request further interpretation by Rockland staff by sending results to support@rocklandscientific.com

3.1 On Deck Before Deployment:

All channels are reporting healthy results given the local conditions. Real probes are installed. Note that the shear (ch 8, ch 9) and temperature probe (ch 4-7) channels have low min and max values.

```
ch:   0  min:     +0  max:     +2  mean:     +0.8  stdev:     0.43
ch:   1  min:  -4529  max:  +4255  mean:    -11.6  stdev:  1824.11
ch:   2  min:  -2862  max:  +2525  mean:     -6.4  stdev:   968.94
ch:   4  min:  +1733  max:  +1816  mean:  +1784.1  stdev:    23.78
ch:   5  min:  +1773  max:  +1984  mean:  +1891.0  stdev:    54.75
ch:   6  min:  +3577  max:  +3624  mean:  +3606.9  stdev:    14.56
ch:   7  min:  +3359  max:  +3789  mean:  +3622.7  stdev:    87.35
ch:   8  min:   -747  max:   +733  mean:     -3.5  stdev:   297.96
ch:   9  min:  -1432  max:  +1436  mean:     -2.7  stdev:   533.39
ch:  10  min:    -59  max:    -56  mean:    -57.1  stdev:     0.40
ch:  11  min:    -59  max:    -53  mean:    -56.8  stdev:     1.27
ch:  12  min:  -1755  max:  -1754  mean:  -1754.7  stdev:     0.44
ch:  32  min: +17199  max: +17546  mean: +17466.8  stdev:    90.65
ch:  40  min: -32768  max: -16385  mean: -27934.8  stdev:  7476.71
ch:  41  min: -16509  max: -16494  mean: -16502.6  stdev:     4.23
ch:  42  min: -31463  max: -31462  mean: -31462.9  stdev:     0.27
ch: 255  min: +32752  max: +32752  mean: +32752.0  stdev:     0.00
```

3.2 On the surface a few days after deployment:

Shear channel min and max are higher due to local surface condition. Remember that shear probes are vibration sensors and can reach very high raw counts in rough surface conditions. It is not possible to fully assess health of shear probe channels when the glider is on the surface.

```
ch:   0  min:     +0  max:     +2  mean:     +0.7  stdev:     0.45
ch:   1  min:  -7477  max:  +7291  mean:   -219.0  stdev:  1187.45
ch:   2  min:  -1808  max:  +1749  mean:    -92.4  stdev:   475.84
ch:   4  min:   +637  max:   +652  mean:   +644.0  stdev:     4.71
ch:   5  min:   +506  max:   +761  mean:   +662.6  stdev:    42.63
ch:   6  min:  +2450  max:  +2463  mean:  +2456.1  stdev:     3.89
ch:   7  min:  +2363  max:  +2678  mean:  +2482.9  stdev:    37.79
ch:   8  min:  -4957  max:  +6899  mean:    -14.6  stdev:  1642.71
ch:   9  min:  -3573  max:  +6394  mean:    -56.8  stdev:  1259.54
ch:  10  min:    -56  max:    -53  mean:    -54.8  stdev:     0.73
ch:  11  min:    -99  max:    -55  mean:    -70.6  stdev:     9.15
ch:  12  min:  -1871  max:  -1868  mean:  -1869.6  stdev:     0.49
ch:  32  min: +17020  max: +17257  mean: +17157.5  stdev:    86.48
ch:  40  min: -32574  max: -32502  mean: -32545.1  stdev:    26.16
ch:  41  min: -18828  max: -18557  mean: -18667.7  stdev:    82.57
ch:  42  min: -31455  max: -31455  mean: -31455.0  stdev:     0.0
ch: 255  min: +32752  max: +32752  mean: +32752.0  stdev:     0.00
```

3.3 On the surface after damage to all four microstructure probes:

Note the high min and max values in the shear and temperature probe channels. In some cases these values may slowly increase over a number of days indicating minor damage that allows water to slowly ingress into the tip of a microstructure probe.

```
ch:   0  min:     +0  max:     +1  mean:     +0.8  stdev:     0.42
ch:   1  min:   -466  max:   +336  mean:    -42.4  stdev:   146.83
ch:   2  min:   -274  max:   +391  mean:    +35.6  stdev:   104.24
ch:   4  min:   +602  max:  +8239  mean:  +5077.3  stdev:  2126.21
ch:   5  min: -32212  max: +32767  mean:   +813.8  stdev: 24494.84
ch:   6  min: +18392  max: +22723  mean: +20113.3  stdev:  1325.76
ch:   7  min: -32128  max: +32767  mean: +11801.5  stdev: 24875.95
ch:   8  min: -15654  max: +32767  mean:    -95.5  stdev:  6832.56
ch:   9  min: -14848  max: +32767  mean:    -35.6  stdev:  7129.56
ch:  10  min:    -49  max:    -47  mean:    -47.8  stdev:     0.43
ch:  11  min:   -106  max:    -32  mean:    -65.9  stdev:    20.52
ch:  12  min:  -1969  max:  -1738  mean:  -1803.4  stdev:    25.03
ch:  32  min: +16828  max: +17321  mean: +17118.8  stdev:   182.82
ch:  40  min: -31858  max: -31625  mean: -31746.0  stdev:    75.62
ch:  41  min: -31242  max: -30702  mean: -31108.4  stdev:   139.15
ch:  42  min: -31458  max: -31458  mean: -31458.0  stdev:     0.00
ch: 255  min: +32752  max: +32752  mean: +32752.0  stdev:     0.00
```

3.4 MicroRider with EM Sensor in Lab, Test Probes Installed

Calibrate All results from and healthy MicroRider with EM sensor:

```
ch:   0  min:     +2  max:     +4  mean:     +3.1  stdev:     0.39
ch:   1  min:   -122  max:   +201  mean:     +3.2  stdev:    56.36
ch:   2  min:   -106  max:   +133  mean:     +4.5  stdev:    25.66
ch:   4  min:    -60  max:    -58  mean:    -58.5  stdev:     0.51
ch:   5  min:    -60  max:    -39  mean:    -49.4  stdev:     3.07
ch:   6  min:    -74  max:    -73  mean:    -73.6  stdev:     0.49
ch:   7  min:    -70  max:    -50  mean:    -60.4  stdev:     3.40
ch:   8  min:     +1  max:    +11  mean:     +6.4  stdev:     2.05
ch:   9  min:     +1  max:     +9  mean:     +5.0  stdev:     2.01
ch:  10  min:    -19  max:    -17  mean:    -18.0  stdev:     0.41
ch:  11  min:    -20  max:    -13  mean:    -17.5  stdev:     1.41
ch:  12  min:   +571  max:   +574  mean:   +572.3  stdev:     0.48
ch:  15  min: -12834  max: +11265  mean:   -776.7  stdev:  6316.27
ch:  32  min: +19448  max: +19462  mean: +19454.3  stdev:     2.46
ch:  40  min: -16387  max: -16385  mean: -16386.2  stdev:     0.46
ch:  41  min: -16391  max: -16390  mean: -16390.3  stdev:     0.46
ch:  42  min: -31484  max: -31484  mean: -31484.0  stdev:     0.00
ch: 144  min:  +2382  max:  +2738  mean:  +2507.9  stdev:   119.52
ch: 255  min: +32752  max: +32752  mean: +32752.0  stdev:     0.00
```

3.5 Unshielded MicroCTD in Lab, Test Probes Installed

Calibrate all Results from a healthy unshielded MicroCTD:

```
ch:   0  min:     +5  max:     +7  mean:     +5.7  stdev:     0.47
ch:   1  min:    -48  max:    +47  mean:     +4.9  stdev:    17.30
ch:   2  min:   -117  max:   +121  mean:     +7.1  stdev:    37.03
ch:   4  min:    -10  max:     -9  mean:     -9.4  stdev:     0.48
ch:   5  min:     -9  max:    +10  mean:     +1.8  stdev:     3.33
ch:   8  min:   -140  max:   +158  mean:     +7.9  stdev:   103.63
ch:   9  min:   -137  max:   +152  mean:     +7.1  stdev:   100.57
ch:  10  min:   +158  max:   +160  mean:   +159.2  stdev:     0.42
ch:  11  min:   +159  max:   +163  mean:   +160.6  stdev:     1.01
ch:  12  min:  -1365  max:  -1362  mean:  -1363.8  stdev:     0.38
ch:  32  min: +26470  max: +26489  mean: +26482.3  stdev:     5.43
ch:  40  min:  +3293  max:  +3296  mean:  +3294.9  stdev:     0.66
ch:  41  min:    +12  max:    +13  mean:    +12.0  stdev:     0.16
ch:  42  min:  +1275  max:  +1275  mean:  +1275.0  stdev:     0.00
ch:  48  min: -21310  max: -21286  mean: -21297.2  stdev:     4.11
ch:  49  min:     +4  max:    +11  mean:     +9.2  stdev:     0.55
ch:  50  min: -30739  max: -30724  mean: -30730.5  stdev:     2.33
ch:  52  min:  +1393  max:  +1681  mean:  +1423.7  stdev:    15.44
ch:  53  min:  +5931  max:  +6181  mean:  +5941.6  stdev:    11.02
ch:  64  min:  -5141  max:  -5139  mean:  -5140.0  stdev:     0.34
ch:  65  min:  -5199  max:  -5149  mean:  -5173.6  stdev:     9.24
ch: 255  min: +32752  max: +32752  mean: +32752.0  stdev:     0.00
```

3.6 Shielded MicroCTD in Lab, Test Probes Installed

Calibrate all Results from a healthy shielded MicroCTD, sheilding inluded placing the entire MicroCTD in a carboard tube covered in alluminum foil. The shielding was grounded to the rear sealing nut of the MicroCTD using a cable with aligator clips:

```
ch:   0  min:     +5  max:     +6  mean:     +5.8  stdev:     0.43
ch:   1  min:    -33  max:    +34  mean:     +4.6  stdev:    11.93
ch:   2  min:    -19  max:    +24  mean:     +6.2  stdev:     7.63
ch:   4  min:    -11  max:     -9  mean:     -9.8  stdev:     0.41
ch:   5  min:     -9  max:    +11  mean:     +1.4  stdev:     3.37
ch:   8  min:     +5  max:    +11  mean:     +7.9  stdev:     1.03
ch:   9  min:    -16  max:    +25  mean:     +7.0  stdev:     2.37
ch:  10  min:   +158  max:   +160  mean:   +159.1  stdev:     0.36
ch:  11  min:   +159  max:   +163  mean:   +161.0  stdev:     1.05
ch:  12  min:  -1354  max:  -1352  mean:  -1353.6  stdev:     0.50
ch:  32  min: +26427  max: +26445  mean: +26438.2  stdev:     5.28
ch:  40  min:   +170  max:   +171  mean:   +170.5  stdev:     0.50
ch:  41  min: +16261  max: +16262  mean: +16261.7  stdev:     0.45
ch:  42  min:  +1273  max:  +1273  mean:  +1273.0  stdev:     0.00
ch:  48  min: -21152  max: -21130  mean: -21140.6  stdev:     3.89
ch:  49  min:     +5  max:    +11  mean:     +9.2  stdev:     0.51
ch:  50  min: -30885  max: -30869  mean: -30877.2  stdev:     2.58
ch:  52  min:  +2900  max:  +3007  mean:  +2964.9  stdev:    13.09
ch:  53  min: -13989  max: -13539  mean: -13976.3  stdev:    19.80
ch:  64  min:  -5141  max:  -1044  mean:  -5131.8  stdev:   181.01
ch:  65  min:  -5201  max:  -5146  mean:  -5173.6  stdev:     8.46
ch: 255  min: +32752  max: +32752  mean: +32752.0  stdev:     0.00
```

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