Old Computers

1. MITS Altair 8800
    a. I/O
        i. MITS 88-DISK Floppy Disk Controller
        ii. Cassette interface
        iii. Cromemco Dazzler graphics card
        iv. Paper tape reader
    b. Minimum RAM: 256 bytes
    c. Maximum RAM: 64 KB (65536 bytes, 524288 bits)
    d. CPU: Intel 8080
2. MOS KIM-1
    a. I/O
        i. 2 8-bit bi-directional ports
        ii. Programmable interval timer
        iii. 24-key keypad
        iv. 2 serial ports
        v. Cassette tape
    b. Minimum RAM: 1 KB
    c. Maximum RAM: 1 KB
    d. CPU: MCS6502
3. Apple 1
    a. I/O
        i. ASCII keyboard (not included)
        ii. Composite video output
    b. Minimum RAM: 4 KB
    c. Maximum RAM: 48 KB
    d. CPU: MOS 6502
4. IBM Personal Computer 5150
    a. I/O
        i. Cassette
        ii. Keyboard
    b. Minimum RAM: 16 KB
    c. Maximum RAM: 604 KB
    d. CPU: Intel 8088
5. Apple Macintosh
    a. I/O
        i. Serial port (for printer)
        ii. Floppy disk drive
    b. Minimum RAM: 128 KB
    c. Maximum RAM: 512 KB
    d. CPU: 68000

Base Conversion

$1_{(10)}$ → base 2 → $1 \cdot 2^0 = 1_{(10)}$ → $1_{(2)}$

$1_{(16)}$ → base 8 → $1 \cdot 8^0 = 1_{(10)}$ → $1_{(8)}$

$1_{(10)}$ → base 16 → $1 \cdot 16^0 = 1_{(10)}$ → $1_{(16)}$

$10_{(10)}$ → base 2 → $1 \cdot 2^4 + 1 \cdot 2^1 + 0 = 1010_{(2)}$

$10_{(10)}$ → base 8 → $1 \cdot 8^1 + 2 \cdot 8^0 = 12_{(8)}$

$10_{(10)}$ → base 16 → $10 \cdot 16^0 = A_{(16)}$

$42_{(10)}$ → base 2 → $1 \cdot 2^5 + 0 \cdot 2^4 + 1 \cdot 2^3 + 0 \cdot 2^2 + 1 \cdot 2^1 + 0 \cdot 2^0 = 101010_{(2)}$

$42_{(10)}$ → base 8 → $5 \cdot 8^1 + 2 \cdot 8^0 = 52_{(8)}$

$42_{(10)}$ → base 16 → $2 \cdot 16^1 + 10 \cdot 16^0 = 2A_{(16)}$

$255_{(10)}$ → base 2 → $1 \cdot 2^7 + 1 \cdot 2^6 + 1 \cdot 2^5 + 1 \cdot 2^4 + 1 \cdot 2^3 + 1 \cdot 2^2 + 1 \cdot 2^1 + 1 \cdot 2^0 = 11111111_{(2)}$

$255_{(10)}$ → base 8 → $3 \cdot 8^2 + 7 \cdot 8^1 + 7 \cdot 8^0 = 377_{(8)}$

$255_{(10)}$ → base 16 → $15 \cdot 16^1 + 15 \cdot 16^0 = FF_{(16)}$

$F_{(16)}$ → base 10 → $15 \cdot 10^0 = 15_{(10)}$

$F_{(16)}$ → base 8 → $1 \cdot 8^1 + 7 \cdot 8^0 = 17_{(8)}$

$F_{(16)}$ → base 2 → $1 \cdot 2^3 + 1 \cdot 2^2 + 1 \cdot 2^1 + 1 \cdot 2^0 = 1111_{(2)}$

$DF_{(16)}$ → base 10 → $13 \cdot 10^1 + 15 \cdot 10^0 = 145_{(10)}$

$DF_{(16)}$ → base 8 → $2 \cdot 8^2 + 2 \cdot 8^1 + 1 \cdot 8^0 = 221_{(8)}$

$DF_{(16)}$ → base 2 → $1 \cdot 2^7 + 1 \cdot 2^6 + 0 \cdot 2^5 + 1 \cdot 2^4 + 1 \cdot 2^3 + 1 \cdot 2^2 + 1 \cdot 2^1 + 1 \cdot 2^0$

$= 11011111_{(2)}$

Base Conversions (Continued)

$81_{(16)} \rightarrow$ base 10 $\rightarrow 9 \cdot 10^1 + 6 \cdot 10^0 = 96_{(10)}$

$81_{(16)} \rightarrow$ base 8 $\rightarrow 1 \cdot 8^2 + 4 \cdot 8^1 + 0 \cdot 8^0 = 140_{(8)}$

$81_{(16)} \rightarrow$ base 2 $\rightarrow 1 \cdot 2^7 + 0 \cdot 2^6 + 0 \cdot 2^5 + 0 \cdot 2^4 + 0 \cdot 2^3 + 0 \cdot 2^2 + 0 \cdot 2^1 + 0 \cdot 2^0$

$= 1000000_{(2)}$

$04_{(16)} \rightarrow$ base 10 $\rightarrow 4 \cdot 10^0 = 4_{(10)}$

$04_{(16)} \rightarrow$ base 8 $\rightarrow 4 \cdot 8^0 = 4_{(8)}$

$04_{(16)} \rightarrow$ base 2 $\rightarrow 1 \cdot 2^2 + 0 \cdot 2^1 + 0 \cdot 2^0 = 0100_{(2)}$

$10010011_{(2)} \rightarrow$ base 10 $\rightarrow 2 \cdot 10^2 + 9 \cdot 10^1 + 1 \cdot 10^0 = 291_{(10)}$

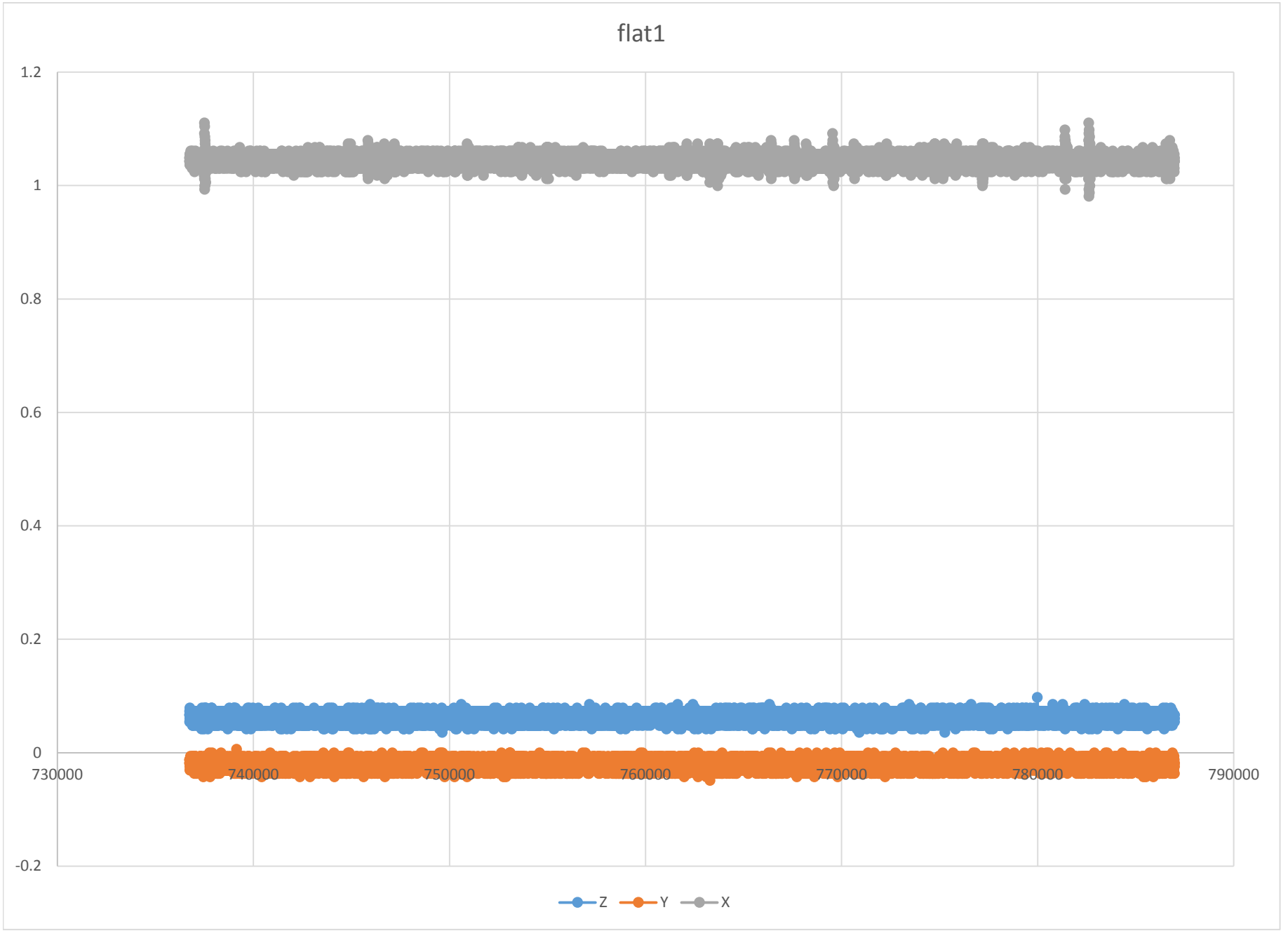
$10010011_{(2)} \rightarrow$ base 8 $\rightarrow 4 \cdot 8^2 + 4 \cdot 8^1 + 3 \cdot 8^0 = 443_{(8)}$

$10010011_{(2)} \rightarrow$ base 16 $\rightarrow 1 \cdot 16^2 + 2 \cdot 16^1 + 3 \cdot 16^0 = 123_{(16)}$

$00111111_{(2)} \rightarrow$ base 10 $\rightarrow 6 \cdot 10^1 + 3 \cdot 10^0 = 63_{(10)}$

$00111111_{(2)} \rightarrow$ base 8 $\rightarrow 7 \cdot 8^1 + 7 \cdot 8^0 = 77_{(8)}$

$00111111_{(2)} \rightarrow$ base 16 $\rightarrow 3 \cdot 16^1 + 15 \cdot 16^0 = 3F_{(16)}$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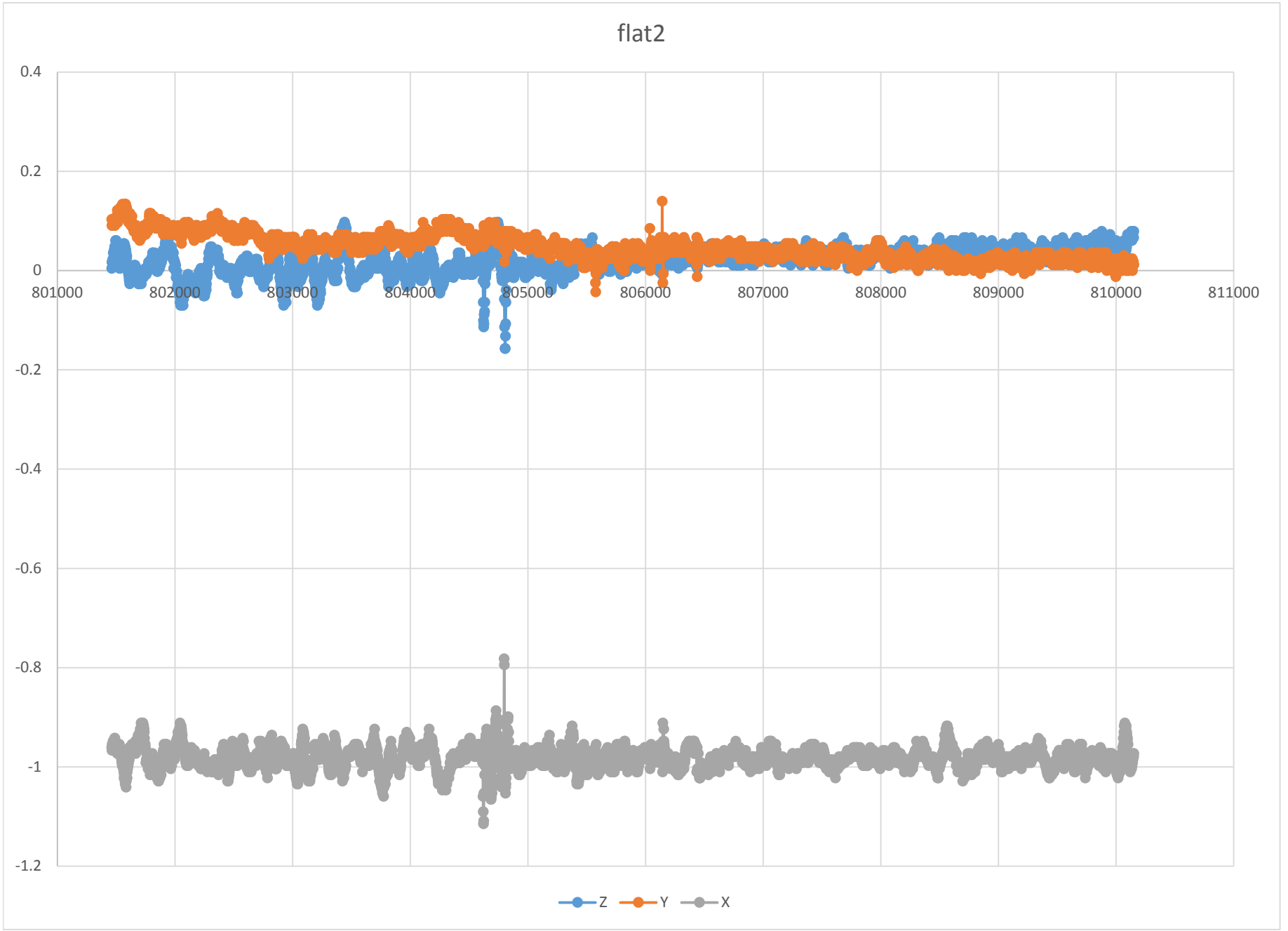
740000
750000
760000
770000
780000
790000
Z
Y
X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-0.6
-0.8
-1
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808000
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Z
Y
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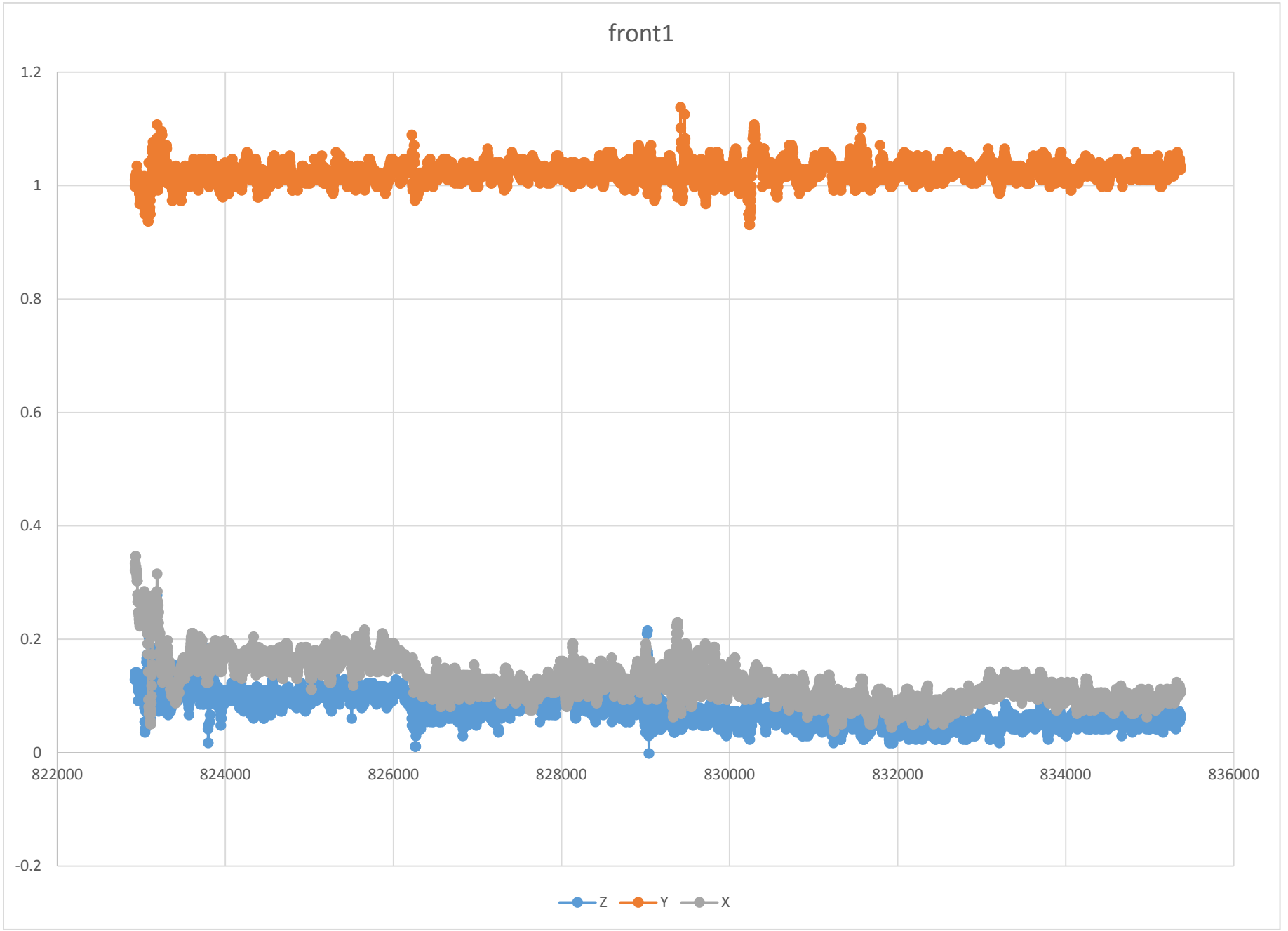
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0.8
0.6
0.4
0.2
0
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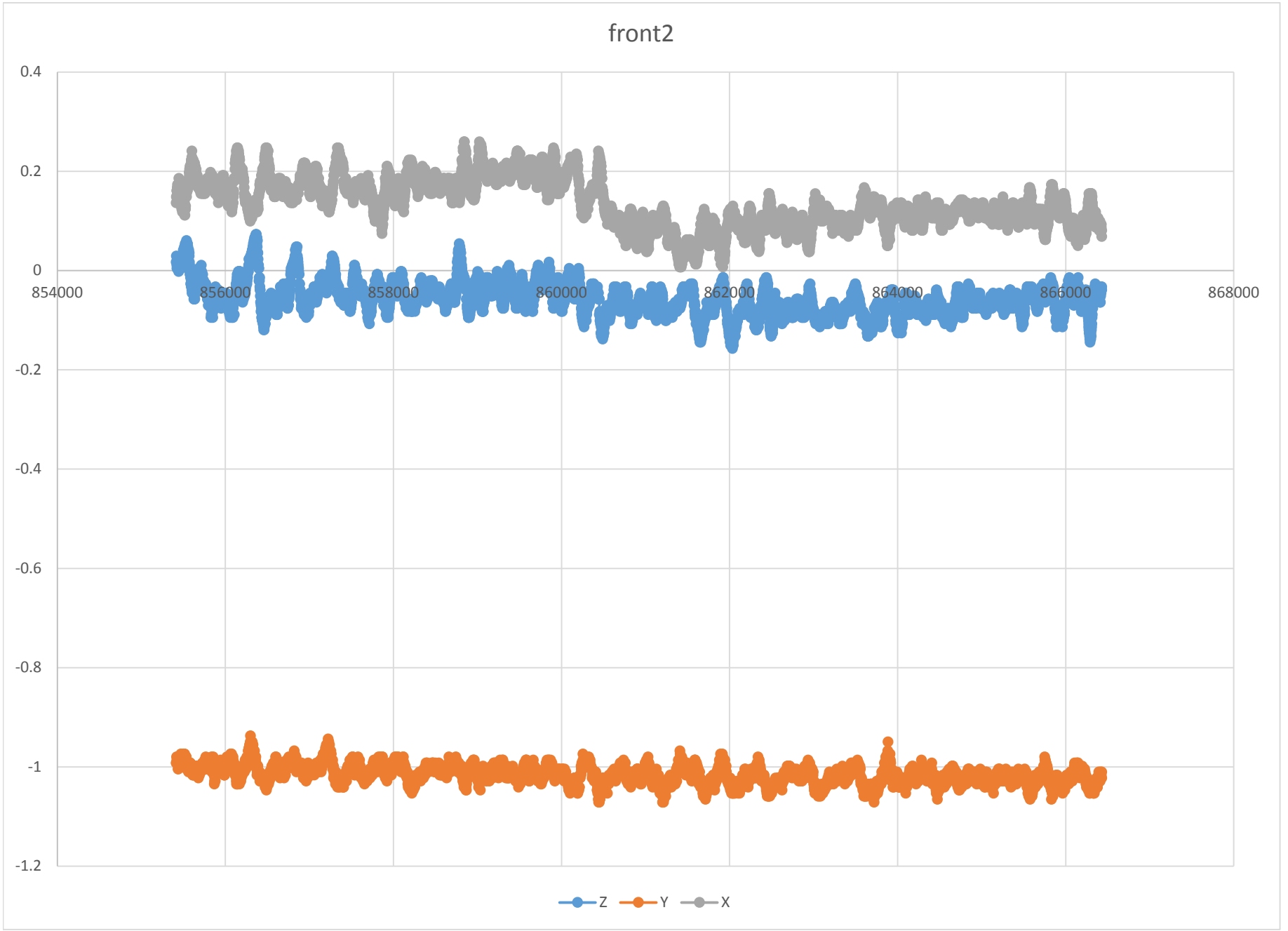
830000
832000
834000
836000
Z
Y
X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-1.2
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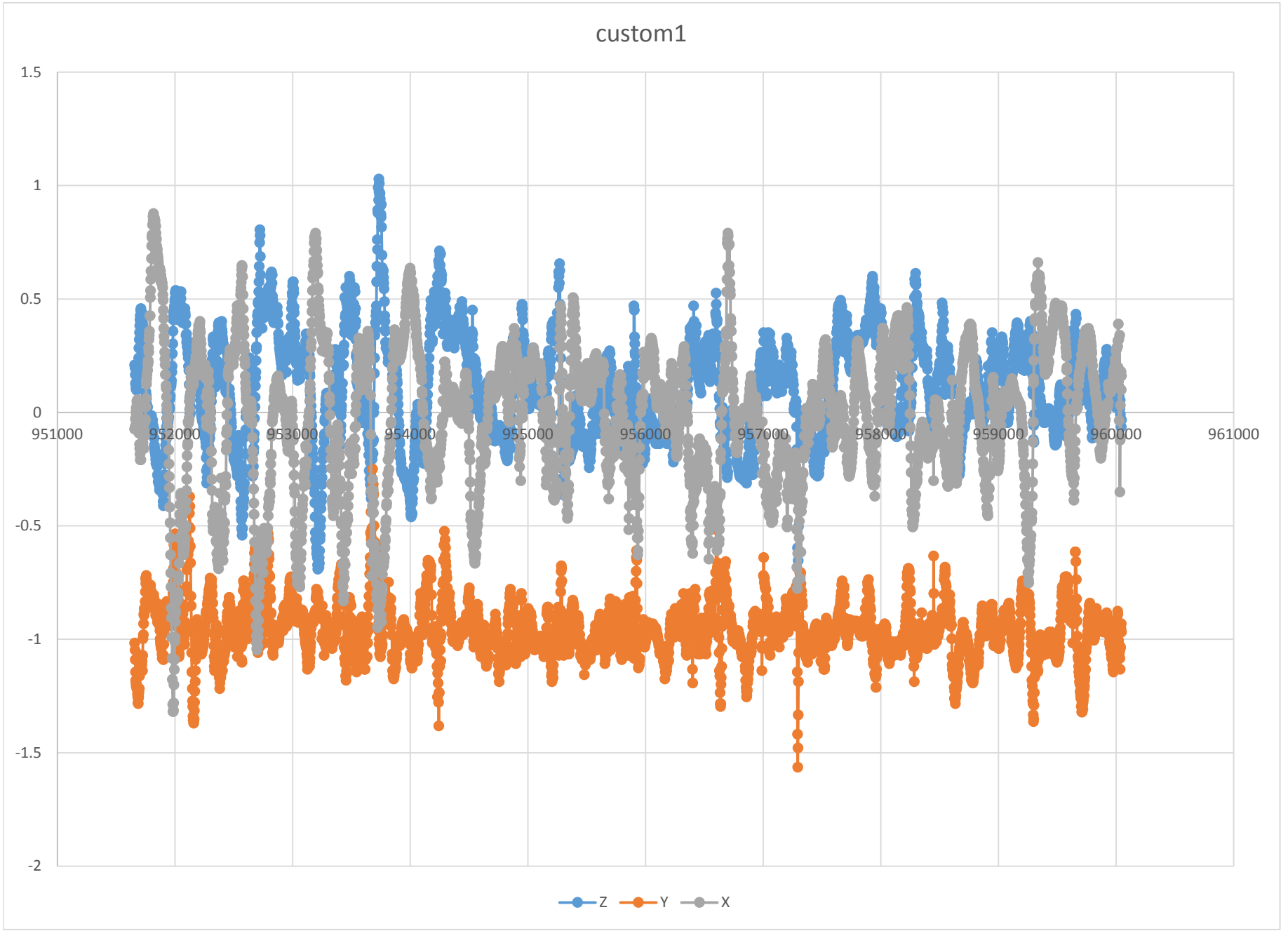
860000
862000
864000
866000
868000
Z
Y
X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-1
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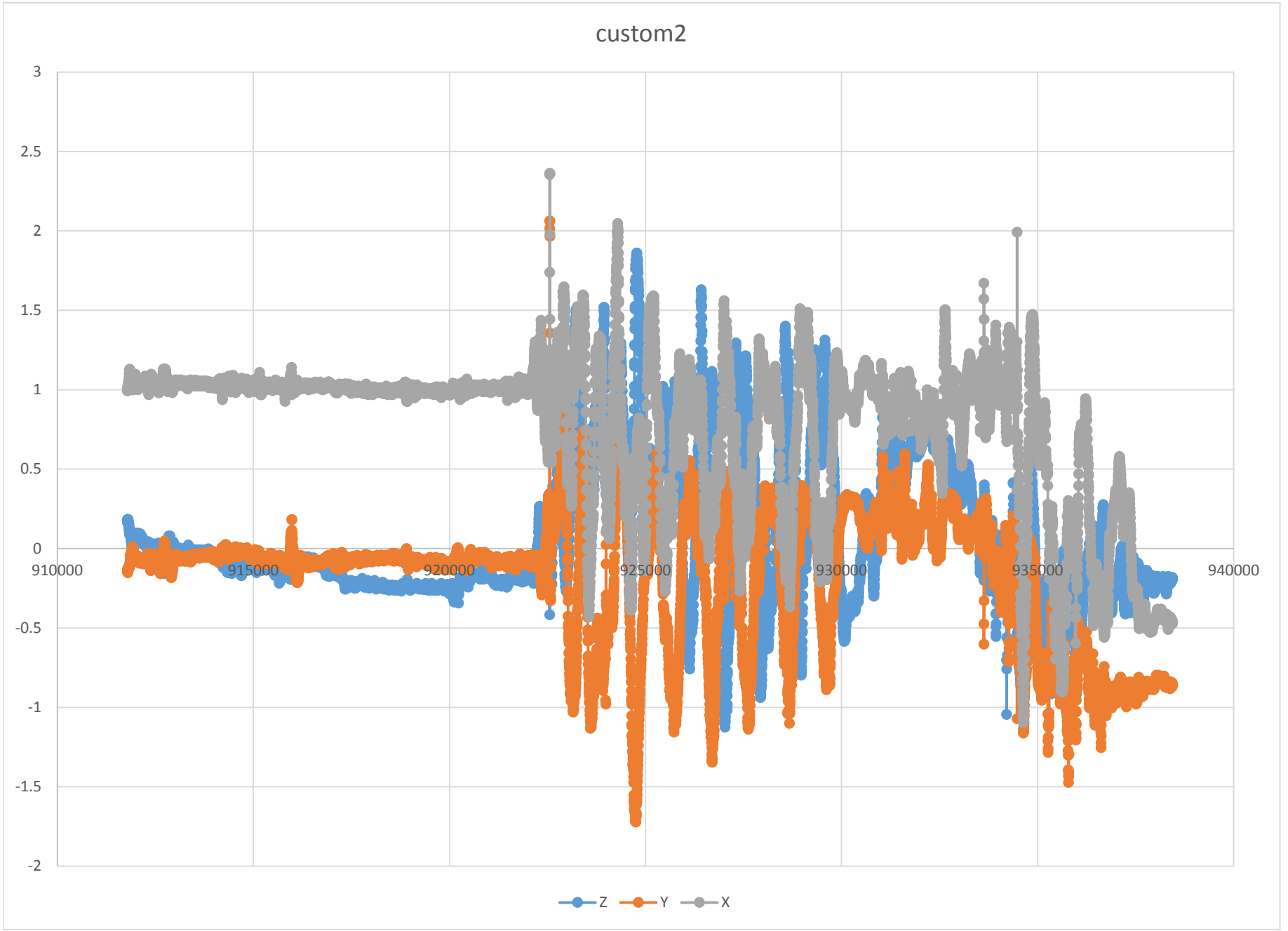
958000
959000
960000
961000
Z
Y
X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-1
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-2
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915000
920000
925000
930000
935000
940000
Z
Y
X

Joystick Calibration

1. x = (a - 10) / (-512)
   y = (b - 8) / (-512)
   The -10 and -8 in the equations account for the joystick not being perfectly centered
2. Center: (10,8)

   It is not perfectly centered because of the manufacturing. The precision of the joystick potentiometers could not be perfectly matched by the manufacturing process.

3. The effect could be that whatever application would not be accurate. For example, if the joystick was programmed to control a robot, the robot would drift to one side.
4. The joystick's initial value could be read at the beginning of the program and use the measured values.