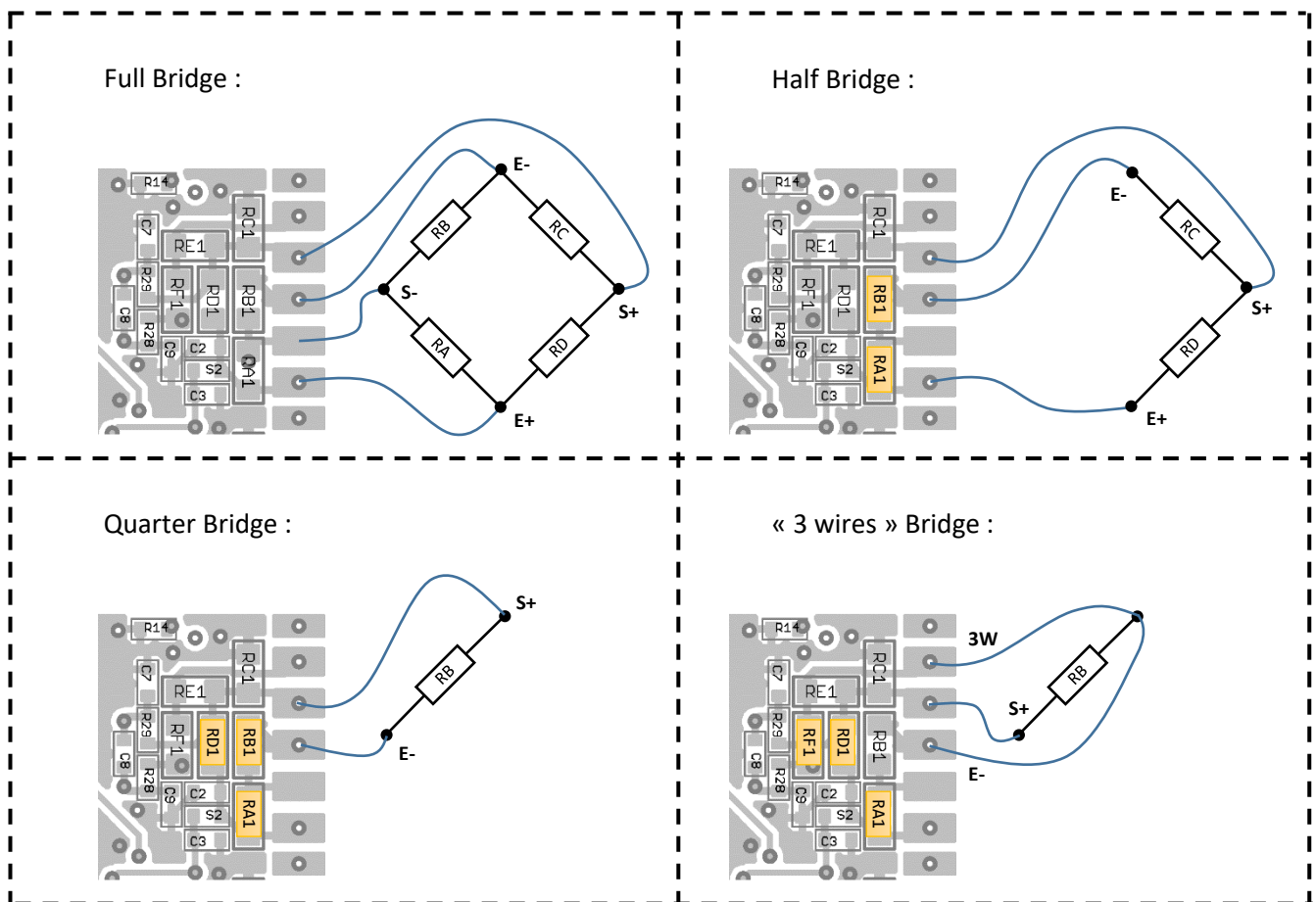# XN5

User guide

This user guide describes how to use and calibrate XN5 amplifiers.

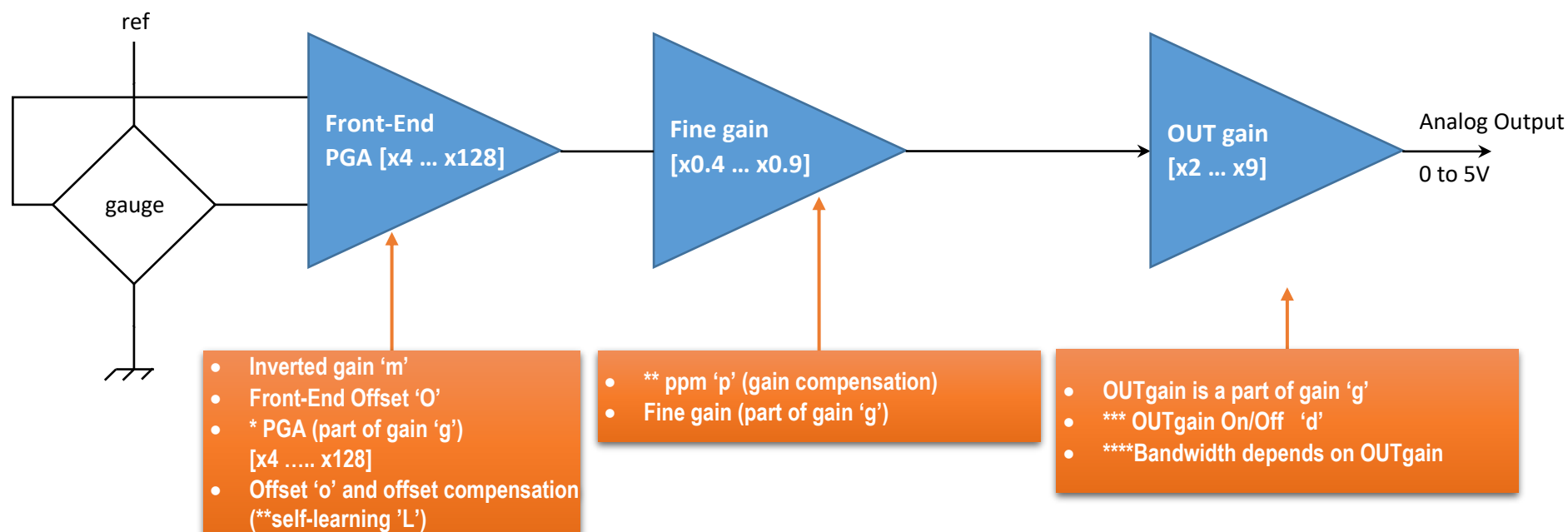## 1. Wirings bridge

Four different type of bridge. Complete the bridge with adequate resistors: " "

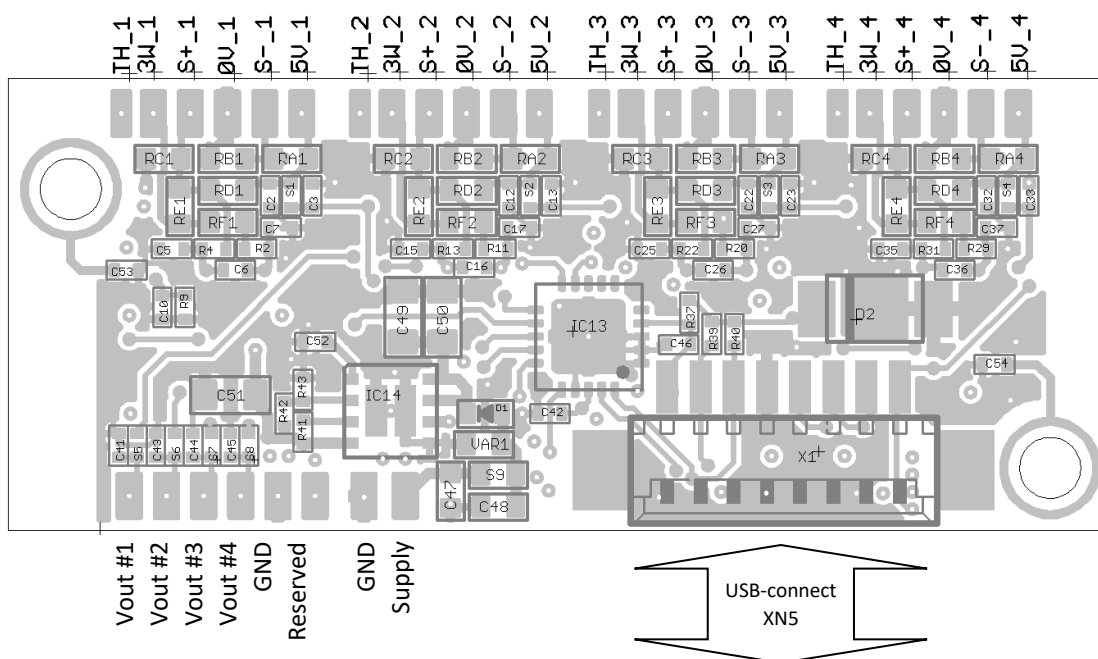Recommended resistor: 0603, 0.1%, 50ppm, 0.125W min.

Bridge impedance ≥ 120 ohms

2. Diagram of Amplifier Board

ref

gauge

Front-End PGA [x4 … x128]

Fine gain [x0.4 … x0.9]

OUT gain [x2 … x9]

Analog Output
0 to 5V

- **Inverted gain 'm'**
- **Front-End Offset 'O'**
- *** PGA (part of gain 'g') [x4 ….. x128]**
- **Offset 'o' and offset compensation (**self-learning 'L')**

- **** ppm 'p' (gain compensation)**
- **Fine gain (part of gain 'g')**

- **OUTgain is a part of gain 'g'**
- ***** OUTgain On/Off 'd'**
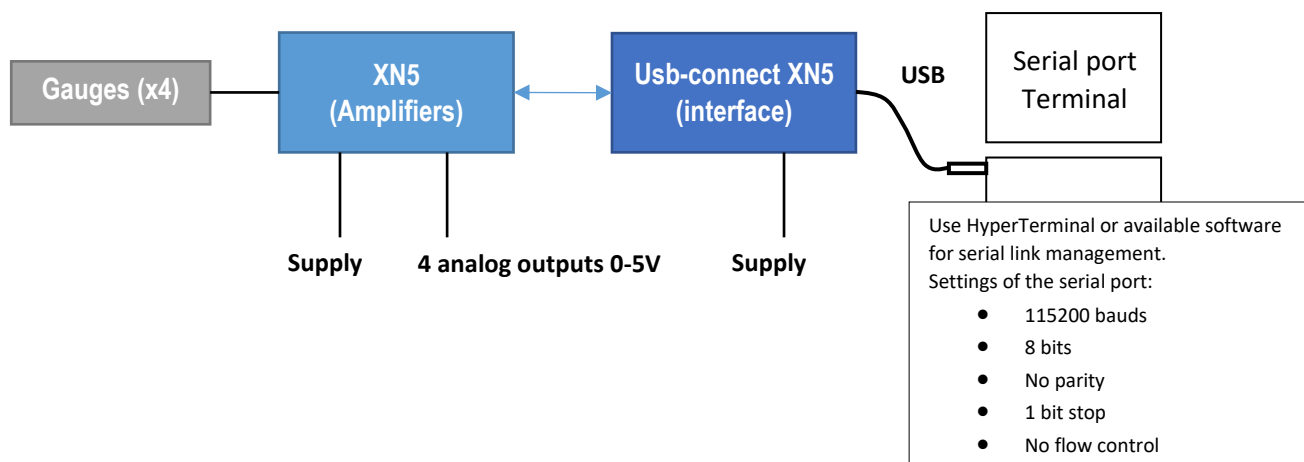- ******Bandwidth depends on OUTgain**

* PGA is before the Fine Offset. Therefore you must set the gain 'g' before setting offset 'o'.

* PGA is blocked if an offset compensation exist (self-learning), so do not change it, otherwise you have to redo self-learning.

** You must set the ppm before to do a self-learning offset 'L'

*** When OUT gain is disconnected (OFF), the range gain is between 2.0 to 1000.0

**** See XN5_Bandwidth_Calculator for more details: http://twist.texense.com/download/XN5_Bandwidth_Calculator.xls

3. Pinout of the Amplifier Board

Top connector labels:
TH_1 3W_1 S+_1 0V_1 S-_1 5V_1 TH_2 3W_2 S+_2 0V_2 S-_2 5V_2 TH_3 3W_3 S+_3 0V_3 S-_3 5V_3 TH_4 3W_4 S+_4 0V_4 S-_4 5V_4

Board components:
RC1 RB1 RA1 RC2 RB2 RA2 RC3 RB3 RA3 RC4 RB4 RA4
RE1 RD1 S1 C2 C3 RE2 RD2 C12 S2 C13 RE3 RD3 C22 S3 C23 RE4 RD4 C32 S4 C33
RF1 C7 RF2 C17 RF3 C27 RF4 C37
C5 R4 R2 C15 R13 R11 C25 R22 R20 C35 R31 R29
C53 C6 C16 C26 C36
C10 R9 C49 C50 IC13 R37 R39 R40 D2 C54
C52 C46
C51 R42 R43 R41 IC14 D1 C42 VAR1 S9 C47 C48 X1
C41 S5 C43 S6 C44 S7 C45 S8

Bottom labels:
Vout #1 Vout #2 Vout #3 Vout #4 GND Reserved GND Supply

USB-connect
XN5

4. Connect XN5 to a PC

Gauges (x4) → XN5 (Amplifiers) ↔ Usb-connect XN5 (interface) → USB → Serial port Terminal

Supply

4 analog outputs 0-5V

Supply

Use HyperTerminal or available software for serial link management.
Settings of the serial port:
- 115200 bauds
- 8 bits
- No parity
- 1 bit stop
- No flow control

5. Header

At power up, the XN5 displays a header (with current parameter values and a list of commands).
- Press 'h' to display the header
- For amplifier parameters, select an amplifier. Otherwise, commands are displayed.

Example: Amp #2 selected, with default values

```
XN5 4xAmps V0.61-2W   SN00000    [user mode]
_____

Selected Amp #2       Amp Offset = 2.500V  |          Amp Gain =   450.0
   .------>  |  Compens Offset = NO       | Compens Gain (PPM) =      0
   |         |Front-End Offset = +0.00mV  | Inverted Front-End =     NO
   |____     |                            |  PGA=128.00 OUTGain=ON=9.0
INTERNAL TAmb|--- Offset compensation ---|----- Gain compensation ----------
  TAmb = -30.0 | 32768=32768=2.500V=50.00% |    0.3906259 ==>   450.00
  TAmb = -20.0 |     0=32768=2.500V=50.00% |    0.3906259 ==>   450.00
  TAmb = -10.0 |     0=32768=2.500V=50.00% |    0.3906259 ==>   450.00
  TAmb =   0.0 |     0=32768=2.500V=50.00% |    0.3906259 ==>   450.00
  TAmb =  10.0 |     0=32768=2.500V=50.00% |    0.3906259 ==>   450.00
  TAmb =  20.0 |     0=32768=2.500V=50.00% |    0.3906259 ==>   450.00
  TAmb =  30.0 |     0=32768=2.        9 ==>   450.00
  TAmb =  40.0 |     0=32768=2.  Internal or external TAmb  9 ==>   450.00
  TAmb =  50.0 |     0=32768=2.        9 ==>   450.00
  TAmb =  60.0 |     0=32768=2.500V=50.00% |    0.3906259 ==>   450.00
  TAmb =  70.0 |     0=32768=2.500V=50.00% |    0.3906259 ==>   450.00
  TAmb =  80.0 |     0=32768=2.500V=50.00% |    0.3906259 ==>   450.00
  TAmb =  90.0 |     0=32768=2.500V=50.00% |    0.3906259 ==>   450.00
  TAmb = 100.0 |     0=32768=2.500V=50.00% |    0.3906259 ==>   450.00
  TAmb = 110.0 |     0=32768=2.500V=50.00% |    0.3906259 ==>   450.00
  TAmb = 120.0 |     0=32768=2.500V=50.00% |    0.3906259 ==>   450.00
  TAmb = 130.0 |     0=32768=2.500V=50.00% |    0.3906259 ==>   450.00
```

6. Interface connexion

This is not hot plug system.

When you want to connect interface board on the amplifier board, you must reboot the interface (with '!') to load amplifier's parameters in the interface.

Several parameters need to reboot the supply of the amplifier board.

7. Operating Standalone mode

When you finish adjusting the amps, you can remove the interface and use only the amplifier board.

- Remove supply
- Disconnect the interface from the amplifiers
- Supply only the amplifiers.
  - Amplifiers work alone with their parameters in EEPROM.

Compensation (offset and gain) is active only in standalone mode (or when no amplifier is selected). If an amplifier is selected and if you would check compensation of this amplifier, it must return to standalone mode to activate compensation.

8. Commands

Key	function	handling	Comments
1-4	Select an amplifier (1 to 4)	Press numkey 1,2,3 or 4	To see parameters of each amplifiers
0	No amplifier selected	Press numkey 0	To see interface settings
a	To switch line displayed	Press 'a'	If no amplifier selected, then special line is displayed
A	Display frequency (1Hz or 10Hz)	Press 'A' to switch	
h	Display header (current settings)	Press 'h'	Amp settings (1-4) or interface (0)
H/?	Help (command list)	Press 'H'	
esc	Cancel the current entry	Press 'escape'	
!	to reset uC, or to stop correctly the offset learning	Press '!'	No confirmation

Parameters stored in the EEPROM amps:

Key	function	handling	Comments
i	Initialize amp # to default values	Press 'i' and confirm	Default values: see Header example. Interface settings are not affected.
m	Invert frond-end	Press 'm' and confirm	Inversion of measurements
O	Front-End Offset adjustment (coarse)	Presse 'O' and confirm	Select one of the values.
o	Offset adjustment (Fine Offset)	Press 'o' and confirm. Value (mV) + enter	Be sure to have no force on the bridge. You must set Front-End Offset 'O' before to do an offset 'o'.
d	OUT gain stage On/Off	Press 'd' and confirm	When disconnected (OFF), OUTgain = 1.0
g	Gain adjustment	Press 'g' and confirm. Value in tenth + enter	_ If change, you must readjust an Amp Offset. _ PGA is blocked if an offset compensation exist (self-learning), so do not change it, otherwise you have to redo self-learning. _ if ppm ≠ 0, the target gain is adjusted at 25°C ambient temperature in the gain compensation table.
p	PPM setting	Press 'p' and confirm.Value (ppm) + enter	Before setting ppm, you must set gain 'g' (it's the gain at 25°C). You must set the ppm before to do a self-learning offset 'L'.
L	Start of a self-learning process	Follow instructions	In oven with slow drop in temperature (max speed: -1°C/min), 5 hours max. Before to do self-learning, you must set: offset coarse 'O', offset 'o', gain 'g', ppm 'p'
T	Switch ambient temperature used	Press 'T' and confirm to switch	internal or external. If change, gain & offset compensations will be erased!

XN5 User Guide v3

9. Descriptions

• Ambient temperature measurement

The measurement of ambient temperature is used to compensation of offset and gain.
<u>Therefore the ambient temperature must be closest of the piece's temperature</u>.
For each amplifier independently, you can choose between:
- o "internal Tamb" (default): ambient temperature from the amplifier (on amplifiers board).
OR
- o "external Tamb", ambient temperature from thermistor (close to the gauge).
  Temperature probe must be a 15kΩ NTC Thermistor (15kΩ at 25°C, Beta ≈ 4000).
  Just connect the thermistor between the "TH..." pad and the gauge supply.
  Here are some examples:
    - ➢ Through-Hole: AVX ND03N00153J 3.5mm (Farnell ref 1672367, Newark ref 33P7738)
    - ➢ SMT 0402: Vishay BC Components - NTCS0402E3153FHT (Farnell ref 1761139, Newark ref 34R4323)

To switch :
- • Press 'T' and confirm the switch
- • WARNING: Gain compensation and offset compensation will be erased!

• Inversion of Front-End

If the bridge is mounted upside down, you can invert the analog front-end.
- • Press 'm' to invert front-end

• Front-End Offset

Front-End Offset is adjustable from -60mV to +60mV in 32 steps, to adjust the imbalance of the gauge.
- • Before, be sure to have no stress on the bridge.
- • Press 'O' and choose among the 32 steps proposed.

• Amplifier Offset adjustment

The offset of output amplifier is adjustable between 400mV to 4600mV.
- • Before setting the offset :
  - o Be sure to have no force on the bridge (≈ 0mV)
  - o You must set the gain because PGA is before Fine Offset (see diagram)
- • Press 'o' and enter the offset desired, in tenth of mV.
- • XN5 goes into search mode.
- • When the offset search is finished, <u>make sure the offset register is not in saturation</u> (0 or 65535). Otherwise, it means that the bridge is too unbalanced and you must adjust the front-end Offset.

• Amplifier Gain setting

The gain of the amplifier is adjustable between 3.2 to 1000.0 (or 2.0 to 1000.0 when OUTgain is disconnect).
- • Press 'g' and enter the gain desired, in tenth.

• Compensation

Compensation (offset and gain) is active only in standalone mode (or <u>when no amplifier is selected</u>). If an amplifier is selected and if you would check compensation of this amplifier, it must return to standalone mode to activate compensation.

• Offset compensation (Self-learning process)

You can create your offset compensation with the self-learning process.
- • Before, you must set: offset coarse 'O', offset 'o', gain 'g', ppm 'p'
- • You need put the part to compensate in an oven at high temperature (125°C max), then turn off the oven to create a slow drop in temperature.

6 / 7

- o   Max speed: -1°C/min.
- Start the self-learning at the beginning of the high-temperature.
  - o   Press 'L' and confirm
- Then, at low temperature you can stop the process.
  - o   Stop the process :
    - ▪ Wait the timeout (5 hours)
    - ▪ Or press '!' to force the end of the process.
  - o   Then, the compensation table is created, with extrapolations [-30°C ; +130°C]

• Gain compensation (PPM setting)

The ppm of the gain of the amplifier is adjustable between -3000 to 3000 (= -0.3%/°C to +0.3%/°C)
- Before, you must set the gain 'g' (at 25°C ambient)
- Press 'p' and enter the ppm desired. (100ppm = 0.01%/°C, 10000ppm = 1%/°C)

10.   Handlings

There must be a certain order in the settings.

1. First, use the Front-End Offset to adjust the imbalance of the gauge (coarse).
   - o   Press 'O'
   - o   Correction : -60mV to +60mV
   - o   You can measure the impact directly on the bridge.
2. Before offset setting, you must set the desired gain amplifier
   - o   Press 'g'
   - o   Enter the gain
3. After gain setting, you may choose the desired bandwidth by changing capacitors on board.
   - o   See Calculator : http://twist.texense.com/download/XN5_Bandwidth_Calculator.xls
4. Then, set the desired offset voltage, between 400mV to 4600mV
   - o   Press 'o'
   - o   Enter the desired value in mV
   - o   If saturation of offset register (value 0 or 65535), you must change Front-End Offset and redo an offset adjustment.
5. After gain setting, you can set the compensation of gain with (ppm)
   - o   Press 'p'
   - o   Enter the ppm
6. After ppm setting, (gain compensation), you can set the offset compensation with self-learning:
   - o   Put amplifiers into an oven with slow drop in temperature (max speed: -1°C/min)
   - o   The drop in temperature must be between 125°C max and -20°C min.
   - o   Press 'L'
   - o   Enter the ppm

For complete information, contact us at info@texense.com