11.1.2010

Nokeval 6601

Agricultural transmitter

User manual

Based on hardware V1.1 and firmware V1.1

INTRODUCTION

Nokeval 6601 is a low cost transmitter with 3-wire 0/4-20mA output. Measurement ranges include several millivolt and microampere inputs, potentiometer input, frequency and pulse count inputs and four switch inputs.

The transmitter is microprocessor based and can be configured with Nokeval Mekuwin program or 6790 hand-held configurator.

Signal path is as follows:

PHYSICAL INPUT -> [INPUT CIRCUITS] -> [LINEARISATION] -> [FILTER] -> [OUTPUT SCALING] -> mA

It is possible to monitor both linearised+filtered input value and calculated output in mA.

The changes from firmware version 1.0 to 1.1 are highlighted by a vertical line in this manual.

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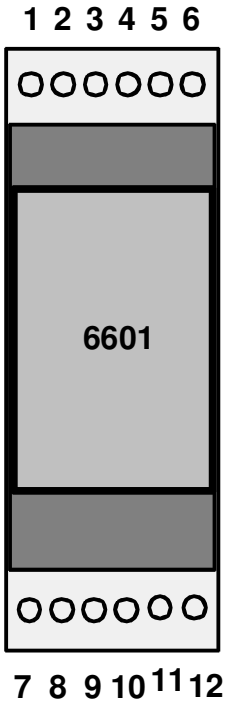
INSTALLING

Connectors

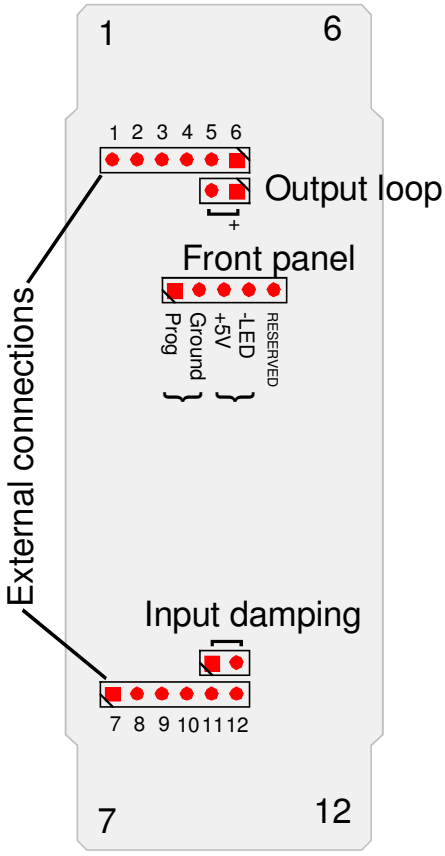


Terminal	Supply/Output	Analog input	Frequency	Switch
1	+Supply 12...28VDC			
2	Ground			
3	Output 0/4-20mA			
4	Not connected			
5	+10V excitation out			
6				Input 2 (South)
7	+5V excitation out	Pot excitation		
8		mV/µA/pot input	Freq input	Input 3 (West)
9		Ground	Ground	Ground
10		µA shunt		
11			Count reset	Input 0 (North)
12				Input 1 (East)

Jumpers and headers

Inside the case, there are several pin headers.

Headers marked “External connections” are one-to-one connected to the screw terminals. They are there for factory calibration, but may be used for user purposes too.

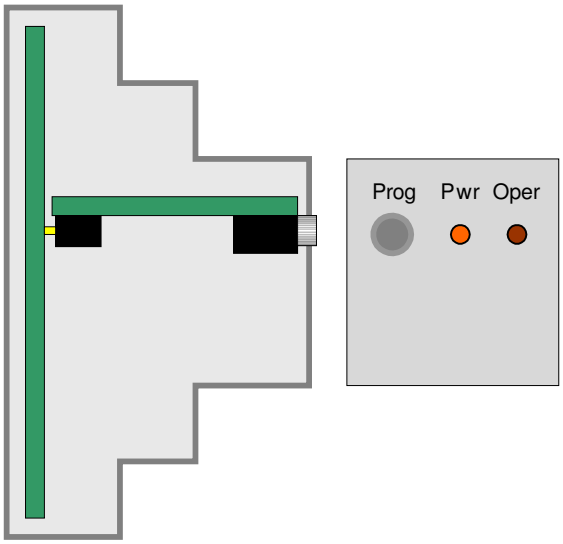


The output signal from 6601 travels via the header noted “Output loop”. Normally these pins are shorted to enable the current to flow. Note that the potential of these pins depends on the external load of the output. Factory setting: shorted with a jumper.

Input damping jumper, when closed, will strongly attenuate the general input at terminal 8. It may be used in very noisy environments when using mV or uA inputs; it enables a 1st degree lowpass of about 1 Hz. Naturally it must be open when using frequency inputs. Factory setting: open.

In the middle of the board, there is a five pin header for front panel connections. These connections are optional. The configuration tool is connected to pins 1 (tip of the plug) and 2 (body of the plug). If a front panel LED is desired, it is connected between pins 3+ and 4-. The current supplied is about 10mA with a red LED. You can also use the internal 5V supply; it is available between pins 2- and 3+. Do not take more than 10mA to not to overheat the regulator.

A front panel riser board “6601PYSTY” may be available for the front panel header. It has a 3.5mm jack for the configuration tool and two LEDs: a power LED and an operation LED. Please check the availability.



CONFIGURATION

This chapter explains how to use the configuration tools Mekuwin and 6790 to access configuration parameters of the transmitter.

A programming cable is required for Mekuwin configuration. Suitable cables are POL-RS232 (for RS-232 port of a PC) and DCS772 (for USB port of a PC). Mekuwin is a free software. If the 6601 is not equipped with “PYSTY” board, an adapter POL-2PIN is also required.

In your configuration device, select communication settings as follows:

- Baud = 9600
- Slot = 0
- Addr = 0

Then, try to open connection. If the connection fails, verify that you have connected the supply voltage. Also check the polarity of the programming cable.

When connection is established, enter the configuration menu. Adjust all relevant settings to your preference. See chapters Input modes (appropriate section) and Common settings. Finally Save the settings. Start monitoring and verify the transmitter operates properly. Close connection before switching power off.

Configuration menu

Mode selection

See chapter Input modes.

Sensor selection

See chapter Input modes, section Frequency input.

Direction setting

See chapter Input modes, section Switch inputs.

LoPass

Lowpass filter (damping). See chapter Common settings.

Output submenu

See chapter Common settings.

Linearisation submenu

See chapter Common settings.

INPUT MODES

Millivolt inputs

Connect the millivolt signal to connectors 8+ and 9-.

There are several millivolt ranges: 20, 50, 100, 250, 1000, and 5000 mV. The range is only nominal; there is always some overhead, e.g. the 20mV range can measure up to 22mV typical. 5000mV range has no overhead.

The transmitter measures the input about 80 times to get averages over 100 ms period in order to attenuate the 50 and 60 Hz hum. Unfortunately signal parts exceeding the input range (e.g. going below zero) are not averaged linearly. If there is too much noise in the input and it cannot be removed externally, there is possibility to use a heavily damping passive lowpass at the input. See chapter Installing / Jumpers and headers.

There is no offset nulling circuitry. The input offset of the op amp used is compensated in software. If the op amp has negative offset, the transmitter A/D converter is fed with 0 volts before the actual signal reaches 0 mV. Consequently there may be small (typ 0.5 mV, max 1.0 mV) dead zone around 0 mV.

Select Mode = 20mV or whatever mV range. You can use LoPass filter to damp the value. Scale the output.

LED operation: the led will be on when the input signal is above approx 6% of the range.

Microampere inputs

There is a 200 ohm resistor built in to enable microampere measurements. Connect the signal to terminals 10+ and 9- (there's the resistor) and connect the terminals 8 and 10 together with a piece of wire.

Now you could use mV ranges, but if you use uA ranges, the transmitter divides the mV reading with a factory calibrated value to convert the result to microamperes. So there is no need for a precision shunt resistor.

Select Mode=100uA or any uA range. You can use LoPass filter to damp the value. Scale the output.

LED operation: the led will be on when the input signal is above approx 6% of the range.

Potentiometer inputs

The transmitter can handle both 2-wire and 3-wire potentiometers. 3-wire potentiometer is preferable since there is no need to adjust anything according to the potentiometer value.

3-wire

When using 3-wire connection, use terminals 7 (+excitation), 8 (wiper), 9 (-common). Select Mode=Pot at configuration menu. The input value will be 0…99.6. See

chapter Output on how to live calibrate the pot. The potentiometer should be minimum 500 ohm to not to have too much current consumption.

2-wire

2-wire connection is based on a voltage divider formed with the pot and an external resistor. Connect the potentiometer between terminals 8+ and 9-. Have a resistor with equal resistance (e.g. 5 kohm pot, get a 5 kohm fixed resistor) and connect it in terminals 7 and 8. Now, when the pot is in zero position, the input voltage at terminal 8 is 0V. And when the pot is in max position, there is voltage half of the excitation (5V/2 = 2.5V). The correlation between pot resistance and the voltage is not linear, but the transmitter will compensate this. Select Mode=Pot2. The input value will be 0…100. See chapter Output on how to live calibrate the pot. The pot should be minimum 250 ohms to not to have too much current consumption.

LED

LED operation: the led will be on when the input signal is above approx 0.3 V.

Frequency input

Physical

Select Mode=Freq at the conf menu. Select Sensor to match the type of input. There are four options: Pickup, NPN, Volt, and PNP. The signal is fed in terminals 8+ and 9-.

The pickup input is used with magnetic pickups generating AC voltage. There is a hysteresis in the transmitter to eliminate ripple in the signal. The trip points are 0 mV and about 200 mV at low frequencies. Additionally, there is some band limiting and slew rate losses in the input circuit, so more voltage is needed at higher frequencies. 500 mV is sufficient for maximum frequency of 1500 Hz.

The NPN, Volt, and PNP inputs use typically 2.5V decision level with hysteresis of about 1V. The difference between NPN, Volt, and PNP is that with NPN, there is a pullup (10 kohm to 5V) switched on, while with PNP, there is a pulldown (10kohm to ground), and with Volt selection, 6601 does not pull up nor down. For relay/switch sensor, select NPN. A maximum of 12V is allowed to be fed.

Debouncing

If there are debounce problems with a physical switch or reed relay sensor, you can attenuate this by coupling a small capacitor across the input of the transmitter. Calculate the capacitor value in nF: C = 4000/fmax, where fmax is maximum frequency to be measured (in Hz). Select the nearest practical value.

Measurement method

The measurement is based on both period and pulse count measurements, these working together. At very low frequency (< 3 Hz), the transmitter will compute the frequency on each pulse. When the frequency is increased, more pulses are involved in the period. On 1000 Hz, there is in order of 150 pulses.

When the transmitter doesn’t receive a pulse in 1 sec and there should be a pulse according to the previous pulse interval, the transmitter starts estimating the maximum frequency there could be. After 5 seconds without pulses, the transmitter resolves 0.2 Hz, after 6 seconds 0.17 Hz, and so on. The input value slowly

approaches 0. After 3500 seconds, the minimum frequency is reached and the value is dropped to zero.

LED

LED operation: the led will blink for 50 ms for every pulse (rising edge). Consequently above 20 Hz, the led is light continuously.

Count input

Select Mode=Count. Select Sensor to match the type of the input. See chapter Frequency input on sensors and debouncing.

The transmitter can count up to 4 000 000 000 pulses. After reaching the maximum, the count is halted, not reset. At 1500 Hz input, reaching the maximum takes one month.

Reset

The count can be externally reset to zero. When Sensor=Pickup, NPN, or Volt, use a switch connected between terminals 11+ and 9-. The switch can use terminals 11+ and 10- alternatively. There is an internal pullup 10kohm to 5V. When Sensor=PNP, connect the reset switch between 7+ and 11-. A pulse of at least 50 milliseconds is needed to reset.

If the reset switch is normally closed (active state = open), switch on the NC setting in the conf menu, otherwise off.

The pulse count will be reset whenever the transmitter supply voltage is cut off.

LED

LED operation: the led will blink for 50 ms for every pulse (rising edge). Above 20 Hz, the led is light continuously.

Switch inputs

Logical modes

There is three logical modes to select of: Bin, Gray, and 1-of-4.

In Bin mode, the four inputs are combined for one binary number representing 0…15 in decimal. Least significant bit is connected to terminal 1 (switch input 0) and so on. Scale the output Lo=0 and Hi=15.

Gray mode is like Bin mode except for the Gray coding.

In 1-of-4 mode, one of the four inputs should be activated at a time. Switch 0 gives reading of 0, switch 1 gives 1, switch 2 gives 2, and switch 3 gives 3. When two adjacent switches are activated simultaneously, the reading will be their average, e.g. switches 1 and 2 closed gives 1.5. When no switch or more than 2 switches is closed, the previous reading is preserved.

1-of-4 input is intended for (wind) direction sensors, so there is one more feature. When we close switch 0 after switch 3, the reading will be 4 instead of 0. So there is two representations for North, 0 and 4. Here we have a hysteresis: if the input varies between 3 and 0, the reading varies between 3 and 4. Without this feature, when the wind changes between West (3) and North (0), the output would swing between 4 and 16 mA making the indicator show something like Southeast (1.5). Due to this

circular nature of the switches, it is not recommended to use lowpass filtering. Scale the output Lo=0 and Hi=4.

Physical modes

NPN and switch sensors: Set Direction=NPN in the conf menu. This will activate the internal pullups (10 kohm to 5V) in the transmitter. Connect the switches in terminals 11, 12, 6, and 8, and their commons in terminal 9.

PNP sensors: Set Direction=PNP in the conf menu. This will activate the internal pulldowns (10 kohm to ground) in the transmitter.

If the switches are normally closed (active state = open), switch on the NC setting in the conf menu, otherwise off.

Debouncing

The level of all the four inputs must be still for 50 milliseconds for the transmitter to accept any of them. This ensures simultaneous change using Bin mode and rejects disturbances effectively.

LED

LED operation: the led will blink when any of the inputs is changed (high or low).

COMMON SETTINGS

These settings are common to all ranges and are thus described separately.

Filter

LoPass is a 1st degree software lowpass filter (damping value). Set the time constant in seconds. After the time set the measurement value has reached 63% of final change when a step input is applied. Set to 0 (zero) to not to use the filter.

The filter is temporarily switched off when configuration settings are changed.

Output

Out submenu has settings associated with the analog output:

Out Range has two options: 0-20mA and 4-20mA. In 4-20mA output, there is no low-limit: the signal can still go to 0 mA.

Out Lo and Hi: select engineering values on which the output is 0/4mA and 20mA, respectively. By issuing a Lock command (see configuration device docs) for Out Lo or Out Hi, the current input value is copied to associated scaling value, enabling quick live scaling for e.g. potentiometer!

Linearisation

The transmitter offers possibility for customer linearisation with up to 6 points both x and y values freely selectable. Between the points, linear interpolation is used. Outside the range, extrapolation is used according to the two nearest points.

First select the number of points used and set it in Pts setting. Set 0 if no linearisation is desired.

Set the X (input) and Y (linearised) value pairs in the Lin submenu. When the actual input value matches some X value, the corresponding Y value is passed to the processing and output.

If Pts setting is less than 6, the last X Y pairs are not used.

Linearisation table may be used for live calibration thanks to its freedom to select both X and Y values freely. The desired engineering values of the test points are fed to the Y values of the linearisation (e.g. 15,45,90,180,270, and 345 degrees). Then each physical input is applied to the transmitter and the current non-linearised input value is copied to the corresponding X value. This copying may be done with single Meku Lock command for that X menu item. While doing this, the linearisation must be switched off (set Pts=0) so that the X values are unlinearised!

OUTPUT AND EXCITATION

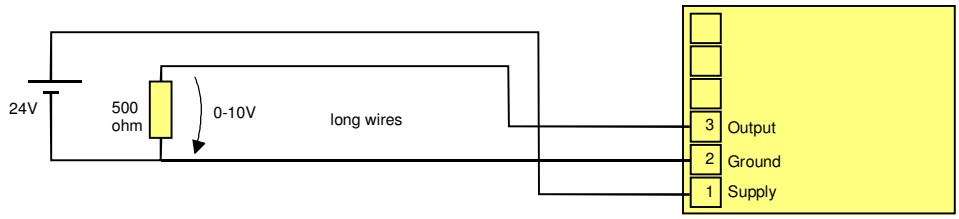
The transmitter has an active milliamp output signal. There is no need for an external power supply in the mA loop.

The ground is common between the signal and the supply. So the transmitter can be connected using three wires: supply, output, and ground.

The output signal flows out of terminal 3 and is returned to the terminal 2 (ground).

Maximum output voltage is supply voltage reduced with 2 volts. E.g. 12V supply, maximum load is 10V (corresponds to 500 ohms).

The output can be converted to a 0-10V signal using an external 500 ohm resistor. For maximum accuracy, this resistor should be placed at the receiving end, so that the cable voltage drops have no effect. The supply voltage must be at least 12.0V.



The transmitter provides two excitation voltages for external use: 5V and 10V. These should not be loaded more than 10mA. The ground is common with input and output.

TROUBLESHOOTING

- If the frequency input does not work except on the lowest frequency, ensure the damping jumper inside the case is open.
- If the count input doesn’t count and gives zero reading, check the polarity of the reset switch.
- If the 1-of-4 input does not work, check the Direction setting.

CALIBRATION

Preface

The transmitter is factory calibrated for mV and uA inputs and should not need recalibration unless there is components replaced.

Calibrating the potentiometer range, and other user calibration, should be done with the resources offered in the Configuration menu (output scaling, linearisation), not in the Calibration menu! See chapter Common settings about output scaling and linearisation points.

Before calibrating, set all options “off”, e.g. the lowpass filter and the linearisation. Open the Cal menu under the device Main menu. There is no password.

Millivolts

The transmitter has an 8 bit A/D converter. Its output (prescaled to 0…0.996) is first multiplied by the relevant calibration value in the calibration menu (e.g. on 20mV range “20mV” calibration coefficient is used) and then the common Offset value is added. The offset is not used on 1000mV and 5000mV ranges.

To define both the offset and the coefficient, two test points are needed.

The offset is determined on 20mV range, then left alone. Select 20mV range and set calibration values in the Cal\In menu “Offset”=0 and “20mV”=1 to get uncalibrated readings. Feed two positive mV values (call them X1 and X2) to the transmitter; 5mV and 20 mV are good values. On both inputs, record the input monitor values (Y1 and Y2). Finally calculate as follows:

Coefficient “20mV” = K = (X2-X1)/(Y2-Y1), this should be abt 22 (indicating range width).

Offset = X1 - K*Y1, this should be about ±0.5 (mV).

Write these values to the calibration menu. Finally test the range.

On the 50, 100, and 250mV ranges, proceed as follows. First select the mode at conf menu, and set the relevant coefficient at cal menu to 1. Feed the calibration value (on 100mV range feed X=100mV) to the transmitter. Monitor the input (=Y). Calculate the coefficient (X-Offset)/(Y-Offset) and write in the cal menu. Test.

On 1000mV and 5000mV ranges, the method described above can be used, with exception of not using the offset. Calculate the coefficient X/Y.

The 5000mV range is not normally calibrated as it is referenced to the 5V reference/excitation of the transmitter and there is no big errors (set Cal\In\5V=5000). However, if calibrated, a value of 4000mV should be used because there is no overhead above 5000mV and the converter could be saturated.

Milliamps

Milliamp inputs 100, 250, and 500uA use millivolt inputs 20, 50, and 100mV and divide the millivolt reading with a calibrated factor (Cal\In\uA). To calibrate this internal resistor, select 500uA range, set the factor (Cal\In\uA) to 1 to get

uncalibrated readings. Feed 500uA=X and monitor the output=Y. Calculate Y/X and set in calibration menu. This should be about 0.2 kohms (kohms to get mV->uA).

Potentiometer

Potentiometer calibration is used for determining the engineering value range of the pot, not for live pot calibration! Do not alter this calibration unless necessary. Normally this value is 100.0.

Output

Open the Cal\Out menu. There is two items with possibility to send Lock commands for them. First send the Lock command for the first item and externally measure the output current (should be around 5 mA). Record this and send Free command to return to normal operation. Write the mA value to the menu. Repeat this for the other item (should be about 18 mA). The output is calibrated.

SPECIFICATIONS

Supply

Supply voltage: 11…30 VDC (12…30 VDC when using 0-10V output)
Supply current: typ 10 mA + output signal + excitation. Max 80 mA.
Polarity protect: Yes, with series diode

Inputs

Frequency input

Range: 0.0003 ... 1500 Hz

Sensors: Pickup >=200 mV peak, NPN, PNP, relay, voltage 4..12 V

NPN/PNP decision levels: 1.5 and 3 V typ, 1 and 4 V at extreme cases.
Gate time: 1/3 seconds or 128 pulses, whichever shorter

Accuracy: 0.5% at 25℃, 0.8% over whole temperature range

Pulse count input

Maximum count: 4 000 000 000 pulses
Maximum frequency: 1500 Hz
Sensors: See Frequency input
External reset: Yes, see Parallel switch input
Automatic reset: No
Power-off backup: No

Parallel switch inputs

Number of contacts: 4
Input modes: 1-of-4 (wind vane), binary, gray

Polarity: selectable (NC/NO, NPN/PNP)

Sensors: TTL level or relay contacts (pullups 5V/10kohm within transmitter give 500µA)
Debounce: All inputs must stay still for 50ms to be accepted

Microampere input

Ranges: 100µA, 250µA, 500µA
Input resistance: 200 ohms +/-1%
Resolution: 8 bits
Accuracy: 1% of range and ±3µA, possible dead zone <5µA
Calibration: software calibration of internal shunt resistance

Millivolt input

Ranges: 20, 50, 100, 1000, 2500 mV unipolar
Input impedance: >1 Mohm
Resolution: 8 bits
Noise rej: about 100 measurements averaged over 100ms period
Accuracy: 1% of range and ±0.5mV, possible dead zone <1mV
Calibration: software coeff + offset for physical units (mV)

Potentiometer input 3-wire

Potentiometer: >= 500 ohm

Excitation: 5.0V DC from transmitter, max 10 mA
Resolution: 8 bits (linear)
Calibration: Via output scaling

Potentiometer input 2-wire

Potentiometer: >= 250 ohms
Excitation: 5.0V DC from transmitter thru an external resistor
Resolution: 7 bits (non-linear)
Calibration: Via output scaling

External excitation for sensors

Excitation: 10V/35mA or 5V/35mA
Short circuit protection: Unlimited

Output

Range: 0-20mA or 4-20mA, active output
Limits: low end limited to 0mA, high end overranges to 25mA typ
Calibration: in software, 2 points
Resolution: 10 bits
Accuracy: 0.5% at 25°C
Maximum load: Supply - 2V (e.g. 24V->1100ohm, 12V->500ohm)
Scaling: Lo (0/4mA) and Hi (20mA) on input value
Isolation from input: No; grounds connected together

Programming connector

Physical interface: Nokeval POL, 2 header pins at 2.54 pitch
Protocol: Nokeval SCL, any address, 9600 baud, 8N1
Language: Nokeval Meku 1

Environmental

Mounting: 35 mm DIN rail
Temperature: -20…+60 °C
Humidity: 0…90% non-condensing
Protection class: IP20
Pollution class: 2
Mounting position: Any