Instruction and Installation Manual

K-Factor Scaler Board
Model: B220-880 & B220-881

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Specifications

- **External Power:**
  - Input Voltage – 8.5 to 30 Vdc (Diode protected)
  - Maximum Current draw – 18mA (using internal resistor @ 30Vdc input)

- **Environmental:**
  - OPERATING TEMPERATURE
    -22° F (-30° C) to 158° F (70° C)

- **Inputs:**
  - MAGNETIC PICKUP INPUT:
    Frequency Range: 0 to 4000 Hz
    Trigger Sensitivity: 30 mV p-p to 30 V p-p

- **Output Signal**
  - Max. Voltage = 30Vdc
  - Max Power = 0.25W
  - Pulse Type (using internal pull-up resistor)
    V_H = Power Input Voltage – 0.7Vdc
    V_L = Less then 0.4V @ max input power
  - Pulse Type (using external pull-up resistor)
    V_H = Input Voltage to external pull-up resistor
    $V_L = (V_H/(\text{selected resistor value} + 47\Omega)) * 47\Omega$
  - Pulse Length: 150us, 1ms, 25ms, 100ms, 500ms, 1s, or Auto mode selectable.

- **Internal Pull-up Resistor**
  - Jumper disable option
  - 3.6KΩ

- **Enclosure**
  - Appleton GR Conduit Outlet Box GRL100-A and GRLB100-A
  - CSA approved Class I, Groups B,C, and D; Class II, Groups E,F, and G; and Class III
  - Explosion proof
  - Dust-Ignition-Proof

- **Agency Listings**

  CSA - "Ordinary Locations"
  Pollution Degree 2, Overvoltage Category III

  Definitions:
  Pollution Degree 2: Normally only non-conductive Pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.
  Overvoltage Category III*:* Distribution level, fixed installation, with smaller transient overvoltage than installation category IV (Primary supply level).

  Important: For this CSA rating to be valid, the circuit board must be mounted in a certified Appleton 1" NPT model GRL100-A or GRLB100-A conduit outlet box.

Description

The Blancett K-factor Scaler board is a field adjustable frequency divider which interfaces the output signal from a turbine meter with a magnetic pickup to the input of a PLC, RTU, CPU data acquisition card, or similar totalizer device. The adjustable frequency divisor, referred to as the K-factor, allows the pulses being sent from a turbine meter to be divided into a recognizable unit that an end device, such as a PLC can count and display.

Different K-factors allow the end device to display in any number of volume measurements such as gallons, cubic meter, liters, barrels, and so forth. A calibration sheet provided with a turbine meter will list a nominal K-factor (for the range of the meter) tested to a specific volumetric flow rate. This K-factor can be place directly into the K-factor board to provide an output with the same volumetric flow rate or modified to a different volumetric flow rate by re-calculating the K-factor with the appropriate conversion factor.

In addition, if the K-factor is set to 1, the K-factor Scaler board can be used as a pre-amplifier where the frequency from a low-level turbine meter is proportional to the logic level frequency output needed by a PLC or CPU data acquisition card. This option allows the end device to control the dividing process of the turbine meter output to a recognizable flow rate.

Operation

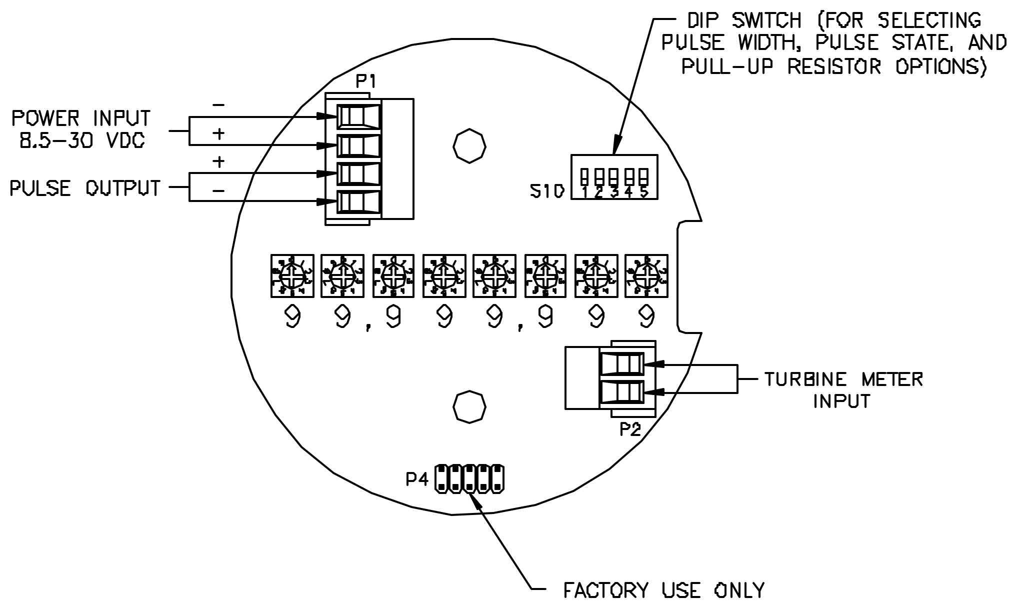
Fluid moving though a turbine flow meter causes the rotor to rotate in relation to the flow rate. The rotation of the rotor blades cuts through the magnetic field generated by the magnetic pick-up which in turn generates a frequency output signal that is directly proportional to the speed of the rotor.

The signal produced is received by the K-factor Scaler board input amplifier, which has an input sensitivity of 30mV p-p to 30V p-p. The signal is then sent to an onboard microcontroller, which acts as a divisor with a range of 1 to 99,999,999. The divisor (K-factor) is user adjustable and set by the eight rotary switches. The microcontroller handles the dividing process by counting the input pulses and comparing it to the value of the eight rotary switches. Once the count equals the value set by the eight rotary switches, an output pulse occurs for a selectable time period and the counting process starts over.

Installation

The K-factor Scaler board was designed with terminal connections with removable plugs for easy connection and removal from the system once it's been installed. Refer to the Diagram below for the I/O terminal connections. The board connections include Power Input, Turbine Meter Input, and the Pulse Output to a totalizing device.

Diagram 1. Board Connections



Enclosure Mounting **(necessary for CSA certification)**

If the circuit board is supplied without an enclosure, it must be mounted within a certified Appleton 1" NPT model GRL100-A or GRLB100-A conduit outlet box to maintain the CSA "Ordinary Locations" certification. The label containing the hookup information should be placed on the inside of the cover of the enclosure. The label containing the CSA logo should be placed on the bottom exterior of the enclosure.

Power

The K-factor board requires 8.5 - 30VDC to operate. The power connections are reverse polarity protected by a diode but must be connected properly for operation of the device. Polarity is shown in Diagram 1 above.

Turbine Meter

The Turbine Meter connections are non-polarized and located on a separate 2 position terminal. Shielded twisted pair wire is recommended for this connection to the Turbine meter.

Pulse Output

Either the internal pull-up resistor or an external resistor **must** be used for the K-factor Scaler board to provide an output pulse. This option is controlled by position 5 of the Dip Switch.

Internal Pull-up Resistor

The internal pull-up resistor allows for a simple installation but care must be taken to ensure that the device being connected to by the pulse output can handle voltage levels as high as the power feeding the K-factor board. Another important setup consideration when using the internal pull-up resistor is to make sure the output pulse from the K-factor board can supply enough current for the receiving device to be able to read the pulse. The available current that the K-factor Board can supply the receiving device can be calculated with the following equation.

$$AvailableCurrent = \left(\frac{InputVoltage - 0.7V}{3600\Omega + 47\Omega} \right)$$

Verify that the receiving device input current requirement is below this value for proper operation. Otherwise, an external pull-up resistor less then 3.6KΩ will have to be used.

External Pull-up Resistor

Using an external pull-up resistor offers the end user greater flexibility of controlling the output pulse provided by the K-factor board to a receiving device. Since power sources and receiving devices differ between users, different resistor values may be required by different setups.

The external pull-up resistor is connected between the receiving device's input and a power source. This power source would be the maximum input voltage (of the pulse) to the receiving device. Refer to the following equation to help determine the resistor value needed.

$$R = \left(\frac{SupplyVoltage}{I} \right)$$

Where: ***R*** = the Resistor value in ohms
Supply Voltage = the supply voltage connected to the external pull-up resistor
I = the input current required by the receiving device in amps

After the Resistor value has been calculated, make sure in the following equation, that "P" is less then or equal to 0.25. "P" represents the power capability of the output and should not exceed 0.25 Watts. Exceeding this value could damage the K-factor Board. Raising the Resistor value will decrease the power calculation.

$$P = (SupplyVoltage)\left(\frac{SupplyVoltage}{R + 47} \right)$$

Startup and Configuration

After the K-factor Board has been properly installed, power can be applied. The unit can be configured with the power either on or off. If the power is on, the on-board microcontroller constantly scans for any changes and adjusts accordingly. Note that the pulse output should be ignored while any changes are being made while power is applied. Any changes cause the internal counter to reset and the dividing process to start over.

Configuring the K-factor Board consists of the following four items:
1) Setting the K-factor (divider)
2) Setting the output pulse width
3) Setting the output level normally high or normally low
4) Setting the output pulse to use the internal or external pull-up resistor

Setting the K-factor

The K-factor is the ratio of input pulses per each output pulse and can be viewed as a divisor. The minimum K-factor can be set to 1 where each input pulse yields an output pulse. The maximum K-factor can be set to 99,999,999 where it would take this many input pulses to yield one output pulse.

The K-factor is set by the eight rotary switches. Each switch is a ten position switch that's used to select a number from 0 to 9 by pointing the arrow to the corresponding digit inscribed on its casing. When looking at the Scaler board so that the text 99,999,999 is below the switches, the right most switch represents the least significant digit of the K-factor number. For example, to set the K-factor as 4,572, the switches should be set as shown below.

0 0 0 0 4 5 7 2	→	Switch settings
9 9,9 9 9,9 9 9	→	Text below switches

Setting the Output Pulse Width

The output pulse width is the length of time the pulse remains active before resetting to its resting state. The K-factor Scaler board has a total of six different pulse widths to choose from. Some end devices require that the pulse be a certain length or longer in order for proper detection of each incoming pulse. For these devices, it's important to select a pulse width that is long enough for the end device to recognize.

The pulse width options are selected by the Dip Switch positions 1, 2, and 3. Table 1 shows the position of each switch to select the desired pulse width output.

Table 1. Dip Switch Settings for Selecting the Width of the Output Pulse.

Pulse Width	**Dip Switch**		
	1	2	3
150us	⇩	⇩	⇩
1ms	⇧	⇩	⇩
25ms	⇩	⇧	⇩
100ms	⇧	⇧	⇩
500ms	⇩	⇩	⇧
1s	⇧	⇩	⇧
Auto	⇩	⇧	⇧
Factory test	⇧	⇧	⇧

In addition to six pre-set pulse widths to choose from, another option is also available called "Auto" mode. This mode acts in the same manor but does not restrain the output pulse to a specific length. Instead, it varies and is dependent on output frequency. The higher the output frequency, the shorter the pulse width output. The lower the frequency output, the longer the pulse width output.

Setting the output level normally high or normally low

Most end devices will be unaffected by this setting but the K-factor Scaler board has the ability to invert the output pulse level. This option is controlled by position 4 of the Dip Switch.

When the switch is in the "off" position (down, in reference to Diagram 1), the output level is normally low and the duration of the selected pulse width is high.

When the switch is in the "on" position (up, in reference to Diagram 1), the output level is normally high and the duration of the selected pulse width is low.

Setting the output pulse to use the internal or external pull-up resistor

Either the internal pull-up resistor or an external resistor **must** be used for the K-factor Scaler board to provide an output pulse. This option is controlled by position 5 of the Dip Switch.

When dip switch 5 is in the "on" position (up, in reference to Diagram 1), the internal 3.6K pull-up resistor is connected to the input voltage of the board. The output pulse swing is approximately 0.7 volts less then the input voltage to near zero volts.

Setting dip switch 5 in the "off" position (down, in reference to Diagram 1), the internal pull-up resistor is disconnected and an external pull-up resistor and supply voltage is required.