Programmable Universal Frequency Transducer

Data Sheet 1140A

April 2000

Features

• Completely programmable frequency range from 0.1 Hz…120 kHz (programmed using membrane keypad)

• LCD to display the input or output signals

• 3-way isolation of signals (input, output and power supply)

• Industry standard analog outputs (0-10 V, 0-5 V, 0-20 mA and 4-20 mA) and inverse signals. Digital output: PNP transistor 24 V dc @ 100 mA

• Compact 45 mm Din rail mount housing with plug-in screw terminals

• Tested to comply with international standards for electromagnetic compatibility (CE)

• UL/CUL recognition and Class 1, Div. 2 (groups A, B, C and D) Installation

General Description

The MCR-f/UI-DC universal frequency module converts any frequency range between 0.1 Hz to 120 kHz into industry standard analog signals. All common frequency signals in 2, 3 and 4-wire configurations including signals from encoders are accepted. The module’s input frequencies can originate from the following sources:

– PNP/NPN Transistor
– NAMUR Sensors
– Dry Contacts
– Frequency Generator
– Encoders

Devices such as proximity sensors and magnetic speed switches can be utilized as frequency input devices. Frequencies can be programmed into the module in Hz or revolutions per minute (RPM) according to user preference. A programmable division feature (between 0.1 to 9999) allows accurate RPM measurement when multiple targets are required or for precise positioning applications. Additionally, the module can be programmed to accept a range between 0-20 mA or 0-10 V dc (e.g. 3-10 mA or 2-6 V) signal and convert/isolate it to a standard analog output. The input or output measurement values can be monitored on a LCD display.

The input pulses are evaluated using period measurement between the lower and upper input range. The microprocessor then converts this into a proportional analog voltage or current signal. This method offers highly accurate outputs (0.15% of the end value) when measuring both low or high frequency ranges.

The module is programmed using membrane keypads located on the front face. A 1500 V three-way isolation between input, output, and power prevents ground loop errors and provides high accuracy measurements. The output signals are 0-20 mA, 4-20 mA, 0-5 V dc or 0-10
V dc and the inverses of each. In addition, a PNP transistor output is provided that can source up to 100 mA of current for alarm/control applications. Wire break, power-on delay, and zero/span adjustments are standard features.

**Isolation/Surge/Short Circuit Protection**

The MCR-f... module features a combination of optical and transformer isolation. The optical isolation provides common mode voltage (CMV) isolation up to 1.5 kV between the sensor input and the process signal output. The module’s power supply is isolated from both the sensor input and the output circuit by a DC/DC transformer isolation circuit. Isolation assures that there will be no measurement errors introduced by currents that are developed due to ground loop problems.

The modules are designed for use in industrial environments. Stringent IEC testing has shown that the modules have passed the IEC 801.2 (Electrostatic discharge) and IEC 801.4 (Electrical Fast Transient / Burst) tests. Suppressor diodes have been integrated to protect both input and output circuits from both wiring errors and shorting.

**Input Signal Wiring**

**PNP/NPN Inputs**

One of the more popular types of frequency input devices are proximity sensors. The MCR-f... module can accept 3-wire or 4-wire versions of PNP (sourcing) and NPN (sinking) sensor inputs. A sensor excitation of 15 V/<25 mA is provided at input terminal 6 to power the sensor.
Input Signal Wiring

**NAMUR Sensor Input/2-wire DC Inductive Proximity Switches**

![Figure 6. 2-wire DC NAMUR sensor](image1)

**Figure 6.** 2-wire DC NAMUR sensor

**Input Signal Wiring**

**Dry Contact Inputs**

Magnetic pick-up sensors relay contacts and limit switches are all possibilities for the dry contact frequency input.

**Input Signal Wiring**

**Frequency Generators (Square Wave Inputs)**

The MCR-f... module accepts frequency inputs from frequency generator sources or incremental encoders. The minimum pulse width is 1 µs. Voltage signal levels can range from 1 V dc to 30 V dc.

![Figure 7. 2-wire DC (dry contact)](image2)

**Figure 7.** 2-wire DC (dry contact)

![Figure 8. Dry Contact Inputs](image3)

**Figure 8.** Dry Contact Inputs

![Figure 9. Incremental rotary transducer with HTL logic: Sourcing signal](image4)

**Figure 9.** Incremental rotary transducer with HTL logic: Sourcing signal

![Figure 10. Incremental rotary transducer with HTL logic: Excitation provided by the module](image5)

**Figure 10.** Incremental rotary transducer with HTL logic: Excitation provided by the module
Input Signal Wiring

Analog Voltage and Current Inputs

Although the module is named to accept different types of frequency inputs, its microprocessor is also capable of accepting analog voltage and current signals for conversion and isolation applications. Inputs can be programmed between 0-10 V dc or 0-20 mA. The programmed input signal can be converted and isolated into standard or inverse analog outputs. (see output section)

![Figure 11. Analog voltage input (DC voltage)](image1)

![Figure 12. Analog current input (DC current)](image2)

Outputs

Analog Voltage and Current Inputs

The MCR-f... module provides an analog and a digital switch output.

Analog output:

Industry standard analog outputs, such as: 0-10 V, 0-5 V, 0-20 mA and 4-20 mA can be programmed. Inverse signals of these outputs (e.g. 20-4 mA or 10-0 V) can also be selected for valve control applications.

Digital output:

A PNP (sourcing) transistor @ 24 V dc, 100 mA is provided at the output. Switching behavior, lower/upper limit, and an on and off delay time (0-30 sec) can be programmed using the keypads. This feature can be useful for temperature control applications, by taking the signal directly into a digital input card on the PLC or to a 24 V dc relay for switching higher currents and voltages.

Error Recognition

Error detection is provided for wire breaks and over/under range measurements. The digital output can be programmed for over/under range conditions. A wire-break condition results in the analog output signal to go to its lowest state (0 V or 0 mA) with an adjustable time delay between 0.2 to 10.1 sec. Local indication is provided on the modules’ LCD display:

![Figure 13. LCD error display](image3)
Module Configuration

The input/output functions can be programmed using the keypad on the front face of the module housing

The MCR-f... modules come factory configured to the following settings:

- **Input:** "**IN Hz**"
  - Low range: 0Hz
  - High range: 100kHz
- **Output:** 0...20mA
- **Digital output:** OFF
- **Time delay:** 0 sec.
- **Delay power on:** 1 sec.
- **Delay break time:** 10.1 sec.
- **Span:** 100%
- **Offset:** 0mA
- **Factor:** 1.0
- **Overage:** 110% from Output Range (22mA or 11V)
- **Line break:** 0 (mA or V)
- **Underage:** 0 (mA or V)

(For configuration instructions refer to the installation booklet that is enclosed with the module or call our technical service department for more info).

![Figure 14. MCR-f-UI-DC module front face programming keypad](image)

![Figure 15. MCR-f-UI-DC Block Diagram](image)
Application Example

Pulse counting or frequency conversion is a common industrial application. These signals can originate from switches, encoders etc. Typically they measure the rotational speed of a motor or gear. There are also applications where a frequency transducer is used to measure flow from the digital signal generated from a turbine flow meter. Figure 16 shows a proximity switch that provides a +24 V dc signal used to measure the speed of the gear teeth. The pulse train generated by the switch can be used to calculate how fast the conveyor belt is moving.

Frequency or high speed counting PLC or DCS cards are used for such applications. These cards come in 2 or 4 channel configurations and are dedicated to a preset frequency input range (e.g. 0-10 kHz). These cards do not offer application flexibility and are very expensive.

The MCR-f... module offers complete application flexibility and displays (LCD display) the process input or output signal. Overall installed and operation cost can be saved using this universal frequency transducer.

The module is approved for Class 1 Div 2 (Groups A, B, C and D) installation without the need for an explosion proof or purged enclosure. This is a tremendous cost saving in hazardous area applications.

![Image of a conveyor belt with a proximity switch and a frequency transducer diagram]

Figure 16. Pulse Counting Application

Part Description/Number

MCR-f-UI-DC
Universal Frequency Transducer 2814605

Accessories
Power supply (120 V ac/24 V dc) 2811967
MCR-PS 120 AC/24 DC/650
### Table 1. Technical Specifications

**Frequency Inputs**
- **Frequency range**: 0.1 Hz to 120 kHz
- **Minimum input span**: 2 Hz (for optimal resolution)
- **Input sources**: PN, NPN transistor outputs
- **Sensor excitation**: ±15 V dc, ±25 mA
- **Input frequency/Response time/Resolution**: ±0.1 Hz ±120 kHz / ≤32 ms / ≥12 bit
- **Signal level**: ±1 V (0.1 Hz ... 120 kHz)
- **Max. 1 V (0.1 Hz ... 120 kHz)**
- **Max. 1 V (1.0 Hz ... 120 kHz)**
- **Max. 21 V ac/30 V dc**

**Pulse length**

**Current/Voltage Input**
- **Input signal**: 0 ... 10 V / 0 ... 20 mA
- **Cut-off frequency**: 10 Hz
- **Ascent time (10-90%)**: ≤25 ms

(For analog inputs)

**Output**
- **Output signal**: 0 ... 10 V / 0 ... 20 mA
- **Maximum output signal: current/voltage**: 25 mA / 20 mA / 20 mA / 0(4) mA / 0(4) mA
- **Load: current/voltage**: ≤500 Ω / ≥500 Ω
- **Zero and span adjustment**: ±25%
- **Switching output**: PNP transistor output, switches the supply voltage to terminal SW

**General Data**
- **Supply voltage**: 20 ... 30 V dc
- **Current consumption without load**: ≤60 mA (without switching output)
- **Transmission error**: ≤0.15% of range (typ. 0.1%)
- **Temperature coefficient**: ≤0.1% K (typ. 0.01% K)
- **Isolation voltage: input/power supply**: 1.5 kV, 50 Hz, 1 min.
- **Output/power supply**: 1.5 kV, 50 Hz, 1 min.
- **Protection circuit**: Transient protection, polarity protection
- **Ambient temperature range**: -20°C to +65°C (-4°F to +145°F)
- **Operation indicator**: LCD display
- **Control panel**: Membrane keypad with 3 keys and LCD
- **Type of connection**: Plug-in screw connection
- **Installation position/assembly**: Any/preferably horizontal
- **Dimensions (W / H / D) in mm**: 45 x 75 x 110
- **Conductor cross section**: 0.2 - 2.5 mm (AWG 24-14)
- **Approvals**: CE, UL/CUL recognition, Class 1, Div. 2 (groups A, B, C and D)
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Headquarters, U.S.
Phoenix Contact Inc.
P.O. Box 4100
Harrisburg, PA 17111-0100
Technical Support and Information: (800) 322-3225
Fax: (717) 948-3475
Fax-On-Demand: (800) 944-9901
Email: info@phoenixcon.com
Web Site: http://www.phoenixcontact.com

Headquarters, Canada
Phoenix Contact Ltd.
235 Watline Avenue
Mississauga, Ontario L4Z 1P3
Phone: (905) 890-2820
Fax: (905) 890-0180