EGE spol. s r.o.

**ELECTRICAL ENGINEERING DIVISION**

**Distribution Network Department**

# MCI P-01

## MULTIFREQUENCY CURRENT INJECTION

## DATASHEET


ELA T206.2 en (07/2020)


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# Multifrequency Current Injection

Multifrequency current injection module (MCI) is designed for automatic tuning of arc suppression coils (ASC) using a new multi-frequency method. The principle is based on injecting a multi-frequency current signal into the auxiliary power winding of an arc suppression coil and evaluating the voltage response.

Information about network characteristics as detuning of the arc suppression coil comparing to the actual earth capacitance of the network or network damping are always displayed during the injection process.

MCI module enables a cooperation with a superior controller (REG-DP(A)).

# Function

The main function of the current injection is provided by semiconductor converter which generates several current components of different amplitude, frequency and phase shift. The individual generated current components are merged into one multi-frequency signal.

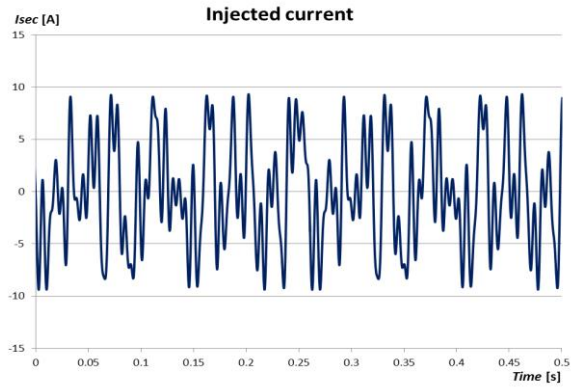


Figure 1: Current signal generated by MCI P-01

The resulting signal consists of up to 8 frequency components and it is injected into the power auxiliary winding (PAW) of the arc suppression coil. MCI measures voltage response of the network and it needs no additional voltage transformer.

Using a mathematical model of arc suppression coil, parameters of a distribution network are calculated. The measured and calculated values provide information about the status of tuning of the resonant circuit that is formed by the arc suppression coil and the network-earth capacitances.

MCI unit is primarily intended for cooperation with the superior REG-DP(A) controller via the serial interface RS-485 by MODBUS-RTU protocol. In case of communication loss, MCI can operate as an autonomous controller with limitations. Advantages of using REG-DP(A) controller together with MCI is well-arranged visualization of states, measured and calculated parameters of the distribution network and possibility of manual control and parameterization of MCI. MCI can be also connected to dispatching control system via REG-DP(A).

# Inputs/outputs

MCI can be operated in two modes. In the first one, all the binary electrical commands for the adjustment of the arc suppression coil (Up and Down), limit switches and potentiometer states are directly connected to MCI. If the communication with REG-DP(A) is lost, MCI can maintain the arc suppression coil tuned thanks to implemented simple control algorithms. It is not a full replacement of the controller, because there is no direct communication with the control system, no human machine interface and no possibility to modify MCI parameters.

In the second mode, all the ASC commands and states are connected to the REG-DP(A) controller. If the communication of MCI with the controller is lost, MCI cannot operate, but the controller can use the resonance method for ASC tuning, which may not work reliably in all situations.

# Measurement

All measurement circuits are implemented in the device, therefore MCI is not equipped with any measurement inputs for external measurements (converters, voltage and current transformers).

# Communication

MCI is equipped with the RS-485 interface using a MODBUS-RTU protocol for a communication with the superior system. MCI communicates in “SLAVE” mode. This connection is used for a transmission of control commands, states and measured values and parameterization.

Communication with superior system is possible through REG-DP(A) via protocols supported by regulator (e.g. standard IEC 60870-5-101/103/104, IEC 61850 and more)

# Technical parameters

### Power supply

| | |
|---|---|
| Power voltage | 230 V AC, +25%,-30% |
| Network frequency | 50 Hz |
| Power consumption: | <160 VA |
| Internal fuse type: | T1A / 250 V |
| Insulation level: | 4 kV |

### Power circuit

| | |
|---|---|
| Nominal voltage | 500 V AC |
| Max voltage during injection | 165 V rms |
| Network frequency | 50 Hz |
| Nominal current | 5 A rms |
| Frequency range of generated current components | 15–160 Hz (8 frequency components) |
| Operation time (Duty) | Continuous/short-term |

### Binary inputs

| | |
|---|---|
| Number of channels | 4 |
| Voltage level | 230 V AC, 50 Hz |
| Overload capacity | 120 % |
| Internal consumption | 1.5 mA |
| Insulation level | 4 kV |

### Binary outputs

| | |
|---|---|
| Number of channels | 4 |
| Relay contact NO (SPNO) | 3 x single pole |
| Relay contact NO/NC (SPDT) | 1 x single pole |
| Max. switching voltage | 250 V AC |
| Switching current | 8 A AC |
| Insulation level | 4 kV |

### Potentiometer input

| | |
|---|---|
| Potentiometer resistance | 150 Ω – 3 kΩ |
| Measuring voltage | 5 V DC |
| Insulation level | 4 kV |

### LEDs

| | |
|---|---|
| Number of LEDs | 6 |
| Type | 4x G/R<br>2x Y |

### Communication

| | |
|---|---|
| System communication | 2x RS-485 – FULL Duplex, RJ45 |
| Service communication | USB 2.0 type B |

### Ambient conditions

| | |
|---|---|
| Ambient temperature (operation) | -25…+65 °C |
| Ambient temperature (storage) | -45…+85 °C |
| Relative humidity | < 95 % non-condensing |

### Design

| | |
|---|---|
| Case | anodized aluminum |
| Case dimensions (W x H x D) | 210 x 310 x 130 mm |
| Total dimensions (W x H x D) | 260 x 360 x 141 mm |
| Mounting hole spacing | 170 x 330 mm or 230 x 270 mm |
| Weight | 10 kg |
| Mounting | panel mounting |
| Connectors | detachable, fixed with screws |
| Cooling | passive |

### Electrical safety

| | |
|---|---|
| Degree of pollution: | 2 |
| Safety class: | I |
| Over-voltage category: | II |
| IP code | IP2X |

# Typical connection of REG-DP(A) a MCI

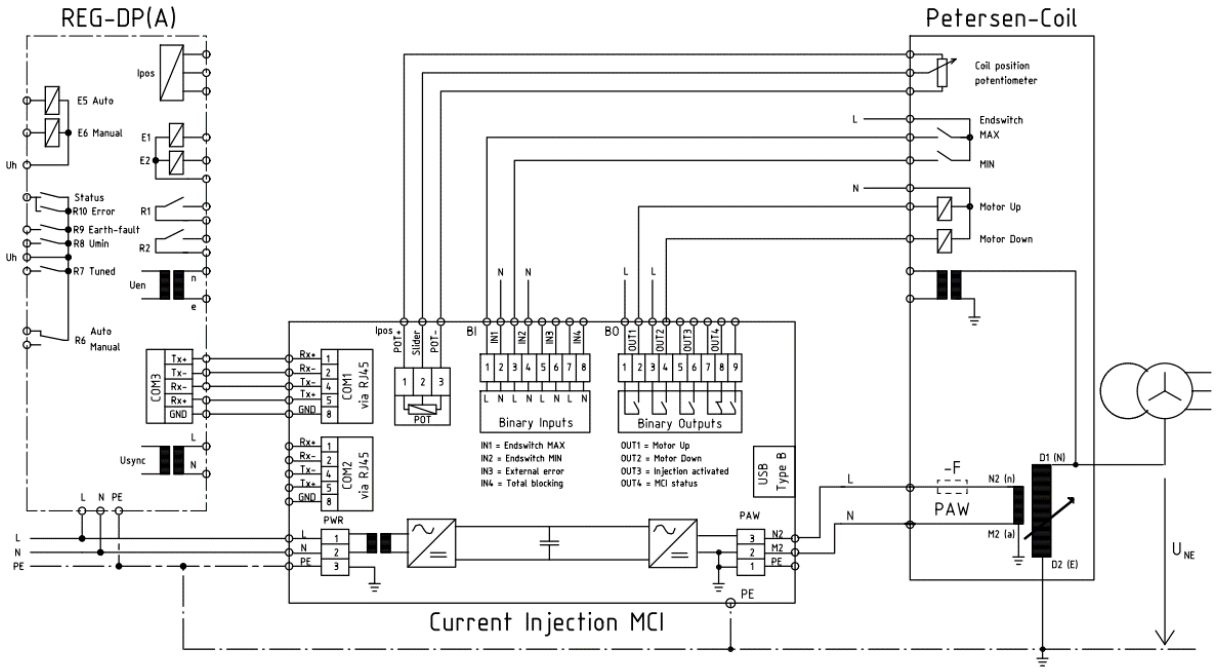


Figure 2: Typical connection for mode 1

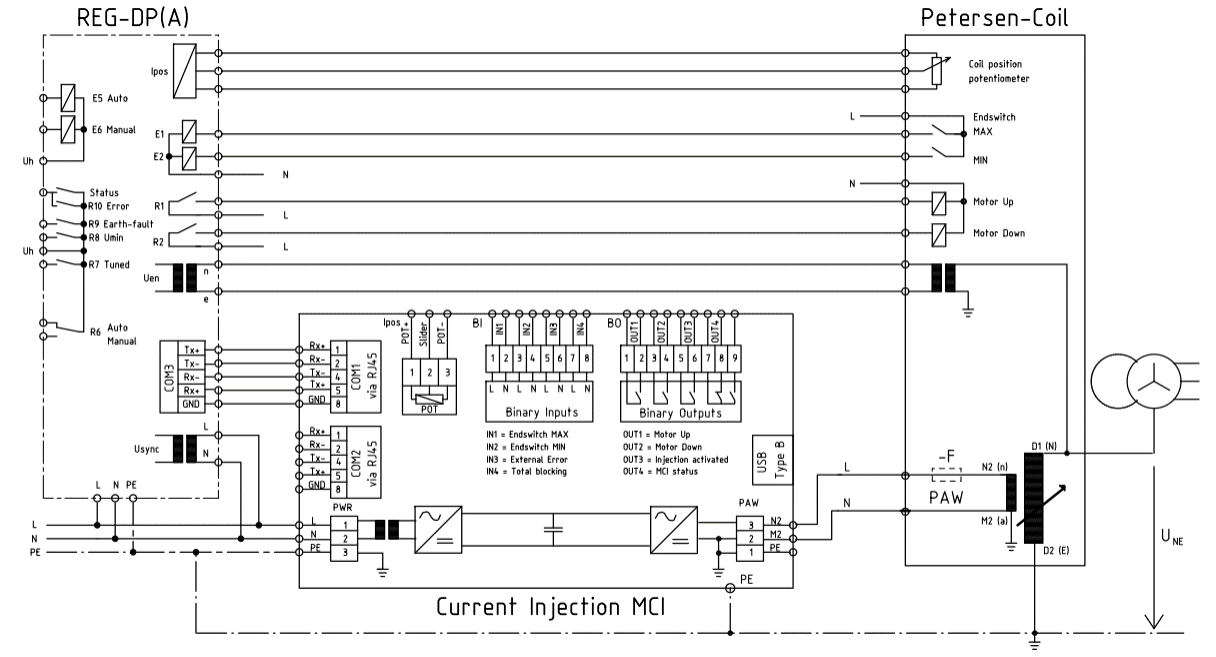


Figure 3: Typical connection for mode 2

It is recommended to use following cross-section of wires depending on length for connection of PAW connector to power auxiliary winding of ASC:

| Wire length | < 10 m | < 20 m | < 50 m | < 100 m | < 200 m |
|---|---|---|---|---|---|
| Minimum cross-section | 1.5 mm$^2$ | 2.5 mm$^2$ | 4 mm$^2$ | 6 mm$^2$ | 10 mm$^2$ |

It is not recommended to use wires longer than 200 m. Wires 1.5 mm$^2$ and 2.5 mm$^2$ are recommended only for installation inside of control box of ASC. Fuse according to the cable dimensioning.

# Dimensions of MCI and mounting holes

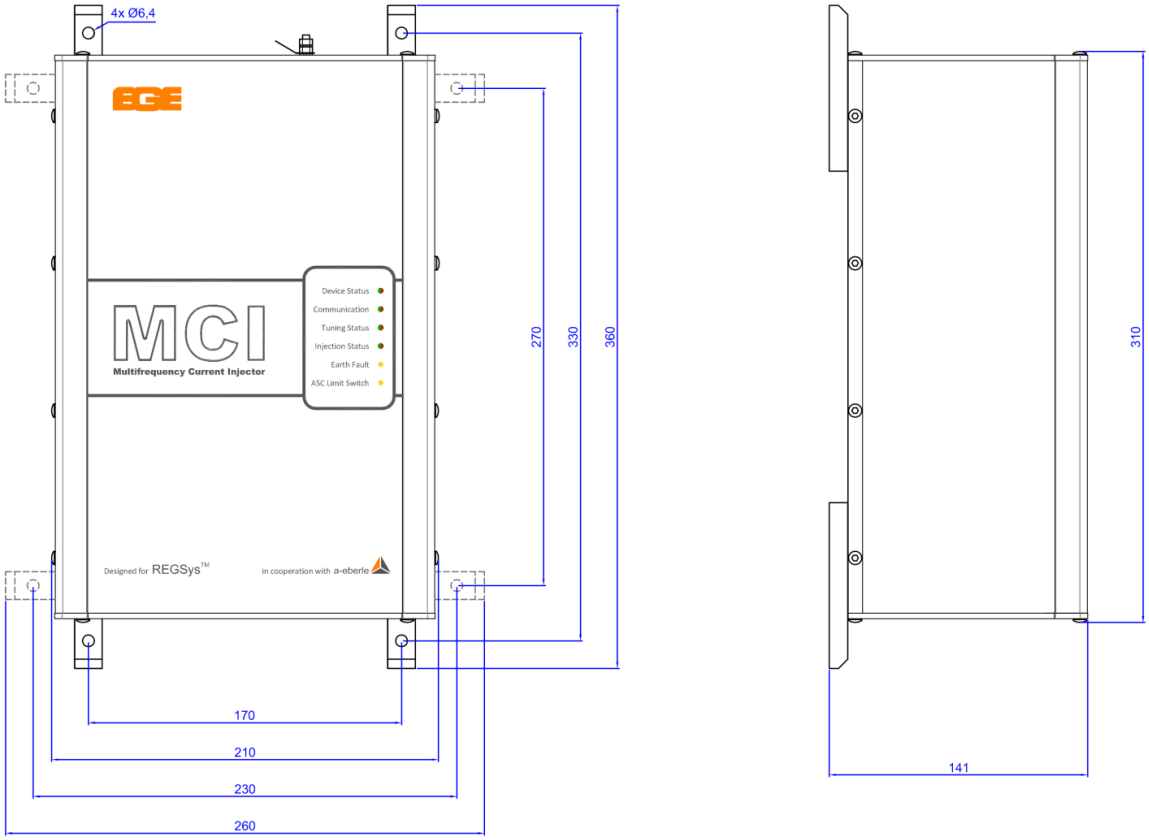


Figure 4: Basic MCI dimensions and layout of mounting holes

# Connectors

**Protective earth**
The M4 earthing pin (screw) on the top of the case is provided for protective grounding of MCI. FASTON connector 6.3 mm is also possible to use.

**Power supply – PWR**
External fuse: ≥ 2 A
Connector: GMSTB 2.5/ 3-STF-7.62, conductor cross section min/max: 0.7/2.5 mm2

| Pin | Marking | Function/Polarity | Description |
|---|---|---|---|
| 1 | **L** | Phase conductor | |
| 2 | **N** | Neutral conductor | |
| 3 | **PE** | Protective conductor | |

**Power circuit output – PAW**
External fuse: ≥ 10 A
Connector: GIC 2.5/ 3-STF-7.62, conductor cross section min/max: 1.5/2.5 $mm^2$

| Pin | Marking | Function/Polarity | Description |
|---|---|---|---|
| 1 | **PE** | Protective conductor | Internally connected to M2 |
| 2 | **M2** | Neutral conductor | Internally connected to PE |
| 3 | **N2** | Phase conductor | |

**Binary inputs – BI**
Connector: MSTB 2.5/ 8-STF, conductor cross section min/max: 0.7/2.5 mm$^2$

| Pin | Marking | Function/Polarity | Description (Default) |
|---|---|---|---|
| 1 | **IN1 - 1** | L | Programmable (End switch – max) |
| 2 | **IN1 - 2** | N | |
| 3 | **IN2 - 1** | L | Programmable (End switch – min) |
| 4 | **IN2 - 2** | N | |
| 5 | **IN3 - 1** | L | Programmable (External error) |
| 6 | **IN3 - 2** | N | |
| 7 | **IN4 - 1** | L | Programmable (Total blocking) |
| 8 | **IN4 - 2** | N | |

**Binary inputs – BO**
External fuse: ≤ 6 A AC
Connector: MSTB 2.5/ 9-STF, conductor cross section min/max: 0.7/2.5 mm$^2$

| Pin | Marking | Function/Polarity | Description (Default) |
|---|---|---|---|
| 1 | **OUT1 - COM** | | Programmable (Motor Up) |
| 2 | **OUT1 - NO** | | |
| 3 | **OUT2 - COM** | | Programmable (Motor Down) |
| 4 | **OUT2 - NO** | | |
| 5 | **OUT3 - COM** | | Programmable (Injection activated) |
| 6 | **OUT3 - NO** | | |
| 7 | **OUT4 - COM** | | Programmable (Status) |
| 8 | **OUT4 - NC** | | |
| 9 | **OUT4 - NO** | | |

**Potentiometer input – POT**
Connector: MSTB 2.5/ 3-STF, conductor cross section min/max: 0.7/2.5 mm$^2$

| Pin | Marking | Function/Polarity | Default |
|---|---|---|---|
| 1 | **POT+** | Potentiometer + | |
| 2 | **SLIDER** | Potentiometer value | |
| 3 | **POT-** | Potentiometer - | |

**Service communication connector – USB**
USB type B.

| Pin | Marking | Function | Description |
|---|---|---|---|
| 1 | **+5V** | Supply | |
| 2 | **D-** | Data | |
| 3 | **D+** | Data | |
| 4 | **GND** | Reference potential | Internally connected to PE |
| 5 | **Shield** | | Internally connected to PE |
| 6 | **Shield** | | Internally connected to PE |

**Communication connectors – COM1, COM2**
Connector: RJ45

| Pin | Marking | Function |
|---|---|---|
| 1 | **Rx+ (A)** | Data IN |
| 2 | **Rx- (B)** | Data IN |
| 4 | **Tx- (Z)** | Data OUT |
| 5 | **Tx+ (Y)** | Data OUT |
| 8 | **GND** | Reference potential |

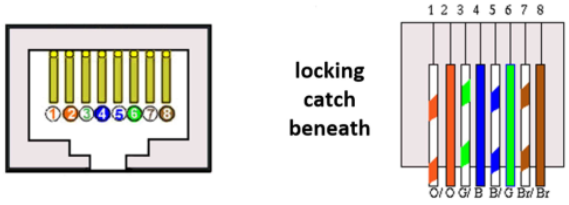


Figure 5: Socket (right) and plug (left) of communication

# Standard and laws

**Ambient conditions**

| | |
|---|---|
| Cold | IEC/EN 60068-2-1<br>- 40 °C / 16 h |
| Dry heat | IEC/EN 60068-2-2<br>65 °C / 16 h |
| Damp heat, cyclic | IEC/EN 60068-2-30<br>55 °C / 6 cycles / 95 % rel. humidity, non-cond. |
| Composite cyclic test | IEC/EN 60068-2-38<br>10 cycles |
| Altitude | <= 2000 m |
| IP code | IEC/EN 60529<br>IP20 |

**Vibration and seismic test**

| | |
|---|---|
| Vibration | IEC/EN 60255-21-1 |
| Shock and bump | IEC/EN 60255-21-2 |
| Seismic test | IEC/EN 60255-21-3 |

**EMC**

| | |
|---|---|
| 1MHz – burst disturbance | IEC/EN 60255-22-1<br>IEC/EN 61000-4-18<br>2,5kV asym., 1kV sym. |
| Electrostatic discharge | IEC/EN 60255-22-2<br>IEC/EN 61000-4-2<br>8kV contact, 15kV air |
| Radio frequency interference | IEC/EN 60255-22-3<br>IEC/EN 61000-4-3<br>80MHz - 1GHz / 10V/m<br>1,4GHz - 2,7GHz /10V/m |
| Fast transient disturbance | IEC/EN 60255-22-4<br>IEC/EN 61000-4-4<br>4kV, 5kHz or 100kHz, 2kV (communication) |
| Surge immunity | IEC/EN 60255-22-5<br>IEC/EN 61000-4-5<br>4kV L-PE, 2kV L-L |
| Radio frequency interference | IEC/EN 60255-22-6<br>IEC/EN 61000-4-6<br>150kHz - 80MHz, 10V |
| Power frequency immunity | IEC/EN 60255-22-7<br>150 V common mode, 300 V differential mode |
| Voltage dips | IEC/EN 60255-11<br>IEC/EN 61000-4-11<br>IEC/EN 61000-4-29<br>IEC/EN 61000-4-17<br>1 cycle/ 20 ms |
| Power frequency magnetic field immunity | IEC/EN 61000-4-8<br>30 A/m continually, 300 A/m 3s |
| Ring wave immunity | IEC/EN 61000-4-12<br>4kV L-PE, 2kV L – L |
| Emissions | IEC/EN 60255-25 |

**Safety**

| | |
|---|---|
| Safety requirements | IEC/EN 60255-27 |

Figure 6: Installation example of MCI P-01 inside of the ASC control box.


Figure 7: Example of MCI P-01 in a separate box for additional instalation to ASC.