USER GUIDE

EE210 - Humidity and Temperature Sensor for demanding Climate Control Applications

Find this document and further product information on our website at www.epluse.com/ee210.

GENERAL

The EE210 sensor which is available for wall or duct mounting, with remote probe as well as an outdoor version, is designed for highly accurate measurement of humidity and temperature in demanding climate control applications. The EE210 incorporates a state of the art E+E humidity and temperature sensing element.
For use in special applications do not hesitate to contact E+E Elektronik or a local distributor.

CAUTION

• For accurate measurement it is essential that the temperature of the probe and mainly of the sensing head is same as the temperature of the air to measure. Avoid mounting the sensor in a way which creates temperature gradients along the probe.
• The sensor and mainly the sensing head shall not be exposed to extreme mechanical stress.
• The sensor must be operated with the filter cap on at all times. Do not touch the sensing element inside the sensing head.
• While replacing the filter cap (because of pollution for instance) against an original spare one please take very good care to not touch the sensors.

SCOPE OF SUPPLY

<table>
<thead>
<tr>
<th>Model</th>
<th>EE210 Wall mount / Outdoor (Type T1/T13)</th>
<th>EE210 Duct mount (Type T2)</th>
<th>EE210 with remote probe (Type T3)*</th>
<th>PE210 Remote probe* for Type T3</th>
<th>Additionally for all EE210 with RS485 interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE210 according ordering guide</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cable gland</td>
<td>✓</td>
<td>✓</td>
<td>(2 pcs.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting materials</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting flange</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspection certificate according to DIN EN 10204-3.1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick Guide - EE210 RS485 Setup</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

* PE210 is not included in the Scope of Supply of the EE210 Type T3

ACCESSORIES

USB configuration adapter HA011066
Product configuration software EE-PCS (free download: www.epluse.com/ee210)
Radiation shield for EE210 Outdoor (Type T13) HA010501
Power supply adapter V03 (see data sheet Accessories)
Protection cap for 12 mm probe HA010783
DIMENSIONS / MOUNTING
Values in mm (inch)

Type T1

FOR CONDUIT INSTALLATION

CABLE GLAND M16x1.5

L = filter cap mm (inch)
Membrane 34 (1.4)
Stainless steel 33 (1.3)
Metal grid 33 (1.3)

Type T2

Mounting flange
In the scope of supply for Type T2 and T3

PE210

Type T3

Radiation Shield HA010501 for Type T13
(needs to be ordered separately)

EE210 with cable gland: Use a matching wrench to install the cable gland (in the scope of supply) onto the EE210 enclosure. EE210 with conduit connection for the North American market: use a flat screwdriver to knock open the blind, carefully, in order to avoid damaging the electronics inside the enclosure. The conduit adapter is not included in the scope of supply. The M16x1.5 opening for the cable gland shall be tightly closed using the blind plug included in the scope of supply.
Important note:
The manufacturer cannot be held responsible for personal injuries or damage to property as a result of incorrect handling, installation, wiring, power supply and maintenance of the device.

**EE210-M1xA6**

**Output:** 4-20 mA

Important: The EE210-M1xA6 (4...20 mA, 2-wire) with display operates correctly only if both outputs are connected.

**EE210-M1xA3**

**EE210-M1xA2/3/5**

**Output:** 0-5 V

**Output:** 0-10 V

**Output:** 0-20 mA

**EE210-M1xJ3**

**Power supply**
15...35 V DC
24 V AC ±20 %

Selection output signal U / I

**Bus termination resistor 120 Ω (jumper)**

**Important note:**
The PE210 (remote probe for EE210-M1T3x) shall be ordered and it is supplied as separate item. PE210 is to be connected to the EE210 by the user.

- Install first the cable gland (included in EE210 scope of supply) onto the EE210 enclosure.
- Before connecting the probe, disconnect the EE210 power supply.
- Insert the PE210 cable through the cable gland and connect it to the screw terminals according to the connection diagram below.

**PE210 for Type T3**

The PE210 is an intelligent probe with digital output and as such it is interchangeable. In case the probe or its cable gets destroyed or if a longer cable is needed, please order a replacement probe according to EE210 data sheet. The replacement probe shall be installed as described above.

Please note:

**Important:**
Make sure that the cable glands are closed tightly for both PE210 probe cable and for the power supply and outputs cable. This is necessary for assuring the protection class (IP class) of the enclosure according to EE210 specification, as well as for stress relief at the screw terminals on the EE210 board.
**LED INDICATION**

Green LED
Information during normal operation

on = everything OK

flashing = the main board does not recognize the
measurement electronics inside the RH probe

off = no power supply or main board failure

Blue LED
Information during setup with the optional USB
configuration adapter HA011066 and the EE-PCS
Product Configuration Software

on = USB stick connected to PC, no communication
with EE-PCS

flashing = communication in progress with EE-PCS

off = USB stick not connected to PC

**DISPLAY**

**Factory Setup:**
The display shows the two parameters selected for output 1 and output 2 (according to ordering
code). For digital output versions the display shows RH and T.

**User Setup:**
The user can change the display layout to 1, 2 or 3 lines and select the
parameters to be displayed by using EE-PCS Product Configuration Software (free download from
www.epluse.com/configurator) and the optional USB configuration adapter (not included in the
scope of supply).

**Important:** The EE210-M1xA6 (4...20 mA, 2-wire version) with display operates correctly only if
both outputs are connected.

**SELECTION OUTPUT SIGNAL U/I**
The factory setup of the output signal and scaling corresponds to the type number as ordered.
The output signal (voltage or current 3-wire) can be selected with the DIP switch on the main electronics board (see picture PCB
EE210-M1xA2/3/5). This does not impact on the scaling of the outputs, which can be changed using USB configuration adapter and
the EE-PCS.

**Examples**
Factory setup: voltage output 0 - 5 V or 0 - 10 V corresponds to 0…100%RH.
After switching from U to I: current output 0…20 mA corresponds to 0…100%RH.
A change of the current output range for instance to 4 - 20 mA (3-wire) can be made subsequently with the USB configuration adapter
and EE-PCS.

Factory setup: current output 0 - 20 mA corresponds to -10…50 °C.
After switching from I to U: voltage output 0 - 10 V corresponds to -10…50 °C.
A change of the voltage output range for instance to 0 - 5 V can be made subsequently with the USB configuration adapter and
EE-PCS.

**DIGITAL SETTINGS**

**HARDWARE BUS TERMINATION**
If required, the bus termination shall be realized with 120 Ohm resistor, jumper on the board.

* Jumper mounted = bus terminated
* Jumper not mounted = bus not terminated

**ADDRESS SWITCH**

**Address setting via EE-PCS Product Configuration Software**
All DIP switches at position 0 → address has to be set via
Product Configuration Software
Factory setting: 242 (permitted values: 1…247).
Example: Slave address is set via configuration software.

**Address setting via DIP switch**
Setting the DIP switches to any other address than 0, overrules the
slave address set via configuration software (permitted values: 1…247).
Example: Slave address set to 11 (= 0000 1011 binary).
### DIGITAL SETTINGS

<table>
<thead>
<tr>
<th>Factory settings</th>
<th>Selectable values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baud rate</strong></td>
<td>9600, 19200, 38400, 57600, 76800, 115200</td>
</tr>
<tr>
<td><strong>Data bits</strong></td>
<td>8</td>
</tr>
<tr>
<td><strong>Parity</strong></td>
<td>EVEN</td>
</tr>
<tr>
<td><strong>Stop bits</strong></td>
<td>1 or 2</td>
</tr>
<tr>
<td><strong>Slave address</strong></td>
<td>242</td>
</tr>
</tbody>
</table>

ID address, baud rate, parity and stop bits can be set via:
1. EE-PCS, Product Configuration Software and the appropriate configuration cable.
2. Modbus protocol in the register 60001 (0x00) and 60002 (0x01). See Application Note Modbus AN0103 (available on www.epluse.com/ee210)

The measured values are saved as a 32 bit float value and as 16 Bit signed integer, see the Modbus Register map below.
The firmware version is located at register address 30009 (bit 15..8 = major release; bit 7...0 = minor release). The sensor name is located at register address 30010.

### MODBUS REGISTER MAP

#### FLOAT 32 bit (read register):

<table>
<thead>
<tr>
<th>Function code / Register number</th>
<th>Register address</th>
<th>Parameter name</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30026</td>
<td>0x19</td>
<td>temperature</td>
<td>[°C], [°F]</td>
</tr>
<tr>
<td>30028</td>
<td>0x1B</td>
<td>relative humidity</td>
<td>[%]</td>
</tr>
<tr>
<td>30030</td>
<td>0x1D</td>
<td>water vapour partial pressure</td>
<td>[mbar], [psi]</td>
</tr>
<tr>
<td>30032</td>
<td>0x1F</td>
<td>dew point temperature</td>
<td>[°C], [°F]</td>
</tr>
<tr>
<td>30034</td>
<td>0x21</td>
<td>wet bulb temperature</td>
<td>[°C], [°F]</td>
</tr>
<tr>
<td>30036</td>
<td>0x23</td>
<td>absolute humidity</td>
<td>[g/m²], [gr/ft²]</td>
</tr>
<tr>
<td>30038</td>
<td>0x25</td>
<td>mixing ratio</td>
<td>[g/kg], [gr/lb]</td>
</tr>
<tr>
<td>30040</td>
<td>0x27</td>
<td>specific enthalpy</td>
<td>[kJ/kg], [BTU/lb]</td>
</tr>
<tr>
<td>30042</td>
<td>0x29</td>
<td>frost point temperature</td>
<td>[°C], [°F]</td>
</tr>
</tbody>
</table>

#### INTEGER 16 bit (read register):

<table>
<thead>
<tr>
<th>Function code / Register number</th>
<th>Register address</th>
<th>Parameter name</th>
<th>Unit</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>30031</td>
<td>0x12C</td>
<td>temperature</td>
<td>[°C], [°F]</td>
<td>100</td>
</tr>
<tr>
<td>30032</td>
<td>0x12D</td>
<td>relative humidity</td>
<td>[%]</td>
<td>100</td>
</tr>
<tr>
<td>30033</td>
<td>0x12E</td>
<td>water vapour partial pressure</td>
<td>[mbar], [psi]</td>
<td>100</td>
</tr>
<tr>
<td>30034</td>
<td>0x12F</td>
<td>dew point temperature</td>
<td>[°C], [°F]</td>
<td>100</td>
</tr>
<tr>
<td>30035</td>
<td>0x130</td>
<td>wet bulb temperature</td>
<td>[°C], [°F]</td>
<td>100</td>
</tr>
<tr>
<td>30036</td>
<td>0x131</td>
<td>absolute humidity</td>
<td>[g/m²], [gr/ft²]</td>
<td>100</td>
</tr>
<tr>
<td>30037</td>
<td>0x132</td>
<td>mixing ratio</td>
<td>[g/kg], [gr/lb]</td>
<td>100</td>
</tr>
<tr>
<td>30038</td>
<td>0x133</td>
<td>specific enthalpy</td>
<td>[kJ/kg], [BTU/lb]</td>
<td>100</td>
</tr>
<tr>
<td>30039</td>
<td>0x134</td>
<td>frost point temperature</td>
<td>[°C], [°F]</td>
<td>100</td>
</tr>
</tbody>
</table>

#### INTEGER 16 bit (read and write register):

<table>
<thead>
<tr>
<th>Function code / Register number</th>
<th>Register address</th>
<th>Parameter name</th>
</tr>
</thead>
<tbody>
<tr>
<td>60001</td>
<td>0x00</td>
<td>Slave-ID modbus address</td>
</tr>
<tr>
<td>60002</td>
<td>0x01</td>
<td>Modbus protocol settings</td>
</tr>
</tbody>
</table>

#### INFO (read register):

<table>
<thead>
<tr>
<th>Function code / Register number</th>
<th>Register address</th>
<th>Parameter name</th>
</tr>
</thead>
<tbody>
<tr>
<td>30001</td>
<td>0x00</td>
<td>Serial number (as ASCII)</td>
</tr>
<tr>
<td>30009</td>
<td>0x01</td>
<td>Firmware version</td>
</tr>
<tr>
<td>30010</td>
<td>0x09</td>
<td>Sensor Name</td>
</tr>
</tbody>
</table>

1) Register number starts from 1
2) Register address starts from 0
3) The choice of measurement units (metric or non-metric) must be done in the ordering guide, see EE210 data sheet. Switching from metric to non-metric or vice versa by using the EE-PCS is not possible.
4) 100 is scale 1:100 (2550 is equivalent to 25.5 °C)
5) If the ID is set via DIP-switch the response will be NAK
6) For Modbus protocol settings please see Application Note Modbus AN0103 (available on www.epluse.com/ee210)
READING EXAMPLE

Example of MODBUS RTU command for reading the temperature (float value) \( T = 24.270019 \, ^\circ C \) from the register 0x19:

Device EE210; slave ID 242 [F2 in Hex]

<table>
<thead>
<tr>
<th>Modbus ID address</th>
<th>Function code</th>
<th>Starting address Hi</th>
<th>Starting address Lo</th>
<th>No. of register Hi</th>
<th>No. of register Lo</th>
<th>CRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Request [Hex]:</td>
<td>F2 03</td>
<td>00</td>
<td>19</td>
<td>00</td>
<td>02</td>
<td>0F</td>
</tr>
</tbody>
</table>

Request [Hex]: F2 03 00 19 00 02 01 0F

<table>
<thead>
<tr>
<th>Modbus ID address</th>
<th>Function code</th>
<th>Byte count</th>
<th>Register 1 value Hi</th>
<th>Register 1 value Lo</th>
<th>Register 2 value Hi</th>
<th>Register 2 value Lo</th>
<th>CRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response [Hex]:</td>
<td>F2 03</td>
<td>04</td>
<td>29</td>
<td>00</td>
<td>41</td>
<td>C2</td>
<td>80  A1</td>
</tr>
</tbody>
</table>

Response [Hex]: F2 03 04 29 00 41 C2 80 A1

For decoding of float values (stored according standard IEEE754), please refer to AN0103, chapter 7.

Example of decoding:

<table>
<thead>
<tr>
<th>Value in decimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>24,270019</td>
</tr>
</tbody>
</table>

Technological Data

- RH accuracy\( ^1 \) (incl. hysteresis, non-linearity and repeatability)
- Type T1 (wall), T2 (duct):
  - \(-15...+40 \, ^\circ C \) (\(-5...+104 \, ^\circ F\))
  - \(\leq 90 \, %RH\)
  - \(\pm (1.3 + 0.003 \times \text{measured value}) \, %RH\)
  - \(>90 \, %RH\)
  - \(\pm 2.3 \, %RH\)
- Type T3 (remote):
  - at 20 \( ^\circ C \) (68 \( ^\circ F\))
  - \(\pm 2.5 \, %RH\)
- Type T13 (outdoor):
  - \(-15...+40 \, ^\circ C \) (\(-5...+104 \, ^\circ F\))
  - \(\leq 90 \, %RH\)
  - \(\pm (1.6 + 0.005 \times \text{measured value}) \, %RH\)
  - \(>90 \, %RH\)
  - \(\pm 3 \, %RH\)
- Type T13 (outdoor):
  - \(-40...+60 \, ^\circ C \) (\(-40...+140 \, ^\circ F\))
  - \(\pm (2.3 + 0.008 \times \text{measured value}) \, %RH\)

Temperature (T)

<table>
<thead>
<tr>
<th>T accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>± ( \Delta T ) [( ^\circ C )]</td>
</tr>
<tr>
<td>T [( ^\circ C )]</td>
</tr>
</tbody>
</table>

\( ^1 \) Traceable to intern. standards, administrated by NIST, PTB, BEV,... The accuracy statement includes the uncertainty of the factory calibration with an enhancement factor \( k=2 \) (2-times standard deviation). The accuracy was calculated in accordance with EA-4/02 and with regard to GUM (Guide to the Expression of Uncertainty in Measurement).

For Type T13: at 24 V DC and RL=250 for A6 versions.
## Calculated parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>From</th>
<th>Up to</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dew point temperature (Td)</td>
<td>-40</td>
<td>60</td>
<td>°C (°F)</td>
</tr>
<tr>
<td>Frost point temperature (Tf)</td>
<td>-40</td>
<td>0</td>
<td>°C (°F)</td>
</tr>
<tr>
<td>Wet bulb temperature (Tw)</td>
<td>0</td>
<td>60</td>
<td>°C (°F)</td>
</tr>
<tr>
<td>Water vapour partial pressure (e)</td>
<td>0</td>
<td>200</td>
<td>mbar (psi)</td>
</tr>
<tr>
<td>Mixing ratio (r)</td>
<td>0</td>
<td>160</td>
<td>g/kg (gr/lb)</td>
</tr>
<tr>
<td>Absolute humidity (dv)</td>
<td>0</td>
<td>150</td>
<td>g/m³ (gr/ft³)</td>
</tr>
<tr>
<td>Specific enthalpy (h)</td>
<td>-40</td>
<td>500</td>
<td>kJ/kg (BTU/lb)</td>
</tr>
</tbody>
</table>

## Outputs

### Analogue output

<table>
<thead>
<tr>
<th>Range</th>
<th>-1 mA &lt; I&lt;sub&gt;L&lt;/sub&gt; &lt; 1 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Supply</td>
<td>max. 12 mA; with display max. 23 mA</td>
</tr>
<tr>
<td>AC Supply</td>
<td>max. 34 mA&lt;sub&gt;rms&lt;/sub&gt;; with display max. 49 mA&lt;sub&gt;rms&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

### Digital output

- RS485 (BACnet MS/TP or Modbus RTU), EE210 = 1 unit load

## General

### Power supply (Class III)

- for 4 - 20 mA, 2-wire: 10 V + R<sub>L</sub> x 20 mA < V<sub>P</sub> < 30 V DC
- for Type T13: 24 V DC ±10 % recommended
- 0 - 20 mA (3-wire): R<sub>L</sub> ≤ 500 Ω recommended

### Current consumption at 24 V

- DC supply max. 12 mA; with display max. 23 mA
- AC supply max. 34 mA<sub>rms</sub>; with display max. 49 mA<sub>rms</sub>

### Current output

- 2-wire: DC supply max. 40 mA; with display max. 40 mA
- AC supply typ. 65 mA<sub>rms</sub>; with display max. 84 mA<sub>rms</sub>

- 3-wire: DC supply typ. 33 mA; with display max. 44 mA
- AC supply typ. 15 mA<sub>rms</sub>; with display max. 35 mA<sub>rms</sub>

### Display

- Available for Type T1/T2/T3
- 1, 2 or 3 lines, user configurable
- Optional with backlight

### Electrical connection

- Screw terminals, max. 1.5 mm<sup>2</sup>

### Enclosure material

- Polycarbonate, UL94 V-0 (with Display UL94HB) approved

### Protection rating

- IP65 / NEMA 4X

### Cable gland

- M16 x 1.5

### Probe cable (for PE210)

- PVC, Ø 4.3 mm, 4 x 0.25 mm<sup>2</sup>, Length: 1.5 or 3 m (4.9 or 9.8 ft)

### Electromagnetic compatibility

- EN 61326-1, EN 61326-2-3
- Industrial Environment, FCC Part15 Class A, ICES-003 Class A

### Temperature ranges

- **Without display**
  - Working: -40...60 °C (-40...140 °F) (-40...80 °C / -40...176 °F for probe PE210)
  - Storage: -40...60 °C (-40...140 °F)

- **With display**
  - Working: -20...50 °C (-4...122 °F) (-40...80 °C / -40...176 °F for probe PE210)
  - Storage: -20...60 °C (-4...140 °F)

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2) USA & Canada: class 2 supply required. max. supply voltage 30 V DC
3) For display operation with EE210-M1xA6 (4 - 20 mA, 2-wire) both outputs must be connected
SETUP AND ADJUSTMENT

The EE210 is ready to use and does not require any configuration by the user. The factory setup of EE210 corresponds to the type number ordered. For ordering guide please see data sheet at www.epluse.com/ee210. If needed, the user can change the factory setup by using the USB configuration adapter (HA011066) and the EE-PCS, Product Configuration Software.

The user can change the scaling and the analogue output signal, the digital settings and perform RH and T adjustment.

**Note:** The EE210 may not be connected to any additional power supply when using the USB configuration adapter HA011066.

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**EE-PCS PRODUCT CONFIGURATION SOFTWARE**

1. Download the EE-PCS Product Configuration Software from [www.epluse.com/configurator](http://www.epluse.com/configurator) and install it on the PC.
2. Connect the E+E device to the PC using the USB configuration adapter.
3. Start the EE-PCS software.
4. Follow the instructions on the EE-PCS opening page for scanning the ports and identifying the connected device.
5. Click on the desired setup or adjustment mode from the main EE-PCS menu on the left and follow the online instructions of the EE-PCS.

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**MAINTENANCE**

Humidity calibration and adjustment:

Depending on the application and the requirements of certain industries, there might arise the need for periodical humidity calibration (comparison with a reference) or adjustment (bringing the device in line with a reference).

- Calibration and adjustment at E+E Elektronik
  Calibration and/or adjustment can be performed in the E+E Elektronik calibration laboratory. For information on the E+E capabilities in ISO or accredited calibration please see [www.eplusecal.com](http://www.eplusecal.com).
- Calibration and adjustment by the user
  Depending on the level of accuracy required, the humidity reference can be:
  - Humor 20 Humidity Calibrator, please see [www.epluse.com](http://www.epluse.com).
  - Omniport30 handheld device, please see [www.epluse.com/omniport30](http://www.epluse.com/omniport30).
  - Calibrated salt solutions, please see [www.epluse.com/ee210](http://www.epluse.com/ee210).

Temperature calibration and adjustment:

Due to the outstanding protection of the Pt1000 temperature sensing element integrated in the E+E RH/T sensing element, a drift of the T measurement is rather unlikely. If adjustment seems necessary, although the user can perform a one or two point T adjustment with USB configuration adapter and EE-PCS against a reference of his choice, it is highly recommended to return the device to the manufacturer for this. The reasons rest on the difficulty of an accurate T calibration in the air. The calibration shall take into account the self-heating of EE210 with closed enclosure, in its real mounting position and in continuous operation, the impact of the output current and of the probe orientation to the self-heating, as well as the cooling effect of the air circulation in a climate chamber possibly used for calibration.

When employed in dusty, polluted environment:

- The filter cap shall be replaced once in a while with an E+E original one. A polluted filter cap causes longer response time of the device.
- If needed, the sensing head can be cleaned. For cleaning instructions please see [www.epluse.com/ee210](http://www.epluse.com/ee210).
EMC note USA (FCC):

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

EMC note Canada (ICES-003):

CAN ICES-3 (A) / NMB-3 (A)