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This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2004/108/EC) and concerning electrical equipment for use within specified voltage limits (Low-voltage directive 2006/95/EC). This conformity is the result of tests conducted by ABB in accordance with the product standards EN 50263 and EN 60255-26 for the EMC directive, and with the product standards EN 60255-1 and EN 60255-27 for the low voltage directive. The product is designed in accordance with the international standards of the IEC 60255 series.
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Section 1  Introduction

1.1  This manual

The point list manual describes the outlook and properties of the data points specific to the IED. The manual should be used in conjunction with the corresponding communication protocol manual.

1.2  Intended audience

This manual addresses the communication system engineer or system integrator responsible for pre-engineering and engineering for communication setup in a substation from an IED perspective.

The system engineer or system integrator must have a basic knowledge of communication in protection and control systems and thorough knowledge of the specific communication protocol.
1.3 Product documentation

1.3.1 Product documentation set

The engineering manual contains instructions on how to engineer the IEDs using the different tools in PCM600. The manual provides instructions on how to set up a PCM600 project and insert IEDs to the project structure. The manual also recommends a sequence for engineering of protection and control functions, LHMI functions as well as communication engineering for IEC 60870-5-103, IEC 61850 and DNP3.

The installation manual contains instructions on how to install the IED. The manual provides procedures for mechanical and electrical installation. The chapters are organized in chronological order in which the IED should be installed.

The commissioning manual contains instructions on how to commission the IED. The manual can also be used by system engineers and maintenance personnel for assistance during the testing phase. The manual provides procedures for checking of external circuitry and energizing the IED, parameter setting and configuration as
well as verifying settings by secondary injection. The manual describes the process of testing an IED in a substation which is not in service. The chapters are organized in chronological order in which the IED should be commissioned.

The operation manual contains instructions on how to operate the IED once it has been commissioned. The manual provides instructions for monitoring, controlling and setting the IED. The manual also describes how to identify disturbances and how to view calculated and measured power grid data to determine the cause of a fault.

The service manual contains instructions on how to service and maintain the IED. The manual also provides procedures for de-energizing, de-commissioning and disposal of the IED.

The application manual contains application descriptions and setting guidelines sorted per function. The manual can be used to find out when and for what purpose a typical protection function can be used. The manual can also be used when calculating settings.

The technical manual contains application and functionality descriptions and lists function blocks, logic diagrams, input and output signals, setting parameters and technical data sorted per function. The manual can be used as a technical reference during the engineering phase, installation and commissioning phase, and during normal service.

The communication protocol manual describes a communication protocol supported by the IED. The manual concentrates on vendor-specific implementations.

The point list manual describes the outlook and properties of the data points specific to the IED. The manual should be used in conjunction with the corresponding communication protocol manual.

### 1.3.2 Document revision history

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<th>History</th>
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<td>-/June 2012</td>
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### 1.3.3 Related documents

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<td>Application manual</td>
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<td>1MRK 505 278-UEN</td>
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### Documents related to REL650

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<th>Commissioning manual</th>
<th>Product Guide</th>
<th>Type test certificate</th>
<th>Application notes for Circuit Breaker Control</th>
</tr>
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### 650 series manuals

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1.4 Symbols and conventions

1.4.1 Symbols

The caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.

The information icon alerts the reader of important facts and conditions.

The tip icon indicates advice on, for example, how to design your project or how to use a certain function.

Although warning hazards are related to personal injury, it is necessary to understand that under certain operational conditions, operation of damaged equipment may result in degraded process performance leading to personal injury or death. Therefore, comply fully with all warning and caution notices.

1.4.2 Document conventions

A particular convention may not be used in this manual.

- Abbreviations and acronyms in this manual are spelled out in the glossary. The glossary also contains definitions of important terms.
- Push button navigation in the LHMI menu structure is presented by using the push button icons.
  To navigate between the options, use [1] and [2].
- HMI menu paths are presented in bold.
  Select **Main menu/Settings**.
- LHMI messages are shown in Courier font.
  To save the changes in non-volatile memory, select **Yes** and press [3].
- Parameter names are shown in italics.
The function can be enabled and disabled with the *Operation* setting.

- The ^ character in front of an input or output signal name in the function block symbol given for a function, indicates that the user can set an own signal name in PCM600.
- The * character after an input or output signal name in the function block symbol given for a function, indicates that the signal must be connected to another function block in the application configuration to achieve a valid application configuration.

### 1.4.3 Functions included in 650 series IEDs

#### Table 1: Main protection functions

<table>
<thead>
<tr>
<th>IEC 61850 / Function block name</th>
<th>ANSI</th>
<th>Function description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Differential protection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T2WPDIF</td>
<td>87T</td>
<td>Transformer differential protection, two winding</td>
</tr>
<tr>
<td>T3WPDIF</td>
<td>87T</td>
<td>Transformer differential protection, three winding</td>
</tr>
<tr>
<td>REFPDIF</td>
<td>87N</td>
<td>Restricted earth fault protection, low impedance</td>
</tr>
<tr>
<td>H2PDIF</td>
<td>87</td>
<td>1Ph High impedance differential protection</td>
</tr>
<tr>
<td>GENPDIF</td>
<td>87G</td>
<td>Generator differential protection</td>
</tr>
<tr>
<td><strong>Impedance protection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZQMPDIS</td>
<td>21</td>
<td>Five-zone distance protection, Quadrilateral and Mho characteristic</td>
</tr>
<tr>
<td>FDPSPDIS</td>
<td>21</td>
<td>Phase selection with load enchroachment, quadrilateral characteristic</td>
</tr>
<tr>
<td>FMPSPDIS</td>
<td>21</td>
<td>Faulty phase identification with load enchroachment for mho</td>
</tr>
<tr>
<td>ZDARDIR</td>
<td>21</td>
<td>Additional distance protection directional function for earth faults</td>
</tr>
<tr>
<td>ZDNRDIR</td>
<td>21</td>
<td>Directional impedance quadrilateral and mho</td>
</tr>
<tr>
<td>PPLPHIZ</td>
<td></td>
<td>Phase preference logic</td>
</tr>
<tr>
<td>ZMRPSB</td>
<td>68</td>
<td>Power swing detection</td>
</tr>
<tr>
<td>ZCVPSONF</td>
<td></td>
<td>Automatic switch onto fault logic, voltage-and current-based</td>
</tr>
<tr>
<td>ZGCPDIS</td>
<td>21G</td>
<td>Underimpedance protection for generators and transformers</td>
</tr>
<tr>
<td>LEXPDIS</td>
<td>40</td>
<td>Loss of excitation</td>
</tr>
<tr>
<td>OOSPPAM</td>
<td>78</td>
<td>Out-of-step protection</td>
</tr>
<tr>
<td>LEPDIS</td>
<td></td>
<td>Load enchroachment</td>
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#### Table 2: Backup protection functions

<table>
<thead>
<tr>
<th>IEC 61850 / Function block name</th>
<th>ANSI</th>
<th>Function description</th>
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<tbody>
<tr>
<td><strong>Current protection</strong></td>
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<td></td>
</tr>
<tr>
<td>PHIIOC</td>
<td>50</td>
<td>Instantaneous phase overcurrent protection</td>
</tr>
<tr>
<td>SPTPIOC</td>
<td>50</td>
<td>Instantaneous phase overcurrent protection</td>
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</table>

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<thead>
<tr>
<th>IEC 61850 / Function block name</th>
<th>ANSI</th>
<th>Function description</th>
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<tr>
<td>OC4PTOC</td>
<td>51/67</td>
<td>Four-step phase overcurrent protection</td>
</tr>
<tr>
<td>OC4SPTOC</td>
<td>51/67</td>
<td>Four-step phase overcurrent protection</td>
</tr>
<tr>
<td>EFPIOC</td>
<td>50N</td>
<td>Instantaneous residual overcurrent protection</td>
</tr>
<tr>
<td>EF4PTOC</td>
<td>51N/67</td>
<td>Four-step directional residual overcurrent protection</td>
</tr>
<tr>
<td>SDEPSDE</td>
<td>67N</td>
<td>Sensitive directional residual overcurrent and power protection</td>
</tr>
<tr>
<td>UC2PTUC</td>
<td>37</td>
<td>Time-delayed two-step undercurrent protection</td>
</tr>
<tr>
<td>LCPTTR</td>
<td>26</td>
<td>Thermal overload protection, one time constant, Celsius</td>
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<tr>
<td>LFPTTR</td>
<td>26</td>
<td>Thermal overload protection, one time constant, Fahrenheit</td>
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<tr>
<td>TRPTTR</td>
<td>49</td>
<td>Thermal overload protection, two time constants</td>
</tr>
<tr>
<td>CCRBRF</td>
<td>50BF</td>
<td>Breaker failure protection</td>
</tr>
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<td>CSPRBRF</td>
<td>50BF</td>
<td>Breaker failure protection</td>
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<td>STBPTOC</td>
<td>50STB</td>
<td>Stub protection</td>
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<tr>
<td>CCRPLD</td>
<td>52PD</td>
<td>Pole discordance protection</td>
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<td>BRCPTOC</td>
<td>46</td>
<td>Broken conductor check</td>
</tr>
<tr>
<td>GUPPDUP</td>
<td>37</td>
<td>Directional underpower protection</td>
</tr>
<tr>
<td>GOPPDOP</td>
<td>32</td>
<td>Directional overpower protection</td>
</tr>
<tr>
<td>DNSPTOC</td>
<td>46</td>
<td>Negative sequence-based overcurrent function</td>
</tr>
<tr>
<td>AEGGAPC</td>
<td>50AE</td>
<td>Accidental energizing protection for synchronous generator</td>
</tr>
<tr>
<td>NS2PTOC</td>
<td>46I2</td>
<td>Negative-sequence time overcurrent protection for machines</td>
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<tr>
<td>VR2PVOC</td>
<td>51V</td>
<td>Voltage-restrained time overcurrent protection</td>
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**Voltage protection**

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<td>27</td>
<td>Two-step undervoltage protection</td>
</tr>
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<td>OV2PTOV</td>
<td>59</td>
<td>Two-step overvoltage protection</td>
</tr>
<tr>
<td>ROV2PTOV</td>
<td>59N</td>
<td>Two-step residual overvoltage protection</td>
</tr>
<tr>
<td>OEXPVPH</td>
<td>24</td>
<td>Overexcitation protection</td>
</tr>
<tr>
<td>LOVPTUV</td>
<td>27</td>
<td>Loss-of-voltage check</td>
</tr>
<tr>
<td>STEFPHIZ</td>
<td>59THD</td>
<td>100% Stator earth fault protection, 3rd harmonic based</td>
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**Frequency protection**

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<td>SAPTUF</td>
<td>81</td>
<td>Underfrequency function</td>
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<tr>
<td>SAPTOF</td>
<td>81</td>
<td>Overfrequency function</td>
</tr>
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<td>SAPFRC</td>
<td>81</td>
<td>Rate-of-change frequency protection</td>
</tr>
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<td>IEC 61850 / Function block name</td>
<td>ANSI</td>
<td>Function description</td>
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<td>---------------------------------------</td>
</tr>
<tr>
<td>SESRSYN</td>
<td>25</td>
<td>Synchrocheck, energizing check and synchronizing</td>
</tr>
<tr>
<td>SMBRREC</td>
<td>79</td>
<td>Autorecloser</td>
</tr>
<tr>
<td>STBRREC</td>
<td>79</td>
<td>Autorecloser</td>
</tr>
<tr>
<td>SCILO</td>
<td>3</td>
<td>Logical node for interlocking</td>
</tr>
<tr>
<td>BB_ES</td>
<td>3</td>
<td>Interlocking for busbar earthing switch</td>
</tr>
<tr>
<td>A1A2_BS</td>
<td>3</td>
<td>Interlocking for bus-section breaker</td>
</tr>
<tr>
<td>A1A2_DC</td>
<td>3</td>
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<tr>
<td>ABC_BC</td>
<td>3</td>
<td>Interlocking for bus-coupler bay</td>
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<tr>
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<td>Interlocking for 1 1/2 breaker diameter</td>
</tr>
<tr>
<td>BH_LINE_A</td>
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<td>Interlocking for 1 1/2 breaker diameter</td>
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<td>BH_LINE_B</td>
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<td>Interlocking for 1 1/2 breaker diameter</td>
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<tr>
<td>DB_BUS_A</td>
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<td>Interlocking for double CB bay</td>
</tr>
<tr>
<td>DB_BUS_B</td>
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<td>Interlocking for double CB bay</td>
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<tr>
<td>DB_LINE</td>
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<td>Interlocking for double CB bay</td>
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<td>ABC_LINE</td>
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<td>Interlocking for line bay</td>
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<td>AB_TRAFO</td>
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<td>Interlocking for transformer bay</td>
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<tr>
<td>SCSWI</td>
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<td>Switch controller</td>
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<tr>
<td>SXCBR</td>
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<td>Circuit breaker</td>
</tr>
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<td>SXSWI</td>
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<td>Circuit switch</td>
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<tr>
<td>POS_EVAL</td>
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<td>Evaluation of position indication</td>
</tr>
<tr>
<td>SELGGIO</td>
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<td>Select release</td>
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<tr>
<td>QCBAY</td>
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<td>Bay control</td>
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<tr>
<td>LOCREM</td>
<td></td>
<td>Handling of LR-switch positions</td>
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<tr>
<td>LOCREMCTRL</td>
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<td>LHMI control of PSTO</td>
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<td>TR8ATCC</td>
<td>90</td>
<td>Automatic voltage control for tap changer, parallel control</td>
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<tr>
<td>TCMYLTCA</td>
<td>84</td>
<td>Tap changer control and supervision, 6 binary inputs</td>
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<tr>
<td>SLGGIO</td>
<td></td>
<td>Logic-rotating Switch for function selection and LHMI presentation</td>
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<tr>
<td>VSGGIO</td>
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<td>Selector mini switch extension</td>
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<tr>
<td>DPGGIO</td>
<td></td>
<td>IEC61850 generic communication I/O functions double point</td>
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<tr>
<td>SPC8GGIO</td>
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<td>Single-point generic control 8 signals</td>
</tr>
<tr>
<td>AUTOBITS</td>
<td></td>
<td>AutomationBits, command function for DNP3.0</td>
</tr>
<tr>
<td>I103CMD</td>
<td></td>
<td>Function commands for IEC60870-5-103</td>
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<tr>
<td>I103IEDCMD</td>
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<td>IED commands for IEC60870-5-103</td>
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<td>I103USRCMD</td>
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<td>Function commands user defined for IEC60870-5-103</td>
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<td>Function commands generic for IEC60870-5-103</td>
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<tr>
<td>I103POSCMD</td>
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<td>IED commands with position and select for IEC60870-5-103</td>
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<table>
<thead>
<tr>
<th>IEC 61850 / Function block name</th>
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<th>Function description</th>
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<tbody>
<tr>
<td><strong>Secondary system supervision</strong></td>
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<tr>
<td>CCSRDIF</td>
<td>87</td>
<td>Current circuit supervision</td>
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<tr>
<td>SDDRFUF</td>
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<td>Fuse failure supervision</td>
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<tr>
<td>TCSCCBR</td>
<td></td>
<td>Breaker close/trip circuit monitoring</td>
</tr>
<tr>
<td><strong>Logic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMPPTRC</td>
<td>94</td>
<td>Tripping logic</td>
</tr>
<tr>
<td>SPTPTRC</td>
<td>94</td>
<td>Tripping logic</td>
</tr>
<tr>
<td>TMAGGIO</td>
<td></td>
<td>Trip matrix logic</td>
</tr>
<tr>
<td>OR</td>
<td></td>
<td>Configurable logic blocks, OR</td>
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<tr>
<td>INVERTER</td>
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<td>Configurable logic blocks, Inverter</td>
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<tr>
<td>PULSETIMER</td>
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<td>Configurable logic blocks, PULSETIMER</td>
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<td>GATE</td>
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<td>Configurable logic blocks, Controllable gate</td>
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<td>XOR</td>
<td></td>
<td>Configurable logic blocks, exclusive OR</td>
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<tr>
<td>LOOPDELAY</td>
<td></td>
<td>Configurable logic blocks, loop delay</td>
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<tr>
<td>TimerSet</td>
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<td>Configurable logic blocks, timer</td>
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<tr>
<td>AND</td>
<td></td>
<td>Configurable logic blocks, AND</td>
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<tr>
<td>SRMEMORY</td>
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<td>Configurable logic blocks, set-reset memory</td>
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<tr>
<td>RSMEMORY</td>
<td></td>
<td>Configurable logic blocks, reset-set memory</td>
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<tr>
<td>FXDSIGN</td>
<td></td>
<td>Fixed-signal function block</td>
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<tr>
<td>B16I</td>
<td></td>
<td>Boolean 16 to Integer conversion</td>
</tr>
<tr>
<td>B16FCVI</td>
<td></td>
<td>Boolean 16 to Integer conversion with logic node representation</td>
</tr>
<tr>
<td>IB16A</td>
<td></td>
<td>Integer to Boolean 16 conversion</td>
</tr>
<tr>
<td>IB16FCVB</td>
<td></td>
<td>Integer to boolean 16 conversion with logic node representation</td>
</tr>
<tr>
<td><strong>Monitoring</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CVMMXN</td>
<td></td>
<td>Measurements</td>
</tr>
<tr>
<td>CMMXU</td>
<td></td>
<td>Phase current measurement</td>
</tr>
<tr>
<td>VMMXU</td>
<td></td>
<td>Phase-phase voltage measurement</td>
</tr>
<tr>
<td>CMSQI</td>
<td></td>
<td>Current sequence component measurement</td>
</tr>
<tr>
<td>VMSQI</td>
<td></td>
<td>Voltage sequence measurement</td>
</tr>
<tr>
<td>VNMMXU</td>
<td></td>
<td>Phase-neutral voltage measurement</td>
</tr>
<tr>
<td>AISVBAS</td>
<td></td>
<td>Function block for service values presentation of the analog inputs</td>
</tr>
<tr>
<td>TM_P_P2</td>
<td></td>
<td>Function block for service value presentation of primary analog inputs 600TRM</td>
</tr>
<tr>
<td>AM_P_P4</td>
<td></td>
<td>Function block for service value presentation of primary analog inputs 600AIM</td>
</tr>
<tr>
<td>TM_S_P2</td>
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<td>Function block for service value presentation of secondary analog inputs 600TRM</td>
</tr>
<tr>
<td>AM_S_P4</td>
<td></td>
<td>Function block for service value presentation of secondary analog inputs 600AIM</td>
</tr>
<tr>
<td>CNTGGIO</td>
<td></td>
<td>Event counter</td>
</tr>
<tr>
<td>DRPRDRE</td>
<td></td>
<td>Disturbance report</td>
</tr>
<tr>
<td>AxRADR</td>
<td></td>
<td>Analog input signals</td>
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### IEC 61850 / Function block name

<table>
<thead>
<tr>
<th>Function Description</th>
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<tbody>
<tr>
<td>BxRBDR: Binary input signals</td>
</tr>
<tr>
<td>SPGGIO: IEC61850 generic communication I/O functions</td>
</tr>
<tr>
<td>SP16GGIO: IEC61850 generic communication I/O functions 16 inputs</td>
</tr>
<tr>
<td>MVGGIO: IEC61850 generic communication I/O functions</td>
</tr>
<tr>
<td>MVEXP: Measured value expander block</td>
</tr>
<tr>
<td>LMBRFLO: Fault locator</td>
</tr>
<tr>
<td>SPVNZBAT: Station battery supervision</td>
</tr>
<tr>
<td>SSIMG: Insulation gas-monitoring function</td>
</tr>
<tr>
<td>SSIML: Insulation liquid-monitoring function</td>
</tr>
<tr>
<td>SSCBR: Circuit breaker condition monitoring</td>
</tr>
<tr>
<td>I103MEAS: Measurands for IEC60870-5-103</td>
</tr>
<tr>
<td>I103MEASUSR: Measurands user defined signals for IEC60870-5-103</td>
</tr>
<tr>
<td>I103AR: Function status auto-recloser for IEC60870-5-103</td>
</tr>
<tr>
<td>I103EF: Function status earth-fault for IEC60870-5-103</td>
</tr>
<tr>
<td>I103FLTPROT: Function status fault protection for IEC60870-5-103</td>
</tr>
<tr>
<td>I103IED: IED status for IEC60870-5-103</td>
</tr>
<tr>
<td>I103SUPERV: Supervision status for IEC60870-5-103</td>
</tr>
<tr>
<td>I103USRDEF: Status for user defined signals for IEC60870-5-103</td>
</tr>
<tr>
<td><strong>Metering</strong></td>
</tr>
<tr>
<td>PCGGIO: Pulse counter logic</td>
</tr>
<tr>
<td>ETPMMTR: Function for energy calculation and demand handling</td>
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### Designed to communicate

<table>
<thead>
<tr>
<th>IEC 61850 / Function block name</th>
<th>ANSI</th>
<th>Function Description</th>
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<tbody>
<tr>
<td><strong>Station communication</strong></td>
<td></td>
<td>IEC61850 communication protocol</td>
</tr>
<tr>
<td>IEC61850-8-1</td>
<td></td>
<td>IEC61850 communication protocol</td>
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<tr>
<td>DNP3.0 for serial communication EIA485</td>
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<td></td>
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<tr>
<td>DNP3.0 for TCP/IP communication protocol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DNP3.0 fault records for TCP/IP communication protocol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DNP3.0 for TCP/IP communication protocol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DNP3.0 for TCP/IP communication protocol</td>
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<td></td>
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<tr>
<td>DNP3.0 for serial communication protocol</td>
<td></td>
<td></td>
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<tr>
<td>DNP3.0 for optical RS-232 communication protocol</td>
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<tr>
<td>RS485</td>
<td></td>
<td></td>
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<tr>
<td>Operation selection for optical serial</td>
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<td></td>
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<tr>
<td>Operation selection for RS485</td>
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<td></td>
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<tr>
<td>DNP3.0 fault records for TCP/IP communication protocol</td>
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<tr>
<td>IEC60870-5-103 Optical serial communication</td>
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<tr>
<td>IEC60870-5-103 serial communication for RS485</td>
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<td></td>
</tr>
<tr>
<td>Horizontal communication via GOOSE for interlocking</td>
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### IEC 61850 / Function block name

<table>
<thead>
<tr>
<th>Function block name</th>
<th>ANSI</th>
<th>Function description</th>
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<tr>
<td>GOOSEBINRCV</td>
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<td>GOOSE binary receive</td>
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<tr>
<td>GOOSEVCTRCONF</td>
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<td>GOOSE VCTR configuration for send and receive</td>
</tr>
<tr>
<td>VCTRSEND</td>
<td></td>
<td>Voltage control sending block for GOOSE</td>
</tr>
<tr>
<td>GOOSEVCTRRCV</td>
<td></td>
<td>Voltage control receiving block for GOOSE</td>
</tr>
<tr>
<td>ETHFRNT ETHLAN1 GATEWAY</td>
<td></td>
<td>Ethernet configuration of front port, LAN1 port and gateway</td>
</tr>
<tr>
<td>GOOSEDPRCV</td>
<td></td>
<td>GOOSE function block to receive a double point value</td>
</tr>
<tr>
<td>GOOSEINTRCV</td>
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<td>GOOSE function block to receive an integer value</td>
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<tr>
<td>GOOSEMVRCV</td>
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<td>GOOSE function block to receive a measurand value</td>
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<tr>
<td>GOOSESPRCV</td>
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<td>GOOSE function block to receive a single point value</td>
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### Scheme communication

<table>
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<tr>
<th>Function block name</th>
<th>Value</th>
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<tbody>
<tr>
<td>ZCPSCH</td>
<td>85</td>
<td>Scheme communication logic with delta based blocking scheme signal transmit</td>
</tr>
<tr>
<td>ZCRWPSCH</td>
<td>85</td>
<td>Current reversal and weak end infeed logic for distance protection</td>
</tr>
<tr>
<td>ZCWSPSCH</td>
<td>85</td>
<td>Current reversal and weak end infeed logic for distance protection</td>
</tr>
<tr>
<td>ZCLCPLAL</td>
<td></td>
<td>Local acceleration logic</td>
</tr>
<tr>
<td>ECPSCH</td>
<td>85</td>
<td>Scheme communication logic for residual overcurrent protection</td>
</tr>
<tr>
<td>ECRWPSCH</td>
<td>85</td>
<td>Current reversal and weak end infeed logic for residual overcurrent protection</td>
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### Table 5: Basic IED functions

<table>
<thead>
<tr>
<th>Function block name</th>
<th>Function description</th>
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<tbody>
<tr>
<td>Basic functions included in all products</td>
<td></td>
</tr>
<tr>
<td>INTERRSIG</td>
<td>Self-supervision with internal event list</td>
</tr>
<tr>
<td>SELFSUPEVLST</td>
<td>Self-supervision with internal event list</td>
</tr>
<tr>
<td>TIMESYNCHGEN</td>
<td>Time synchronization</td>
</tr>
<tr>
<td>SNTP</td>
<td>Time synchronization</td>
</tr>
<tr>
<td>DTSBEGIN</td>
<td>Time synchronization</td>
</tr>
<tr>
<td>DTSEND</td>
<td>Time synchronization</td>
</tr>
<tr>
<td>TIMEZONE</td>
<td>Time synchronization</td>
</tr>
<tr>
<td>IRIG-B</td>
<td>Time synchronization</td>
</tr>
<tr>
<td>SETGRPS</td>
<td>Setting group handling</td>
</tr>
<tr>
<td>ACTVGRP</td>
<td>Parameter setting groups</td>
</tr>
<tr>
<td>TESTMODE</td>
<td>Test mode functionality</td>
</tr>
<tr>
<td>CHNGLCK</td>
<td>Change lock function</td>
</tr>
<tr>
<td>ATHSTAT</td>
<td>Authority status</td>
</tr>
<tr>
<td>ATHCHCK</td>
<td>Authority check</td>
</tr>
<tr>
<td>TERMINALID</td>
<td>IED identifiers</td>
</tr>
<tr>
<td>PRODINF</td>
<td>Product information</td>
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<table>
<thead>
<tr>
<th>IEC 61850 / Function block name</th>
<th>Function description</th>
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<tbody>
<tr>
<td>PRIMVAL</td>
<td>Primary system values</td>
</tr>
<tr>
<td>SMAI_20_1 - SMAI_20_12</td>
<td>Signal Matrix for analog inputs</td>
</tr>
<tr>
<td>3PHSUM</td>
<td>Summation block 3 phase</td>
</tr>
<tr>
<td>GBASVAL</td>
<td>Global base values for settings</td>
</tr>
<tr>
<td>DOSFRNT</td>
<td>Denial of service, frame rate control for front port</td>
</tr>
<tr>
<td>DOSLAN1</td>
<td>Denial of service, frame rate control for LAN1 port</td>
</tr>
<tr>
<td>DOSSCKT</td>
<td>Denial of service, socket flow control</td>
</tr>
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</table>
Section 2  

DNP3 data mappings

2.1 Overview

This document describes the DNP3 data points and structures available in REC650/REB650/REG650/REL650/REQ650/RET650 Ver. 1.2. The data points are unmapped as a default. The point lists describe a superset of all data available including the optional functionalities.

The point tables show all the available DNP3 data points in these IEDs. The DNP3 points can be freely added, removed, reorganized and reconfigured using PCM600.

As a default, the class assignments are Class 0 and Class 3 for binary inputs and outputs and for double bit indications. The class assignment for analog inputs and for counters are Class 0 and Class 2. Analog values are provided with default scalings. The scalings can be freely modified.

This list represents the superset of DNP3 points. The actual set of available points depends on the product, optional functionalities and configuration.

The point list table only shows the signals of the first instance of each function if more than one instance of a function can be configured.

See the engineering manual and DNP3 communication protocol manual for more information.

2.2 Point list for the 650 series IEDs

<table>
<thead>
<tr>
<th>Function name</th>
<th>Signal type</th>
<th>Signal name</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Hardware input and output monitoring</td>
<td>Binary inputs</td>
<td>BIO_3; BIO.BI_ERROR</td>
<td>In CMT the 1st input signal for binary input and output card at slot 3 is shown as &quot;BIO_3;BIO_CPI.BI&quot;</td>
</tr>
<tr>
<td>BIO</td>
<td>Binary inputs</td>
<td>BIO_3; BIO.BI1</td>
<td>Binary input 1</td>
</tr>
<tr>
<td>BIO</td>
<td>Binary inputs</td>
<td>BIO_3; BIO.BI2</td>
<td>Binary input 2</td>
</tr>
<tr>
<td>BIO</td>
<td>Binary inputs</td>
<td>BIO_3; BIO.BI3</td>
<td>Binary input 3</td>
</tr>
<tr>
<td>BIO</td>
<td>Binary inputs</td>
<td>BIO_3; BIO.BI4</td>
<td>Binary input 4</td>
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</tbody>
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Table continues on next page
<table>
<thead>
<tr>
<th>Function name</th>
<th>Signal type</th>
<th>Signal name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO_3; BIO:BI5</td>
<td>Signal name</td>
<td>Binary input 5</td>
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</tr>
<tr>
<td>BIO_3; BIO:BI6</td>
<td>Signal name</td>
<td>Binary input 6</td>
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</tr>
<tr>
<td>BIO_3; BIO:BI7</td>
<td>Signal name</td>
<td>Binary input 7</td>
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<tr>
<td>BIO_3; BIO:BI8</td>
<td>Signal name</td>
<td>Binary input 8</td>
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<tr>
<td>BIO_3; BIO:BI9</td>
<td>Signal name</td>
<td>Binary input 9</td>
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</tr>
<tr>
<td>BIO_3; BIO:BO_ERROR</td>
<td>Signal name</td>
<td>Binary output module error</td>
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<tr>
<td>BIO_3; BIO:BO1_PO</td>
<td>Signal name</td>
<td>Binary output status 1</td>
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<tr>
<td>BIO_3; BIO:BO2_PO</td>
<td>Signal name</td>
<td>Binary output status 2</td>
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</tr>
<tr>
<td>BIO_3; BIO:BO3_PO</td>
<td>Signal name</td>
<td>Binary output status 3</td>
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</tr>
<tr>
<td>BIO_3; BIO:BO4_SO</td>
<td>Signal name</td>
<td>Binary output status 4</td>
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<tr>
<td>BIO_3; BIO:BO5_SO</td>
<td>Signal name</td>
<td>Binary output status 5</td>
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</tr>
<tr>
<td>BIO_3; BIO:BO6_SO</td>
<td>Signal name</td>
<td>Binary output status 6</td>
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</tr>
<tr>
<td>BIO_3; BIO:BO7_SO</td>
<td>Signal name</td>
<td>Binary output status 7</td>
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</tr>
<tr>
<td>BIO_3; BIO:BO8_SO</td>
<td>Signal name</td>
<td>Binary output status 8</td>
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<tr>
<td>BIO_3; BIO:BO9_SO</td>
<td>Signal name</td>
<td>Binary output status 9</td>
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</tr>
<tr>
<td>COM05</td>
<td>Binary inputs</td>
<td>COM_101:COM05:Bi1</td>
<td>Binary input 1</td>
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<tr>
<td>COM_101:COM05:Bi2</td>
<td>Signal name</td>
<td>Binary input 2</td>
<td></td>
</tr>
<tr>
<td>COM_101:COM05:Bi3</td>
<td>Signal name</td>
<td>Binary input 3</td>
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<tr>
<td>COM_101:COM05:Bi4</td>
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<td>Binary input 4</td>
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</tr>
<tr>
<td>COM_101:COM05:Bi5</td>
<td>Signal name</td>
<td>Binary input 5</td>
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<tr>
<td>COM_101:COM05:Bi6</td>
<td>Signal name</td>
<td>Binary input 6</td>
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<tr>
<td>COM_101:COM05:Bi7</td>
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<td>Binary input 7</td>
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<td>COM_101:COM05:Bi8</td>
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<td>Binary input 8</td>
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<td>COM_101:COM05:Bi9</td>
<td>Signal name</td>
<td>Binary input 9</td>
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<td>COM_101:COM05:Bi10</td>
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<td>Binary input 10</td>
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<tr>
<td>COM_101:COM05:Bi11</td>
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<tr>
<td>COM_101:COM05:Bi12</td>
<td>Signal name</td>
<td>Binary input 12</td>
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<tr>
<td>COM_101:COM05:ERROR</td>
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<td>PSM02</td>
<td>Binary inputs</td>
<td>PSM_102; PSM02:BLOCK</td>
<td>Block binary outputs</td>
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<tr>
<td>PSM_102; PSM02:BO1_PO_TCS</td>
<td>Signal name</td>
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<tr>
<td>PSM_102; PSM02:BO2_PO_TCS</td>
<td>Signal name</td>
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<tr>
<td>PSM_102; PSM02:BO3_PO_TCS</td>
<td>Signal name</td>
<td>Binary output 3, power output relay with trip coil supervision</td>
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</tr>
<tr>
<td>PSM_102; PSM02:BO4_PO</td>
<td>Signal name</td>
<td>Binary output 4, power output relay</td>
<td></td>
</tr>
<tr>
<td>PSM_102; PSM02:BO5_PO</td>
<td>Signal name</td>
<td>Binary output 5, power output relay</td>
<td></td>
</tr>
<tr>
<td>PSM_102; PSM02:BO6_PO</td>
<td>Signal name</td>
<td>Binary output 6, power output relay</td>
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</table>

Table continues on next page
<table>
<thead>
<tr>
<th>Function name</th>
<th>Signal type</th>
<th>Signal name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSM_102; PSM02:BO7_SO</td>
<td>Signal output</td>
<td>Binary output 7, signal output relay</td>
<td></td>
</tr>
<tr>
<td>PSM_102; PSM02:BO8_SO</td>
<td>Signal output</td>
<td>Binary output 8, signal output relay</td>
<td></td>
</tr>
<tr>
<td>PSM_102; PSM02:BO9_SO</td>
<td>Signal output</td>
<td>Binary output 9, signal output relay</td>
<td></td>
</tr>
<tr>
<td>PSM03</td>
<td>Binary inputs</td>
<td>PSM_102; PSM03BLOCK</td>
<td>Block binary outputs</td>
</tr>
<tr>
<td>PSM_102; PSM03:BO1_PO_TCS</td>
<td>Power output relay</td>
<td>Binary output 1, power output relay with trip coil supervision</td>
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</tr>
<tr>
<td>PSM_102; PSM03:BO2_PO_TCS</td>
<td>Power output relay</td>
<td>Binary output 2, power output relay with trip coil supervision</td>
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</tr>
<tr>
<td>PSM_102; PSM03:BO3_PO_TCS</td>
<td>Power output relay</td>
<td>Binary output 3, power output relay with trip coil supervision</td>
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<tr>
<td>PSM_102; PSM03:BO4_PO</td>
<td>Power output relay</td>
<td>Binary output 4, power output relay</td>
<td></td>
</tr>
<tr>
<td>PSM_102; PSM03:BO5_PO</td>
<td>Power output relay</td>
<td>Binary output 5, power output relay</td>
<td></td>
</tr>
<tr>
<td>PSM_102; PSM03:BO6_PO</td>
<td>Power output relay</td>
<td>Binary output 6, power output relay</td>
<td></td>
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<tr>
<td>PSM_102; PSM03:BO7_SO</td>
<td>Signal output</td>
<td>Binary output 7, signal output relay</td>
<td></td>
</tr>
<tr>
<td>PSM_102; PSM03:BO8_SO</td>
<td>Signal output</td>
<td>Binary output 8, signal output relay</td>
<td></td>
</tr>
<tr>
<td>PSM_102; PSM03:BO9_SO</td>
<td>Signal output</td>
<td>Binary output 9, signal output relay</td>
<td></td>
</tr>
</tbody>
</table>

### General command handling from DNP master

"In CMT, the 1st binary command signal of instance 1 is shown as 'AUTOBITS:1.CMDBIT1'. The signals can be connected to any binary input signal of any function."

<table>
<thead>
<tr>
<th>AUTOBITS</th>
<th>Binary outputs</th>
<th>Description</th>
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<tbody>
<tr>
<td>AUTOBITS:CMDBIT1</td>
<td>Command out bit 1</td>
<td></td>
</tr>
<tr>
<td>AUTOBITS:CMDBIT2</td>
<td>Command out bit 2</td>
<td></td>
</tr>
<tr>
<td>AUTOBITS:CMDBIT3</td>
<td>Command out bit 3</td>
<td></td>
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<tr>
<td>AUTOBITS:CMDBIT4</td>
<td>Command out bit 4</td>
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<td>AUTOBITS:CMDBIT5</td>
<td>Command out bit 5</td>
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<td>AUTOBITS:CMDBIT6</td>
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<td>AUTOBITS:CMDBIT7</td>
<td>Command out bit 7</td>
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<td>AUTOBITS:CMDBIT8</td>
<td>Command out bit 8</td>
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<td>AUTOBITS:CMDBIT9</td>
<td>Command out bit 9</td>
<td></td>
</tr>
<tr>
<td>AUTOBITS:CMDBIT10</td>
<td>Command out bit 10</td>
<td></td>
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<tr>
<td>AUTOBITS:CMDBIT11</td>
<td>Command out bit 11</td>
<td></td>
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<tr>
<td>AUTOBITS:CMDBIT12</td>
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<tr>
<td>AUTOBITS:CMDBIT13</td>
<td>Command out bit 13</td>
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<td>AUTOBITS:CMDBIT14</td>
<td>Command out bit 14</td>
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<tr>
<td>AUTOBITS:CMDBIT15</td>
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Table continues on next page
### Table of DNP3 Data Mappings

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<th>Signal name</th>
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<tbody>
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<td>AUTOBITS:CMDBIT16</td>
<td>Command out bit 16</td>
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<td>Command out bit 17</td>
<td>AUTOBITS:CMDBIT17</td>
<td>Command out bit 17</td>
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<td>Command out bit 26</td>
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General functions for showing signals for DNP master

<table>
<thead>
<tr>
<th>MVGGIO</th>
<th>Analog inputs</th>
<th>MVGGIO:VALUE</th>
<th>Magnitude of deadband value</th>
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<tbody>
<tr>
<td>SP16GGIO</td>
<td>Binary inputs</td>
<td>SP16GGIO:OUT1</td>
<td>Output 1 status</td>
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<td>SP16GGIO:OUT2</td>
<td>Output 2 status</td>
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<td>SP16GGIO:OUT3</td>
<td>Output 3 status</td>
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<td>SP16GGIO:OUT4</td>
<td>Output 4 status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP16GGIO:OUT5</td>
<td>Output 5 status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP16GGIO:OUT6</td>
<td>Output 6 status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP16GGIO:OUT7</td>
<td>Output 7 status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP16GGIO:OUT8</td>
<td>Output 8 status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP16GGIO:OUT9</td>
<td>Output 9 status</td>
<td></td>
<td></td>
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<tr>
<td>SP16GGIO:OUT10</td>
<td>Output 10 status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP16GGIO:OUT11</td>
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<td>SP16GGIO:OUT12</td>
<td>Output 12 status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP16GGIO:OUT13</td>
<td>Output 13 status</td>
<td></td>
<td></td>
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<tr>
<td>SP16GGIO:OUT14</td>
<td>Output 14 status</td>
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<tr>
<td>SP16GGIO:OUT15</td>
<td>Output 15 status</td>
<td></td>
<td></td>
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<tr>
<td>SP16GGIO:OUT16</td>
<td>Output 16 status</td>
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<table>
<thead>
<tr>
<th>Function name</th>
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<th>Signal name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP16GGIO:OUT</td>
<td>Binary inputs</td>
<td>SP16GGIO:OUT</td>
<td>Output status logic OR gate for input 1 to 16</td>
</tr>
<tr>
<td>SP16GGIO:OUT</td>
<td>Binary inputs</td>
<td>SP16GGIO:OUT</td>
<td>Output status</td>
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**Directly linked signals**

<table>
<thead>
<tr>
<th>Signal type</th>
<th>Signal name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binary inputs</td>
<td>AEGGAPC:TRIP</td>
<td>Trip signal from accidental energizing protection</td>
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</table>

<table>
<thead>
<tr>
<th>Signal type</th>
<th>Signal name</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Analog inputs</td>
<td>B16I:OUT</td>
<td>Output value</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>B16IFCVI:OUT</td>
<td>Output value</td>
</tr>
<tr>
<td>Binary inputs</td>
<td>BRCPTOC:TRIP</td>
<td>Backup signal of the protection logic</td>
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<tr>
<td>Analog inputs</td>
<td>BRCPTOC:TRBU</td>
<td>Retrip by breaker failure protection function</td>
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</table>

**In CMT the analog signal of instance 1 of B16I is shown as "B16I: 1.OUT"**

<table>
<thead>
<tr>
<th>Signal type</th>
<th>Signal name</th>
<th>Description</th>
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<tbody>
<tr>
<td>Binary inputs</td>
<td>CCRBRF:TRBU</td>
<td>Retrip by breaker failure protection function</td>
</tr>
<tr>
<td>Binary inputs</td>
<td>CCRBRF:TRBU</td>
<td>Trip signal to CB</td>
</tr>
<tr>
<td>Binary inputs</td>
<td>CCRBRF:TRBU</td>
<td>Backup trip by breaker failure protection function</td>
</tr>
<tr>
<td>Binary inputs</td>
<td>CCRBRF:TRBU</td>
<td>Trip signal from accidental energizing protection</td>
</tr>
<tr>
<td>Binary inputs</td>
<td>CCRBRF:TRBU</td>
<td>Trips signal from CB</td>
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<table>
<thead>
<tr>
<th>Signal type</th>
<th>Signal name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binary inputs</td>
<td>CCRBRF:TRBU</td>
<td>Retrip by breaker failure protection function</td>
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**Detection of current circuit failure**

<table>
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<tr>
<th>Signal type</th>
<th>Signal name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog inputs</td>
<td>CMMXU:IL1</td>
<td>IL1 Amplitude</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>CMMXU:IL1</td>
<td>IL1 Angle</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>CMMXU:IL2</td>
<td>IL2 Amplitude</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>CMMXU:IL2</td>
<td>IL2 Angle</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>CMMXU:IL3</td>
<td>IL3 Amplitude</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>CMMXU:IL3</td>
<td>IL3 Angle</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signal type</th>
<th>Signal name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog inputs</td>
<td>CMSQI:3I0</td>
<td>3I0 Amplitude</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>CMSQI:3I0</td>
<td>3I0 Angle</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>CMSQI:I1</td>
<td>I1 Amplitude</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>CMSQI:I1</td>
<td>I1 Angle</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>CMSQI:I2</td>
<td>I2 Amplitude</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>CMSQI:I2</td>
<td>I2 Angle</td>
</tr>
</tbody>
</table>

Table continues on next page
<table>
<thead>
<tr>
<th>Function name</th>
<th>Signal type</th>
<th>Signal name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVMMXN:P</td>
<td>Signal name</td>
<td>Active power magnitude of deadband value</td>
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</tr>
<tr>
<td>CVMMXN:PF</td>
<td>Signal name</td>
<td>Power factor magnitude of deadband value</td>
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</tr>
<tr>
<td>CVMMXN:Q</td>
<td>Signal name</td>
<td>Reactive power magnitude of deadband value</td>
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</tr>
<tr>
<td>CVMMXN:S</td>
<td>Signal name</td>
<td>Apparent power magnitude of deadband value</td>
<td></td>
</tr>
<tr>
<td>CVMMXN:U</td>
<td>Signal name</td>
<td>Calculated voltage magnitude of deadband value</td>
<td></td>
</tr>
</tbody>
</table>

**Binary inputs**

<table>
<thead>
<tr>
<th>Signal name</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>CVMMXN:ILAG</td>
<td>Current is lagging voltage</td>
</tr>
<tr>
<td>CVMMXN:ILEAD</td>
<td>Current is leading voltage</td>
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**DNPFREC**

**Analog inputs**

<table>
<thead>
<tr>
<th>Signal name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNPFREC:Ch1Ang</td>
<td>Prefault Angle</td>
</tr>
<tr>
<td>DNPFREC:Ch1FltAng</td>
<td>Fault Angle</td>
</tr>
<tr>
<td>DNPFREC:Ch1FltMag</td>
<td>Fault Magnitude</td>
</tr>
<tr>
<td>DNPFREC:Ch1Mag</td>
<td>Prefault Magnitude</td>
</tr>
<tr>
<td>DNPFREC:Ch2Ang</td>
<td>Prefault Angle</td>
</tr>
<tr>
<td>DNPFREC:Ch2FltAng</td>
<td>Fault Angle</td>
</tr>
<tr>
<td>DNPFREC:Ch2FltMag</td>
<td>Fault Magnitude</td>
</tr>
<tr>
<td>DNPFREC:Ch2Mag</td>
<td>Prefault Magnitude</td>
</tr>
<tr>
<td>DNPFREC:Ch3Ang</td>
<td>Prefault Angle</td>
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<tr>
<td>DNPFREC:Ch3FltAng</td>
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<tr>
<td>DNPFREC:Ch3FltMag</td>
<td>Fault Magnitude</td>
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**Binary outputs**
- DNPFREC:GetFirstRec: Get first disturbance
- DNPFREC:GetNextRec: Get next disturbance

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<td>Double bit indications</td>
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<td>VSGGIO:POSITION</td>
<td>Position indication, integer</td>
</tr>
<tr>
<td>ZCLCPLAL</td>
<td>Binary inputs</td>
<td>ZCLCPLAL:TRLL</td>
<td>Trip by loss of load</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCLCPLAL:TRZE</td>
<td>Trip by zone extension</td>
</tr>
<tr>
<td>ZCPSCH</td>
<td>Binary inputs</td>
<td>ZCPSCH:CS</td>
<td>Carrier sending signal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCPSCH:LCG</td>
<td>Loss of carrier guard signal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCPSCH:PRORX</td>
<td>Carrier signal received or missing carrier guard signal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCPSCH:TRIP</td>
<td>Trip output</td>
</tr>
<tr>
<td>ZCRWPSCH</td>
<td>Binary inputs</td>
<td>ZCRWPSCH:CR</td>
<td>POR Carrier signal received from remote end</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCRWPSCH:ECHO</td>
<td>Carrier sending by WEI logic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCRWPSCH:TRWEI</td>
<td>Trip of WEI logic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCRWPSCH:TRWEIL1</td>
<td>Trip of WEI logic in phase L1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCRWPSCH:TRWEIL2</td>
<td>Trip of WEI logic in phase L2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCRWPSCH:TRWEIL3</td>
<td>Trip of WEI logic in phase L3</td>
</tr>
<tr>
<td>ZCVPSOF</td>
<td>Binary inputs</td>
<td>ZCVPSOF:TRIP</td>
<td>Trip output</td>
</tr>
<tr>
<td>ZCWSPSCH</td>
<td>Binary inputs</td>
<td>ZCWSPSCH:CR</td>
<td>POR Carrier signal received from remote end</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCWSPSCH:ECHO</td>
<td>Carrier send by WEI logic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCWSPSCH:TRWEI</td>
<td>Trip of WEI logic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCWSPSCH:TRWEIL1</td>
<td>Trip of WEI logic in phase L1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCWSPSCH:TRWEIL2</td>
<td>Trip of WEI logic in phase L2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZCWSPSCH:TRWEIL3</td>
<td>Trip of WEI logic in phase L3</td>
</tr>
<tr>
<td>ZDARDIR</td>
<td>Binary inputs</td>
<td>ZDARDIR:STDRCND</td>
<td>Start condition - binary coded</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZDARDIR:STRVPE</td>
<td>Reverse start signal from phase-to-earth directional element</td>
</tr>
<tr>
<td>ZGCPDIS</td>
<td>Binary inputs</td>
<td>ZGCPDIS:TRIP</td>
<td>General trip</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZGCPDIS:TRZ1</td>
<td>Trip signal Zone1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZGCPDIS:TRZ2</td>
<td>Trip signal Zone2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZGCPDIS:TRZ3</td>
<td>Trip signal Zone3</td>
</tr>
<tr>
<td>ZMRPSB</td>
<td>Binary inputs</td>
<td>ZMRPSB:START</td>
<td>Power swing detected</td>
</tr>
<tr>
<td>ZQMPDIS</td>
<td>Binary inputs</td>
<td>ZQMPDIS:TRIP</td>
<td>General trip signal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZQMPDIS:TRL1</td>
<td>Trip signal from phase L1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZQMPDIS:TRL2</td>
<td>Trip signal from phase L2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZQMPDIS:TRL3</td>
<td>Trip signal from phase L3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZQMPDIS:TRZ1</td>
<td>Trip signal Zone1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZQMPDIS:TRZ2</td>
<td>Trip signal Zone2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZQMPDIS:TRZ3</td>
<td>Trip signal Zone3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZQMPDIS:TRZ4</td>
<td>Trip signal Zone4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZQMPDIS:TRZ5</td>
<td>Trip signal Zone5</td>
</tr>
</tbody>
</table>
3.1 DNP3 device profile

The following table provides a device profile document in the standard format defined in the DNP3 Subset Definitions Document. While it is referred to in the DNP3 Subset Definitions as a document, it is in fact a table, and only a component of a total interoperability guide. The table, in combination with the Implementation table and the point list tables, provides a complete configuration/interoperability guide for communicating with a device.

When going down in baudrate, the size of the configuration on DNP must be considered.

Table 7: Device profile document

<table>
<thead>
<tr>
<th>Vendor name:</th>
<th>ABB AB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device name:</td>
<td>650 series IED</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Highest DNP level supported:</th>
<th>Device function:</th>
</tr>
</thead>
<tbody>
<tr>
<td>For requests: Level +</td>
<td>○ Master</td>
</tr>
<tr>
<td>For responses: Level +</td>
<td>● Slave</td>
</tr>
</tbody>
</table>

Notable objects, functions and/or qualifiers supported in addition to the highest DNP levels supported (the complete list is described in the attached table):

- For static (non-change event) object requests, request qualifier codes 07 and 08 (limited quantity) and 17 and 28 (index) are supported.
- Static object requests sent with qualifiers 07 or 08 are responded with qualifiers 00 or 01.
- 16-bit, 32-bit and Floating point analog change events with time may be requested.
- Floating point analog output status and output block objects 40 and 41 are not supported.
- Sequential file transfer, object 70, variations 2 through 7, are not supported.
- Octet string and string event objects 110 and 111 are not supported.
- Virtual terminal output and event objects 112 and 113 are not supported.
- Device attribute object 0 is not supported.
- Data set objects 85-88 are not supported.

<table>
<thead>
<tr>
<th>Maximum data link frame size (octets):</th>
<th>Maximum application fragment size (octets):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitted: 292</td>
<td>Transmitted: Configurable up to 2048</td>
</tr>
<tr>
<td>Received: 292</td>
<td>(ApLayMaxTxSize for each master session)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum data link retries:</th>
<th>Maximum application layer retries:</th>
</tr>
</thead>
<tbody>
<tr>
<td>● None</td>
<td>● None</td>
</tr>
<tr>
<td>○ Fixed</td>
<td>○ Configurable</td>
</tr>
<tr>
<td>○ Configurable (0...65535)</td>
<td></td>
</tr>
<tr>
<td>(DLinkRetries for each channel)</td>
<td></td>
</tr>
</tbody>
</table>
### DNP3 device profile document

**Requires data link layer confirmation:**
- Never
- Always
- Sometimes
  - Configurable as: only when reporting event data
    (DLinkConfirm for each channel)

**Requires application layer confirmation:**
- Never
- Always
- When reporting event data (slave devices only)
- When sending multi-fragment responses (slave devices only)
- Sometimes
  - Configurable as: “Only when reporting event data” or “When reporting event data or multi-fragment messages.”
    (ConfMultiFrag for each master session)

**Timeouts while waiting for:**

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Fixed at ____</th>
<th>Variable</th>
<th>Configurable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data link confirm:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(tDLinkTimeout on DNP3Channel in PST)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete appl. fragment:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application confirm:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(tApplConfTimeout on DNP3Master in PST)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete appl. response:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- Transmission delay, configurable (tRxToTxMinDel for each channel).
- Selecting/Operating arm timeout, configurable (tSelectTimeout for each master session).
- Need time interval, configurable (tSynchTimeout for each master session).
- Unsolicited notification delay, configurable (tUREvBufTout1, tUREvBufTout2, tUREvBufTout3 for each master session).
- Unsolicited response retry delay, configurable (tURRetryDelay for each master session).
- Unsolicited offline interval, configurable (tUROfflineRetryDelay for each master session).

**Change events in the IED are generated by the device's internal event system; they are not polled at a protocol-specific scan rate. The periodicity for each point depends on the point's data rate in the IED.**

- Binary change event scan period – see above
- Double bit change event scan period – see above
- Analog change event scan period – see above
- Counter change event scan period – see above

**Sends/Executes Control Operations:**

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Fixed at ____</th>
<th>Variable</th>
<th>Configurable</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRITE binary outputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SELECT/ OPERATE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table continues on next page
### DNP3 device profile document

<table>
<thead>
<tr>
<th>Operation</th>
<th>Never</th>
<th>Always</th>
<th>Sometimes</th>
<th>Configurable</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIRECT OPERATE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIRECT OPERATE - NO ACK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count &gt; 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulse on</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulse off</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latch on</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latch off</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Queue</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clear queue</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Explanation of "Sometimes" above: Supported binary output control operations depend on the type of point. Please consult the binary output point list description.

### Reports binary input change events when no specific variation requested:

- Never
- Only when time-tagged
- Only non-time-tagged
- Configurable to send one or the other (Obj2DefVar on DNP3Master)

### Reports time-tagged binary input change events when no specific variation requested:

- Never
- Binary input change with time
- Binary input change with relative time
- Configurable (Obj2DefVar on DNP3Master)

### Sends unsolicited responses:

- Never
- Configurable (UREnable on DNP3Master)
- Only certain objects
- Sometimes (attach explanation)
- ENABLE/DISABLE UNSOLICITED function codes supported

### Sends static data in unsolicited responses:

- Never
- When device restarts
- When status flags change
- No other options are permitted.

### Default counter object/variation:

- No counters reported
- Configurable (obj20DefVar and obj22DefVar in DNP3Master)
- Default object
- Default variation:
- Point-by-point list attached

### Counters roll over at:

- No counters reported
- Configurable (attach explanation)
- 16 bits
- 32 bits
- Other value: _______
- Point-by-point list attached

### Sends multi-fragment responses:

- Yes
- No

Table continues on next page
Deadbanding is not performed in the DNP protocol stack. Any deadbanding is a property of the IED’s underlying data and is configured through the IED configuration tools.

3.2 DNP3 implementation table

The following table identifies which object variations, function codes and qualifiers the IED supports in both request messages and in response messages. For static (non-change event) objects, requests sent with qualifiers 00, 01, 06, 07 or 08 are responded with qualifiers 00 or 01. Requests sent with qualifiers 17 or 28 are responded with qualifiers 17 or 28. For change event objects, qualifiers 17 or 28 are always responded.

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>REQUEST (Slave will parse)</th>
<th>RESPONSE (Slave will respond with)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Object number</td>
<td>Variation number</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1 (read)</td>
</tr>
<tr>
<td>1</td>
<td>1 (default)</td>
<td>1 (read)</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1 (read)</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1 (read)</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1 (read)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1 (read)</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>1 (read)</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1 (read)</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1 (read)</td>
</tr>
<tr>
<td>OBJECT</td>
<td>REQUEST (Slave will parse)</td>
<td>RESPONSE (Slave will respond with)</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>4</td>
<td>Double bit input change - any variation</td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty)</td>
</tr>
<tr>
<td>4</td>
<td>Double bit input change without time</td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
<tr>
<td>4</td>
<td>Double bit input change with time</td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
<tr>
<td>4</td>
<td>Double bit input change with relative time</td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
<tr>
<td>10</td>
<td>Binary output status — any variation</td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index)</td>
</tr>
<tr>
<td>10</td>
<td>Binary output</td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 129 (response) 00, 01 (start-stop) 17, 28 (index)</td>
</tr>
<tr>
<td>10</td>
<td>Binary output status</td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 129 (response) 00, 01 (start-stop) 17, 28 (index)</td>
</tr>
<tr>
<td>12</td>
<td>Control relay output block</td>
<td>3 (select) 4 (operate) 5 (direct op) 6 (dir.op. noack) 17, 28 (index) 129 (response) echo of request</td>
</tr>
<tr>
<td>20</td>
<td>Binary counter — any variation</td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index)</td>
</tr>
<tr>
<td>20</td>
<td>32-bit binary counter (with flag)</td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 129 (response) 00, 01 (start-stop) 17, 28 (index)</td>
</tr>
<tr>
<td>20</td>
<td>16-bit binary counter (with flag)</td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 129 (response) 00, 01 (start-stop) 17, 28 (index)</td>
</tr>
<tr>
<td>20</td>
<td>32-bit binary counter without flag</td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 129 (response) 00, 01 (start-stop) 17, 28 (index)</td>
</tr>
<tr>
<td>20</td>
<td>16-bit binary counter without flag</td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 129 (response) 00, 01 (start-stop) 17, 28 (index)</td>
</tr>
<tr>
<td>22</td>
<td>Counter change event — any variation</td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty)</td>
</tr>
<tr>
<td>22</td>
<td>32-bit counter change event without time</td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
<tr>
<td>22</td>
<td>16-bit counter change event without time</td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
<tr>
<td>22</td>
<td>32-bit delta counter change event without time</td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
</tbody>
</table>

Table continues on next page
<table>
<thead>
<tr>
<th>OBJECT</th>
<th>REQUEST (Slave will parse)</th>
<th>RESPONSE (Slave will respond with)</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>4</td>
<td>16-bit delta counter change event without time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
<tr>
<td>22</td>
<td>5</td>
<td>32-bit counter change event with time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
<tr>
<td>22</td>
<td>6</td>
<td>16-bit counter change event with time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
<tr>
<td>30</td>
<td>0</td>
<td>Analog input — any variation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 22 (assign class) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 129 (response)</td>
</tr>
<tr>
<td>30</td>
<td>1</td>
<td>32-bit analog input</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 129 (response) 00,01 (start-stop) 17, 28 (index)</td>
</tr>
<tr>
<td>30</td>
<td>2</td>
<td>16-bit analog input</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 129 (response) 00,01 (start-stop) 17, 28 (index)</td>
</tr>
<tr>
<td>30</td>
<td>3</td>
<td>32-bit analog input without flag</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 129 (response) 00,01 (start-stop) 17, 28 (index)</td>
</tr>
<tr>
<td>30</td>
<td>4</td>
<td>16-bit analog input without flag</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 129 (response) 00,01 (start-stop) 17, 28 (index)</td>
</tr>
<tr>
<td>30</td>
<td>5</td>
<td>Short floating point</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 129 (response) 00,01 (start-stop) 17, 28 (index)</td>
</tr>
<tr>
<td>30</td>
<td>6</td>
<td>Long floating point</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 129 (response) 00,01 (start-stop) 17, 28 (index)</td>
</tr>
<tr>
<td>32</td>
<td>0</td>
<td>Analog change event — any variation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response)</td>
</tr>
<tr>
<td>32</td>
<td>1</td>
<td>32-bit analog change event without time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
<tr>
<td>32</td>
<td>2</td>
<td>16-bit analog change event without time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
<tr>
<td>32</td>
<td>3</td>
<td>32-bit analog change event with time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
<tr>
<td>32</td>
<td>4</td>
<td>16-bit analog change event with time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
<tr>
<td>32</td>
<td>5</td>
<td>Short floating point analog change event without time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
<tr>
<td>32</td>
<td>6</td>
<td>Long floating point analog change event without time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 (read) 06 (no range, or all) 07, 08 (limited qty) 129 (response) 130 (unsol. resp) 17, 28 (index)</td>
</tr>
</tbody>
</table>

Table continues on next page
<table>
<thead>
<tr>
<th>OBJECT</th>
<th>REQUEST (Slave will parse)</th>
<th>RESPONSE (Slave will respond with)</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>Short floating point analog change event with time</td>
<td>1 (read)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Long floating point analog change event with time</td>
<td>1 (read)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>Time and date</td>
<td>1 (read)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 (write)</td>
</tr>
<tr>
<td>50</td>
<td>Time and date last recorded time</td>
<td>2 (write)</td>
</tr>
<tr>
<td>51</td>
<td>Time and date CTO</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>Unsynchronized time and date CTO</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>Time delay coarse</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>Time delay fine</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>Not defined</td>
<td>1 (read)</td>
</tr>
<tr>
<td>60</td>
<td>Class 0 data</td>
<td>1 (read)</td>
</tr>
<tr>
<td>60</td>
<td>Class 1 data</td>
<td>1 (read)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 (enbl. unsol.) 21 (dab.unsol.) 22 (assign class)</td>
</tr>
<tr>
<td>60</td>
<td>Class 2 data</td>
<td>1 (read)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 (enbl. unsol.) 21 (dab.unsol.) 22 (assign class)</td>
</tr>
<tr>
<td>60</td>
<td>Class 3 data</td>
<td>1 (read)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 (enbl. unsol.) 21 (dab.unsol.) 22 (assign class)</td>
</tr>
<tr>
<td>80</td>
<td>Internal indications</td>
<td>1 (read)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 (write)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) A default variation refers to the variation responded when variation 0 is requested and/or in class 0, 1, 2 or 3 scans. Default variations are configurable; however, default settings for the configuration parameters are indicated in the table above.

2) For static (non-change event) objects, qualifiers 17 or 28 are only responded when a request is sent with qualifiers 17 or 28. Otherwise, static object requests sent with qualifiers 00, 01, 06, 07 or 08 are responded with qualifiers 00 or 01. (For change event objects, qualifiers 17 or 28 are always responded.)

3) Writings of internal indications are only supported for index 7 (Restart lin1–7).
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Alternating current</td>
</tr>
<tr>
<td>ACT</td>
<td>Application configuration tool within PCM600</td>
</tr>
<tr>
<td>A/D converter</td>
<td>Analog-to-digital converter</td>
</tr>
<tr>
<td>ADBS</td>
<td>Amplitude deadband supervision</td>
</tr>
<tr>
<td>AI</td>
<td>Analog input</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>AR</td>
<td>Autoreclosing</td>
</tr>
<tr>
<td>ASCT</td>
<td>Auxiliary summation current transformer</td>
</tr>
<tr>
<td>ASD</td>
<td>Adaptive signal detection</td>
</tr>
<tr>
<td>AWG</td>
<td>American Wire Gauge standard</td>
</tr>
<tr>
<td>BI</td>
<td>Binary input</td>
</tr>
<tr>
<td>BOS</td>
<td>Binary outputs status</td>
</tr>
<tr>
<td>BR</td>
<td>External bistable relay</td>
</tr>
<tr>
<td>BS</td>
<td>British Standards</td>
</tr>
<tr>
<td>CAN</td>
<td>Controller Area Network. ISO standard (ISO 11898) for serial communication</td>
</tr>
<tr>
<td>CB</td>
<td>Circuit breaker</td>
</tr>
<tr>
<td>CCITT</td>
<td>Consultative Committee for International Telegraph and Telephony, A United Nations-sponsored standards body within the International Telecommunications Union.</td>
</tr>
<tr>
<td>CCVT</td>
<td>Capacitive Coupled Voltage Transformer</td>
</tr>
<tr>
<td>Class C</td>
<td>Protection Current Transformer class as per IEEE/ ANSI</td>
</tr>
<tr>
<td>CMPPS</td>
<td>Combined megapulses per second</td>
</tr>
<tr>
<td>CMT</td>
<td>Communication Management tool in PCM600</td>
</tr>
<tr>
<td>CO cycle</td>
<td>Close-open cycle</td>
</tr>
<tr>
<td>Codirectional</td>
<td>Way of transmitting G.703 over a balanced line. Involves two twisted pairs making it possible to transmit information in both directions</td>
</tr>
<tr>
<td>COMTRADE</td>
<td>Standard format according to IEC 60255-24</td>
</tr>
<tr>
<td>Contra-directional</td>
<td>Way of transmitting G.703 over a balanced line. Involves four twisted pairs, two of which are used for transmitting data in both directions and two for transmitting clock signals</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>CPU</td>
<td>Central processor unit</td>
</tr>
<tr>
<td>CR</td>
<td>Carrier receive</td>
</tr>
<tr>
<td>CRC</td>
<td>Cyclic redundancy check</td>
</tr>
<tr>
<td>CROB</td>
<td>Control relay output block</td>
</tr>
<tr>
<td>CS</td>
<td>Carrier send</td>
</tr>
<tr>
<td>CT</td>
<td>Current transformer</td>
</tr>
<tr>
<td>CVT</td>
<td>Capacitive voltage transformer</td>
</tr>
<tr>
<td>DAR</td>
<td>Delayed autoreclosing</td>
</tr>
<tr>
<td>DARPA</td>
<td>Defense Advanced Research Projects Agency (The US developer of the TCP/IP protocol etc.)</td>
</tr>
<tr>
<td>DBDL</td>
<td>Dead bus dead line</td>
</tr>
<tr>
<td>DBLL</td>
<td>Dead bus live line</td>
</tr>
<tr>
<td>DC</td>
<td>Direct current</td>
</tr>
<tr>
<td>DFC</td>
<td>Data flow control</td>
</tr>
<tr>
<td>DFT</td>
<td>Discrete Fourier transform</td>
</tr>
<tr>
<td>DHCP</td>
<td>Dynamic Host Configuration Protocol</td>
</tr>
<tr>
<td>DIP-switch</td>
<td>Small switch mounted on a printed circuit board</td>
</tr>
<tr>
<td>DI</td>
<td>Digital input</td>
</tr>
<tr>
<td>DLLB</td>
<td>Dead line live bus</td>
</tr>
<tr>
<td>DNP</td>
<td>Distributed Network Protocol as per IEEE/ANSI Std. 1379-2000</td>
</tr>
<tr>
<td>DR</td>
<td>Disturbance recorder</td>
</tr>
<tr>
<td>DRAM</td>
<td>Dynamic random access memory</td>
</tr>
<tr>
<td>DRH</td>
<td>Disturbance report handler</td>
</tr>
<tr>
<td>DSP</td>
<td>Digital signal processor</td>
</tr>
<tr>
<td>DTT</td>
<td>Direct transfer trip scheme</td>
</tr>
<tr>
<td>EHV network</td>
<td>Extra high voltage network</td>
</tr>
<tr>
<td>EIA</td>
<td>Electronic Industries Association</td>
</tr>
<tr>
<td>EMC</td>
<td>Electromagnetic compatibility</td>
</tr>
<tr>
<td>EMF</td>
<td>(Electric Motive Force)</td>
</tr>
<tr>
<td>EMI</td>
<td>Electromagnetic interference</td>
</tr>
<tr>
<td>EnFP</td>
<td>End fault protection</td>
</tr>
<tr>
<td>EPA</td>
<td>Enhanced performance architecture</td>
</tr>
<tr>
<td>ESD</td>
<td>Electrostatic discharge</td>
</tr>
<tr>
<td>FCB</td>
<td>Flow control bit; Frame count bit</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>FOX 20</td>
<td>Modular 20 channel telecommunication system for speech, data and protection signals</td>
</tr>
<tr>
<td>FOX 512/515</td>
<td>Access multiplexer</td>
</tr>
<tr>
<td>FOX 6Plus</td>
<td>Compact time-division multiplexer for the transmission of up to seven duplex channels of digital data over optical fibers</td>
</tr>
<tr>
<td>G.703</td>
<td>Electrical and functional description for digital lines used by local telephone companies. Can be transported over balanced and unbalanced lines</td>
</tr>
<tr>
<td>GCM</td>
<td>Communication interface module with carrier of GPS receiver module</td>
</tr>
<tr>
<td>GDE</td>
<td>Graphical display editor within PCM600</td>
</tr>
<tr>
<td>GI</td>
<td>General interrogation command</td>
</tr>
<tr>
<td>GIS</td>
<td>Gas-insulated switchgear</td>
</tr>
<tr>
<td>GOOSE</td>
<td>Generic object-oriented substation event</td>
</tr>
<tr>
<td>GPS</td>
<td>Global positioning system</td>
</tr>
<tr>
<td>HDLC protocol</td>
<td>High-level data link control, protocol based on the HDLC standard</td>
</tr>
<tr>
<td>HFBR connector type</td>
<td>Plastic fiber connector</td>
</tr>
<tr>
<td>HMI</td>
<td>Human-machine interface</td>
</tr>
<tr>
<td>HSAR</td>
<td>High speed autoreclosing</td>
</tr>
<tr>
<td>HV</td>
<td>High-voltage</td>
</tr>
<tr>
<td>HVDC</td>
<td>High-voltage direct current</td>
</tr>
<tr>
<td>IDBS</td>
<td>Integrating deadband supervision</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrical Committee</td>
</tr>
<tr>
<td>IEC 60044-6</td>
<td>IEC Standard, Instrument transformers – Part 6: Requirements for protective current transformers for transient performance</td>
</tr>
<tr>
<td>IEC 61850</td>
<td>Substation automation communication standard</td>
</tr>
<tr>
<td>IEC 61850–8–1</td>
<td>Communication protocol standard</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers</td>
</tr>
<tr>
<td>IEEE 802.12</td>
<td>A network technology standard that provides 100 Mbits/s on twisted-pair or optical fiber cable</td>
</tr>
<tr>
<td>IEEE P1386.1</td>
<td>PCI Mezzanine Card (PMC) standard for local bus modules. References the CMC (IEEE P1386, also known as Common Mezzanine Card) standard for the mechanics and the PCI specifications from the PCI SIG (Special Interest Group) for the electrical EMF (Electromotive force).</td>
</tr>
<tr>
<td><strong>IEEE 1686</strong></td>
<td>Standard for Substation Intelligent Electronic Devices (IEDs) Cyber Security Capabilities</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>IED</strong></td>
<td>Intelligent electronic device</td>
</tr>
<tr>
<td><strong>I-GIS</strong></td>
<td>Intelligent gas-insulated switchgear</td>
</tr>
<tr>
<td><strong>Instance</strong></td>
<td>When several occurrences of the same function are available in the IED, they are referred to as instances of that function. One instance of a function is identical to another of the same kind but has a different number in the IED user interfaces. The word &quot;instance&quot; is sometimes defined as an item of information that is representative of a type. In the same way an instance of a function in the IED is representative of a type of function.</td>
</tr>
</tbody>
</table>
| **IP**       | 1. Internet protocol. The network layer for the TCP/IP protocol suite widely used on Ethernet networks. IP is a connectionless, best-effort packet-switching protocol. It provides packet routing, fragmentation and reassembly through the data link layer.  
2. Ingression protection, according to IEC standard |
| **IP 20**    | Ingression protection, according to IEC standard, level 20 |
| **IP 40**    | Ingression protection, according to IEC standard, level 40 |
| **IP 54**    | Ingression protection, according to IEC standard, level 54 |
| **IRF**      | Internal failure signal                                                               |
| **IRIG-B:**  | InterRange Instrumentation Group Time code format B, standard 200                     |
| **ITU**      | International Telecommunications Union                                                |
| **LAN**      | Local area network                                                                    |
| **LIB 520**  | High-voltage software module                                                          |
| **LCD**      | Liquid crystal display                                                                 |
| **LDD**      | Local detection device                                                                 |
| **LED**      | Light-emitting diode                                                                  |
| **MCB**      | Miniature circuit breaker                                                              |
| **MCM**      | Mezzanine carrier module                                                               |
| **MVB**      | Multifunction vehicle bus. Standardized serial bus originally developed for use in trains. |
| **NCC**      | National Control Centre                                                                |
| **OCO cycle**| Open-close-open cycle                                                                  |
| **OCP**      | Overcurrent protection                                                                 |
| **OLTC**     | On-load tap changer                                                                     |
| **OV**       | Over-voltage                                                                            |
Overreach
A term used to describe how the relay behaves during a fault condition. For example, a distance relay is overreaching when the impedance presented to it is smaller than the apparent impedance to the fault applied to the balance point, that is, the set reach. The relay “sees” the fault but perhaps it should not have seen it.

PCI
Peripheral component interconnect, a local data bus

PCM
Pulse code modulation

PCM600
Protection and control IED manager

PC-MIP
Mezzanine card standard

PMC
PCI Mezzanine card

POR
Permissive overreach

POTT
Permissive overreach transfer trip

Process bus
Bus or LAN used at the process level, that is, in near proximity to the measured and/or controlled components

PSM
Power supply module

PST
Parameter setting tool within PCM600

PT ratio
Potential transformer or voltage transformer ratio

PUTT
Permissive underreach transfer trip

RASC
Synchrocheck relay, COMBIFLEX

RCA
Relay characteristic angle

RFPP
Resistance for phase-to-phase faults

RFPE
Resistance for phase-to-earth faults

RISC
Reduced instruction set computer

RMS value
Root mean square value

RS422
A balanced serial interface for the transmission of digital data in point-to-point connections

RS485
Serial link according to EIA standard RS485

RTC
Real-time clock

RTU
Remote terminal unit

SA
Substation Automation

SBO
Select-before-operate

SC
Switch or push button to close

SCS
Station control system

SCADA
Supervision, control and data acquisition

SCT
System configuration tool according to standard IEC 61850
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDU</td>
<td>Service data unit</td>
</tr>
<tr>
<td>SMA connector</td>
<td>Subminiature version A, A threaded connector with constant impedance.</td>
</tr>
<tr>
<td>SMT</td>
<td>Signal matrix tool within PCM600</td>
</tr>
<tr>
<td>SMS</td>
<td>Station monitoring system</td>
</tr>
<tr>
<td>SNTP</td>
<td>Simple network time protocol – is used to synchronize computer clocks on local area networks. This reduces the requirement to have accurate hardware clocks in every embedded system in a network. Each embedded node can instead synchronize with a remote clock, providing the required accuracy.</td>
</tr>
<tr>
<td>SRY</td>
<td>Switch for CB ready condition</td>
</tr>
<tr>
<td>ST</td>
<td>Switch or push button to trip</td>
</tr>
<tr>
<td>Starpoint</td>
<td>Neutral point of transformer or generator</td>
</tr>
<tr>
<td>SVC</td>
<td>Static VAr compensation</td>
</tr>
<tr>
<td>TC</td>
<td>Trip coil</td>
</tr>
<tr>
<td>TCS</td>
<td>Trip circuit supervision</td>
</tr>
<tr>
<td>TCP</td>
<td>Transmission control protocol. The most common transport layer protocol used on Ethernet and the Internet.</td>
</tr>
<tr>
<td>TCP/IP</td>
<td>Transmission control protocol over Internet Protocol. The de facto standard Ethernet protocols incorporated into 4.2BSD Unix. TCP/IP was developed by DARPA for Internet working and encompasses both network layer and transport layer protocols. While TCP and IP specify two protocols at specific protocol layers, TCP/IP is often used to refer to the entire US Department of Defense protocol suite based upon these, including Telnet, FTP, UDP and RDP.</td>
</tr>
<tr>
<td>TNC connector</td>
<td>Threaded Neill-Concelman, a threaded constant impedance version of a BNC connector</td>
</tr>
<tr>
<td>TPZ, TPY, TPX, TPS</td>
<td>Current transformer class according to IEC</td>
</tr>
<tr>
<td>UMT</td>
<td>User management tool</td>
</tr>
<tr>
<td>Underreach</td>
<td>A term used to describe how the relay behaves during a fault condition. For example, a distance relay is underreaching when the impedance presented to it is greater than the apparent impedance to the fault applied to the balance point, that is, the set reach. The relay does not “see” the fault but perhaps it should have seen it. See also Overreach.</td>
</tr>
<tr>
<td>UTC</td>
<td>Coordinated Universal Time. A coordinated time scale, maintained by the Bureau International des Poids et Mesures (BIPM), which forms the basis of a coordinated dissemination of standard frequencies and time signals. UTC</td>
</tr>
</tbody>
</table>
is derived from International Atomic Time (TAI) by the addition of a whole number of "leap seconds" to synchronize it with Universal Time 1 (UT1), thus allowing for the eccentricity of the Earth's orbit, the rotational axis tilt (23.5 degrees), but still showing the Earth's irregular rotation, on which UT1 is based. The Coordinated Universal Time is expressed using a 24-hour clock, and uses the Gregorian calendar. It is used for aeroplane and ship navigation, where it is also sometimes known by the military name, "Zulu time." "Zulu" in the phonetic alphabet stands for "Z", which stands for longitude zero.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>UV</td>
<td>Undervoltage</td>
</tr>
<tr>
<td>WEI</td>
<td>Weak end infeed logic</td>
</tr>
<tr>
<td>VT</td>
<td>Voltage transformer</td>
</tr>
<tr>
<td>X.21</td>
<td>A digital signalling interface primarily used for telecom equipment</td>
</tr>
<tr>
<td>3I₀</td>
<td>Three times zero-sequence current. Often referred to as the residual or the earth-fault current</td>
</tr>
<tr>
<td>3U₀</td>
<td>Three times the zero sequence voltage. Often referred to as the residual voltage or the neutral point voltage</td>
</tr>
</tbody>
</table>