InteliNano^{NT}

InteliNano^{NT} MRS 3

Single small gen-set controller

Single small gen-set controller for prime-power applications

SW version 1.0.0, July 2017

ComAp

Reference Guide

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AMPS

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1 Document information

INTELINANO^{NT}® MRS 3 - REFERENCE GUIDE
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DOCUMENT HISTORY

REVISION NUMBER	RELATED SW. VERSION	DATE
1	1.0.0	14.07.2017

1.1 Clarification of notation

NOTE:
These boxes contain helpful tips, remarks and other notes.

CAUTION!
These boxes call special attention to procedures or adjustments, which if done incorrectly can cause damage or equipment failure.

WARNING!
These boxes call special attention to important procedures or adjustments, which if done incorrectly could result in personal injury or death.

1.2 Conformity Declaration

CE	The following described machine complies with the appropriate basic safety and health requirement of the EC Low Voltage Directive No: 73/23 / EEC and EC Electromagnetic Compatibility Directive 89/336 / EEC based on its design and type, as brought into circulation by us.

1.3 Legal notice

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1.4 Important

SAVE THESE INSTRUCTION – This manual contains important instructions for the **InteliNano^{NT}** controllers' family that shall be followed during installation and maintenance of the **InteliNano^{NT}** gen-set controllers.

This manual is intended for use by gen-set control panel builders and parties concerned with installation, operation, and maintenance of the gen-set.

This manual describes the **InteliNano^{NT} MRS 3** software, which is designed for single gen-set, prime-power applications.

NOTE:
ComAp believes that all information provided herein is correct and reliable and reserves the right to update at any time. ComAp does not assume any responsibility for its use unless otherwise expressly undertaken.

NOTE:
SW and HW must be compatible otherwise some functions will be disabled.

NOTE:
Because of large variety of the InteliNano^{NT} parameters settings, it is not possible to describe all combinations. Some of the InteliNano^{NT}'s functions are subject of changes depend on SW version. The data in this manual only describes the product and is not intended as a warranty of performance or characteristics.

CAUTION!
Dangerous voltage
In no case touch the terminals for voltage measurement!
Always connect grounding terminals!

CAUTION!
All parameters are preset to initial values. But the set points in the "**Basic settings**" settings group **!must!** be adjusted before the first start-up of the gen-set.

INCORRECT ADJUSTMENT OF BASIC PARAMETERS CAN RESULT IN DAMAGE TO THE GEN-SET!

The following instructions are for qualified personnel only. To avoid personal injury do not perform any action not specified in this User guide!!!

WARNING!

Remote control

The **InteliNano^{NT}** controller can be controlled remotely. When working on the gen-set, ensure that remote start is disabled.

This is done by:

Disconnect inputs ***I02 Remote Start/Stop*** or ***I03 Remote Start and Load***
or
Disconnect output ***O01 Starter*** and outputs ***O05 GCB Close/Open***

1.5 Text

Following table depicts how the buttons of controller front panel are represented within this guide.

Symbol	Button
STOP	
AUTO	
START	
	
	

Following table depicts how particular class of objects are represented within this guide.

B01 Nominal Voltage Ph-N	Setpoints
O02 Fuel Solenoid	Input / Output function
T15	Physical terminal of controller
Manual Start	Event or ECU message
Low Fuel Level	Warning alarm
Start Fail	Shutdown alarm

2 System Overview

2.1 General description

The **InteliNano^{NT} MRS 3** is an **Manual Remote Start** controller for single gen-sets. The **InteliNano^{NT}** controllers supports electronic engines.
InteliNano^{NT} controllers are equipped with an intuitive graphic display, which together with extensive functionality, set the new standard in gen-set control.
InteliNano^{NT} supports diesel and gasoline engines.
The key features of **InteliNano^{NT}** are easy installation and intuitive operation. Users may choose between predefined configurations for typical applications and user-defined configurations for special applications.

2.2 Configurability

One of the key features of the controller is high level of adaptability to the needs of every particular application. This customization is accomplished in the configuration.

NOTE:
Use **NanoEdit** PC software to read configuration from the controller or the file, view it, modify it, and write the configuration to the controller or the file.

The firmware contains large number of binary inputs and outputs for all available. Configuration will be determined by application and hardware constraints. One of main tasks of the configuration is mapping of "logical" firmware inputs and outputs to the "physical" hardware input and output terminals.

A complete configuration consists of the following:

1. Mapping of logical ***binary and analog inputs*** (functions) to physical binary input terminals,
2. Mapping of logical ***binary outputs*** (functions) to physical binary output terminals,
3. Assigning sensor characteristics,
4. Selecting of ECU type if an ECU is connected.

The controller is delivered with a **default configuration, which should fit most standard applications**. The default configuration can be changed from controller's front panel or using **NanoEdit** PC software. See **NanoEdit** documentation for details.

NOTE:
For connection with PC use integrated USB module. The controller can be powered directly using USB communication port. In this case the LCD backlight is turned off and all outputs are open. Don't use USB hub for connection!

Once the configuration is modified (using **NanoEdit**) it can be stored in a file for reference or use with another controller. This configuration file is called the **archive** and has file extension ".ain". If the archive is saved while the PC is connected with the controller, it will contain a full image (setpoints, measured values, and history log) of the controller at the moment of saving (except firmware).

The archive can then be used for the **cloning** of controllers, which means preparing controllers with identical configuration and settings.

3 Application Overview

3.1 MRS – Manual Remote Start

The **InteliNano^{NT} MRS 3** can be used with a generator circuit breaker – GCB (**Figure 3.1**) or without a breaker (**Figure 3.2**).

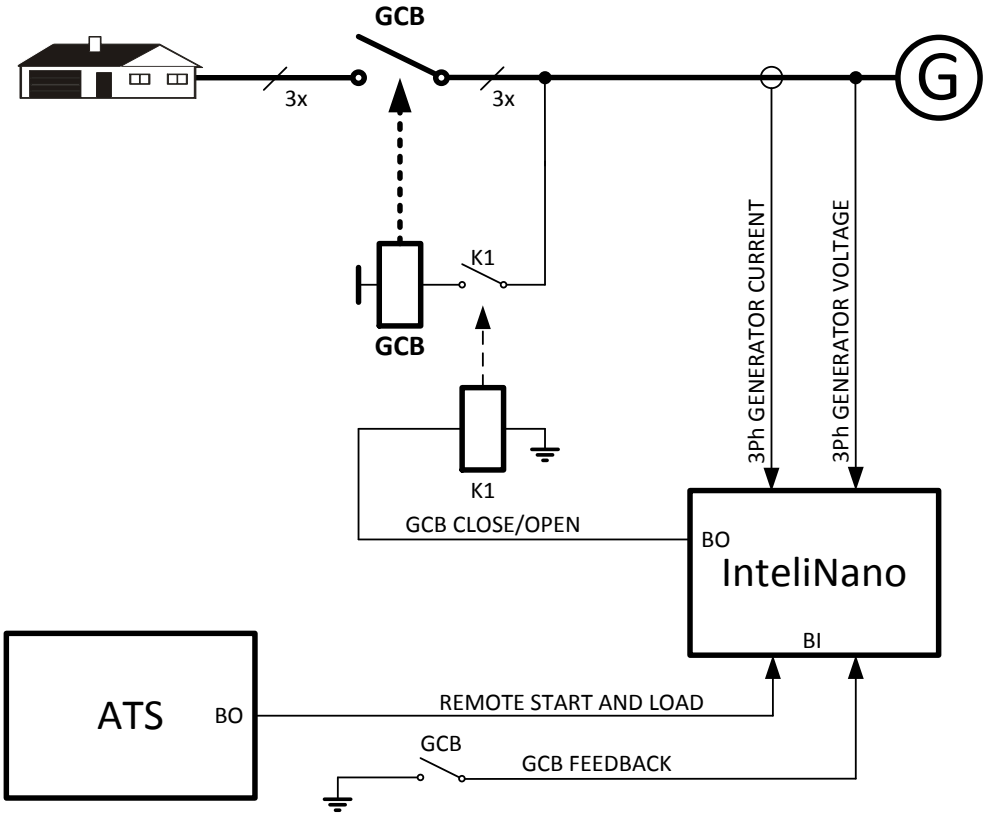


Figure 3.1
MRS application with GCB control

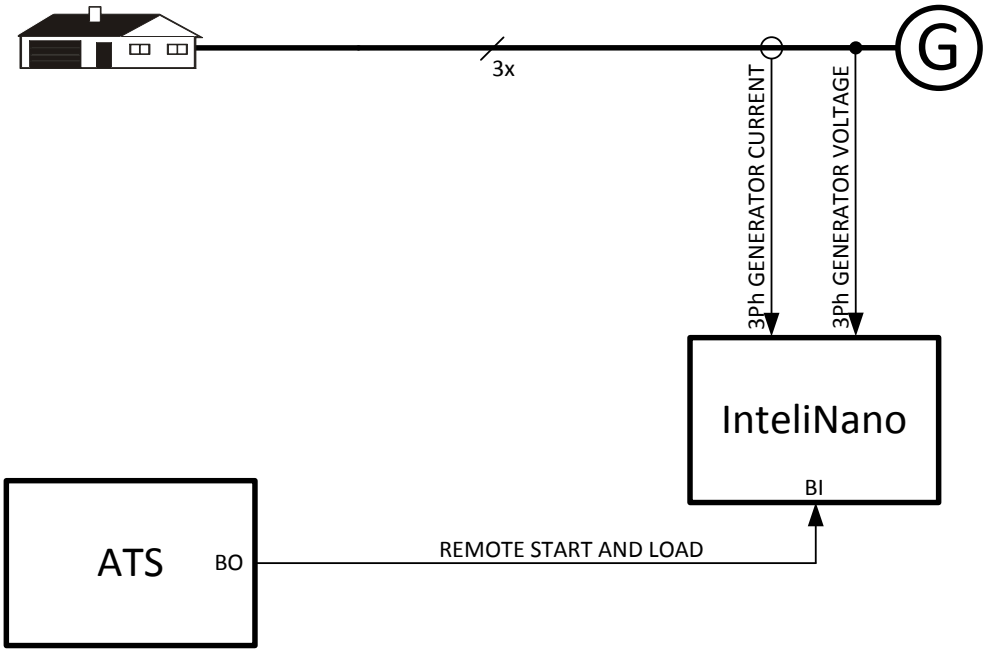


Figure 3.2
simple MRS application

3.2 True RMS measurement

This controller measures AC values based on *True RMS* principle. This principle corresponds exactly to the physical definition of alternating voltage effective values. Under normal circumstances the generator voltage should have a pure sinusoidal waveform. However, some nonlinear elements connected to the generator may produce harmonic waveforms with frequencies of multiples of the basic generator frequency, and this may result in deformation of the voltage waveforms. The True RMS measurement **gives accurate readings** of effective values not only for pure sinusoidal waveforms, but also for deformed waveforms.

4 Installation and wiring

4.1 Mounting

The controller is to be mounted onto the switchboard or gen-set control panel door. Mounting cut-out size is 96x96mm. Use the screw holders included with the controller to mount the controller into the door as depicted on pictures below.

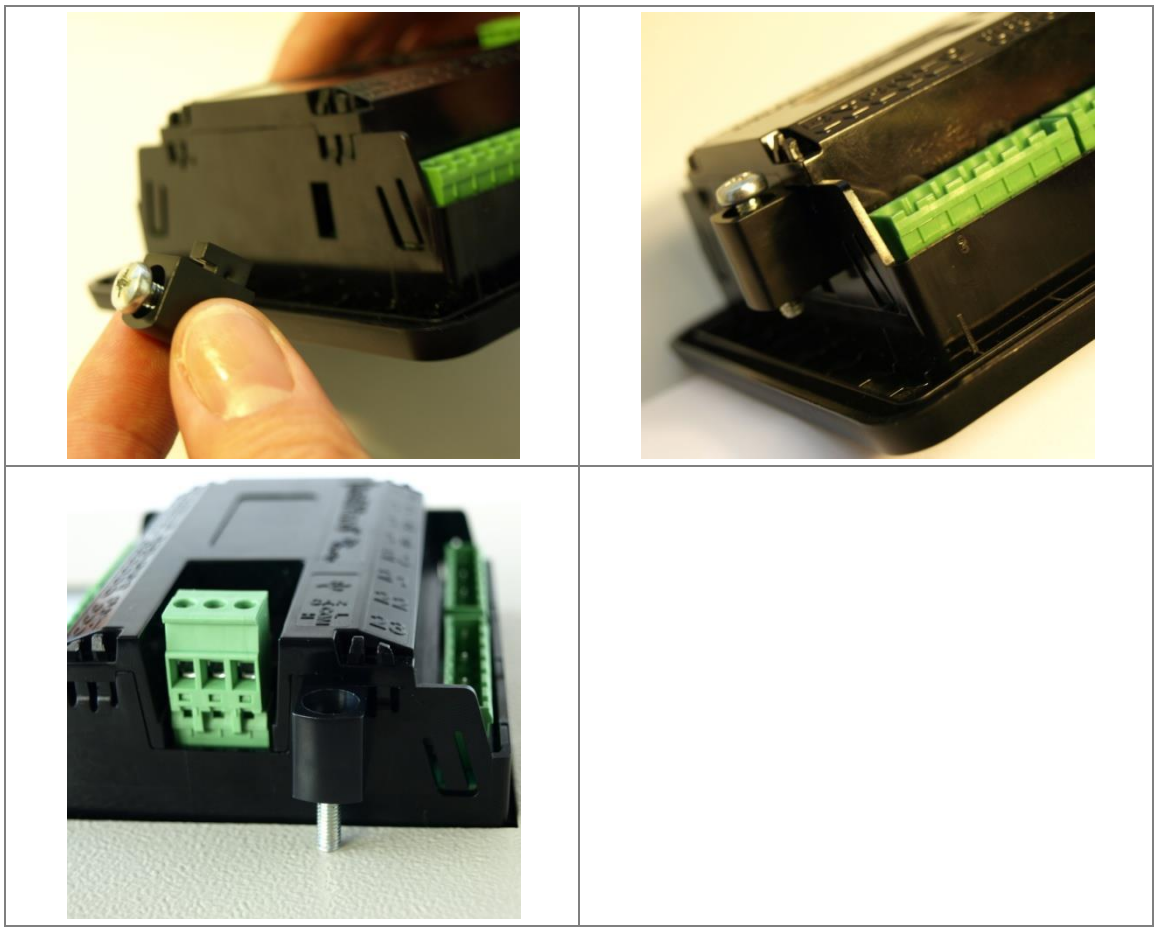


Figure 4.1
InteliNano^{NT} chassis mounting

4.2 Package contents

Accessories	Description	Optional / Obligatory
InteliNano^{NT} MRS 3	**InteliNano^{NT} MRS 3** controller unit	Obligatory
Fast User Guide	Fast User Guide for the **InteliNano^{NT} MRS 3**	Obligatory
Gasket IN-NT	Gasket under the **InteliNano^{NT}** controller	Optional
Fixing clips	Two controller holders	Obligatory

4.3 Terminal diagram

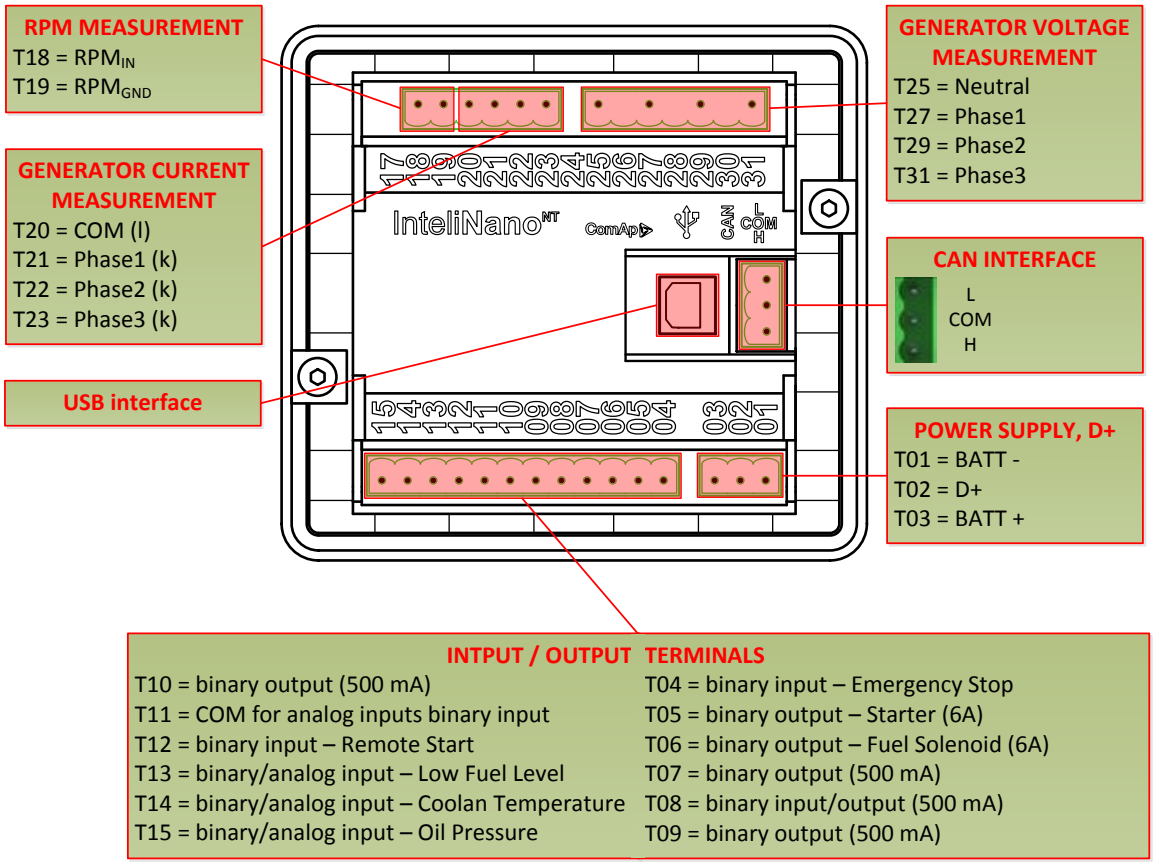


Figure 4.2
InteliNano^{NT} MRS 3 terminals description

4.4 Power supply

To ensure proper function:
It is strictly recommended to use power supply cable 2.5 mm²!

Maximum continuous DC power supply voltage is 36 VDC. The **InteliNano^{NT}**'s power supply terminals are protected against large pulse power disturbances. When there is a potential risk of the controller being subjected to conditions outside its capabilities, an outside protection devise should be used.

For the connections with 12VDC power supply, the **InteliNano^{NT}** includes internal capacitors that allow the controller to continue operation during cranking if the battery voltage dip occurs. If the voltage before drop is 10V, after 100ms the voltage recovers to 5 V, the controller continues operating.

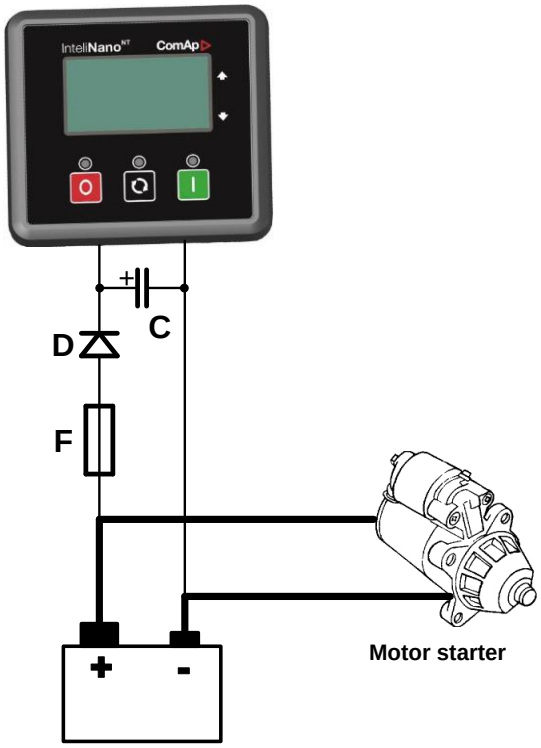


Figure 4.3
recommended power supply wiring

The capacitor size should be 5 000 µF to withstand 150 ms voltage dip under following conditions: Voltage before the drop is 12 V, after 150 ms the voltage recovers to min. allowed voltage, i.e. 8 V.

4.4.1 Power supply fusing

A 15 A fuse should be connected in-line with the battery positive terminal to the controller and modules. The controller should never be connected directly to the starting battery.
Fuse value and type depends on number of connected devices and wire length.
Recommended fuse (not fast) type - T15A. Not fast due to internal capacitors charging during power up.

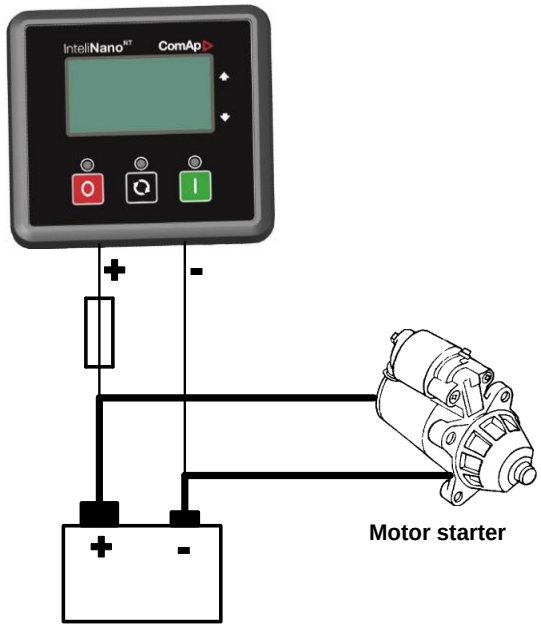


Figure 4.4
InteliNano^{NT} MRS 3 power supply fusing

4.5 D+

Charging alternator D+ output is on terminal ***T02***.
D+ current is up to 250 mA and is switched off after 5s when starter is disconnected.

WARNING!
If the D+ feature is not used, connect this terminal to battery positive!

In case of charging alternator malfunction the warning ***Low Battery (Charge Fail)*** will appear in event log.

4.6 Voltage measurement and generator connection types

WARNING!
Risk of personal injury due to electric shock when manipulating the voltage terminals under voltage! Be sure the terminals are not energized before beginning work.

Use **1.5 mm^2** cables for voltage measurement connection.

There are 4 voltage measurement connection types (setpoint ***B04 Connection Type [Mono Ph / Split Ph / 3Ph3Wire / 3Ph4Wire / Autodetect]***) Each matches a corresponding generator connection type.

4.6.1 Connection Type: 3 Phase 4 Wires

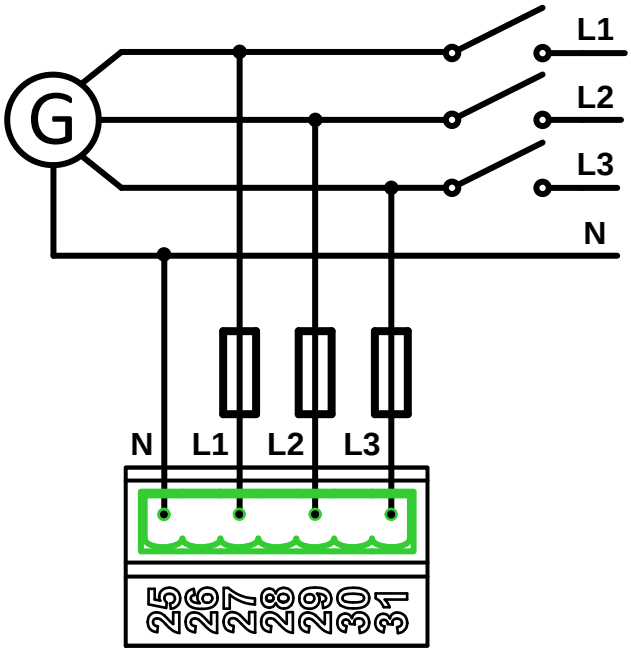


Figure 4.5
InteliNanoNT MRS 3 3 phases and 4 wires terminals connection

Three phase “wye” measurement – 3PY

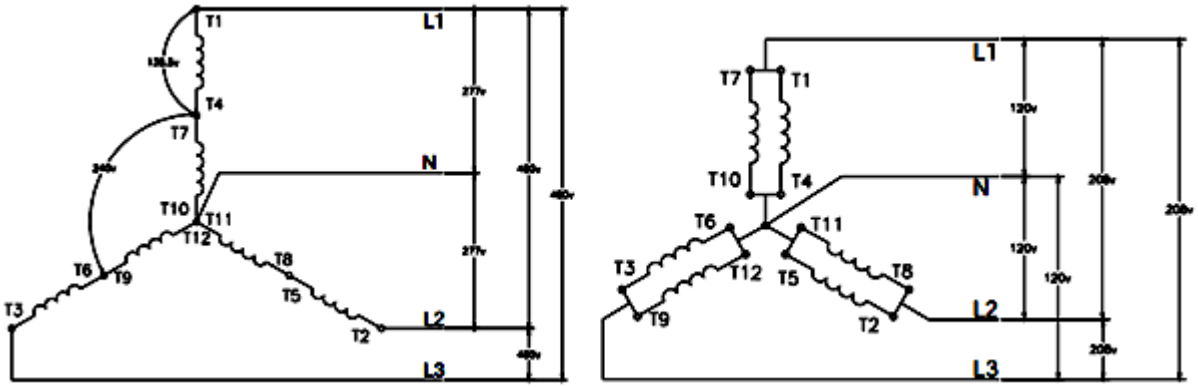


Figure 4.6
star connection

4.6.2 Connection Type: 3 Phase 3 Wires

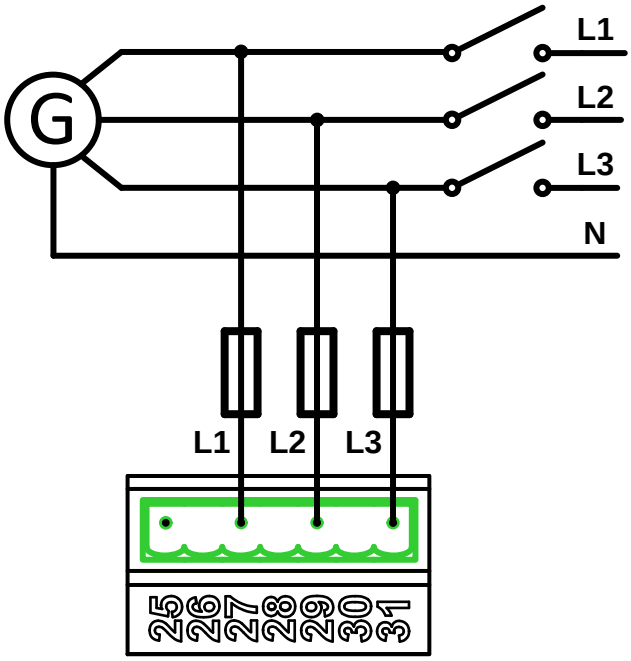


Figure 4.7
InteliNanoNT MRS 3 3 phases and 3 wires terminals connection

Three phase "delta" measurement – 3PD

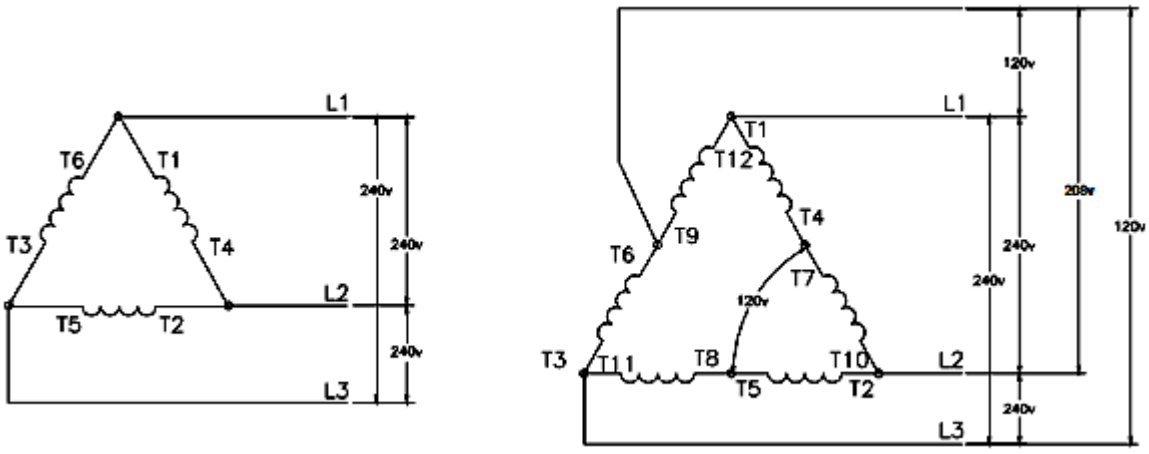


Figure 4.8
delta connection (left), high-leg delta connection (right)

NOTE:
In case of HIGH-LEG DELTA connection, the N (neutral) wire (in the diagram connected between T6 and T9) has to be connected!

4.6.3 Connection Type: Split Phase

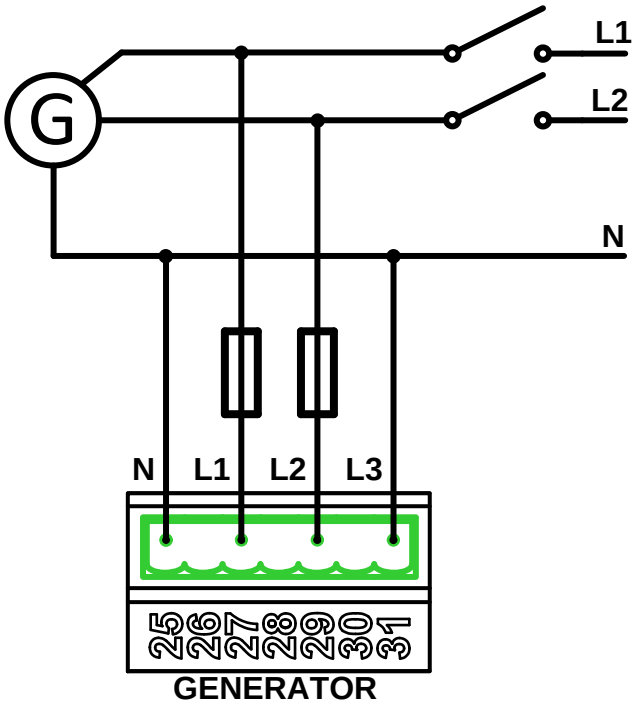


Figure 4.9
InteliNanoNT MRS 3 split phase terminals connection

Split-phase measurement – 1Ph

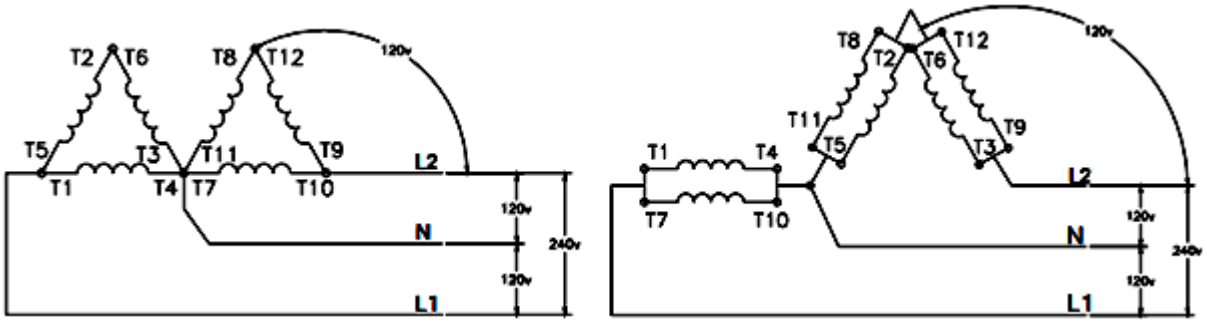


Figure 4.10
double delta connection (left), zig-zag(dog leg) connection (right)

4.6.4 Connection Type: Mono Phase

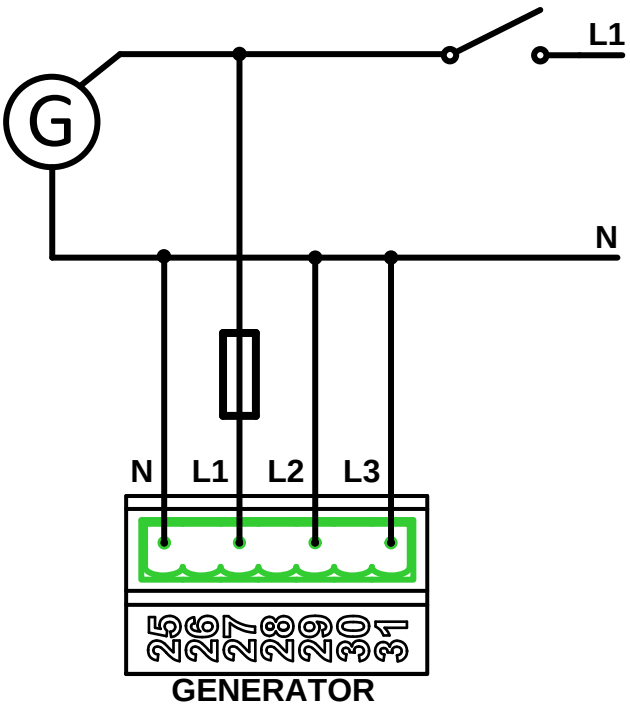


Figure 4.11
InteliNanoNT MRS 3 mono phase terminals connection

Single-phase measurement – 1Ph

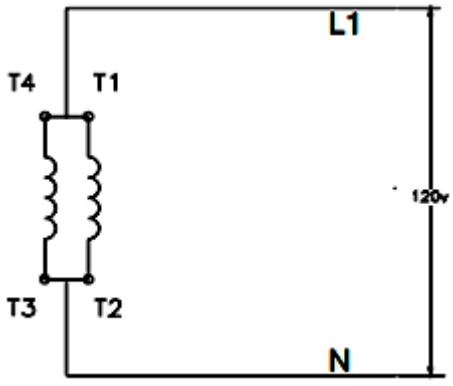


Figure 4.12
monophase connection

4.7 Current measurement

WARNING!
Do not open secondary circuit of current transformers when primary circuit is closed!!! Open the primary circuit first!

To ensure proper function:

1) Use wires of 2.5 mm^2.
2) Use transformers to 5 A.
3) Connect CT according to the following drawing:

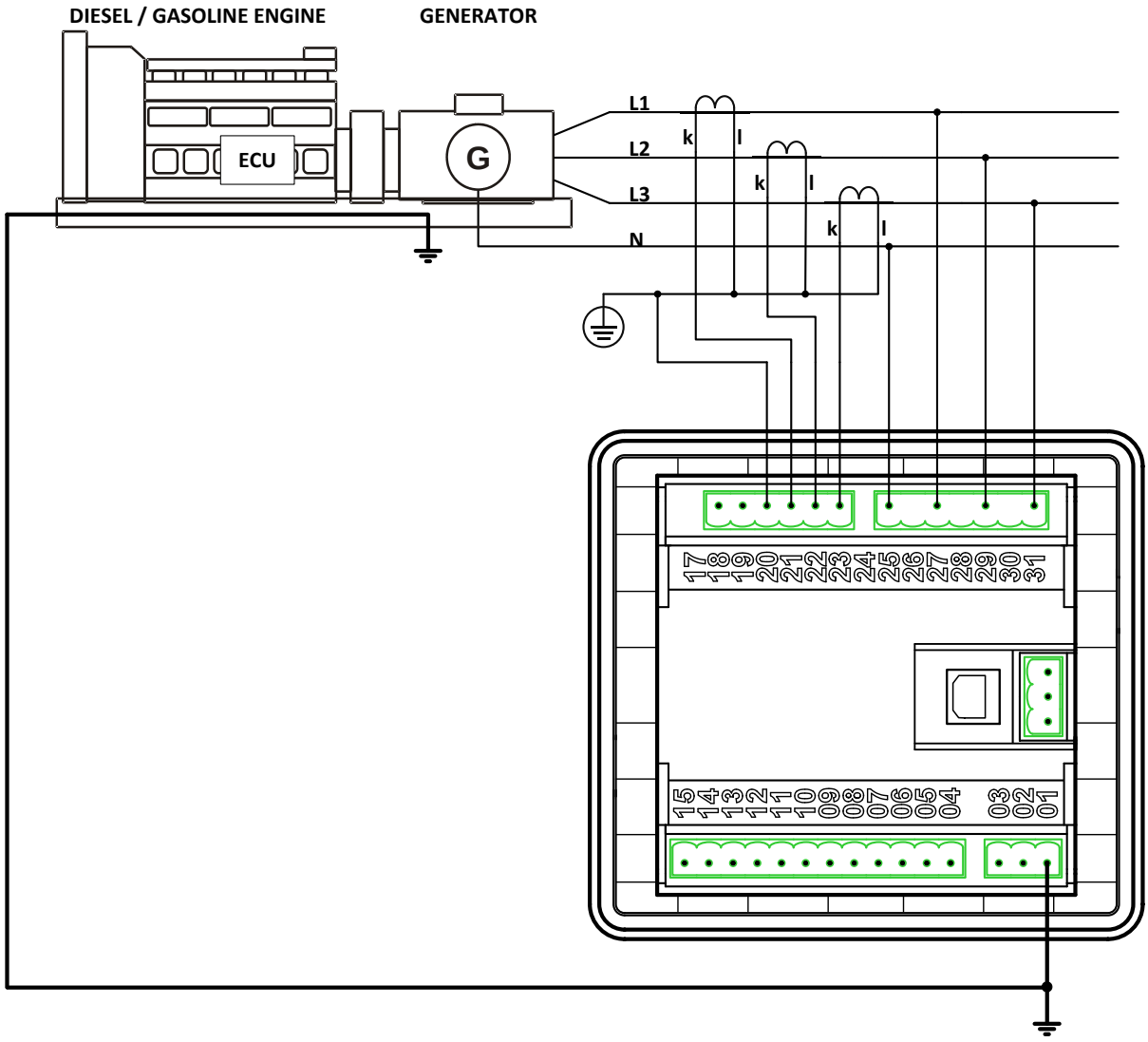


Figure 4.13
recommended CT connection

NOTE:
There is no need to connect "l" terminal of CT to the ground.

4.8 Magnetic pick-up

A magnetic speed sensor (pick-up) is the most common method of engine speed measurement. To use this method, mount the pick-up sensor opposite to the engine flywheel, connect the cable to the controller as shown on the picture below and adjust the setpoint ***B14 Gear Teeth*** according to the number of teeth on the flywheel.

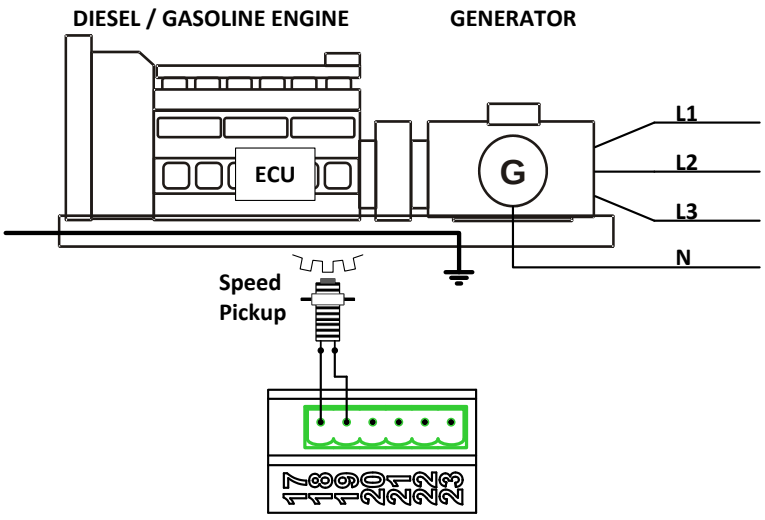


Figure 4.14
magnetic pick-up connection

NOTE:
To ensure proper function use a shielded cable.

4.9 Binary inputs

Use minimally **1 mm²** cables for wiring of standard binary inputs. Use minimally **2.5 mm²** wires for ***T04*** input terminal wiring. It serves as supplying input for high current output terminals ***T05*** and ***T06***.

NOTE:
Logical binary functions for each binary input have to be assigned during the configuration.

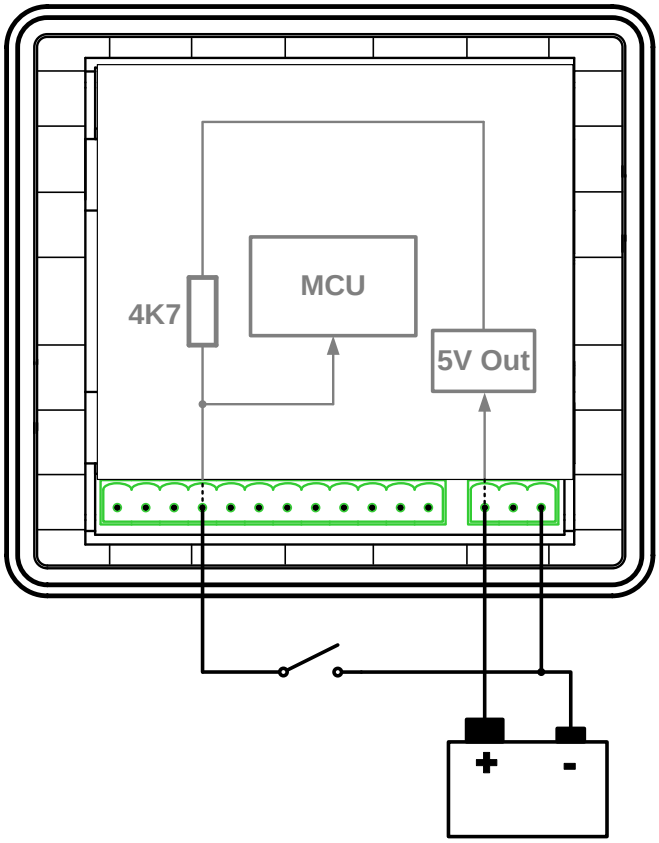


Figure 4.15
recommended binary inputs wiring

4.10 Binary outputs

Use minimal **1 mm²** wires for wiring of binary outputs ***T07***, ***T09***, ***T10*** and eventually ***T08***. **2.5 mm²** wires are required for high current outputs ***T05*** and ***T06***. For more technical detail see chapter ***13.5 Binary outputs.***

WARNING!
Controller outputs switch high side! Never connect any analog sensor to this output to avoid sensor damage. All outputs are short circuit protected.

Use suppression diodes on all relays and other inductive loads!

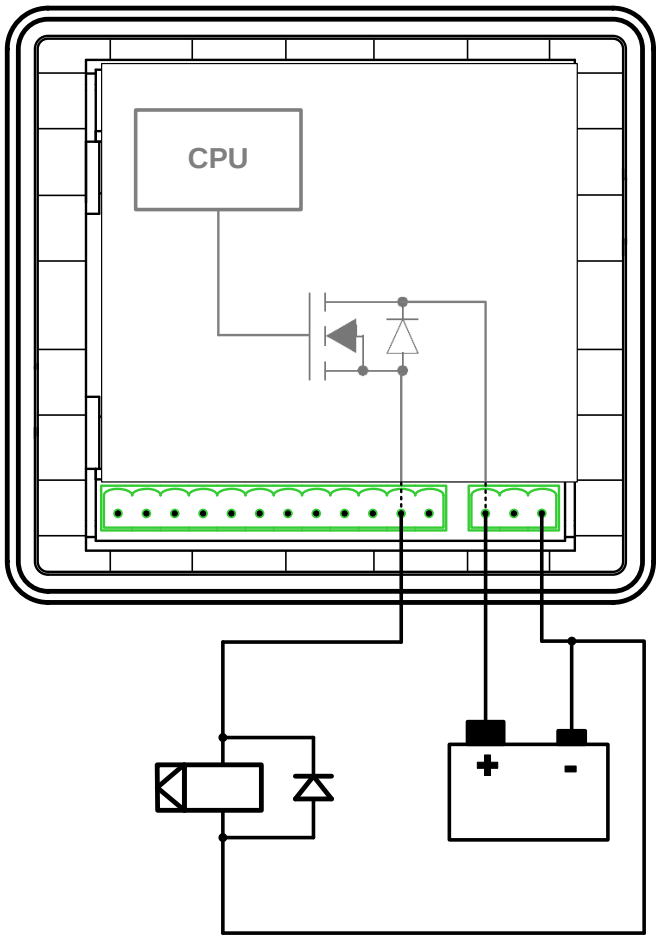


Figure 4.16
recommended binary output wiring

4.11 Analog inputs

The analog inputs are designed for resistive automotive type sensors like VDO or DATCON. The sensors are connected either by one wire (the second pole is sensor body) or by two wires.

CAUTION!
In case of grounded sensors connect the terminal ***T11*** to the engine body as near the sensor as possible!

CAUTION!
In case of isolated sensors connect the terminal ***T11*** to the negative power supply terminal of the controller as well as the opposite poles of the sensors!

NOTE:
Value #### is displayed when measured value is out of range or sensor's wire is broken.

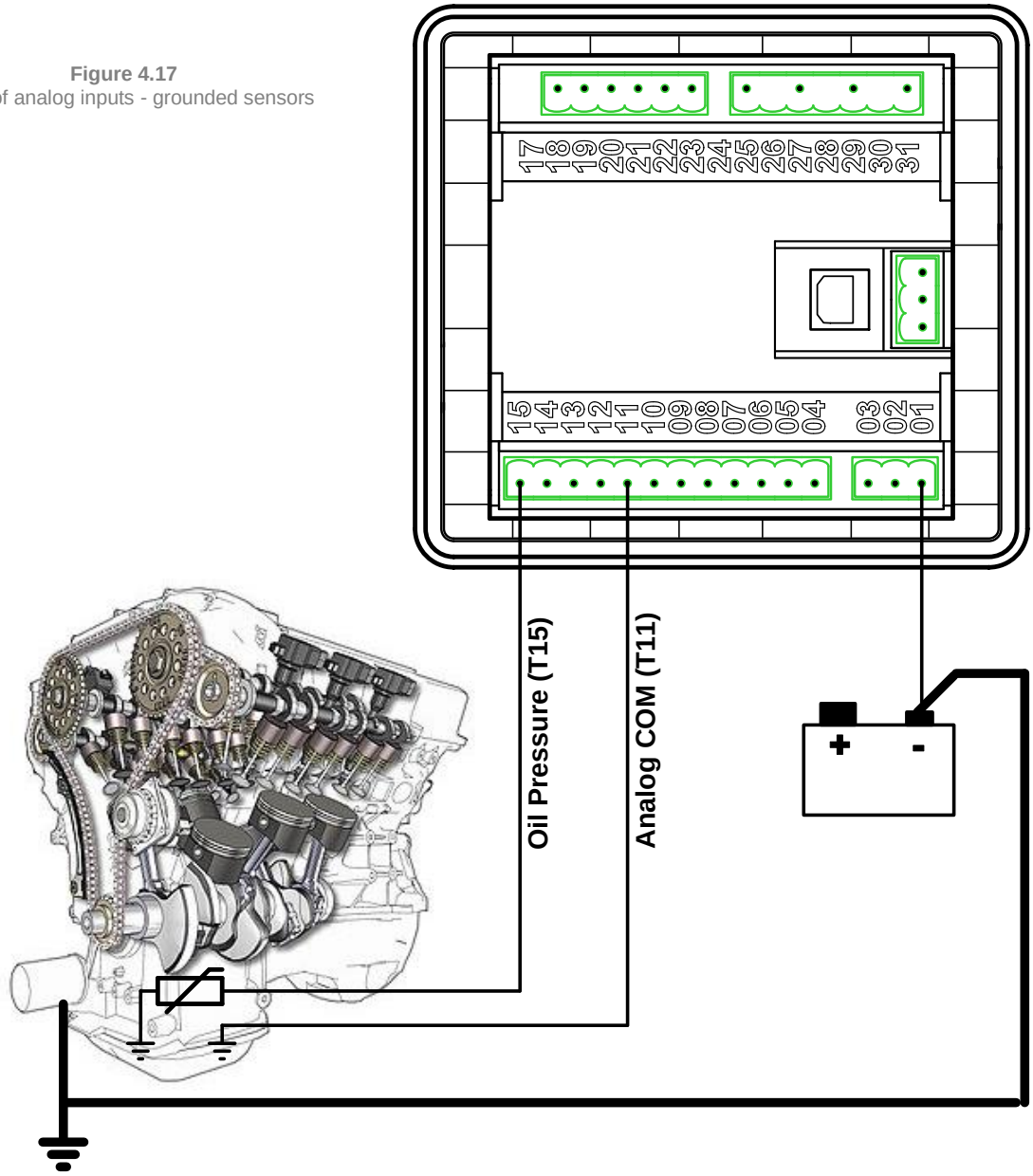


Figure 4.17
wiring of analog inputs - grounded sensors

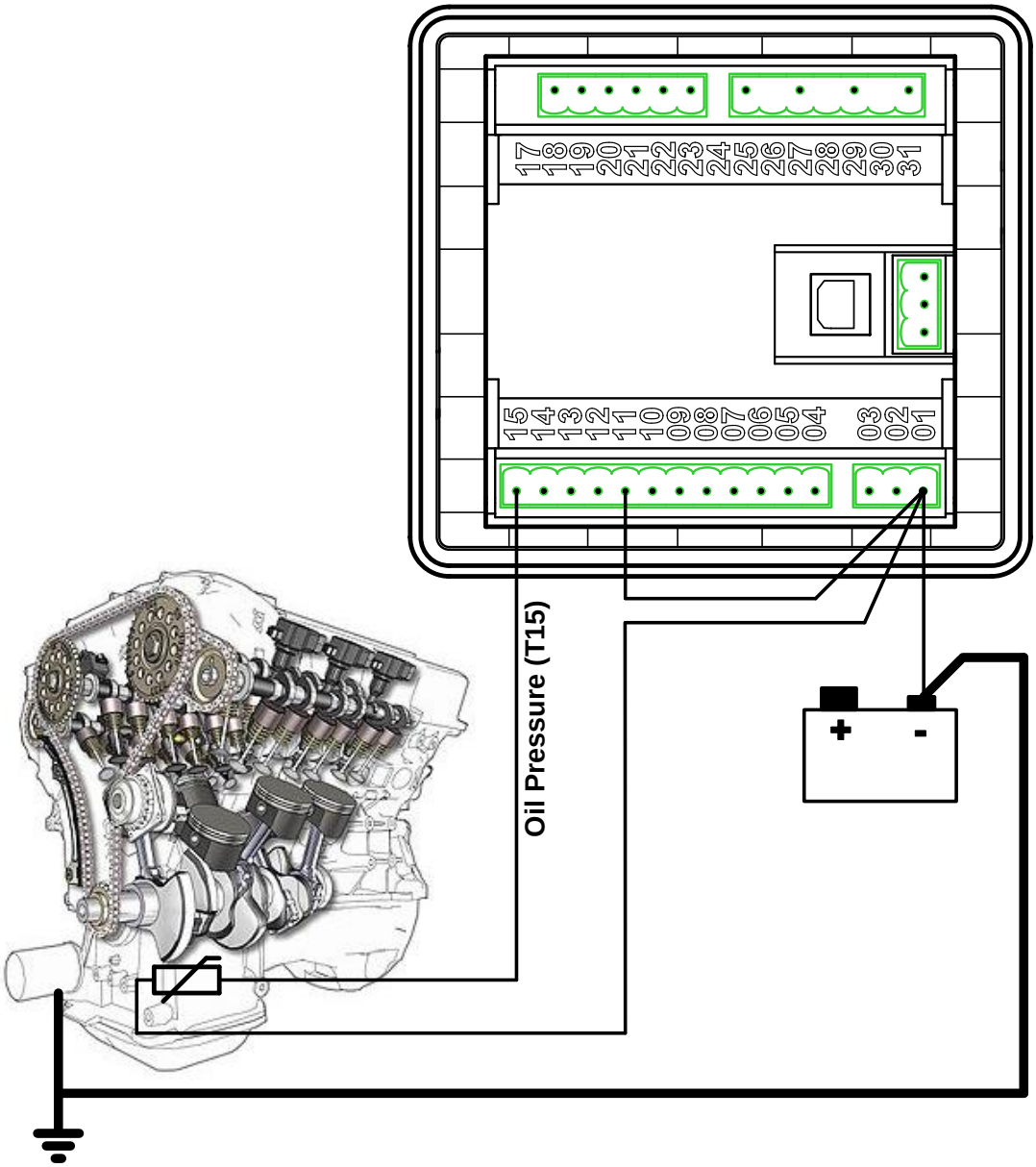


Figure 4.18
wiring of analog inputs - isolated sensors

5 Recommended Wiring

5.1 InteliNano^{NT} MRS 3 – Wiring Diagram

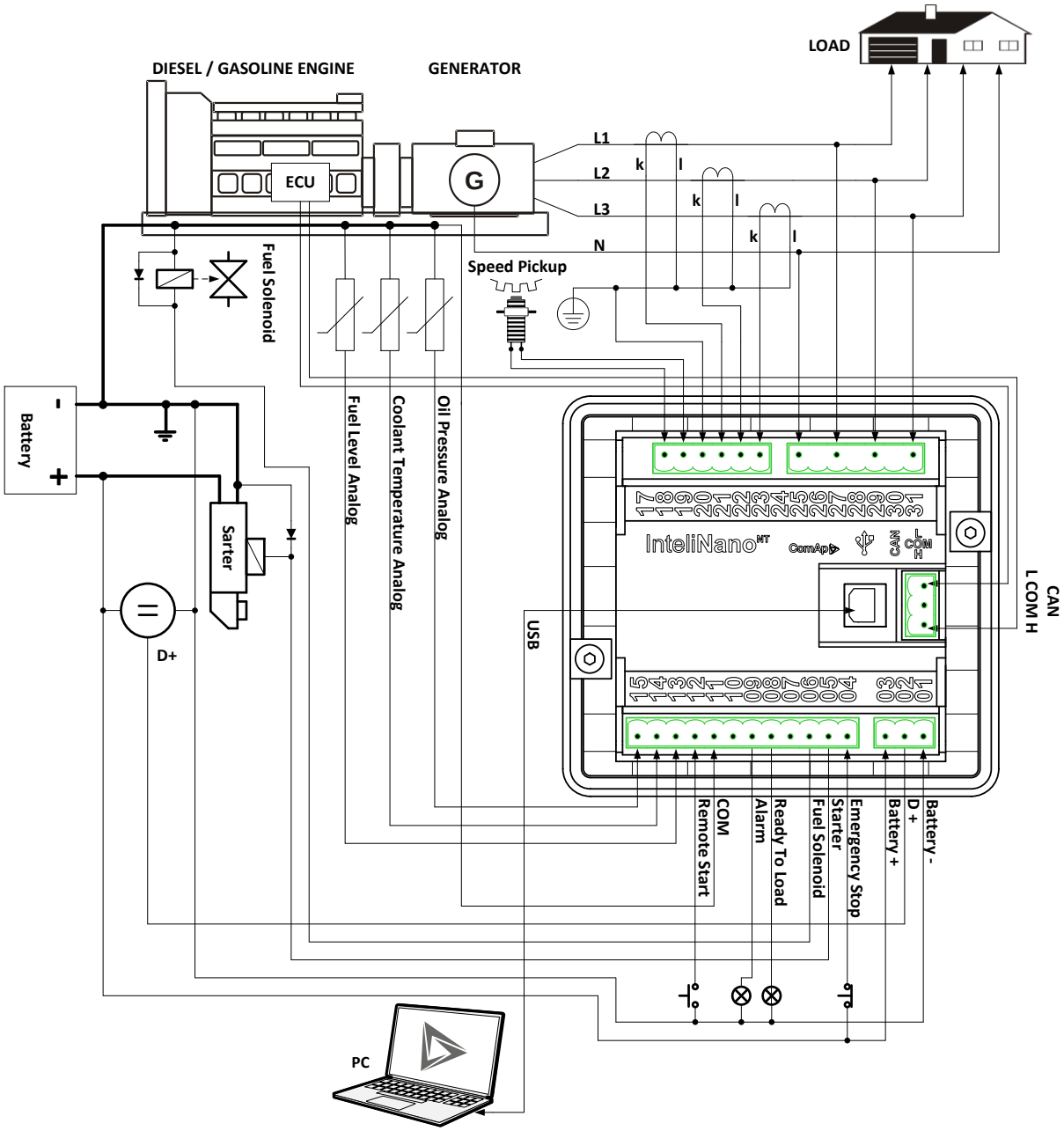


Figure 5.1
typical wiring diagram of MRS application

6 Controller Settings

6.1 Setup mode

CAUTION!
Controller must be in manual mode before you can enter the controller's setup mode. Use AUTO button for switching between **Auto** and **Manual** mode. Green LED above button AUTO is turned off when the controller is in Manual mode.

If you have not configured custom initialization (init) screen then press and hold STOP button, then briefly press ▲ button then AUTO (**Figure 6.1).**

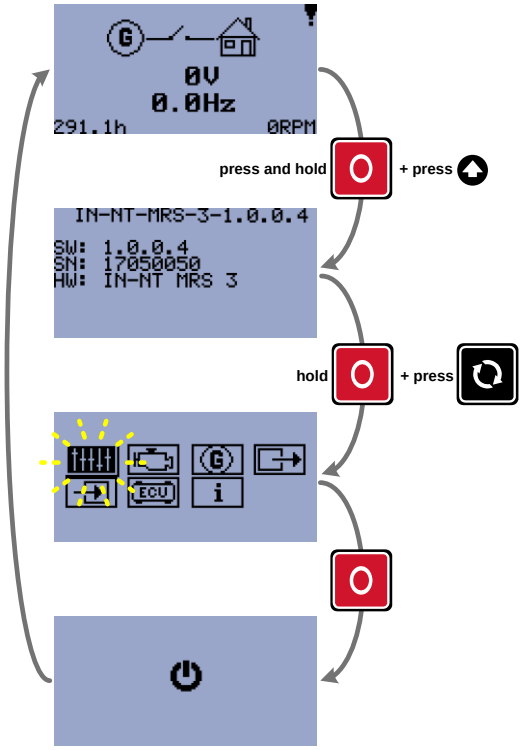


Figure 6.1
entry to setup mode (without custom screen)

If you have already created your own init screen then press and hold STOP button and then press briefly press ▲ the custom init screen will appear, keep holding the STOP button. Then press ▼ to switch LCD to default init screen and then press (**Figure 6.2**).

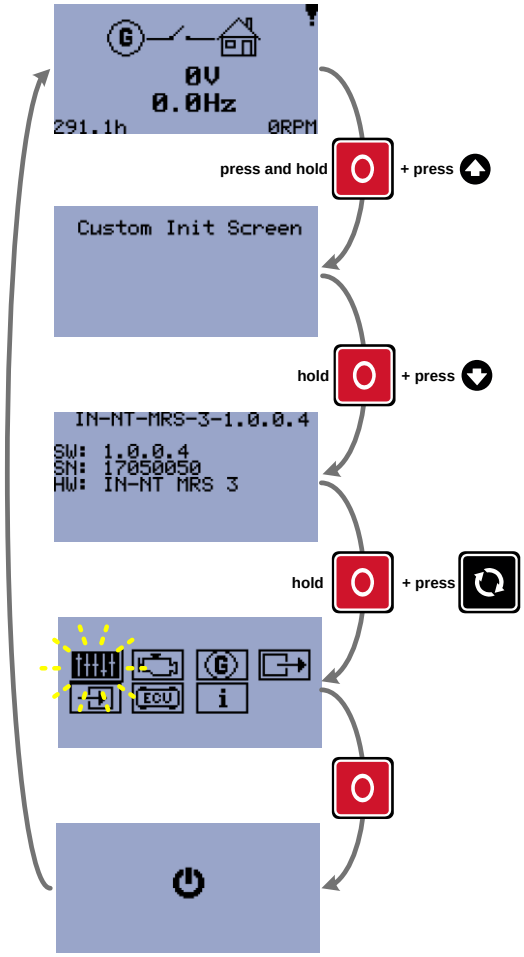


Figure 6.2
entry to setup mode (with custom screen)

NOTE:
The controller will automatically switch to Setup mode when there is a problem with the CRC or there is an incompatibility between firmware and archive version. This situation can occur when you upgrade a firmware. If this occurs, verify that all setpoints are properly configured.

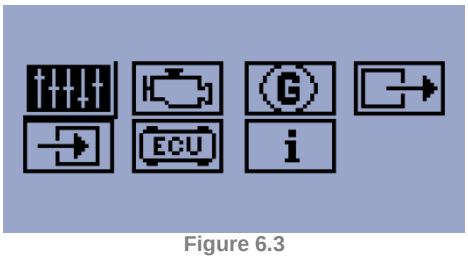
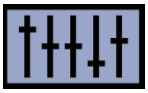
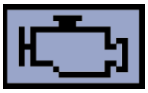
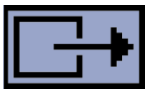
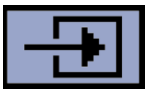


Figure 6.3
setup screen

	***Basic settings***
	***Engine parameters and protections***
	***Generator protections***
	***Outputs settings***
	***Inputs settings***
	***ECU settings***
	***Info***

To move up and down in the setup menu use ▲ and ▼ buttons. Press START button to select or STOP button for exit (**Figure 6.4**).

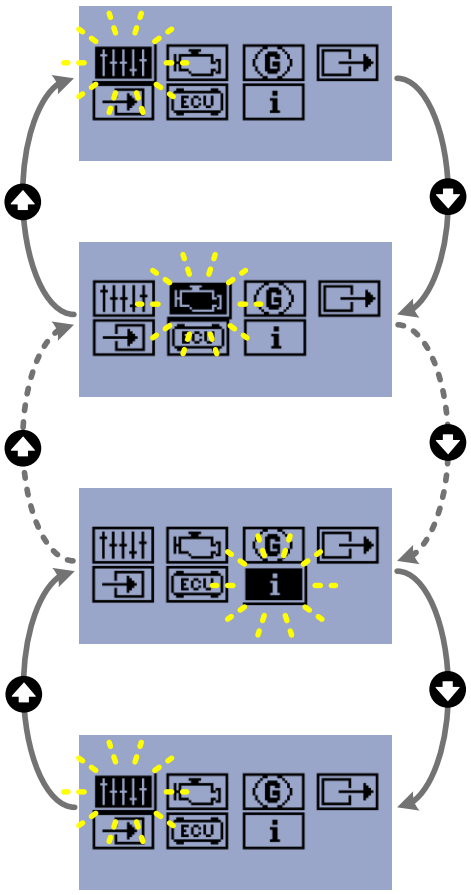


Figure 6.4
setup menu organization

To apply all changes, return to the main setup menu and restart the controller by pressing the STOP button.

7 Inputs and Outputs

In the table below you can see which logical function can be assigned to physical binary or analog input or binary output. Each logical input or output function has unique code. Input code's firs letter is **"I"** output code's letter is **"O"**. Summary of all logical input function is in chapter ***Logical binary and analog inputs***, summary of logical output function is in ***Logical binary outputs***.

Each logical binary input and output can be configured as ***Normally Open*** (NO) or ***Normally Closed*** (NC)

Inputs			
Terminal	**Type**	**Direction**	**Input function assignment**
T04	binary	input	*I01*
T08	binary	input/output	*I00 I04 I07 I10 I11 I12 I13 I14 I15 I20 I22 I24 I29*
T12	binary	input	*I00 I02 I03 I04 I07 I10 I11 I12 I13 I14 I15 I20 I22 I24 I29*
T13	binary/analog	input	*I00 I04 I07 I10 I11 I12 I13 I14 I15 I20 I21 I22 I23 I24 I25 I29*
T14	binary/analog	input	*I00 I04 I07 I10 I11 I12 I13 I14 I15 I20 I21 I22 I23 I24 I25 I29*
T15	binary/analog	input	*I00 I04 I07 I10 I11 I12 I13 I14 I15 I20 I21 I22 I23 I24 I25 I29*

Outputs			
Terminal	**Type**	**Direction**	**Input function assignment**
T05	binary	output	*O00 O01 O02 O09*
T06	binary	output	*O00 O01 O02 O09*
T07	binary	output	*O00 O03 O04 O05 O07 O08 O09 O10 O11 O14 O15 O16 O17*
T08	binary	output/input	*O00 O03 O04 O05 O07 O08 O09 O10 O11 O14 O15 O16 O17*
T09	binary	output	*O00 O03 O04 O05 O07 O08 O09 O10 O11 O14 O15 O16 O17*
T10	binary	output	*O00 O03 O04 O05 O07 O08 O09 O10 O11 O14 O15 O16 O17*

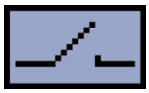
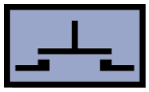
NOTE:
Terminal *T04* is dedicated for *I01 Emergency Stop* only. This function can't be configured to any other input terminal.
Functions *I02 Remote Start/Stop* and *I03 Remote Start And Load* can be configured only to *T12* terminal.
All remaining inputs except for *I21 Fuel Level Analog*, *I25 Coolant Temperature Analog* and *I23 Oil Pressure Analog* can be configured to the controller terminals number *T12*, *T13*, *T14*, *T15* and shared input/output terminal *T08*.

Terminals *T05* and *T06* are dedicated for outputs *O01 Starter*, *O02 Fuel Solenoid* and *O09 ECU PowerRelay* only.
All remaining outputs can be configured to terminals *T07*, *T08*, *T09*, *T10*.

7.1 Normally Open Contact

Normally Open Contact represents a standard opened contact – no voltage on output terminal and no passing current from/to binary input terminal. When the contact is opened the controller reads logical 0 (L) on the binary input. When contact is closed the controller reads a logical 1 (H).

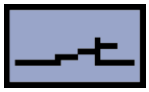
In this case 0V on the binary output represents a logical 0 (L) Battery positive voltage on the output represents a logical 1 (H).

	**Normally Open Contact – output**
	**Normally Open Contact – input button**

7.2 Normally Closed Contact

Normally Closed Contact (inverted) represents a closed contact – positive voltage on output terminal or passing current from/to binary input terminal. When the contact is opened the controller reads logical 1 (H) on the binary input. When the contact is closed the controller reads a logical 0 (L).

In this case 0V on binary output represents a logical 1 (H). Battery positive voltage on the output represents a logical 0 (L).

	**Normally Closed Contact – output**
	**Normally Closed Contact – input button**

8 Outputs settings

8.1 Binary outputs InteliNano^{NT} MRS - default

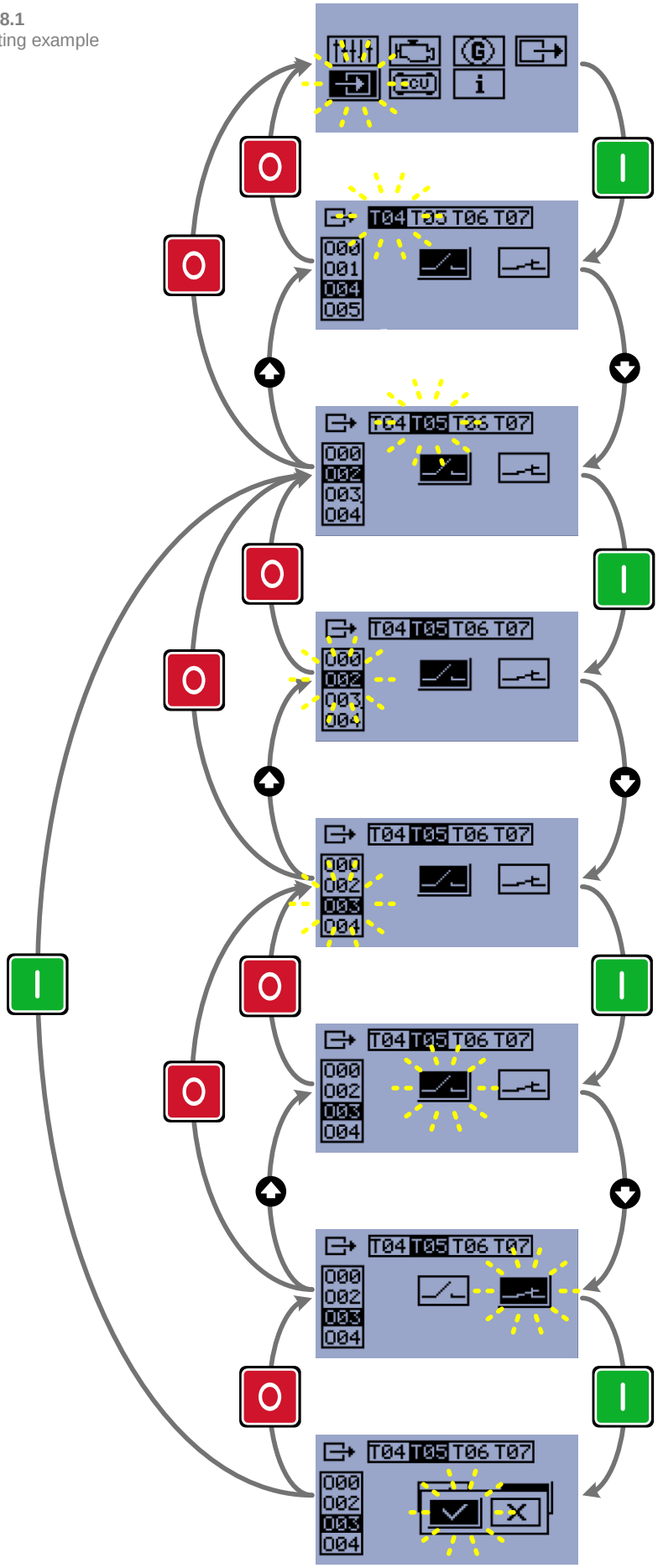
- T05 O01 Starter
- T06 O02 Fuel Solenoid
- T07 O05 GCB Close/Open
- T08 O07 Ready To Load
- T09 O04 Alarm
- T10 O08 Prestart

8.2 Logical binary outputs

Output code	Output name	Type	Terminal assignment
O00	Not Used	binary	T05 T06 T07 T08 T09 T10
O01	Starter	binary	T05 T06
O02	Fuel Solenoid	binary	T05 T06
O03	Stop Solenoid	binary	T07 T08 T09 T10
O04	Alarm	binary	T07 T08 T09 T10
O05	GCB Close/Open	binary	T07 T08 T09 T10
O07	Ready To Load	binary	T07 T08 T09 T10
O08	Prestart	binary	T07 T08 T09 T10
O09	ECU Power Relay	binary	T05 T06 T07 T08 T09 T10
O10	Choke	binary	T07 T08 T09 T10
O11	Glow Plugs	binary	T07 T08 T09 T10
O14	Low Fuel Level Alarm	binary	T07 T08 T09 T10
O15	Common Warning	binary	T07 T08 T09 T10
O16	Common Shutdown	binary	T07 T08 T09 T10
O17	Mode Auto	binary	T07 T08 T09 T10

For the configuration of outputs use the PC software, **NanoEdit,** or switch controller to setup mode. **Figure 8.1** is an example of how to configure a binary output via the controller's screen. First select an output terminal. Then use ▲ and ▼ buttons to select a function. Then press START button to confirm the selection. Lastly press STOP button to return. Then choose a logical function (O00–O17) and select contact type (*Normally Open contact* or *Normally Closed contact*) and confirm the change.

Figure 8.1
binary output setting example

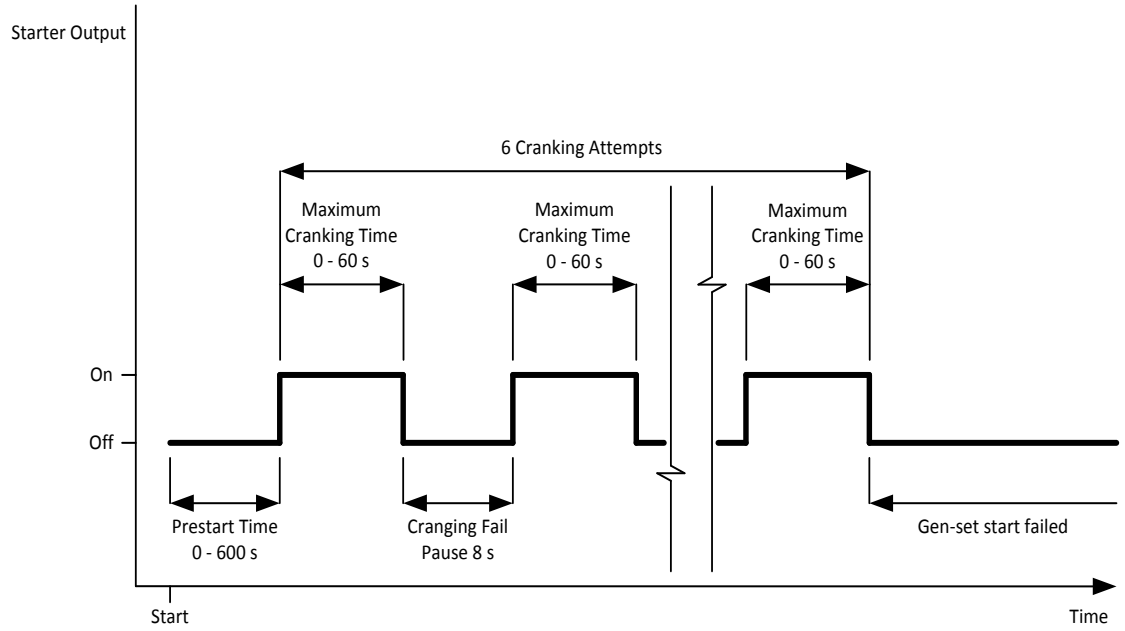


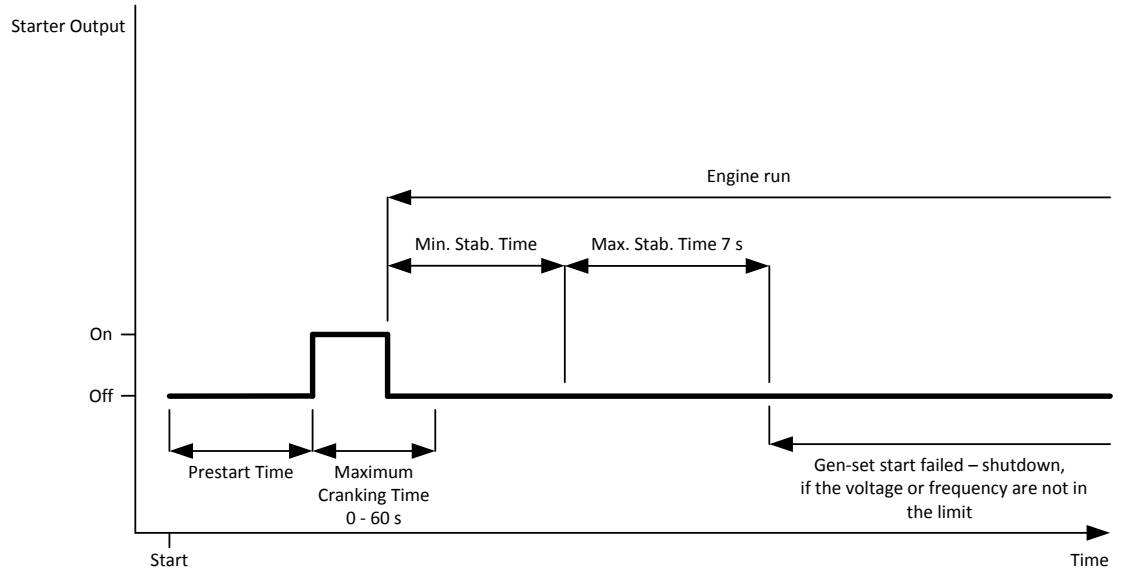
O00 Not Used

Output has no function. Use this configuration when output is not connected.

O01 Starter

This output is dedicated for starter motor control. The number of cranking attempts can be adjusted via ***E12 Cranking Attempts*** setpoint.



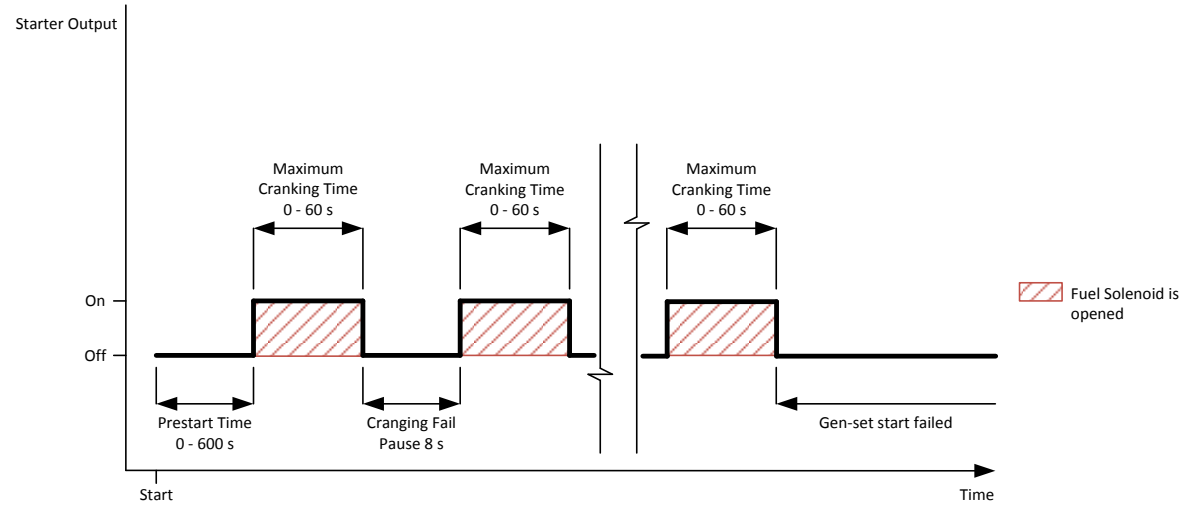


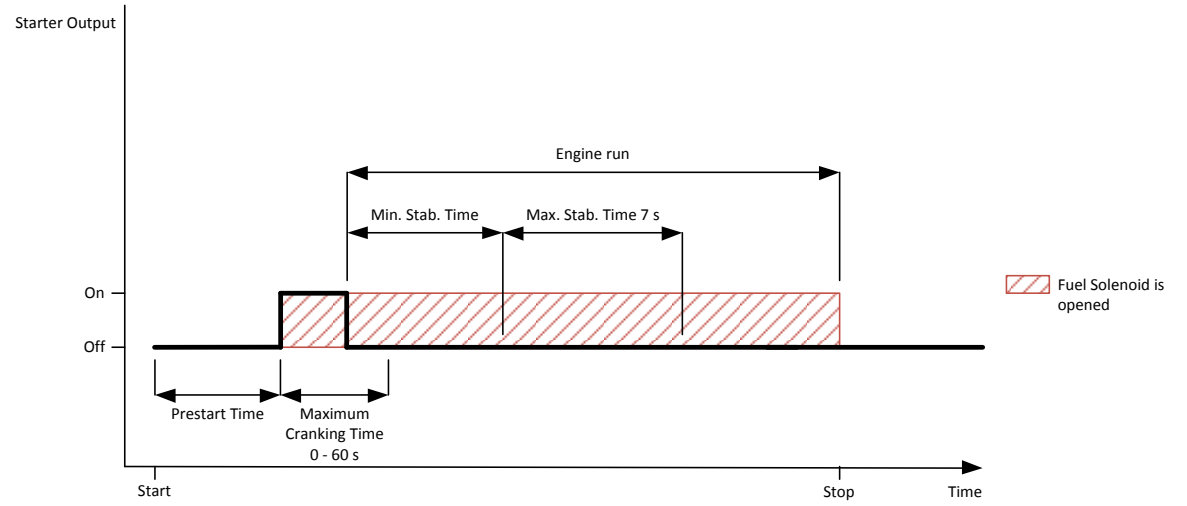
The starter output become inactive when one of following conditions is met:

- RPM ≥ ***E11 Starting RPM*** setpoint (relative to nominal RPM),
- ***I23 Oil Pressure Analog*** ≥ 3 bar (43 PSI), only when ***E08 Oil Pressure Starter Disengagement*** is enabled,
- ***I22 Low Oil Pressure*** input is opened, only when ***E08 Oil Pressure Starter Disengagement*** is enabled
- voltage on D+ terminal ***T02*** ≥ 80% of battery voltage for 1 s or longer.

O02 Fuel Solenoid

This output is dedicated to control the fuel solenoid (valve). The output is closed in the same time as ***O01 Starter*** output and remains closed while the engine is running.



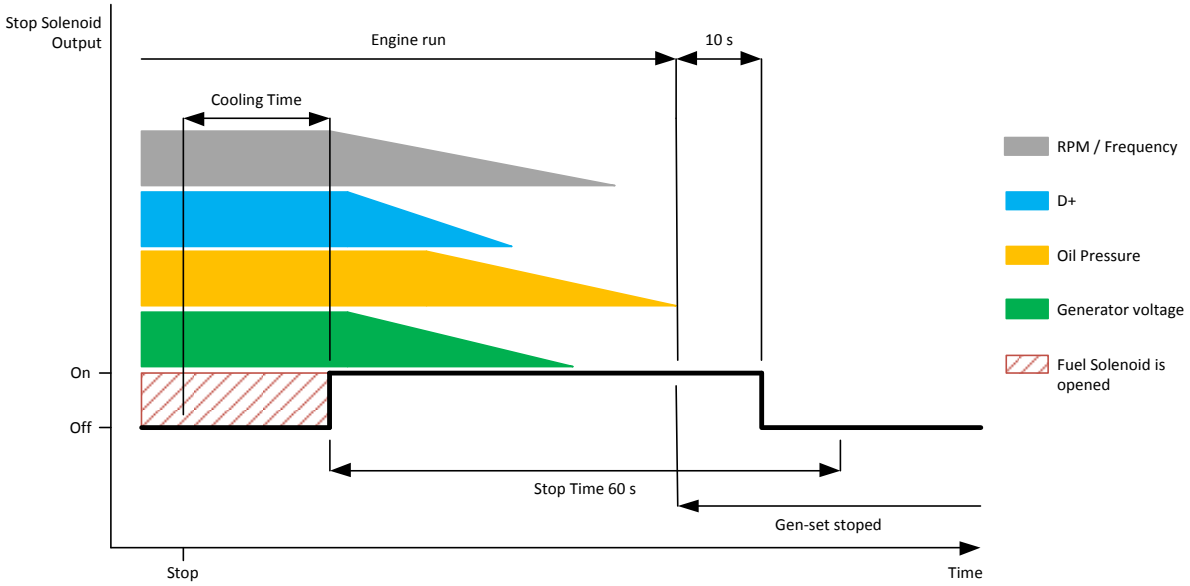


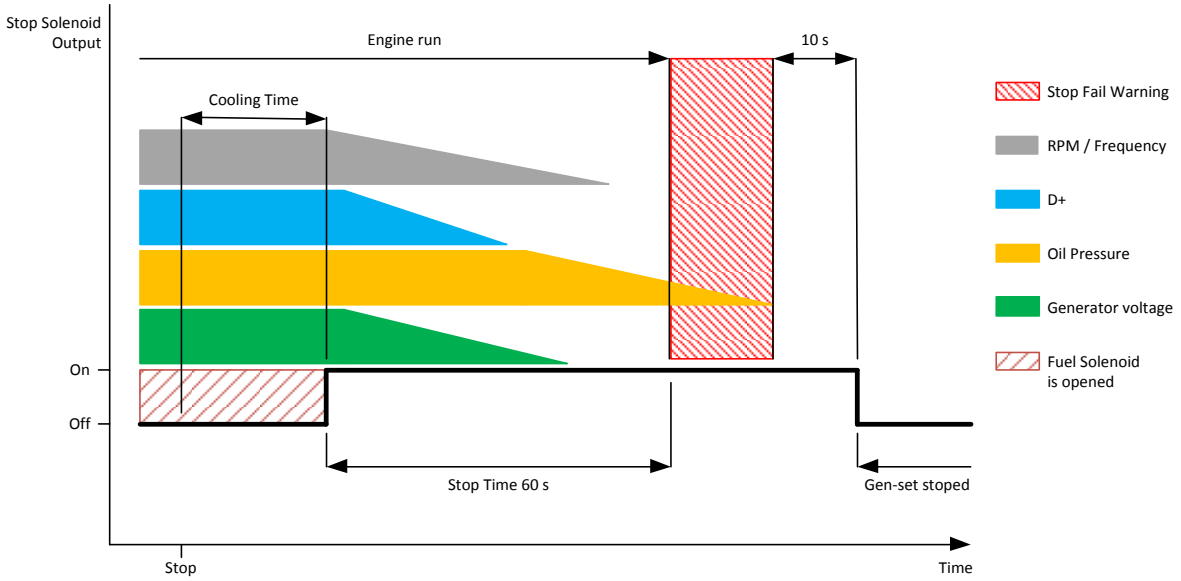
O03 Stop Solenoid

This output is dedicated to control the stop solenoid (valve). The output closes when an engine stop command is received and remains active until the gen-set is stopped.

The engine is stopped if:

- **RPM < 2**
  and
- **Generator voltage < 10V**
  and
- **Oil pressure < 3 Bar. (43 PSI)**



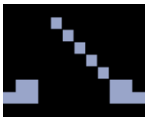


O04 Alarm

The output is to be used for external alarm indication. The output is active when at least one unconfirmed and active alarm is present in the event log.

O05 GCB Close/Open

This output is to be used for a contactor control in case a contactor is used in the GCB position.
GCB position is indicated on the mains screen when feedback is configured.
Wrong breaker / contactor position is indicated on mains screen also.



GCB is opened but has to be close.

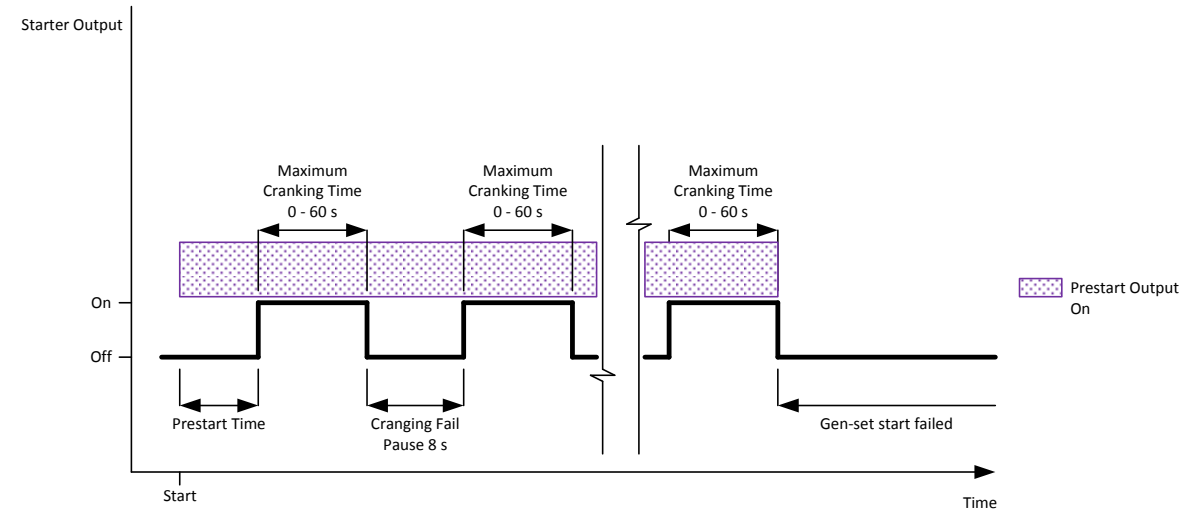
GCB is closed but has to be open.

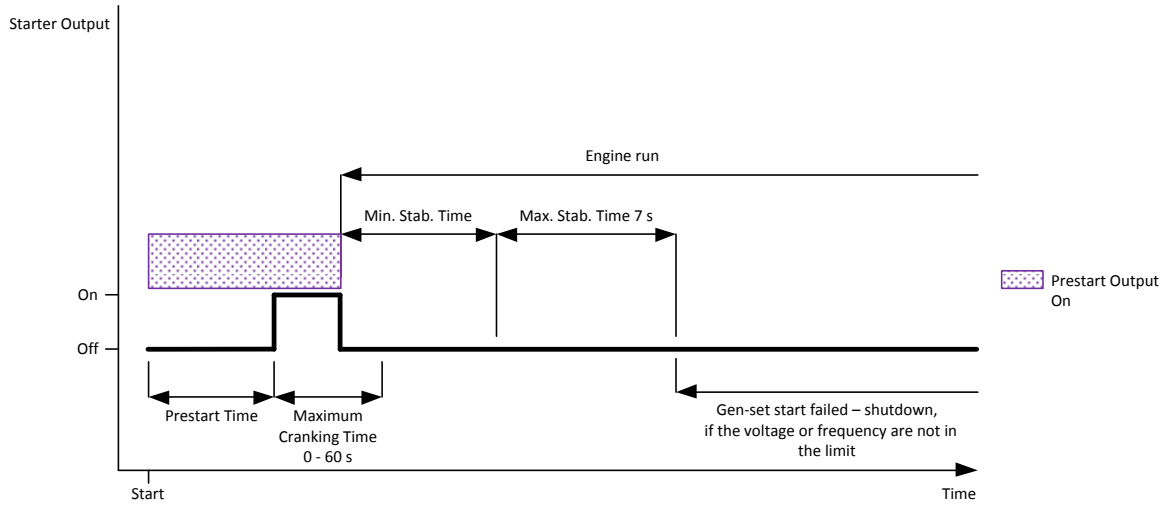
O07 Ready To Load

The output is activated when gen-set is running and all electrical values are in limits and no shutdown alarms are active - it is possible to close GCB or it is already closed. The output opens during cooling state or when ***Emergency Stop*** or any shutdown is active.

O08 Prestart

The output is activated while engine is cranking, but prior to the engine start. It is deactivated when ***E11 Starting RPM*** value of Nominal RPM speed is reached. This output is typically used for pre-heat or pre-lubrication.





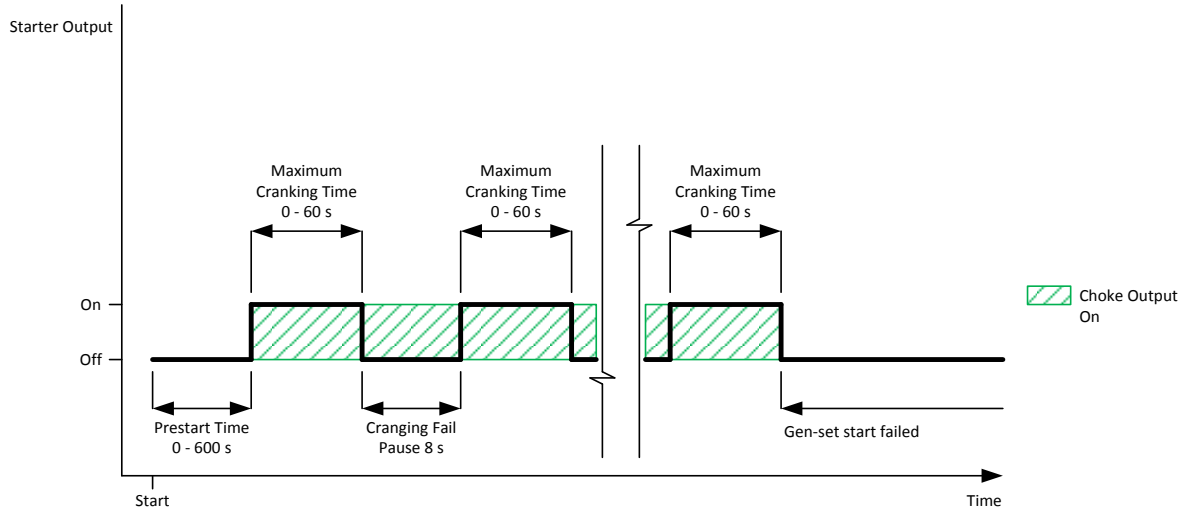
O09 ECU Power Relay

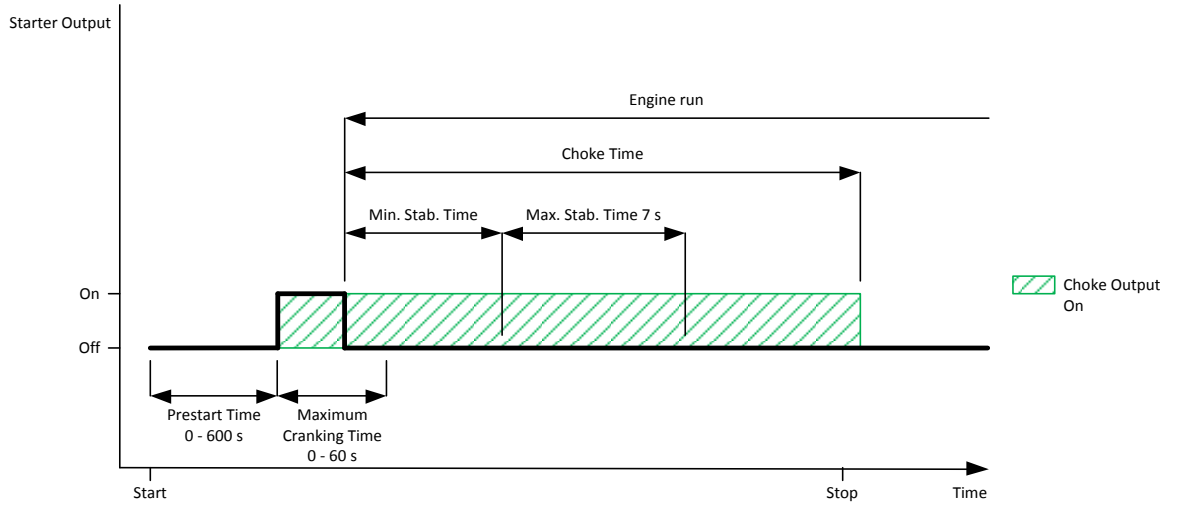
This output is to be used for "keyswitch" input to the ECU. If the particular ECU does not have keyswitch or similar input, it can be used for control of DC power for the ECU.
The output closes together with ***O08 Prestart*** and remains closed while the engine is running. It is opened when a stop command is received. (i.e. together with the ***O02 Fuel Solenoid***).

NOTE:
The controller does not evaluate the communication failure alarm during the period when this output is not active.

O10 Choke

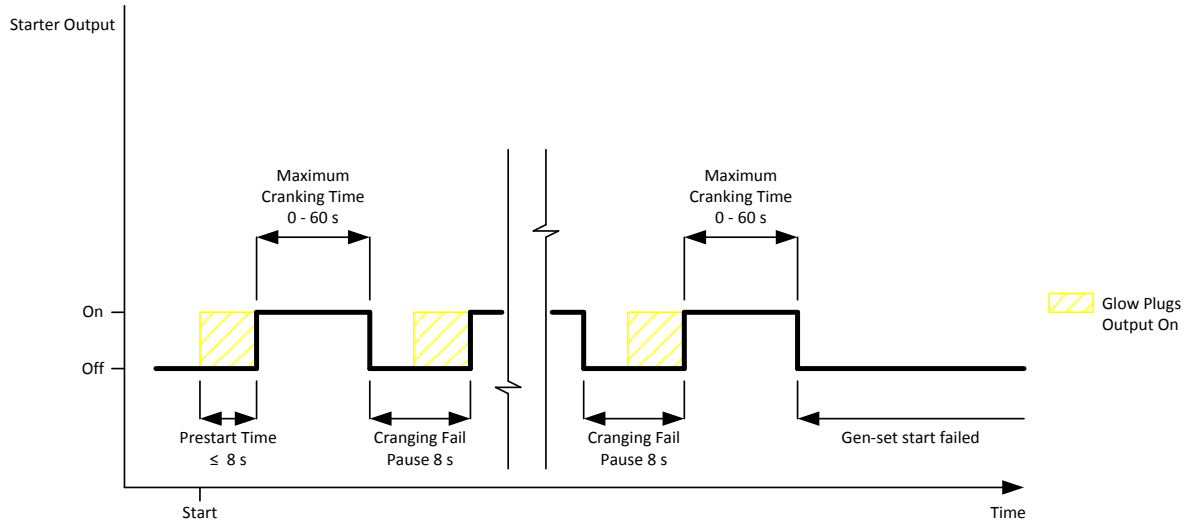
The output is activated while engine is cranking and between cranking attempts. Choke Time (timer) will start on engine run. The Choke output will close when Choke Time elapsed.

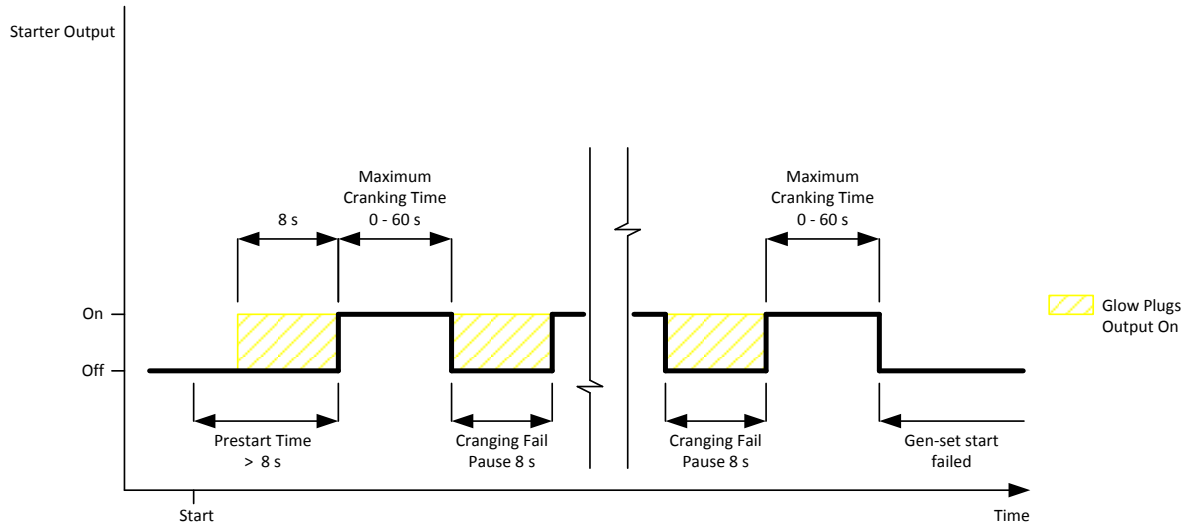


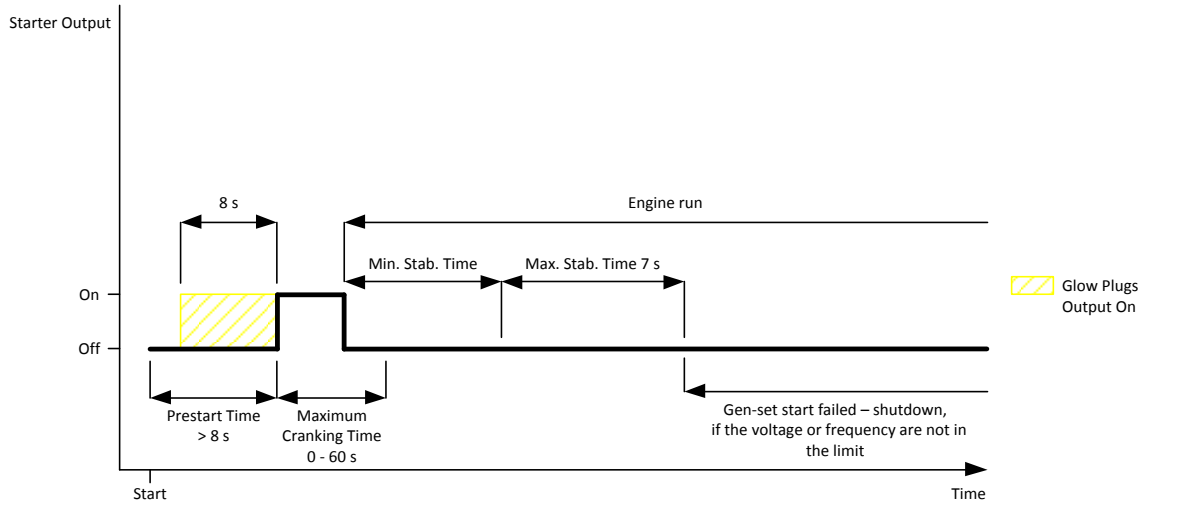


O11 Glow Plugs

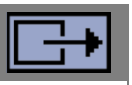
This output is activated before each cranking procedure for Prestart Time but maximally for 8s!





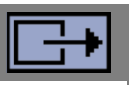


O14 Low Fuel Level Alarm



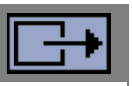
This output is activated when ***Low Fuel Level*** warning is active or when ***Fuel Level SD*** shutdown is active and/or unconfirmed.

O15 Common Warning



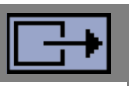
This output is activated when any warning alarm is active.

O16 Common Shutdown



This output is activated when any shutdown alarm is active and/or unconfirmed.

O17 Mode Auto



This output is active whenever the controller is in Auto mode.

9 Inputs settings

9.1 Binary and analog inputs InteliNano^{NT} MRS - default

- *T04* *I01 Emergency Stop* – *Normally Closed contact*
- *T08* *I00 Not Used* – terminal is configured as output
- *T12* *I03 Remote Start And Load*
- *T13* *I21 Fuel Level Analog* – VDO Level %
- *T14* *I25 Coolant Temperature Analog* – VDO 40–120 °C
- *T15* *I23 Oil Pressure Analog* – VDO 10 bar

9.2 Logical binary and analog inputs

Input code	Input name	Type	Terminal assignment
I00	*Not Used*	binary	*T08* *T12* *T13* *T14* *T15*
I01	*Emergency Stop*	binary	*T04*
I02	*Remote Start/Stop*	binary	*T12*
I03	*Remote Start And Load*	binary	*T12*
I04	*Access Lock*	binary	*T08* *T12* *T13* *T14* *T15*
I07	*GCB Feedback*	binary	*T08* *T12* *T13* *T14* *T15*
I10	*External Warning 1*	binary	*T08* *T12* *T13* *T14* *T15*
I11	*External Warning 2*	binary	*T08* *T12* *T13* *T14* *T15*
I12	*External Warning 3*	binary	*T08* *T12* *T13* *T14* *T15*
I13	*External Shutdown 1*	binary	*T08* *T12* *T13* *T14* *T15*
I14	*External Shutdown 2*	binary	*T08* *T12* *T13* *T14* *T15*
I15	*External Shutdown 3*	binary	*T08* *T12* *T13* *T14* *T15*
I20	*Low Fuel Level*	binary	*T08* *T12* *T13* *T14* *T15*
I21	*Fuel Level Analog*	analog	*T13* *T14* *T15*
I22	*Low Oil Pressure*	binary	*T08* *T12* *T13* *T14* *T15*
I23	*Oil Pressure Analog*	analog	*T13* *T14* *T15*
I24	*High Coolant Temperature*	binary	*T08* *T12* *T13* *T14* *T15*
I25	*Coolant Temperature Analog*	analog	*T13* *T14* *T15*
I29	*Fuel Level SD*	Binary	*T08* *T12* *T13* *T14* *T15*

For the configuration of inputs use the PC software, **NanoEdit,** or switch the controller to setup mode. is an example of how to configure a binary input via the controller's screen. First select an input terminal. Then use ▲ and ▼ buttons to select a function. Then press START button to confirm the selection. Lastly press STOP button to return. Then choose a logical function (*I00*–*I20* or *I22* or *I24*) and select contact type (*Normally Open contact* or *Normally Closed contact*) and confirm change. **Figure 9.2** is an example of how to configure a binary input as analog.

Figure 9.1
binary input setting example

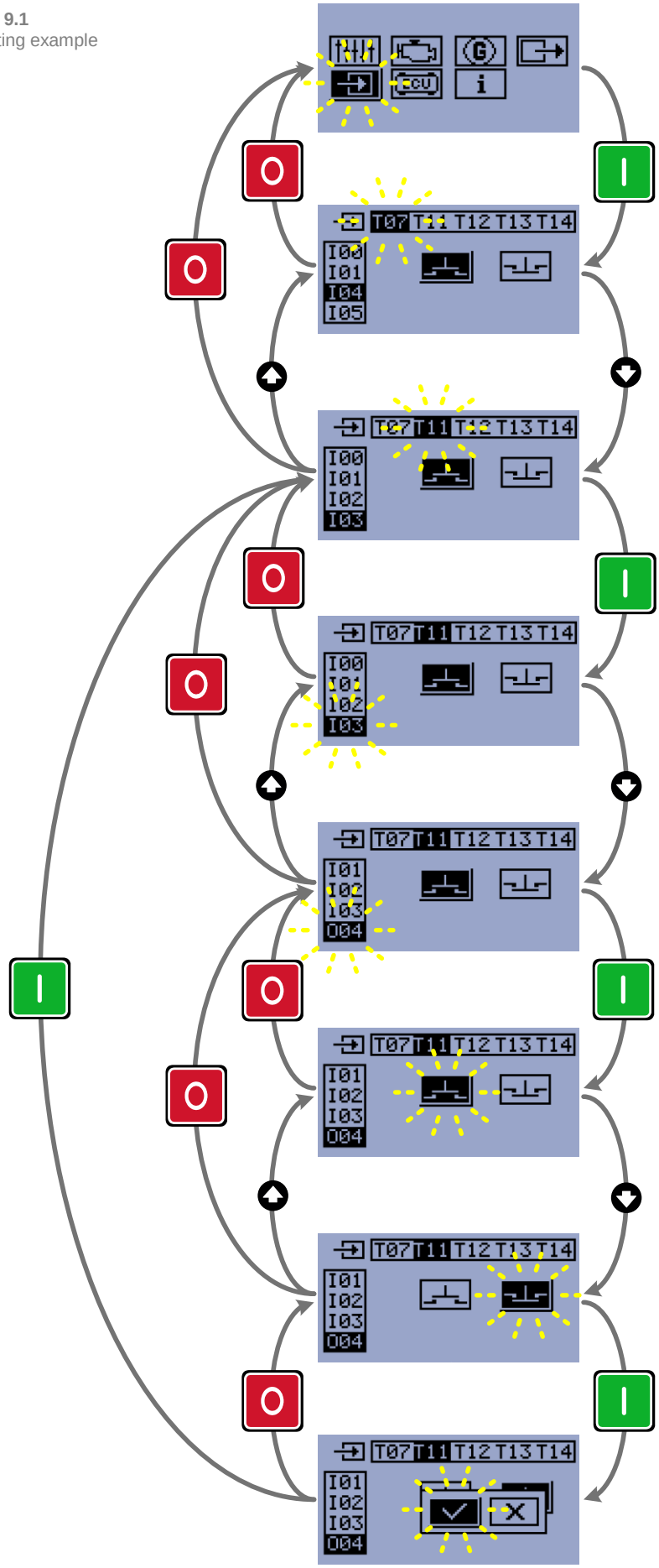
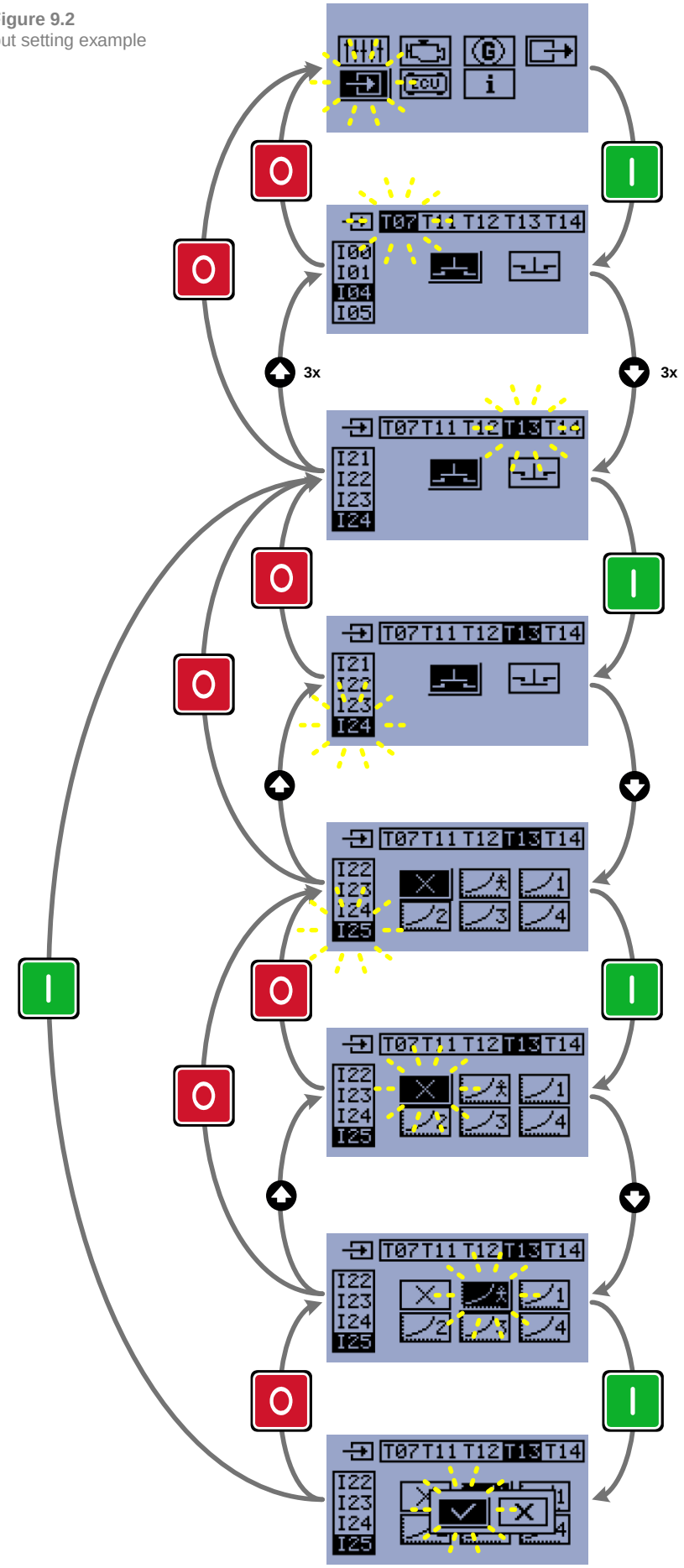
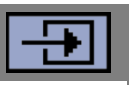


Figure 9.2
analog input setting example



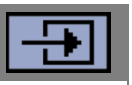
I00 Not Used



Input has no function. Use this configuration when binary or analog input is not connected.

NOTE:
T08 is input/output terminal. Primarily it is configured as an output. To configure as an input, assign the function ***O00 Not Used*** in the output configuration for this terminal.

I01 Emergency Stop

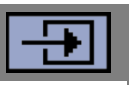


This input will activate the built-in ***Emergency Stop*** alarm. This input can be configured to terminal ***T04*** only. It is only possible to use a ***Normally Closed*** contact type for this input.

If this binary input is activated, the left red LED above STOP button will blink, the general shutdown symbol will be displayed on LCD's upper right corner, ***Emergency Stop*** symbol will be displayed on event log with running hours stamp and shut down procedure will occur. For more details see Shutdown procedure in chapter ***12 Alarm, Events and History Management***.

CAUTION!
This is a software function only. But with opening ***T04*** terminal ***T05*** and ***T06*** terminals (used for Starter and Fuel Solenoid outputs) will be unenergized which should lead to engine stop.

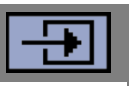
I02 Remote Start/Stop



This input is an external request for engine to run and stop. It is evaluated in **Auto** mode only.
When this input is activated, controller starts the engine and keeps the GCB open. ***Remote Start*** event is written into history log.
When this input is deactivated, controller stops the engine. ***Remote Stop*** event is written into history log.

NOTE:
The Remote Start/stop can be configured only on terminal ***T12*** This is also used for waking the controller from "Zero Power" mode.

I03 Remote Start And Load



The Remote Start And Load input can be used only when the controller is in **Auto** mode.

This input starts engine and closes the GCB (only when is configured) after all engines and generator parameters are within tolerance. ***Remote Start*** event is written into history log.
When this input is deactivated the controller will open the breaker (only when is configured) and stop the engine. ***Remote Stop*** event is written into history log.

NOTE:
The Remote Start And Load can be configured only on terminal ***T12***. This is also used for waking the controller from "Zero Power" mode.

I04 Access Lock

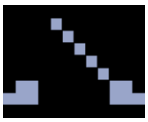
When this input is closed, no setpoints can be adjusted from controller's front panel and gen-set mode (**Manual** / **Auto**) cannot be changed.
Access Lock does not protect setpoints changing using **NanoEdit**. Also history is accessible.
Access Lock is also functionless in case that the controller is already in setup mode.

I07 GCB Feedback

This is an input from the generator circuit breaker. If the input is active, the controller will consider the GCB as closed and vice versa. If the GCB is not in expected position, the alarm ***GCB Fail*** will occur. For more details see ***Shutdown procedure*** in chapter ***12 Alarm, Events and History Management***.

NOTE:
The feedback time limit is 5s.

GCB position is indicated on the mains screen when feedback is configured.



GCB is opened but has to be closed.

GCB is closed but has to be opened.

I10 External Warning 1

If this binary input is activated the red LED above STOP button will blink, general warning symbol will be displayed on LCD's upper right corner and ***External Warning 1*** symbol will be displayed on event log with running hours stamp. This alarm is only warning. For more details see ***Warning procedure*** in chapter ***12 Alarm, Events and History Management***.

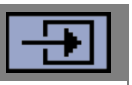
I11 External Warning 2

If this binary input is activated the red LED above STOP button will blink, general warning symbol will be displayed on LCD's upper right corner and ***External Warning 2*** symbol will be displayed on event log with running hours stamp. This alarm is only warning. For more details see ***Warning procedure*** in chapter ***12 Alarm, Events and History Management***.

I12 External Warning 3

If this binary input is activated left red LED above STOP button will blink, general warning symbol will be displayed on LCD's upper right corner and ***External Warning 3*** symbol will be displayed on event log with running hours stamp. This alarm is only warning. For more details see ***Warning procedure*** in chapter ***12 Alarm, Events and History Management***.

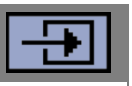
I13 External Shutdown 1



When this binary input is activated the red LED above STOP button will blink, general shutdown symbol will be displayed on LCD's upper right corner, ***External Shutdown 1*** symbol will be displayed on event log with running hours stamp, and the shut down procedure will occur. For more details see ***Shutdown procedure*** in chapter ***12 Alarm, Events and History Management***.

CAUTION!
This is a software function only.

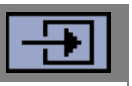
I14 External Shutdown 2



When this binary input is activated the red LED above STOP button will blink, general shutdown symbol will be displayed on LCD's upper right corner, ***External Shutdown 2*** symbol will be displayed on event log with running hours stamp, and the shut down procedure will occur. For more details see ***Shutdown procedure*** in chapter ***12 Alarm, Events and History Management***.

CAUTION!
This is a software function only.

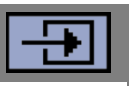
I15 External Shutdown 3



When this binary input is activated the red LED above STOP button will blink, general shutdown symbol will be displayed on LCD's upper right corner, ***External Shutdown 3*** symbol will be displayed on event log with running hours stamp, and the shut down procedure will occur. For more details see ***Shutdown procedure*** in chapter ***12 Alarm, Events and History Management***.

CAUTION!
This is a software function only.

I20 Low Fuel Level



When this binary input is activated the red LED above STOP button will blink, the general warning symbol will be displayed on LCD's upper right corner, and ***Low Fuel Level*** symbol will be displayed on event log with running hours stamp. This alarm is only warning. For more details see ***Warning procedure*** in chapter ***12 Alarm, Events and History Management***.

NOTE:
Input has 10s delay.

I21 Fuel Level Analog

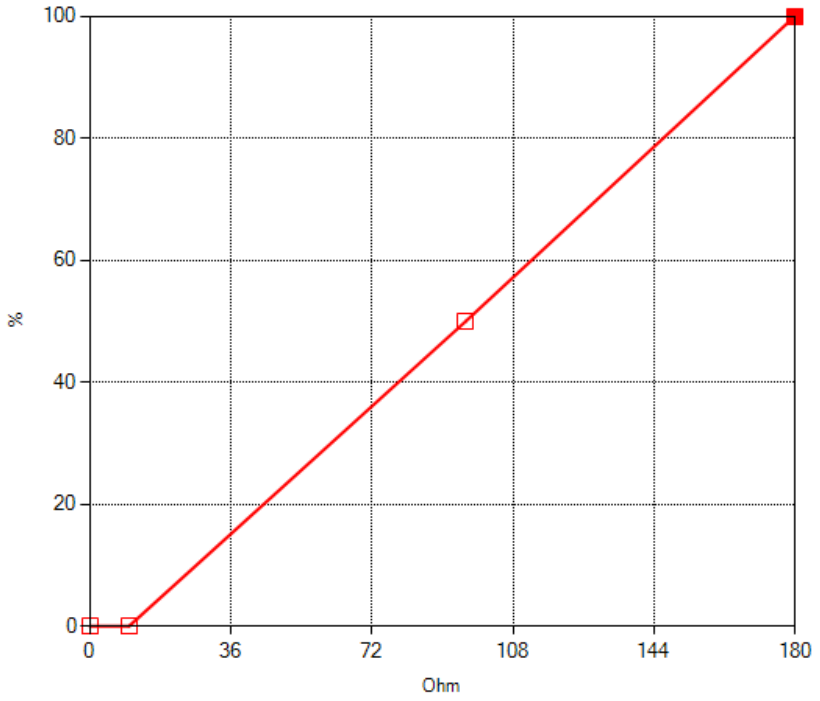
Analog input for fuel level measurement. When measured value exceeds the preset threshold ***E15 Fuel Level Shutdown***, the left red LED above STOP button will blink, the general warning symbol will be displayed on LCD's upper right corner, and fuel level symbol will be displayed on event log with running hours stamp. This alarm is only warning. For more details see ***Warning procedure*** in chapter ***12 Alarm, Events and History Management***.

Threshold for ***Low Fuel Level*** warning is 20 % of measurement range.

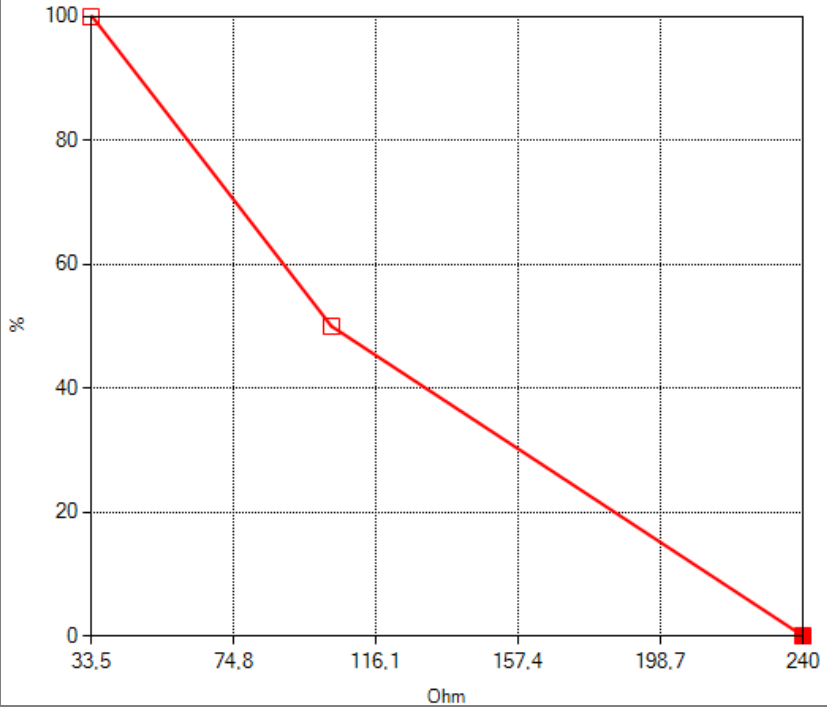
You can choose one from two preset resistive sensors (VDO, Datcon) or you can create your own sensor curve.

NOTE:
Input has 10s delay.

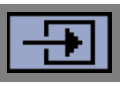
VDO Level %		
	Ohm	%
1	0	0
2	10	0
3	96	50
4	180	100



Datcon Level %		
	Ohm	%
1	33,5	100
2	103	50
3	240	0



I22 Low Oil Pressure



When this binary input is activated the red LED above STOP button will blink, the general shutdown symbol will be displayed on LCD's upper right corner, the oil pressure symbol will be displayed on event log with running hours stamp, and the shutdown procedure will occur. For more details see ***Shutdown procedure*** in chapter ***12 Alarm, Events and History Management***.

Evaluation of the protection is delayed for 1s.

I23 Oil Pressure Analog

Analog input for oil pressure measurement. When the measured value exceeds the preset threshold the red LED above STOP button will blink, the general shutdown symbol will be displayed on LCD's upper right corner, the oil pressure symbol will be displayed on event log with running hours stamp and the shutdown procedure will occur. For more details see ***Shutdown procedure*** in chapter ***12 Alarm, Events and History Management***.

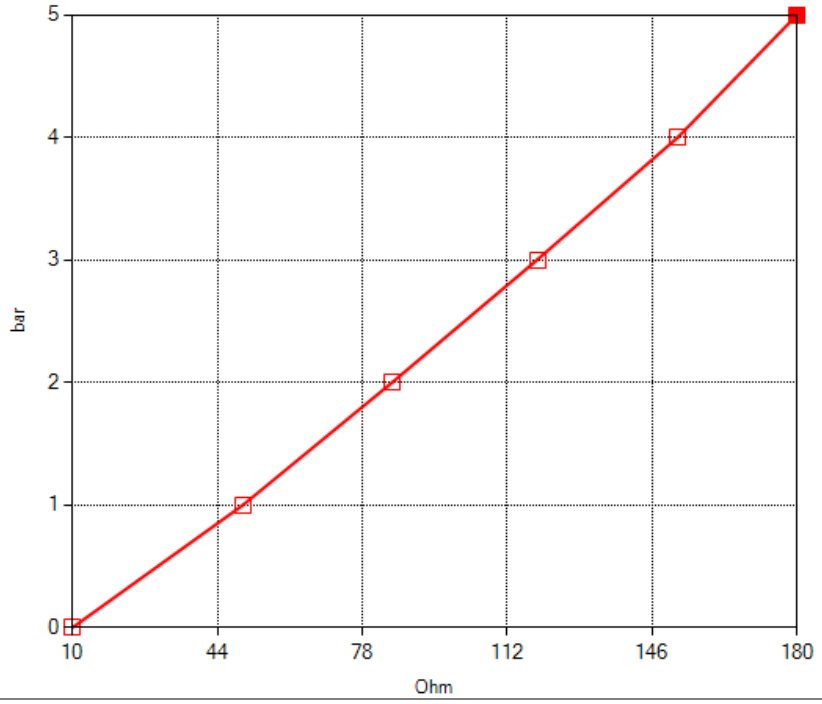
Default threshold is 1 bar.

You can choose one from five default resistive sensors (VDO, Datcon) or you can create your own sensor curve.

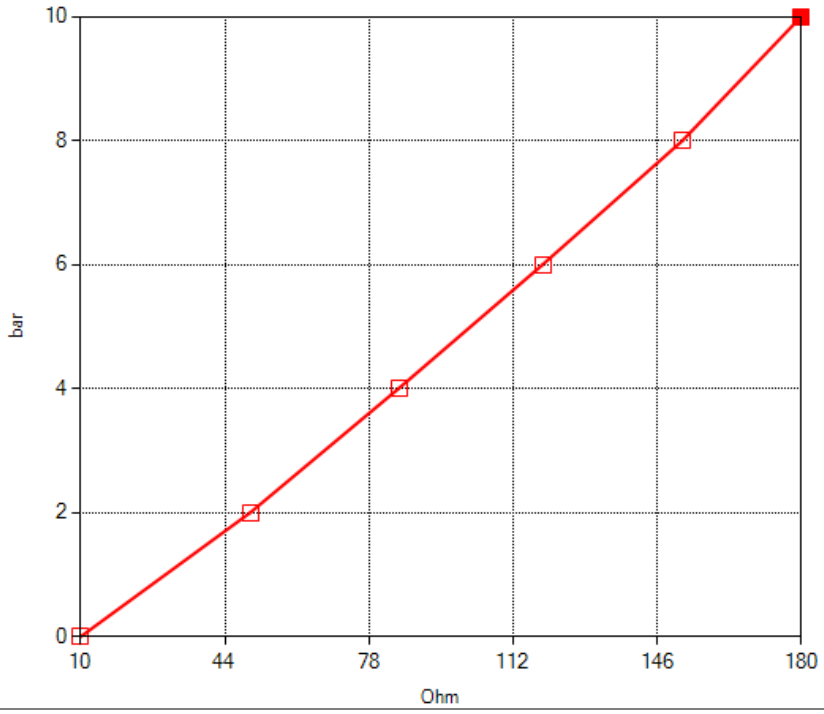
You can setup shutdown threshold (***E04 Oil Pressure Shutdown***) in Engine parameters and protection group.

NOTE:
Input has 3s delay.

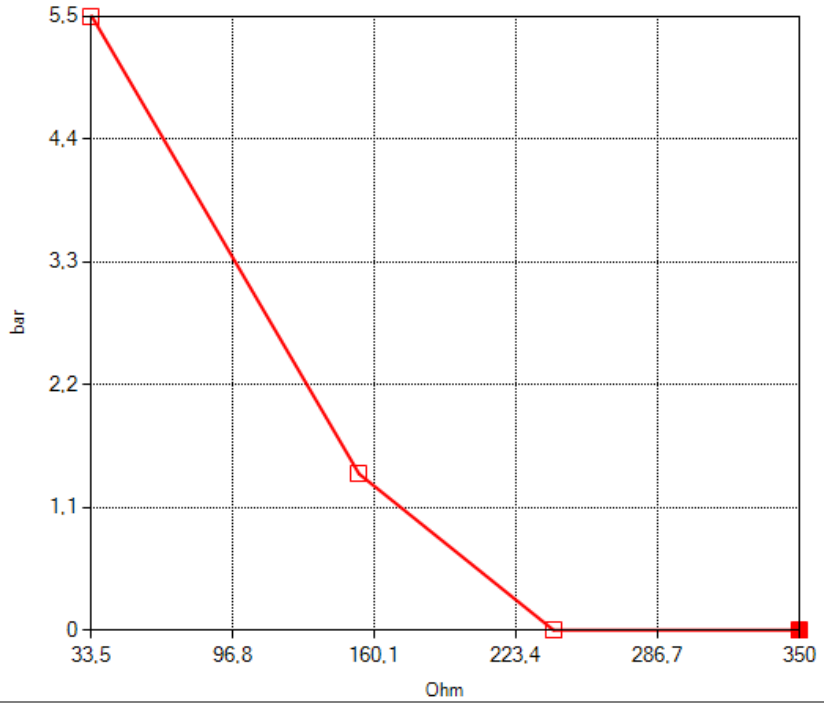
VDO 5 Bar		
	Ohm	Bar
1	10	0
2	50	1
3	85	2
4	119	3
5	152	4
6	180	5



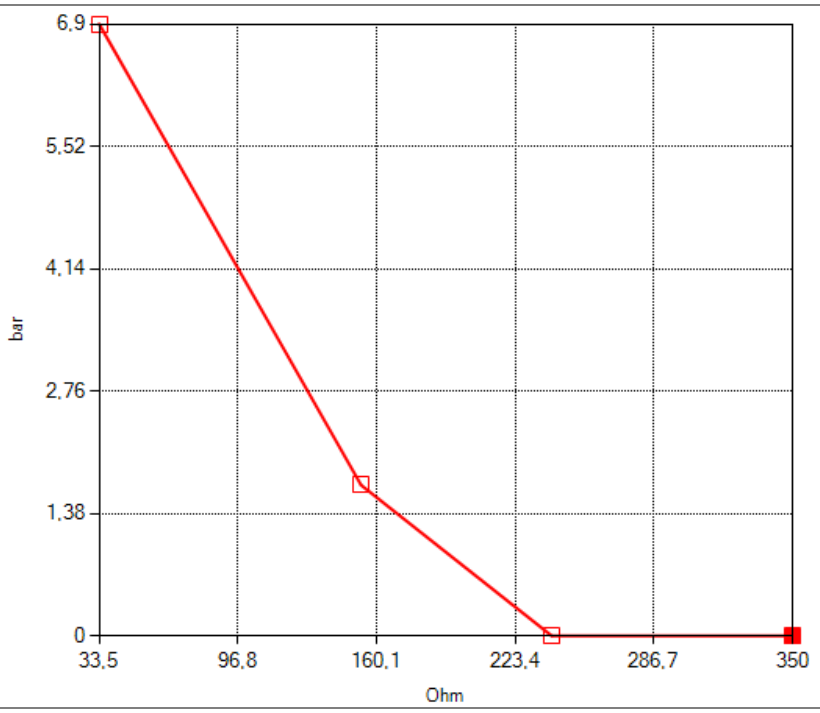
VDO 10 Bar		
	Ohm	Bar
1	10	0
2	50	2
3	85	4
4	119	6
5	152	8
6	180	10



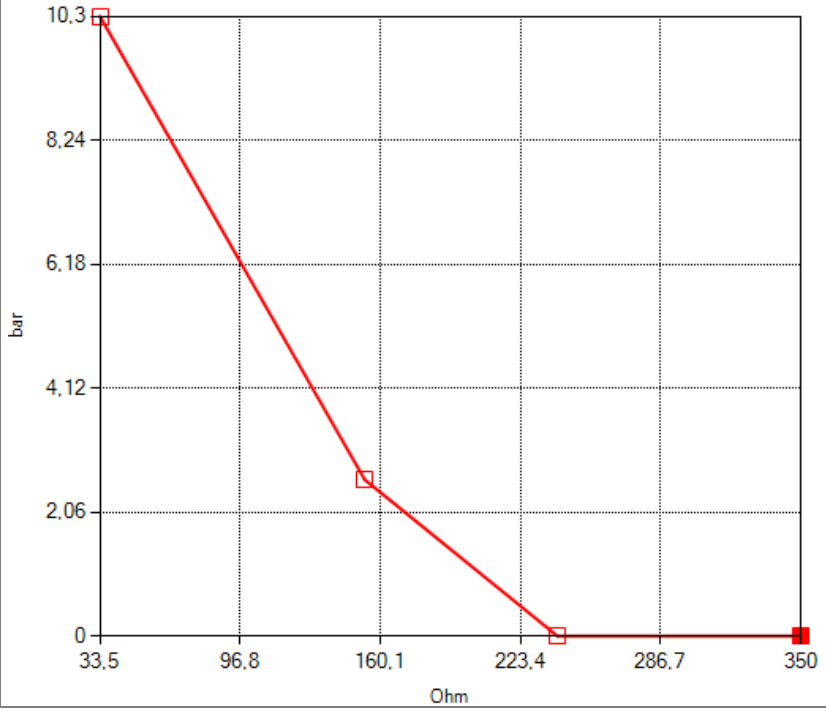
Datcon 5 Bar		
	Ohm	Bar
1	33,5	5,5
2	153	1,4
3	240	0
4	350	0



Datcon 7 Bar		
	Ohm	Bar
1	33,5	6,9
2	153	1,7
3	240	0
4	350	0



Datcon 10 Bar		
	Ohm	Bar
1	33,5	10,3
2	153	2,6
3	240	0
4	350	0



I24 High Coolant Temperature

When this external binary input is activated the red LED above STOP button will blink, the general shutdown symbol will be displayed on LCD's upper right corner, the ***High Coolant Temperature*** shutdown symbol will be displayed on event log with running hours stamp, and the shutdown procedure will occur. For more details see ***Shutdown procedure*** in chapter ***12 Alarm, Events and History Management***.

I25 Coolant Temperature Analog

Analog input for coolant temperature measurement. When the measured value exceeds the preset threshold, the red LED above STOP button will blink, the general shutdown symbol will be displayed on the LCD's upper right corner, the coolant temperature symbol will be displayed on event log with running hours stamp, and the shutdown procedure will occur. For more details see ***Shutdown procedure*** in chapter ***12 Alarm, Events and History Management***.

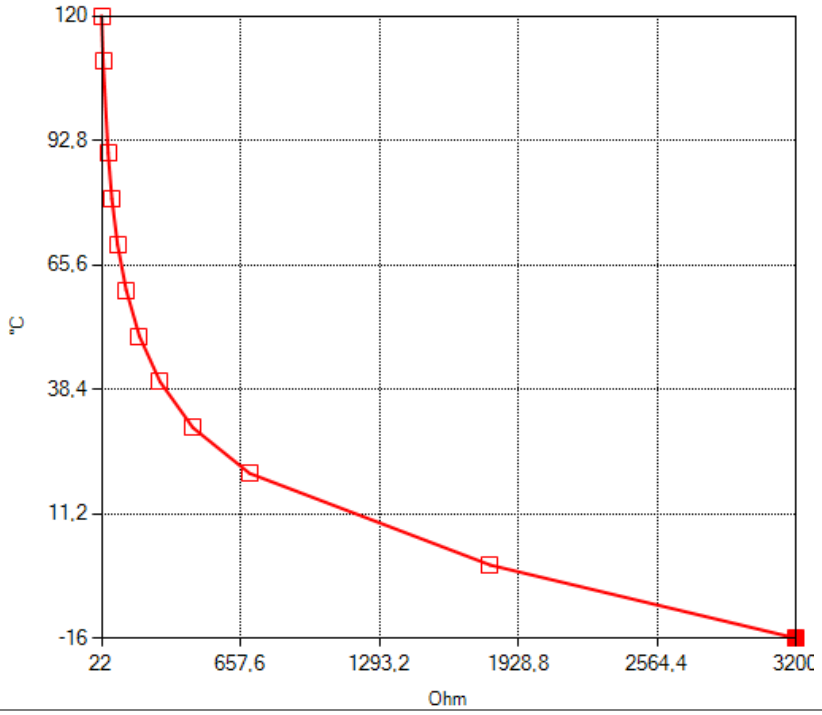
Default threshold is 90 °C.

You can choose one from four default resistive sensors (VDO, Datcon) or you can create your own sensor curve.

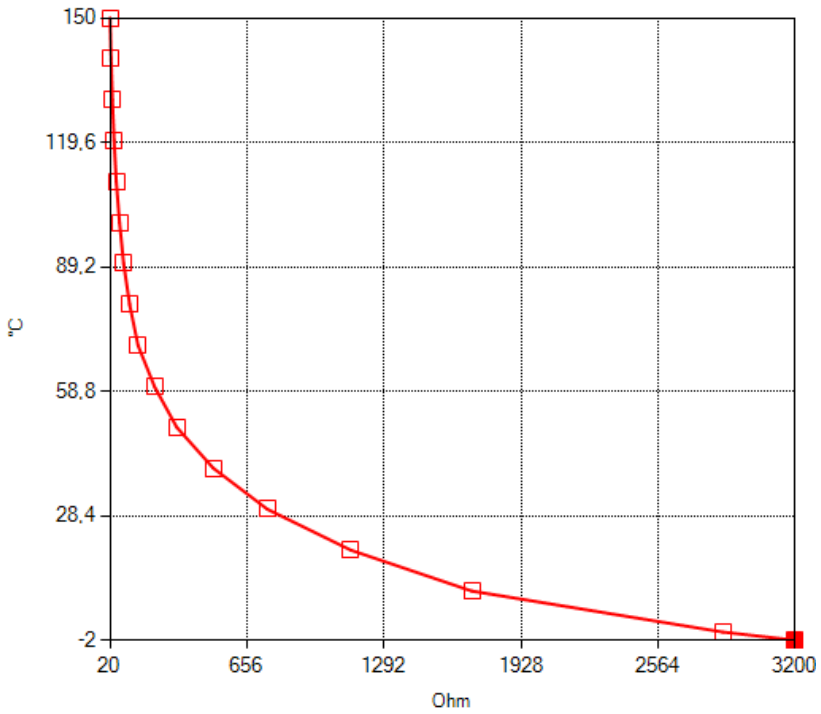
You can setup shutdown threshold (***E05 Coolant Temperature Shutdown***) in Engine parameters and protection group.

NOTE:
Input has 5s delay.

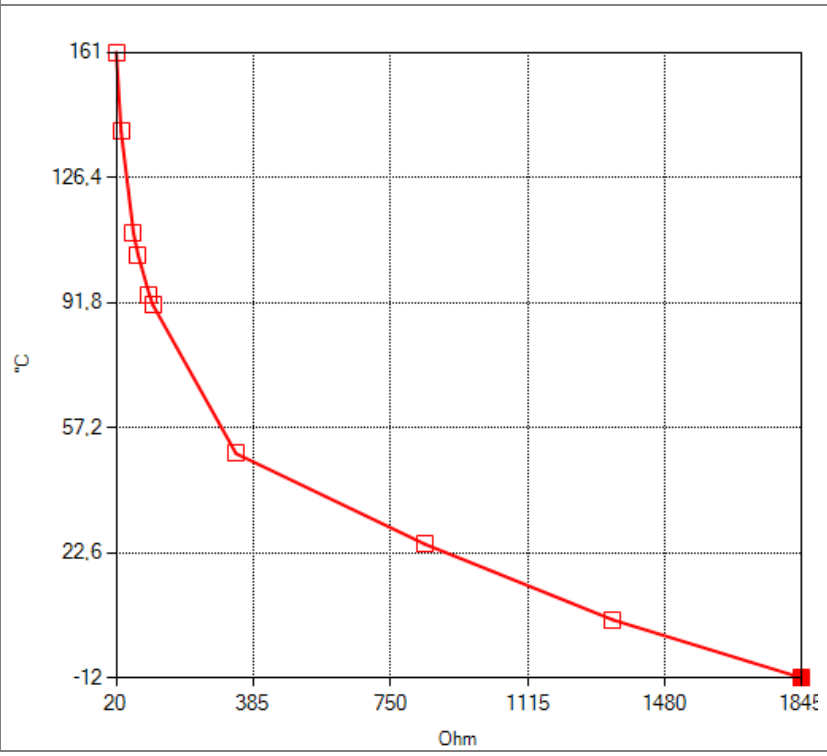
VDO 40-120 °C		
	Ohm	°C
1	22	120
2	29	110
3	52	90
4	69	80
5	95	70
6	135	60
7	195	50
8	290	40
9	440	30
10	700	20
11	1800	0
12	3200	-16



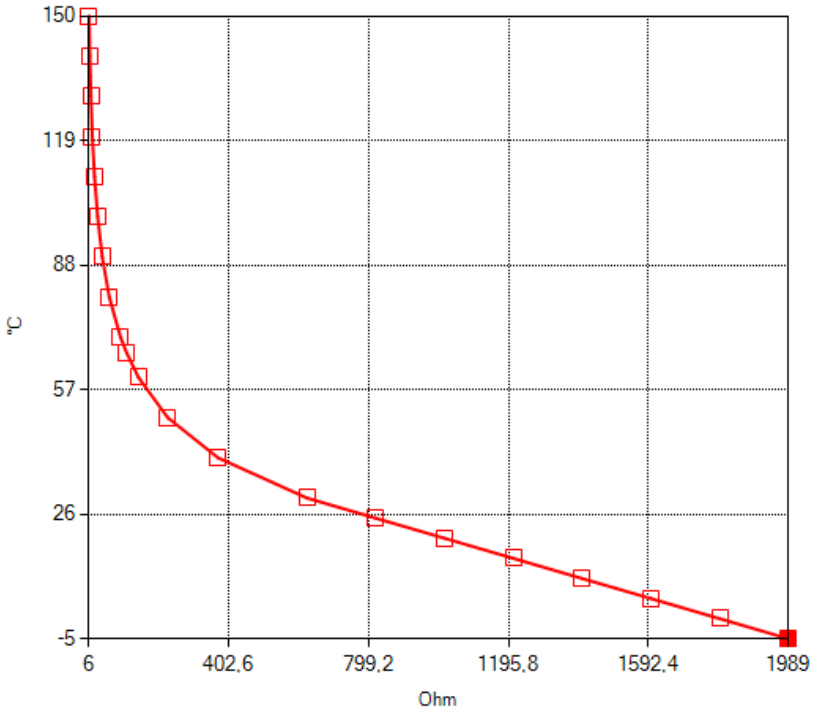
VDO 50-150 °C		
	Ohm	°C
1	20	150
2	25	140
3	31	130
4	39	120
5	49	110
6	64	100
7	83	90
8	111	80
9	150	70
10	226	60
11	330	50
12	500	40
13	750	30
14	1138	20
15	1700	10
16	2865	0
17	3200	-2



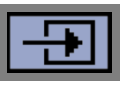
Datcon High °C		
	Ohm	°C
1	20	161
2	30	139
3	66	111
4	78	105
5	108	94
6	118	91
7	339	50
8	841	25
9	1343	4
10	1845	-12



Datcon Low °C		
	Ohm	°C
1	6	150
2	8	140
3	11	130
4	15	120
5	21	110
6	30	100
7	43	90
8	63	80
9	95	70
10	113	66
11	146	60
12	229	50
13	372	40
14	624	30
15	819	25
16	1014	20
17	1209	15
18	1404	10
19	1599	5
20	1794	0
21	1989	-5



I29 Fuel Level SD



When this binary input is activated the red LED above STOP button will blink, the general warning symbol will be displayed on LCD's upper right corner. ***Fuel Level SD*** symbol will be displayed on event log with running hours stamp and ***Shutdown procedure*** will occur.

Input has 10s delay.

10 Setpoints

Setpoints are analog, binary, or special data objects that are used for adjusting the controller to the specific environment or application. Setpoints are separated into groups according to their function. Setpoints can be adjusted from the controller‘s front panel or from a PC. **Figure 10.1** is an example of how to change the Nominal Frequency from 50Hz to 60Hz via controller’s front panel.

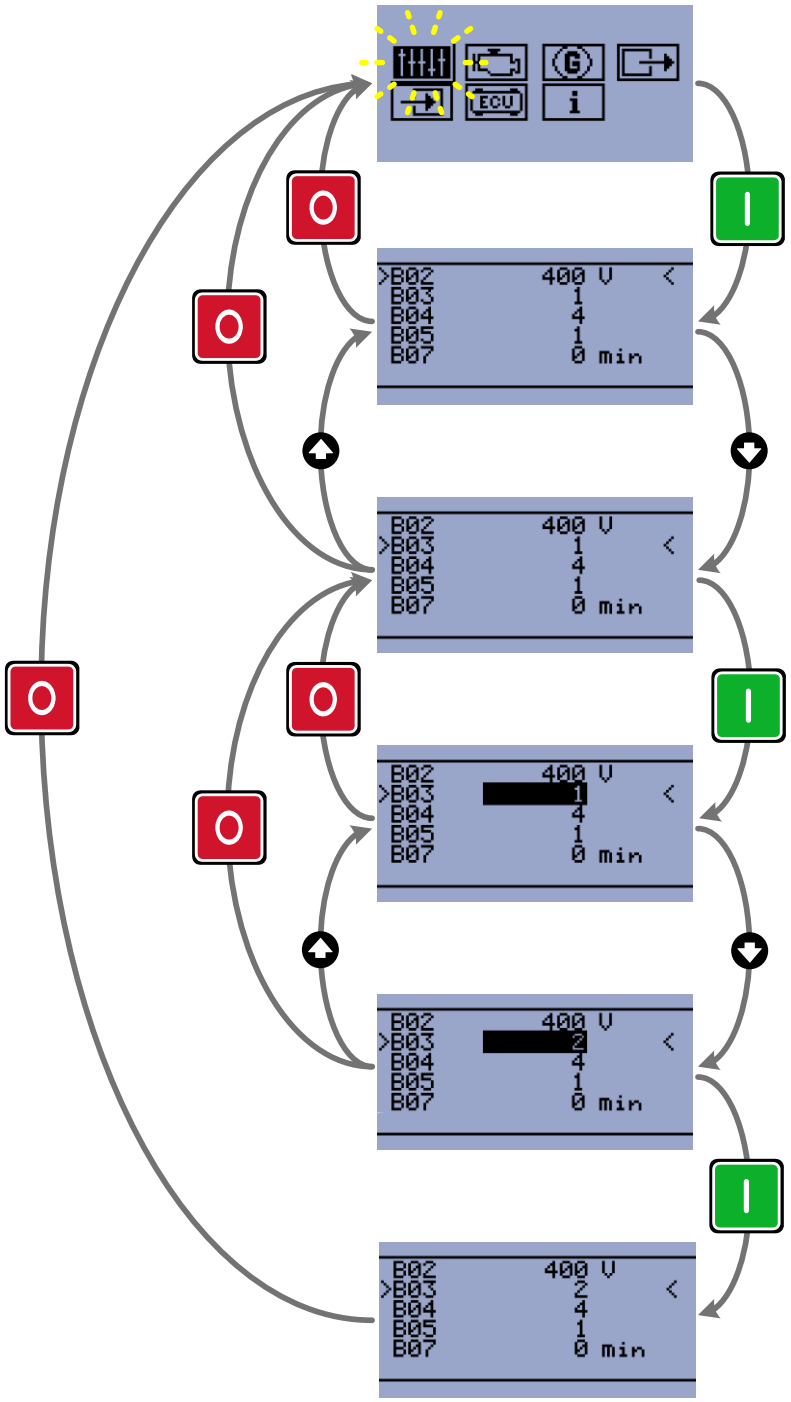
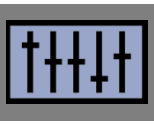
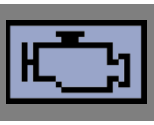


Figure 10.1
Nominal Frequency setup example



Basic settings

Setpoint code	Setpoint name
B01	Nominal Voltage Ph-N
B02	Nominal Voltage Ph-Ph
B03	Nominal Frequency
B04	Connection Type
B05	Units Format
B07	Zero Power Mode Delay
B08	Light Tower Mode
B09	Nominal Current
B10	CT Ratio
B11	Nominal RPM
B12	CT Connected
B13	Nominal Power
B14	Gear Teeth



Engine parameters and protections

Setpoint code	Setpoint name
E01	Prestart Time
E02	Maximum Cranking Time
E03	Cooling Time
E04	Oil Pressure Shutdown
E05	Coolant Temperature Shutdown
E06	Battery Undervoltage
E07	Warning Maintenance
E08	Oil Pressure Starter Disengagement
E09	Choke Time
E10	Minimal Stabilization Time
E11	Starting RPM
E12	Cranking Attempts
E13	Low Battery Start
E14	Low Battery Running Time
E15	Fuel Level Shutdown

	Generator protections
Setpoint code	**Setpoint name**
G01	Generator Overvoltage Shutdown
G02	Generator Undervoltage Shutdown
G03	Generator Overfrequency Shutdown
G04	Generator Underfrequency Shutdown
G05	Generator Short Circuit Shutdown
G06	Generator Short Circuit Delay
G07	Generator Overload Shutdown
G08	Generator Overload Delay

10.1 B - Basic settings

B01 Nominal Voltage Ph-N

Units:	Volts [V]
Step:	1 V
Range:	80–480 V
Default value:	230 V

Nominal system voltage (phase to neutral). This setpoint can be hidden depending on the connection type (setpoint ***B05 Connection Type***). You can setup this value only if you will choose the connection type as Mono phase or Split phase - ***B05 Connection Type*** (1;2).

B02 Nominal Voltage Ph-Ph

Units:	Volts [V]
Step:	1 V
Range:	80–600 V
Default value:	400 V

Nominal system voltage (phase to phase). This setpoint can be hidden depending on the connection type (setpoint ***B04 Connection Type***).You can setup this value only if you will choose the connection type as 3Ph3Wire or 3Ph4Wire - ***B04 Connection Type*** (3;4).

B03 Nominal Frequency

Units:	
Step:	
Range:	1,2
Default value:	1

Nominal system frequency.

Setpoint code	Value	Meaning
B03	1	50Hz
B03	2	60Hz

B04 Connection Type

Units:	
Step:	
Range:	1,2,3,4,5
Default value:	4

Generator winding connection.

Setpoint code	Value	Meaning
B04	1	Mono Phase
B04	2	Split Phase
B04	3	3Ph3Wire
B04	4	3Ph4Wire
B05	5	Autodetect

Mono Phase: MONOPHASE,
Single-phase measurement – 1PH

Split Phase: DOUBLE DELTA Connection, Split Phase,
Single-phase measurement – 1PH

3Ph3Wire: DELTA Connection, 3 Phase without neutral - 3 Wires,
Three phase “delta” measurement – 3PD

3Ph4Wire: STAR Connection, 3 phases and neutral - 4 wires,
Three phase “wye” measurement – 3PY

Autodetect:

	3Ph3Wire (High-Leg Delta)	L1 ≥100V; L1 ≤140V L2 ≥140V
or		L3 ≥100V; L3 ≤140V
	3Ph4Wire	L1 ≥100V L2 ≥100V
or		L3 ≥100V
	Split Phase	L1 ≥100V L2 ≥100V
or		L3 ≤ 20V
	Mono Phase	L1 ≥100V L2 ≤ 20V
or		L3 ≤ 20V

Voltage Autodetect shutdown is issued.

B05 Units Format

Units:	
Step:	
Range:	1,2
Default value:	1

This setpoint is affecting unit format for pressure and temperature.

Setpoint code	Value	Meaning	Pressure	Temperature
B05	1	Metric unit format	bar	°C
B05	2	US unit format	PSI	°F

When you change this setpoint all values will be automatically recalculated including user definable sensor curve for analog input

B07 Zero Power Mode Delay

Units:	minutes [min]
Step:	1 min
Range:	0–360 min
Default value:	0 min

The controller is switched to Zero Power Mode when there is no user interaction with the controller for the preset time. Value 0 disables this function. For the controller wake up press button START or activate input T12. The controller will not switch to Zero Power Mode if any alarm is active.

B08 Light Tower Mode

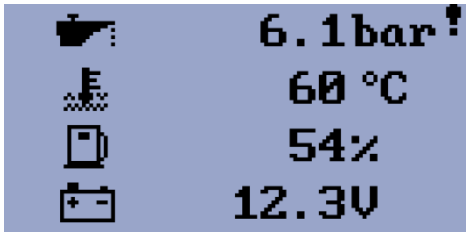
Units:	
Step:	
Range:	1,2
Default value:	1

When this setpoint is enabled, the controller is switched to special operation mode. First screen was changed and generator voltage measurement is hides in this operation mode.

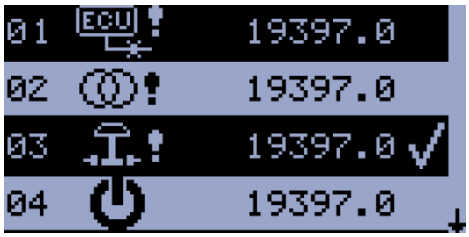
Setpoint code	Value	Meaning
B08	1	Disable
B08	2	Enable

First main screen shows battery voltage, running hours and engine status (stop, starting/stopping, run) via symbol in light tower reflector (upper left corner).

Second screen shows all analog values which are available. (Oil Pressure, Coolant Temperature; Fuel Level and Battery Voltage)



Last screen is event log.



B09 Nominal Current

Units:	Ampere [A]
Step:	1
Range:	1–1000 A
Default value:	50 A

The nominal current of the generator. Serves as a base value for ***G05 Generator Short Circuit Shutdown***.

NOTE:
The nominal current can be different from generator rated value.

B10 CT Ratio

Units:	Ampere / 5 Ampere [A/5 A]
Step:	1 A/5 A
Range:	1–5000 A/5 A
Default value:	50 A/5 A

Gen-set current transformers ratio.

NOTE:
For CT Ratio < 50 the values of power and current are displayed with one decimal.
For CT Ratio ≥ 50 the values of power and current are displayed as integer term.

B11 Nominal RPM

Units:	RPM
Step:	1 RPM
Range:	100–4000 RPM
Default value:	1500 RPM

Nominal engine speed.

B12 CT Connected

Units:	
Step:	
Range:	1, 2
Default value:	1

Use this setpoint to suppress showing any current related information on controller screens when no current transformers are used.

Setpoint code	Value	Meaning
B12	1	Yes
B12	2	No

When CT Connected setpoint is set to No value, following changes are performed:

- CT symbol is not shown on main screen.
- Value of real power is not shown on main screen.
- Current measurement screen isn't displayed at all.
- Power measurement screen isn't displayed at all.
- Counters screen isn't displayed at all.
- These setpoints are hidden:
  - ***B09 Nominal Current***
  - ***B10 CT Ratio***
  - ***B13 Nominal Power***
  - ***G05 Generator Short Circuit Shutdown***
  - ***G06 Generator Short Circuit Delay***
  - ***G07 Generator Overload Shutdown***
  - ***G08 Generator Overload Delay***

NOTE:
No changes to the protections subsystem are introduced. Current measurement isn't deactivated internally. So, it is strongly recommended to not connect CT when CT Connected setpoint is set to No to prevent unexpected controller behavior.

B13 Nominal Power

Units:	kilowatt [kW]
Step:	1 kW
Range:	1–500 kW
Default value:	35 kW

The nominal power of the generator. Serves as a base value for ***G07 Generator Overload Shutdown***.

B14 Gear Teeth

Units:	
Step:	1
Range:	0–300
Default value:	120

The number of teeth on the engine flywheel where the pick-up sensor is installed. Set to zero if no pick-up sensor is used and the Engine speed will be derived from the generator frequency.

10.2 E - Engine parameters and protections

E01 Prestart Time

Units:	seconds [s]
Step:	1 s
Range:	0–600 s
Default value:	2 s

Time of closing of the ***O08 Prestart*** output prior to the engine start.
Set to zero if you want to leave the output ***O08 Prestart*** open.

E02 Maximum Cranking Time

Units:	seconds [s]
Step:	1 s
Range:	0–60 s
Default value:	5 s

Maximum duration when the starter motor is energized.

E03 Cooling Time

Units:	seconds [s]
Step:	1 s
Range:	0–3600 s
Default value:	30 s

Runtime of the unloaded gen-set to cool the engine before stop.

E04 Oil Pressure Shutdown

Units:	Bar [Bar]
Step:	0.1 Bar
Range:	0.0–10.0 Bar
Default value:	1.0 Bar
Delay:	3 s

Shutdown threshold level for ***I23 Oil Pressure Analog*** input.

E05 Coolant Temperature Shutdown

Units:	degree Celsius [°C]
Step:	1 °C
Range:	0–150 °C
Default value:	90 °C
Delay:	5 s

Shutdown threshold level for ***I25 Coolant Temperature Analog*** input.

E06 Battery Undervoltage

Units:	Volts [V]
Step:	0.1 V
Range:	8.0–40.0 V
Default value:	11.5 V
Delay:	30 s

Warning threshold for ***Low Battery*** voltage.

E07 Warning Maintenance

Units:	hours [h]
Step:	1 h
Range:	0–10000 h
Default value:	9999 h

Counts down when the engine is running. When the counter reaches zero, an alarm will appear. When the value 10000 is set, than the Maintenance function is disabled and counter will not count. Counter value will not appear in the controller's statistics. Maximum value for running countdown is 9999. ***Warning Maintenance*** will appear when counter time has elapsed.

E08 Oil Pressure Starter Disengagement

Units:	
Step:	
Range:	1,2
Default value:	1

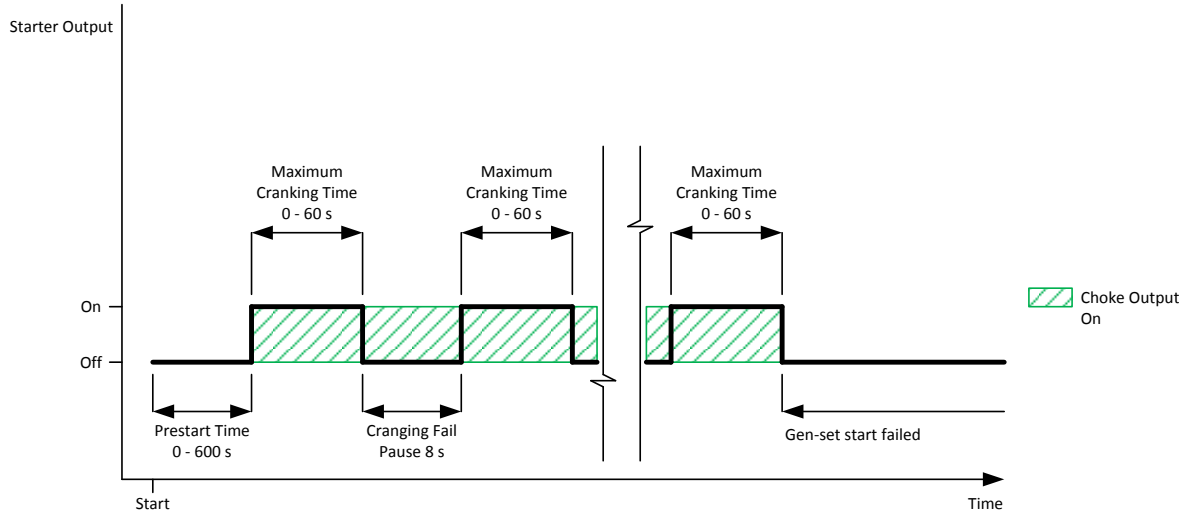
When this setpoint is enabled, the controller will use ***I22 Low Oil Pressure*** or ***I23 Oil Pressure Analog*** signal for starter disengagement. Starter will be disengaged when oil pressure reach starting oil pressure or binary input ***I22 Low Oil Pressure*** will be opened (***Normally Open*** contact) or closed (***Normally Closed*** contact).
When is disabled then only RPM (frequency), generator voltage or D+ will be used for starter disengagement.

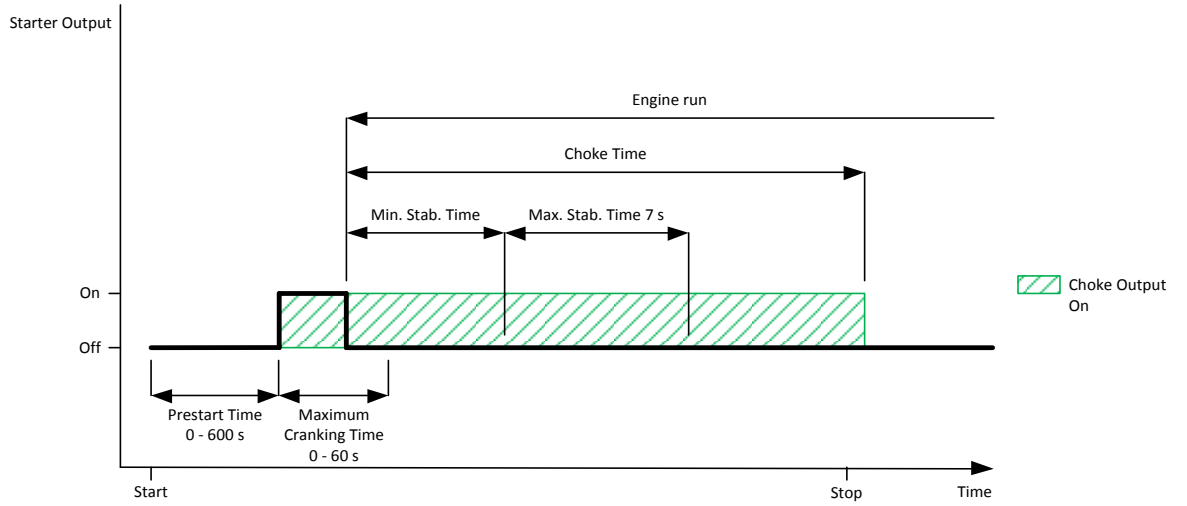
Setpoint code	Value	Meaning
E08	1	Disable
E08	2	Enable

E09 Choke Time

Units:	seconds [s]
Step:	1 s
Range:	0–3600 s
Default value:	0 s

Choke output timer. The timer is started on engine run.

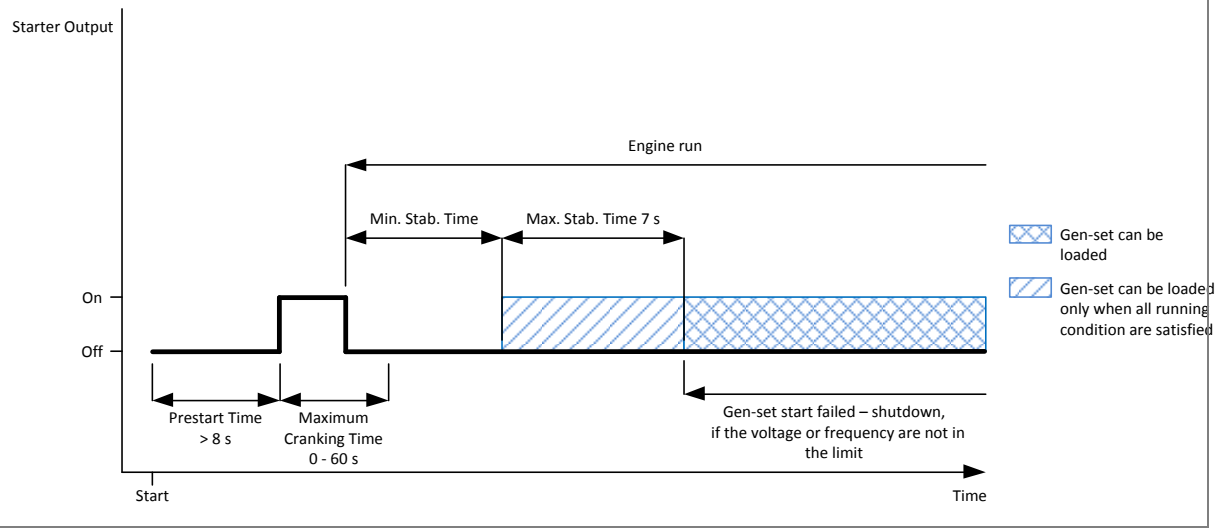




E10 Minimal Stabilization Time

Units:	seconds [s]
Step:	1 s
Range:	1–300 s
Default value:	3 s

Minimum time after reaching of defined level of RPM to the closing GCB.



E11 Starting RPM

Units:	percentage [%]
Step:	1 %
Range:	5–60 %
Default value:	25 %

When starting RPM are reached controller stops cranking. (Starter is disengaged.)
As a base value is used ***B11 Nominal RPM*** setpoint.

E12 Cranking Attempts

Units:	
Step:	1
Range:	1–10
Default value:	6

Maximal number of cranking attempts. When maximal number of cranking attempts is reached without successful engine start, ***Start Fail*** shutdown alarm is issued.

E13 Low Battery Start

Units:	
Step:	
Range:	1, 2
Default value:	1

Enables battery recharging function.

Setpoint code	Value	Meaning
E13	1	Disable
E13	2	Enable

When this function is enabled and all other conditions are met:

- controller is in **Auto** mode;
- battery voltage is below the threshold for more than 5 minutes;
- no *Low Fuel Level* alarm active;

the controller will automatically start the engine to recharge battery.

The engine will run for the time period set in *E14 Low Battery Running Time* setpoint.

When charging alternator fail is detected during the battery recharging process the controller automatically avoid next attempt of recharging cycle (allowed again after controller reset).

On the beginning of recharging cycle ***Start on Low Battery*** event is written into history log. At the end of recharging cycle ***Stop After Charging Cycle*** event is written into history log.

NOTE:
If battery undervoltage is detected when controller is in **Manual** mode and controller is switched to **Auto** mode after 5 or more minutes, gen-set will be started immediately to initiate recharging cycle!

E14 Low Battery Running Time

Units:	minutes [min]
Step:	1 min
Range:	1–240 min
Default value:	60 min

This setpoint define engine running time period to recharge the battery when the function Low Battery Start is enabled.

E15 Fuel Level Shutdown

Units:	%
Step:	1
Range:	0–20 %
Default value:	10 %

When this protection is activated the red LED above STOP button will blink, the general shutdown symbol will be displayed on LCD's upper right corner. *Fuel Level SD* symbol will be displayed on event log with running hours stamp and the *Shutdown procedure* will occur.

Input has 10s delay.

10.3 G - Generator protections

G01 Generator Overvoltage Shutdown

Units:	percentage [%]
Step:	1 %
Range:	*G02 Generator Undervoltage Shutdown*–200 %
Default value:	110 %
Delay:	3 s

Threshold for ***Generator Overvoltage*** shutdown. All three phases are evaluated. The highest measured value is used.
Generator Overvoltage shutdown will appear when output voltage exceed preset threshold and ***Shutdown procedure*** will start.

G02 Generator Undervoltage Shutdown

Units:	percentage [%]
Step:	1 %
Range:	0–*G01 Generator Overvoltage Shutdown* %
Default value:	70 %
Delay:	3 s

Threshold for ***Generator Undervolatge*** shutdown. All three phases are evaluated. The lowest measured value is used.
Generator Undervolatge shutdown will appear when output voltage exceed preset threshold and ***Shutdown procedure*** will start.

G03 Generator Overfrequency Shutdown

Units:	percentage [%]
Step:	0.1 %
Range:	*G04 Generator Underfrequency Shutdown*–130 %
Default value:	110 %
Delay:	3 s

Threshold for ***Generator Overfrequency*** shutdown, relative to the nominal frequency (setpoint ***B03 Nominal Frequency***).

G04 Generator Underfrequency Shutdown

Units:	percentage [%]
Step:	0.1 %
Range:	0–*G03 Generator Overfrequency Shutdown* %
Default value:	85 %
Delay:	3 s

Threshold for ***Generator Underfrequency*** alarm, relative to the nominal frequency (setpoint ***B03 Nominal Frequency***).

G05 Generator Short Circuit Shutdown

Units:	percentage [%]
Step:	1 %
Range:	100–500 %
Default value:	150 %
Delay:	G06 Generator Short Circuit delay

Generator Short Circuit shutdown occurs when generator current exceed preset current limit for more than G06 Generator Short Circuit delay.
B09 Nominal Current setpoint serves as a base value.

G06 Generator Short Circuit Delay

Units:	second [s]
Step:	0.01 s
Range:	0.00–100.00 s
Default value:	0.04 s

The delay for the Generator Short Circuit shutdown.

G07 Generator Overload Shutdown

Units:	percentage [%]
Step:	1 %
Range:	70–130 %
Default value:	110 %
Delay:	G08 Generator Overload Delay

Generator Overload shutdown occurs when generator load exceed preset power limit for more than G08 Generator Overload Delay.
B13 Nominal Power setpoint serves as a base value.

G08 Generator Overload Delay

Units:	second [s]
Step:	1 s
Range:	1–300 s
Default value:	10 s

The delay for the Generator Overload shutdown.

11 ECU

For ECU configuration you have to use PC software NanoEdit. It is impossible to configure ECU via controller's front fascia.

If ECU is configured simultaneously with analog inputs (*I21 Fuel Level Analog*, *I23 Oil Pressure Analog*, *I25 Coolant Temperature Analog*) value from analog measurement will be displayed and used for protection.

If ECU is configured simultaneously with binary inputs (*I20 Low Fuel Level*, *I22 Low Oil Pressure*, *I24 High Coolant Temperature*) value from ECU will be displayed. For protections is used value from ECU and binary input signal. For more detail see example.

ECU configured	Analog input	Binary input	Protections from	Displayed value from
yes	no	no	ECU	ECU
yes	yes	no	analog input	analog input
yes	no	yes	ECU or binary input	ECU
yes	yes	yes	analog or binary input	analog input
no	no	yes	binary input	binary input status

11.1 CAN bus wiring

The wiring of CAN bus communication should be provided so that following rules are kept:

- Max. length of the CAN bus depends on the communication speed. For the speed of 250 kbps, which is used on the CAN for communication with ECU the max. length is 200 m.
- The bus must be wired in linear form with termination resistors at both ends. No nodes except on the controller terminals are allowed.
- Use cable with following parameters:

Cable type	Shielded twisted pair
Impedance	120 Ω
Propagation velocity	≥ 75 % (delay ≤ 4.4 ns/m)
Wire cross-section	≥ 0.25 mm^2
Attenuation (@1 MHz)	≤ 2 dB/100 m

12 Alarms, Events and History Management

Following alarms and records are available:

- ***Event***
- ***Warnings***
- ***Shutdowns***
- ***ECU Messages***

Four records can be displayed simultaneously on the LCD screen. Total capacity is 15 records. The **Figure 12.1** is an example of how the history is organized. The last screen in this example is showing the four latest events.
To view further history records press ▼ button (see **Figure 12.2**). For alarm (shutdown) confirmation press STOP button.

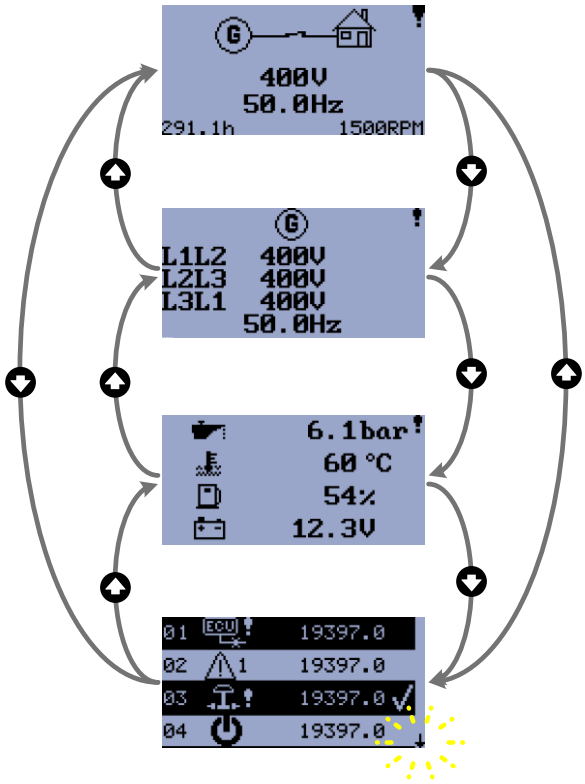


Figure 12.1

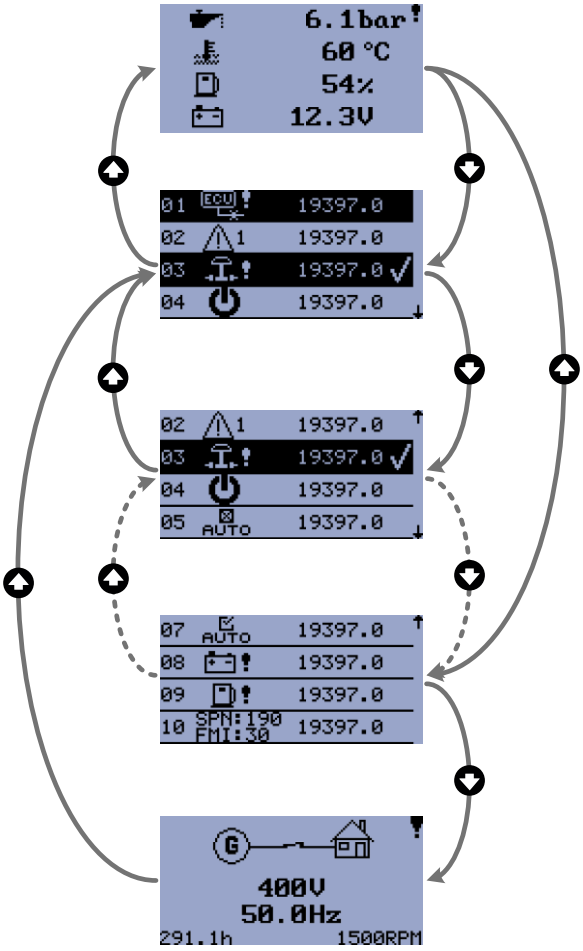

6.1bar
60 °C
54%
12.3V
01 ECU 19397.0
02 1 19397.0
03 19397.0
04 19397.0
02 1 19397.0
03 19397.0
04 19397.0
05 AUTO 19397.0
07 AUTO 19397.0
08 19397.0
09 19397.0
10 SPN:190 FMI:30 19397.0
G
400V
50.0Hz
291.1h
1500RPM

Figure 12.2

12.1 Events

Every event listed in table below is saved in history with running hours stamp see **Figure 12.3**.

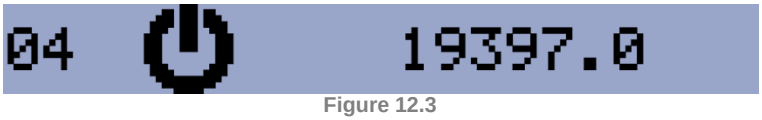


Figure 12.3
event – Power On

Possible Events

	***Manual Start*** Engine was manually started by pressing button START in **Manual** mode.
	***Remote Start*** Engine was remotely started via input terminal's function ***I02 Remote Start/Stop*** or ***I03 Remote Start And Load***. The controller is in **Auto** mode.
	***Manual Stop*** Engine was manually stopped by pressing button STOP in **Manual** mode.
	***Remote Stop*** Engine was remotely stopped via input terminal's function ***I02 Remote Start/Stop*** or ***I03 Remote Start And Load***. The controller is in **Auto** mode.
	***Auto On*** Auto mode is activated.
	***Auto Off*** Auto mode is inactivated.
	***Power On*** The controller is turned on.
	***Start on Low Battery*** The engine was automatically started to recharge battery. The controller is in **Auto** mode and functionality is enabled using ***E13 Low Battery Start*** setpoint.

	***Stop After Charging Cycle*** The engine was automatically stopped after battery charging cycle was performed when time set by ***E14 Low Battery Running Time*** setpoint is elapsed.

12.2 Warnings

12.2.1 Active warning

When a warning occurs, ***O04 Alarm*** and ***O15 Common Warning*** outputs will close and the red LED above STOP button will blink. Warning symbol will blink in the upper-right corner of the LCD and the proper warning symbol will be displayed in the history with running hours stamp. Active warning can't be confirmed. See list of ***Possible warnings***.

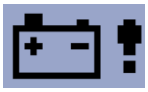
Figure 12.4
active warning – Low Battery

12.2.2 Inactive warning

When a warning becomes inactive, ***O04 Alarm*** and ***O15 Common Warning*** output will open, the red LED above STOP button will stop blinking, and the warning symbol on main screen will go out.

Figure 12.5
inactive warning – Low Battery

12.2.3 Possible warnings

	***Warning Maintenance*** The service interval is determined by the setpoint ***E07 Warning Maintenance***. The protection becomes active when the engine running hours reach this value.
	***Low Battery (Charging Fail)*** This warning comes up if the battery voltage is lower than preset ***E06 Battery Undervoltage*** threshold for more than 30s. This warning also comes up when charging alternator fails.
	***Low Fuel Level*** This warning occurs when input ***I21 Fuel Level Analog*** is below 20% or binary input ***I20 Low Fuel Level*** is closed longer than 10s.
	***External Warning 1*** This warning occurs when ***I10 External Warning 1*** input is activated.

	***External Warning 2*** This warning occurs when ***I11 External Warning 2*** input is activated.
	***External Warning 3*** This warning occurs when ***I12 External Warning 3*** input is activated.
	***ECU Communication Error*** This warning is activated when the ECU (if configured) is not communicating. All values from ECU show #####.

12.3 Shutdowns

12.3.1 Shutdown procedure

The **InteliNano^{NT}** controller opens outputs ***O05 GCB Close/Open***, ***O01 Starter***, ***O08 Prestart*** and ***O02 Fuel Solenoid*** and closes ***O03 Stop Solenoid*** to stop the engine immediately. ***O04 Alarm*** and ***O16 Common Shutdown*** outputs are closed. Active or not confirmed shutdowns are blocking next start of gen-set.

12.3.2 Active unconfirmed shutdown

When a shutdown occurs, the ***Shutdown procedure*** will start, the red LED above STOP button blinks, the shutdown symbol will blink in the upper right corner of LCD, and the proper shutdown symbol is displayed in history with running hours stamp. The record in history is inversed, see **Figure 12.6**. See list of ***Possible shutdown alarms***. For shutdown alarm confirmation press STOP button.

Figure 12.6
active unconfirmed shutdown – Emergency Stop

12.3.3 Active confirmed shutdown

When an active shutdown is confirmed the red LED above the STOP button stops blinking. The record in history stays inversed with confirmation symbol at the end. ***O04 Alarm*** and ***O16 Common Shutdown*** outputs are open.

Figure 12.7
active confirmed shutdown – Emergency Stop

12.3.4 Inactive unconfirmed shutdown

O04 Alarm and ***O16 Common Shutdown***o utputs are closed, red LED above STOP button blinks. Shutdown symbol is displayed in upper-right corner of the LCD, and proper warning symbol is displayed in history with running hours stamp. See **Figure 12.8**.. See list of ***Possible shutdown alarms***. For shutdown alarm confirmation press STOP button.

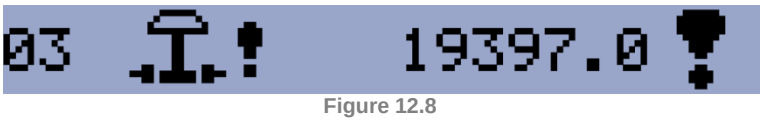


Figure 12.8
inactive unconfirmed shutdown – Emergency Stop

12.3.5 Inactive confirmed shutdown

O04 Alarm and *O16 Common Shutdown* outputs are opened. It is possible to start engine when all shutdowns are inactive and confirmed.

Figure 12.9
inactive confirmed shutdown – Emergency Stop

12.3.6 Possible shutdown alarms

	***Emergency Stop*** The binary input *I01 Emergency Stop* was activated.
	***Overspeed*** The protection comes active if the speed is greater than 120 % of nominal engine RPM. Actual speed value is derived from generator frequency or is sensed directly using magnetic pick-up input.
	***Underspeed*** Low engine RPM. This alarm will be issued when the gen-set is running and then stops by itself, i.e. the RPM drops under the *E11 Starting RPM*. The underspeed alarm starts to be evaluated 5 sec after successful gen-set start and is being evaluated all the time the output *O02 Fuel Solenoid* is active.
	***Low Oil Pressure*** Engine will stop when oil pressure drops below threshold set by *E04 Oil Pressure Shutdown* setpoint or when binary input *I22 Low Oil Pressure* is activated.
	***High Coolant temperature*** Engine will stop when temperature of coolant exceeds *E05 Coolant Temperature Shutdown* threshold.
	***External Shutdown 1*** This shutdown occurs when *I13 External Shutdown 1* input is activated.
	***External Shutdown 2*** This shutdown occurs when *I14 External Shutdown 2* input is activated.

External Shutdown 3

This shutdown occurs when *I15 External Shutdown 3* input is activated.

GCB Fail

Failure of generator circuit breaker.

Generator Overvoltage

Generator will stop when output voltage exceeds the preset threshold *G01 Generator Overvoltage Shutdown*.

Generator Undervoltage

Generator will stop when output voltage drops below the preset threshold *G02 Generator Undervoltage Shutdown*.

Generator Overfrequency

The generator frequency is out of limits given by setpoints *G03 Generator Overfrequency Shutdown* and *G04 Generator Underfrequency Shutdown*.

Generator Underfrequency

The generator frequency is out of limits given by setpoints *G03 Generator Overfrequency Shutdown* and *G04 Generator Underfrequency Shutdown*.

Generator Overload

The gen-set will stop when output load exceeds the preset threshold *G07 Generator Overload Shutdown*.

Generator Short Circuit

The gen-set will stop when output current exceeds the preset threshold *G05 Generator Short Circuit Shutdown*.

Generator CCW Rotation

Incorrect generator phase sequence.

	***Start Fail*** Gen-set start failed.
	***Stop Fail*** Gen-set stop failed.
	***Battery Flat*** If the controller loses power during starting sequence due to bad battery condition, it will not try to start again and will activate this protection.
	***Voltage Autodetect*** If measured generator voltage doesn't correspond with predefined values for particular connection type when Autodetect value for ***B04 Connection Type*** is used.
	***Fuel Level SD*** This shutdown occurs when analog input ***I21 Fuel Level Analog*** is below shutdown threshold or when binary input ***I29 Fuel Level SD*** is activated. Both longer than 10s.

12.4 ECU Messages

Figure 12.10
ECU mesaage

	ECU Message Diagnostic messages are read and displayed in the history behind the ECU Warning symbol. For Standard J1939 SPN (Suspect Parameter Number) and FMI (Failure Mode Identifier) are shown. Detail SPN/FMI code specification see in: • SAE Truck and Bus Control and Communications Network Standards Manual, SAE HS-1939 Publication • Or refer to corresponding engine manufacturer's ECU error codes list. Complete list of text diagnostic messages for each ECU can be found in ComAp Electronic Engines Support manual.

13 Technical data

13.1 Power supply

<table>
<tr><td>Power supply range</td><td>8–36 VDC</td></tr>
<tr><td>Power supply drop-out immunity</td><td>100 ms</td></tr>
<tr><td>Power consumption</td><td>
<table>
<tr><th>Supply voltage (V)</th><th>Power consumption (mA) (25 °C)</th></tr>
<tr><td>8</td><td>90</td></tr>
<tr><td>12</td><td>60</td></tr>
<tr><td>24</td><td>35</td></tr>
<tr><td>36</td><td>32</td></tr>
</table>
</td></tr>
<tr><td>Zero Power Mode consumption</td><td>
<table>
<tr><th>Supply voltage (V)</th><th>Power consumption (mA) (25 °C)</th></tr>
<tr><td>8</td><td>0.05</td></tr>
<tr><td>12</td><td>0.08</td></tr>
<tr><td>24</td><td>0.15</td></tr>
<tr><td>36</td><td>0.35</td></tr>
</table>
</td></tr>
</table>

13.2 Operating conditions

Operating temperature	−20 to 70 °C
Storage temperature	−30 to 80 °C
Operating humidity	95% non-condensing (IEC/EN 60068-2-30)
Protection degree (front panel)	IP65
Vibration	5–25 Hz, ±1.6 mm; 25–100 Hz, a = 4g
Shocks	A_{max} = 500 m·s^{-2}

13.3 Physical dimensions

Dimensions	118 × 108 × 43 mm (W × H × D)
Weight	246 g (incl. connectors counterparts and fixing clips)
Mounting cut-out size	94 × 94 mm (W × H)
Recommended torque for holders	15–20 cN·m

13.4 Binary inputs

Number of binary inputs	up to 6
Galvanic isolation	non-isolated
Closed contact voltage	< 2 V
Open contact voltage	> 3.5 V

13.5 Binary outputs

Total number of binary outputs	up to 6
Number of low current binary outputs	up to 4
Number of high current binary outputs	2
Galvanic isolation	non-isolated
Type	transistor, switching to positive supply terminal
Operating voltage	8–36 VDC
Switching current of low current binary output	500 mA (suppression diodes required for inductive loads)
Switching current of high current binary output	6 A (long term) 10 A (short term)
Total output current	10 A (long term) 15 A (short term)

NOTE:
One low current (500 mA) binary output – ***T08*** can be configured as binary input.

13.6 Analog inputs

Number of analog inputs	up to 3
Galvanic isolation	non-isolated
Range nominal	0–250 Ω
Range maximal	up to 2.5 kΩ
Resolution	0.1 Ω
Supported sensor types	Predefined: VDO, Datcon (Pressure, Temperature, Fuel Level). User defined: up to 32 points polygonal sensor curve.
Accuracy	±2 % of measured value ± 5 Ω (0–250 Ω) ±4 % of measured value (250 Ω–2.5 kΩ)

13.7 Generator voltage measurements

Measurement inputs	3Ph-N generator voltage
Measurement type	True RMS
Nominal voltage (Ph-N)	230 V
Range (Ph-N)	277 V
Max. voltage (Ph-N)	350 V
Accuracy	±1 % of nominal value (70 %–130 % of nominal voltage)
Frequency range	40–70 Hz
Frequency accuracy	±0.1 Hz
Input impedance	> 300 kΩ (Ph-N) > 600 kΩ (Ph-Ph)

13.8 Generator current measurements

Measurement inputs	3Ph generator current
Range	5 A
Max. current	10 A
Accuracy	±20 mA (0–2 A) ±1 % of measured value (2–5 A)
Input impedance	< 0.1 Ω

13.9 Charging alternator preexcitation circuit

Excitation current	up to 250 mA
Charging fail threshold	80% of U_{BATT}

13.10 Magnetic pick-up

Voltage range	4–50 V_{pk-pk} (4 Hz–1 kHz) 6–50 V_{pk-pk} (4 Hz–5 kHz) 10–50 V_{pk-pk} (4 Hz–10 kHz)
Frequency range	4 Hz–10 kHz
Accuracy	±0.2 % of full scale

13.11 Communication interface

USB (device)	internal, non-isolated

13.12 CAN interface

Type	CAN bus
Galvanic isolation	non-isolated
Baud rate	250 kbps
Bus length	max. 200 m
Termination resistor	120 Ω, built-in

13.12.1 Recommended CAN cables

- Belden 3082A DeviceBus for Allen-Bradley DeviceNet
- Belden 3083A DeviceBus for Allen-Bradley DeviceNet
- Belden 3084A DeviceBus for Allen-Bradley DeviceNet
- Belden 3085A DeviceBus for Allen-Bradley DeviceNet
- Belden 3086A DeviceBus for Honneywell SDS
- Belden 3087A DeviceBus for Honneywell SDS
- Lapp Cable Unitronic Bus DeviceNet Trunk Cable
- Lapp Cable Unitronic Bus DeviceNet Drop Cable
- Lapp Cable Unitronic Bus CAN
- Lapp Cable Unitronic-FD Bus P CAN UL/CSA