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DCU 305 R3 LT Engine Controller

Installation Manual

auto MASKIN

Table of contents

1 Document revisions

Date	Revision
July 2005	Created
November 2007	Minor adaptations for firmware 6.53 and onwards, because of a new menu layout.
July 2014	Added support for the DCU 305 R3 LT, including picture updates
August 2020	Sample Schematic Page 1 updated
December 2024	Revised document

Related documents

- DCU 305 R3 (LT) User's Manual
- DCU 305 R3 (LT) Communication Manual
- DCU 305 R3 CAN / J1939 Manual
- RSP 305 Remote Panel User's Manual
- RSP 305 Installation Manual
- Rudolf R3 Configuration Tool User's Manual

2 Introduction

2.1 About this Manual

This manual has been published primarily for professionals and qualified personnel.

The user of this material is assumed to have basic knowledge of marine systems and must be able to carry out related electrical work.

⚠ Work on the low-voltage circuit should only be carried out by qualified and experienced personnel.

Installation or work on the shore power equipment must only be carried out by electricians authorised to work with such installations.

2.2 Responsibilities

⚠ It is the installer's sole responsibility to ensure that the installation work is carried out satisfactorily, that it is operationally in good order, that the approved material and accessories are used and that the installation meets all applicable rules and regulations.

ⓘ Auto-Maskin continuously upgrades its products and reserves the right to make changes and improvements without prior notice.

All information in this manual is based upon information at the time of printing. For updated information, please contact your local distributor.

The crossed-out wheeled bin symbol indicates that the item should be disposed of separately. The item should be handed in for recycling following local environmental regulations for waste disposal.

Separating a marked item will help reduce the volume of waste sent to incinerators or landfills and minimise any potential negative impact on human health and the environment.

2.3 Reference

This installation manual is for the two engine controllers, DCU 305 R3 and DCU 305 R3 LT. The manual commonly refers to these panels as the **DCU** or **Engine Controller**.

The RK-66 Interface Module may be referenced as the **Interface Module**.

2.4 About the DCU 305

The DCU 305 is an electronic engine control panel—engine controller—for controlling and monitoring diesel engines used as propulsion engines or gensets.

Switches and sensors on the engine are interfaced on the accompanying RK-66 Interface Module.

Several engine controllers can be connected to the self-configuring RSP 305 Remote Panel, using a simple 4-wire cable.

Each project is unique, and the DCU 305 R3 is configured using a configuration tool for Windows®, the Rudolf R3™ software.

Note! The DCU 305 R3 LT is identical to the DCU 305 R3 except that the LT version does not support the J1939 CAN bus.

2.5 Certified

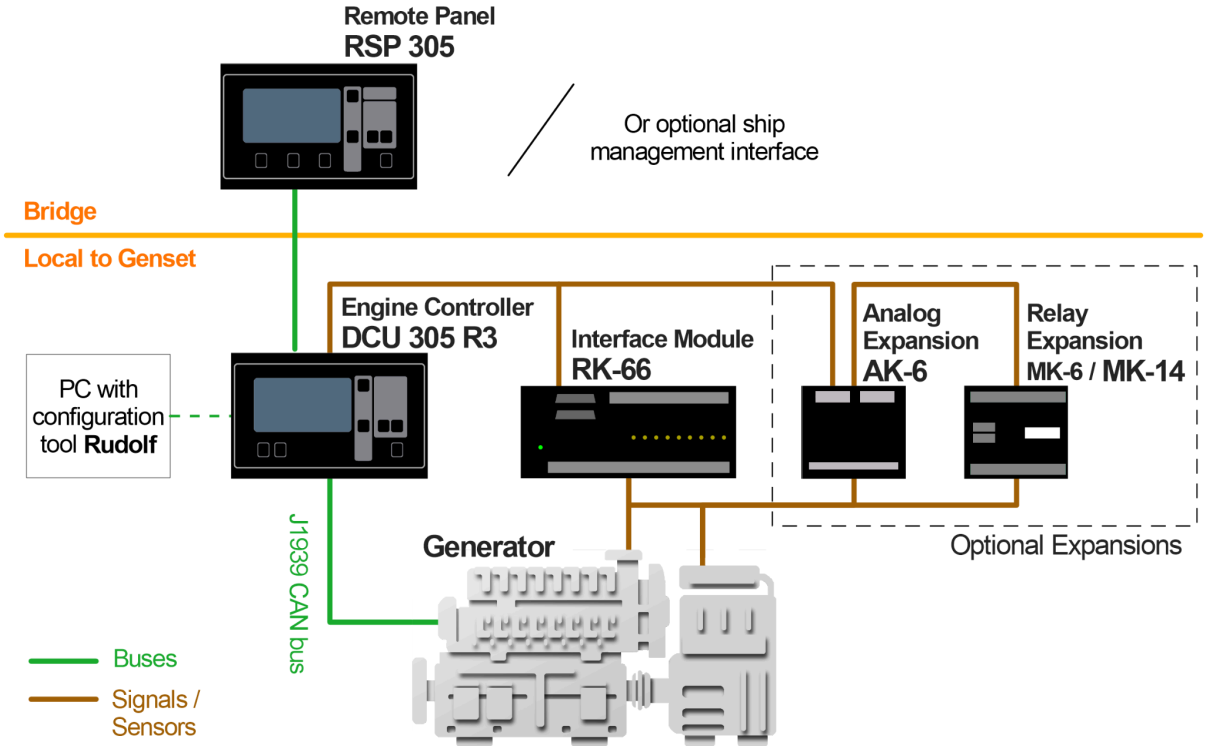
All modules in the 300 Series are certified by major classification societies.

Certificates can be obtained from the Auto-Maskin website.

3 System Overview

The engine monitoring system's basic components are the DCU 305 Engine Controller and the RK-66 Interface Module. Optional analogue units and relay cards may be added to expand the I/O capability and overall flexibility.

The engine controller is configured using a laptop PC with the configuration software Rudolf R3. The configuration can be printed and stored on disk.



3.1 DCU 305 Engine Controller

The DCU 305 R3 is at the heart of the installation. This engine controller supports the J1939 CAN bus and can be used with or without it.

If the engine is without an ECM and the J1939 CAN bus is not being used, then the DCU 305 R3 LT Engine Controller can be used.

Except for the CAN bus interface, the connections and interface to these panels are the same.

3.2 RK-66 Interface Module

All wires and sensors shall be connected to the RK-66 Interface Module, which is a mandatory unit in all installations.

3.3 MK-6/14 Relay Expansion Units

The MK-6 and the MK-14 Relay Expansion Units add 6 or 14 relays to the system.

Each relay can be configured to act on one of the many predefined functions, or any configured warning, alarm or shutdown setpoints. Either the MK-6 or the MK-14 can be used, not both.

See Chapter 8.1 MK-6 and MK14 Relay Expansion Unit.

3.4 AK-6 Analog Expansion Unit

The AK-6 is an optional interface unit that adds six 4-20 mA channels to the standard five, making a total of 11 channels with 4-20 mA inputs.

See Chapter 8.2 AK-6 Analog Expansion Unit.

3.5 RSP 305 Remote Panel

An RSP 305 Remote Panel can be connected to one or up to four DCU 305 engine controllers, which can be of different types.

The RSP 305 configures itself automatically and is always in sync with the network's engine controllers' configuration.

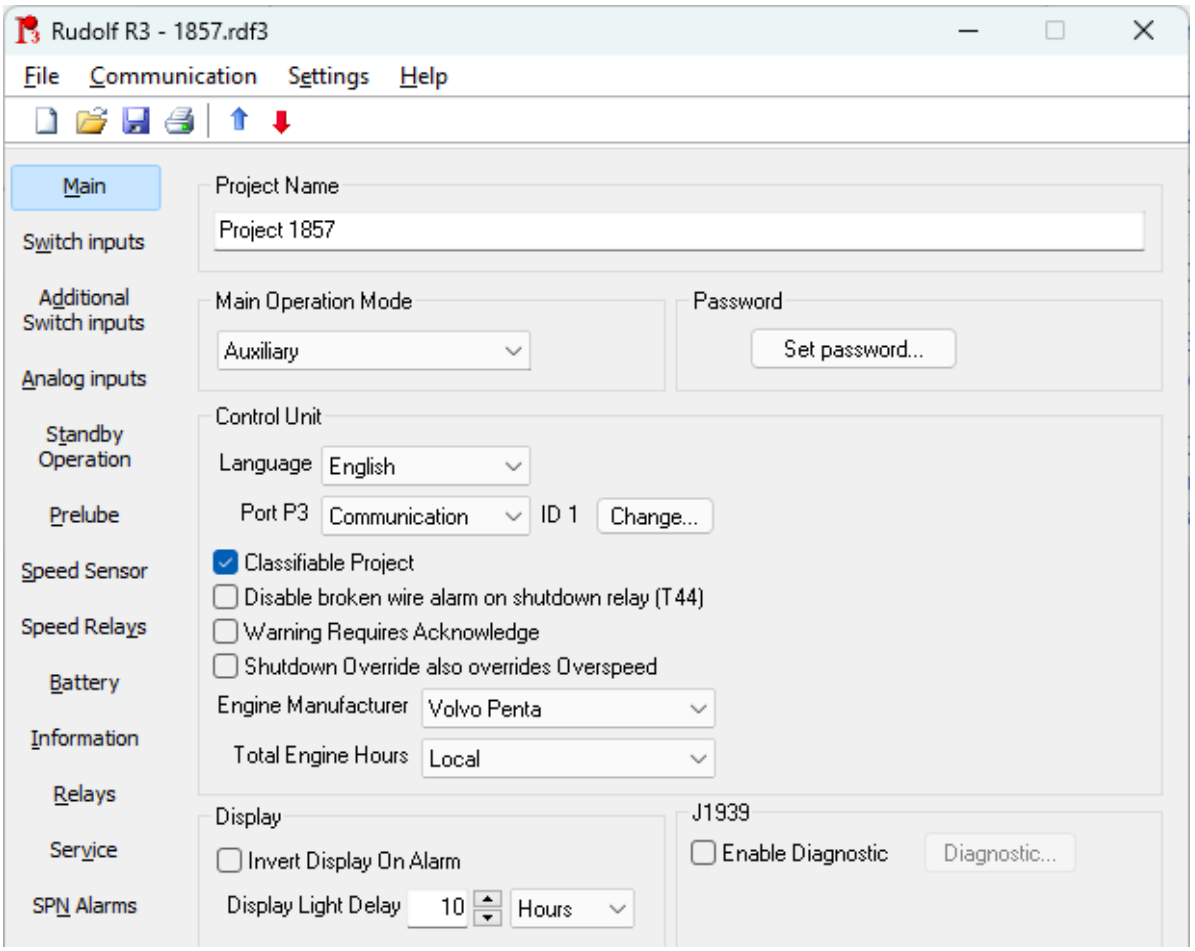
RSP 305 Remote Panel

3.6 Communication

The DCU 305 Engine Controllers support the Modbus protocol for communication. For more information, see the DCU 305 R3 Communication Manual.

3.7 Configuration

The engine controller is fully customised using the Rudolf R3™ configuration software for Windows. For safety reasons, no parameters are adjustable without using the configuration software.



Connect the Rudolf Cable between the laptop PC and port P3 on the engine controller to start configuring.

Rudolf Cable

Note! If the laptop does not have an RS-232 port, add the USB-A to RS-232 cable. The Rudolf Cable is still necessary.

USB to RS-232 Converter Cable

For more information on using the Rudolf R3 configuration software, see the Rudolf R3 User's Manual.

4 Wire Connections

All wire connections are made on the RK-66 Interface Module.

4.1 In General

To protect against EMC noise, we recommend that all cables be shielded.

The shield of all cables shall be connected to the ground, not to 0V. Some cables shall be grounded on one end only, while others shall be grounded on both ends.

Some cables, such as the pickup signal and power supply, shall be separate. Other signals can be in a multi-cable with a shield.

See the example schematics and cable specification for details.

4.2 Grounding

Note! Please keep ground and 0V separated, and observe the difference between ground and 0 volts.

Ground and 0V shall not be connected. In a ship installation, the hull is the “ground” whilst the battery negative is the 0V.

In the DCU 305 R3 system, the +24V and 0V are filtered to the ground using special filter components to avoid electrical noise. If ground and 0V are connected, these filters do not work properly.

In general, all switches shall be referenced to 0V.

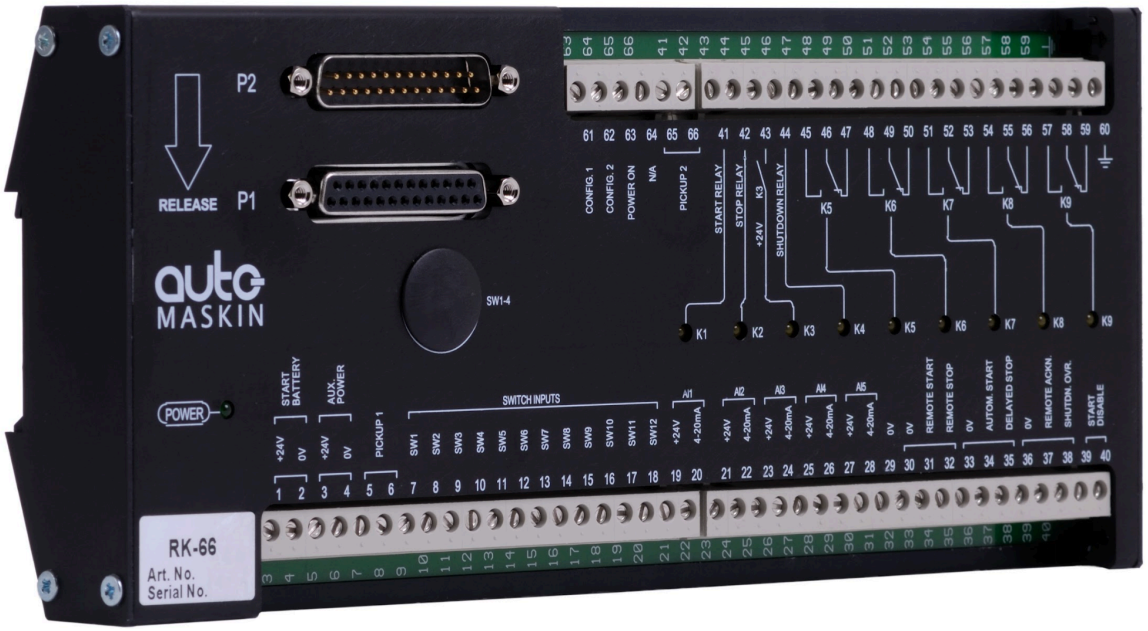
4.3 Connection Order

All connections are made on the RK-66 Interface Module. The only exceptions are communication cables, and analogue/relay expansion cables, which are connected directly to the back panel.

Start by connecting the ground cable to terminal 60 on the RK-66 Interface Module.

Note! Terminal 60 is connected to the ground plane (not to 0V) on the RK-66.

Connect the two cables between the RK-66 and the control unit (Connector P1 and P2).



The RK-66 wire terminal unit

Now, connect the rest of the wires and complete the installation by connecting power to the supply inputs. Terminals 1 and 2 are for the start battery supply, and terminals 3 and 4 are for the auxiliary power supply.

4.3.1 RK-66 DIP-switches

When the rubber lid on the front of the RK-66 is removed, four DIP switches numbered 1-4 will appear.

Switch	Factory setting	Purpose
1	ON	When ON, a start is enabled. This functions similarly to connecting a jumper over terminals 39 and 40. When OFF, no starts are possible. A jumper between terminals 39 and 40 will enable start.
2	OFF	When ON, it bypasses the return path diode to start-battery negative (terminal 2), which may reduce noise interference in some installations. Increases the measured battery voltage by 0.3V.
3	OFF	Noise filter between terminals 1 and 3 to ground. Set the switch to ON to enable the filter.
4	OFF	Noise filter between terminals 2 and 4 to ground. Set the switch to ON to enable the filter.

4.4 Power Supply

4.4.1 24V Supply

Use a twisted pair wire to minimize the effect of electrical disturbances on the cable. The start battery power shall be connected to the primary supply on terminals 1 and 2.

The secondary (or auxiliary) supply shall be connected to terminals 3 and 4.

Note! A redundant power supply must be connected to terminals 3 and 4 in a classified system.

The engine controller uses the highest voltage available from the two supplies.

The primary voltage is constantly monitored and displayed on the LCD screen. The engine controller alarms if the primary supply is below the configured value, or when the secondary supply is below 12 volts (fixed setpoint).

Note! The LCD backlight disappears if the primary voltage drops below ~17 volts and reappears when it rises above ~21 volts.

4.4.2 12V Supply

Note! The DCU 305 R3 is a 24V system, so there is no native support for a 12V supply.

However, the controller *can* be used in 12-volt systems using an external DC/DC converter. The configuration in Rudolf must be set to a 12-volt system. See the Battery submenu in the configuration software.

Connect the start battery to the primary input at terminals 1 and 2 as above. This supply voltage is not high enough to make the engine controller work, but it measures and displays the battery voltage.

Connect a 12/24 volt DC/DC converter to the 12-volt start battery, and connect the 24-volt output from the DC/DC to the secondary input, terminals 3 and 4.

Note! The engine controller does not have a true redundant supply in this configuration.

4.5 Start- and Stop Relay Outputs

Connect auxiliary relays for the Start (cranking), Stop, Run and Shutdown solenoids. Observe the polarity of the relay coils if they are fitted with voltage suppressor diodes.

Coil resistance on auxiliary relays must be in the range of 250 ohm - 2 kohm.

4.6 Pickup Sensors

Note! The pickup cable shall be shielded to the ground, not to 0V.

4.6.1 One pickup in use

Connect pickup 1 between terminals 5 and 6. Please verify that the signal strength is between 2.5-30 Vpp.

4.6.2 Two pickups in use

Connect the second pickup to terminals 65 and 66 if two pickups are used. If the measured RPM differs > 100 RPM for 20 seconds, there will be an alarm on the pickup with the lowest RPM.

The signal from pickup 1 has precedence unless the frequency from pickup 2 is >100 RPM higher than pickup 1, where pickup 2 will be used.

Note! The use of two pickups must be enabled and configured in Rudolf R3.

4.7 Switch Input Channels

The engine controller has 12 input channels. All 12 channels can be fully customised with descriptive text and activated on a high or low input. It can have a persistence timer and activate a warning, alarm or engine shutdown.

Channels 1-6 have extra functionality. When configured as a normally closed switch, they can detect wire breaks. They also have internal backup when configured as an engine shutdown channel.

This is summarised in the following table.

Channel	1	2	3	4	5	6	7	8	9	10	11	12
Terminal	7	8	9	10	11	12	13	14	15	16	17	18
Configure as a warning, alarm or engine shutdown	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Internal support for wire break detection	✔	✔	✔	✔	✔	✔						
Internal backup, if configured as engine shutdown	✔	✔	✔	✔	✔	✔						

Note! Do not connect +24V to the switch inputs. All input switches shall be connected via their corresponding wire terminal to 0V, not to ground.

4.7.1 Wire break detection

Channels 1-6 can detect wire breaks. This is useful when the channel is being used as a shutdown channel.

A 10k ohm resistor must be connected in parallel with the switch and be 0.125W or better.

Note! The Wire Break Detection feature must be enabled in Rudolf R3 for each channel 1-6. Otherwise, there will not be a broken wire alarm.

If the wire into the engine controller is broken, the control panel will indicate a “Broken Wire” event, which is delayed five (5) seconds.

A broken wire event is displayed as in this example:

```
* Broken Wire [T9]
```

Here, the wire on terminal 9, which corresponds to switch channel 3 (see the table above), is broken.

Considerations when using wire break detection

Ensure the switch's return path is connected to 0V (terminal 29) at the RK-66 Interface Module.

Example: A wire break detection installation on switch channel 1 should have a switch connected between terminal 7 (channel 1) and terminal 29 (0V reference). The 10k ohm resistor must be connected across the switch and not across terminals 7 and 29.

4.8 Analog Channels

The engine controller has five standard 4-20 mA input channels. These may or may not be used; if used, they are displayed on the LCD screen as horizontal bars.

All analogue channels can be customised with text and delays and whether to activate a warning, alarm or engine shutdown.

Note! An optional expansion unit, the AK-6, can expand the number of analogue channels from 5 to 11.

Using the configuration software Rudolf R3, all analogue channels can be configured as a 0-20 mA or 4-20 mA type.

Channel 1 can be configured as 0-10 V. This requires physically opening the engine panel and changing the setting of the J12-switch.

This is summarized in this table.

Channel	1	2	3	4	5	6	7	8	9	10	11
RK-66	✔	✔	✔	✔	✔						
AK-6[1]						✔	✔	✔	✔	✔	✔
CAN bus[2]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0-10 V	✔										

Note! If channel 1 is used as a 0-10 V channel, use a separate and shielded cable for this channel, as the 0-10 V signal is susceptible to electrical noise. The 5-pin switch **J12** inside the engine controller must be set as follows:

0-20 mA / 4-20 mA[3]	■	■		■	■
0-10 V			■	■	

Carefully remove the back lid and change as appropriate, then put the lid back on.

4.8.1 Analog channel setpoints

In the LCD, the following indications are used for the different setpoints.

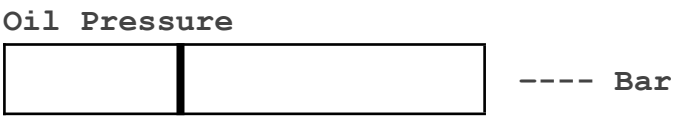
Setpoint type	Indication
None	None
Warning	Dashed line
Alarm	Thin line
Shutdown	Thick line

4.8.2 Analog Sensor Failure

The alarm Analog Sensor Failure appears if an enabled analogue channel is not connected or if the signal strength is too low (<2 mA).

[1] Optional analog expansion module
[2] Not on the DCU 305 R3 LT, only supported on the 305 R3
[3] Default factory setting

Instead of a numeric value to the right of the bargraph, the sign “----“ will be displayed, for instance like this:



Note! If 0-10 V or 0-20 mA is selected, the analogue Sensor Failure alarm is disabled.

4.8.3 Connecting the Analog Sensors

Connect the sensors according to the project documentation and drawings. All five analogue input channels are 0/4-20 mA or 0-10 V (channel 1 only).

For PT100 and PT1000 sensors, an appropriate signal converter must be used.

Analogue Channel	RK-66 terminal number	
	+24V supply[4] to the sensor	Analog input
1	19	20
2	21	22
3	23	24
4	25	26
5	27	28

4.9 J1939 CAN bus Connection

4.9.1 The CAN bus cable

The CAN bus is a high-speed data transmission network and requires more cable installation than many other signal types.

The bus consists of two wires: CAN_H and CAN_L. Between units, these wires should be connected CAN_H to CAN_H and CAN_L to CAN_L, ie they should not be crossed.

The maximum cable length for the entire cable is 250m (820 feet).

The cable must be a twisted pair with a shield. The minimum wire thickness is 0.5mm^2 (20AWG), and the maximum is 0.8mm^2 (18AWG). The cable should be certified for CAN/J1939 use.

[4] With self-resetting overload protection fuse and alarm

The minimum cable curve is 8x the cable diameter (i.e., it should not be bent too sharp) and must not be deformed in any way.

On the DCU 305 R3 port P10, CAN_H is pin 7, and CAN_L is pin 2. No other pins should be connected. The shield should normally be connected at one end only.

4.9.2 Terminating Resistors

A CAN bus cable can connect many units. A 120-ohm terminating resistor must be connected at each end of the bus. If only two modules are connected to the bus (which is common), each should have a 120-ohm resistor connected at the end.

The DCU 305 R3 has an internal 120-ohm resistor. If the DCU is not at the end of the CAN bus, a “CAN bus card without J1” must be ordered and fitted. Alternatively, competent personnel can remove the jumper J1 on the CAN bus card.

Note! The CAN bus might work even if there are too many terminating resistors or if one is missing, but it will not be optimal.

If a 24VDC signal is accidentally connected to the CAN bus, the terminating resistor might be destroyed, and the CAN bus card must be repaired.

4.9.3 Cable ducts

The CAN bus cable can be strapped together with other communication cables.

We recommend that the CAN bus cable not be strapped together with cables carrying high voltages or high currents or cables connected to inductive loads (power relay coils, electric engines, etc.). Shielded cables typically reduce the rub-off effect by 20dB but do not completely remove the problems.

In general, if the installation has cables carrying PWM signals (high-frequency magnetic fields around the cable), for instance, from a frequency converter, these cables should be routed separately and at a good physical distance (5cm/2”) from parallel signal cables.

4.9.4 Distance between Engine ECM and DCU 305

If the CAN bus is routed to a different room/area on the ship that might have a supply voltage different from the supply on the engine, we strongly recommend using a CAN-repeater unit. The CAN-repeater will be a galvanic isolation.

If using the same power supply as on the engine, a CAN-repeater is not necessary.

4.9.5 The CAN bus in star network topologies

The CAN bus must not be connected to a star network. If this is necessary, a CAN-repeater must be used. The maximum distance for the branch is 30cm at 1Mbit/s.

4.9.6 The CAN-repeater and shield

When utilising CAN-repeaters, the shields must not be connected to the new cable.

4.10 Miscellaneous Connections

4.10.1 Remote Start

Remote Start works in the same way as the local Start Button.

Connect terminal 31 to terminal 30 to engage.

4.10.2 Remote Stop

Remote Stop works the same way as the local Stop Button, except it is immediate[5].

Connect terminal 32 to terminal 30 to engage.

Note! For safety reasons, local and remote Start and Stop works regardless of the Manual and Standby settings.

4.10.3 Remote Reset (Acknowledge)

Connect terminal 37 to terminal 36 to activate the Remote Reset.

This works as the local reset button on the front panel, and it resets all the current alarms.

4.10.4 Blackout Start

When the engine controller is set to Standby and receives this signal, it will initiate the Automatic Start procedure. The number of start attempts is configured in Rudolf.

Connect terminal 34 to terminal 33 to activate. The signal can be removed when the engine has started, but it will not stop if it is removed.

Note! If Blackout Start and Delayed Stop are connected simultaneously, Blackout Start is given priority. The Delayed Stop signal has no effect if the Blackout Start signal is present.

4.10.5 Delayed Stop

When the engine controller receives the Delayed Stop signal, it disconnects the gen. breaker and runs the genset for the predefined cooling time before stopping.

Connect terminal 35 to terminal 33 to engage.

4.10.6 Power-On

Terminal 63 can be used as an external power-on. Connect terminal 63 to +24V to activate.

[5] The Stop Button on the panel has a 0.5 second delay.

Note! For this feature to work, the jumper J1 inside the main unit must be removed. With the jumper ON, the engine controller is always powered.

To remove jumper J1, remove the back lid. It is located in the bottom left corner.

4.10.7 Shutdown override

On auxiliary gensets, shutdown may be overridden by connecting terminal 38 to terminal 36.

All shutdowns are now disabled, except for overspeed. The shutdown channels will trigger an alarm instead.

Note! If in shutdown, applying Shutdown Override will abandon the current shutdown.

4.10.8 Configurable Inputs

Terminals 61 and 62 are user-defined. They are activated by connecting the terminal to 0V.

For available functions, see the Rudolf R3 User's Manual.

4.11 RK-66 Interface Module Fuses

The RK-66 Interface Module has several automatic fuses.

Fuse	Type	Purpose
F1, F2, F5	Raychem Polyswitch™ type RXE090. Maximum load must be less than 1.4A.	Internal circuitries
F3	Raychem Polyswitch™ type RXE050. Maximum load must be less than 0.8A.	Power for the relays connected to terminals 41-44
F4		Secures the 0V on terminals 29, 30, 33, and 36.
F6		Secures the 24V power for the analogue channels at terminals 19, 21, 23, 25, and 27.

When the overload is removed, the fuse repairs itself. Typical recovery time is 15-20 seconds at 20°C ambient temperature.

5 Backup System Configuration

The DCU 305 R3 has a redundant backup system that is always on.

5.1 Overview

In the (unlikely) event of failure in the DCU 305 R3 main microprocessor, the built-in backup system will detect this and activate the common alarm output relay.

Also, if the backup system fails, then the Engine Controller will indicate with a “Backup System Failure” alarm.

Note! The backup system setting is advised automatically by Rudolf R3. Set the DIP switches according to the Rudolf R3 recommendation.

Note! The backup system monitors all enabled switch input channels 1-6 and overspeed. These are the only channels on which the backup system can act.

The backup system activates only if the main microcontroller fails. When the control panel is working normally, it is enabled but not activated.

The backup system activity can be observed on the back panel as a slowly flashing (~1Hz) green LED. If the LED is flashing quickly, (~4Hz), the backup system has detected a main microcontroller failure and is activated.

5.2 Operation Mode

If the backup system is activated and a genuine shutdown situation is detected, it activates the Stop and Shutdown outputs on terminals 42 and 44.

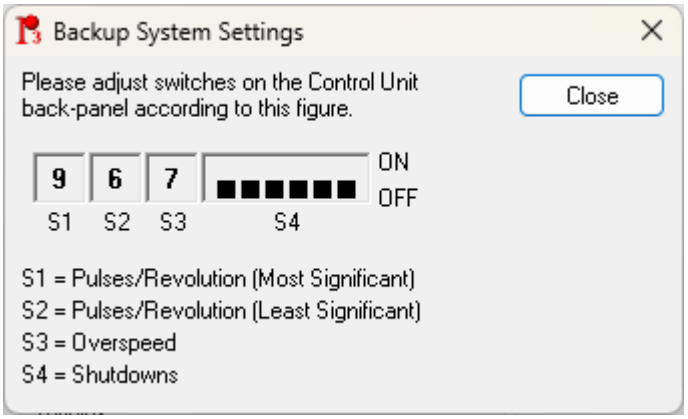
These outputs are held active for 2 minutes before being released.

5.3 Configuration of DIP Switches

All backup system configurations are made using switch S1-S4 on the DCU back panel. There are three settings to be made:

- Set pulses/revolutions using hex-switch S1 and S2.
- Set the overspeed setpoint using hex-switch S3.
- Enable shutdown switch channels by setting dipswitch S4.

Note! The configuration software Rudolf R3 advises the correct setting for S1-S4 whenever the project is transferred to the engine controller. It can also be called up by choosing the menu **Settings** > **Backup System Settings …** The dialogue looks like this:



Example dialog for Backup System Setting.

6 Internal Alarms

The DCU 305 R3 Engine Controller has several internal alarms, as outlined in the table below.

Alarm text	Comment
`Low battery voltage`	Low voltage at the start battery. The alarm is interlocked during starting (cranking) and stopping.
`Secondary battery low voltage`	Low voltage at the secondary battery source.
`Overspeed`	The engine ran faster than the overspeed setpoint. Shutdown.
`Engine Stopped`	The engine stopped for no known reason.
`Engine failed to stop`	The engine has not stopped for 60 seconds after issuing the stop command.
`Start Failure`	The engine failed to start after the final configured start attempt.
`Pickup failure`	Unable to read the pickup signal while the engine is running.
`Output circuit overload`	Short circuit in one of the +24V outputs. The outputs are secured with an automatic fuse. Remove the overload to correct the problem.
`Analog sensor failure [A7]`	Information on which 4-20 mA analogue channel(s) is below 2 mA. Here, Channel 7.
`Broken wire [T7 T9 T44]`	Information on which terminal(s) has a broken wire. Here on terminals 7, 9 and 44.

7 Overspeed Test

This section describes how to enter the RPM Test mode. In test mode, the Overspeed Setpoint (typically 1725 RPM) is reduced to the Nominal Setpoint (typically 1500 RPM).

Note! The actual setpoints may vary from the above example. Consult the Rudolf R3 configuration for the project in question.

7.1 Enter the RPM Test Mode

Note! The RPM Test mode cannot be activated unless the engine controller is Ready[6].

Follow these steps to enable the RPM Test mode:

- From the menu, select **Overspeed/RPM Test**.
- The Overspeed Setpoint is now reduced to the Nominal Setpoint. The bottom left status field displays “RPM TEST” to indicate and remind of this.

The setpoint is now reduced. Start the engine and observe the shutdown at the reduced setpoint.

7.2 Exit the RPM Test Mode

The RPM test mode can be manually deactivated by toggling the **Overspeed/RPM Test menu item**.

The Engine Controller also automatically exit the test when either of these conditions are met:

- After a 4-minute timeout since the test was enabled
- When an Overspeed shutdown is activated.

[6] The engine controller is ready to start the engine.

8 Optional Expansion Modules

The DCU 305 Series has a few optional expansion modules, to expand the overall I/O capability.

8.1 MK-6 and MK-14 Relay Expansion Unit

In addition to the nine relays on the RK-66 Interface Module, an optional relay unit may be connected, adding 6 or 14 relays to the system.

MK-6

MK-14

Each relay's function is configured using the Rudolf R3 software. All relays can be configured with any function from an extensive signal pool.

8.1.1 Cable Interface

The relay expansion unit is connected to the engine controller with a shielded 15-pin D-SUB connector cable and is then ready for use.

Note! If the AK-6 Analog Expansion Unit is in use, then the MK-6/MK-14 cable is connected to the AK-6 unit and not to the engine controller.

8.1.2 Available relay unit functions

These are all the available functions in the DCU 305 R3 that can be routed to any relay on the MK-6 and MK-14 relay expansion units.

Note! Relays K7 and K9 on the RK-66 Interface Module are also configurable.

Function	Comment
Acknowledge button	Manual press of the Acknowledge button.
Analog sensor failure	An analog input (4-20 mA) is defined but the signal is less than 2 mA.
Backup system failure	The backup system is not working.
Buzzer active	The buzzer is activated.
Buzzer off button	Manual press of the Buzzer Off button.
Common analogue input current overload	The sensor fuse is blown. The fuse resets itself when the short circuit is removed.
Common shutdown	The sum of all shutdown channels.
Common warning	The sum of all warning channels.
Cooling state	The genset is cooling and running at no load.
Cranking state	The engine controller signals the start motor. The genset is cranking. On between start attempts also.
Delayed stop activated	The engine controller has received a signal saying the genset will eventually stop.
Disconnect gen breaker relay activated	The generator circuit breaker relay is activated.
Downloading parameters	A new configuration is being transmitted to the engine controller.
Engine started	The engine controller detects the engine is running, but no start signal is detected.
The engine stopped for an unknown reason	The engine stopped for no known reason.
The first start attempt failed	The *first* of several start attempts failed during automatic start.
Local mode	LOCAL mode is selected, and no remote commands will work.
Lamp test button	Manual press of the Lamp test button.
Manual mode	The engine controller is set to Manual mode.
Manual stop	Manual Stop button, local or remote.
Overspeed	The engine speed is too high. Stays until Acknowledged.
Pickup failure	Unable to detect a valid pickup signal. Dependent upon at least one defined *Additional RUN Detection*. Either pickups 1 or 2.

Function	Comment
Preheat	Preheating before and during start attempts. Stays on until the engine has started or failed to start.
Ready to start	The genset is ready to start.
Ready to take the load	The engine has reached the predefined RPM setpoint.
Running state	The genset is running. It is on as long as the engine runs, like the green LED in the Start button.
Secondary battery failure	The secondary battery is not connected or its voltage is below 12V. Terminals 3 and 4.
Shutdown override on	The engine controller is disabling shutdowns, except for overspeed.
Shutdown override off	The engine controller has all configured shutdowns enabled.
Standby mode	The engine controller is set to Standby mode. Automatic starts can take place.
Start battery low voltage	The engine's start battery has low voltage. Terminal 1 and 2.
Start command externally	Same as the Blackout signal, e.g. from the main switchboard. Terminal 34.
Start disabled	The engine controller disables local and remote start attempts when set to Standby.
Start failure	The engine did not start after the final start attempt.
Stop failure	A stop signal was given but after 40 seconds, the engine was still running.
Stopped state	The engine has stopped. Engine speed is less than 5 RPM.
Stopping state	The engine is about to stop.

In addition, all channels configured with a warning, alarm or shutdown will appear in the above list and can be selected to activate on any available relay.

8.2 AK-6 Analog Expansion Unit

The analog unit AK-6 connects directly to the DCU 305 R3. The control unit then has six additional 4-20 mA channels, for a total of 11 channels.

The unit has two 15-pin D-SUB connectors. One connects directly to the engine controller, and the other to the optional MK-6 or MK-14 relay expansion unit.

Note! If Rudolf R3 enables any of the analogue channels 6-11, the engine controller assumes the AK-6 unit is connected.

All input channels on the AK-6 are of type 4-20 mA.

AK-6

The update time for the six expansion channels is somewhat longer than for the five standard channels. The standard channel five will also have a longer update interval when the AK-6 is used. Therefore, we recommend connecting mostly “slow” media, e.g., temp transmitters, to the AK-6 card.

Note! Limitation when using the AK-6 with the MK-14.
Channels 12, 13 and 14 on the MK-14 are unavailable.

8.3 Wiring

The fifth analogue input on the RK-66 Interface Module (terminals 27 and 28) becomes the first analogue input on the AK-6.

If there is a connection at terminals 27 and 28 on the RK-66 card, move these to terminals 1 and 2 on the AK-6 card. Consult the schematic.

Consider the following table when using the AK-6 analogue expansion unit.

Channel	RK-66 terminal #		AK-6 terminal #		LCD page
	+24V	4-20 mA	+24V	4-20 mA	
1	19	20			1
2	21	22			1
3	23	24			1

Channel	RK-66 terminal #		AK-6 terminal #		LCD page
	+24V	4-20 mA	+24V	4-20 mA	
4	25	26			1
5[7]	~~27~~	~~28~~	1	2	1
6			3	4	2
7			5	6	2
8			7	8	2
9			9	10	2
10			11	12	2
11			13	14	2

On the AK-6, connect terminals 27, 28 and 29 directly to terminals 27, 28 and 29 on the RK-66.

Terminal 29 on the AK-6 is a 0V that can be connected to sensors that need a +24V and a 0V connection. Otherwise, disregard it.

Note! Terminals 15 and 16 on the AK-6 are not in use and shall not be connected.

[7] If the AK-6 is in use, then channel 5 shall be connected to the AK-6 unit.

9 Communication

The information from sensors and switches connected to the DCU 305 R3 can be remotely monitored by utilising the built-in communication channel.

Any common supervision systems, such as Factory Link®, InTouch®, etc. that support the Comli or Modbus RTU protocol can be used.

The DCU 305 R3 supports the CAN J1939 standard for interface between Engine ECM and DCU 305.

When connected, the supervision system has all the DCU 305 R3 display data. In addition, commands such as Start, Stop and Acknowledge are available.

9.1 Protocol and Pin Outline

The DCU 305 R3 has the Comli and Modbus communication protocols built in. It communicates at 9600 baud on its RS232 communication port, P3.

To communicate, the engine controller's ID number must be known. The ID number may be any number between 1 and 239. Rudolf's printout documentation includes the ID number indicated on the engine controllers' Communication Status page.

The document DCU 305 R3 Communication Manual includes the complete list of available signals and their address. Please refer to this document when communicating with the engine controller.

In addition, the DCU 305 R3[8] has the J1939 CAN bus communication protocol built in. Port P10 is dedicated to CAN bus communication.

For further information, see the installation manual for DCU 305 R3.

9.1.1 Port P3

The DCU 305 R3 has a 9-pin D-SUB male connector at port P3, outlined as follows.

Pin #	Description
2	RxD
3	TxD
4	DTR
5	SG
7	RTS
8	CTS

[8] Not the LT version

9.1.2 Port P10

The DCU 305 R3 has a 9-pin D-SUB male connector at port P10, outlined as follows.

Pin #	Description
2	CAN-L
7	CAN-H

9.2 Multidrop Communication

Several DCU 305 R3 units may be connected in a multidrop network. Two typical scenarios exist.

- An RSP 305 Remote Panel can communicate with 1-4 DCU 305 R3 or R3 LT engine controllers.
- An external system may communicate with an unlimited[9] number of DCU 305 R3 or R3 LT engine controllers.

For this to work correctly, each connected unit must have a unique ID number in the range 1-239. This is configured in the Rudolf R3 configuration software.

Further, the multidrop net must be an RS-485 net. This means an RS-232/RS-485 converter unit must be connected close to the communication port P3 of each DCU 305 R3 unit.

We recommend using a twisted pair cable with two pairs of at least 0.22 mm^2, and a capacitance lower than 60pF/m.

For more information, see the Communication Manual.

[9] Up to 240

10 Wiring Tables

This chapter describes the wiring of the three modules

- RK-66 Interface Module (mandatory)
- MK-6 and MK-14 Relay Expansion
- AK-6 Analog Expansion

10.1 RK-66 Interface Module

#	DCU 305 R3 (RK-66)	Comment
1	+24V	Primary supply. Connect to the start battery.
2	0V	
3	+24V	Secondary supply. Connect to auxiliary supply.
4	0V	
5	Pickup 1	Used when one pickup only. 2.5 - 30Vpp.
6	Pickup 1	
7	Switch input 1	Referenced to 0V, terminal 29
8	Switch input 2	Referenced to 0V, terminal 29
9	Switch input 3	Referenced to 0V, terminal 29
10	Switch input 4	Referenced to 0V, terminal 29
11	Switch input 5	Referenced to 0V, terminal 29
12	Switch input 6	Referenced to 0V, terminal 29
13	Switch input 7	Referenced to 0V, terminal 29
14	Switch input 8	Referenced to 0V, terminal 29
15	Switch input 9	Referenced to 0V, terminal 29
16	Switch input 10	Referenced to 0V, terminal 29
17	Switch input 11	Referenced to 0V, terminal 29
18	Switch input 12	Referenced to 0V, terminal 29
19	+24V	Output, protected by fuse F6
20	Analog input 1, 4-20 mA	

#	DCU 305 R3 (RK-66)	Comment
21	+24V	Output, protected by fuse F6
22	Analog Input 2, 4-20 mA	
23	+24V	Output, protected by fuse F6
24	Analog Input 3, 4-20 mA	
25	+24V	Output, protected by fuse F6
26	Analog Input 4, 4-20 mA	
27	+24V	Output, protected by fuse F6
28	Analog Input 5, 4-20 mA	
29	0V	Common 0V
30	0V	Common 0V
31	Remote Start	Connect to terminal 30 to activate
32	Remote Stop	Connect to terminal 30 to activate
33	0V	Common 0V
34	Blackout Start	Connect to terminal 33 to activate
35	Delayed Stop	Connect to terminal 33 to activate
36	0V	Common 0V
37	Remote Reset	Connect to terminal 36 to activate
38	Shutdown Override	Connect to terminal 36 to activate
39	Keyswitch Start Disable	Connect a wire between terminals 39 and 40 to enable start[10]. If the wire is removed, an engine start is inhibited.
40	Keyswitch Start Disable	
41	To Start Solenoid	Relay K1. +24V supply to auxiliary start relay

[10] The RK-66 Interface Module has a DIP switch, SW1. If the switch is ON (default) it simulates a jumper between terminals 39 and 40. The switch is located underneath the rubber seal on top of the RK-66.

#	DCU 305 R3 (RK-66)	Comment
42	To Stop Solenoid, +24V	Relay K2. +24V supply to auxiliary stop relay
43	To Run Solenoid, +24V	Relay K3. +24V supply to auxiliary run relay
44	To Shutdown Solenoid	Relay K4. +24V supply to auxiliary shutdown solenoid.
45	Common Alarm, NO	Relay K5. The Common *Alarm* relay.
46	Common Alarm, C	
47	Common Alarm, NC	
48	Common Shutdown, NO	Relay K6. The common *Shutdown* relay.
49	Common Shutdown, C	
50	Common Shutdown, NC	
51	K7, NO	Relay K7. Configurable relay.
52	K7, C	
53	K7, NC	
54	Ready to Start, NO	Relay K8. Activates when ready to start, and not in LOCAL mode or MANUAL mode.
55	Ready to Start, C	
56	Ready to Start, NC	
57	K9, NO	Relay K9. Configurable relay.
58	K9, C	
59	K9, NC	
60	GND – chassis – hull	Connect to the hull.
61	Config input 1	Configurable input.
62	Config input 2	Configurable input.
63	Power-on[11]	Connect to +24V to power on in parallel with the keyswitch found on DCU 305 R3 P[12].
64	Reserved input	For future expansion

[11] This feature has no effect unless internal jumper J1 is removed.
[12] This product is discontinued.

#	DCU 305 R3 (RK-66)	Comment
65	Pickup 2	For pickup 2.
66	Pickup 2	Use Pickup 1 inputs if there is one pickup only. 2.5-30Vpp.

10.2 MK-6 and MK-14 Relay Expansion Unit

The function on these optional relays is user-defined using the Rudolf R3 configuration software.

Relay	Terminal	Relay
K1	1	Relay 1, C
	2	Relay 1, NC
	3	Relay 1, NO
K2	4	Relay 2, C
	5	Relay 2, NC
	6	Relay 2, NO
K3	7	Relay 3, C
	8	Relay 3, NC
	9	Relay 3, NO
K4	10	Relay 4, C
	11	Relay 4, NC
	12	Relay 4, NO
K5	13	Relay 5, C
	14	Relay 5, NC
	15	Relay 5, NO
K6	16	Relay 6, C
	17	Relay 6, NC
	18	Relay 6, NO
K7	19	Relay 7, C
	20	Relay 7, NC
	21	Relay 7, NO
K8	22	Relay 8, C
	23	Relay 8, NC
	24	Relay 8, NO
K9	25	Relay 9, C

Relay	Terminal	Relay
	26	Relay 9, NC
	27	Relay 9, NO
K10	28	Relay 10, C
	29	Relay 10, NC
	30	Relay 10, NO
K11	31	Relay 11, C
	32	Relay 11, NC
	33	Relay 11, NO
K12	34	Relay 12, C
	35	Relay 12, NC
	36	Relay 12, NO
K13	37	Relay 13, C
	38	Relay 13, NC
	39	Relay 13, NO
K14 #1	40	Relay 14, C1
	41	Relay 14, NC1
	42	Relay 14, NO1
K14 #2	43	Relay 14, C2
	44	Relay 14, NC2
	45	Relay 14, NO2

10.3 AK-6 Analog Expansion Unit

When using the AK-6 unit, the analogue channel 5 is moved from the RK-66 to the AK-6 unit.

Terminal	AI channel	Signal type
1	5	+24V supply
2	□	4-20 mA input
3	6	+24V supply
4	□	4-20 mA input
5	7	+24V supply
6	□	4-20 mA input
7	8	+24V supply

Terminal	AI channel	Signal type
8	□	4-20 mA input
9	9	+24V supply
10	□	4-20 mA input
11	10	+24V supply
12	□	4-20 mA input
13	11	+24V supply
14	□	4-20 mA input
15	-	NC
16	-	NC
27	*)	Connect to RK-66 terminal 27
28	*)	Connect to RK-66 terminal 28
29	*)	Connect to RK-66 terminal 29

*) Connect these three wires to the corresponding wire terminals between the RK-66 and the AK-6.

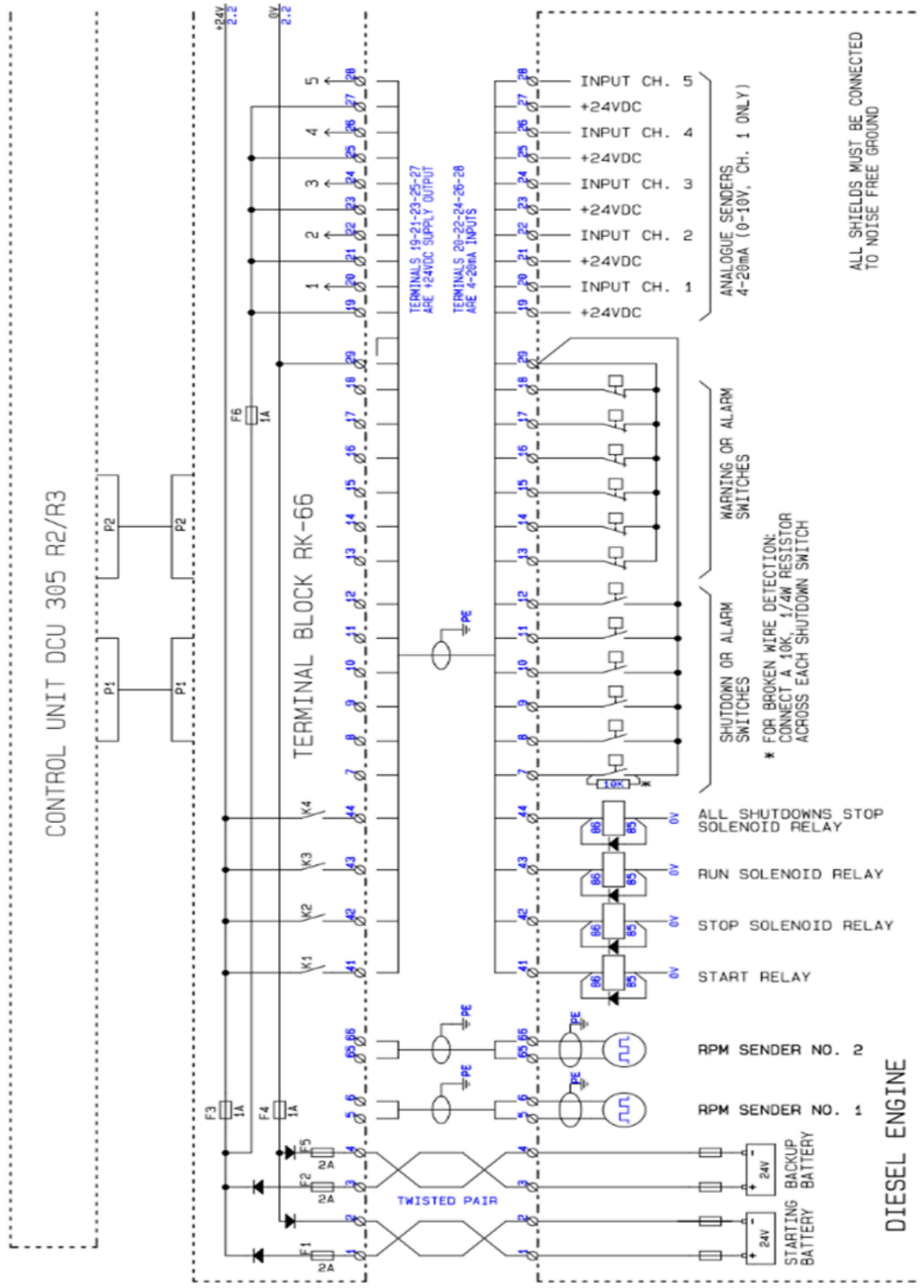
11 Cable Specification

When wiring the RK-66 Interface Module, use wires and cables as specified below.

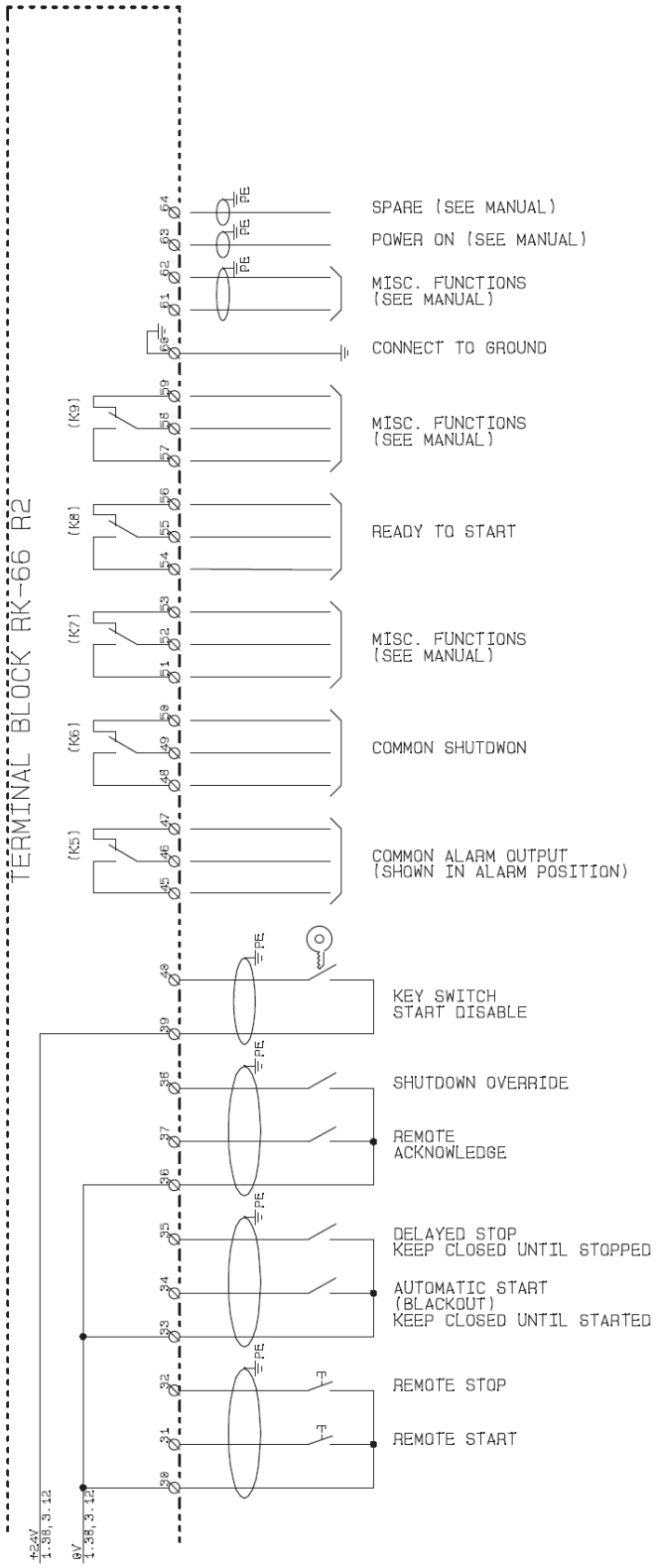
Terminal	Function	Cable specification	Comment
1-2	Primary 24VDC supply	Twisted pair 1.5 mm^2	
3-4	Secondary 24VDC supply	Twisted pair 1.5 mm^2	
5-6	Pickup 1	Shielded cable 2 x 0.5 mm^2 *Separate cable*	Shield to be connected to GND at both ends
7-18	Digital inputs	Shielded cable 0.5 mm^2	Shield to be connected to GND at both ends
19-20	Analog input 1	Shielded cable 0.5 mm^2 *Separate cable if used as 0-10 VDC*	Shield to be connected to GND at both ends
21-29	Analog input 2 - 5	Shielded cable 0.5 mm^2	Shield to be connected to GND at both ends
30-32	Remote Start Remote Stop	Shielded cable 0.5 mm^2	Shield to be connected to GND at both ends
33-35	Blackout Start Delayed Stop	Shielded cable 0.5 mm^2	Shield to be connected to GND at both ends
36-38	Remote Acknowledge Shutdown Override	Shielded cable 0.5 mm^2	Shield to be connected to GND at both ends
39-40	Remote Keyswitch	Shielded cable 0.5 mm^2	Shield to be connected to GND at both ends
41-44	Relays for Start/Stop	Shielded cable 0.5 mm^2	
45-59	Relay outputs	Up to 2.5 mm^2 wire	
60	GND	2.5 mm^2 ground cable	Connect to GND. L < 1 meter
61-62	Configurable inputs	Shielded cable 0.5 mm^2	Shield to be connected to GND at both ends
63	External power-on	Shielded cable 0.5 mm^2	Shield to be connected to GND at both ends
64	Spare input	-	Not in use
65-66	Pickup 2	Shielded cable 2 x 0.5 mm^2	Shield to be connected to

Terminal	Function	Cable specification	Comment
		Separate cable	GND at both ends
DSUB P3	- Rudolf Configuration - Comli/Modbus communication	Shielded cable 0.20 mm^2 *Separate cable*	Shield to be connected to DSUB housing at DCU 305 R3 end only
DSUB P7	AK-6, MK-14, C1-C2-C3 cable Expansion port	Shielded cable 0.20 mm^2 *Separate cable*	Shield to be connected to DSUB housing at DCU 305 R3 end only
DSUB P9	J1708, J1587	Shielded cable 0.20 mm^2 *Separate cable*	Shield to be connected to DSUB housing at DCU 305 R3 end only
DSUB P10	CAN, J1939	Shielded cable 0.20 mm^2 *Separate cable*	Shield to be connected to DSUB housing at DCU 305 R3 end only

12 Schematics



Schematics page 2



Schematics optional units, AK-6 and MK-14/MK-6