Installation Manual

DCU 305 R3
DCU 305 R3 LT

Diesel Engine Control Unit

Auto-Maskin

Content

Document information

Document revisions

Date	Revision
July 2005	Created
November 2007	Minor adaptations for firmware 6.53 and onwards, because a new menu layout.
July 2014	DCU 305 R3 LT included, picture updates

Related documents

- DCU 305 R3 & R3 LT User's Manual
- DCU 305 R3 & R3 LT Communication Manual.
- RSP 305 Remote Panel.
- Rudolf R3 User's Manual.
- Rudolf R3 PC Configuration Software.

Introduction

About this manual

This manual has been published primarily for professionals and qualified personnel. A person using this material is assumed to have basic knowledge in marine systems, and be able to carry out related electrical work.

Work on the boats low-tension circuit should only be carried out by qualified and experienced persons. Installation or work on the shore power equipment *must only* be carried out by electricians authorised to work with such installations.

It is the sole responsibility of the installer to ensure that the installation work is carried out in a satisfactorily manner, that it is operationally in good order, that the approved material and accessories are used and that the installation meet all applicable rules and regulations.

Note: 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 dealer.

Assumptions

This document describes the DCU 305 R3 and DU 305 R3 LT, and it will commonly be referred to as the **DCU** or the **Control Unit**.

When referring to voltages, we always assume DC-voltages. When referring to AC-voltages it will be mentioned explicitly.

About the DCU 305 R3 and DCU 305 R3 LT

In general

The DCU 305 R3 is an electronic control unit for control and monitoring of diesel engines used as propulsion engines or gensets.

Switches and senders from the engines are connected to the control unit on the wire terminal card RK-66.

The DCU 305 R3 can be connected directly to a printer for output of all alarms and events, or it can be connected to a remote panel in a network of control units.

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

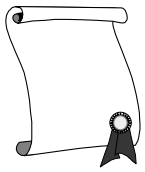
DCU 305 R3 LT

The DCU 305 R3 LT is identical to the DCU 305 R3 with the exception that the LT version is without CAN bus capability.

The DCU 305 R3 LT has the physical CAN bus port, but there is no support for CAN bus internally.

Classified system

The DCU 305 R3 is classified by the following classification societies with their respective certificate number as follows:



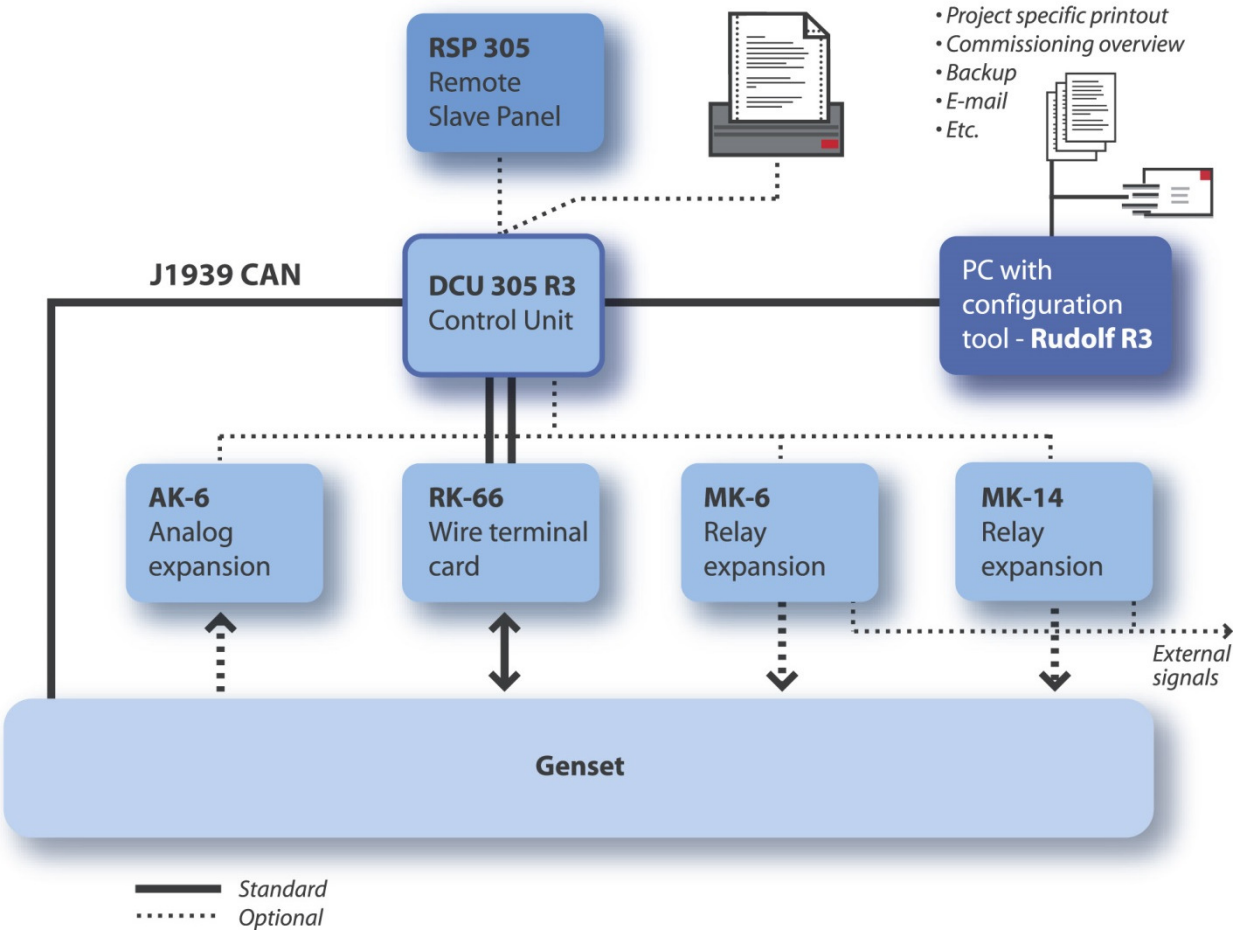
Classification Society	Certificate Number
Det norske Veritas, DnV	
Lloyd's Register of Shipping, LR	
Germanischer Lloyds, GL	
Bureau Veritas, BV	
Russian Maritime Register of Shipping, RS	
Registro Italiano Navale, RINA	
American Bureau of Shipping, ABS	

Other certificates and approvals may exist.
Please see www.auto-maskin.com for latest update.

System Overview

The control unit and the wire terminal card with cables make a complete genset monitoring system. Optional analogue cards and relay cards may be added to further enhance the functionality and flexibility.

The control unit is configured using a laptop PC with the configuration software Rudolf™ installed. The configuration can be printed and stored on disk.



Standard system

The *DCU 305* and the *RK-66* is part of the standard delivery that makes a complete system. The other items are optional.

Remote panel

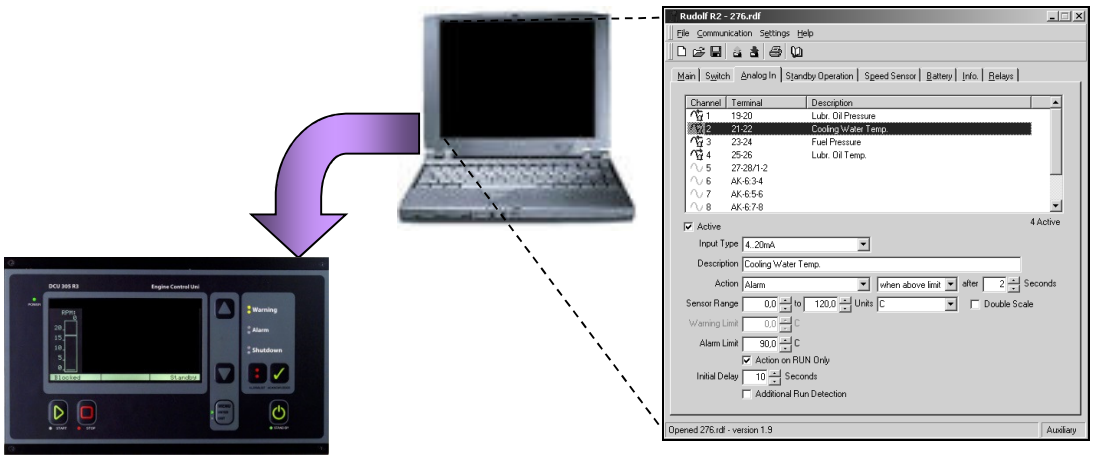
The optional RSP 305 Remote Panel can be added any time, as it communicates directly towards the DCU 305 R3, and is self-configuring.

The RSP 305 Remote Panel configures itself automatically when connected to one to four DCU 305 units, and as such requires no extra configuration.

Configuration overview

The control unit is fully customised using the Rudolf™ configuration program. For safety reasons, *no* parameters are adjustable without using the configuration tool Rudolf.

No settings are necessary in the DCU 305 R3, nor in Rudolf, to connect and use the Rudolf program. Just connect the cable between your laptop PC and port P3 on the control unit.



A PC with the Rudolf ™ parameter program is used to customize the DCU 305 R3.

Discussion of the Rudolf configuration software is beyond the scope of this manual. For more information, please see the *Rudolf R3 User's Manual*.

Technical Specifications

Part	Value	
Overall dimensions (1)	160 x 260 x 35mm (6.3 x 10.2 x 1.4") [H x W x D]	
Cut-out dimensions	146 x 230mm (5.8 x 9.1") [H x W]	
Overall depth inc. cables	105mm	
Supply voltage (2)	24V smoothed, (18– 32VDC)	
Power consumption (3)	Typical:	500mA @ 24V DC
	Maximum:	700mA @ 24VDC

Part	Value	
Weight	Control unit:	1250g
Protection level	Front panel:	IP54
	Back panel:	IP30
Ambient temperature	Operation:	0-70°C
	Storage:	-20-70°C
Air humidity	Operation:	<90%
	Storage:	Dry
Analogue alarm latency	Built-in channels:	~1 sec
	Expansion card AK-6:	~5 sec
RK-66 relays	120VAC	1A
	24VDC	1A

Notes

(1) *The cables on the backpanel add to the overall depth.*

(2) *LCD backlight disappears if primary supply is below 18 volts, and reappears when primary supply is above 20 volts.*

(3) *Display brightness full, 5 x 50% (12mA) analogue inputs.*

Cable connection

In general

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

The shield of all cables shall be connected to ground, **not** to 0V!
Some cables are to be grounded in one end only, others in both ends.

Some cables shall be separate – for instance pickup signal and power supply. Others signals can be in a multi-cable with shield.

See the example schematics and cable specification for details.

Grounding

Please observe the difference between ground and 0 volt!

Please keep ground and 0V separated!

Ground and 0V should *not* be connected together. In a ship installation, the hull is the "ground" whilst the battery negative is the 0V.

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

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

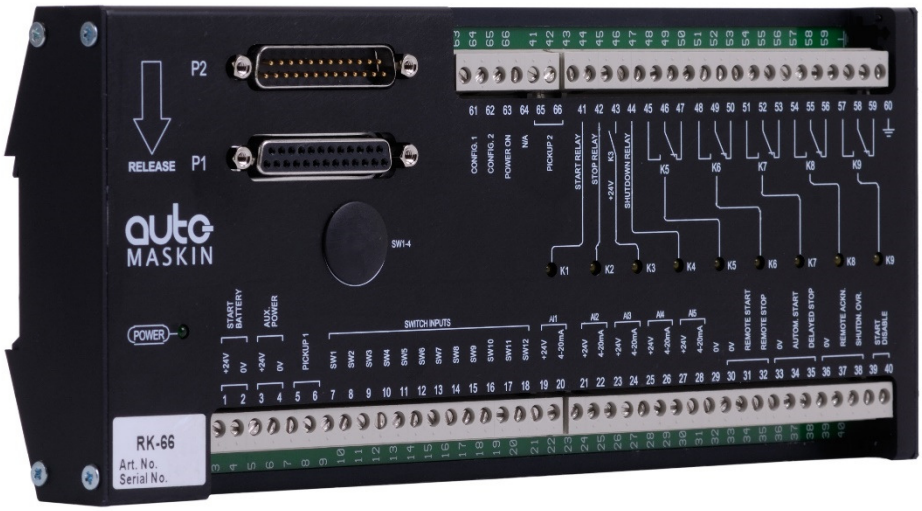
Connection order

All connections are made on the RK-66 terminal unit. The only exception is communication cables, and analogue/relay expansion cables, which are connected directly on the back-panel.

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

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

Connect the two cables between the RK-66 and the control unit.



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 from the auxiliary supply.

Switch setting

By removing the rubber lid on the front of the RK-66, four dip-switches numbered 1-4 will appear.

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

Power supply

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 terminals 1 and 2. This is the *primary* supply.

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

Note: In a classified system, a redundant supply *must* be connected to terminals 3 and 4.

The control unit uses the highest voltage available from the two supplies.

The *primary* voltage is constantly monitored and displayed on the LCD. The control unit alarms if the primary supply is below the configured value, or when the *secondary* supply is below 12V (fixed setpoint).

The LCD light disappears if the *primary* voltage drops below 18V, and reappear when the *primary* voltage rises above 20V.

12V supply installations

The DCU 305 R3 is a 24V system, but can be used in 12V systems using an external DC/DC converter. The configuration in Rudolf must be switched to fit a 12V system.

Connect the start battery to the *primary* input at terminal 1 and 2 as above. This voltage is not high enough to make the control panel work, but it measures the battery voltage.

Connect a 12/24V DC/DC converter to the 12V start battery, and connect the 24V output to the *secondary* input, terminal 3 and 4.

Start- and Stop Relay Outputs

Connect auxiliary relays for Start (cranking), Stop, Run solenoid and Shutdown solenoid.

Observe polarity if the relay coils are fitted with voltage suppressor diodes.

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

Pickup sensors

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

Note: The pickup cable must be shielded to ground, **not** to 0V.

Two pickups

If two pickups are being used, connect the second pickup to terminal 65 and 66. If the rpm differs >100rpm 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 >100rpm higher than pickup 1, where pickup 2 will be used.

Note: Two Pickups must be *enabled* in Rudolf before it can be used.

Switch Input Channels

The control unit has 12 on/off input channels. All 12 channels can be fully customised with text, delays and instructions to give a Warning, Alarm or Shutdown.

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*

Switch Input Channels and their corresponding wire terminal number on the RK-66 wire terminal card.

Inputs are connected to the Wire Terminal Card RK-66 as in the above table.

The six first switch input channels can detect a broken wire situation, and utilizes a backup system for shutdown purposes. See page 22 for more information on the backup system.

Note: In a classified system, all *shutdown* switches must be connected to switch inputs 1-6.

The following table illustrates the capabilities of the switch input channels.

Channel	Broken Wire Detection possibility	Backup on Shutdown channels	Warning, Alarm and Shutdown possibility
1-6	*Yes*	*Yes*	*Yes*
7-12	*No*	*No*	*Yes*

Note: Do ***not*** connect +24V to the switch inputs! All input switches must be connected via its corresponding wire terminal to 0V, *not* to ground. Please see the schematic drawing page 35.

Connecting the Switches

Connect the warning, alarm and/or shutdown switches according to the project documentation and drawings. All switches must be connected between a wire terminal (7-18) and 0V.

An open (not connected) input is pulled 'high' internally. The external switch must pull the input 'low' (0V).

Example: Switch channel 1 might be the Oil Pressure Low Shutdown. The switch is then connected between Terminal 7 and 0V.

Wire break detection

Channel 1-6 has the ability to detect wire break. This is useful in conjunction with the channel being used as a shutdown channel.

A **10k** resistor (10 000 ohm) must be connected in parallel with the switch. The resistor must withstand 1/8W (0.125W) or more.

Note: The Wire Break Detection feature must be enabled in Rudolf for each of the channels 1-6 that are being used. Otherwise, there will not be a Broken Wire alarm.

The control panel will now issue a "Broken Wire" alarm if the wire into the control panel is broken. The alarm is delayed 5 seconds (fixed time).

An alarm is displayed as:

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

Here, there is a broken wire on T9, terminal 9. Terminal 9 is switch channel 3.

Considerations when using wire break detection

Make sure the return-path from the switch is connected to 0V (terminal 29) at the connection card RK-66, not at the engine

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 resistor must be connected across the switch, not across the terminals 7 and 29.

Analogue Input Channels

The control unit has five industrial-standard 4-20mA inputs. These may or may not be used, and – if used – are displayed on the LCD as horizontal bars.

Note: An optional expansion card, the AK-6, is available to expand the number of analogue inputs from 5 to 11. Please see page 27 for details.

Using Rudolf, *all* 11 analogue channels can be configured as a 0-20mA or 4-20mA type.

Channel 1 can be configured as 0-10V.

Note: If channel 1 is used as 0-10V, use a separate shielded cable for this signal as the 0-10V signal is highly susceptible to noise.

All analogue channels can be customised with text and delays and whether to issue a Warning, Alarm or Shutdown.

Note: Analogue channel one only, can be configured as a 0-10V channel. The dipswitch **J12** inside the unit must be set as follows:

0-20mA / 4-20mA 

0-10V 

Please note that this is applicable for analogue channel one only! Default setting is 0-20mA / 4-20mA.

Analogue channel setpoints

In the display, the following markers are used to distinguish between different types of setpoints:

None	No setpoint
Warning	Dashed line
Alarm	Single line
Shutdown	Double line

Analogue Sensor Failure

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

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

```
Oil Pressure OP1
                              ---- Bar
```

Note! If 0-10V or 0-20mA is selected, the *Analogue Sensor Failure* alarm will not appear.

Connecting the Analogue Sensors

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

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

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

Analogue Input Channels and the corresponding wire terminal number on RK-66

Terminal 19, 21, 23, 25 and 27 are all +24V supply *outputs*. These outputs are fused with a common, internal, automatic fuse (F3). The fuse is located on the RK-66 card.

The fuse will automatically reset when the overload or short circuit is removed. An alarm is given if the fuse blows and the alarm stays activated as long as the short circuit is present.

For fuse sizes and characteristics, please see page 21.

Example: Analogue channel 1 might be the Oil Pressure sensor. The sensor is then connected between terminal 19 (+24V supply) and terminal 20 (4-20mA input).

J1939 CAN connections

The CAN bus cable

The CAN bus is a high speed data transmission network and requires more from the 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.

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

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

Minimum cable curve is 8x the cable diameter (ie it should not be bent too sharp). It 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, but in certain installations with a long cable it may be favorable to connect it at both ends.

Terminating Resistors

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

The DCU 305 R3 has a 120ohm resistor internally. If the DCU is not at the end of the bus, a "CAN-card without J1" must be ordered and fitted. Alternatively, the jumper J1 on the CAN-card can be removed by competent personnel.

Note! The CAN bus might work even if there is a terminating resistor too much or if one is missing, but it will **not** work if both terminating resistors are missing.

If by accident, a 24VDC signal has been connected into the CAN bus, the terminating resistor might be destroyed, and the CAN-card must be sent in for repair.

Cable ducts

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

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

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 in good physical distance (5cm/2") from parallel signal cables.

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.

The CAN bus in star network topologies

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

The CAN-repeater and shield

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

Miscellaneous connections

Please also refer to the schematics, page 35, for the following connections.

Remote Start

Remote Start works as the local Start Button.

Connect terminal 31 to terminal 30 to engage.

Remote Stop

Remote Stop works as the local Stop Button, except it is immediate

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 setting.

Remote Reset (Acknowledge)

Connect terminal 37 to terminal 36 to activate Remote Reset.

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

Blackout Start

When the control unit 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. See the schematics on page 35.

When the engine has started, the signal can be removed. The engine will not stop if the signal 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.

Delayed Stop

When the control unit receives the Delayed Stop signal, it will disconnect the gen. breaker and run the genset for the predefined cooling time before stopping.

Connect terminal 35 to terminal 33 to engage. Also, see schematic page 35.

Power-On

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

Note! The jumper J1 inside the main unit must be removed for this feature to work. With the jumper ON, the control unit is always powered.

How to remove jumper J1

Remove the back lid. The jumper J1 is located in the bottom left corner.

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.

Configurable inputs

Terminal 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*.

The automatic fuses on the RK-66 module

The RK-66 wire terminal card has six automatic fuses.

- Fuses F1, F2 and F5 are used by the DCU 305 R3 to secure internal circuits.

  These fuses are of type Raychem Polyswitch™ type RXE090. Maximum load must be less than 1.4A.

- Fuse F6 secures the +24V power for the analogue channels at terminal 19, 21, 23, 25 and 27.
  Fuse F3 secures power for the relays connected to terminal 41-44. See the schematics on page 35.

- Fuse F4 secures the 0V on terminals 29, 30, 33 and 36.

The fuses F3, F4 and F6 are of type Raychem Polyswitch™ type RXE050. Maximum load must be less than 0.8A.

If the values are exceeded, the fuse will eventually blow. When the overload is removed, the fuse repairs itself. Typical recovery time is 15-20 seconds at 20°C ambient temperature.

Backup system configuration

Note! The backup setting is automatically advised by the configuration software Rudolf R3.

You may use these settings and skip this chapter entirely.

Overview

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

Also, if the backup system fails, then the main microcontroller will give the “Backup System Failure” alarm.

Note: The backup system setting is calculated automatically by Rudolf R3.

Set the DIP-switches according to the Rudolf R3 recommendation.

The backup system monitors all of the *enabled* switch inputs channels 1-6, and overspeed. These are the only channels on which the backup system can act.

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

The working of the backup system 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.

What it does

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

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

Configuration of dipswitches

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

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

Pulses/Revolution, S1 and S2

Set the pulses/revolution on pickup #1 (connected to terminals 5 and 6) by switching the two rotary hex-switches S1 and S2 to the correct value.

See the *Appendix* page **Error! Bookmark not defined.** for details.

MS is the *most significant* value whereas LS is the *least significant* value.

Example: A pickup issues 165 pulses/revolution. 165 decimal = A5 hex.

A is the MS; 5 is the LS.

Set S1 = A
Set S2 = 5

Overspeed, S3

Note: The Backup System measures rpm from pickup 1 only.

Set correct overspeed setpoint by turning the hex-switch as follows:

Switch S3	Value [rpm]	Switch S3	Value [rpm]
0	*Disabled*	8	1800
1	480	9	1885
2	670	A	2010
3	1025	B	2030
4	1370	C	2120
5	1670	D	2340
6	1720	E	2430
7	1760	F	2730

Select the next value that is *above* the Rudolf R3 overspeed setting.

Example: If the main configuration overspeed is set to 1740, then set the S3 switch to 7, ie. 1760 rpm.

Shutdown channels, S4

There is a dipswitch in combination with each of the first six switch channels.

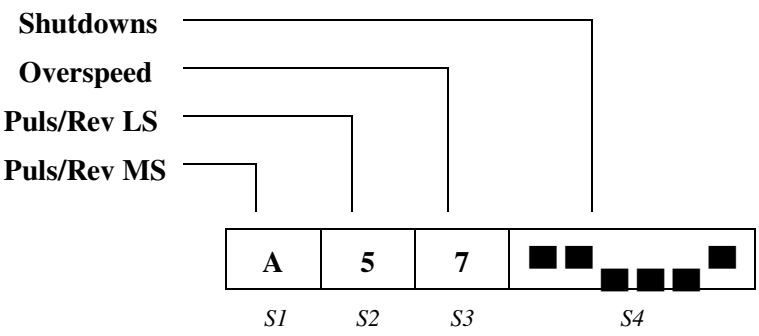
The DIP-settings are for selection of the shutdown channels. All of the channels 1-6 that are configured as shutdown must have its corresponding DIP set to ON.

In the example below, channels 1, 2 and 6 are set as shutdown channels.

Note: The backup settings MUST correspond with the Rudolf R3 configuration.

When the DIP is set to ON, it means these channels will be monitored by the backup system.

In the backup system, there is a four second delay before pulling the stop-solenoid. Once activated, the stop-solenoid remains activated for two minutes to allow the engine to completely stop. The stop-solenoid then deactivates.



Example of Backup System setting.

The above example is a system with shutdowns on channel 1, 2 and 6, overspeed set to 1760 rpm and 165 pulses/revolution (see text above)

In the above example, channel 1, 2 and 6 are shutdown channels. Here, channels 3, 4 and 5 may be configured as Warning or Alarm channels, or may not be in use.

Built-in Alarms

The control unit has a number of internal alarms. These are always displayed – in the language selected by Rudolf.

The following is a list of the built-in alarms.

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.

Alarm text	Comment
Overspeed	Engine running faster than the overspeed setpoint.
Engine Stopped	Engine stopped for no known reason.
Engine failed to stop	60 seconds after issuing the stop command, the engine has still not stopped.
Start Failure	Engine failed to start after the last start attempt.
Pickup failure	Unable to read the pickup signal while engine is running.
Output circuit overload	Short circuit in one of the +24V outputs. The outputs are secured with fuse F3 that makes an automatic reset. Remove the overload to correct the problem. For details, see page 21.
Analogue sensor failure [A7]	Detailed information on which analogue channel that is below 2mA. Here channel 7.
Broken wire [T7 T9 T44]	Information on which terminal has a broken wire. Here on terminal 7, 9 and 44.

Adjusting the LCD screen

The control unit uses a graphical Liquid Crystal Display.

The optical performance of the display changes with temperature, light conditions and age.

There is a built-in automatic compensation for temperature changes. Still, from time to time, it may be necessary to adjust the display.

Automatic Backlight Shutoff

To preserve LCD lifetime, the display automatically shuts off after the predefined amount of time, if no action has been observed in that period.

The display turns on again at any key press, or if an event occurs in the system.

Note: The terminals 61 and 62 can be configured as LCD Backlight On. A 0V on the terminal will trigger the LCD Backlight On.

Contrast

Contrast is automatically compensated for with temperature.

If however the display seems dim or unclear, it may be necessary to adjust it. Access the menu and select Contrast to adjust.

The new setting is automatically stored in internal memory, and stays resident regardless of future power loss.

Overspeed test

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

Note: The actual setpoints may vary from the above example. Consult the Rudolf configuration.

How to enable the RPM test mode

Follow these steps to enable the RPM Test mode:

- Access the menu and select *Overspeed/RPM Test*.

Note! It is not possible to enable the RPM Test mode unless the control unit is in the **Ready** state.

The Overspeed Setpoint is now reduced to the Nominal Setpoint. The bottom left status field displays “RPM TEST” to indicate and remind of this.

Note: The test automatically times out after 4 minutes or after an Overspeed shutdown. To leave the test earlier, toggle it again, as described above.

Optional expansion modules

Relay unit MK-14

In addition to the nine relays found on the RK-66 terminal board, an optional relay unit may be connected.

The optional MK-14 unit, which add 14 relay channels to the DCU 305 R3. The function on each relay is configured using the configuration tool Rudolf R3.

All relays can be given *any* function from an extensive signal pool.

The relay card is connected to the control unit with a shielded 15-pin D-SUB connector cable, and is then ready for use.

For connections, please see page 42.

Available signals to the relay unit

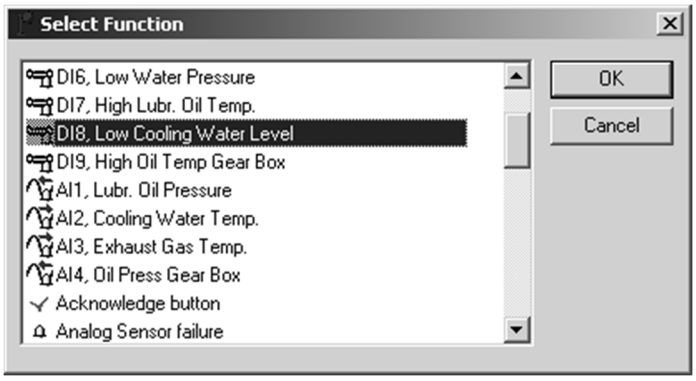
These are all the available signals in the DCU 305 R3 that can be routed to any of the relays on the relay cards.

Relay K7 and K9 on the terminal card RK-66 are configurable in the same manner.

Signal	Comment
Acknowledge button	Manual press of the Acknowledge button.
Analogue sensor failure	An analogue input (4-20mA) is defined but the signal is less than 2mA.
Backup system failure	The backup system is not working.
Buzzer active	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	Sum of all shutdown channels.
Common warning	Sum of all warning channels
Cooling state	The genset is cooling and running at no load.
Cranking state	The Control Unit signals the start motor. The genset is cranking. On between start attempts also.
Delayed stop activated	The Control Unit has received 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 control unit.
Engine started	The Control Unit detects the engine is running but no start signal has been detected.
Engine stopped for unknown reason	The engine stopped for no known reason.
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 Control Unit is set to Manual mode.
Manual stop	Manual Stop button, local or remote.
Overspeed	Engine speed too high. Stays until Acknowledged.
Pickup failure	Unable to detect a valid pickup signal. Dependent upon at least one defined *Additional RUN Detection*. Sum of pickup 1 and 2.

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

All channels – analogue or switch – configured as a warning, alarm or shutdown can be routed to any relay.



A screenshot from the configuration tool Rudolf R3, where signals are selected to the relays.

Analogue unit AK-6

The analogue unit AK-6 connects directly into the DCU 305 R3. Another six 4-20 mA channels are then available in the control unit, to make a total of 11 channels.

The unit has two 15-pin D-SUB connectors. One connects directly to the control unit. The other connects to the optional relay expansion unit MK-14, if used.

If any of the analogue channels 6-11 are activated in Rudolf, the control unit assumes the AK-6 unit is connected.

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

Note: The *update time* for the six expansion channels is somewhat longer than for the five standard channels. The standard channel five will also have longer update interval when AK-6 is used. We recommend connection of mostly "slow" media to the AK-6 card, eg. temp. transmitters.

Note: When using the AK-6 card and the MK-14 card together, the last three channels (channel 12, 13 and 14) on the MK-14 are unavailable for use.

The optional AK-6 analogue card, which adds six 4-20 mA channels to the DCU 305 R3.

Connections

The fifth analogue input on the RK-66 unit (terminal 27 and 28) becomes the first analogue input on the AK-6 card.

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

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

	RK-66 terminal #		**AK-6 terminal #**		
Channel	**+24V**	**4-20mA**	**+24V**	**4-20mA**	***Screen***
1	19	20			*1*
2	21	22			*1*
3	23	24			*1*
4	25	26			*1*
5	~~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*

For further connection information, please see the schematics.

On the AK-6, connect terminal 27, 28 and 29 directly to terminal 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.

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

Displaying the analogue values.

As illustrated in the table above, channel 1-5 will be displayed in the first analogue screen, along with the battery voltage (standard).

Note! Screen 2 displays channels 6-11. Screen 2 is not available if none of the channels 6-11 are in use.

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 like Factory Link®, InTouch®, etc. that supports the Comli or Modbus protocol can be used.

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

When connected, all data available on the DCU 305 R3 display is available in the supervision system. In addition, commands such as Start, Stop and Acknowledge can be done.

Protocol and pin-configuration

The DCU 305 R3 has the *Comli* and *modbus* communication protocol built-in. It communicates at 9600 baud on its RS232 communication port, P3.

In order to communicate, the control units ID-number must be known. This ID-number may be any number in the range 1-239. The printout documentation from Rudolf includes the ID-number. The ID-number is also displayed in the Communication Status view.

The document *DCU 305 R3 Communication Manual* includes the complete list of available signals and their address. Please refer to this document when communicating towards the control panel.

In addition the DCU 305 R3 has the J1939 CAN bus communication protocol built-in. On the DCU 305 R3 port P10 is dedicated to CAN communication. For further description, please see installation manual for DCU 305 R3.

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

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

Multidrop communication

Several DCU 305 R3 units may be connected together in what is known as a *multidrop* network.

For this to work correctly, each of the connected units must have its unique ID-number in the range 1-239. This is done using the parameter program Rudolf.

Further, the multi-drop net must be an RS-485 net. This means that RS-232/RS-485 converter units, for instance the ICPCON RS232/RS485 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 capacity lower than 60pF/m.

Please contact your dealer or Auto-Maskin for correct dip setting and cabling of these units in a network.

Retrieve the log to a PC

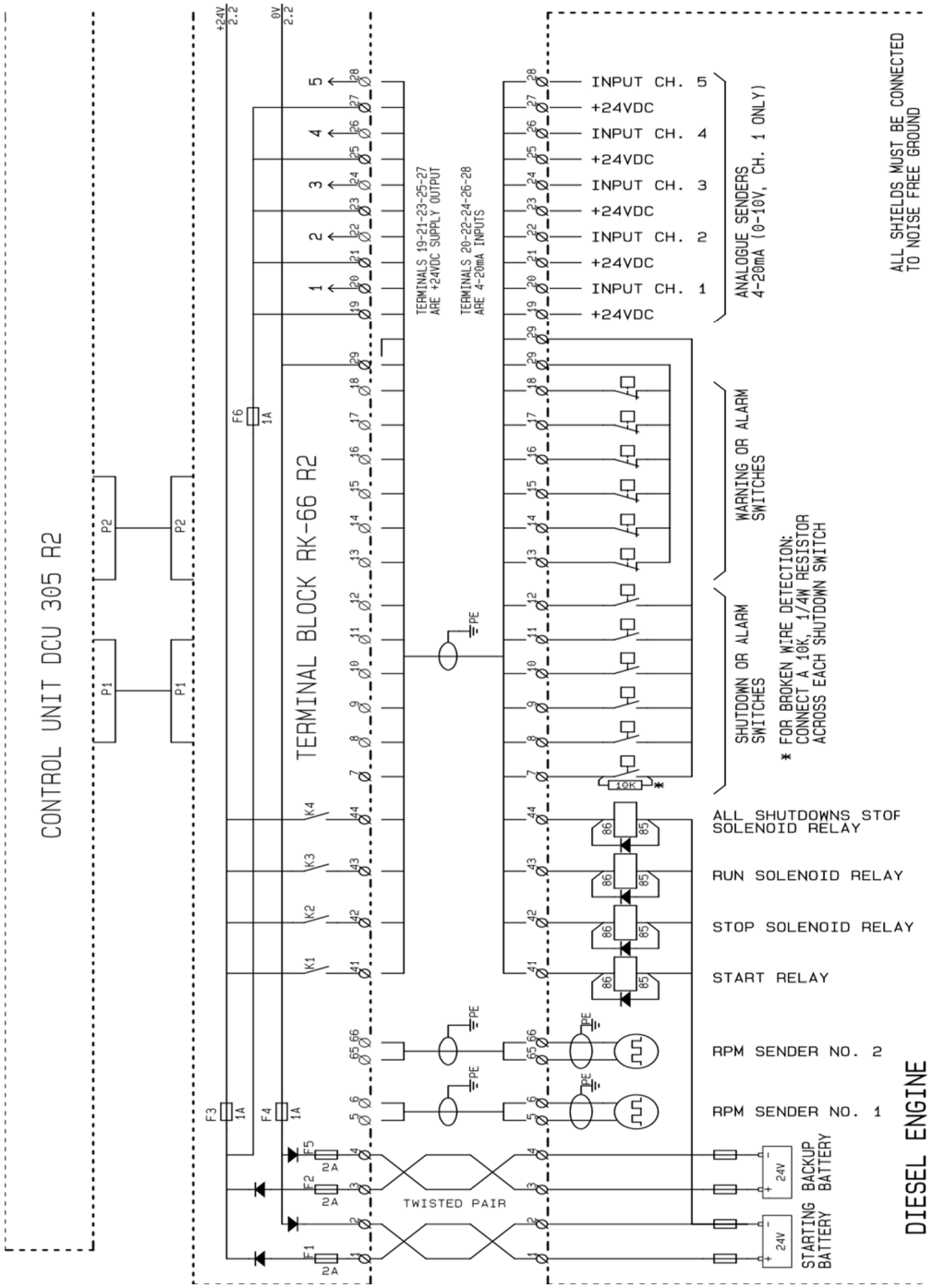
The built-in event log in the control unit can be retrieved with simple means.

- Connect the configuration software to the DCU 305 R3 using the Rudolf cable.
- In the configuration software, select Communication – Retrieve Log…

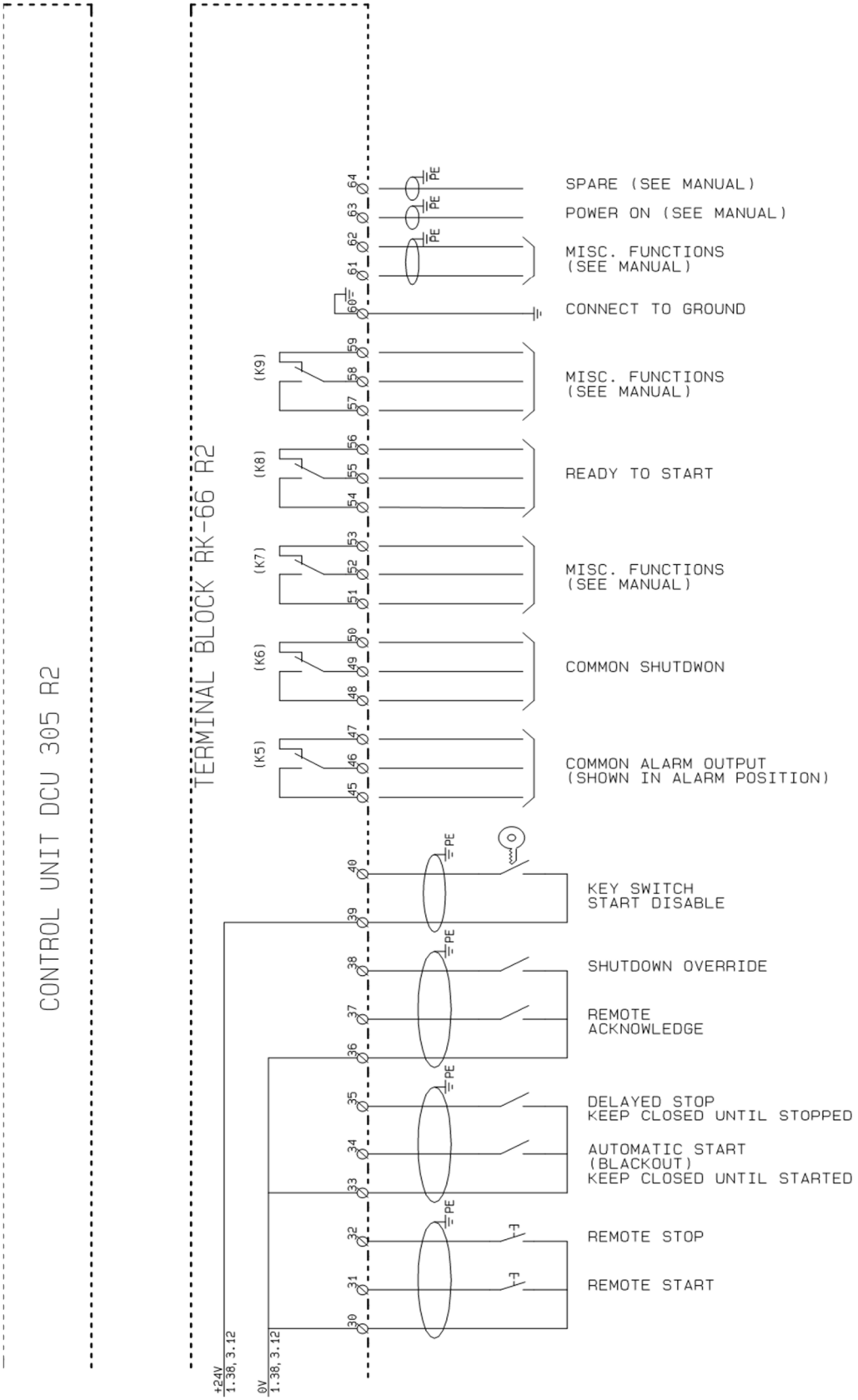
Wait while the log is uploaded into the PC.

Schematic Drawings

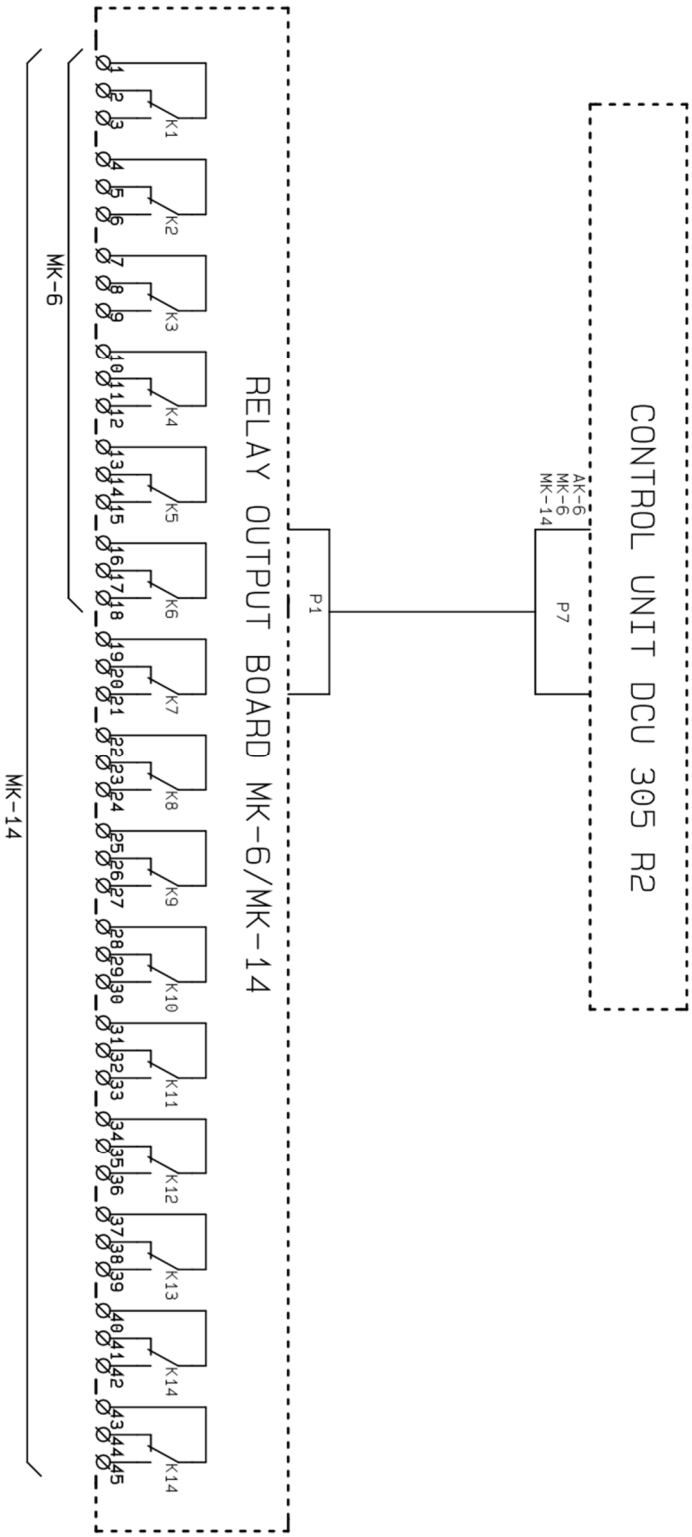
Sample Schematic Page 1



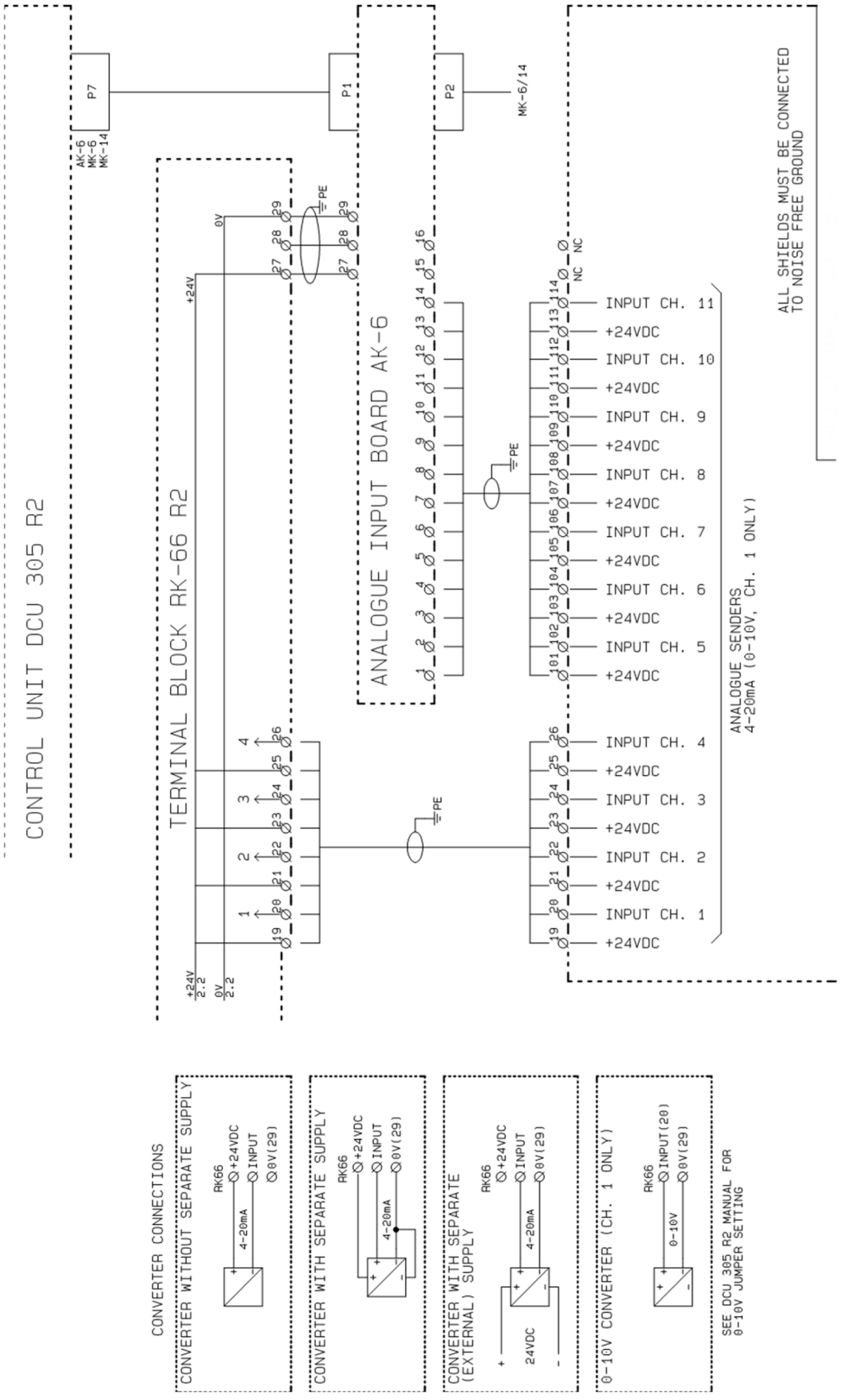
Sample Schematic Page 2



Optional Relay Unit MK-14



Optional Analogue Unit AK-6



Cable Specification

Terminal	Function	Cable specifications	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	Analogue input 1	Shielded cable 0.5 mm^2 *Separate cable if used as 0-10VDC*	Shield to be connected to GND at both ends
21-29	Analogue 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	Unshielded cable max 2.5 mm^2	
60	GND	Unshielded 2.5 mm^2 GND cable	Connect to noise-free earth. L<1m
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 2x0.5 mm^2 *Separate cable*	Shield to be connected to 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

Wire Terminal Tables

RK-66 wire terminal unit

#	DCU 305 R3 (RK-66)	Comment
1	+24V	Primary supply. Connect to start battery.
2	0V	
3	+24V	Secondary supply. Connect to auxiliary supply.
4	0V	
5	Pickup 1	Used when one pickup only.
6	Pickup 1	2.5 - 30Vpp.
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	Analogue input 1, 4-20mA	
21	+24V	Output, protected by fuse F6
22	Analogue Input 2, 4-20mA	
23	+24V	Output, protected by fuse F6
24	Analogue Input 3, 4-20mA	
25	+24V	Output, protected by fuse F6
26	Analogue Input 4, 4-20mA	
27	+24V	Output, protected by fuse F6

#	DCU 305 R3 (RK-66)	Comment
28	Analogue Input 5, 4-20mA	
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 terminal 39 and 40 to enable start.[1].
40	Keyswitch Start Disable	If the wire is removed, start is inhibited. Set switch SW1 to jumper across terminal 39 and 40.
41	To Start Solenoid	Relay K1. +24V supply to auxiliary start relay
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.
46	Common Alarm, C	The Common *Alarm* relay.
47	Common Alarm, NC	
48	Common Shutdown, NO	Relay K6.
49	Common Shutdown, C	The common *Shutdown* relay.
50	Common Shutdown, NC	
51	K7, NO	Relay K7.
52	K7, C	Configurable relay.
53	K7, NC	
54	Ready to Start, NO	Relay K8.
55	Ready to Start, C	Activates when ready to start, and not in LOCAL mode or MANUAL mode.
56	Ready to Start, NC	
57	K9, NO	Relay K9.
58	K9, C	Configurable relay.
59	K9, NC	
60	GND – chassis – hull	Connect to the hull.

[1] The wire terminal card has a switch (SW1) connected over terminal 39 and 40. The switch is accessible from underneath the rubber seal on top of the RK-66 terminal card.

#	DCU 305 R3 (RK-66)	Comment
61	Config input 1	Configurable input.
62	Config input 2	Configurable input.
63	Power-on[2]	Connect to +24V to power-on in parallel with the keyswitch found on DCU 305 R3 P.
64	Reserved input	For future expansion
65	Pickup 2	For pickup 2.
66	Pickup 2	Use Pickup 1 inputs if there is one pickup only. 2.5-30Vpp.

Relay unit MK-14

The functions on these optional relays are user defined using the Rudolf configuration tool.

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

[2] This feature has no effect unless internal jumper J1 is removed.

Relay	Terminal	Relay
K9	25	Relay 9, C
	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

Note: Relay 14 has *two* changeover contacts.

Analogue unit AK-6

Please note that when using the optional AK-6 unit, analogue channel 5 is moved from the RK-66 to the AK-6 unit.

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

Terminal	AI channel	Signal type
9	9	+24V supply
10	→	4-20mA input
11	10	+24V supply
12	→	4-20mA input
13	11	+24V supply
14	→	4-20mA 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 between RK-66 and AK-6.