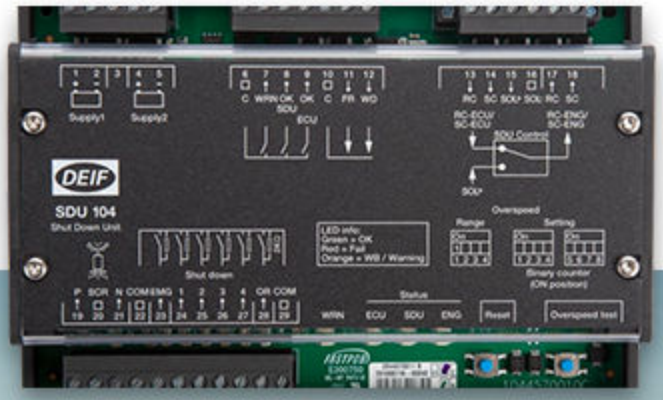
SDU 104

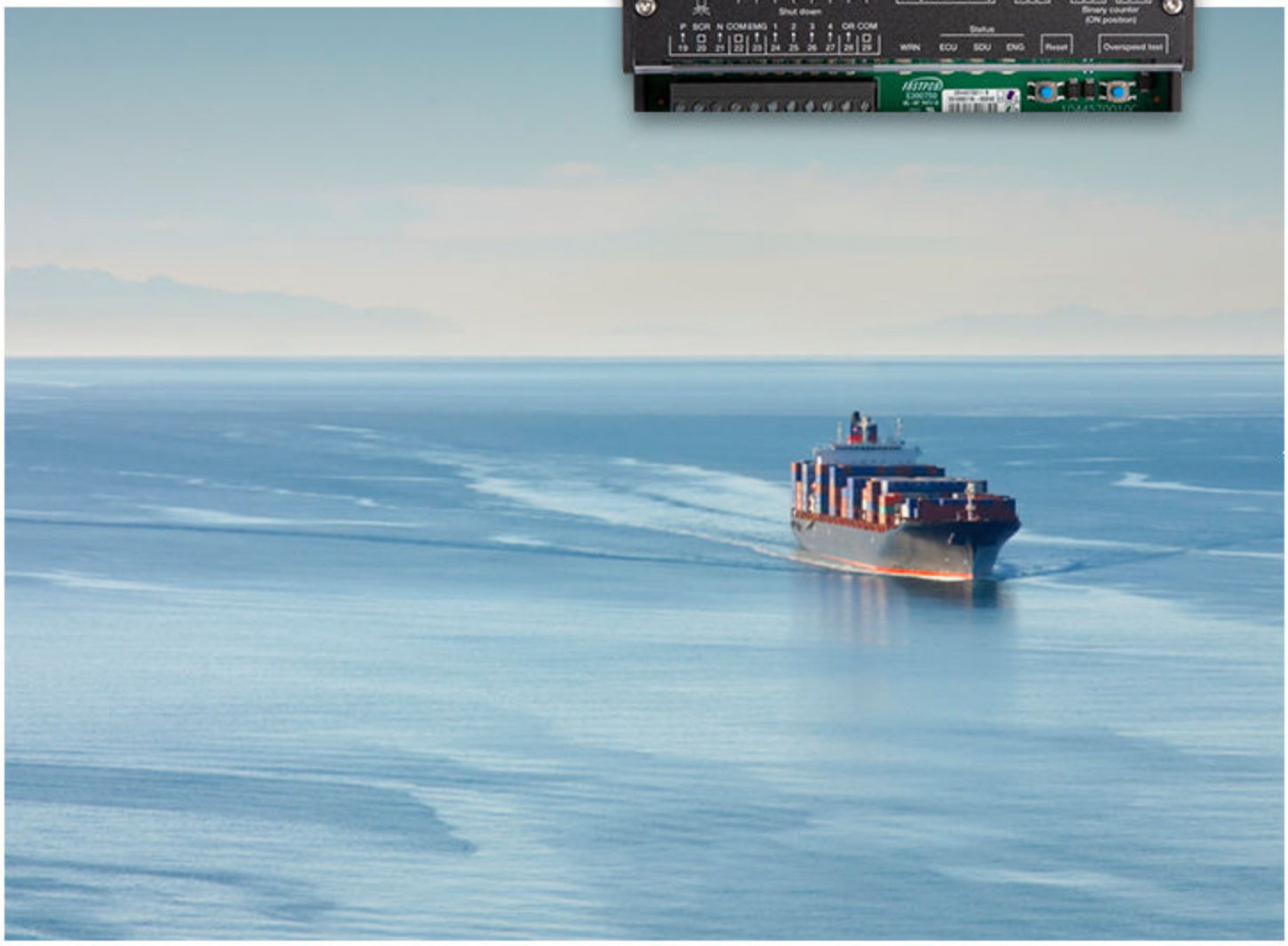
4921240625F

Shut Down Unit

Data sheet

Improve Tomorrow





1. Shut Down Unit 104 (SDU 104)

1.1 About

The Shut Down Unit 104 (SDU 104) is a safety device for the protection of marine engines. The unit keeps the engine running if the main controller fails. The unit can also safely shut down the engine.

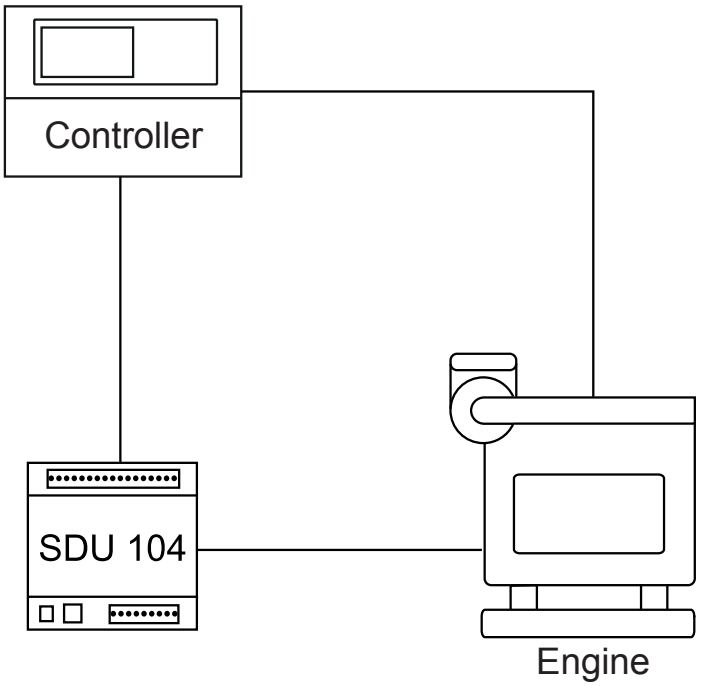
The SDU 104 is a parallel redundancy shutdown unit. The unit can keep the engine running and stop the engine when it detects overspeed, or when the emergency input or a shutdown input is activated. It can also prepare the engine for start. The SDU 104 cannot start the engine.

To meet the requirements of the classification societies, the SDU 104 only uses discreet logic. This means that it does not have a microprocessor or a programmable electronic circuit.

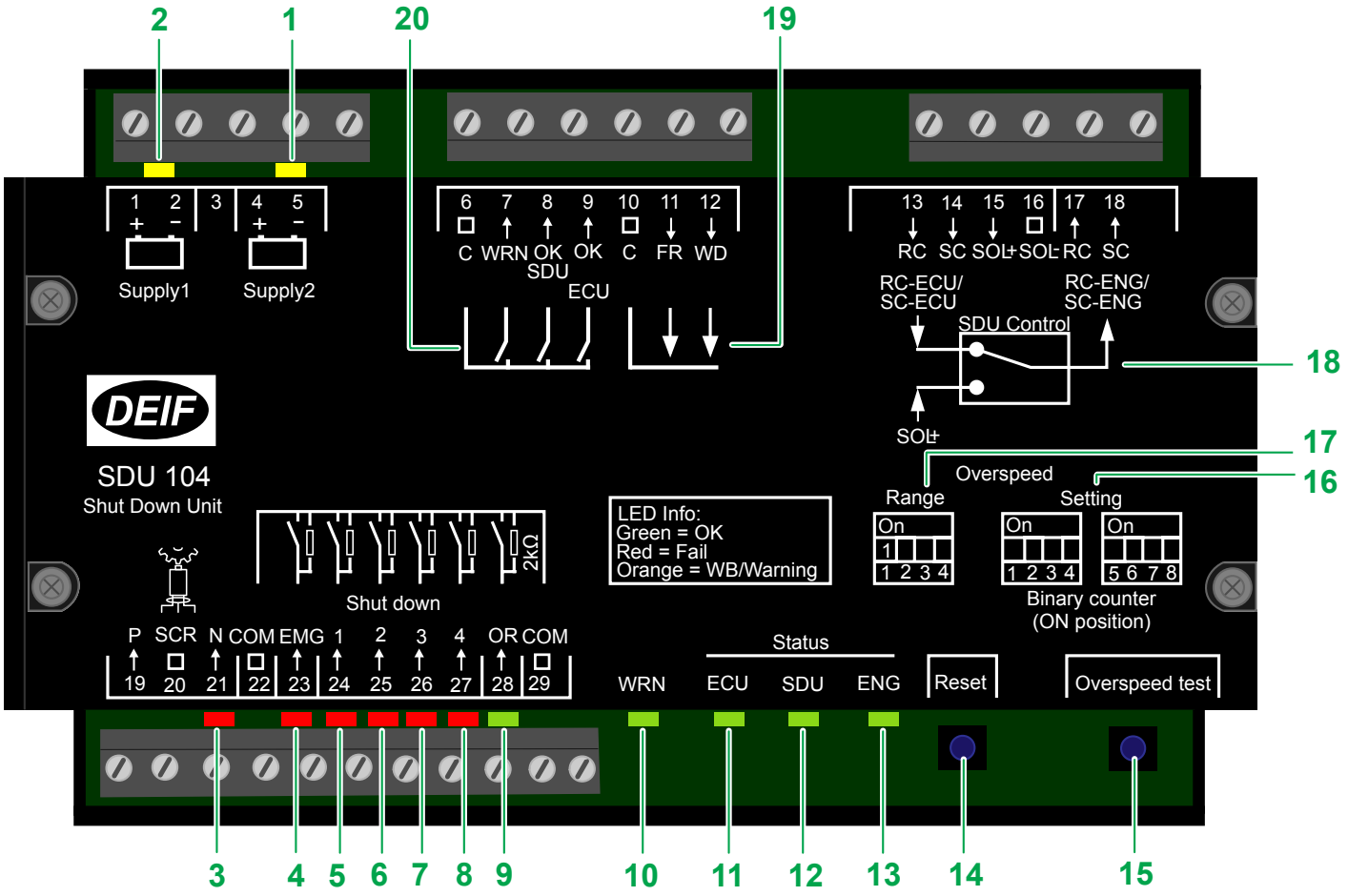
The SDU 104 includes:

- 4 x shutdown inputs
- 1 x emergency stop input
- 1 x override input
- Overspeed detection
- 2 x relay outputs
- LEDs to show status and input state
- Dual 12/24 V DC power supply

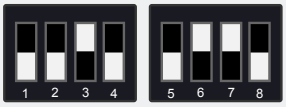
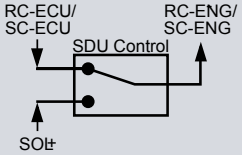
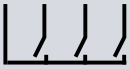
1.2 Application diagram



1.3 Buttons, LEDs, and switches



No.	Item	Symbol	Information
1	Power supply 1	+ − Supply1	**Yellow**: No power supply.
2	Power supply 2	+ − Supply2	**Yellow**: No power supply.
3	MPU	N ↑ 21	**Yellow**: Wire break detected. **Red**: Overspeed detected.
4	Emergency stop	EMG ↑ 23	**Yellow**: Wire break detected. **Red**: Emergency stop input activated.
5	Shutdown input 1	1 ↑ 24	**Yellow**: Wire break detected **Red**: Shutdown input activated.
6	Shutdown input 2	2 ↑ 25	**Yellow**: Wire break detected **Red**: Shutdown input activated.

No.	Item	Symbol	Information
7	Shutdown input 3	3 ↑ 26	**Yellow**: Wire break detected **Red**: Shutdown input activated.
8	Shutdown input 4	4 ↑ 27	**Yellow**: Wire break detected **Red**: Shutdown input activated.
9	Override input	OR ↑ 28	**Green**: Override input activated. **Yellow**: Wire break detected.
10	Warning	WRN	**Green**: No warning **Red**: Warning
11	Controller	ECU	**Green**: The controller is OK. **Red**: Controller failure. Controller failed to send a signal to the watchdog input. **Orange**: There has been a controller failure. The controller is ready to control the engine again. Push the fault reset button on the SDU 104 or activate the reset input to acknowledge the failure. This lets the controller take control of the engine.
12	SDU	SDU	**Green**: The SDU is OK. **Red**: SDU failure.
13	Engine	ENG	**Green**: The engine is OK. **Red**: Engine shut down. **Orange**: Run prepare.
14	Fault reset (FR) button		Push the button to reset all the inputs. Same function as the fault reset input.
15	Overspeed test button		The limit for overspeed is reduced by 50 % when you push the button. This causes the engine to shut down.
16	Overspeed range switch		Remove the front cover to access the switch. Set the range for the overspeed with this switch.
17	Overspeed settings switches		Remove the front cover to access the switches. Set the overspeed limit with these switches.
18	Relays		In normal operation, the SC/RC signals from the controller bypasses the SDU 104. If the controller fails, the relays will switch off the SC/RC signals from the controller. The SC/RC coils are now supplied by SOL+ using internal relays. These internal relays are controlled by the SDU 104.
19	Digital inputs		These digital inputs are bi-directional with a common reference (terminal 10).
20	Status outputs		Three status outputs with a common input (terminal 6). A closed output means that the system is okay for the three status types.

1.3.1 Configuration of overspeed settings

Step	Action	Example
1	Calculate the tooth frequency at overspeed. Tooth frequency = Overspeed [RPM] * (No. of teeth/60)	Tooth frequency = 1600 RPM * (120 teeth/60) = 3200 Hz
2	Use the **Overspeed range** table in this section to select a range.	Tooth frequency = 3200 Hz Range = 1 Divider = 32
3	Calculate the overspeed set point	Set point = 3200 Hz/32 = 100. This is a binary number.

NOTE The overspeed settings depend on the maximum engine speed.

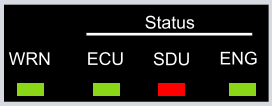
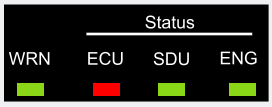
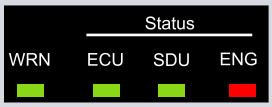
Overspeed range

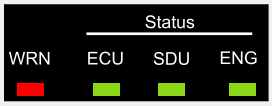
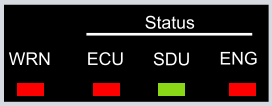
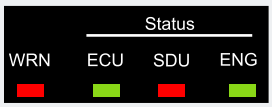
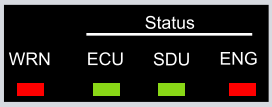
Range	Speed range	Input divider	Gate time	Resolution
1	65 to 8160 Hz	32 (int 512 Hz set)	1 s	40 Hz
2	8 to 2048 Hz	8 (int 128 Hz set)	4 s	10 Hz
3	2 to 512 Hz	2 (int 32 Hz set)	16 s	2.5 Hz
4	0.5 to 128 Hz	0.5 (int 8 Hz set)	64 s	0.7 Hz

NOTE The typical overspeed range is 1 as this gives the fastest response time.

1.3.2 How to clear red status LEDs

There are four status LEDs on the SDU 104: WRN (warning), ECU (controller), SDU (SDU), and ENG (engine). A red LED indicates a failure in the system.

LEDs	Causes	Actions
 **SDU**	• 3.3 V brownout. • Counter failure. The counters are used for overspeed detection. • MPU wire break. • Stop coil wire break (SDU). • Low or no power supply.	• Check if the LED for the MPU input (input 3) is yellow. A yellow LED indicates a wire break, and you need to replace the wire. • Check if there is a wire break on the SDU stop coil input. Replace the wire if necessary. • Check the power supply to the SDU (inputs 1 and 2). A yellow LED indicates that there is no power supply. • Brownout and counter failures indicate that the SDU is defective and must be replaced.
 **ECU (controller)**	• Watchdog wire break. • Faulty controller.	• Replace the wire to the watchdog input. Remember to push the reset button. • Check the controller.
 **ENG (engine)**	• A shutdown input is activated. • Overspeed is detected.	**Activated inputs** • Check if the LED for a shutdown input (inputs 5 to 8) is red. A red LED indicates that the input is active. Deactivate the input. • Make sure the engine has stopped (RPM = 0). • After a four-second delay, the ENG LED turns green. • Push the reset button to go back to normal operations, where the controller controls the engine.

LEDs	Causes	Actions
		The ECU LED should turn green when you push the reset button. **Overspeed** • The MPU input (input 3) has a red LED if overspeed is detected. • Check the overspeed range and make sure it is correct for your engine.
 **WRN (warning)**	• Shutdown input wire break. • No power supply. • Shutdown override input activated.	• Check if the LED for a shutdown input (inputs 5 to 8) is yellow . A yellow LED indicates a wire break, and you need to replace the wire. • Check if the LED for the shutdown override input (input 9) is green . A green LED indicates that the input is active. Deactivate the input. • Check if the LED for the power supplies (inputs 1 and 2) are yellow . A yellow LED indicates no power supply.
 **WRN (warning), ECU, ENG**	• SDU has control of the engine after controller failure. • The emergency input is activated.	• Check if the LED for the emergency input (input 4) is red . A red LED indicates that the input is active. Deactivate the input.
 **WRN (warning), SDU**	• Emergency input wire break.	• Check if the LED for the emergency input (input 4) is yellow . A yellow LED indicates a wire break, and you need to replace the wire.
 **WRN (warning), ENG**	• The controller controls the engine and is continuously sending a signal to the watchdog input. • The emergency input is activated, and the SDU takes control of the engine.	• Check if the LED for the emergency input is red . A red LED indicates that the input is active. Deactivate the input.

1.4 Operation modes

1.4.1 Normal operation

The controller operates as normal. The controller continuously sends a signal to the watchdog input on the SDU 104. The stop coil and run coil signals from the controller bypass the SDU 104.

The SDU 104 stops the engine if the emergency stop input on the SDU 104 is activated or the SDU 104 detects engine overspeed.

The SDU 104 also stops the engine if one of the shutdown inputs are activated. A shutdown input can only be activated when the engine speed is more than half the overspeed set point. However, if you have activated the shutdown override input, then the shutdown inputs are deactivated and cannot stop the engine.

1.4.2 Controller failure

If the controller does not send a signal to the watchdog input, the SDU 104 takes over the control of the engine. The SDU 104 keeps the same output state as before failure of the controller. For example, if the engine was running before the failure, then the SDU 104 keeps the engine running and protects the engine.

The SDU 104 stops the engine if:

- The emergency stop input on the SDU is activated.
- The SDU 104 detects engine overspeed.
- One of the shutdown inputs are activated.

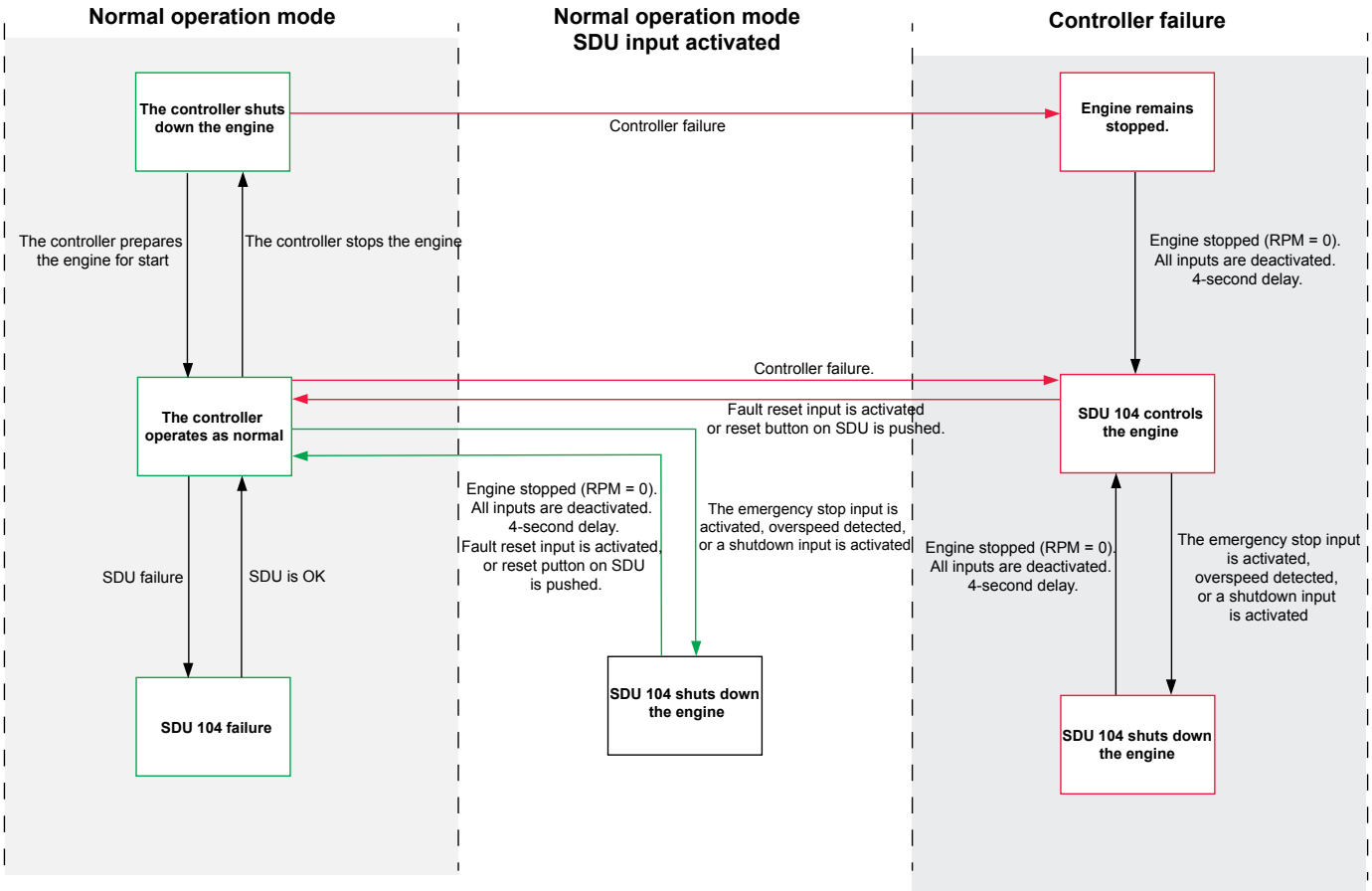
To stop the engine the SDU 104 activates the stop coil. When this happens the engine (ENG) LED on the SDU 104 changes to red. Once the engine has completely stopped (RPM =0), there's a 4-second delay, and then the engine (ENG) LED changes to green. This means the SDU 104 is ready to prepare the engine for start. The SDU 104 does this by deactivating the stop coil and activating the run coil. To go back to normal operation mode, you must push the reset button, or activate the reset input. This also deactivates all inputs. The controller now controls the engine again.

To activate a shutdown input, the engine speed must be more than half the overspeed set point. If you have activated the shutdown override input, then the shutdown inputs are deactivated, and cannot stop the engine.

1.4.3 Power OFF mode

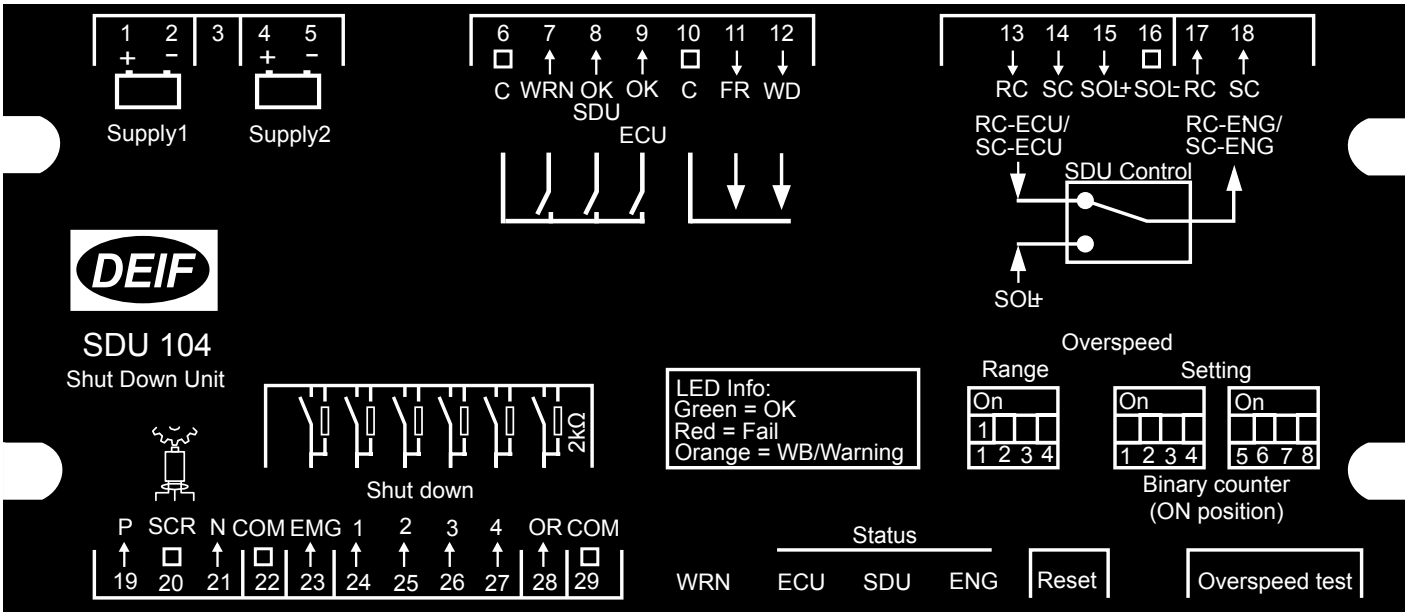
This is when the SDU 104 is OFF. In this mode, the stop coil and run coil signals from the controller bypass the SDU 104.

1.4.4 Flowchart for the operation modes



2. Hardware

2.1 Input and output terminals



5-pin 5.08 mm terminal block

Port	Terminal	Name	Description	Comment
Pwr1 +	1	+		Power supply input 1
Pwr1 -	2	-	Internal GND	
NC	3		Not connected	
Pwr2 +	4	+		Power supply input 2
Pwr2 -	5	-	Internal GND	

7-pin 5.08 mm terminal block

Port	Terminal	Name	Description	Comment
Common	6	C	DC level for switching out (connected Vbatt+ or Vbatt-)	Common for ECU interface (terminal 7, 8 and 9)
WRN	7	WRN	No warning = switch closed	Warning status
SDU OK	8	OK SDU	No fail = switch closed	SDU status
ECU OK	9	OK ECU	No fail = switch closed	Controller status
Signal common	10	C	Reference for digital input FR - WD. Galvanic separated.	Common for terminals 11 and 12
FR	11	FR	Galvanic separated	Fault reset input
WD	12	WD	Galvanic separated	Watchdog input (from ECU)

6-pin 5.08 mm terminal block with screw lock

Port	Terminal	Name	Description	Comment
RC in	13	RC	12 or 24 V	Run coil input
SC in	14	SC	12 or 24 V	Stop coil input

Port	Terminal	Name	Description	Comment
SOL+	15	SOL+	12 or 24 V	Take-over supply
Common reference for RC, FC, and SOL-	16	SOL-	Connect to Batt-	Common for terminals 13, 14, and 15
RC out	17	RC		Run coil output
SC out	18	SC		Stop coil output

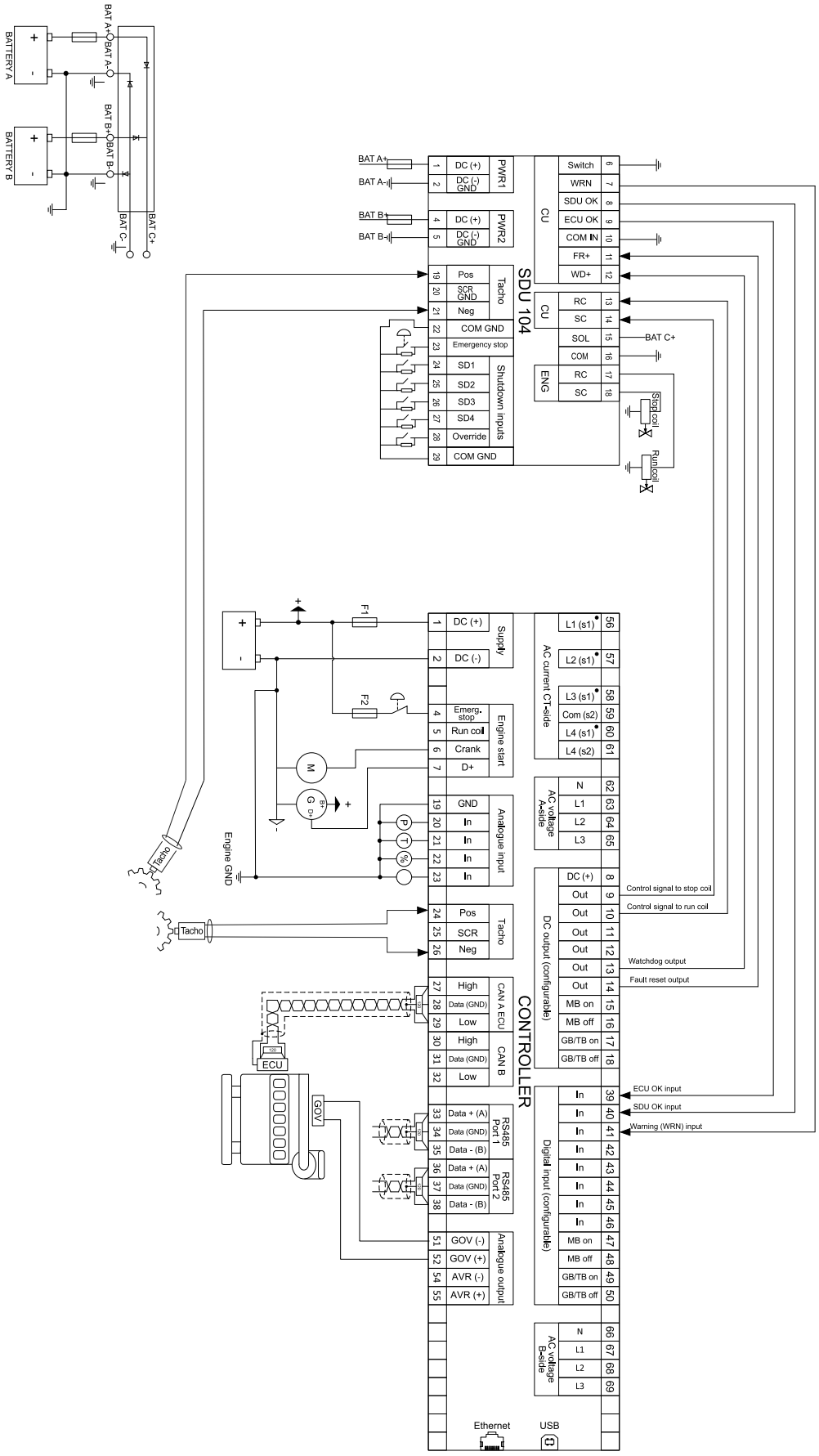
11-pin 5.08 mm terminal block

Port	Terminal	Name	Description	Comment
MPU input+	19	P		MPU input
MPU input Sch (GND)	20	SCR	Connect to cable shield (GND)	
MPU input-	21	N		
Common in (GND)	22	COM		Common for terminals 23 to 28
EMG	23	EMG	2 KΩ/relay switch	Emergency stop input
SD1	24	1	2 KΩ/relay switch	Shutdown input 1
SD2	25	2	2 KΩ/relay switch	Shutdown input 2
SD3	26	3	2 KΩ/relay switch	Shutdown input 3
SD4	27	4	2 KΩ/relay switch	Shutdown input 4
SD override	28	OR	2 KΩ/relay switch	Shutdown override input
Common in (GND)	29	COM		Common for terminals 23 to 28

NOTE Use of the safety system on main propulsion engines should be carefully considered during the design review. This is because all the digital input signals of the SDU 104 can be overridden by activating the override function, except for the overspeed and emergency stop buttons.

2.2 Terminal overview

Typical wiring for SDU 104 and AGC 150.



3. Compatible controllers

- **iE 250:** The iE 250 controller is a versatile and modular-designed controller for land applications. Its design enables you to tailor the installation to your needs. See https://www.deif.com/products/ie-250
- **iE 250 MARINE:** The iE 250 MARINE controller is a versatile and modular-designed controller for marine applications. Its design enables you to tailor the installation to your needs.
- **AGC 150 Engine drive marine:** The AGC 150 Engine drive marine is a single controller for one engine. The controller has all the functions needed to protect and control an engine. See www.deif.com/products/agc-150-engine-drive-marine
- **AGC 150 Generator marine:** The AGC 150 Stand-alone marine (Genset) controller provides flexible protection and control for one genset in non-synchronising applications. The controller contains all the functions needed to protect and control the genset, the genset breaker, and also a tie/mains breaker. See www.deif.com/products/agc-150-generator-marine
- **AGC 150 Generator:** The AGC 150 Generator controller contains all the functions needed to protect and control a genset, and the genset breaker. See www.deif.com/products/agc-150-generator
- **AGC 150 Stand-alone:** The AGC 150 Stand-alone (Genset) controller provides flexible protection and control for one genset in non-synchronising applications. The controller contains all the functions needed to protect and control the genset, the genset breaker, and also a mains breaker. See https://www.deif.com/products/agc-150-generator-stand-alone
- **AGC 150 Engine drive:** The AGC 150 Engine drive is a single controller for one engine. The controller has all the functions needed to protect and control an engine. See www.deif.com/products/agc-150-engine-drive

4. Technical specifications

4.1 Electrical specifications

Power supply	
Power supply range	Nominal voltage: 12 V DC or 24 V DC (-25 %/+50 %) Operating range: 8.5 to 36 V DC
Voltage withstand	Reverse polarity
Power supply drop-out immunity	0 V DC for 10 ms (coming from min. 12 V DC)
LED indication	2 x yellow (this indicates missing power input)
Power consumption	1 W typical 2 W max.

Tacho input	
Voltage input range	±1 V_{peak} to 70 V_{peak}
W	8 to 36 V
Frequency input range	10 to 10 kHz (max.) Maximum overspeed set point is 8.169 Hz.
Frequency measurement tolerance	1 % of reading Resolution: 0.7 Hz to 40 Hz (the resolution depends on the range settings)

Shutdown inputs	
Number of inputs	6 x digital inputs Contact switching
Resistor mount on input	2 kΩ resistor is connected
Wire break	> 6 kΩ
Activation of input	< 600 Ω
Current source (contact cleaning)	Initial 6 mA, continuous 3 mA

Fault reset (FR) input	
Digital input (Reset)	Optocoupler, bi-directional ON: 8 to 36 V DC Impedance: 4.7 kΩ OFF: < 2 V Same function as a reset button.

Watchdog (WD) input	
Digital input	Optocoupler, bi-directional ON: 8 to 36 V DC Impedance: 4.7 kΩ OFF: < 2 V
WD frequency	4 Hz to 1 KHz Pulse width > 50 ms
WD timeout	< 300 ms

Outputs	
Number of outputs	2 relay outputs 2 internal relays for taking control of the stop coil and run coil using the SOL+ supply.
Relays	Electrical rating: 30 V DC, 5 A UL/cUL Listed: 24 V DC, 5 A
Wire break detection (stop coil, run coil, and SOL+)	Nominal voltage: 12 V DC or 24 V DC Operating range: 10 to 36 V DC

Status outputs	
Status output	Warning, SDU OK and ECU OK
Connection	Active closed (terminals 6, 7, 8, and 9) when the status is OK on all terminals. Disconnect if the status is NOT OK or power OFF.
Relay output	Relay type: Solid state relay Electrical rating: 30 V DC and 1 A, resistive load UL/cUL Listed: 30 V DC and 1 A, resistive load B300, pilot duty (B300 is a power limit specification for inductive loads) Voltage withstand: ± 36 V DC
Application	Connect Terminal 6 (common) to Batt- (GND) if connected to a controller with negative switching input. Connect Terminal 6 (GND) to Batt+ if connected to a controller with active digital input.

4.2 Environmental specifications

Operation conditions	
Operating temperature	-40 to +70 °C (-40 to +158 °F)
Storage temperature	-40 to +85 °C (-40 to +185 °F)
Accuracy and temperature	None
Operating altitude	0 to 4000 m
Operating humidity	Damp Heat Cyclic, 20/55 °C at 97 % relative humidity, 144 hours. To IEC 60255-1 Damp Heat Steady State, 40 °C at 93 % relative humidity, 240 hours. To IEC 60255-1
Change of temperature	70 to -40 °C, 1 °C / minute, 5 cycles. To IEC 60255-1
Protection degree	IEC/EN 60529 • IP20
Vibration	Response: • 10 to 58.1 Hz, 0.15 mmpp • 58.1 to 150 Hz, 1 *g*. To IEC 60255-21-1 (Class 2) Endurance: • 10 to 150 Hz, 2 *g*. To IEC 60255-21-1 (Class 2) Seismic vibration: • 3 to 8.15 Hz, 15 mmpp • 8.15 to 35 Hz, 2 *g*. To IEC 60255-21-3 (Class 2)
Shock	10 *g*, 11 ms, half sine. To IEC 60255-21-2 Response (Class 2) 30 *g*, 11 ms, half sine. To IEC 60255-21-2 Withstand (Class 2) 50 *g*, 11 ms, half sine. To IEC 60068-2-27, test Ea Tested with three impacts in each direction in three axes (total of 18 impacts per test)

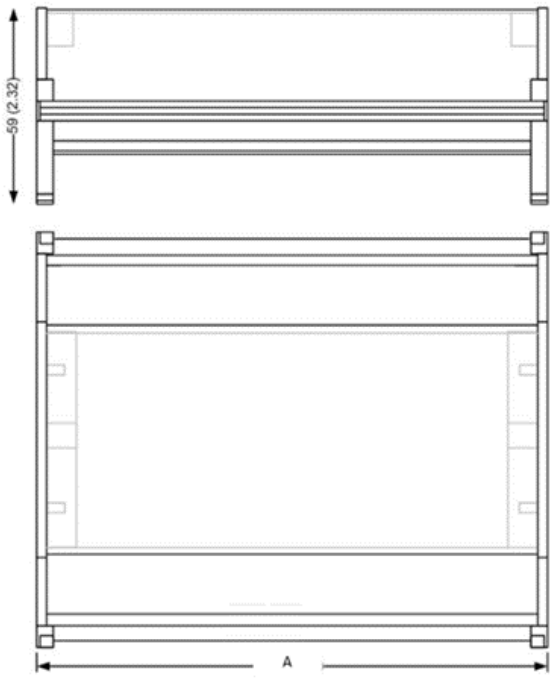
Operation conditions	
Bump	20 *g*, 16 ms, half sine IEC 60255-21-2 (Class 2) Tested with 1000 impacts in each direction on three axes (total of 6000 impacts per test)
Galvanic separation	All terminals on the SDU 104 used for connections between the controller and the SDU 104 are galvanically separated. These terminals are separated into 3 groups: • STATUS OK: Terminals 6 to 9 • Input from controller: Terminals 10 to 12 • ENGINE control: Terminals 13 to 18 Functional barrier: 550 V AC
Safety	Installation CAT. III 600 V Pollution degree 2 IEC/EN 60255-27
Flammability	All plastic parts are self-extinguishing to UL94-V0
EMC	IEC/EN 60255-26

4.3 Approvals

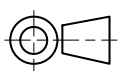
Standards
CE
LR approval
Pending: DNV GL approval

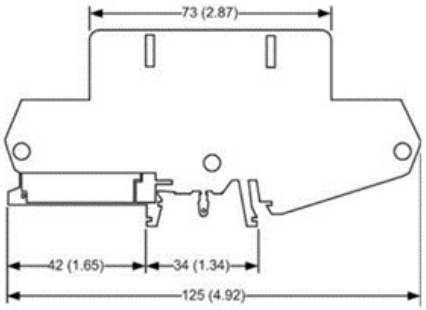
NOTE Refer to www.deif.com for the most recent approvals.

4.4 Dimensions and weight



Width [A]:
156 mm [+/- 0.5 mm] (6.14 in.)





Dimensions and weight	
Dimensions	Length: 156 mm Height: 125 mm Depth: 59 mm
Mounting	DIN mounting
Weight	0.79 kg

5. Legal information

Disclaimer

DEIF A/S reserves the right to change any of the contents of this document without prior notice.

The English version of this document always contains the most recent and up-to-date information about the product. DEIF does not take responsibility for the accuracy of translations, and translations might not be updated at the same time as the English document. If there is a discrepancy, the English version prevails.

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