

Integrel

E-POWER

INTEGREL PRODUCT DATASHEET

Version 1.7 | February 2024



1 Introduction

Integrel generates electrical power using a high efficiency, high-output large-frame alternator (sold as an On-Engine Generator, or OEG). The OEG is belt driven from the PTO of the main propulsion engine and is typically installed in the same physical space as a conventional second alternator. However, unlike a conventional alternator, the power output and voltage of the Integrel OEG are actively managed to ensure that propulsion is always prioritised and engine loading is optimised.

Whilst the main propulsion engine is running, the OEG produces a variable voltage, variable frequency three-phase electrical output which is passed to a custom designed Controller. A high-quality bridge rectifier within the controller converts three-phase power to a precisely controlled DC output. The DC output is electronically limited to 9kW/170A at a nominal 48 volts. A relatively high DC voltage helps to reduce losses in the OEG and keeps cable size, cost and weight to a minimum.

DC power from the Controller passes to a 48 volt power busbar where it is distributed to the vessel's electrical consumers including:

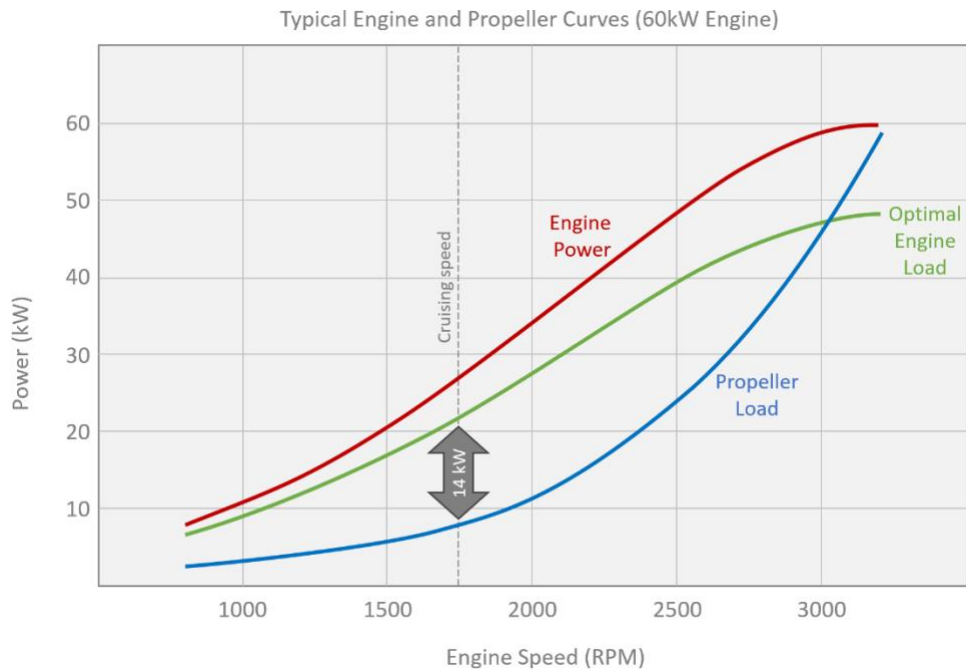
- DC-DC converters/chargers used to power appliances connected to 12V / 24V house batteries
- AC inverters to power mains appliances at 110V/220V including fridges, freezers, ovens, hobs, etc.
- Heavy DC loads such as 48V bow thrusters, winches, and air conditioning (saving weight, cost and complexity compared to powering these items with AC inverters).

Any power not used directly is stored in a large bank of 48 volt batteries, with the aim being to fully charge the batteries by the time the propulsion engine is shut down at the end of the day. After engine shutdown, power to the entire vessel is supplied from the energy stored in the battery bank.

1.1 The Intelligent Generation of Electricity

Integrel exploits the fact that there is a significant power gap between the optimum efficiency load line of an engine and the load applied by the propeller (the green and blue lines respectively in the following diagram). The generator is used as a precisely managed variable load in addition to the propeller load to operate the engine at or near optimum efficiency. The result is one engine doing two jobs: turning the propeller and generating electricity, with both tasks delivered with the best possible efficiency to save fuel.

Since boat speed is locked to propeller speed, with a well governed modern engine, adding the generator load does not change the boat speed. As a practical example, at a cruising speed of 1700 rpm with a typical 60 kW engine, the propeller load is about 8 kW and the optimum engine load is about 22 kW, leaving 14 kW excess power. At this speed, the Integrel OEG produces 8 kW of electrical power and applies around 11kW of mechanical load on the engine, moving the total engine load into the optimum operating area.



1.2 Design and Installation

The Integrel system is designed with a ‘safety first’ approach. The system has a high fault tolerance and is pre-configured for straight forward installation. An engine bracket mounting kit is provided to suit various popular engines from manufacturers including Yanmar and Volvo. There are no through hull connections, valves, fuel, exhaust or cooling systems. The OEG itself is air cooled and, so far as possible, everything is ‘plug and play’ with all connections clearly labeled. To streamline installation, Integrel provides a comprehensive installation manual, together with on-site training for installers.

To avoid customer concerns related to engine warranty, Integrel maintains an independent worldwide engine warranty policy. After thousands of hours of operation on many engines, not a single claim has been made.

1.3 System Specifications

Parameter	Value
Supported Battery Types	LiFePO4 (Lithium), GEL & Flooded Lead Acid
Communication System	Integrel proprietary CANbus (with integrated 12V power)
Third-party Interfaces	J1939/NMEA2K to read BMS and Engine Data
Configuration	USB with Integrel Configurator Software

2 Integrel Controller

Parameter	Specification	Units
Input voltage	12 V (min) – 14 V (max)	V
Current consumption	5.5A Peak	A
Current Sensor Type	Stabilised hall effect	-
Controller sleep mode, current draw	13 mA	mA
Generated current (maximum)	170 A	A
Generated power (maximum)	9000 W	W
Generated power (at 1700 RPM engine speed, 60kW engine)	7.5-8.5 (Temperature dependant)	W
Operating temperature range (ambient)	0 to +65 °C	°C
Rectifier efficiency (AC-DC)	99 %	%
Internal 48V DC output fuse	250 A, 58 V Link fuse	-
Internal CANbus power fuse	2 x 1.5A, 12 V, 5x20 Cartridge style	-
Internal Field Coil fuse	20 A, 12 V, 5x20 Cartridge style	-
Internal DC/DC fuse	3 A, 57.6 V, 5x20 Cartridge style	-
Network Protocol	Integrel proprietary (Argo) CANbus	-
Humidity (Non-condensed)	95 % (max)	%
Weight	5.4 kg	kg
Dimensions	240 (H) x 105 (D) x 290 (W)	mm

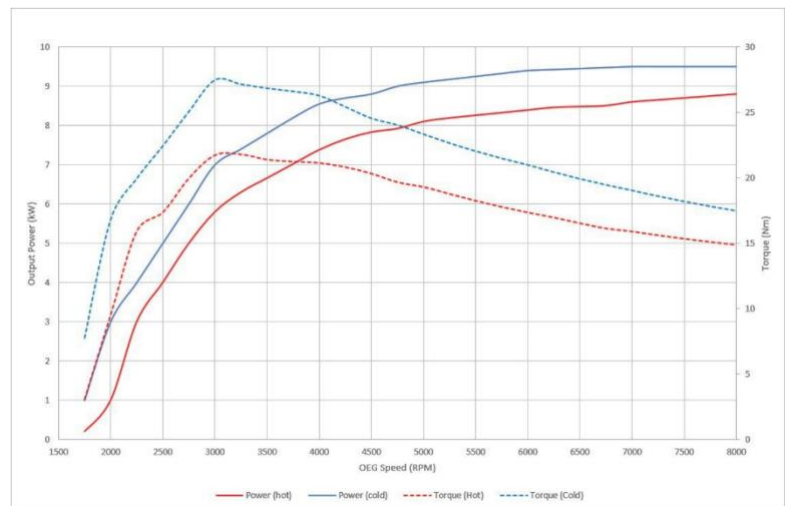


3 Integrel Generator (OEG)

The Integrel alternator is referred to as an On-Engine Generator in all Integrel literature.

Parameter	Specification	Units
Type	Asynchronous	-
Voltage output rating	56 V	V
Cooling	Air cooled	-
Operational temperature limits	0 to 180 °C	°C
Nominal operating temperature	100 - 120 °C (software configurable)	°C
Weight	11.9 kg	kg

The following graph shows the typical output power and applied torque of the Integrel OEG. The OEG RPM is typically configured for a speed of 2.6X engine RPM.



4 Smart Switch

48V

Parameter	Specification	Units
Switching Voltage	48	V
Smart Switch max feed through current	400 / 500 (depends on version)	A
Smart switch 48V tap current draw	250mA	mA
Operating temperature range	0 to +65 °C	°C
Closing time (close)	15	ms
Opening time (open)	8	ms
Bounce time	<5	ms
Switch cycles (max)	100,000	cycles
CANbus terminator option	Yes	-
Open/Close Control	Via the screen and/or remote button	-
Open triggers	Temperature, Voltage, Over current, IO control	-
Humidity (Non-condensed)	Max 95%	%
Weight	1.3	kg
Dimensions	148 (H) x 100 (W) x 135 (D)	mm

24V

Parameter	Specification	Units
Switching Voltage	24	V
Smart Switch max feed through current	400	A
Smart switch 48V tap current draw	250	mA
Operating temperature range	0 to +65 °C	°C
Closing time (close)	15	ms
Opening time (open)	8	ms
Bounce time	<5	ms
Switch cycles (max)	100,000	cycles
CANbus terminator option	Yes	-
Open/Close Control	Via the screen and/or remote button	-
Open triggers	Temperature, Voltage, IO control	-
Humidity (Non-condensed)	Max 95%	%
Weight	1.3	kg
Dimensions	148 (H) x 100 (W) x 135 (D)	mm



5 Battery Bank Sensor

Parameter	Specification	Units
Voltage taps (total current consumption)	0.3 mA	mA
Number of voltage taps	5 (0V, 12V, 24V, 36V, 48V)	-
Integrel Argo CANbus connections (RJ45)	2	-
Humidity (Non-condensed)	95 % (maximum)	%
Weight	197 g	g
Dimensions	30 (H) x 129 (D) x 63 (W)	mm



6 Integrel Display

Display

Parameter	Specification	Units
Screen size (diagonal)	5"	Inches
USB	1 x USB A	-
Integrel Argo CANbus connections (RJ45)	2	-
Wi-Fi	Yes	
Max Current	350mA (@12V)	
IP Rating	IP64	
Weight	200g	grams
Dimensions	38 (H) x 102 (D) x 149 (W)	mm



7 Integrel Junction Box

Parameter	Specification	Units
Integrel Argo CANbus connections (RJ45)	8	-
Integrel Argo CANbus terminator option	Yes (factory installed)	-
Humidity (Non-condensed)	95 % (max)	%
Weight	92g	grams
Dimensions	23 (W) x 41 (D) x 140 (H)	mm



8 Supported Brands

The Integrel system works in conjunction with various brands of power electronics and batteries. Integrated system testing is performed with each brand of battery to ensure safe and robust operation. In addition, we work closely with all supported vendors of power electronics to ensure seamless integration. Key battery and power electronics partners include:

- Victron
- MG
- Mastervolt
- Lithionics



9 Supported Engines

Yanmar

3JH40
4JH45
4JH57
4JH80
4JH110
4JH-5E

4JH-5CE
4JH4-HTE
4LV150
4LV170
4LV195
6LY400
6LY 440
8LV **

Volvo

D2-40
D2-50
D2-60
D2-75
D3-110
TMD22

D4 175, *
D4 230 *
D4 270 *
D4 300 *
D4 320 *
D13*

Nanni

N4.65

N4 115 **

Beta

75

Vetus

45

Cummins

QSL9*

QSB 6.7 *

*In progress, due Q3 2024.

**Planned for Development.

