USER GUIDE

integrel

ADVANCED GENERATOR REPLACEMENT TECHNOLOGY

Introduction

Integrel is a modern, intelligent way of generating, storing and distributing electrical power on board without fitting a second engine. It is completely automatic, delivering significant amounts of power seamlessly throughout the vessel without user input. It is fuel-efficient, reducing overall fuel consumption for propulsion and generation and very cost-effective, with virtually no maintenance costs. Integrel completely replaces a conventional generator and delivers all of the power that you need to make living on board as comfortable as living at home.

Using the system

When you step on board, all you have to do is ensure that your 48V battery banks are turned ON, and the Integrel switch on your distribution panel is ON. The Integrel screen will switch on automatically and show you the current status of your storage batteries and any other banks that have been fitted with Integrel sensors. If your boat has been left on shore power your batteries should already be fully charged. If they are not, Integrel will automatically charge them as soon as you start your boat's engine.

Note that the screen goes to sleep after a period of inactivity. To wake it up, just touch it to see the image again – it will take a couple of seconds to update the data being displayed.

Overview

The Integrel screen provides you with an overview of how your complete electrical system is working. You can see the state of your main storage batteries and other battery systems that you have connected to the Integrel system such as your domestic and engine start batteries. It will show how much power your generator is producing and, with more modern engines, will let you know how efficient your engine is and even how much fuel you have left in your tank.

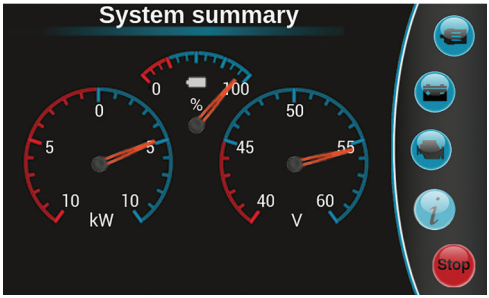
In addition, the screen will advise when it is time to think about recharging your main batteries by sounding an alarm and showing a warning icon. When this appears, you either need to connect to shore supply or start your main engine.

If you have chosen the option to have all of the Integrel information on your phone or tablet, the screen will be fully replicated and accessible through the device you choose.

a. Opening page

The Integrel user interface is designed to be simple and easy to understand. Down the right-hand side of the main screen are a number of buttons, allowing you to select:

- Generator status and information
- Battery status and information
- Engine status and information
- Other system information

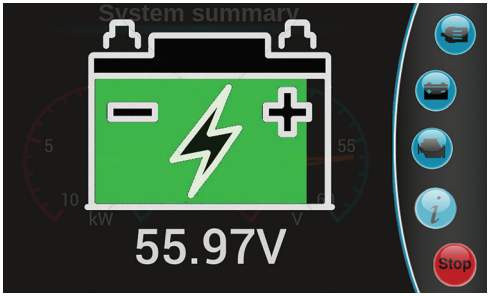


At the bottom-right is a Stop/Start button that allows you to override the system and manually turn power generation off.

The summary page provides a snapshot of information across the whole of the system on one screen, so you can see how the system is functioning.

- The left-hand dial shows the net power usage of the 48v batteries. If the needle is to the left of zero, the batteries are under load and discharging. If the needle is to the right, the generator is supplying enough power to supply to all loads and to charge the batteries.
- The smaller middle dial shows the remaining battery capacity, as a percentage of the total capacity.
- The right-hand dial shows the system voltage.

Pressing anywhere on the summary screen will display this information in a format that is easier to read from a distance should this be required. The green fill of the battery will change to amber or red, reducing in width as the state-of-charge drops. If the batteries are charging, a lightning bolt icon



with be shown in the centre.

Press the screen again to revert to the summary dials.

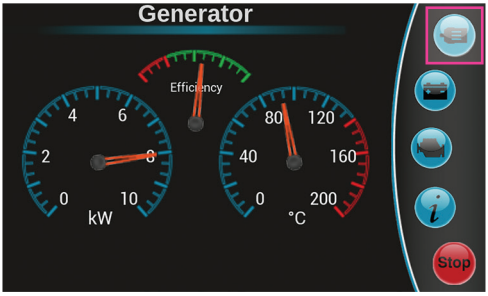
Should the state of charge drop below fixed limits (defaults of 50%, 40% and 30%) the screen will beep and switch to a warning screen, which you will need to acknowledge before reverting back to the main summary page.

This same alert page will be shown in the event that any values or alert states need to be brought to your attention. These alerts are colour coded (red, amber, green) depending on the severity.

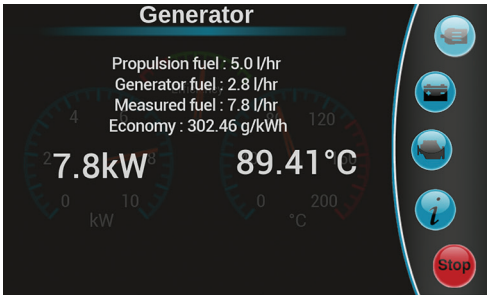
Please note: If using lead acid batteries it is recommended you don't let the batteries' state of charge drop below 30%. These batteries also don't like being left in a partial state of charge for extended periods of time. We recommend that batteries should be fully recharged to 100% at least once a week to maintain their full capacity.

b. Generator Status

Pressing the generator button on the right-hand side of the main screen will display the Generator Status and Information page. This includes the real-time generator output in kilowatts, an indication of system efficiency, and the temperature of the generator itself. If the system does not have access to the engine ECU, the efficiency dial will be replaced with a 'generator load' dial, giving an indication of how hard the generator is working to produce the current power level.



Pressing the main screen will switch between this page and a version showing the same information in text form, with more detail around the fuel usage if available.

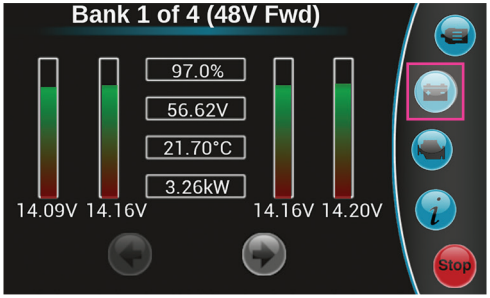


c. Battery Status

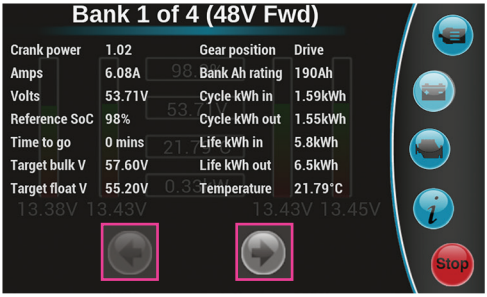
The battery page gives you a bank-by-bank breakdown of the battery system. Depending on your battery configuration, it will show:

- Total and individual battery block voltage
- Overall bank temperature
- Power usage
- Remaining capacity

The arrows at the bottom of the screen allow you to move between the installed battery banks if you have chosen to fit sensors to them all. 48, 24 and 12v banks can be displayed.

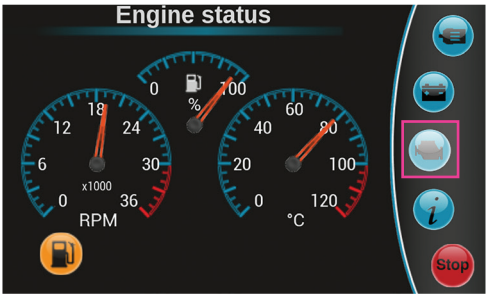


The text version of this page contains further detail regarding the individual battery bank.



d. Engine Status

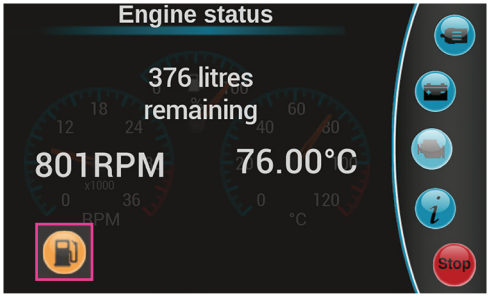
The engine page shows the RPM (revs per minute) of the engine. On modern, electronically controlled engines this information is taken from the engine itself. On older engines, engine RPM is calculated from the voltage frequency coming from the generator. Engine temperature is either from the ECU data or an external temperature sensor.

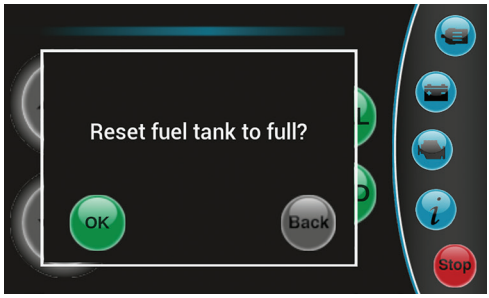


Again, the text version of these numbers is available by tapping the screen.

e. Fuel

A modern engine provides fuel consumption data and Integrel uses this to calculate tank levels. You can see this by touching the fuel pump icon. Pressing it again provides you with the option to add fuel:





It is possible to either fill the tank with one press, or add a set amount of fuel if needed, both requiring confirmation before the fuel levels are adjusted.

Charging the batteries

The main storage batteries are charged whenever the main engine is running. This happens automatically and you do not have to take any action. These storage batteries will also charge the other batteries connected to the system, again completely automatically.

The only time you need to take any action is if the system notifies you that the storage batteries are running low, at which time you will need to start the main engine.

Charging at anchor

Imagine you've been at anchor for a few days (depending on your power consumption and battery bank size). You're down to 30% state of charge on your main storage bank. You now need to start your engine to charge your batteries.

If you're not going anywhere, start your engine, leave it in neutral and adjust the revs to a fast idle of between 1200 and 1400RPM. This will typically generate between 6 - 7.5kW and will charge one 10kWh battery bank from 30% to around 80% in about an hour. If you have 20Kwh of storage it will take around two hours to charge both banks to 80%. Lithium ion batteries will continue to accept charge at this rate until they are fully charged.

Lead acid batteries - above 80% state of charge, the charge acceptance rate of lead-acid batteries reduces, so this may be a good opportunity to stop the engine. To reach 100% will take another two hours regardless of the number of banks fitted. Provided that you run a full charge cycle once a week, high quality lead acid batteries are quite happy operating between 30 and 80% state of charge. If you are running a full charge cycle you may wish to slow the engine speed a little as the charge acceptance rate begins to tail off.

If you're ready to move to the next anchorage, motoring for two hours or so will also bring you back to around 80% providing you are motoring at or below ¾ throttle.

Prioritising propulsion

The Integrel generator is software limited to 9kW of electrical power output and will normally produce a continuous 8kW at cruising speed. This is a substantial amount of power and has to be managed carefully to ensure that the engine is correctly loaded and that propulsion is always prioritised.

The Integrel controller handles all of the load management automatically and all that you may notice is a change in the sound of the engine as the generator load is adjusted. Generator load makes no difference to boat speed on a modern engine with electronic governing. On older engines with a mechanical governor, the engine revs may drop slightly.

The generator is shut down completely in the following circumstances:

- If the engine is below its minimum operating temperature
- When a gear shift is detected
- When manoeuvring
- If there is a rapid change in revs
- At approximately 75% of wide open throttle and above

This is to ensure that when manoeuvring or in circumstances where you need propulsion quickly, all the engine's power is available to turn the propeller.

When the system senses that the engine is in a steady state or that revs are only changing slowly, it will gradually ramp up the electrical load. The Integrel controller will never allow the electrical load to push the total engine load (propulsion and generation) above 75% of the total available power. This is all handled automatically and you do not need to do anything at all.

Maintenance and spare parts

Unlike a stand alone generator, Integrel requires virtually no maintenance and the only spare part required is a drive belt. We recommend that the belt is changed at every main engine service, typically every 500 hours of operation.

The storage batteries, whether lead acid or lithium ion, are sealed units requiring no maintenance.

The generator itself is based on a heavy duty truck alternator and is designed to operate for many thousands of hours without any attention.

Further information

For more information on the User Interface including technical specifications, please refer to the *Technical Guide.*

For information on how to install the Integrel system, please refer to the *Installation Guide*.

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