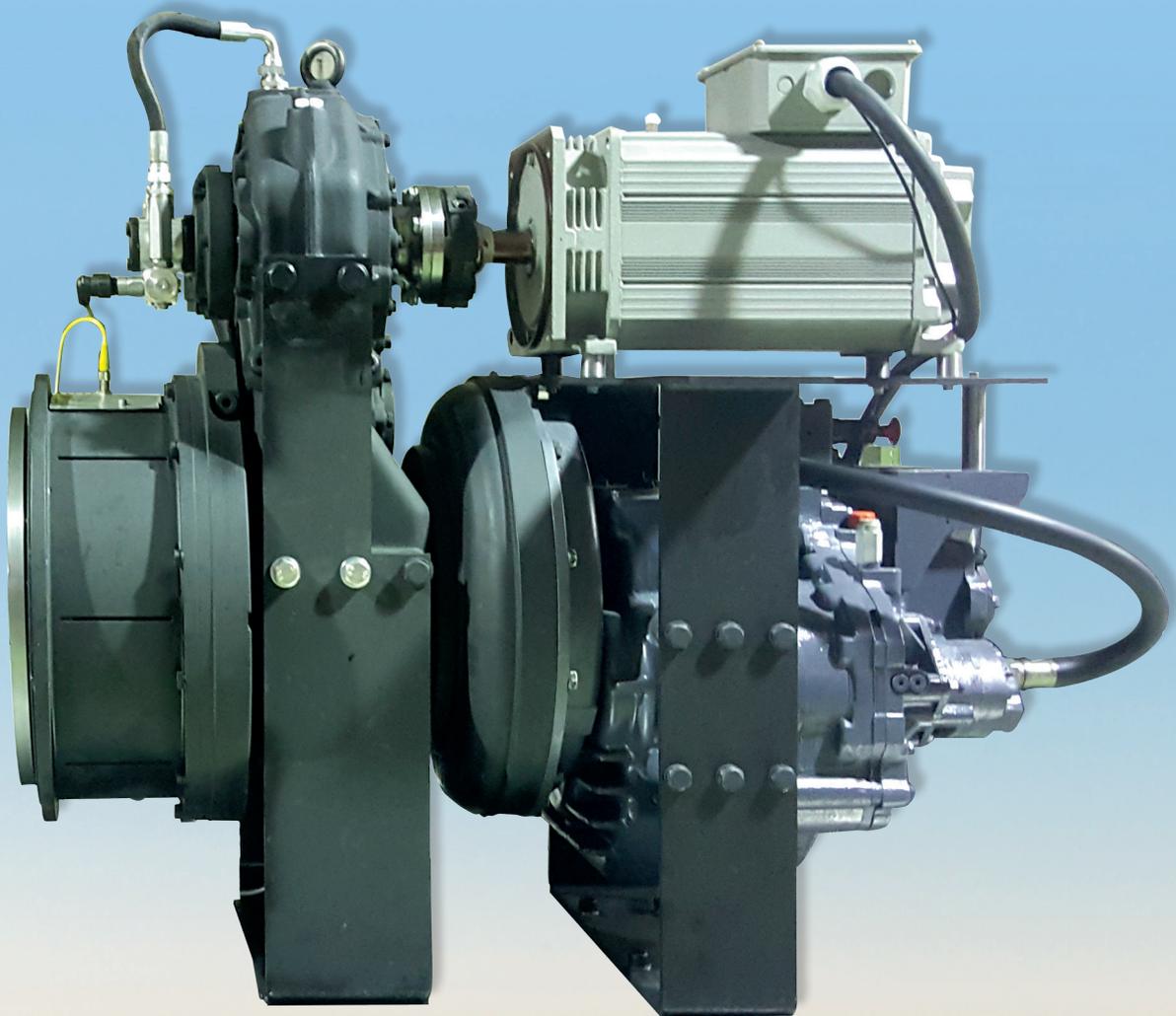




ESCO POWER

Parallel Hybrid Solutions with PHT



Let us bring your ship or application into the Hybrid Era
with full operational modes of both power sources
and the advantages of both : electric and diesel !

www.escopower.be

Why going for a real Parallel Hybrid Solution ?

For many reasons we are looking, beside the conventional diesel drive, to alternative drive line solutions: redressing pollution, fuel consumption, new environmental regulations, efficiency and diesel lifetime improvement and to be ahead on the future !

Many hybrid or alternative solutions are presented, each of them with advantages and disadvantages :

- ✓ **Diesel-Electric** : A Gen-Set is driving an electric motor to drive application.
Advantages : Easy switch from forward to reverse, going as slow as needed
Disadvantages : 8-10% losses, what is very important in higher power consumption,
- ✓ **Full Electric** : Batteries are supplying the energy to electric propulsion motor
Advantages : Easy switch from forward to reverse, going as slow as needed Zero emission !
Disadvantages : No back up for missing battery energy, important needs of batteries/limited autonomy.
- ✓ **Shaft Generator** : Generator built on the driveline shaft
Advantages : Going as slow as needed, easy switch from diesel to electric power
Disadvantages : built on the slow shaft, after gearbox => High power/torque required to operate

Esco Power believes in finding the best solution and developed a full **Parallel Hybrid Solution**. We choose for a heavy duty Parallel Hybrid Solution as it gives us a double energy source availability and keeping the standard drive line configuration. This gives the best of both worlds, as diesel and electric can be used whenever the operator requests or needs and in the optimum curve field.



The heart of the parallel hybrid solution is our

Parallel Hybrid Transmission (PHT models)

It enters the drive line between diesel engine and marine gear (if required) and can be easily installed with input and output SAE connections. A second input/output can transmit a high power, to install an E-motor/generator. We have integrated a ratio (speed up to output/reduction from input to main drive line) for several reasons: increase torque of E-motor to operate at a lower rpm at main drive, decrease E-package due to higher rpm. The internal electro-magnetic clutch, which operates fully independently with 24VDC, enables to connect/disconnect the diesel engine from the drive line. BV approval is available.

The Hybrid Electric Solution Package (HESP)

is the electric hardware and software to operate your hybrid system. On the hardware side, It is composed with an electric motor, frequency inverter, specific hybrid control unit based on PLC managing the hybrid operation, plus indication if gen-mode is in operation, pick-ups for PHT required for software. On the software side, full control of Diesel engine, electric motor and hybrid function in (automatic) mode is standard available. Our automation engineers can adapt this software to your specific application if needed. All control features are displayed on a wide glass touch screen showing all hybrid propulsion parameters & control.

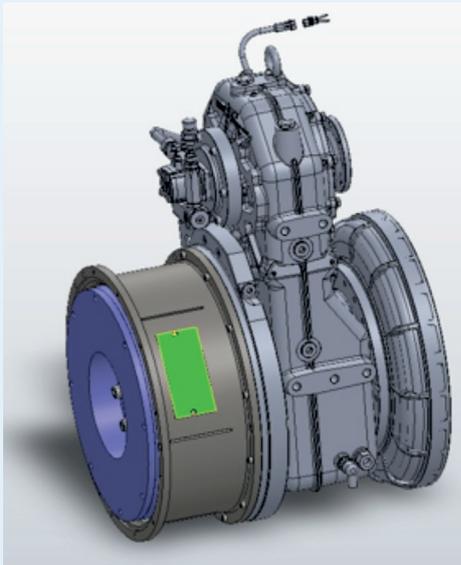
Batteries, battery management system and shore connection can be offered in association with a battery specialist partner.

Of course, we can complete the solution package with a proper Twin Disc **Marine Gear**, preferably a QuickShift® model for his extremely soft and fast engagements.

Parallel Hybrid Transmission PHT

The Parallel Hybrid Transmissions, designed for heavy duty applications with diesel engines from 200 HP to 1700 HP, has a built-in 24VDC electro-magnetic clutch working independently from any other part of transmission to engage and disengage the diesel engine from the driveline. The PHT has an SAE input housing and elastic coupling for direct connection to the engine housing and flywheel.

Very strong PTO/PTI: 1500 Nm to transmit. Unit is executed with a ratio from/to PTO/PTI of 1,47 or 1,7. This feature is giving following advantages:



- We can optimize the speed for generator/electric motor to get optimum efficiency
- By increasing speed to PTO, size of electric parts decreases
- By reducing speed from PTI, torque of motor increases
- Unit can be installed vertically or horizontally (using optional pump)
- Output housing SAE 1 and 14" connection to mount directly marine gear or output flange

Optional:

- Oil pump kit for forced lubrication and/or cooling
- Speeds sensor at PTO/PTI
- Electric oil level sensor
- Silicon temperature sensor

Advantages of our PHT system:

- ✓ Due to a very strong PTO/PTI a large electrical generator/motor can be mounted.
- ✓ Due to the ratio a smaller electrical package can be installed at higher rpm.
- ✓ Longer service life time of diesel engine.
- ✓ Dual electrical use as generator and as motor.
- ✓ By reducing speed from the PTI, the torque of the motor increases.
- ✓ Unit can be installed vertically or horizontally (with additional oil pump kit).
- ✓ Ships which require full engine power for a short time can install a smaller diesel engine by adding electric power when needed.
- ✓ Generated electricity can be stored in batteries or used for on board systems.
- ✓ Bureau Veritas approval is available.

Models

| Model | PHT300A | PHT420A | PHT700A | PHT700B |
|---------------------------------|---------------|----------|--------------------|--------------------------------|
| Max input torque | 1500 Nm | 1800 Nm | 3100 Nm | 5200 Nm |
| Max output torque | 3100 Nm | 3100 Nm | 3100 Nm | 5200 Nm |
| Max PTO/PTI input/output torque | 1500 Nm | 1500 Nm | 1500 Nm | 1500 Nm |
| Ratio to PTO/PTI | 1,47-1,7 | 1,47-1,7 | 1,47-1,7 | 1,47-1,7 |
| SAE input | 2 – 3 – 11.5" | 1 – 14" | 1 – 14" 0 – 18" | 1 – 14" 0 – 18" 00 – 21" |

Important : More input/output torque per model can be accepted after approval of our application engineers !

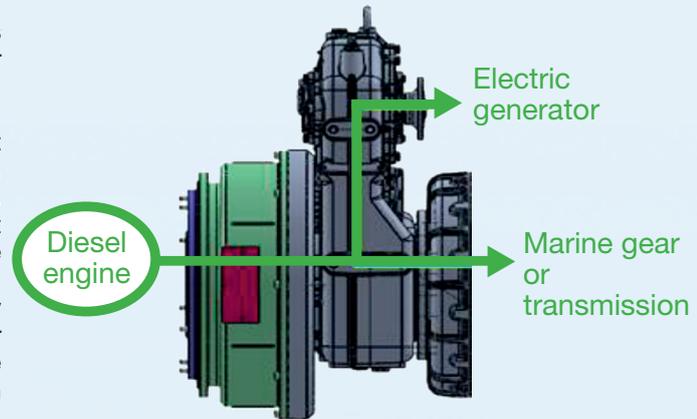
PHT Operations

> Diesel mode

When the diesel engine is running, the clutch is engaged and drives directly the marine gear or transmission. Thanks to the PHT, the diesel engine also drives the electrical generator.

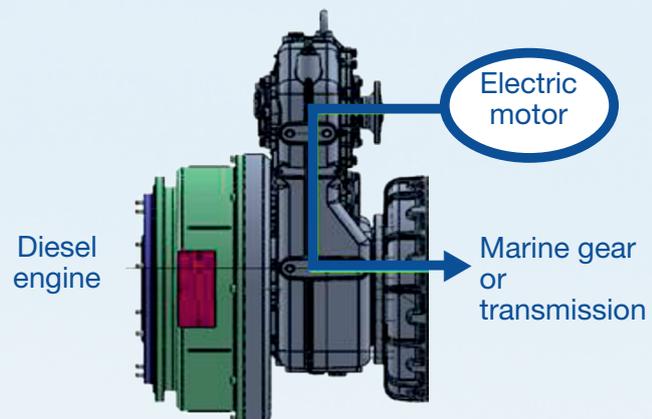
The electrical generator can generate, if not the axis will spin idle inside the generator. Due to the ratio (1.47 or 1.7) inside the PHT, we increase the rpm of the diesel engine at the PTO/PTI which allows us to reduce the electrical motor size.

The electrical generator generates electricity which can be used for on board equipment or for charging on board batteries, which can be used later to drive the electrical motor or on board equipment.



> Electric mode

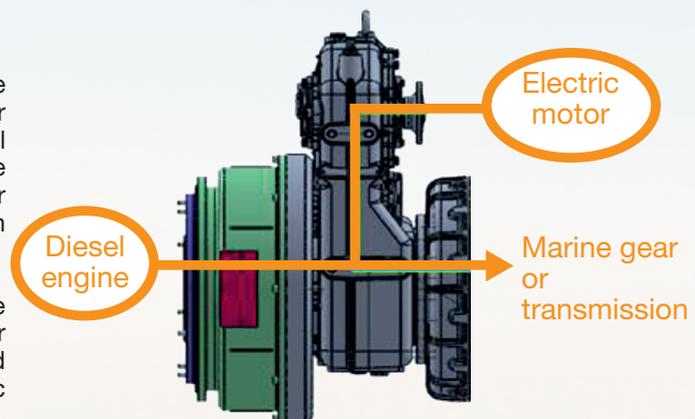
The PHT in electrical mode disconnects the diesel engine by disengaging the clutch, thus the diesel engine can be shut down. The electric motor drives the marine gear or transmission directly through the PHT gears with a ratio (1.47 or 1.7) which decreases the electric motor rpm and increases the torque. The electric motor takes his power from a generator set or from on board batteries.



> Boost mode : Diesel & Electric

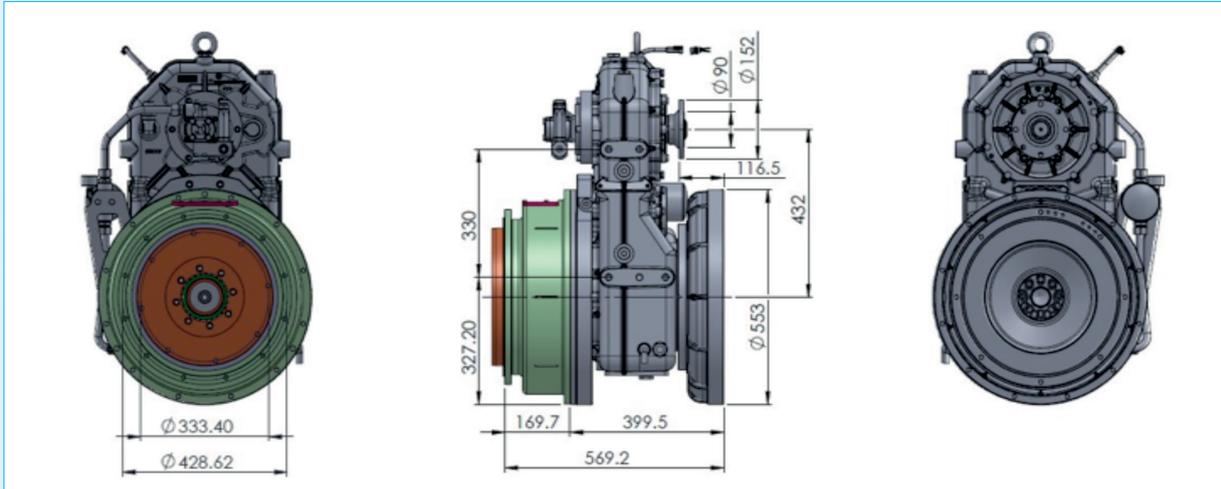
In boost mode the clutch is engaged so the diesel engine is running. The electric motor is also running synchronised with the diesel engine and thus increasing the torque at the transmission or marine gear. The electric motor takes his power from a generator set or from on board batteries.

This way you can reduce diesel engine size when max power is only used for a short time or save fuel by running the diesel engine at limited power and adding power from the electric motor.

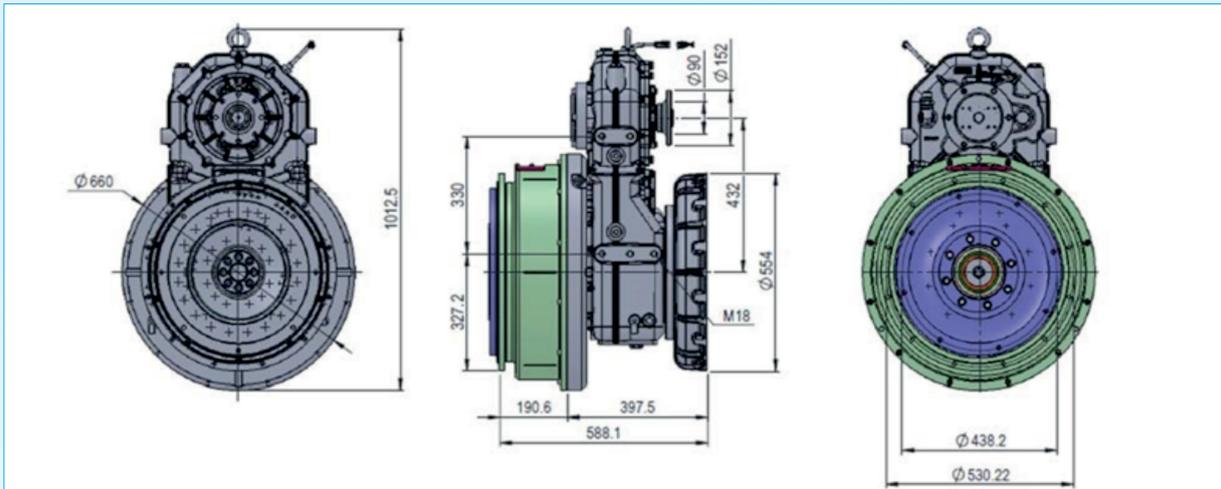


Installation Drawings

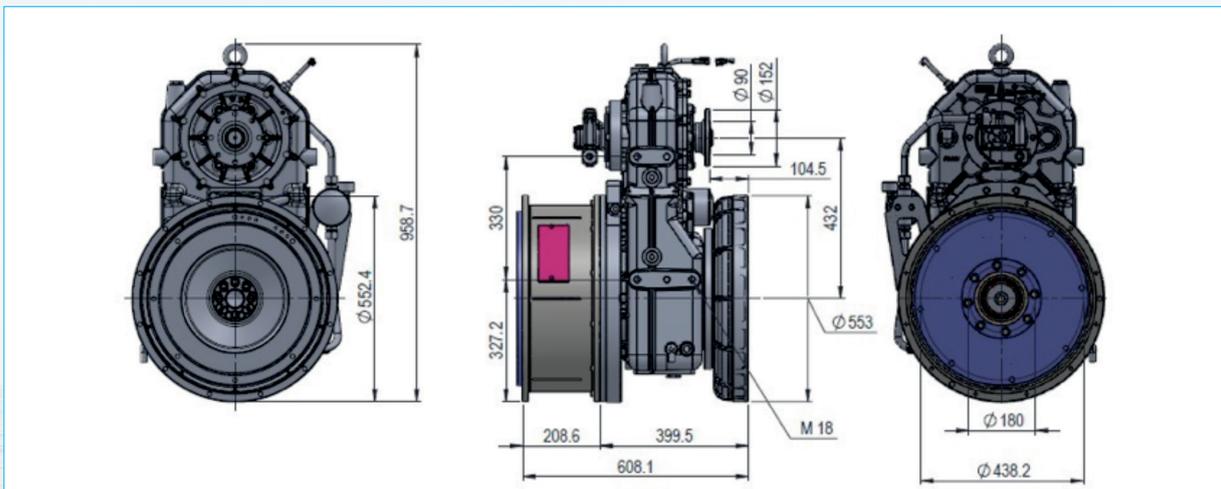
PHT300A (with SAE3 input)



PHT420A



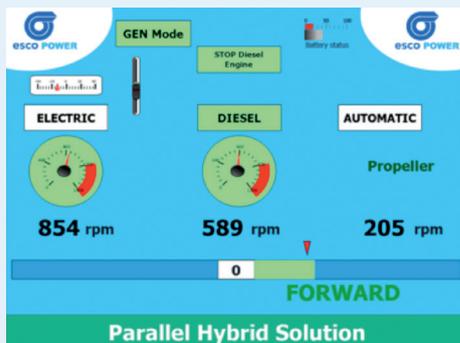
PHT700A / B



Hybrid Electric Solution Package (HESP)

Our hybrid electric solution package, or short called HESP, gives your application a full operational electric system in combination with a PHT model and an electric energy supply. HESP includes an electric motor/generator 3 phase 400 V, water or air cooled, Full 4 quadrant Frequency drive in IP 55 enclosure, Specific hybrid control unit based on PLC, Glass touch screen for system supervision. The software includes the full hybrid parallel control & command of diesel & electric power (as motor & generator). The different operational modes are explained below.

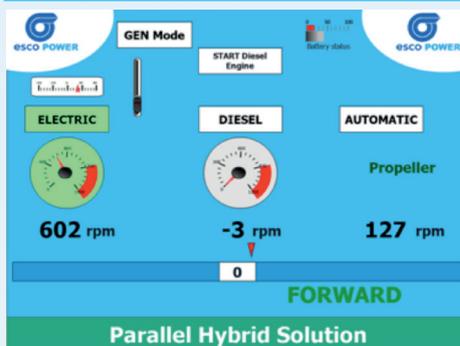
Operational Hybrid modes



Diesel mode

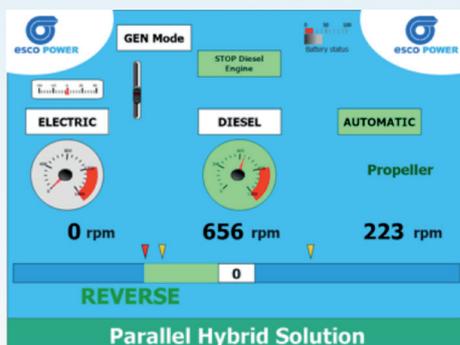
The lever has full motion range in operation of the diesel engine.

The system manages all parameters for Diesel mode such as Diesel motor speed, PHT clutch, engine start/stop, gen-mode, battery level.



Electric mode

The lever (with full motion) is now controlling the electric motor only, his position is monitored by the hybrid control unit and drives the motor at the desired speed over the frequency converter. The system will monitor all parameters in order to run the propeller smoothly. Power source is now coming from the batteries. The battery level is continuously checked for adequate level.



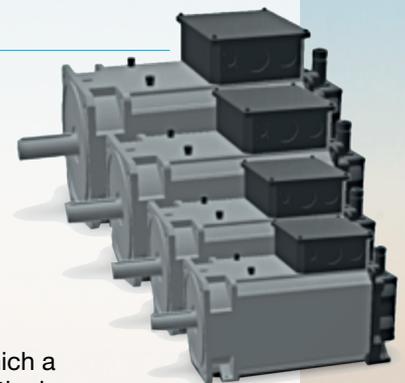
Automatic mode

This mode provides an automatic switch between electric and diesel propulsion. At low speed, the propeller is powered by the electrical motor, energy is coming from the batteries over the inverter. If speed demand becomes higher and diesel motor is ready to start, the system will engage the clutch and propeller will be driven by the diesel motor automatically. All features of diesel or electric modes remain the same, but switching automatically when power/speed is required.

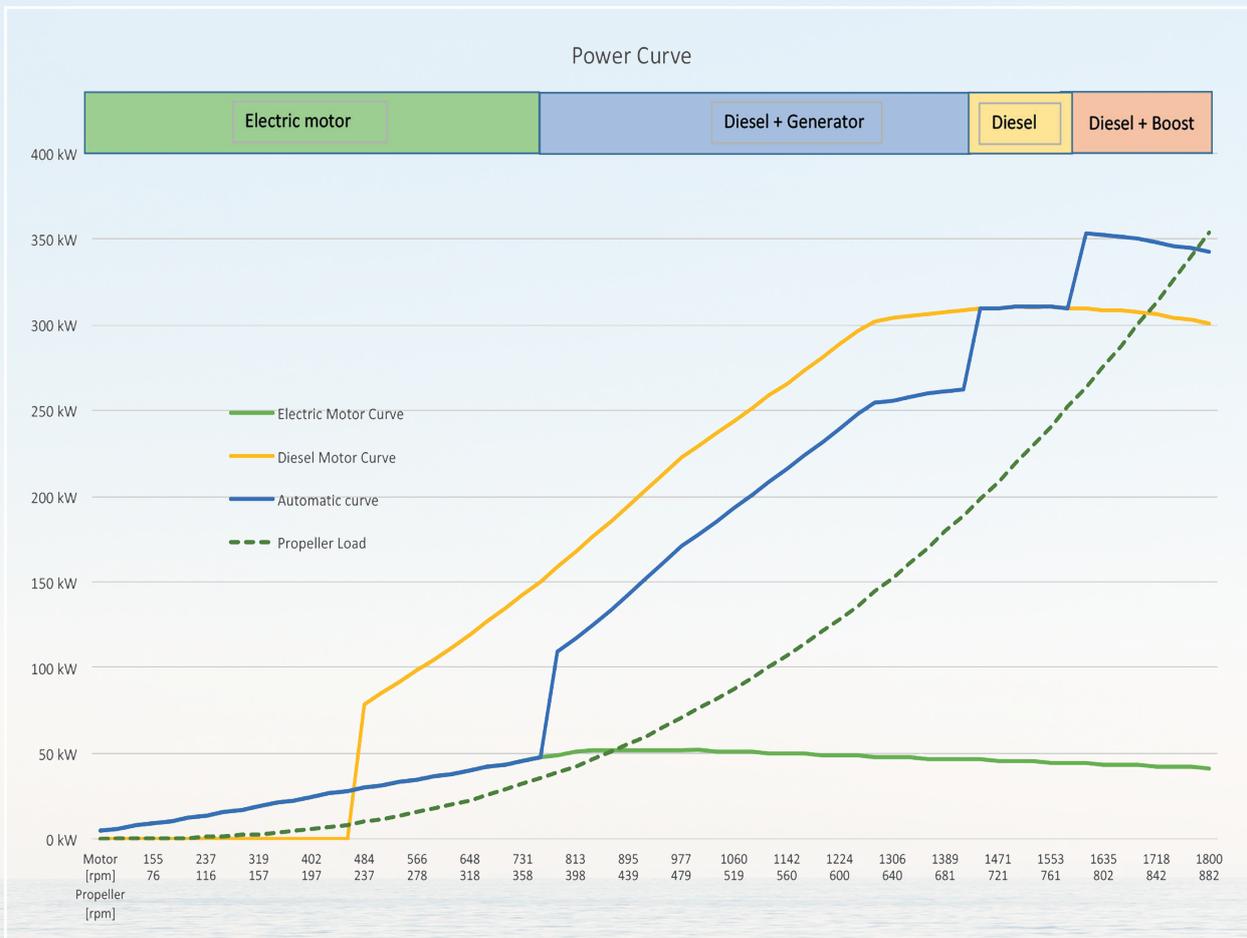
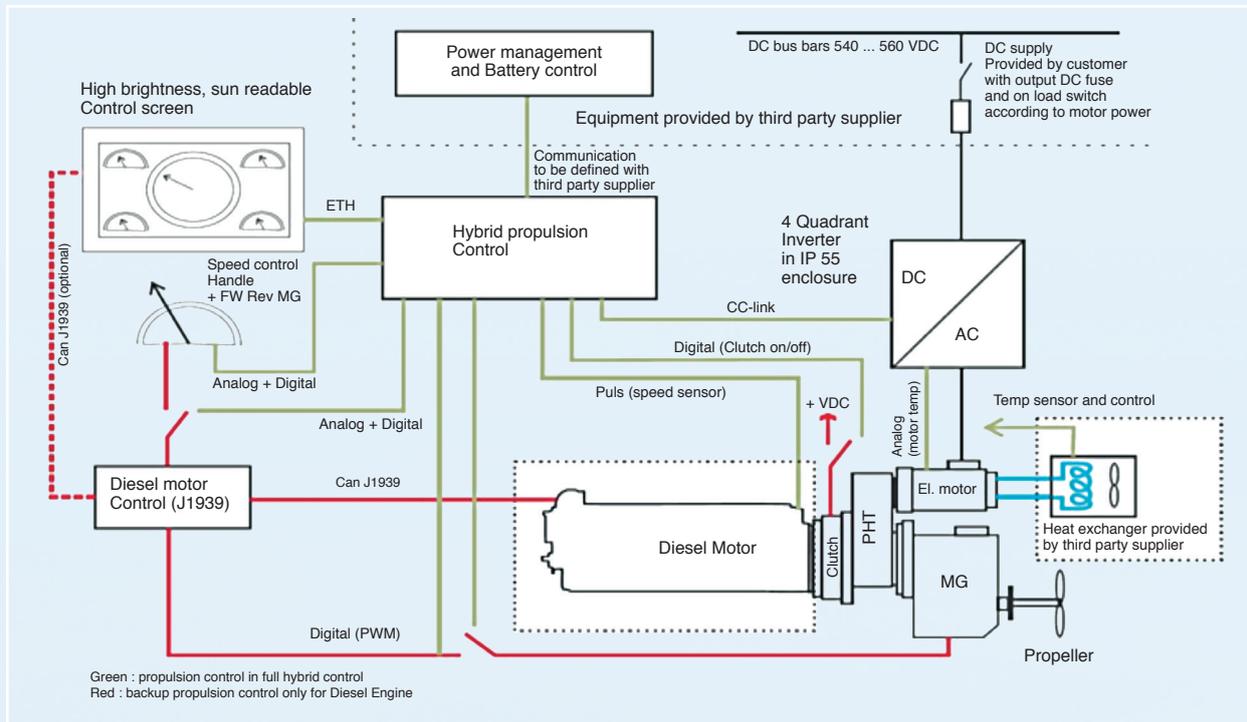
We can supply any electrical motor/generator to mount on the PTO/PTI of our PHT units ranging from 10.5KW up to 310 kW and from 1500 rpm up to 2600rpm. Thanks to the reduction ratio inside the PHT, the high rpm and water cooling of the electromotor/generators, we have the ability to reduce the size of the motor/generator. The maximum engine size that can be mounted with an elastic coupling directly to the PTO/PTI is 132. The larger motors/generators are mounted with an intermediate shaft or cardan shaft depending on the space available.



Esco Power offers in HESP a full solution package, on which a customized battery package and management system with shore connection features can be added from customer or partner supply. Backup propulsion control loop for diesel engine operation is included. Please consider that we don't install the systems on the ships but we provide full assistance on installation, commissioning and after-sales.



Example of parallel hybrid solution integration on ship





ESCO POWER

Escopower is a dynamic member of the Belgian, 70 years old, Escogroup and specialised in offering the best transmissions and solutions for your drivelines in marine and industrial applications.

Application Data Sheet

Company Phone

Contact E-mail

Diesel engine Model

Power kW@ rpm Duty hours/year

Housing SAE Flywheel SAE

Marine Gear Housing SAE

Electric Motor/Generator

Power kW@ rpm Application info/use

Requested autonomy h



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Event and excursion vessel with parallel hybrid propulsion, designed and built by Shiptec AG (www.shiptec.ch)

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