OPERATION MANUAL

MARINE HYBRID SYSTEM

YF12e

with VC20

For JH Common Rail Series

en English

YANMAR

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OPERATION MANUAL	MODEL	YF12e
	CODE	0AMHS-EN0020

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INTRODUCTION

WELCOME TO THE WORLD OF YANMAR MARINE!

YANMAR Marine offers engines, drive systems, marine hybrid systems and accessories for all types of boats, from runabouts to sailboarts, and from cruisers to mega yachts. In marine leisure boating, the worldwide reputation of YANMAR Marine is second to none.

We design our engines to respect nature.
This means quieter engines, with minimal vibrations, cleaner than ever. All of our engines meet applicable regulations, including emissions, at the time of manufacture.

To help you enjoy your YANMAR marine hybrid system for many years to come, please follow these recommendations.

- Read and understand this Operation Manual before you operate the machine to ensure that you follow safe operating practices and maintenance procedures.
- Keep this Operation Manual in a convenient place for easy access.
- If this Operation Manual is lost or damaged, order a new one from your authorized YANMAR Marine dealer or distributor.
- Make sure this manual is transferred to subsequent owners. This manual should be considered a permanent part of the engine and remain with it.
- Constant efforts are made to improve the quality and performance of YANMAR products, so some details included in this Operation Manual may differ slightly from your engine. If you have any questions about these differences, please consult your authorized YANMAR Marine dealer or distributor.
- The specifications and components (instrument panel, fuel tank, etc.) described in this manual may differ from ones installed on your vessel. Please refer to the manual provided by the manufacturer of these components.
- Refer to the YANMAR Limited Warranty Handbook for a complete warranty description.

RECORD OF OWNERSHIP

Take a few moments to record the information you need when you contact YANMAR for service, parts or literature.

Marine Gear Model: _____

Marine Gear Serial No.: _____

Date Purchased: _____

Dealer: _____

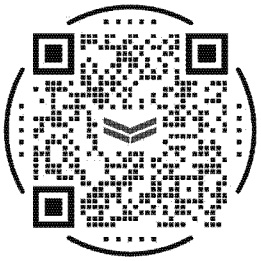
Dealer Phone: _____

To Register Your YANMAR Marine Hybrid System

1. Visit https://www.yanmar.com/marine/service/register-your-engine/ or our website: https://www.yanmar.com/marine
2. Log in the YANMAR Marine Support Portal and register your system.

To Get Multi Language Operation Manual

1. Scan the following two dimensional code.



2. Select your system series.
3. Select your system.
4. Select the language you want, and get the Operation Manual.

SAFETY

YANMAR considers safety of great importance and recommends that anyone that comes into close contact with its products, such as those who install, operate, maintain or service YANMAR products, exercise care, common sense and comply with the safety information in this manual and on the machine's safety labels. Keep the labels from becoming dirty or torn and replace them if they are lost or damaged. Also, if you need to replace a part that has a label attached to it, make sure you order the new part and label at the same time.

This product is to be used as a set with engine: 4JH110/80 and control system: VC20. Never use it with any other engine or control system.



This safety alert symbol appears with most safety statements. It means attention, become alert, your safety is involved! Please read and abide by the message that follows the safety alert symbol.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, *will* result in death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, *could* result in death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, *could* result in minor or moderate injury.

NOTICE

NOTICE indicates a situation which can cause damage to the machine, personal property and/or the environment or cause the equipment to operate improperly.

GENERAL INFORMATION

There is no substitute for common sense and careful practices. Improper practices or carelessness can cause burns, cuts, mutilation, asphyxiation, other bodily injury or death.
This information contains general safety precautions and guidelines that must be followed to reduce risk to personal safety. Special safety precautions are listed in specific procedures.
Read and understand all of the safety precautions before operation or performing repairs or maintenance.

Before You Operate

⚠ DANGER



- **Read and understand this Operation Manual before you operate or service the engine, or marine hybrid system to ensure that you follow safe operating practices and maintenance procedures.**
- **Safety signs and labels are additional remainders for safe operating and maintenance techniques.**
- **See your authorized YANMAR Marine dealer or distributor for additional training.**
- **Check and follow with each country's regulations to see if qualifications are required for maintenance.**

During Operation and Maintenance

⚠ DANGER

Crush Hazard!



- **Always use lifting equipment with sufficient capacity to lift engine, marine gear or battery.**
- **Never stand under hoisted engine, marine gear or battery. If the hoist mechanism fails, the engine, marine gear or battery will fall on you, causing serious injury or death.**
- **Never support engine, marine gear or battery with equipment not designed to support the weight of the engine, marine gear or battery such as wooden pieces, blocks or by only using a jack.**

⚠ WARNING

Explosion Hazard!



- **Avoid serious personal injury or equipment damage.**
- **While the engine or the marine hybrid system is running or the lead or li-ion battery is charging, hydrogen gas is being produced and can be easily ignited.**
- **Keep the area around the lead or li-ion battery well-ventilated and keep sparks, open flame and any other form of ignition out of the area.**
- **Be sure to follow the precautions listed in this manual when connecting to shore power and house devices.**

Fire Hazard!



- **Avoid personal injury or equipment damage. Have appropriate safety equipment available.**
- **Keep fire extinguishers for not only ordinary but li-ion battery handy in case of fire. Clearly indicate the location of the fire extinguishers with a safety sign.**
- **Ensure that the type of fire extinguishers are appropriate for material that might catch fire. Check and follow with national laws and local ordinances.**
  For marine hybrid system, it is necessary to keep fire extinguishers for li-ion battery.
- **Have all fire extinguishers checked periodically for proper operation and/or readiness.**
- **Post evacuation routes prominently. Periodically conduct fire drills.**
- **Avoid injury or equipment damage from fire. Undersized wiring systems can cause an electrical fire.**

Wipe up all spills immediately.

⚠ WARNING

Alcohol and Drug Hazard!



Never operate the engine while under the influence of alcohol or drugs or when feeling ill.

Exposure Hazard!



To avoid injury, Always wear personal protective equipment including appropriate clothing, gloves, work shoes, eye and hearing protection as required by the task at hand.

Entanglement Hazard!



- Never leave the key in the key switch when you are servicing the engine or marine hybrid system. Someone may accidentally start the engine and not realize you are servicing it.
- Avoid personal injury. Never operate the engine while wearing a headset to listen to music or radio because it will be difficult to hear the warning signals.
- If the vessel has more than one engine, never service a marine hybrid system if either of the engines are running. In multi-engine configurations, the propeller for an engine that is shut down may rotate if any of the other engines or marine hybrid system are running.
- Avoid unexpected equipment movement. Shift the marine gear into the NEUTRAL position any time the engine is at idle.

⚠ WARNING

Sever Hazard!



- Never service the marine gear while under tow or if the engine is running at idle speed. The propeller may rotate under these circumstances.
- Rotating parts can cause severe injury or death. Never wear jewelry, unbuttoned cuffs, ties or loose fitting clothing and Always tie long hair back when working near moving/rotating parts such as the flywheel or PTO shaft. Keep hands, feet and tools away from all moving parts.
- If the vessel has more than one engine, Never service a marine gear if either of the engines are running. In multi-engine configurations the propeller for an engine that is shut down may rotate if any of the other engines are running.
- Shift the marine gear into the NEUTRAL position any time the engine is at idle.
- To prevent accidental equipment movement, Never start the engine in gear.
- Before starting the engine, Always make sure that all bystanders are clear of the area. Keep children and pets away while the engine is operating.
- Avoid personal injury or equipment damage. Always remove any tools or shop rags used during maintenance from the area before operation.
- Stop the engine before you begin to service the marine gear and secure the propeller so it will not turn.

Burn Hazard!



- Avoid serious injury. Some of the engine, marine gear and junction box surfaces become very hot during operation and shortly after shut-down. Keep hands and other body parts away from hot engine, marine gear and junction box surfaces.
- Handle hot components with heat-resistant gloves.

⚠ WARNING

Sudden Movement Hazard!

- Avoid personal injury. Always stop the engine and the system before beginning installing or maintenance.
- When you install the “emergency nut” of marine gear, the boat will move as soon as you start the engine! Make sure the area is clear before you start the engine.
- To prevent accidental equipment movement, never start the engine in gear.

Exhaust Hazard!



Avoid serious injury or death. Never block windows, vents, or other means of ventilation if the engine is operating in an enclosed area. All internal combustion engines create carbon monoxide gas during operation and special precautions are required to avoid carbon monoxide poisoning.

Electrical Shock Hazard!



- Avoid serious personal injury or equipment damage. Always turn off the battery switch (if equipped) and rotary switch off on junction box or disconnect the negative battery cable of lead and li-ion before servicing the equipment.
- Avoid personal injury or equipment damage. Always keep the electrical connectors and terminals clean. Check the electrical harnesses for cracks, abrasions, and damaged or corroded connectors.
- Never touch the electrical equipment with wet hands, gloves or clothes.
- Never wear clothes with metal during installing or maintenance.
- Remove bilge water and keep dry condition during installing or maintenance.
- Always pay attention to high voltage during installing, check or maintenance.

- Never attempt to repair yourself.
- Never touch non-insulated power cables, damaged wires or electrical devices.

⚠ CAUTION

Poor Lighting Hazard!

Avoid personal injury or equipment damage. Ensure that the work area is adequately illuminated. Always install wire cages on portable safety lamps.

Tool Hazard!

Avoid personal injury or equipment damage. Always use tools appropriate for the task at hand and use the correct size tool for loosening or tightening machine parts.

Flying Object Hazard!



Avoid personal injury. Always wear eye protection when servicing the engine or when using compressed air or high-pressure water.
Dust, flying debris, compressed air, pressurized water or steam may injure your eyes.

- Periodic maintenance prevents unexpected downtime, reduces the number of accidents due to poor machine performance and helps extend the life of the marine hybrid system.
- If any problem is noted during the visual check, the necessary corrective action should be taken before you operate the marine hybrid system.

Slipping and Tripping Hazard!

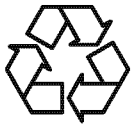


- Ensure that adequate floor space is set aside for servicing marine hybrid system.
  The floor space must be flat and free of holes.
- Keep floor free of dust, mud, spilled liquids and parts to help prevent slipping and tripping.

NOTICE

It is important to perform daily checks as listed in this operation manual.

Periodic maintenance prevents unexpected downtime, reduces the number of accidents due to poor engine or marine hybrid system performance and can help extend the life of the engine and marine hybrid system.



- Always be environmentally responsible.

- Follow the guidelines of the EPA or other governmental agencies for the proper disposal of hazardous materials such as lubrication oil, diesel fuel and engine coolant. Consult the local authorities or reclamation facility.

Never dispose of hazardous materials by dumping them into a sewer, on the ground or into ground water or waterways.

The li-ion battery should be processed by a recognised recycling agency. The li-ion battery may be returned to YANMAR Marine dealer or distributor for disposal. The li-ion battery pack must not be mixed with any domestic or industrial waste.

When using independently procured parts, be sure to use parts that have the characteristics specified by YANMAR.

Only use replacement parts specified.
Other replacement parts may affect warranty coverage.

Always follow the regulations of each country when storing li-ion batteries.

NOTICE

Observe the following environmental operating conditions to maintain marine hybrid system performance and avoid premature marine gear wear.

- Never run the marine hybrid system if the ambient temperature is above +45 °C or below -5 °C. Keep the temperature of the place where the li-ion battery is installed between -45 °C and 70 °C. Keep the li-ion battery temperature between -25 °C and 45 °C when charging.
- If the ambient temperature exceeds +45 °C the marine gear may overheat and cause the marine gear oil to break down.
- If the ambient temperature falls below -5 °C electric motor oil pump can not operate properly. It may be difficult to operate even at temperatures below 0 °C. In that case, warm up the engine in engine mode.
- Contact your authorized YANMAR Marine dealer or distributor if the marine hybrid system will be operated in either temperature extreme.

Observe the following environmental operating conditions to maintain marine hybrid system performance and avoid premature marine gear wear.

- Avoid operating in the presence of chemical gases or fumes.
- Avoid operating in extremely dusty conditions.

Never attempt to modify the marine hybrid system's design or safety features.

NOTICE

Failure to comply may impair the marine hybrid system's safety and performance characteristics and shorten the marine hybrid system's life.
Any alterations to this marine hybrid system may affect the warranty coverage of your marine hybrid system.

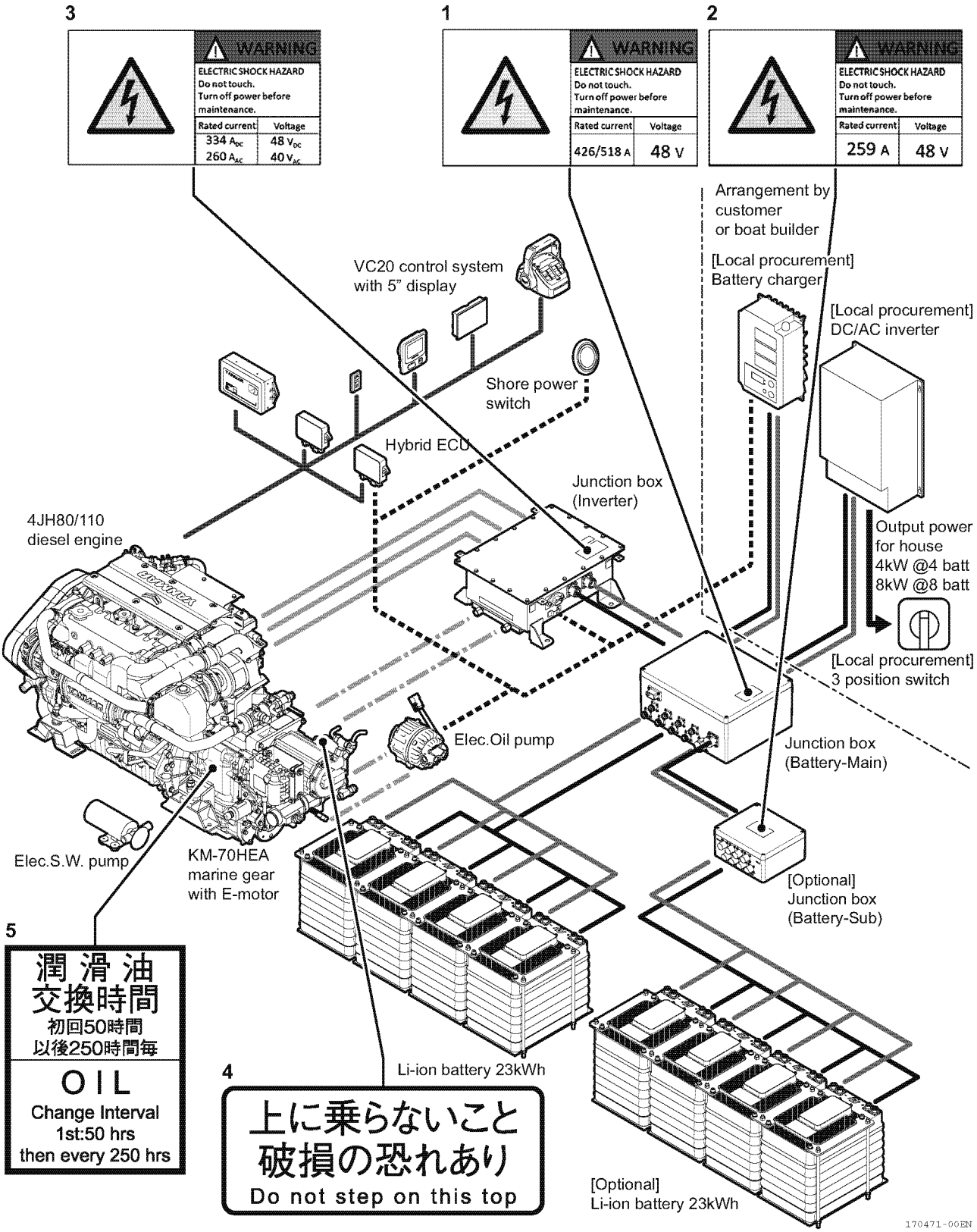
Always tighten components to the specified torque. Loose parts can cause equipment damage or cause it to operate improperly.

If the marine gear oil temperature is too high, stop engine immediately and check the marine gear oil level and check the oil cooler for proper coolant and water flow.

Never use the marine gear lifting eye to lift the engine and marine gear as an assembly. Use the engine lifting eyes to lift the engine and marine gear. Only use the marine gear lifting eye to lift the marine gear as a separate component.

Always use 4 eye bolts when lift the li-ion battery.

LOCATION OF SAFETY DECALS (MARINE GEAR, JUNCTION BOX)



1 – Part Number: 1V6900-07710
2 – Part Number: 1V6900-07720
3 – Part Number: 1V6900-07730
4 – Part Number: 177503-02921
5 – Part Number: 177523-02920

Figure 1

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PRODUCT OVERVIEW

OVERVIEW

This product is to be used as a set with engine: 4JH110/80 and control system: VC20, for single engine installation system.
This product consists of a system control unit, marine gear with an electric motor: KM-70HEA, and a li-ion battery.

This marine hybrid system can work ENGINE mode, ELECTRIC mode, HYBRID mode, GENSET mode, SHORE power mode and STANDBY mode, allowing you to select the mode that best suits your usage conditions.

ENGINE mode is a mode in which propulsion is provided by the engine.
ELECTRIC mode is a mode in which propulsion is provided by the motor installed marine gear using power from the li-ion battery.
HYBRID mode is a mode in which propulsion is provided by the engine and the li-ion battery is charged via the motor by the engine.
GENSET mode is a mode in which the li-ion battery is charged via the motor by the engine.
SHORE mode is a mode in which the li-ion battery is charged by shore power.

The marine gear has 2 speed clutch.
Therefore each mode can be selected the optimal speed for each mode.

The hybrid system is adopted a 48 V system.

The marine gear is a hydraulically-activated helical gear unit, developed for use in pleasure craft.

The marine gear is equipped with a disk-type reversing clutch mounted on the input shaft and the support shaft and supplied with hydraulic pressure from an oil pump.

Operation of the oil pump is installed marine gear is dependent on the engine speed.
For ELECTRIC, HYBRID and GENSET mode, electric motor pump is installed in hybrid system.

The marine gear is lubricated by splash and force-feed lubrication.

New System Break-in

Refer to the engine operation manual for engine operation.

On the initial engine start-up, allow the engine to idle for approximately 15 minutes while you check for proper marine gear function and marine gear oil leaks.

During the break-in period, carefully observe marine gear indicators (if any) for proper marine gear function.

During the break-in period, check the marine gear oil leaves frequently.

To complete engine and marine hybrid system break-in, perform after initial 50 hours of operation maintenance procedures. *See After Initial 50 Hours of Operation on page 32.*

COMPONENT IDENTIFICATION

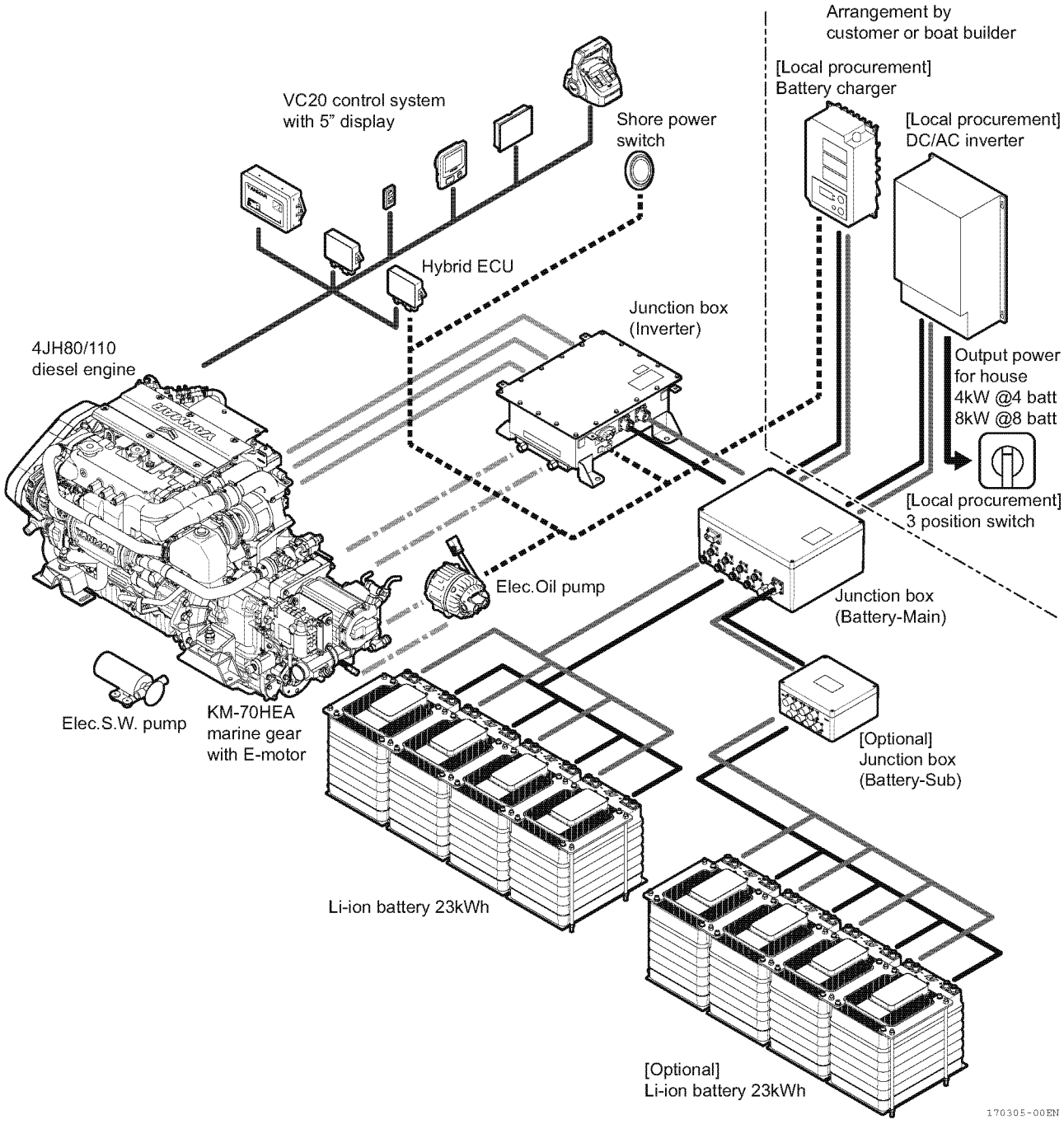


Figure 2

Note: KM-70HEA shown.

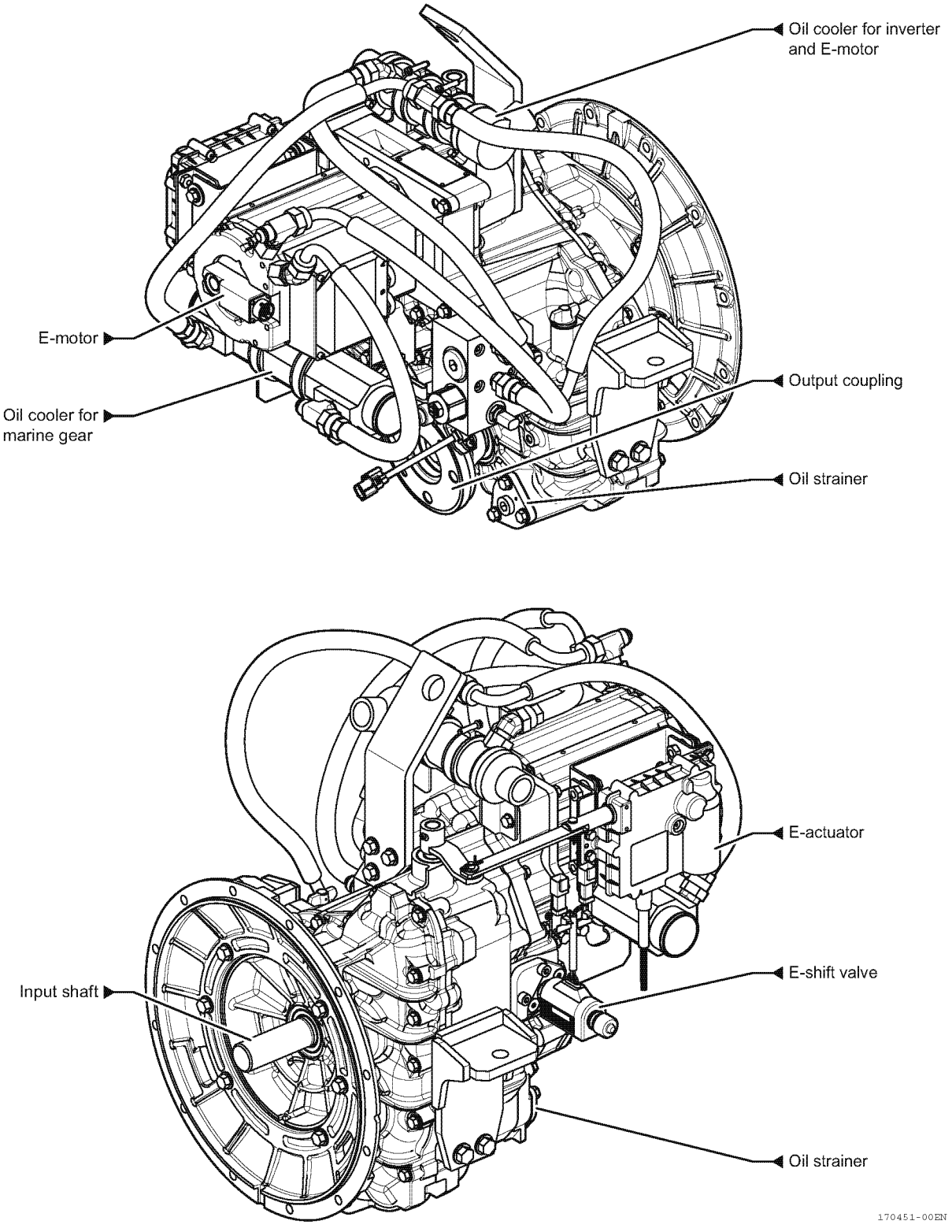


Figure 3

NOTICE

Never use the marine gear lifting eye to lift the engine and marine gear as an assembly. Use the engine lifting eyes to lift the engine and marine gear. Only use the marine gear lifting eye to lift the marine gear as a separate component.

FUNCTION OF MAJOR COMPONENT

Name component	Function
Hybrid ECU (HCU)	Electric Controller Unit that manages Hybrid system by communicating with Electric motor, Li-ion batteries, Engine, Vessel Control System, etc.
Electric motor (E-motor)	Electric motor mounted on the KM-70HEA marine gear for propulsion and charging batteries.
Electric actuator (E-actuator)	Actuator for switching gear train mounted on the KM-70HEA marine gear, used for changing operation modes. Position adjustment is required when performing maintenance.
Junction box (Battery)	Enclosure housing electrical connections for Li-ion batteries, includes relays and fuses for Standard 23 kWh battery pack.
Sub junction box (Battery)	Enclosure housing electrical connections for Li-ion batteries, includes relays and fuses for Optional 23 kWh battery pack.
Junction box (Inverter)	Enclosure housing electrical connections for Inverter, includes a heatsink and fuses.
Electric seawater pump	DC12 V electric driven cooling water pump with a replaceable rubber impeller that pumps sea water from outside vessel to Junction box (Inverter). Do not operate it without sea water as this may damage the impeller.
Electric oil pump	DC12 V electric driven oil pump that pumps gear oil from marine gear to oil cooler.
Oil cooler E-motor and inverter	A heat exchanger that cools marine gear oil for E-motor and Inverter and used when operating with E-motor (not Engine).
Li-ion battery with BMS	Rechargeable battery for propulsion and electric appliance on board, includes built-in Battery management system (BMS) that communicates with HCU and battery charger.
Oil cooler for marine gear oil	A heat exchanger that cools marine gear oil with seawater.
Shore power switch	Start and stop button for charging the Li-ion batteries from shore.

ELECTRONIC CONTROL SYSTEM

⚠ WARNING

- **This product is to be used as a set with engine: 4JH110/80 and control system: VC20. Never use it with any other engine or control system.**
  Refer to the 4JH110/80 operation manual for items related to VC20.
- **Never disassemble the high voltage line and equipment.**
- **Failure to comply may result in death or serious injury.**
- **If a malfunction occurs, consult your nearest YANMAR dealer or distributor.**

- **Never use the ECU for other purposes than intended or in other ways than specified by YANMAR. Doing so will void the product warranty.**
- **Be sure to use the ECU in conjunction with the systems whose models or serial numbers are specified by YANMAR. Other ECU/engine combinations than specified will void the engine warranty.**
- **Replacing the marine gear involves rewriting the actuator data in the ECU. Be sure to consult your local YANMAR dealer before replacing the marine gear. Failure to rewrite the actuator data before replacing the marine gear will void the engine warranty.**
- **Improper use or misuse of the ECU may result in death or serious injury.**
- **Replacing the ECU involves migrating the shift actuator data to the existing ECU to the new unit. Be sure to consult your local YANMAR dealer before replacing the ECU. Failure to migrate the shift actuator data before replacing the ECU will void the engine warranty.**

NOTICE

- Do not plug or unplug the ECU for a period at least 6 seconds after power to the unit has been turned on or off.
- Do not touch connector pins of the ECU with bare hands.
  Doing so may result in corrosion of the connector pins and/or damage to the internal circuits of the ECU due to static electricity.
- Do not force a measuring probe into the female coupler.
  Doing so may cause contact failure of the connector pins, resulting in malfunction of the ECU.
- Take care to prevent water from entering the couplers when plugging or unplugging the connector.
  Water inside the couplers may cause corrosion, resulting in malfunction of the ECU.
- Avoid plugging/unplugging the connector more than approx. 10 times.
  Frequent plugging/unplugging of the connector may cause contact failure of the connector pins, resulting in malfunction of the ECU.
- Do not use the ECU that has ever suffered drop impact.
- Always check the battery for proper charge. Otherwise the electronically controlled engines may fail to start.

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BEFORE YOU OPERATE

Check the engine refer to the engine operation manual.

Under conditions where the gear oil temperature is below 0 deg.C, the electric oil pump may not operate properly and EV, HYBRID, or GENSET mode may not be available. In such a case, start the engine with ENGINE mode and change operation modes after the gear oil temperature rises.

MARINE GEAR OIL

Marine Gear Oil Specifications

Using marine gear oil that does not meet or exceed the following guidelines or specifications may cause seizure of parts, abnormal wear and shorten engine life.

Service Categories

Use marine gear oil that meets or exceeds the following guidelines and classifications.

- SAE viscosity #30
- API service categories CD or CF
- Recommended oil:
  YANMAR Marine Super Oil SAE30

* Only a single grade is possible.

NOTICE

- Always use the specified SAE 30 oil. Never use gear oil or ATF. Never use multi-grade oil or mix oil types.
- Change the marine gear oil after the first 50 hours of operation and then at every 250 hours thereafter.

Checking the Marine Gear Oil

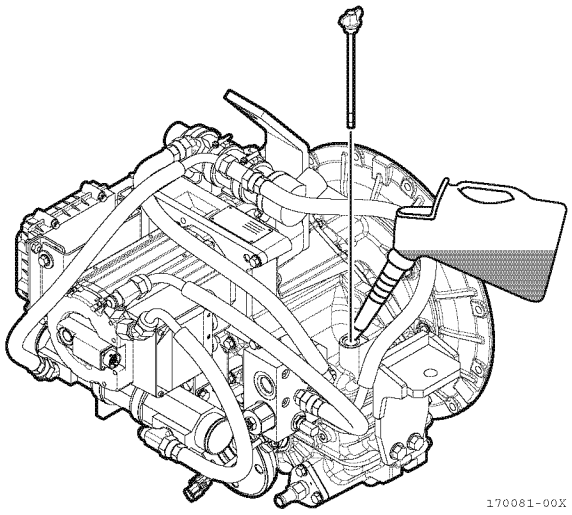
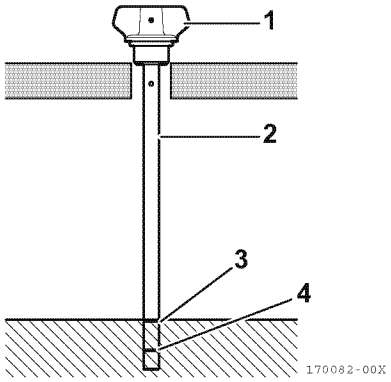


Figure 4



1 – Filler cap
2 – Dipstick (Filler cap combined type)
3 – Upper limit
4 – Lower limit

Figure 5

1. Make sure the engine is level.
2. Remove the filler cap (1, **Figure 5**) at the top of the housing.
3. Remove dipstick (2, **Figure 5**) and wipe with clean cloth.

NOTICE

Prevent dirt and debris from contaminating marine gear oil. Carefully clean the dipstick and the surrounding area before you remove it.

4. Re-insert the dipstick without screw in. See the illustration.
5. Remove dipstick. The oil level should be between upper (3, **Figure 5**) and lower (4, **Figure 5**) lines on the dipstick.
6. Screw in the dipstick.

Adding Marine Gear Oil

1. Make sure the engine is level.
2. Remove the filler cap (1, **Figure 5**) at the top of the housing.
3. Fill with oil to the upper limit on the dipstick (3, **Figure 5**).

NOTICE

Never overfill the marine gear with oil.

4. Screw in the dipstick.
5. Tighten the filler port cap by hand.

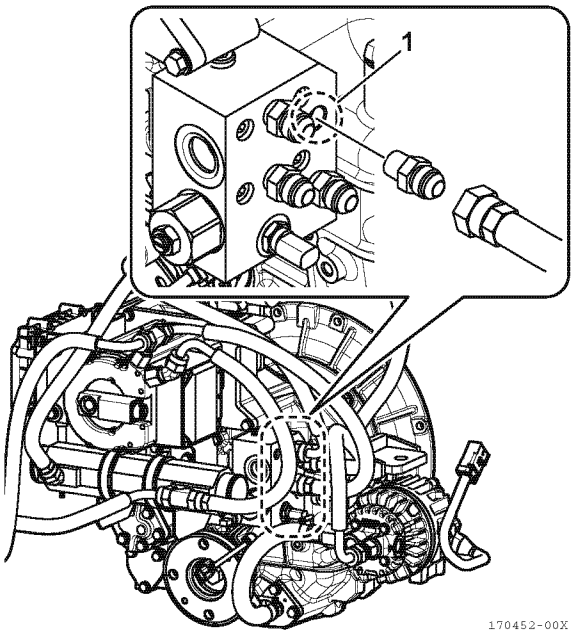


Figure 6

6. Pour oil into the pump discharge port (1, **Figure 6**) to wet the pumping element.
7. Ensure the shift lever is in NEUTRAL.
8. Start the engine. Let the engine run at idle with the shift lever in the NEUTRAL position for several minutes. This will ensure the oil is distributed to all pipelines, oil cooler and marine gear oil passages.
9. Stop the engine. Wait at least 10 minutes for the oil to drain back into the sump.
10. Check the oil level. If necessary, add oil until the level reaches the upper mark on the dipstick. Check the oil level again after operating the marine gear for a short period of time.

Gear oil quantity

Total oil qty.	5.9 L
Marine gear oil qty. (Effective)	3.5 (1.5) L
Hose and heat exchanger, etc. oil qty.	2.4 L

NOTICE

Oil may remain in the intricate areas inside of the marine gear and other components.
Execute the confirmation of the quantity of oil with the dip stick when pouring oil.

SYSTEM OPERATION

The Marine Hybrid System has the following operation modes and it can be changed with 5" display.

Operate the display and select the appropriate mode depending on the situation.

⚠ CAUTION

- **Do not change the operation mode while docking your boat.**
  When changing the operation mode your boat must stay away from other boats or other objects around.
- **Since the maximum output power of electric motor is relatively small compared with diesel engine, the use of ENGINE or HYBRID mode is recommended when there is a strong wind or strong current.**

When the engine is started with the START button on the switch panel, operation with engine is possible as with a VC20, but the Operation mode can not be changed from the display.

YANMAR HYBRID SYSTEM OPERATION

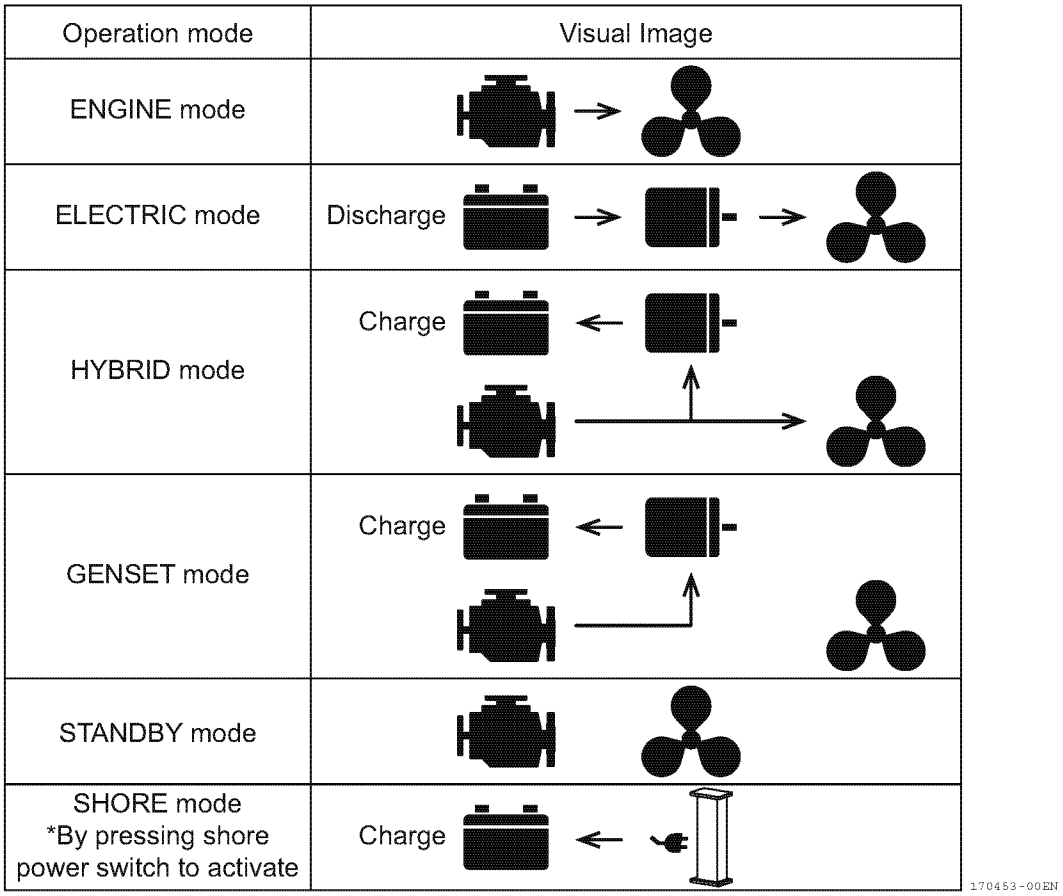


Figure 7

This marine hybrid system can work ENGINE mode, ELECTRIC mode, HYBRID mode, GENSET mode, SHORE power mode and STANDBY mode, allowing you to select the mode that best suits your usage conditions.

ENGINE mode is a mode in which propulsion is provided by the engine.
ELECTRIC mode is a mode in which propulsion is provided by the motor installed marine gear using power from the li-ion battery.
HYBRID mode is a mode in which propulsion is provided by the engine and the li-ion battery is charged via the motor by the engine.
GENSET mode is a mode in which the li-ion battery is charged via the motor by the engine. SHORE mode is a mode in which the li-ion battery is charged by shore power.

Refer to the engine operation manual for engine operation when selecting a mode that requires engine operation.

System Start-up

Turn ON the system and press the control head SEL switch, then select the operation mode.

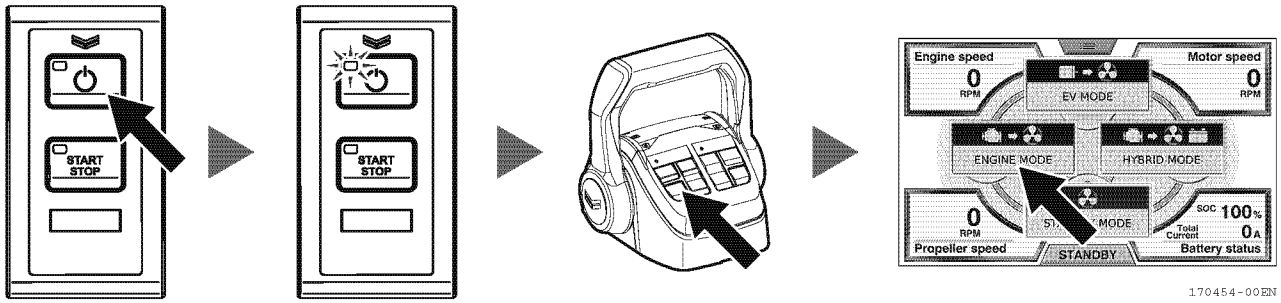


Figure 8

Changing Operation Mode

1. Touch the mode change button.

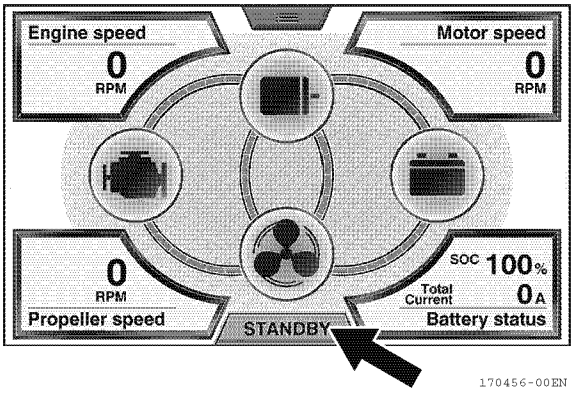


Figure 9

2. Touch and hold the button for the operation mode you want to use more than 1 second (e.g. Engine mode).

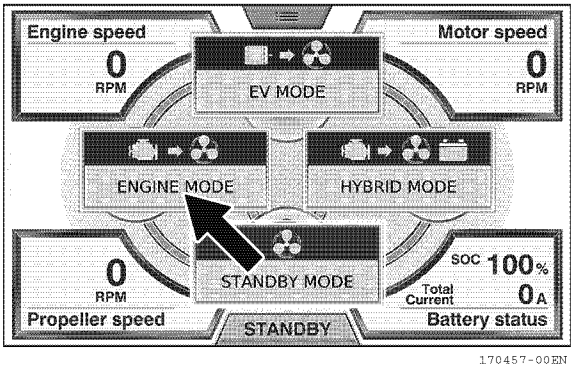


Figure 10

3. Wait a few seconds. The mode change will be completed when the yellow frame is turned on.

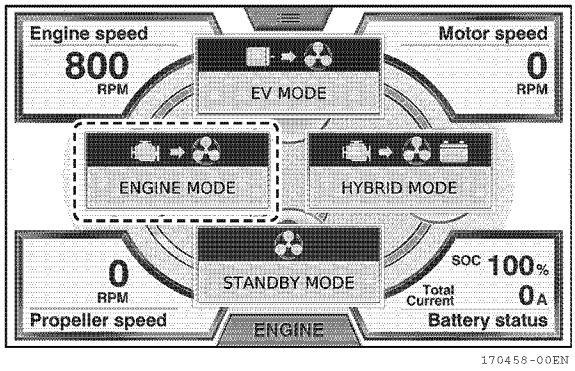


Figure 11

4. Touch anywhere except the buttons or do nothing for 5 seconds to return to the main screen.

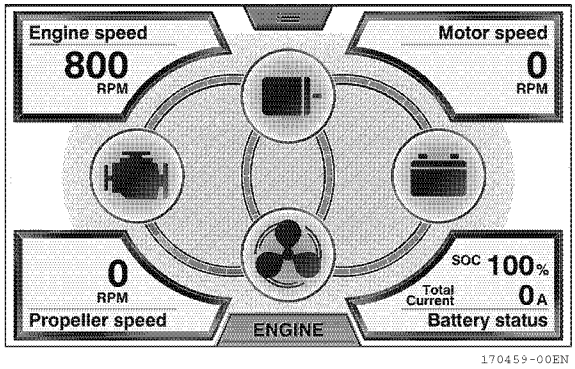


Figure 12

Display Quick Guide

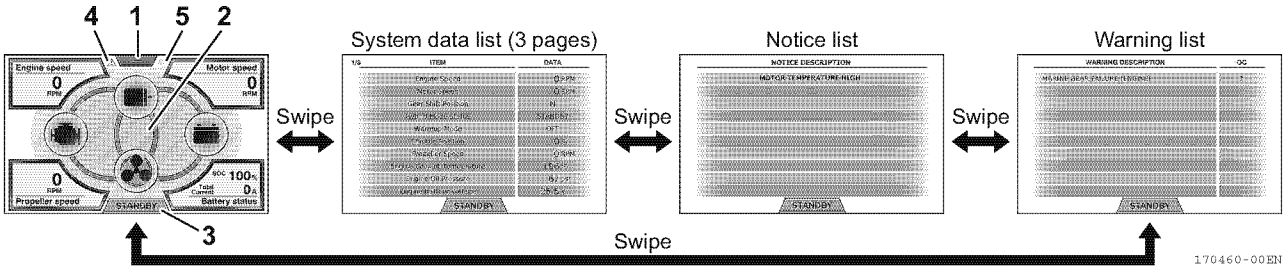


Figure 13

1 Display settings button

Displays a menu for settings.

2 Energy flow

Shows the energy flow according to the hybrid system mode.

3 Mode change button

Displays buttons for changing hybrid system mode.

4 Notice icon

This icon blinks when there is a notification from the system.

5 Warning icon

This icon blinks when an error occurs in the system.

System Shut-down

Select STANDBY mode and turn OFF the system.

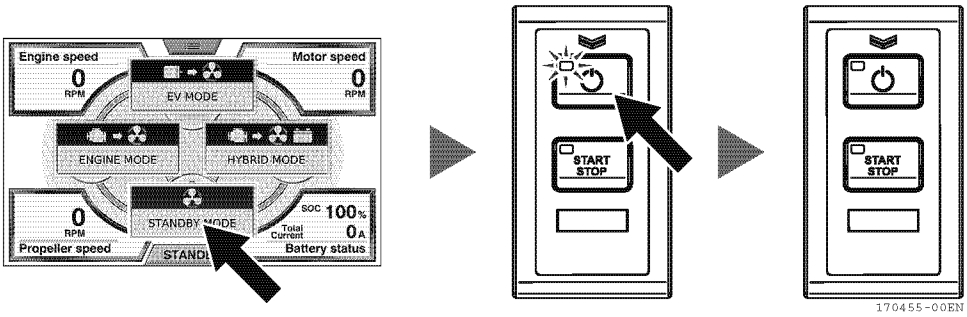


Figure 14

Emergency Stop Switch

Press this switch for emergency stop.
How to release: Restart the system.

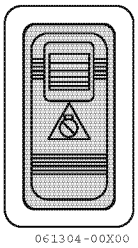


Figure 15

Backup Panel

Engine throttle and gear shift for emergency operation.
This panel is for emergency use only and is limited to engine mode operation.

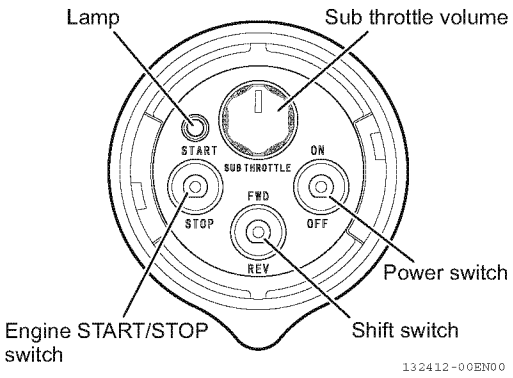
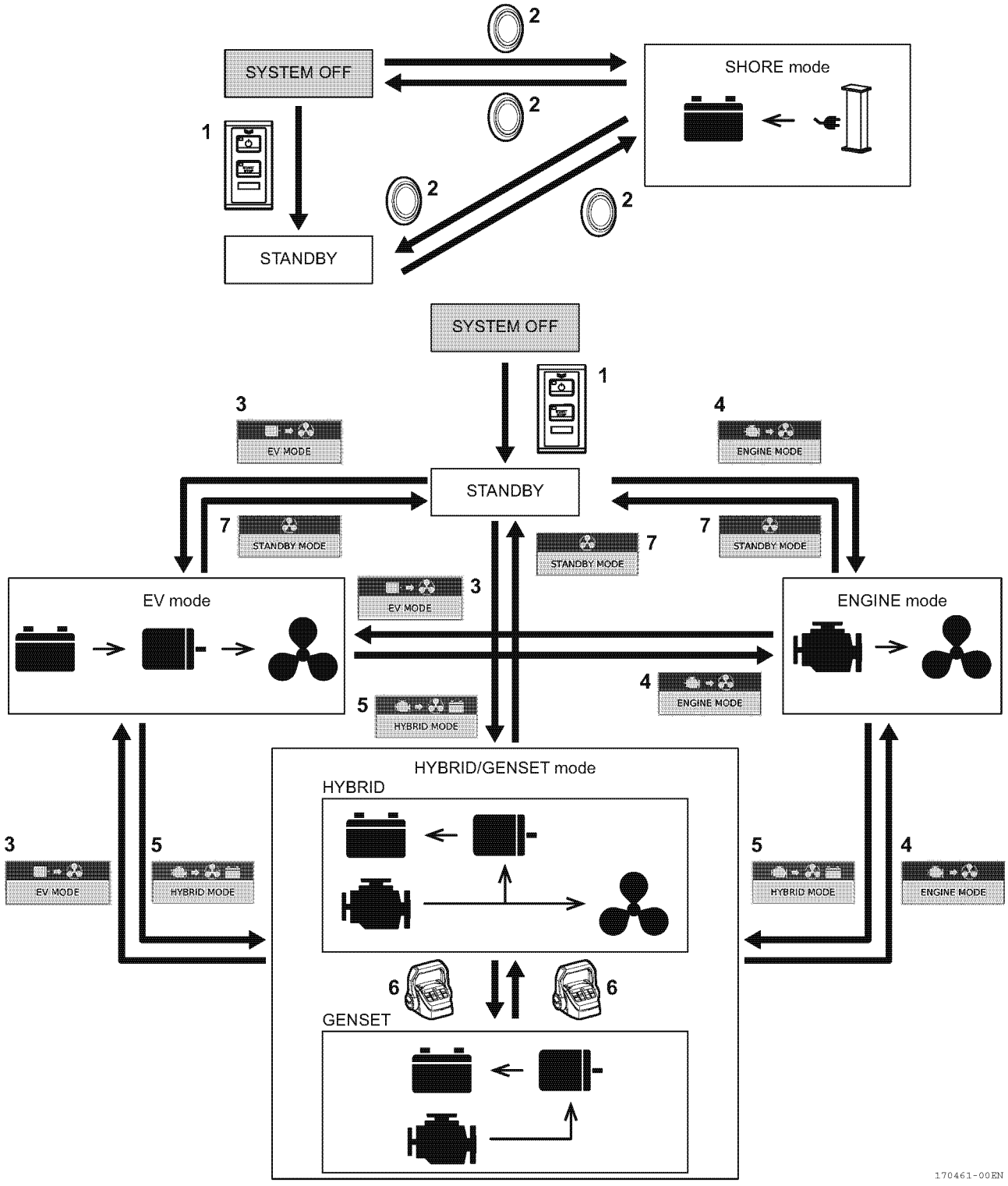


Figure 16

NOTICE

When the boat is sailing (for sailboats) or towed and the propeller shaft is rotated with no lubrication, this may result in mechanical failure for the marine gear. To avoid this, be sure to select ELECTRIC or STANDBY mode and operate the electric oil pump before sailing or the boat is towed. If the electric oil pump has a malfunction be sure to start the engine with the gear in NEUTRAL to rotate the mechanical oil pump.

Mode Select Transition



1 – Key switch ON
2 – SHORE button ON
3 – EV button ON
4 – ENGINE button ON
5 – HYBRID button ON
6 – Neutral button ON
7 – STANDBY button ON

Figure 17

Shore Power Charging

■ Start charging

1. System start-up

Turn ON the system. If operation mode is “EV, ENG or HYBRID”, select the “STANDBY” mode.

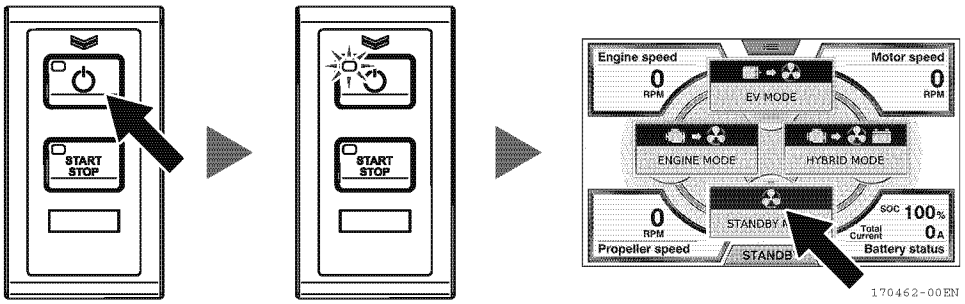


Figure 18

2. Preparing for charging

Plug in the shore power connector.

3. Start charging

Press the Shore power button.
When charging has started, the LED lights up and the display will change to “CHARGING” mode.

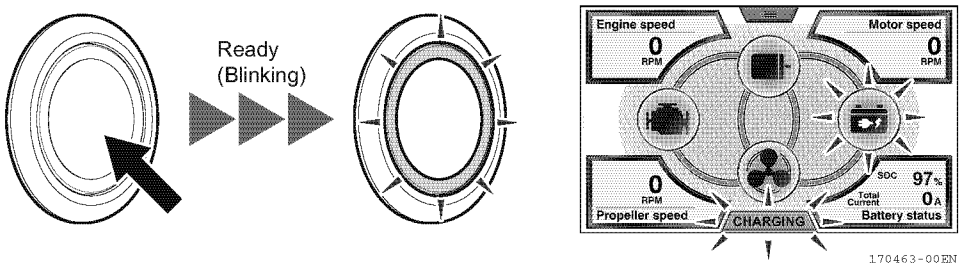


Figure 19

Note:

- *It is also possible to start charging from Step 2 without turning ON the system. In this case, the display will not be activated.*
  ** But when charging without turning ON the system, no need to press the Shore power button again.*
- *If the Li-ion battery is not charged for five minutes after switching to SHORE MODE, the system will automatically go back to STANDBY MODE, or the system will turn off.*

■ Stop charging

1. Stop charging

Press the Shore power button. When charging is stopped, the LED switches off and the display will change to “STANDBY” mode.

* If the battery is fully charged the LED will be automatically turned OFF.

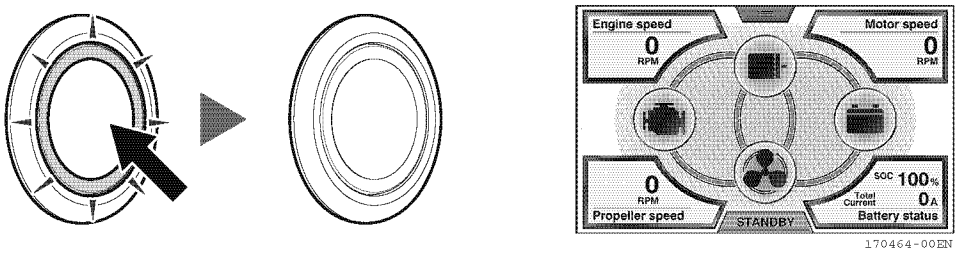


Figure 20

2. Unplug the Shore cable

3. System shut down

Turn OFF the system.

Note: When charging is complete the system will automatically change to “STANDBY” mode, be sure to turn OFF the system before leaving.

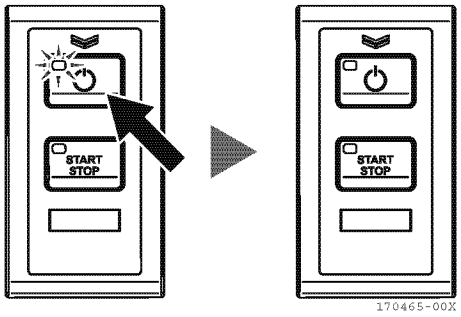


Figure 21

If the onboard load is used during the SHORE MODE, change the 3 position switch to the shore power side, so that the onboard load can be powered from the shore power supply.

Check with your boat builder for definitive information.

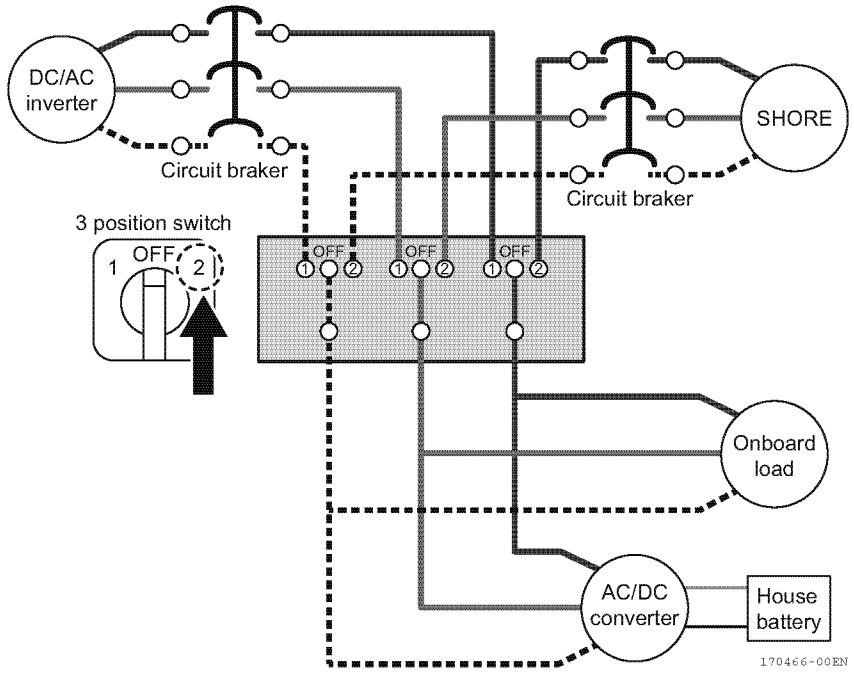


Figure 22

OPERATION (VC20: VESSEL CONTROL SYSTEM)

Starting the Engine

1. Open the seacock (if equipped).
2. Open the fuel tank cock.
3. Turn the battery switch on for engine and engine control system.
4. Press the Power switch on the switch panel of the selected station (1, **Figure 23**).
   - If the "YANMAR E-key" has been set, hold the key fob in front of the blinking lamp on the switch panel to authenticate the key.
   - The switch panel lamp will come on, and the control head (**Figure 24**) "SEL" lamp (**Figure 25**) will come on or flash.
   - To use the Engine START/STOP switch, be sure to turn the Power switch ON.

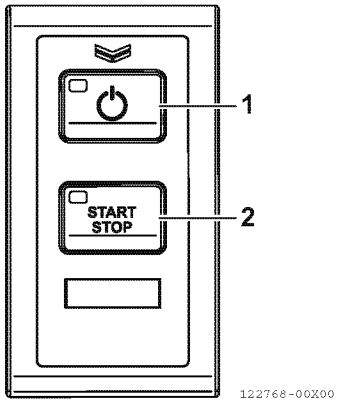


Figure 23

5. If the "Sys on by ID" has been set, enter the password into the display.
6. Press the control head "SEL" switch.
   - Wait until the display shows the engine data. The display is shown.
7. If the "Start by ID" has been set, enter the password into the display.
   - The "Start by ID" has been set, the engine can be started in 10 seconds after entering the password into the display.
8. Move the remote control handle to the N (Neutral) position.



Figure 24

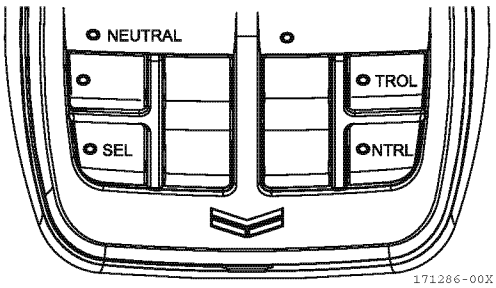


Figure 25

9. Press the Engine START/STOP switch (2, **Figure 23**) and power on the starter.
   - When the engine starts, the VC20 display will show the screen with engine conditions (**Figure 26**).

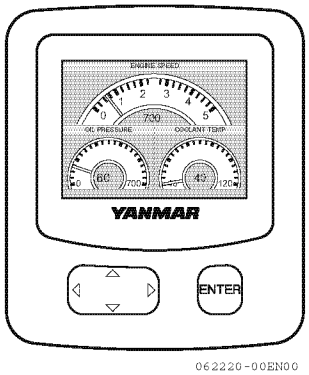


Figure 26

Note:

1. *Concerning the control head "SEL" lamp. For Multi-Station: the "SEL" lamp will flash and for Single Station: the "SEL" lamp will come on.*
2. *Pressing the Engine START/STOP switch when the "SEL" lamp is flashing allows the station to be selected as the engine is started.*
3. *The engine will not start or stop if the Power switch is OFF. The Power switch must be ON at all times when the engine is running.*
4. *Do not press the engine START/STOP switch except for stopping the engine.*

CONTROL THE BACKUP PANEL

⚠ WARNING

Only use this in an emergency.

1. Check that the power switch on the switch panel is OFF and that the remote control handle is in the N (Neutral) position.
2. Press the power switch to the “ON” position on the backup panel. The lamp will come and control by the backup panel is enabled.
3. The engine can be started or stopped with the START/STOP switch.
4. Adjust the engine speed using the sub throttle control volume. (anti-clockwise: lower engine speed, clockwise: raise engine speed)

When controlling the throttle, first move it fully anti-clockwise.

NOTICE

- The throttle of the engine that has been turned on can be controlled.
- When controlling the throttle, always move it fully anti-clockwise first.
- Be sure to lower the engine speed by turning the sub throttle volume fully to anti-clockwise before stopping the engine.

State where cover is removed

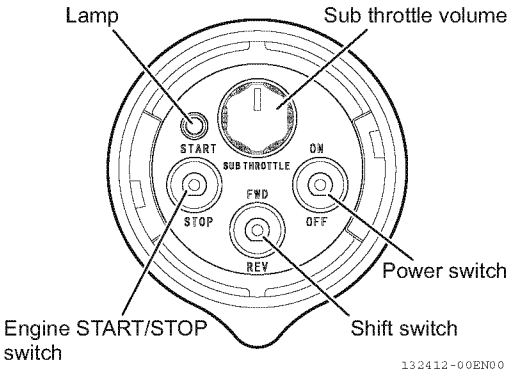


Figure 27

State where cover is attached

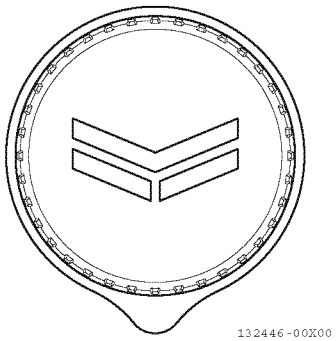


Figure 28

- Remove the cover when operating the backup panel.

PERIODIC MAINTENANCE

PERIODIC MAINTENANCE SCHEDULE

○: Check or clean ◇: Replace ●: Contact your authorized YANMAR Marine dealer or distributor

System	Item	Periodic maintenance interval			
		Daily	At 50 hours (1st period)	Every 250 hours or one year whichever comes first	Every 500 hours or 2 years whichever comes first
Whole	Visual inspection of engine exterior	○ Before starting			
Lubricating system	Check the lubricating oil level and refill if necessary	○ Before starting			
	Replace the lubricating oil		◇	◇	
	Clean oil strainer		○	○	
	Replace oil filter of the electric trolling valve		◇	◇	
	Check and clean oil cooler			●	
Electrical system	Check the wiring connectors			○	
Miscellaneous items	Check friction/steel plates, bearings and gears, replace them if necessary				●
	Check the damper, replace it if necessary				●
Electric seawater pump	Replace the impeller			●	

Check engine operation manual for more details about specific engine procedures.

Consult your authorized YANMAR Marine dealer or distributor when replacing li-ion battery.

PERIODIC MAINTENANCE PROCEDURES

After Initial 50 Hours of Operation

Perform the following maintenance after the initial 50 hours of operation.

- **Changing the marine gear oil and cleaning the marine gear oil strainer**

■ Changing the marine gear oil and strainer

Optimum effectiveness of oil can only be assured if the marine gear oil is changed and the oil strainer is washed with clean oil regularly, according to the maintenance schedule.

1. Position a container under the marine gear to collect the waste oil.

KM-70HEA

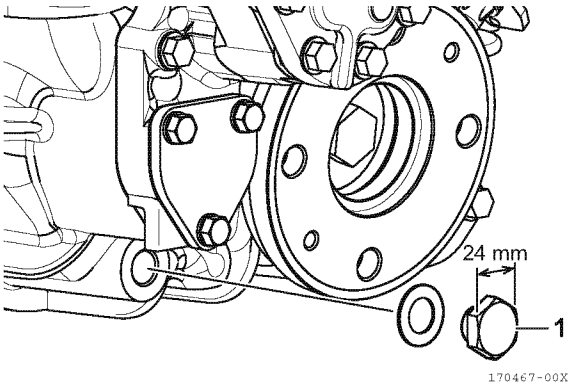


Figure 29

2. Use a 24 mm wrench to remove the M16 drain plug (1, **Figure 29**).

   Note: Clean any metal particles from the drain plug with magnet before installing in housing.

3. Check the seal washer for damage. Replace if necessary.
4. Remove the hose of connection to BOX (INV) (1, **Figure 30**) and drain the oil in the hose. (Tightening torque 49.5 ± 5 N·m)

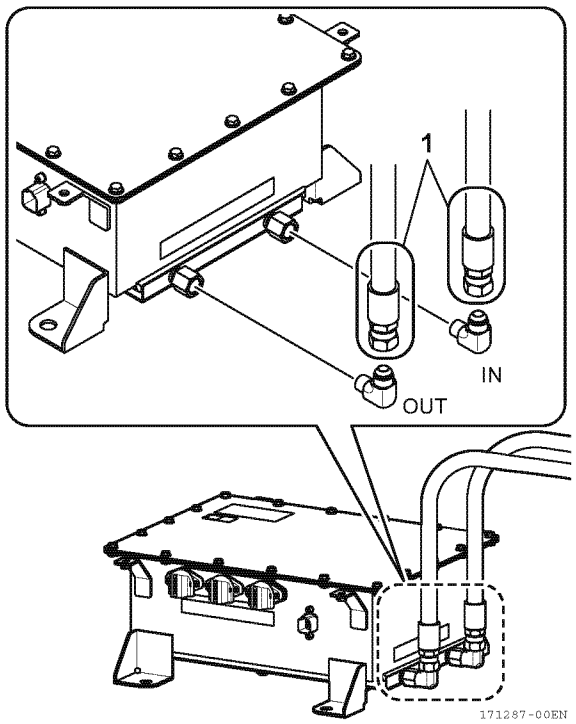


Figure 30

KM-70HEA

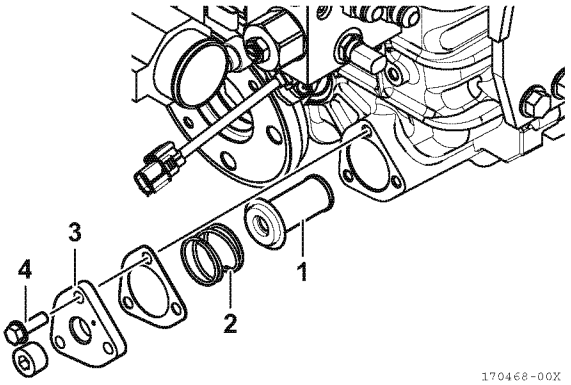


Figure 31

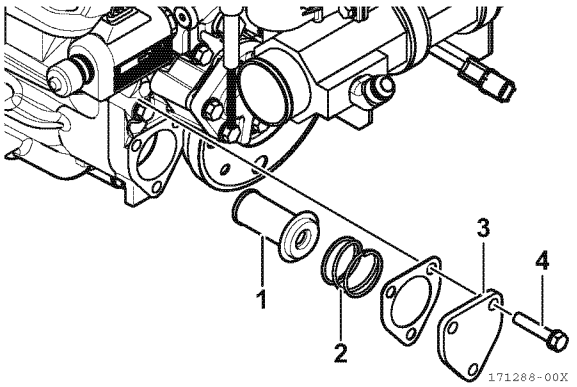


Figure 32

5. Remove three M8 × 40 bolts (4, **Figure 31**, **Figure 32**) and washers.
6. Remove the cover (3, **Figure 31**, **Figure 32**), spring (2, **Figure 31**, **Figure 32**) and oil strainer (1, **Figure 31**, **Figure 32**).
7. Check the cover gasket for damage. Replace if necessary.

   *Note: The oil strainer (1, **Figure 31**, **Figure 32**) must be washed with clean oil whenever the oil is changed.*

8. Install the oil strainer, spring, gasket and cover.
9. Tighten the cover bolts to 18.6 - 20.6 N·m (13.7 - 15.2 ft-lb).

KM-70HEA

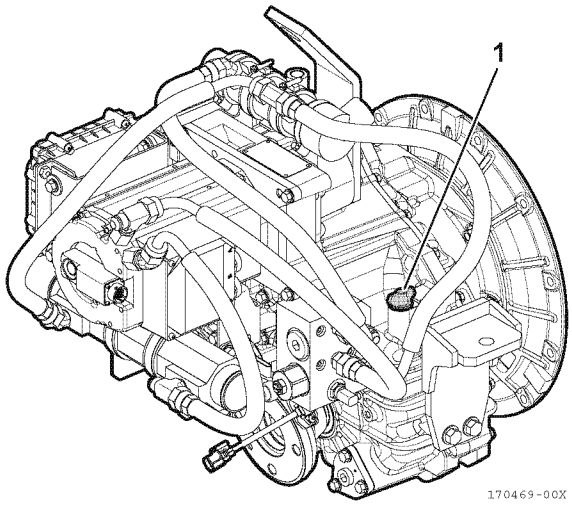


Figure 33

10. Remove the dipstick (1, **Figure 33**). Fill with the following quantities of oil, and add the amount required for oil cooler and pipelines.

NOTICE

Avoid engine damage. Never overfill the marine gear. The oil level must be between the upper and lower level marks on the dipstick.

- Quantities of oil: *See Adding Marine Gear Oil on page 18.*
- Type of oil: *See Marine Gear Oil Specifications on page 17.*

11. After filling the marine gear with oil, reinstall the dipstick and hand-tighten. Over-tightening may damage the cap.
12. Perform a trial run after the oil change.
13. Ensure the shift lever is in the NEUTRAL position.
14. Start the engine. Let the engine idle with the shift lever in the NEUTRAL position for several minutes. This will ensure the oil is distributed to all pipelines and the oil cooler.
15. Stop the engine. Wait at least 10 minutes for the oil to drain back into the sump.
16. Check oil level. *See Checking the Marine Gear Oil on page 17.* If necessary, add oil until the level reaches the upper mark on the dipstick. Check the oil level again after operating the marine gear for a short period of time.

Every 250 Hours of Operation

Perform the following maintenance every 250 hours of operation or yearly, whichever comes first.

- **Changing the marine gear oil and cleaning the marine gear oil strainer**
- **Replace the impeller of electric seawater pump**

■ Changing the marine gear oil and cleaning strainer

See Changing the marine gear oil and strainer on page 32.

■ Replace the impeller of a seawater pump

1. Remove the six screws and open the pump endcover.

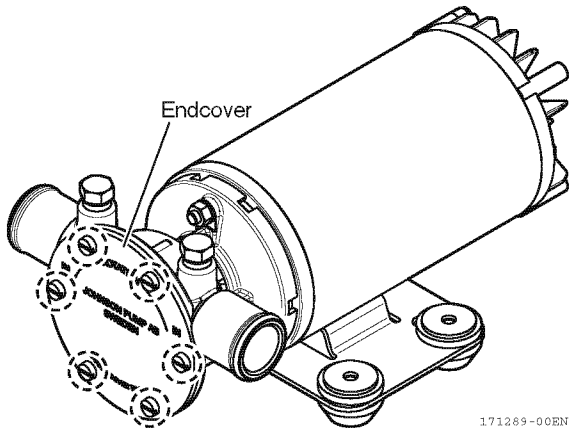


Figure 34

2. Remove the old impeller from the shaft.

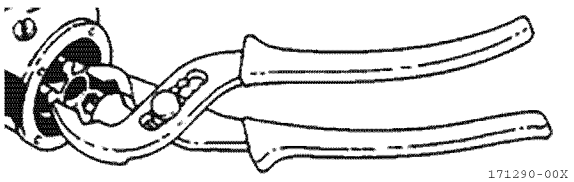


Figure 35

3. Clean the inside of the pump.
4. Lubricate the shaft and the inside of the pump body and endcover with the glycerin included in the kit.
5. Install the new impeller with a rotating movement in the direction that the impeller will turn in.

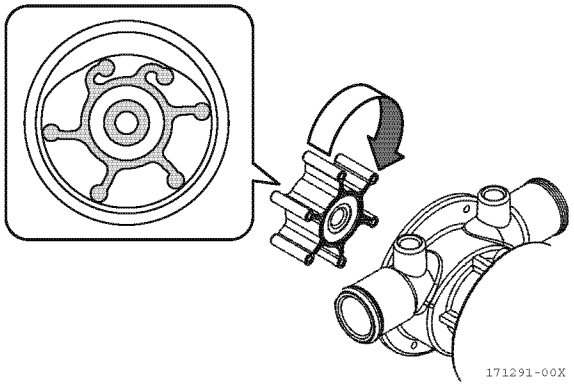


Figure 36

6. Lubricate the new O-ring with the glycerin included in the kit.
7. Install the new O-ring and fix the endcover with six screws.

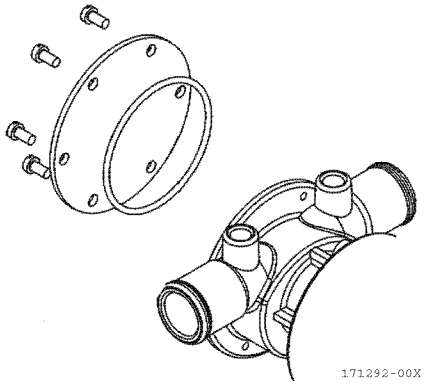


Figure 37

LONG TERM STORAGE

If the system is not to be used for more than 1.5 months, the following measures must be taken:

- Check the li-ion battery charge before long-term storage.
  Battery charge: more than 50%
- Turn off the switch installed on the junction box.
- If the environmental temperature cannot be maintained within the following range, remove the li-ion battery and store it.
  Environment temperature: less than 70 deg.C

If the marine gear is stored for six months or longer, oil should be added through the dipstick hole to full mark to protect the unit from corrosion.

Drain seawater from the cooling system, including the gear oil coolers.

Refer to the engine operation manual for engine procedures.

Before operating the marine gear after a long-term storage, the marine gear oil must be changed.
See Changing the marine gear oil and strainer on page 32.

Never disconnect the cable between the li-ion batteries.

If the cable between the li-ion batteries disconnect, check the voltage of each li-ion battery.
Voltage difference between each battery: less than 0.5 V

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TROUBLESHOOTING

SAFETY PRECAUTIONS

Before performing any troubleshooting procedures within this section, review the *SAFETY section on page 3*.

If a problem occurs, stop the engine immediately.

In case of emergency, start the engine by switch on VCS panel or by backup panel in order to run.

Refer to the Problem column in the Troubleshooting Chart to identify the possible case.

DIAGNOSTIC TROUBLE CODE LIST

DTC	SPN	FMI	DTC description	Detail	Probable cause
P1315	523795	0	MARINE GEAR FAILURE (ENGINE)	Marine gear drive fault (engine)	1. Marine gear failure (Engine transmission failure) 2. Propeller speed sensor failure 3. Wiring failure of the wire-harness, direction of CW and CCW can be opposite 4. Poor connection of connectors
P1316	523796	0	MARINE GEAR FAILURE (MOTOR)	Marine gear drive fault (motor)	1. Marin gear failure (Engine transmission failure) 2. Propeller speed sensor failure 3. Shift actuator failure 4. Wiring failure of the wire-harness 5. Poor connection of connectors
P1317	523797	7	SHIFT DIRECTION FAIRURE (ENGINE)	Forward/Reverse fault (Engine)	1. Wiring failure of the wire-harness 2. Hydraulic clutch solenoid valve failure 3. Propeller speed sensor failure
P1318	523798	7	SHIFT DIRECTION FAIRURE (MOTOR)	Forward/Reverse fault (Motor)	1. Wiring failure of the wire-harness 2. Wiring failure of the motor three-phase line 3. Propeller speed sensor failure
P1319	3174	7	PROP SPPED SENSOR FAILURE	Propeller rotation sensor phase B failure	1. Propeller speed sensor failure 2. Wiring failure of the wire-harness 3. Poor connection of coupler
P1320	5572	1	ABNORMAL MOTOR DRIVE	Motor drive fault	1. Motor failure 2. Inverter failure 3. Wiring failure of the inverter high voltage line 4. Wiring failure of the wire-harness 5. Poor connection of coupler
P1321	523799	5	JB1-2 RELAY FAILURE	JB1-2 relay fault	1. Rotary switch on the Junction box (Batt.) is turned OFF 2. Li-ion battery relay failure (OFF fixation) 3. Wiring failure of the wire-harness 4. Poor connection of coupler
P1322	523799	6	JB1-2 RELAY CONTACT WELDING	JB1-2 Relay Weld fault	1. Li-ion battery relay failure (ON fixation) 2. Wiring failure of the wire-harness
P1323	523800	5	JB2-2 RELAY FAILURE	JB2-2 relay fault	1. Inverter relay failure (OFF fixation) 2. Wiring failure of the wire-harness 3. Poor connection of coupler
P1324	523800	6	JB2-2 RELAY CONTACT WELDING	JB2-2 relay weld fault	1. DC/AC relay failure (ON fixation) 2. Wiring failure of the wire-harness
P1325	523801	6	DC/AC2 RELAY CONTACT WELDING	DC/AC2 relay welding fault	1. DC/AC relay failure (ON fixation) 2. Wiring failure of the wire-harness
P1326	523802	6	CHARGER RELAY CONTACT WELDING	Charger relay welding fault	1. Charger relay failure (ON fixation) 2. Wiring failure of the wire-harness
U1219	523803	9	CAN COM ERROR HELM ECU	Helm ECU communication fault	1. Wiring failure of the wire-harness 2. Poor connection of coupler 3. Lead acid battery low voltage 4. Helm ECU hardware failure
U1220	523804	9	CAN COM ERROR DRIVE ECU	Drive ECU communication fault	1. Wiring failure of the wire-harness 2. Poor connection of coupler 3. Lead acid battery low voltage 4. Drive ECU hardware failure
U1221	523805	9	CAN COM ERROR ENGINE ECU	Engine ECU communication fault	1. Wiring failure of the wire-harness 2. Poor connection of coupler 3. Lead acid battery low voltage 4. Engine ECU hardware failure

DTC	SPN	FMI	DTC description	Detail	Probable cause
U1222	5572	9	CAN COM ERROR INVERTER	Inverter communication fault	1. Wiring failure of the wire-harness 2. Poor connection of coupler 3. Lead acid battery low voltage 4. Inverter failure
U1223	8412	9	CAN COM ERROR BMS (Li-ion BATTERY)	Li-ion battery BMS communication failure	1. Wiring failure of the wire-harness 2. Poor connection of coupler (e.g. Batt. communication cable) 3. Lead acid battery low voltage 4. BMS (Li-ion batt) failure
U1224	1044	9	CAN COM ERROR ELECTRIC OIL PUMP	Electric oil pump communication fault	1. Wiring failure of the wire-harness 2. Poor connection of coupler 3. Lead acid battery low voltage 4. Elec oil pump failure
U1225	752	9	CAN COM ERROR SHIFT ACTUATOR	Shift actuator communication fault	1. Wiring failure of the wire-harness 2. Poor connection of coupler 3. Lead acid battery low voltage 4. Shift actuator failure
P1327	7497	4	LEAD ACID BATTERY VOLTAGE LOW	Lead battery under voltage fault	1. Lead acid battery capacity decrease 2. Lead acid battery over discharge 3. Lead acid battery charging system failure 4. Wiring failure of the wire-harness 5. Poor connection of coupler
P1328	5572	8	INVERTER INITIALIZATION FAILURE	Inverter initialization failure	1. Inverter failure 2. Wiring failure of the wire-harness to the inverter 3. Poor connection of coupler
P1329	752	12	SHIFT ACTUATOR INITIALIZATION FAILURE	Shift actuator initialization failure	1. Shift actuator failure 2. Marine gear failure 3. Wiring failure of the wire-harness 4. Poor connection of coupler
P1330	1044	12	OIL PUMP INITIALIZATION FAILURE	Oil pump initialization fault	1. Electric oil pump failure 2. Wiring failure of the wire-harness 3. Poor connection of coupler 4. Gear oil temp. too low (below -5 deg.C), need to be warmed up by starting the engine for a while
P1331	523806	12	SENSOR FAILURE (DRIVE ECU)	Drive ECU sensor information fault	1. Marine gear oil pressure sensor failure 2. Marine gear oil temp sensor failure 3. Drive ECU failure 4. Wiring failure of the wire-harness 5. Poor connection of coupler
P1332	523807	12	SENSOR FAILURE (ENGINE ECU)	Engine ECU sensor information fault	1. Engine speed sensor failure 2. Engine load detection error 3. Engine ECU failure 4. Wiring failure of the wire-harness 5. Poor connection of coupler
P1333	523808	12	POWER SOURCE INITIALIZE FAILURE	Power component initialization process failed	1. Engine ECU initialization failure 2. Li-ion battery initialization failure 3. Wiring failure of the wire-harness 4. Poor connection of coupler
P1334	523809	7	DOG CLUTCH CANNOT THROW OFF	Failure to disengage the dog clutch	1. Shift actuator failure 2. Marine gear failure 3. Wiring failure of the wire-harness 4. Poor connection of coupler
P1335	630	12	EEPROM FAILURE	EEPROM fault	1. HCU internal circuit failure
P1336	628	12	ROM FAILURE	ROM fault	1. HCU internal circuit failure

DTC	SPN	FMI	DTC description	Detail	Probable cause
P1950	9059	0	MOTOR TEMPERATURE TOO HIGH	Motor high temperature fault	1. Motor overload 2. Cooling system failure 3. Motor failure 4. Wiring failure of the motor three-phase line
P1951	9063	0	MOTOR OVER REVOLUTION	Motor overspeed fault	1. Motor failure 2. Inverter failure 3. Motor power transmission part failure 4. Wiring failure of the motor three-phase line
P1952	5572	7	INVERTER FAILURE (MINOR)	Inverter fault (technically minor issue)	1. Inverter failure with minor issue (detected by inverter)
P1953	5572	12	INVERTER FAILURE(SEVERE)	Inverter fault (technically severe issue)	1. Inverter failure with severe issue (detected by inverter)
P1954	5572	4	INVERTER DC VOLTAGE LOW	Inverter DC low voltage fault	1. Li-ion battery low voltage 2. Inverter failure 3. Wiring failure of the wire-harness 4. Poor connection of coupler
P1955	9101	3	INVERTER DC VOLTAGE HIGH	Inverter DC high voltage fault	1. Li-ion battery high voltage 2. Inverter failure 3. Wiring failure of the wire-harness 4. Poor connection of coupler 5. System was shut down with Emergency stop switch during HYB/GEN mode, needs to be rebooted some short while later
P1956	9099	0	INVERTER OVERCURRENT(MOMENTARY)	Inverter over current fault (momentary)	1. Motor failure 2. Inverter failure 3. Wiring failure of the motor three-phase line 4. Motor overload
P1957	5572	0	INVERTER TEMPERATURE TOO HIGH	Inverter high temperature fault	1. Motor overload 2. Cooling system failure (e.g. water strainer clogged, water pump failure) 3. Inverter failure
P1958	523810	12	Li-ion BATTERY OTHER FAILURE	Li-ion battery other fault	1. Li-ion battery failure 2. Wiring failure of the wire-harness
P1959	8076	1	Li-ion BATTERY TEMPERATURE TOO LOW	Li-ion battery low temperature	1. Li-ion battery temperature too low 2. Li-ion battery failure
P1960	8075	0	Li-ion BATTERY TEMPERATURE TOO HIGH	Li-ion battery high temperature exceeds 60 deg.C	1. Li-ion battery temperature too high 2. Li-ion battery overload 3. Li-ion battery failure 4. No ventilation around the batteries 5. Heat source equipment nearby batteries
P1961	5922	3	Li-ion BATTERY CELL VOLTAGE TOO HIGH	Li-ion battery cell high voltage fault	1. Li-ion battery over-charge 2. Li-ion battery failure
P1962	5923	4	Li-ion BATTERY CELL VOLTAGE TOO LOW	Li-ion battery cell undervoltage fault	1. Li-ion battery over-discharge 2. Li-ion battery capacity decreased 3. Li-ion battery failure
P1963	8083	0	Li-ion BATTERY CHARGE CURRENT TOO HIGH	Li-ion battery overcurrent fault when charging	1. Li-ion battery failure 2. Charger failure 3. Inverter failure
P1964	8082	0	Li-ion BATTERY DISCHARGE CURRENT TOO HIGH	Li-ion battery discharging too much	1. Li-ion battery failure 2. Li-ion battery overload 3. Wiring failure of the wire-harness

DTC	SPN	FMI	DTC description	Detail	Probable cause
P1965	8083	15	Li-ion BATTERY EXCEEDS CHARGE CURRENT DEMAND	Li-ion battery charge authorization current exceeded fault	1. Li-ion battery failure 2. Charger failure 3. Inverter failure
P1966	752	3	SHIFT ACTUATOR VOLTAGE FAILURE	Shift actuator voltage abnormal	1. Lead acid battery low voltage 2. Shift actuator failure 3. Wiring failure of the wire-harness 4. Poor connection of coupler
P1967	752	6	SHIFT ACTUATOR OVERCURRENT	Shift actuator over current fault	1. Shift actuator failure
P1968	752	0	SHIFT ACTUATOR TEMPERATURE FAILURE	Shift actuator temperature fault	1. Shift actuator temperature too high 2. Shift actuator failure
P1969	752	13	SHIFT ACTUATOR CALIBRATION FAILURE	Shift actuator calibration failure	1. Shift actuator failure due to the improper calibration
P1970	1044	7	ELECTRIC OIL PUMP START FAILURE	Electric oil pump starting fault	1. Electric oil pump failure 2. Cooling system failure
P1971	1044	3	ELECTRIC OIL PUMP VOLTAGE HIGH	Electric oil pump high voltage fault	1. Lead acid battery charging system failure 2. Electric oil pump failure
P1972	1044	4	ELECTRIC OIL PUMP VOLTAGE LOW	Electric oil pump under voltage fault	1. Lead acid battery low voltage 2. Electric oil pump failure 3. Wiring failure of the wire-harness 4. Poor connection of coupler
P1973	1044	0	ELECTRIC OIL PUMP TEMPERATURE HIGH	Electric oil pump high temperature fault	1. Electric oil pump temperature too high 2. Electric oil pump failure 3. Cooling system failure

TROUBLESHOOTING CHART

In case of trouble, first check if all items of the mounting and operating instructions have been completed. The subsequent tables will assist you in troubleshooting.

No.	Problem	Possible cause	Action
1	Marine gear cannot be shifted	Electric valve faulty	Replace.
		Electric valve disconnection	Check the wiring connectors.
		Remote control head faulty	Repair remote control head.
		No shifting pressure available	Refer to No. 4.
		Flexible coupling broken	Replace.
2	Clutch is slipping	Incorrect oil used	Use the recommended oil.
		Reduced shifting pressure	Refer to No. 4.
		Wear on clutch disks	Replace.
3	Output shaft turns in NEUTRAL position	Clutch seizure	Replace.
		Clutch piston return spring broken	Replace.
		Oil viscosity high	Use the recommended oil.
4	Reduced shifting pressure	Oil strainer clogged	Clean strainer.
		Oil level too low	Fill with oil.
		Oil pump abnormality	Replace.
		Shifting pressure relief valve faulty	Clean or replace.
		Seal rings on input shaft or support shaft are faulty	Replace seal rings and check the case plate.
		Piston rings in clutch are faulty	Replace clutch.
		Choke port at modulator valve obstructed	Clean pilot valve.
5	Excessive oil temperature	Too much oil	Lower oil level to specified level.
		Oil cooler is dirty	Clean oil cooler.
		Clutch is slipping	Refer to No. 2.
6	Noise	Oil level too low - pump sucks in air	Fill with oil.
		Damage to Parts in marine gear	Replace.
		Damage to propeller	Replace.
		Torsional vibration	Avoid dangerous speeds.
7	No change SOC	Li-ion battery 48 V line disconnected	Check the cable connectors. If it's disconnected consult with YANMAR dealer.
8	No charge with battery charger	No supply power from shore power	Check the cable. Check the capacity of shore power by confirming the specification of battery charger.
		Battery charger parameter setting is incorrect	Consult with YANMAR dealer.
9	No power to the onboard loads	LG mode might be selected	Check the operation mode.
		DC/AC inverter for onboard loads is OFF	Check the DC/AC inverter.
		3-position switch is not switched to hybrid system side	Check the position of the 3-position switch Refer to 27.

APPENDIX

SYSTEM SPECIFICATION

YF12e

No.	Parameters		Specifications	Notes
1	Engine	Available model	4JH80/4JH110	Available only single engine installation
2	Marine gear	Model name	KM-70HEA	i = 2.43 for ENG/HYB mode, i = 8.05 for EV mode
3		Rake angle	8 degree	
4		Lub. oil qty. (Effective)	3.5 litter	Oil type SAE#30
5	Reduction ratio	Engine drive (ENG mode)	2.43 / 2.43	
6		E-motor drive (EV mode)	8.05 / 8.05	
7		E-motor drive (HYB/GEN mode)	5.17 / 5.17	
8	Propeller rotation (viewed from Stern)		Clockwise direction for Forward	Required RH propeller
9	Dry weight; Engine and Marine gear		325 kg	Engine 229 kg, Marine gear & Oil cooler 96 kg
10	Overall dimension; Engine and Marine gear		L: 1252 × W: 613 × H: 696 mm	
11	Li-ion battery	Maximum capacity	23 kWh (Std.) or 46 kWh (Opt.)	4 batteries for 23 kWh, 8 batteries for 46 kWh
12		Nominal voltage	DC 51.8 V	Voltage range DC 43.4 - 58.6 V
13		Total weight	148 kg for 23 kWh, 296 kg for 46 kWh	
14		Unit size	W: 243 × L: 352 × H: 300.5 mm	Dimension for 1 battery
15	Output power for house load		4 kW (Std.) or 8 kW (Opt.)	4 kWh with 23 kWh batt., 8 kWh with 46 kWh batt.
16	Vessel Control System (VCS)		VC20 with 5" display for Hybrid	The latest VC20 software is required
17	EV mode performance	E-motor operation range	1000 - 6000 min^{-1}	Equivalent to engine speed / 300 - 1810 min^{-1}
18		Max. output power	≥ 12.1 kW @51.8 V	Equivalent to engine speed / 1700 min^{-1}
19	GENSET/HYBRID mode performance	Engine operation range	800 - 3000 min^{-1}	
20		Power generation amount (Rated)	≥ 4.5 kW @Engine 1200 min^{-1}	
21		Power generation amount (Max.)	≥ 10.5 kW @Engine 2500 min^{-1}	
22	SHORE mode performance	Charging power with shore power	≤ 3.0 kW	Recommended battery charger is required
23		Input voltage range	AC 100 - 260 V	

OUTLINE

4JH110 × KM-70HEA

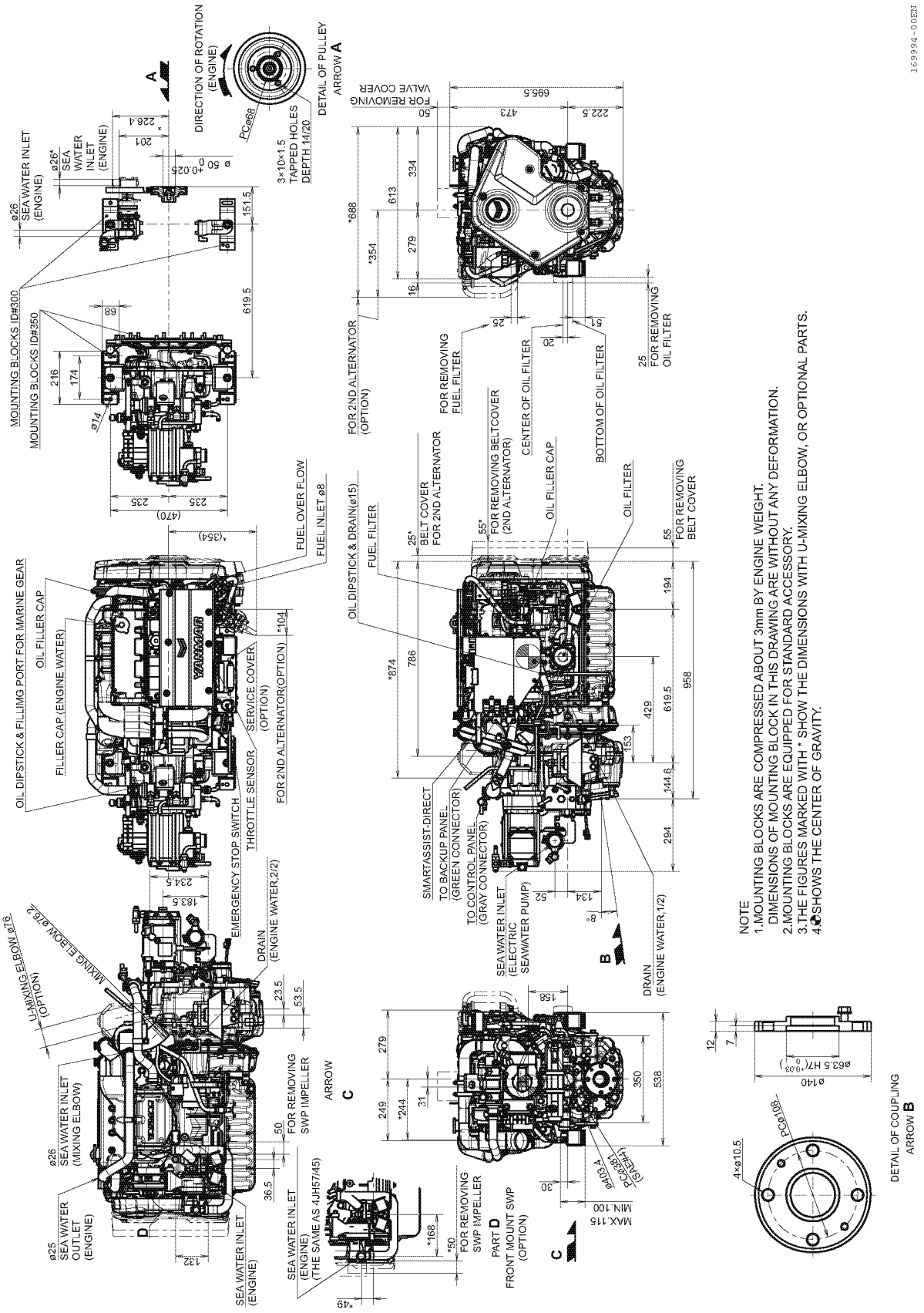


Figure 38

WIRING DIAGRAM

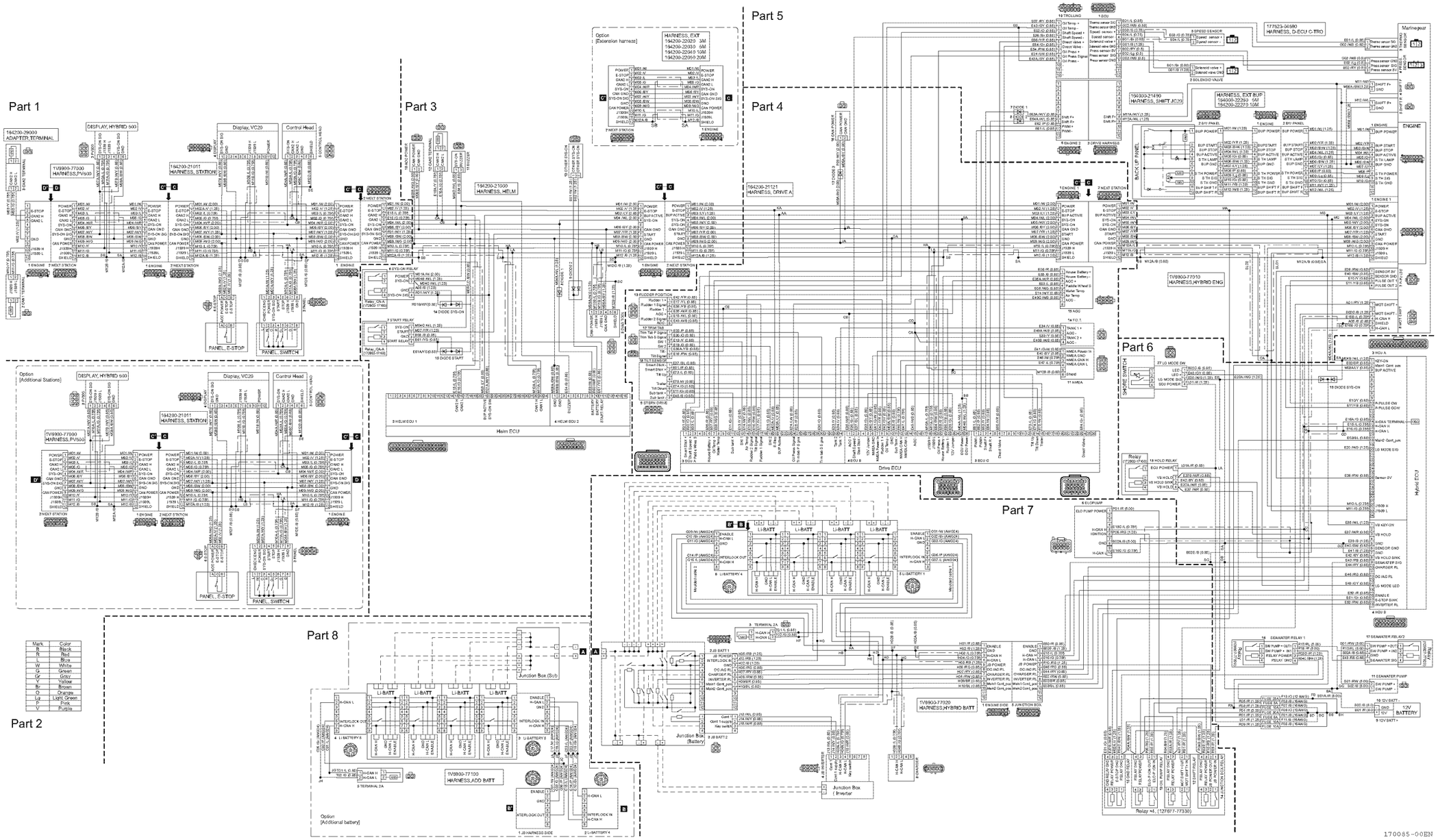


Figure 39

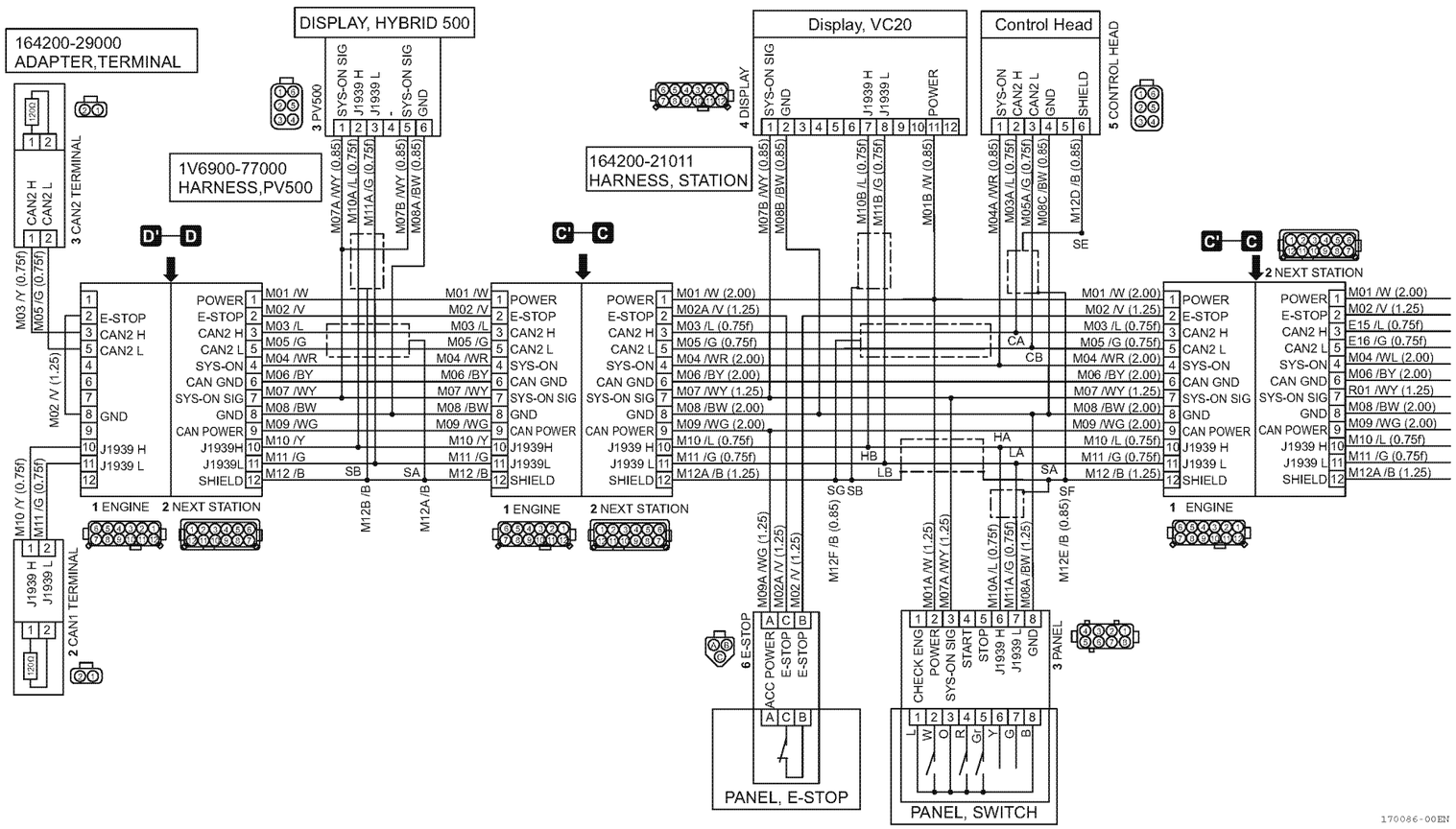


Figure 40 Wiring diagram Part 1

Mark	Color
B	Black
R	Red
L	Blue
W	White
G	Green
Gr	Gray
Y	Yellow
Br	Brown
O	Orange
Lg	Light Green
P	Pink
V	Purple

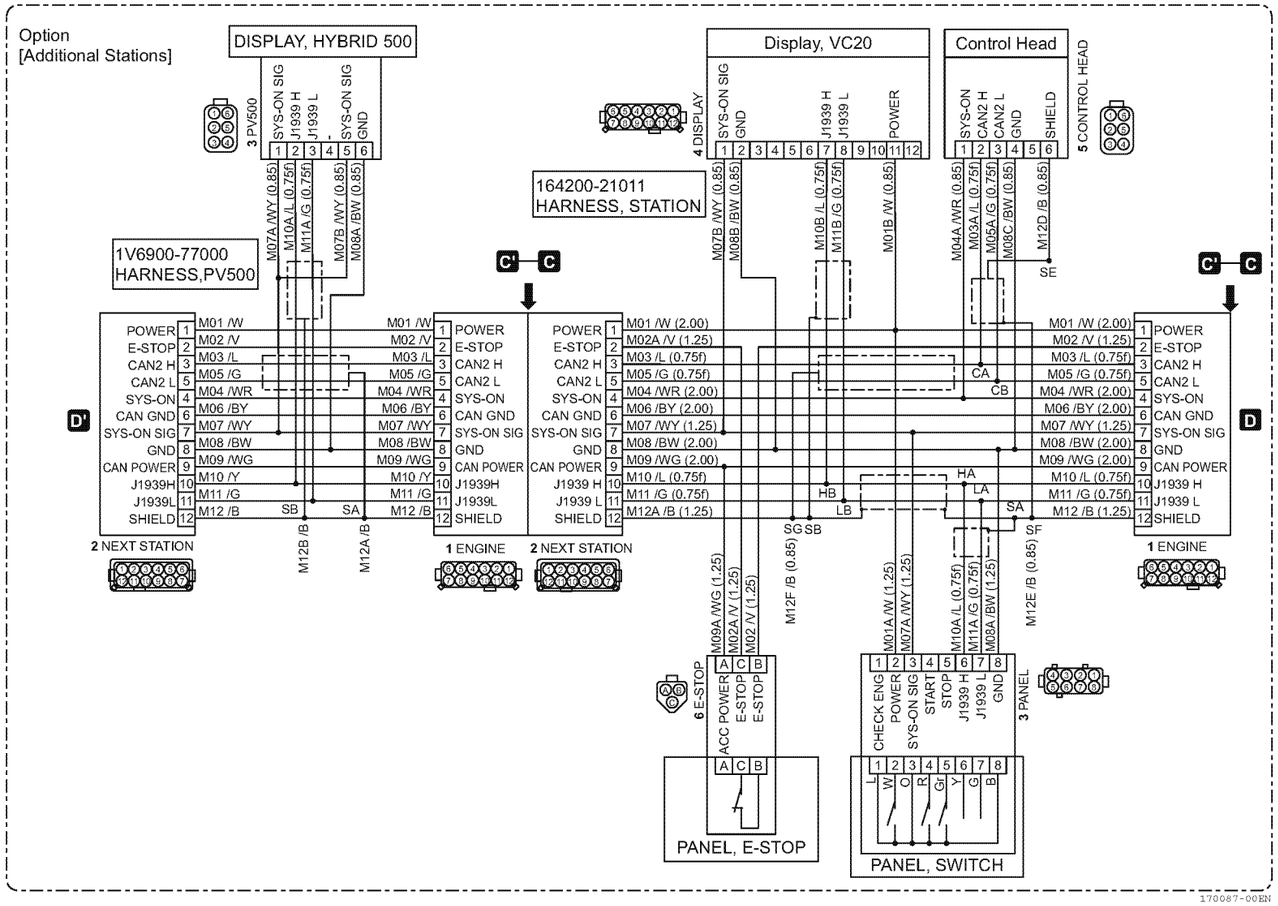


Figure 41 Wiring diagram Part 2

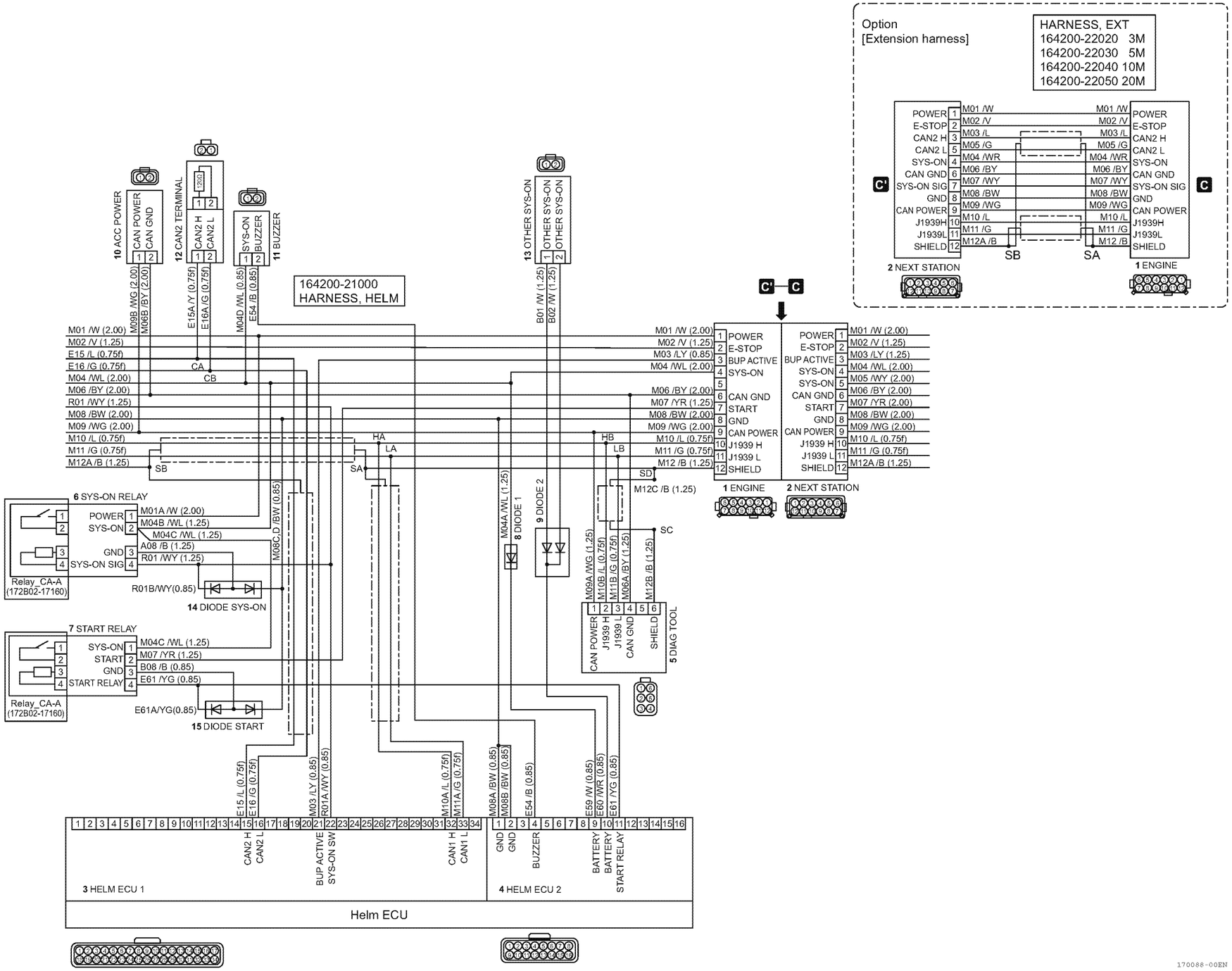


Figure 42 Wiring diagram Part 3

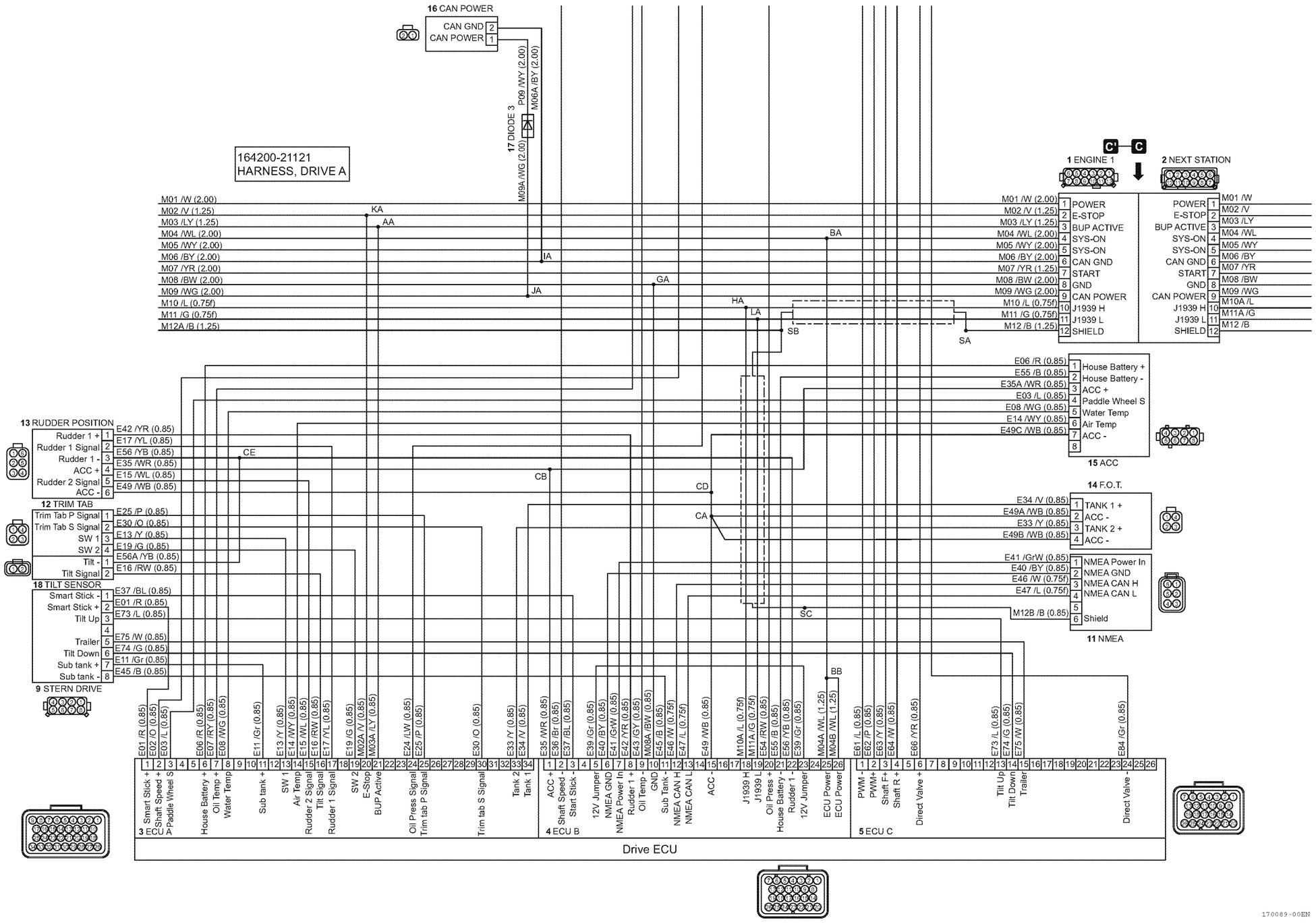


Figure 43 Wiring diagram Part 4

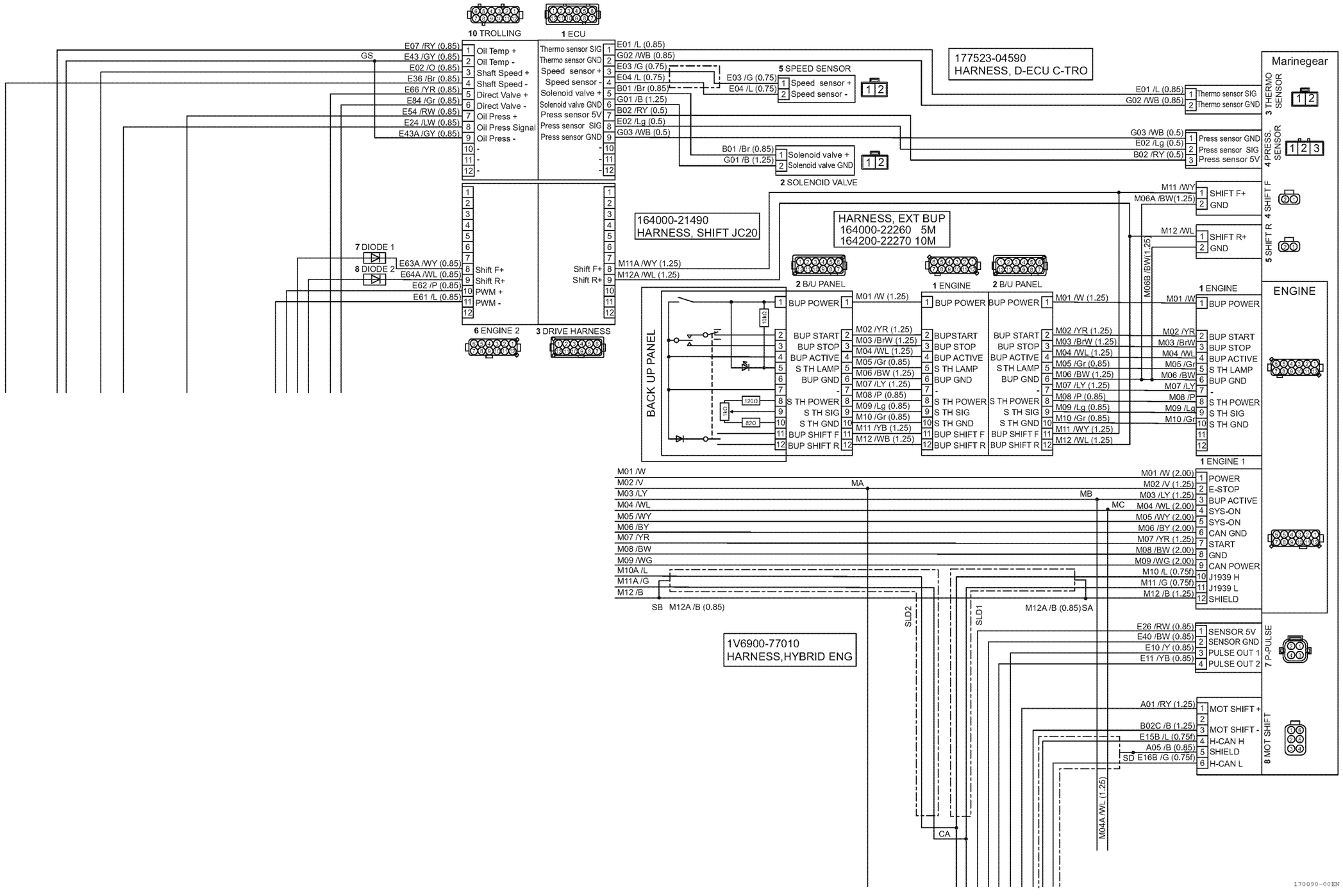


Figure 44 Wiring diagram Part 5

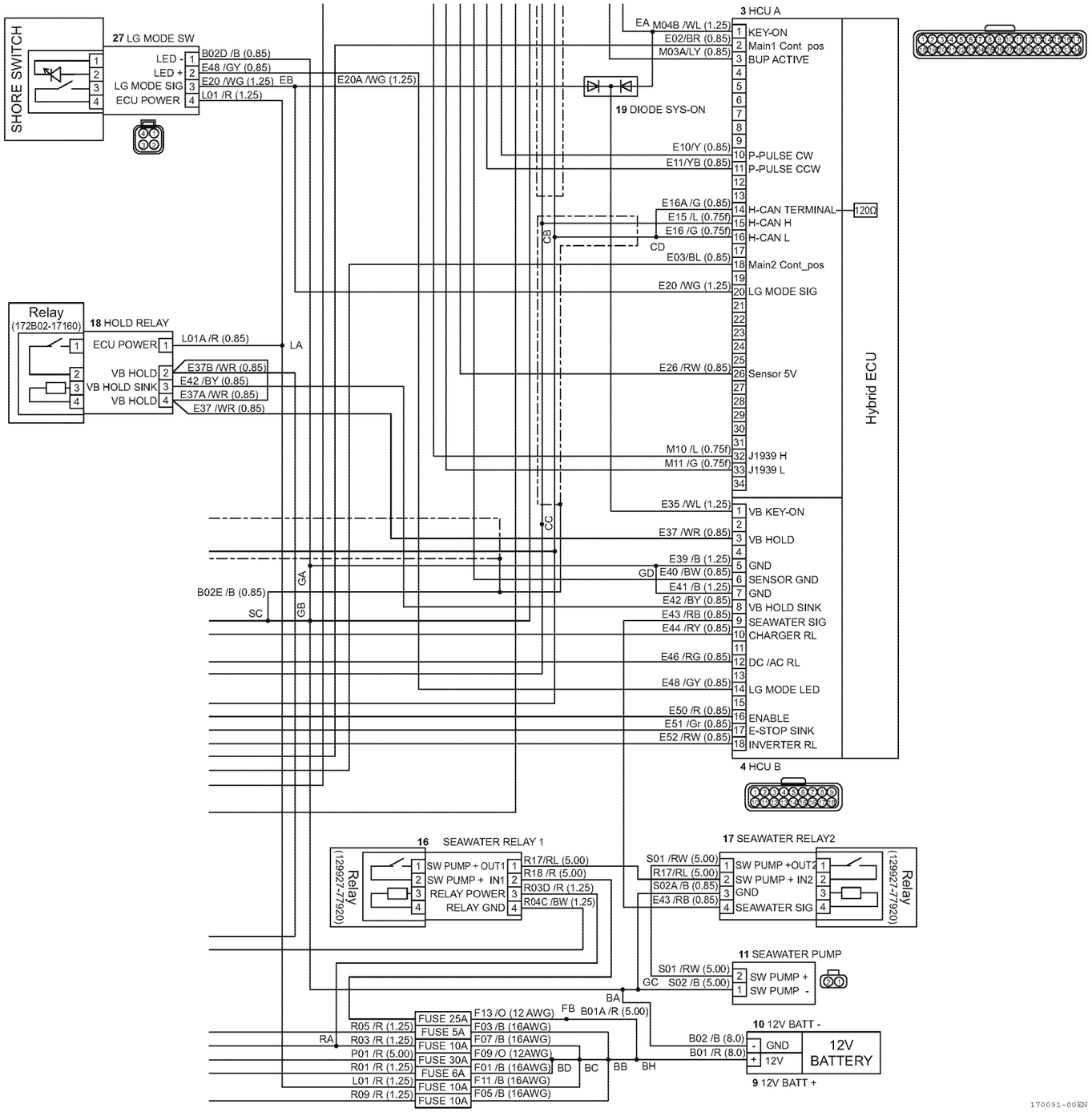


Figure 45 Wiring diagram Part 6

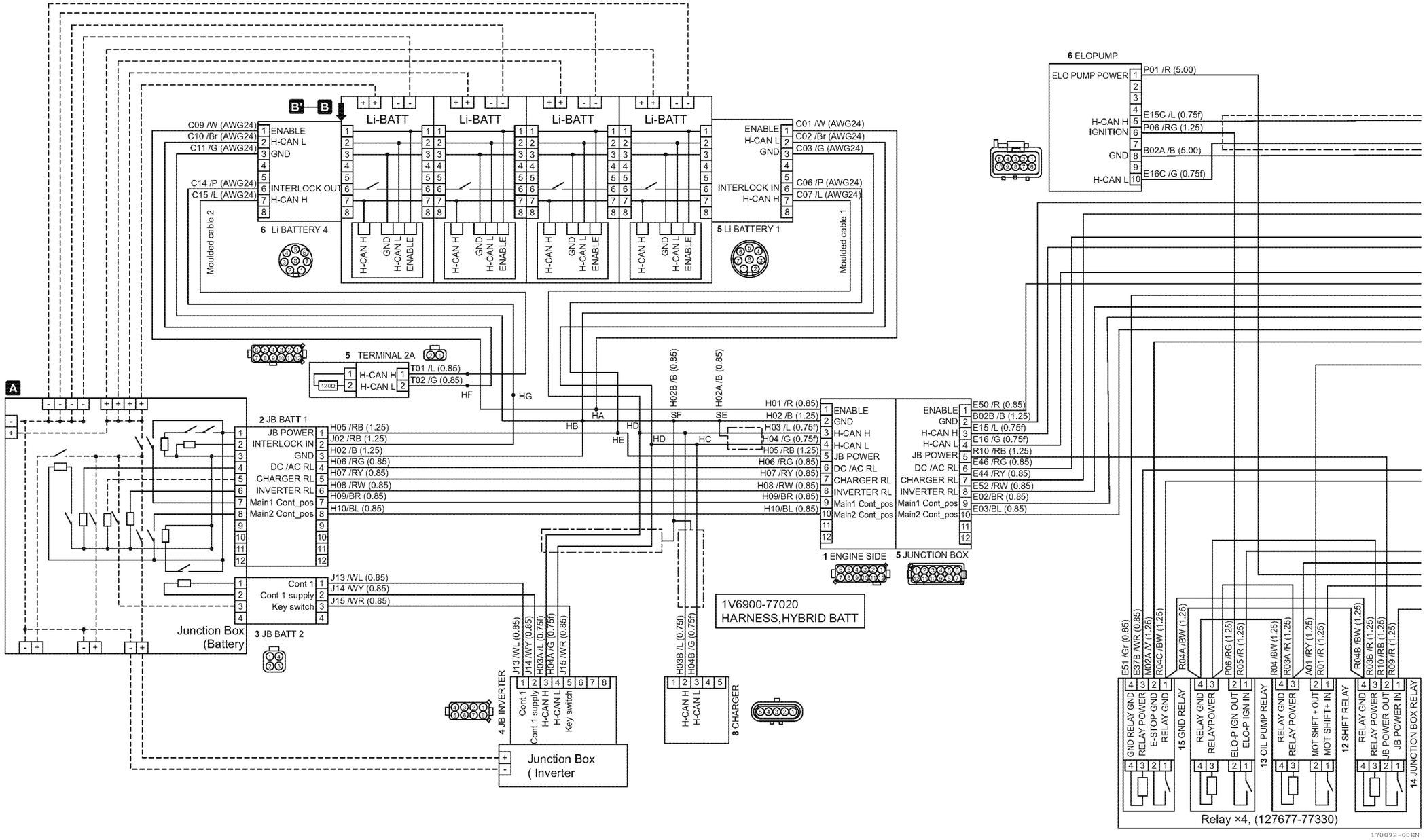


Figure 46 Wiring diagram Part 7

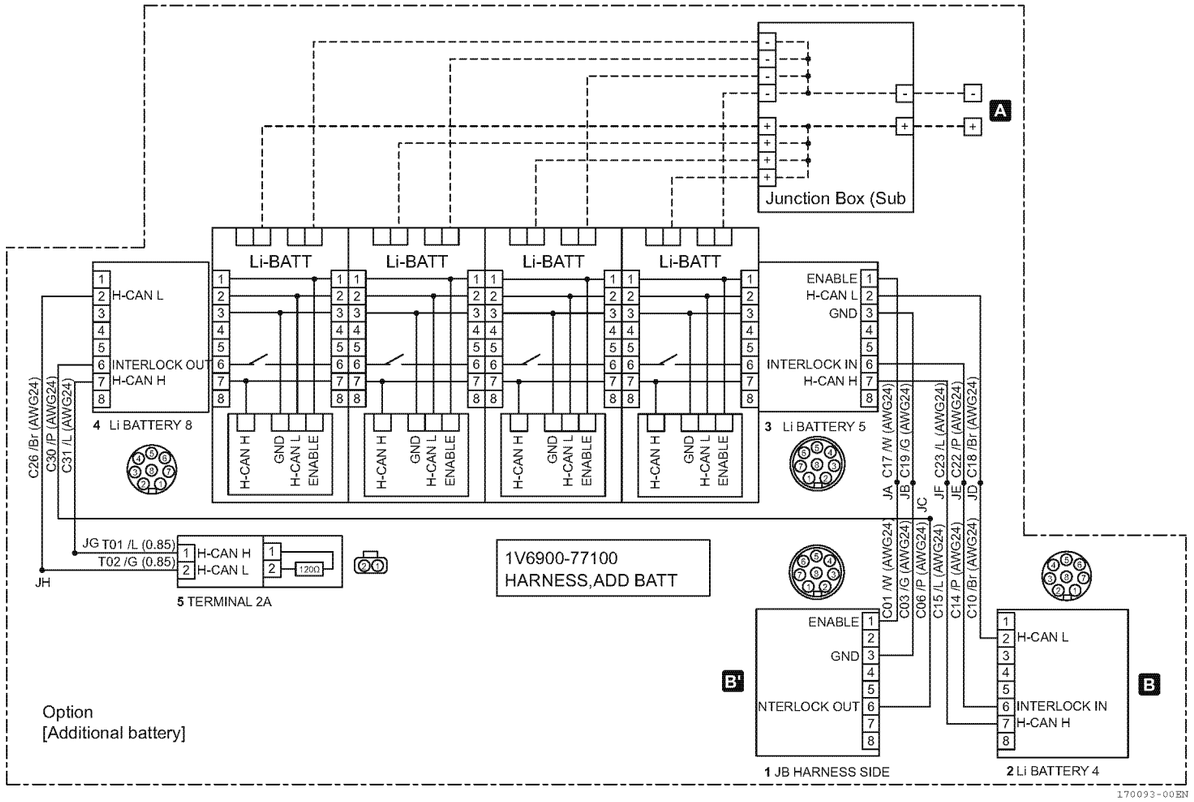


Figure 47 Wiring diagram Part 8

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PIPING DIAGRAM

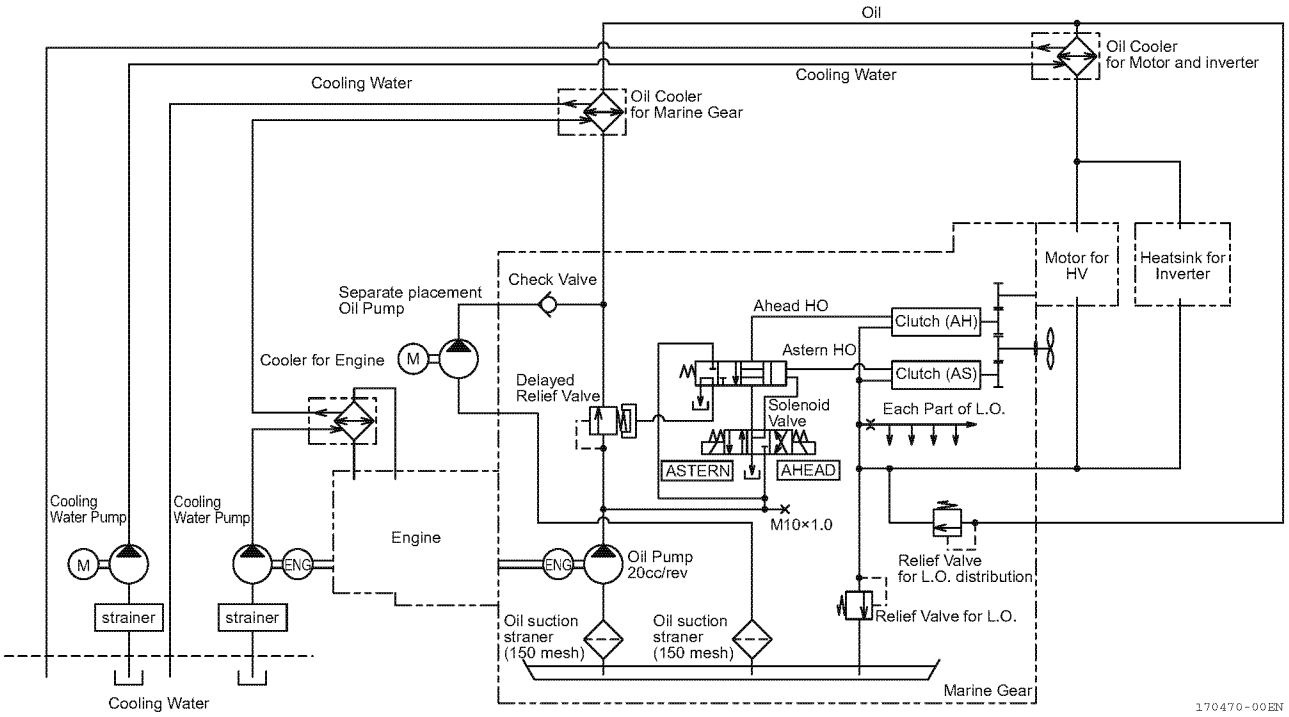


Figure 48

EC DECLARATION OF CONFORMITY

YANMAR MARINE INTERNATIONAL ASIA CO., LTD.

(Name of manufacturer)

2481 Umegahara, Maibara-shi, Shiga 521-8511, Japan

(Address)

declares, in sole responsibility, that the following equipment

Hybrid Propulsion System for Pleasure Crafts
Model: KM-70HEA *(made in Japan)*

(Type or model, designation, country of origin)

referred to in this declaration conforms with the following directive(s):

EMC Directive 2014/30/EU
With reference to EN 55012:2007+A1:2010
With reference to EN 60533:2015
With reference to EN 61000-6-1:2007
With reference to EN 61000-6-3:2007+A1:2011

(Title or number and issue date of normative documents)

Technical Documentation including:

- ***test report(s) prepared by TÜV Rheinland Japan***

Importer/Distributor in EU:

YANMAR MARINE INTERNATIONAL B.V.
Brugplein 11, 1332BS, Almere, The Netherlands

(Name and address, only if non-EU declarant)

Note: This declaration becomes invalid if technical or operational modifications are introduced without the manufacturer's consent.

H. Nomura
Manager
Quality Management Division
Yanmar marine international Asia Co., Ltd.

2023-12-21
Hyogo, Japan

(Place and date issued)

(Name and signature as well as position of declarant)

YANMAR MARINE INTERNATIONAL B.V.

■Yanmar Marine International B.V.
Brugplein 11, 1332 BS Almere-de Vaart, Netherlands
Phone: +31-36-5493534 Fax: +31-36-5493219
https://www.yanmar.com/marine

Overseas Office

■Yanmar Asia (Singapore) Corporation Pte. Ltd. (YASC)
4 Tuas Lane, Singapore 638613
Phone: +65-6861-3855 Fax: +65-6862-5189
https://www.yanmar.com/sg/

■YANMAR Marine International Americas Division
5400 118th Avenue N., Clearwater, FL 33760, USA
Phone: +1-727-803-6565 Fax: +1-727-527-7013
https://www.yanmar.com/marine

■Yanmar Engine (Shanghai) Co., Ltd.
Room 1101-1106, No.757 Mengzi Road,
Huangpu District, Shanghai 200023 PRC
Phone: +86-21-2312-0638 Fax: +86-21-6880-8090
https://www.yanmar.com/cn/

■Yanmar Marine International Asia Co.,Ltd.
5-3-1, Tsukaguchi Honmachi, Amagasaki, Hyogo 661-0001, Japan
Phone: +81-6-6428-3131 Fax: +81-6-6421-2201
https://www.yanmar.com/marine

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