

NHK MEC

KE-4XG

ELECTRONIC CONTROL SYSTEM

INSTRUCTION MANUAL

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INTRODUCTION

This manual has been prepared to ensure your correct installation and operation of the KE-4XG control system. Be sure to read this manual thoroughly to understand how the system works. Always keep the manual within your reach during operation. This product controls the shift (gear) and throttle (governor). It is recommended therefore to also read the owner's manuals of marine engine and gear. The specifications may be subject to change without notice in view of improvement, resulting in some difference between the content of the manual and the product. In case of ambiguity or questions concerning the product or the manual, consult with your dealer. In case of KE control system transfer of ownership, please make sure to include this instruction manual.

SAFETY PRECAUTIONS

 **WARNING (CALIFORNIA PROPOSITION 65)**

This product can expose you to Lead (Pb), which is known to the State of California to cause cancer, birth defects or other reproductive harm. For details: www.P65Warnings.ca.gov.

This manual contains cautions via the following headers, pay particular attention to these symbols.

 **WARNING**

Failure to comply with a Warning may result in an accident of death or serious injury.

 **CAUTION**

Failure to comply with a Caution may result in a minor or moderate injury or damage to product or properties.

INSTALLATION / REPAIR

The installation of this product must be performed following all applicable installation and safety codes.

Only authorized personnel should perform disassembly and repair of this product; otherwise the warranty will be void.

PRODUCT SPECIFICATIONS

1. Electrical Performance

- Supply voltage range: DC9V ~ DC32V
- Current consumption at stop of actuator: 0.5A or less
- Current flow of actuator: 16A peak, 5A average under nominal conditions (49N{5kgf} · 11lbf load, mid-range temperature)

2. Mechanical Performance (via actuator)

- Max. operating thrust: 147N {15kgf} · 33lbf load
- Constraint load : 343N {35kgf} · 77lbf load
- Forward or Reverse shift stroke settings: 24mm to 38mm
- Throttle stroke: 78.5mm MAX

3. Temperature Range

- (1) Operating temperature: $-20^{\circ}\text{C} \sim +77^{\circ}\text{C}$
- (2) Storage temperature : $-40^{\circ}\text{C} \sim +85^{\circ}\text{C}$

PRODUCT COMPLIANCE

ISO 9001
QUALITY



ABYC

**TYPE
APPROVAL
CERTIFIED**

1. USA

- *ABYC*: This control system meets applicable requirements of various ABYC standards.
- *CFR*: Meets Title 46 CFR Part 284 & Title 33 CFR Part 183 marine regulations for US Coast Guard requirements.

2. INTERNATIONAL

- *ISO*: This control system meets applicable requirements of various ISO test standards for performance in addition to ISO 9001 & 14001 Quality Management System standards.
- *CE*: This control system meets applicable requirements of the Recreational Craft Directive & EMC Directive
- *TYPE APPROVAL*: Tested in accordance with relevant requirements of IACS E-10 specifications for type approval certification of recognized associations such as BV, CCS, etc.

PRODUCT FUNCTIONS

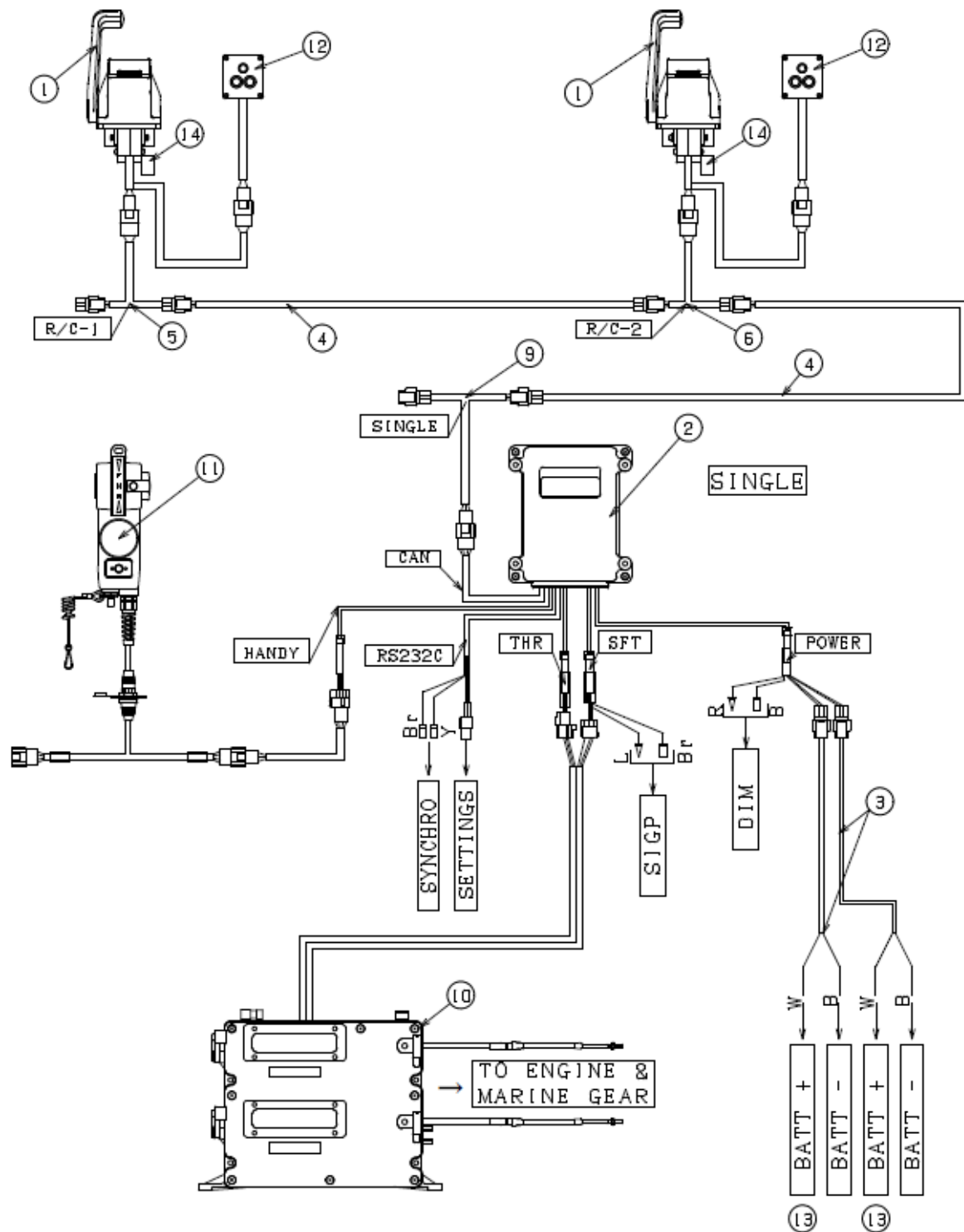
Main

- Shift: Forward/Reverse operation control;
- Throttle: Acceleration/deceleration control
- Neutral throttle: Only throttle is activated in order to warm up the engine.
- Control Station Select: Transfer between up to 4 control heads + 1 optional handheld station
- SIGP (Start in Gear Protection): Engine starts only when in neutral position, for safety.
- Synch: Allows multi-engine speed synchronization; single lever & dual lever modes available.
- Settings: Allows settings for various configurations.
- Alarm Codes: Detected system faults are indicated via flashing LED's on the control head. Fault log can also be viewed & downloaded via the PC Service Tool.

Options

- Handheld Station: Provides an optional mobile version of control head (up to twin only)
- Dim Display: Decreases brightness of control head LED's at night time.
- Buzzer: Adds an audio alarm to visual LED codes & alphanumeric display
- Trim Circuit (for outboards): Master trim control switch available in the handle of the control head lever; in addition, circuit harness to connect to panel trim control switches for individual engine trim control in case of multiple engines
- Idle Control: Provides idle settings of engine via optional switch
- Multi-Engine Control: Up to 4 engines can be controlled via optional switches
- Mechanical Backup: In case of electrical failure, enables mechanical operation of the actuator via the emergency handle

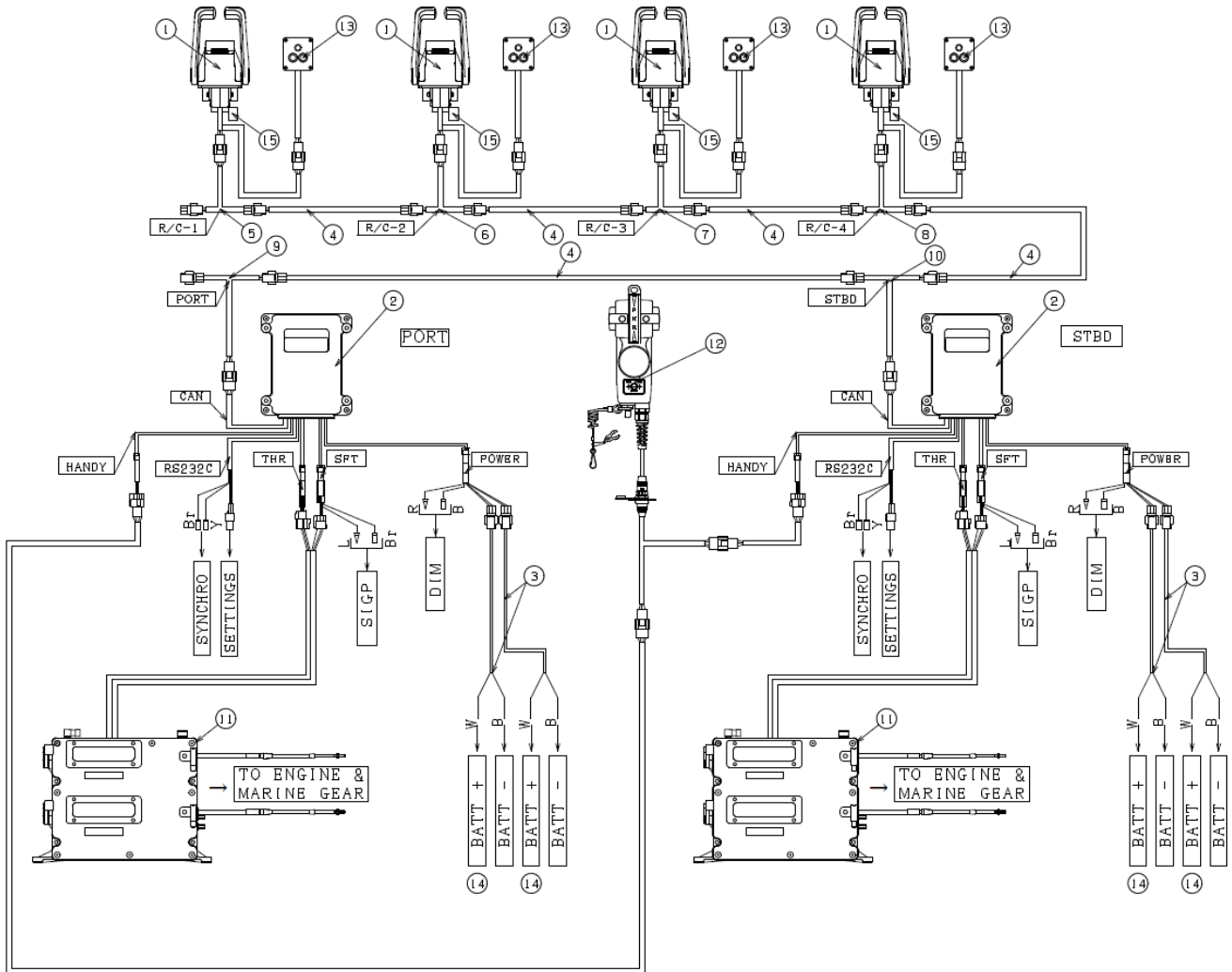
SINGLE ENGINE CONFIGURATON



COMPONENTS LIST: SINGLE ENGINE

KE-4XG Component Parts List (Single)			Required Quantity			
			No. of stations			
Description	Part number	1	2	3	4	
① Control Head, single lever (o/b style)	NM2011-00, NM2012-00	1	2	3	4	
<i>SST = stainless steel, (i/b style)</i>	NM2013-00					
② Control unit 12V/24V	NM3462-00	1				
③ Harness Power Supply	5m	2				
	10m					NM0414-33
④ CANbus Harness: 2m, 4m, 6m, 8m, 10m, 12m, 14m, 16m, 18m, 20m, 24m, 30m, 40m, 50m (1m = 39 inches)	NM0649-XX (XX = length in meters)	1	2	3	4	
⑤ T-harness (R/C-1)	NM0647-09	1				
⑥ (R/C-2) for optional 2 nd station	NM0647-17	1				
⑦ (R/C-3) for optional 3 rd station	NM0647-18	1				
⑧ (R/C-4) for optional 4 th station	NM0647-19	1				
⑨ T-harness (SINGLE)	NM0647-11	1				
⑩ Actuator, shift & throttle	NM0183-00	1				
⑪ Handheld control (optional)	Refer to handheld control manual					
⑫ Idle Switch (optional)	NJ0765-00	1	2	3	4	
⑬ Circuit Breaker (optional)	20A	2				
⑭ Buzzer (optional)	12V	1				
	24V					NJ0515-00
Settings Tool harness	NM1476-01	Refer to SYSTEM SETTINGS				

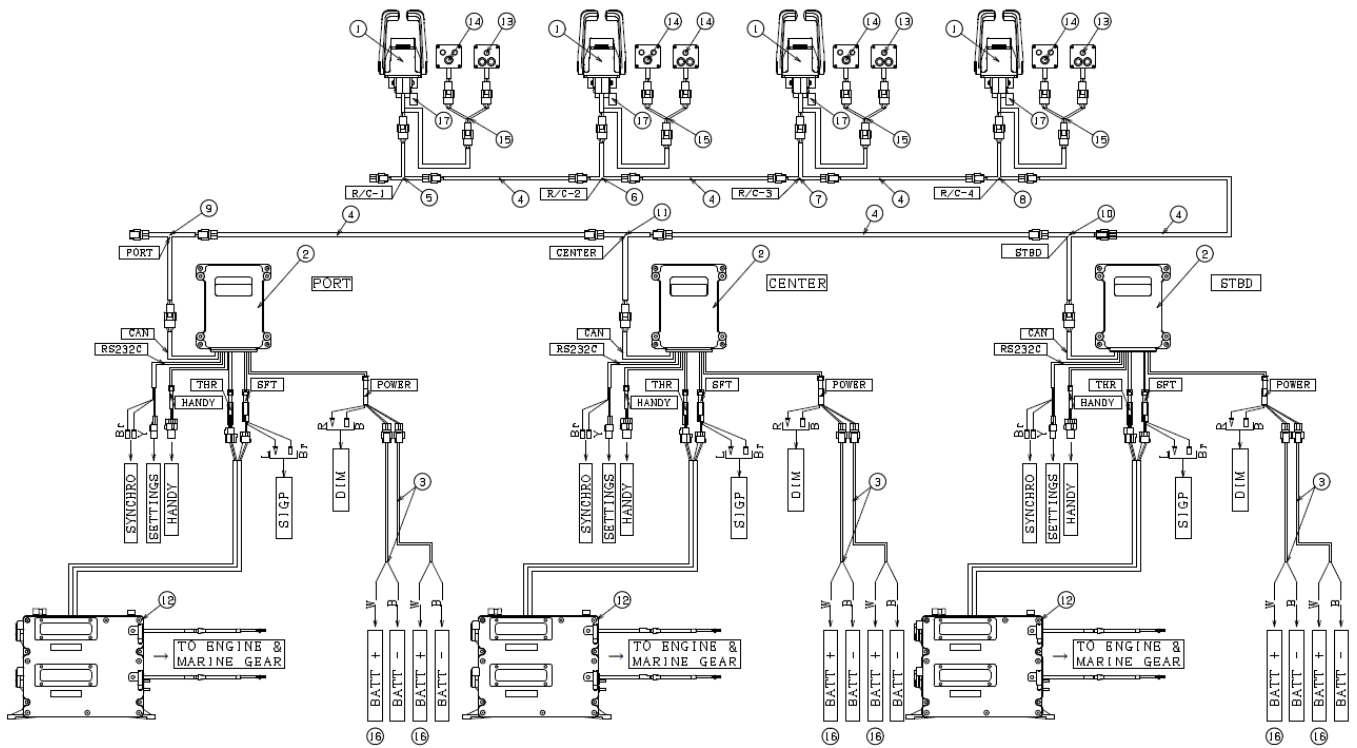
DUAL ENGINE CONFIGURATON



COMPONENTS LIST: DUAL ENGINE

KE-4XG Component Parts List (Dual)			Required Quantity			
			No. of stations			
Description	Part number	1	2	3	4	
① Control Head, dual lever (o/b style)	NM2061-00, NM2062-00	1	2	3	4	
<i>SST = stainless steel, (i/b style)</i>	NM2063-00					
② Control unit 12V/24V	NM3462-00	2				
③ Harness Power Supply	5m	4				
	10m					NM0414-33
④ CANbus Harness: 2m, 4m, 6m, 8m, 10m, 12m, 14m, 16m, 18m, 20m, 24m, 30m, 40m, 50m (1m = 39 inches)	NM0649-XX (XX = length in meters)	2	3	4	5	
⑤ T-harness (R/C-1)	NM0647-09	1				
⑥ (R/C-2) for optional 2 nd station	NM0647-17	1				
⑦ (R/C-3) for optional 3 rd station	NM0647-18	1				
⑧ (R/C-4) for optional 4 th station	NM0647-19	1				
⑨ T-harness (PORT)	NM0647-12	1				
⑩ T-harness (STBD)	NM0647-13	1				
⑪ Actuator, shift & throttle	NM0183-00	2				
⑫ Handheld control (optional)	Refer to handheld control manual					
⑬ Idle Switch (optional)	NJ0765-00	1	2	3	4	
⑭ Circuit Breaker (optional)	20A	4				
⑮ Buzzer (optional)	12V	1	2	3	4	
	24V					NJ0515-00
Settings Tool harness	NM1476-01	Refer to SYSTEM SETTINGS				

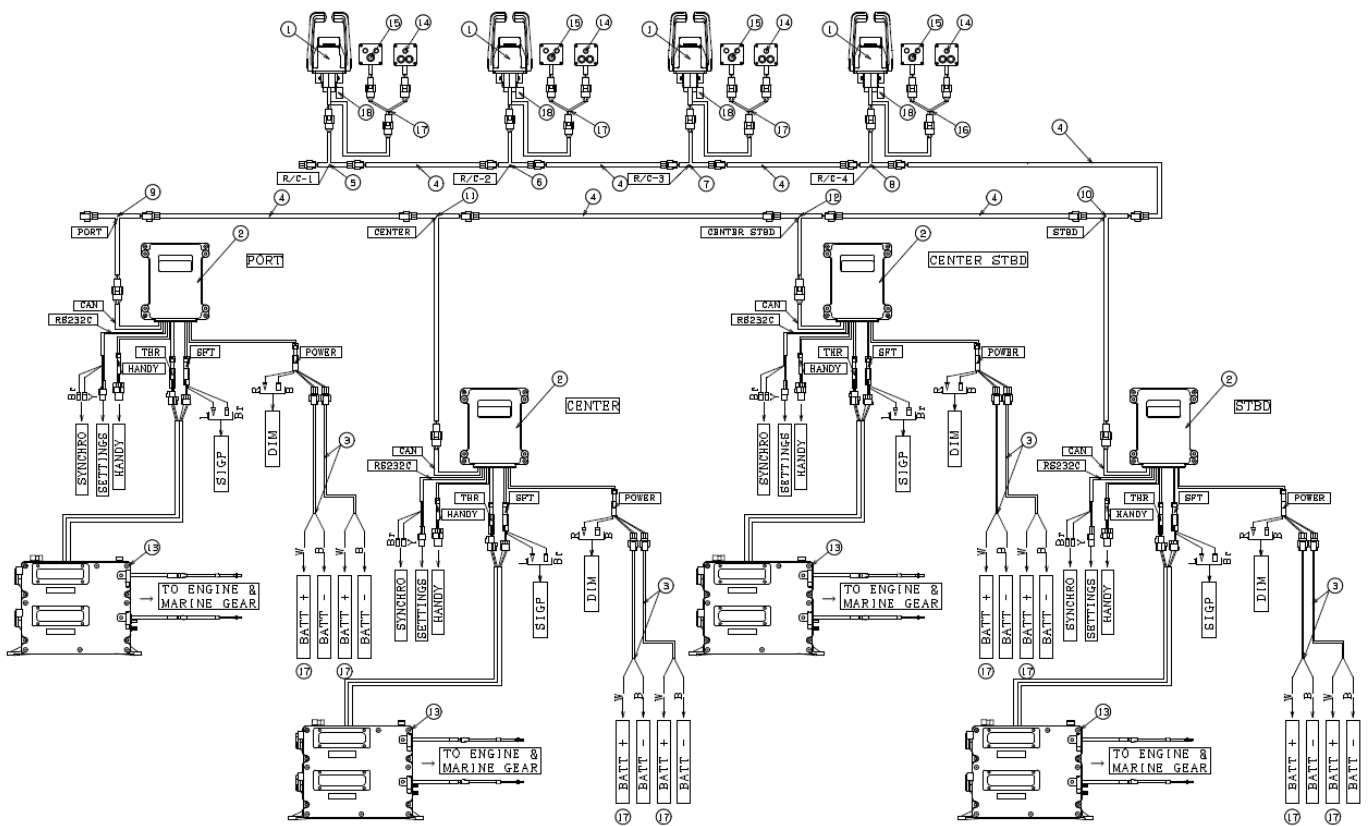
TRIPLE ENGINE CONFIGURATON



COMPONENTS LIST: TRIPLE ENGINE

KE-4XG Component Parts List (Triple)			Required Quantity			
			No. of stations			
Description	Part number	1	2	3	4	
① Control Head, dual lever (o/b style)	NM2061-00, NM2062-00	1	2	3	4	
<i>SST = stainless steel, (i/b style)</i>	NM2063-00					
② Control unit 12V/24V	NM3462-00	3				
③ Harness Power Supply	5m NM0414-28	6				
	10m NM0414-33					
④ CANbus Harness: 2m, 4m, 6m, 8m, 10m, 12m, 14m, 16m, 18m, 20m, 24m, 30m, 40m, 50m (1m = 39 inches)	NM0649-XX (XX = length in meters)	3	4	5	6	
⑤ T-harness (R/C-1)	NM0647-09	1				
⑥ (R/C-2) for optional 2 nd station	NM0647-17	1				
⑦ (R/C-3) for optional 3 rd station	NM0647-18	1				
⑧ (R/C-4) for optional 4 th station	NM0647-19	1				
⑨ T-harness (PORT)	NM0647-12	1				
⑩ T-harness (STBD)	NM0647-13	1				
⑪ T-harness (CENTER)	NM0647-14	1				
⑫ Actuator, shift & throttle	NM0183-00	3				
⑬ Idle Switch (optional)	NJ0765-00	1	2	3	4	
⑭ Triple Switch (optional)	NJ0767-00	1	2	3	4	
⑮ Sw. Ext. Harness (optional)	NM0647-08	1	2	3	4	
⑯ Circuit Breaker (optional)	20A NJ0514-00	6				
	12V NJ0251-00	1	2	3	4	
24V NJ0515-00						
Settings Tool harness	NM1476-01	Refer to SYSTEM SETTINGS				

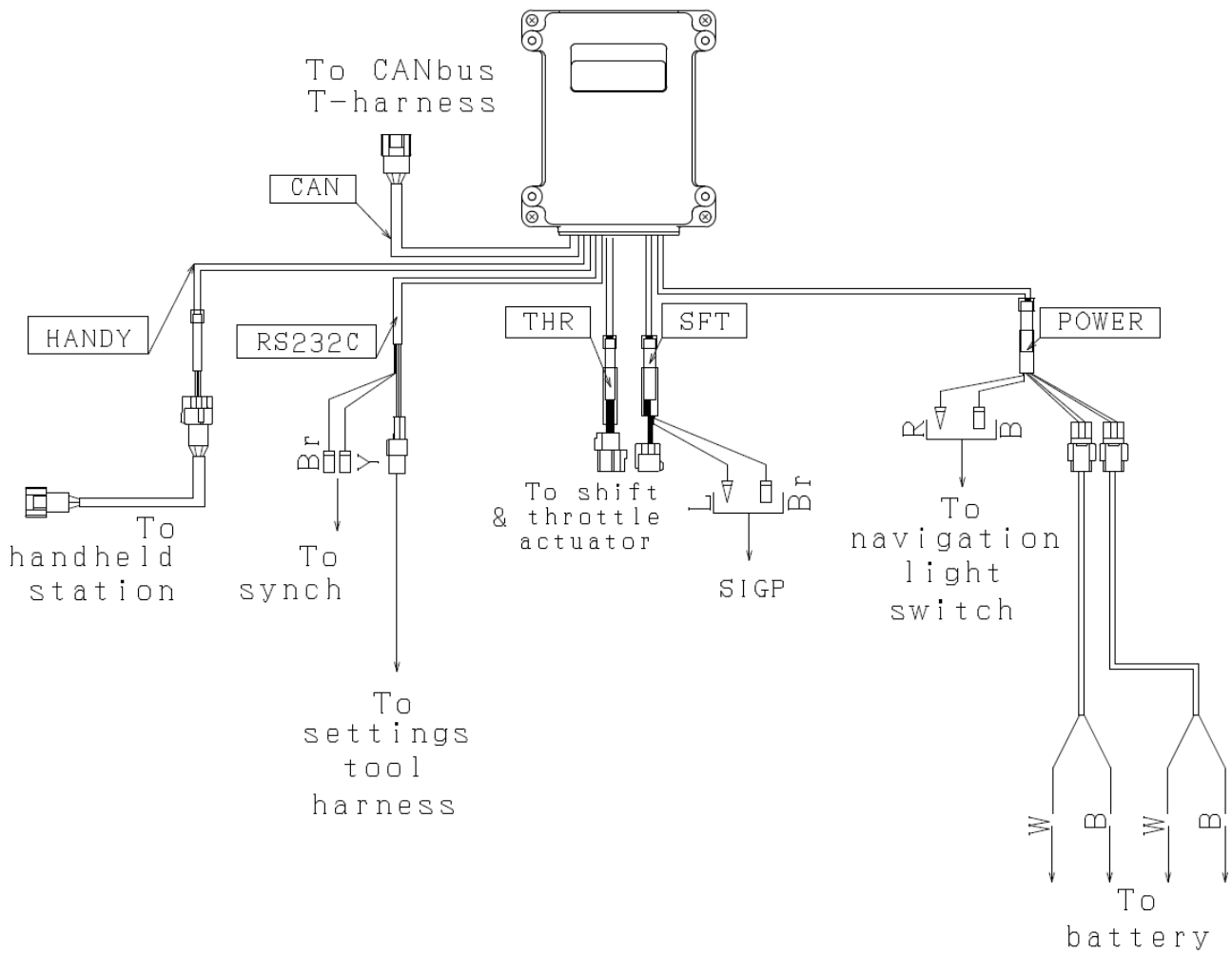
QUAD ENGINE CONFIGURATON



COMPONENTS LIST: QUAD ENGINE

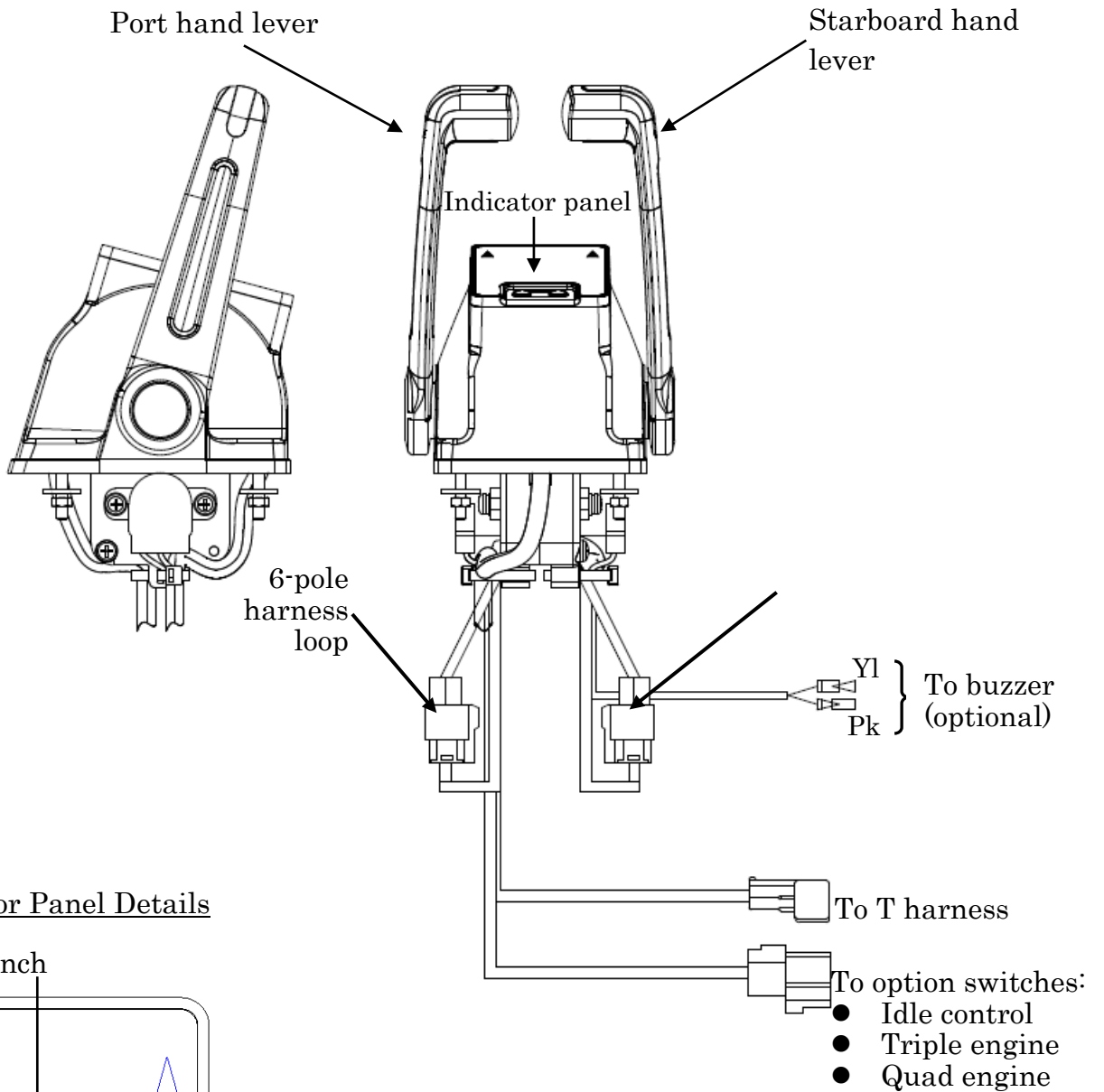
KE-4XG Component Parts List (Quad)			Required Quantity			
			No. of stations			
Description	Part number	1	2	3	4	
① Control Head, dual lever (o/b style)	NM2061-00, NM2062-00	1	2	3	4	
<i>SST = stainless steel, (i/b style)</i>	NM2063-00					
② Control unit 12V/24V	NM3462-00	4				
③ Harness Power Supply	5m	8				
	10m					NM0414-33
④ CANbus Harness: 2m, 4m, 6m, 8m, 10m, 12m, 14m, 16m, 18m, 20m, 24m, 30m, 40m, 50m (1m = 39 inches)	NM0649-XX (XX = length in meters)	4	5	6	7	
⑤ T-harness (R/C-1)	NM0647-09	1				
⑥ (R/C-2) for optional 2 nd station	NM0647-17	1				
⑦ (R/C-3) for optional 3 rd station	NM0647-18	1				
⑧ (R/C-4) for optional 4 th station	NM0647-19	1				
⑨ T-harness (PORT)	NM0647-12	1				
⑩ T-harness (STBD)	NM0647-13	1				
⑪ T-harness (CENTER)	NM0647-14	1				
⑫ T-harness (CENTER-STBD)	NM0647-15	1				
⑬ Actuator, shift & throttle	NM0183-00	4				
⑭ Idle Switch (optional)	NJ0765-00	1	2	3	4	
⑮ Quad Switch (optional)	NJ0768-00	1	2	3	4	
⑯ Sw. Ext. Harness (optional)	NM0647-08	1	2	3	4	
⑰ Circuit Breaker (optional)	20A	8				
⑱ Buzzer (optional)	12V	1 2 3 4				
	24V					NJ0515-00
Settings Tool harness	NM1476-01	Refer to SYSTEM SETTINGS				

CONTROL UNIT

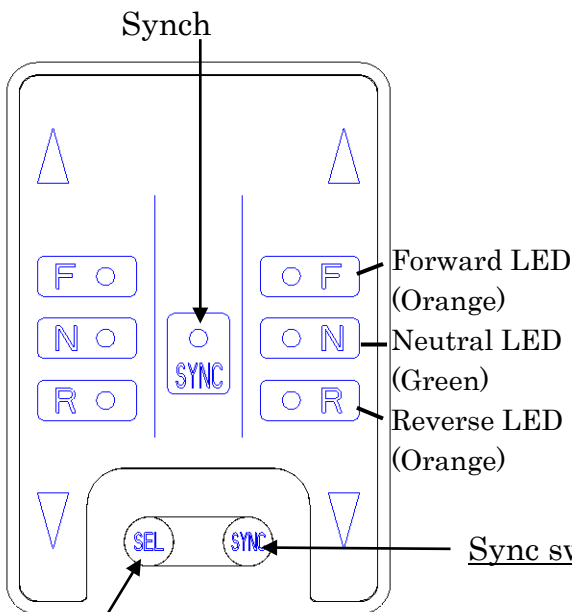


Note: Control unit input (battery) voltage can be either 12V or 24V based.

CONTROL HEAD



Indicator Panel Details



Neutral (N) LED flashes during neutral throttle operation. LED's flash when an alarm is activated.


Sync switch: Use to activate engine synchronization.

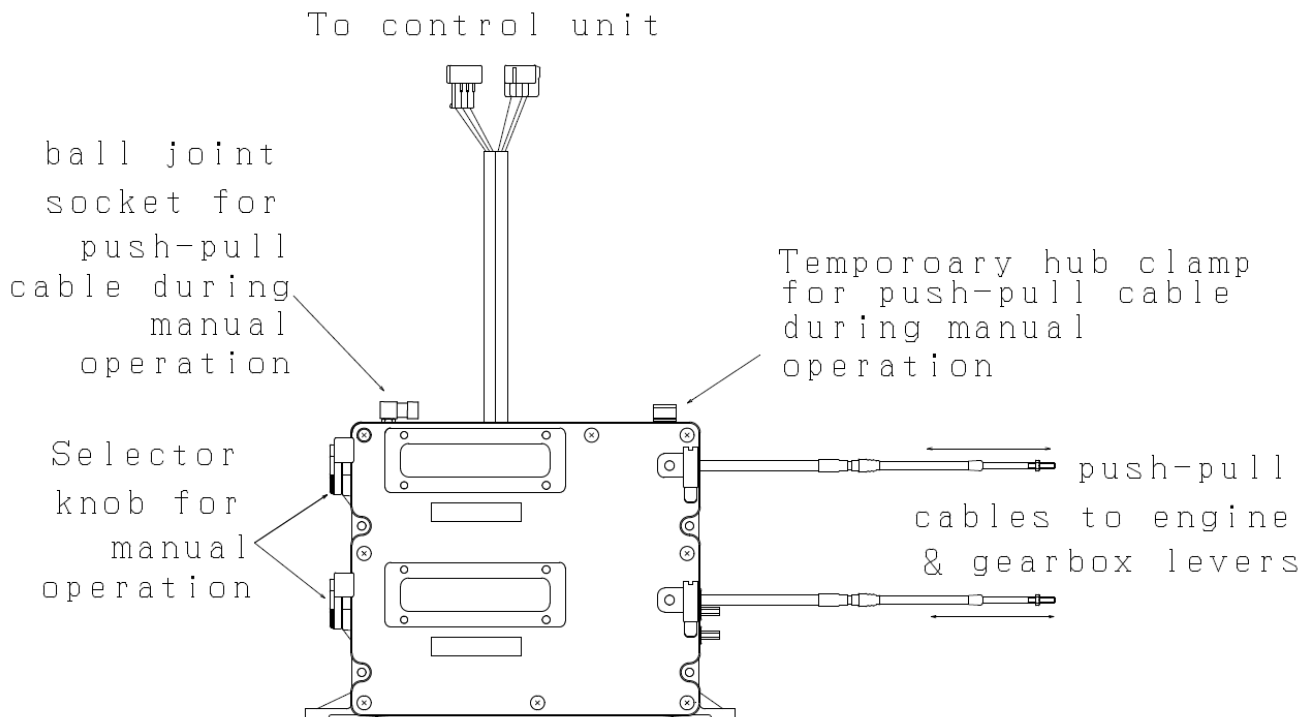
Select switch: Press to select station, set/cancel neutral throttle operation or stop buzzer.

Note: When the power supply is turned ON, the control head connected to R/C-1 T-harness is the first one to become operative. Be sure to connect a control head to R/C-1 T-harness.

ACTUATOR

The actuator responds to control head lever commands for shift operation or throttle operation. In case of electrical failure, manual operation is possible.

 CAUTION
Attempt manual operation only in case of emergency (i.e. electrical system failure). Use for immediate return to shore.



KE CONTROL SYSTEM OPERATION

Initial Operation after Power ON

1. With power ON, and the hand lever(s) in the "Neutral" position, the system will be in the neutral idle condition.
2. (A) Set the handle lever(s) to the Neutral position.
(B) The green neutral LED(s) lights ON indicating the control is operational.

Note: If the hand lever(s) are moved to a forward or reverse gear position while power is not applied to the control system, and then power is applied, control system will not become operational until the hand lever(s) are moved into the neutral position. The green neutral LED(s) then lights ON indicating the control is operational.

3. When other control stations are connected to R/C T-harness perform the following actions.
 - A) Set the hand lever to the Neutral position.
 - B) Press & release SElect switch.
 - C) The green neutral LED(s) then lights ON indicating the control is operational.

Control Lever Operation

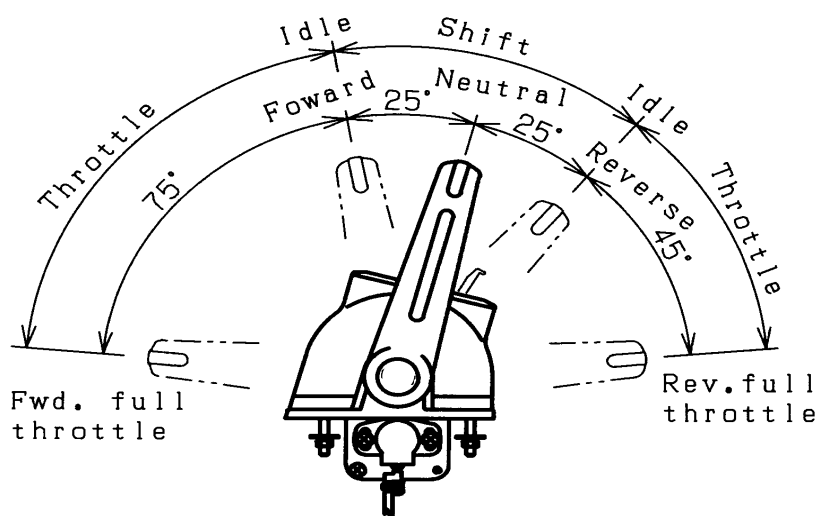


WARNING

DO NOT ATTEMPT sudden forward to reverse the hand lever(s) operation. Sudden acceleration/ deceleration may cause damage to the boat or cause operator or passengers to be ejected from the boat.

(1) Moving the hand lever from the neutral position to the forward or reverse detent causes the gear to shift to forward or reverse. The orange forward or reverse LED(s) light ON to indicate forward or reverse gear position obtained.

(2) Moving the hand lever past the Forward or Reverse detent activates the engine throttle operation and the boat will accelerate.



Neutral Throttle Operation

1. Set the hand lever to the neutral (N) position.
2. Move the hand lever to the forward gear position *while* pressing the station select switch.
3. The green neutral LED flashes and the neutral throttle operation is activated.
4. To deactivate, set the hand lever to the neutral position, press and release the select switch. After the release of the select switch green, neutral LED will stop flashing. This indicates deactivation of the neutral throttle operation.

Station Transfer for 2, 3 and 4 Station Operation from Neutral Position

Set the hand lever(s) of the selected control to the neutral position, press and release the select switch. A continuous green neutral LED(s) indicates that the control station is active.

Station Transfer for 2, 3 and 4 Station Operation from Forward Throttle Position

1. Set the hand lever(s) of the selected control to the neutral position, press and release the select switch. A continuous green neutral LED(s) indicates that the control station is ready for activation.
2. The operator has approximately 4 seconds to move hand levers and match the throttle position of the last active control station. A continuous orange forward LED(s) indicates control station is active and the system is in gear condition.

Note: Keeping the hand lever of the selected control station in the neutral position during those 4 seconds will result in control system automatically returning the control system to a neutral idle condition.

Synchronization Function

1. Set both hand levers to neutral (N) position.
2. Press SYNC button to activate. A continuous green SYNC LED indicates sync mode. Depending on control unit settings, synchronization will be possible in single or dual lever 2 modes.
3. SINGLE LEVER MODE: Synchronization is automatic with the PORT side lever in forward mode
4. To deactivate SYNC: Set levers to neutral position and press SYNC button to turn OFF green SYNC LED.

DETERMINATION OF CABLE LENGTH

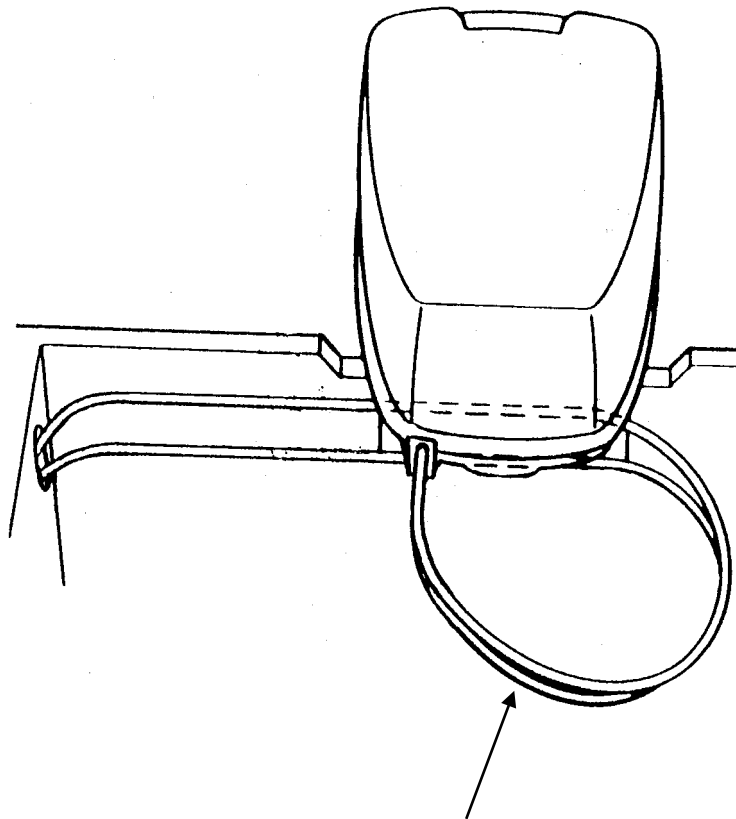
Instructions:

Measure the distance from the shift and throttle actuator to the engine's shift and throttle connection location in as straight a line as possible while avoiding any obstruction, which may cause bending below the specified radius. This distance becomes a guideline to determine the actual cable length. For outboard motors, determine the cable length as determined above, then add 1.0 ~ 1.5m (3.3 ft ~ 5 ft) to create a loop shown below.



CAUTION

DO not bend the push-pull cable to less than the specified radius; otherwise the cable or actuator could be damaged.



Be aware of push-pull cable bending radius specification.

INSTALLING CONTROL HEAD

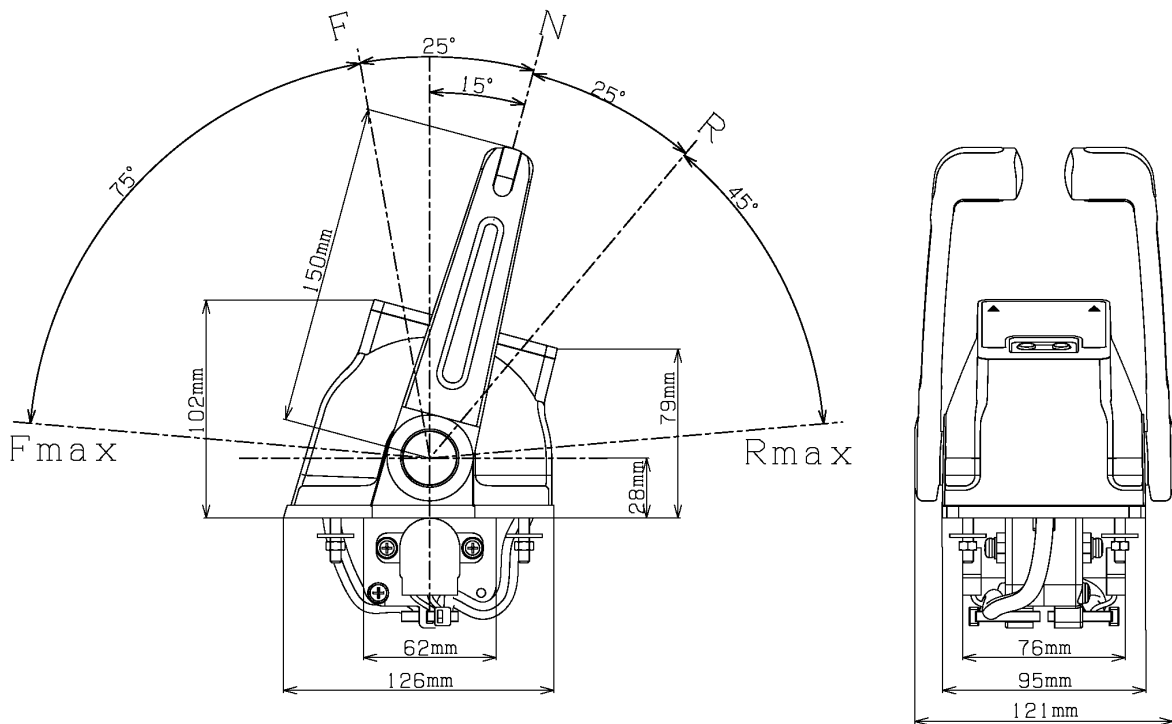
⚠ WARNING

Install the control head in a place accessible for shift & throttle operation at all times.

Instructions:

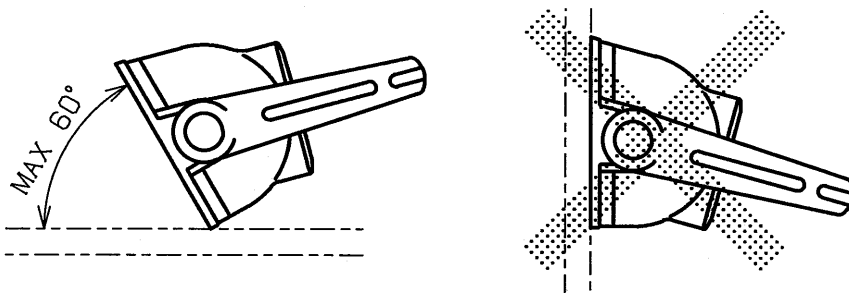
- (1) Select a flat location convenient for operation and installation.
- (2) Drill the mount holes by using an attached template.
- (3) Install with included washers and nuts.

Tightening Torque: 2.9~4.4N·m {2.1~3.2 lbf·ft}



⚠ CAUTION

Mount the control head within 60 degrees from horizontal.



INSTALLING CONTROL UNIT



CAUTION

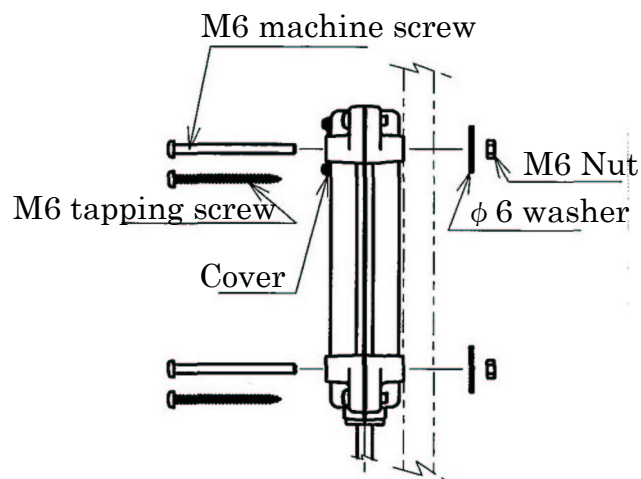
1. Ingress of water into the unit may cause failure
2. Install so that harnesses exit through the bottom and in a location where sea wind and water effects are minimized.
3. Avoid a location where the ambient temperature exceeds 77 °C.
Control unit should be kept cool for optimal performance.

Instructions:

1. Drill mounting hole locations guide by the attached template at the back of the manual.
2. Install with included pan head machine screws or tapping screws (see data below)
3. Tighten to 4.9 ~ 7.8 N · m (3.6 ~ 5.7 lbf · ft) of torque.

Notes:

1. Machine screw mounting plate thickness: 3mm ~ 20mm (1/8 ~ 3/4 in.),
mounting hole diameter: $\phi 7\text{mm}$ ($\phi 1/4$ in.).
2. Tapping screw mounting plate thickness: 15mm min. (5/8 in. min.),
pilot hole diameter: $\phi 3\text{mm}$ ($\phi 1/8$ in.).



INSTALLING ACTUATOR



CAUTION

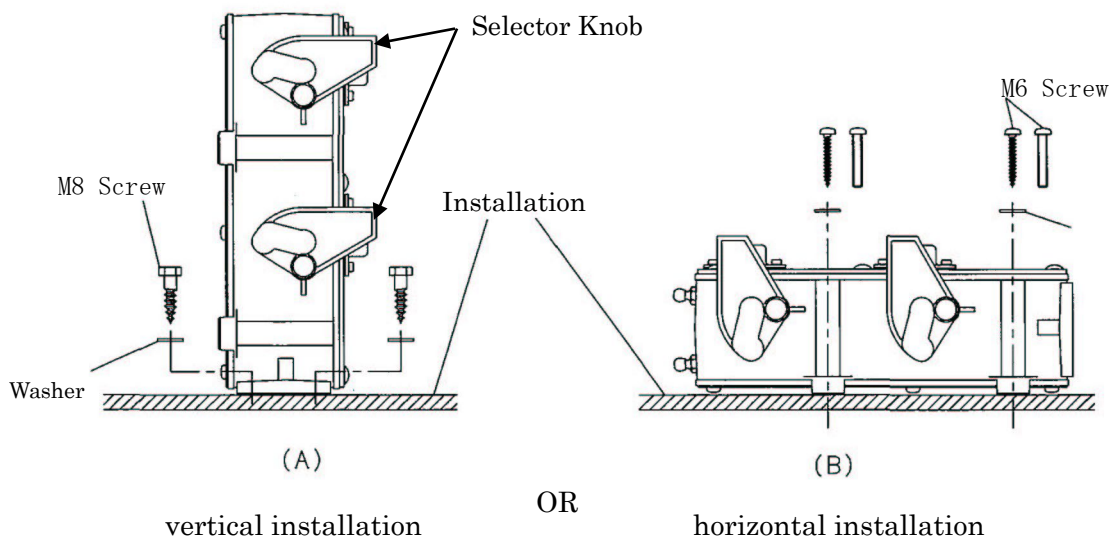
4. Ingress of water into the unit may cause failure
5. Install so that harnesses exit through the bottom and in a location where sea wind and water effects are minimized.
6. Avoid a location where the ambient temperature exceeds 77 °C.
Control unit should be kept cool for optimal performance.

Instructions:

1. Install the actuator in a place convenient for operation of manual selector knob.
2. The actuator harness is 2m (6.5 ft) in length; select the control unit location so that its distance from the actuator is within 2m (6.5 ft).
3. Drill the mount hole using the attached template.
4. Install with bolts or tapping screws and washers.
5. Tighten to 3.9 ~ 5.9 N · m (2.9 ~ 4.3 lbf · ft) of torque.

Notes:

1. Bolt Installation plate thickness : 3 ~ 25mm (1/8" to 1")
 2. Mount hole dia : ϕ 9mm (ϕ 3/8 ")
- or
3. Tapping screw plate thickness : 15mm min (9/16 " min)
 4. Pilot hole dia : ϕ 3mm (ϕ 1/8 ")



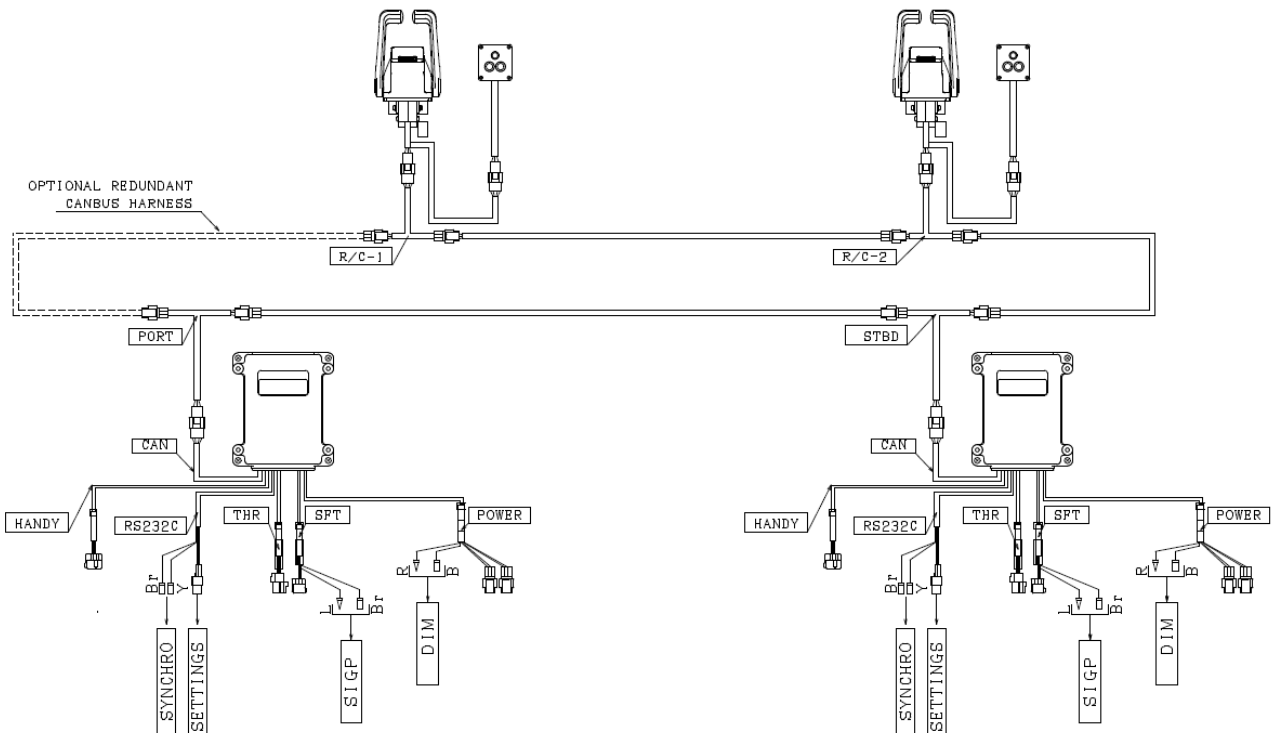
CONNECTING CONTROL HEAD & CONTROL UNIT

CAUTION

1. All connectors must be mated firmly; the system may fail to operate otherwise.
2. Be sure to connect a control head to R/C-1. When power is applied, the control head connected to R/C-1 is the first one to become operative.
3. Locate harnesses such that they are away from accidental compaction damage or cutting.

Instructions:

1. Connect 8-pin harness connector of the first control head to R/C-1 T-harness.
2. Connect 8-pin harness connector of the optional control heads to R/C-2 (shown), R/C-3 & R/C-4 T-harnesses.
3. Connect the 8-pin harness CAN connector of control units to the appropriate T-harnesses: such as SINGLE, PORT, STBD, CENTER, CENTER-STBD
4. Finally connect a main CANbus harness in between each of the T-harness connectors for a continuous data bus between from the first control head to the last control unit.
5. Optional: Add a spare bus harness in between the last 2 ends to close the loop and create a redundant path.

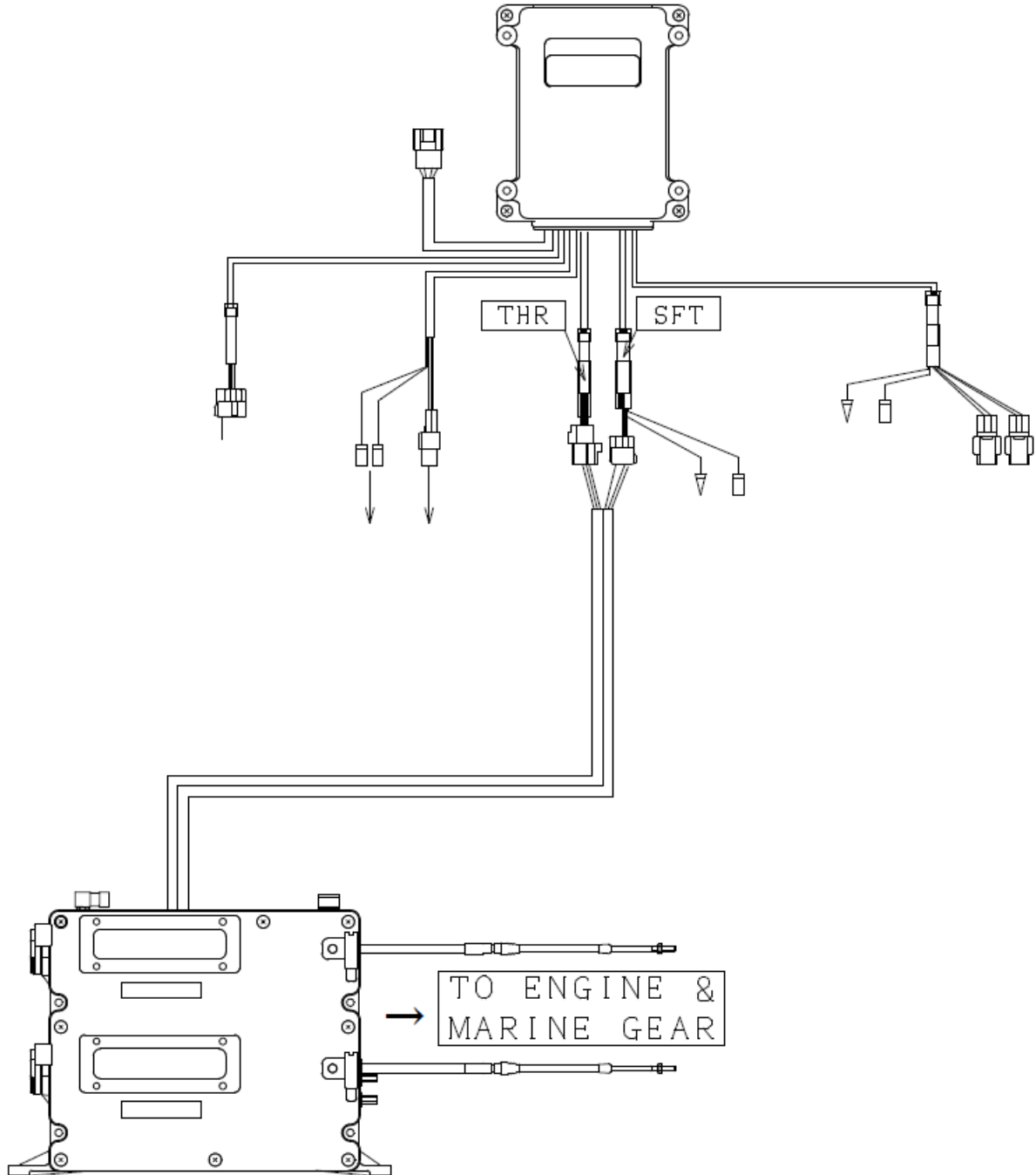


Note: The figure above is an example of a two engines / two control stations system.

CONNECTING ACTUATOR & CONTROL UNIT

Instructions:

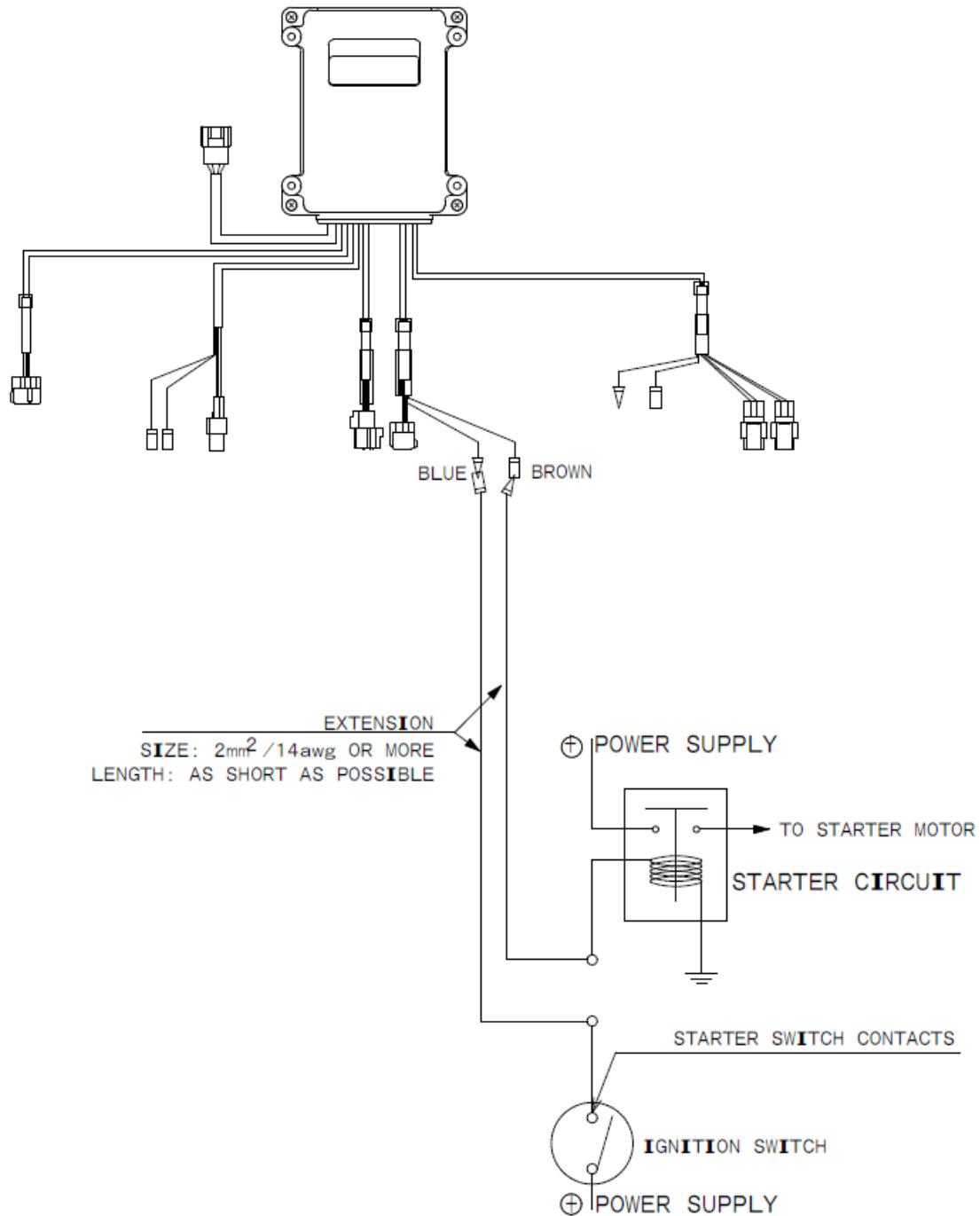
1. Connect the 12-pin connector and 9-pin connector pair to the actuator harness.



CONNECTING SIGP (START-IN-GEAR PROTECTION)

Instructions:

1. Connect KE control SIGP connections between engine starter & ignition circuit of the boat as below. This implements a safety feature that allows engine start only when the KE control system & gearbox are in Neutral position.
2. Keep extension wires as short and as thick as possible to avoid circuit failure.



CONNECTING POWER

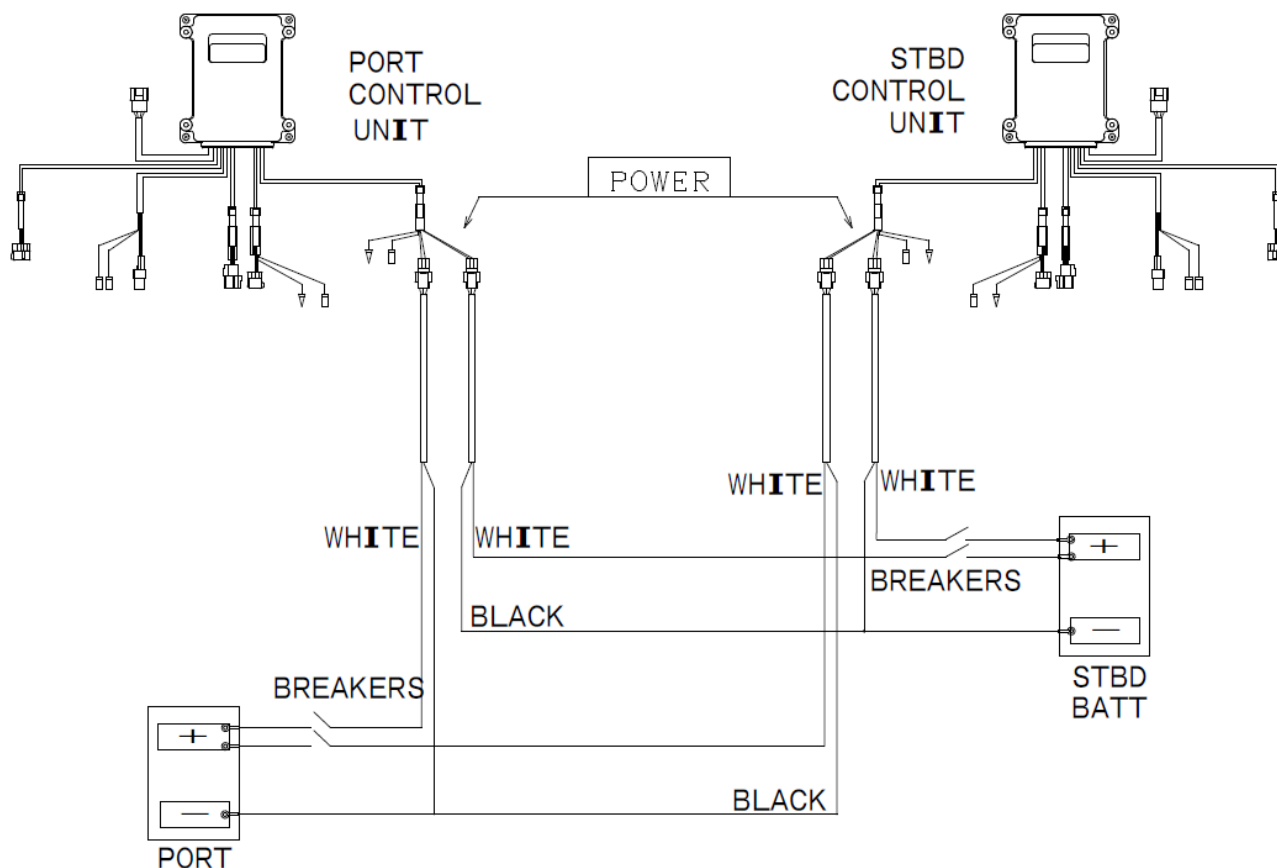
⚠ CAUTION

1. As a safety feature, a duplex power line system is provided. Be sure to connect both lines. Alarm code LED's will flash if only one power line is connected.
2. Once power harness is connected to power (battery), before disconnecting power harnesses from control unit, first disconnect power via circuit breaker or battery switch.

Instructions:

1. Connect the system power harnesses to the control unit before connecting each power harness to battery (power supply).
2. Connect each black wire of the power harness directly to (– **minus**) of battery (power).
3. Connect each white wire of the power harness, via the optional 20-amp circuit breaker, via the boat
4. Circuit breaker or directly to (+ **plus**) of battery (power).

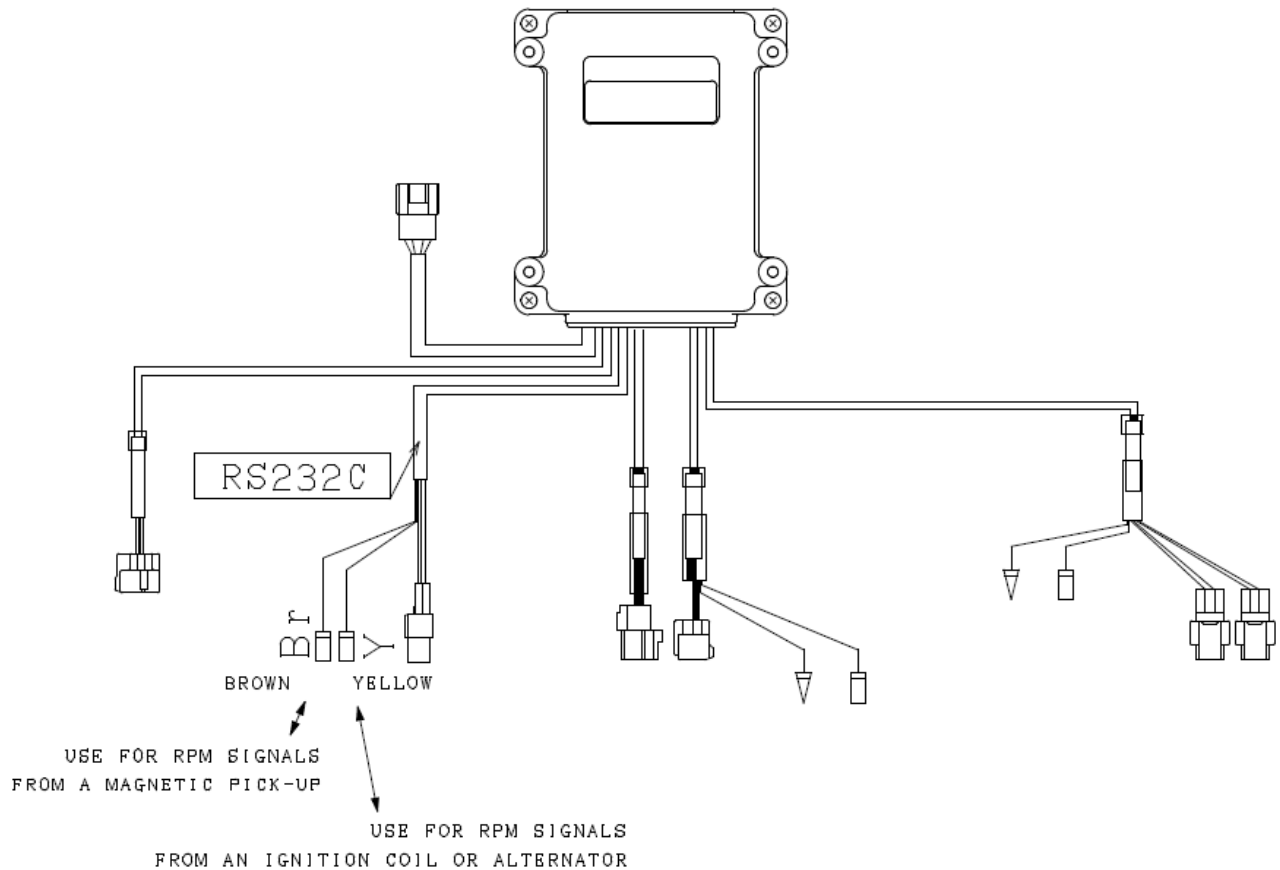
Note: If two batteries are provided, it is recommended to separate the power lines and connect one power line (plus breaker) to each battery, as per dual engine example below.



CONNECTING SYNCHRONIZATION CIRCUIT

Instructions: (in order for the control unit to read engine sync signal properly)

1. Connect the brown wire to the engine rpm (or tachometer) signal in a case of a magnetic pick-up type circuit (typically diesel engine).
2. Connect the yellow wire to the engine rpm (or tachometer) signal in a case of an ignition coil or alternator type circuit (typically gasoline engine).
3. Repeat connection for each engine & control unit pair.

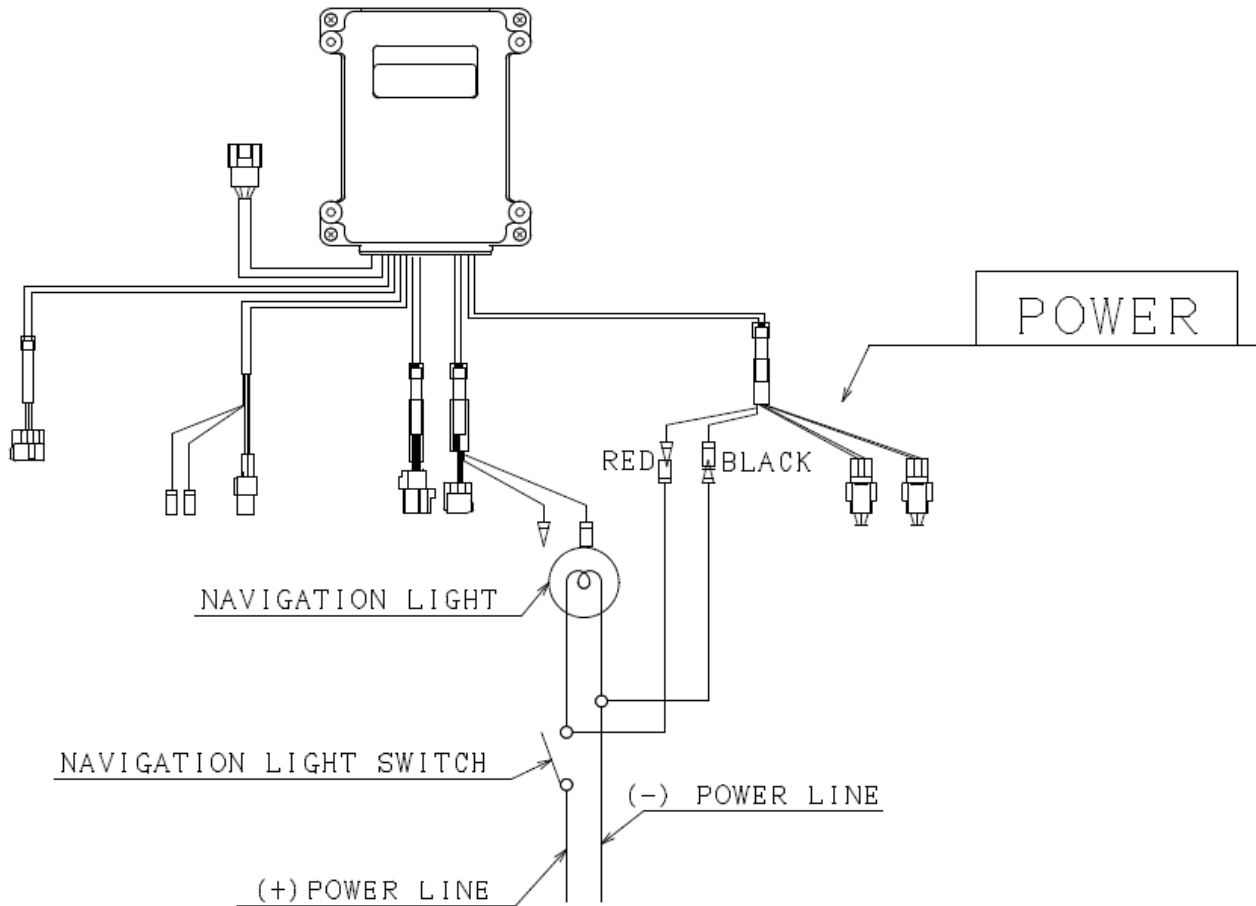


Note: No damage will occur if the case of a wrong connection; synchronization will simply be ineffective.

CONNECTING DIM HARNESS (OPTION)

Instructions:

1. Connect the Dim Harness red line to the (+) wire of navigation light.
2. Connect the Dim Harness black line to the (-) wire of navigation light.



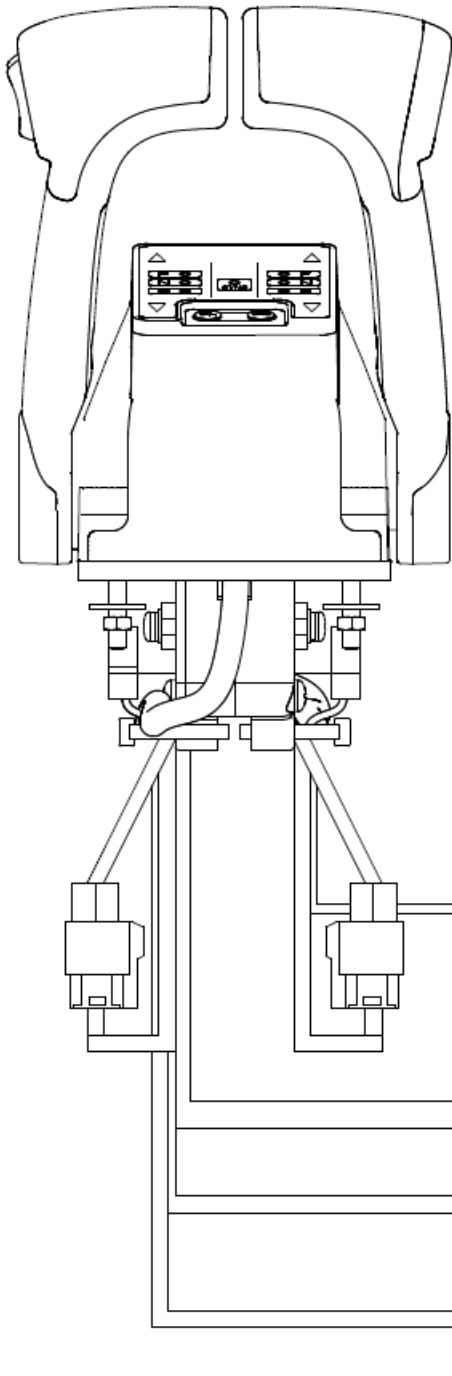
Note: Once dim harness is connected; brightness of the control head LED's illumination will be reduced whenever navigation light is ON.

CONNECTING BUZZER (OPTION)



CAUTION

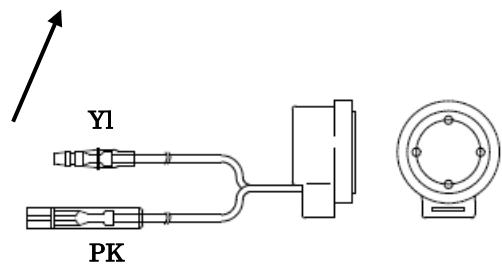
Be sure to select the correct buzzer (12V or 24V) for your power source (battery).



Buzzer (optional)

Instructions:

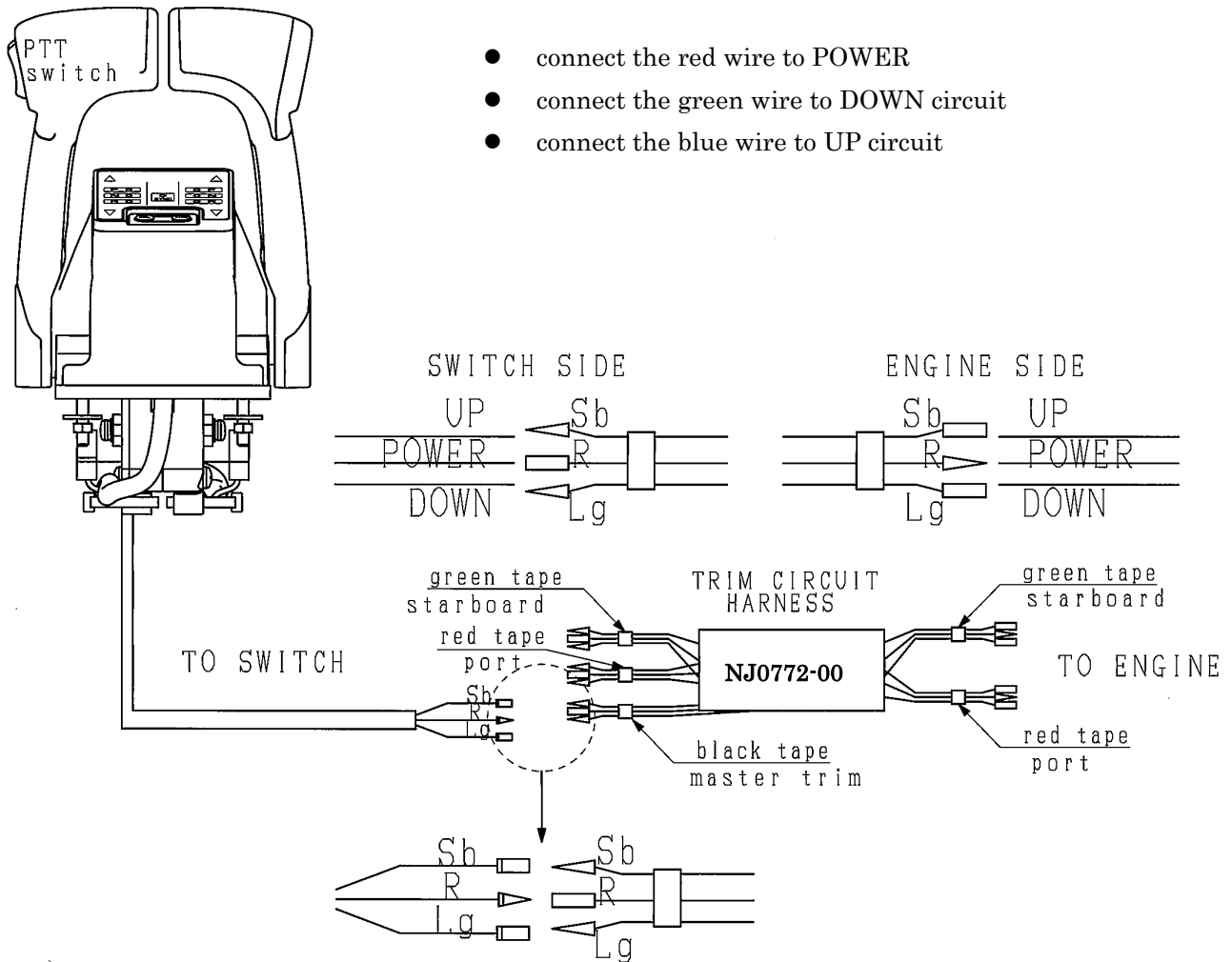
Connect pink & yellow wires of control head to matching pink & yellow wires of buzzer.



CONNECTING TRIM CIRCUIT (OPTION)

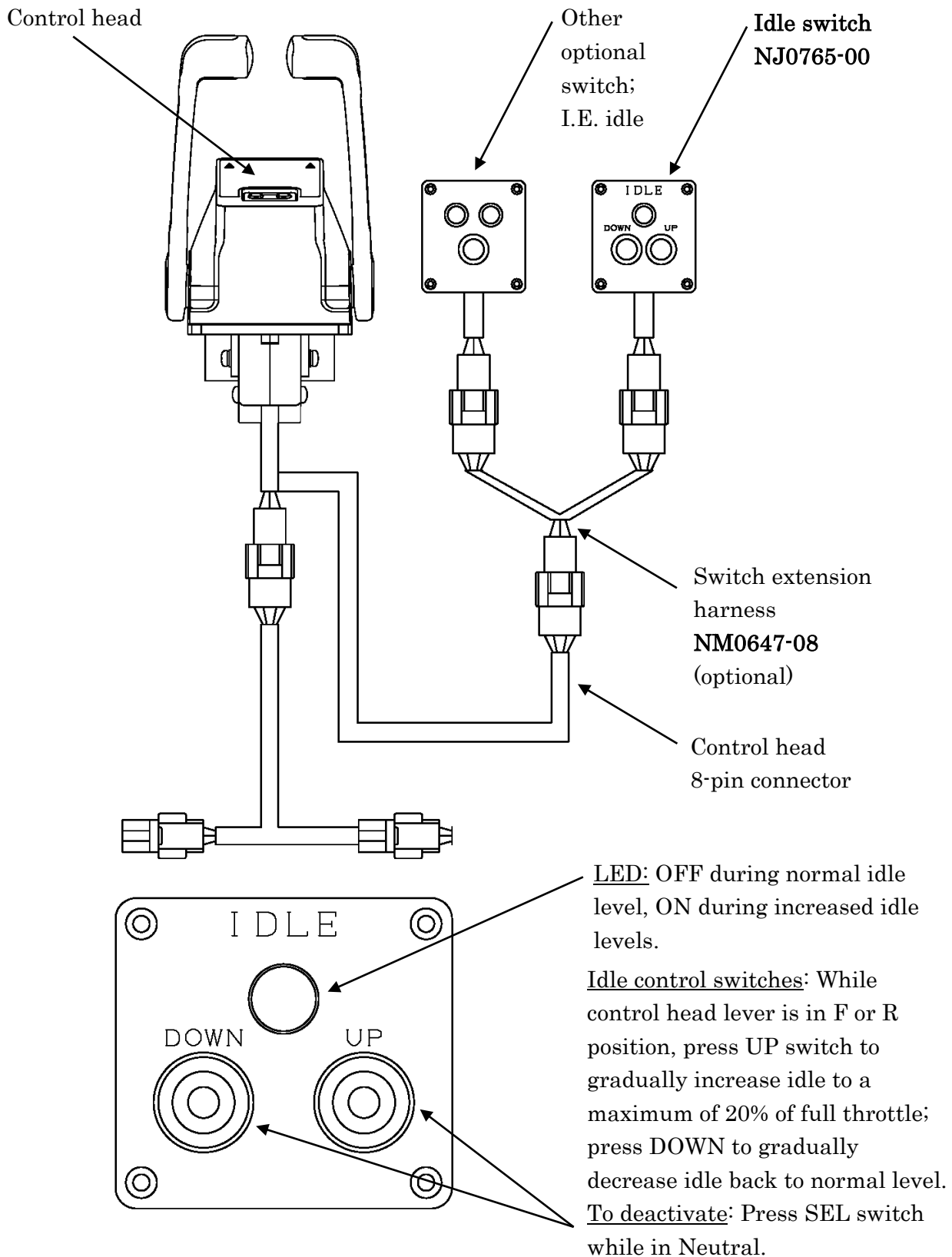
Instructions:

1. Connect the KE-4XG PTT switch (master trim) plus the individual engine trim switches to the switch side of trim circuit harness (included in your PTT kit), as per the circuit below.
2. Connect the other side to the engine connections (engine side), as per the circuit below.



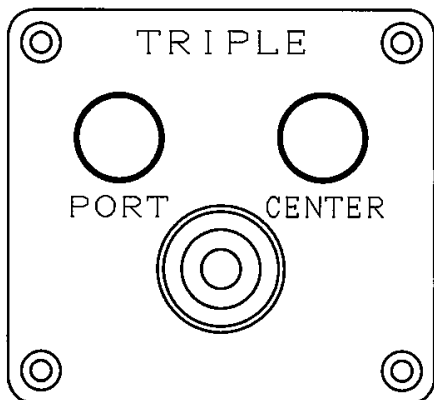
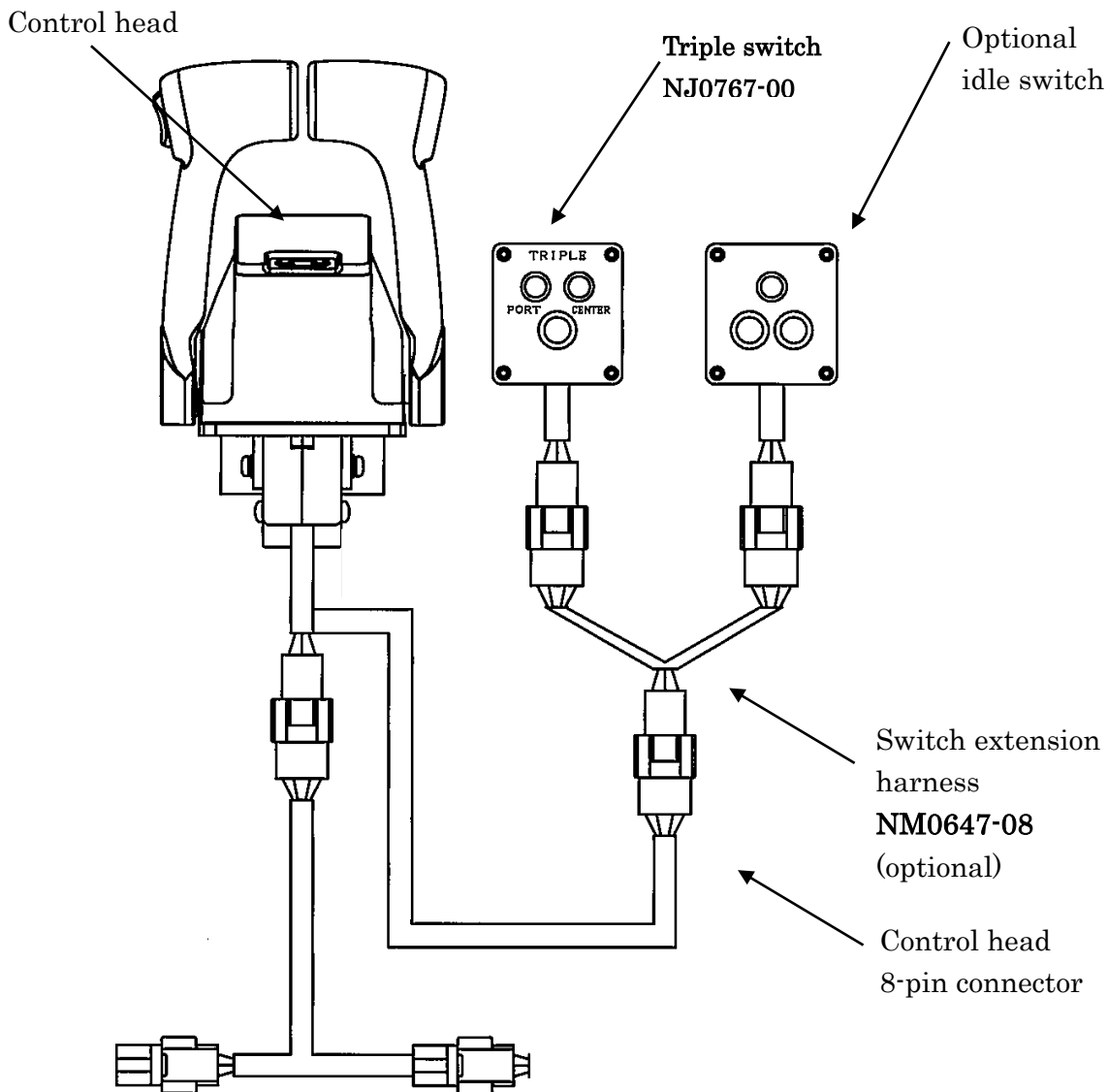
CONNECTING IDLE SWITCH (OPTION)

Instructions: For each control head / idle switch pair, connect the 8 pin harness of the control head to the idle switch directly or via a switch extension harness if other optional switches are also part of the main system.



CONNECTING TRIPLE SWITCH (OPTION)

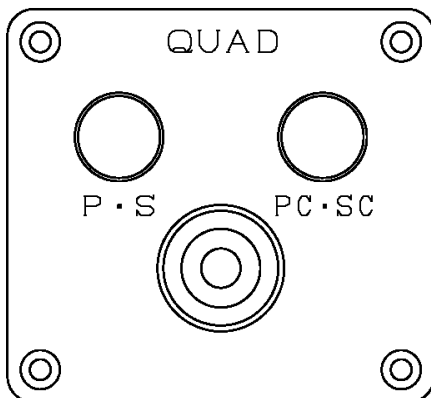
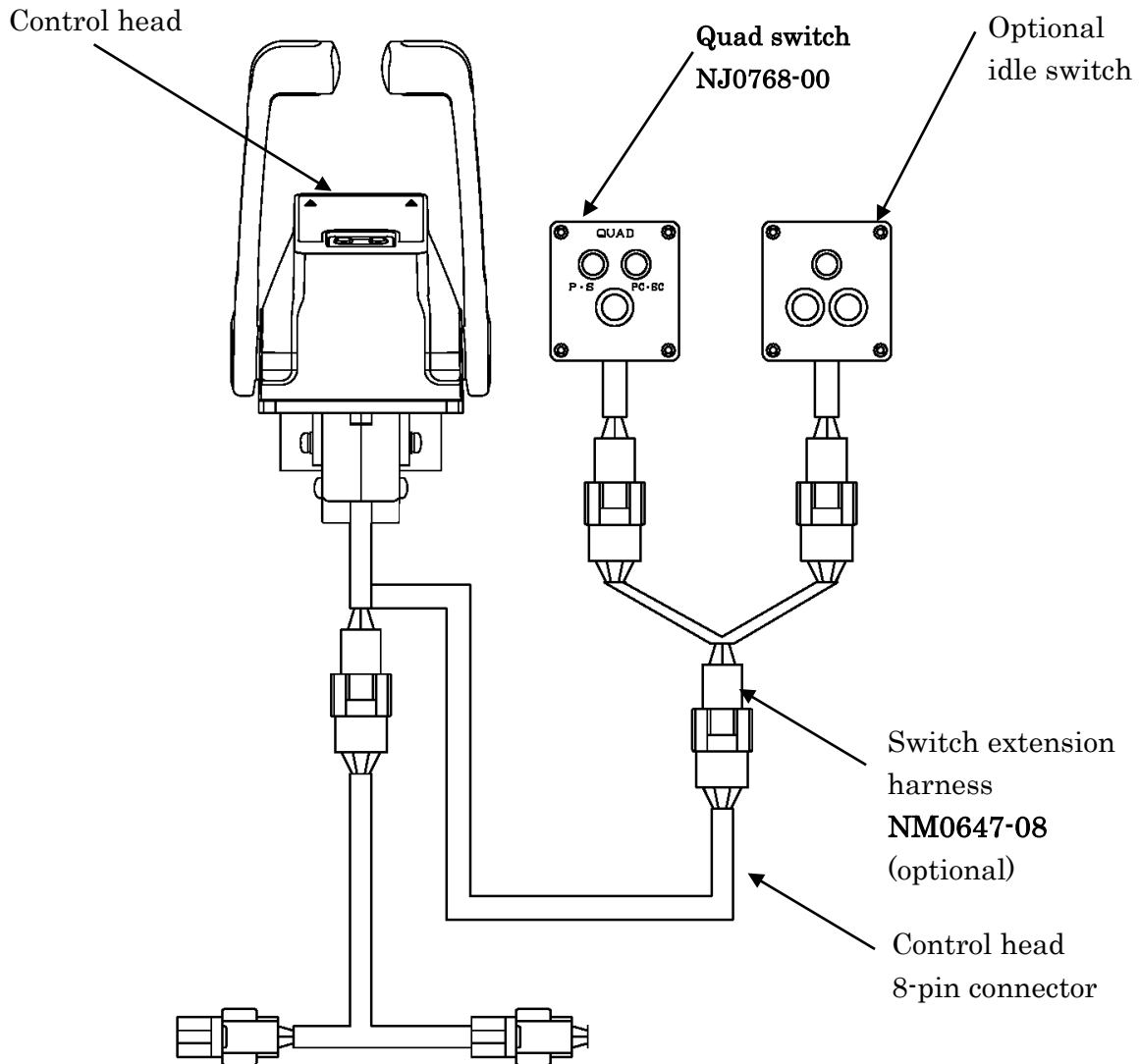
Instructions: For each control head / triple switch pair, connect the 8 pin harness of the control head to the triple switch directly or via a switch extension harness if other optional switches are also part of the main system.



SWITCH STATUS	PORT LED	CENTER LED	PORT LEVER CONTROL
POWER ON	ON	ON	port & center actuators
PUSH 1	ON	OFF	port actuator
PUSH 2	OFF	ON	center actuator
PUSH 3	ON	ON	port & center actuators

CONNECTING QUAD SWITCH (OPTION)

Instructions: For each control head / quad switch pair, connect the 8 pin harness of the control head to the quad switch directly or via a switch extension harness if other optional switches are also part of the main system.

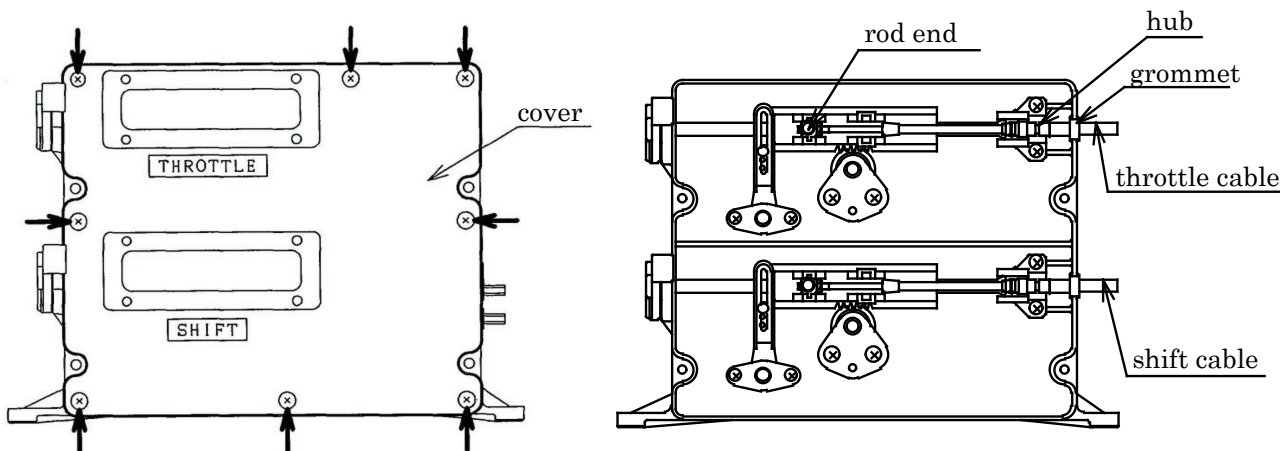
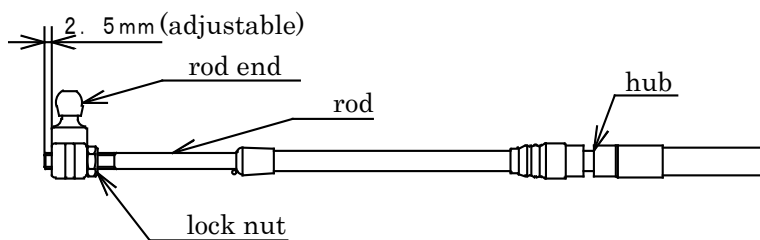


SWITCH STATUS	P·S LED	PC·SC LED	LEVERS CONTROL
POWER ON	ON	ON	all 4 outputs
PUSH 1	ON	OFF	outside outputs
PUSH 2	OFF	ON	inside outputs
PUSH 3	ON	ON	all 4 outputs

PUSH-PULL CABLE INSTALLATION

Instructions: →push-pull cables to actuator

1. Install the rod end to the rod and set with lock nut.
2. Tighten to 2.9 ~ 4.4 N · m (2.1 ~ 3.2 lbf · ft)
3. Remove the eight (8) actuator screws shown with arrows and remove the cover
4. Install the waterproof grommet around the cable.
5. Install the rod end, hub and waterproof grommet to the actuator mount groove as shown below.
6. Re-install the cover onto the actuator with screws.
7. Tighten to 1.2 ~ 1.8 N · m (0.9 ~ 1.3 lbf · ft)



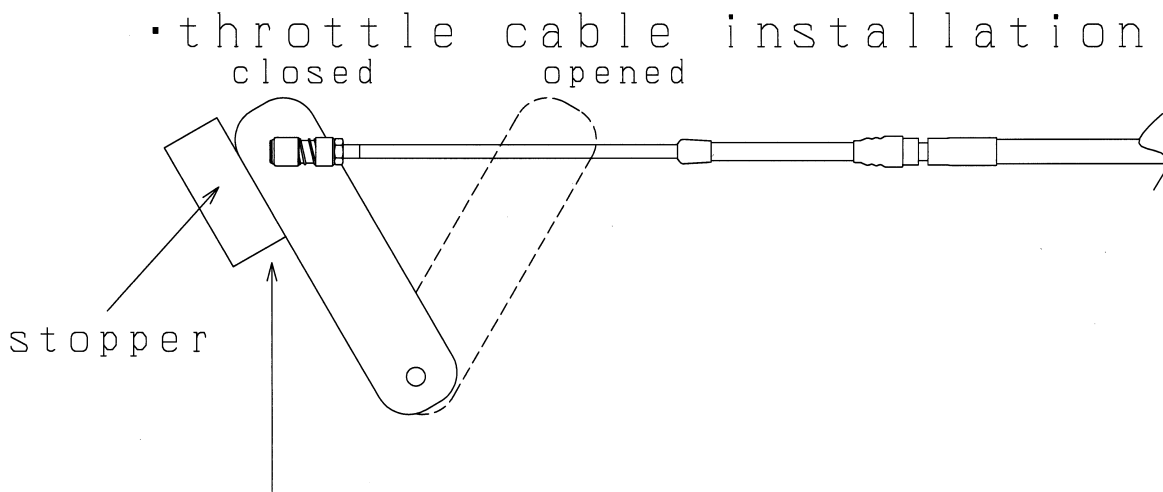
CAUTION

1. Be sure to completely install the push-pull cables in the actuator before installing the other ends to the engine & gear.
2. Also turn OFF power supply to the control unit before installing the push-pull cables to the engine & gear.
3. Install the cables onto the engine as per the engine manual.
4. Please make sure that the system is installed such that the push-pull cable motions correspond properly with the engine and gearbox mode of operation (i.e. stroke direction and distance); otherwise damage could occur.

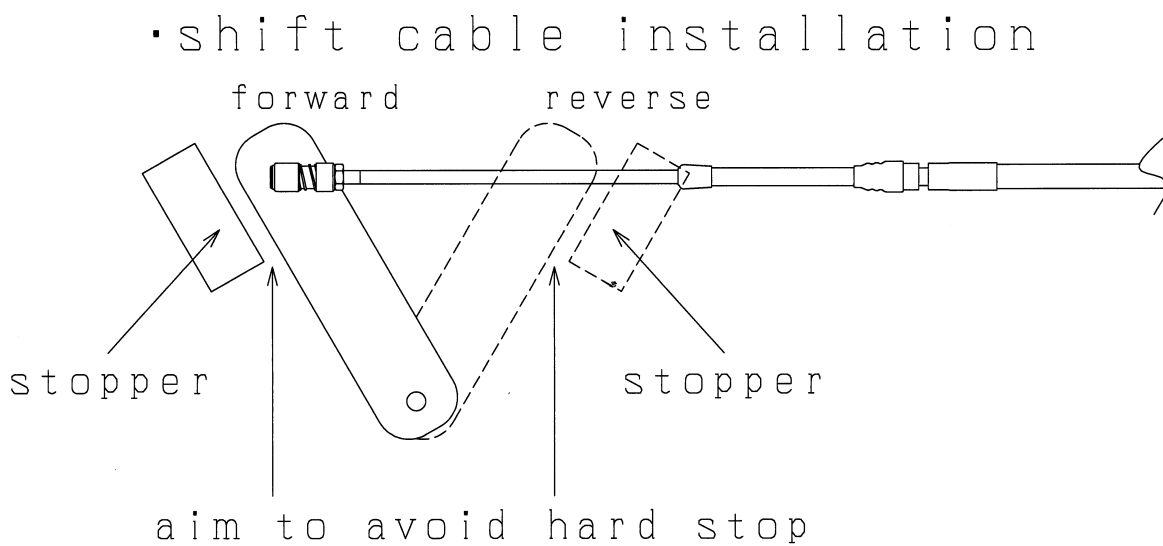
PUSH-PULL CABLE INSTALLATION (cont'd)

Instructions: → Initialization (positioning)

8. Turn power ON to the KE system control unit; observe rack gear movement to of home position.
9. Set the R/C-1 control head lever(s) to neutral position.
10. The throttle actuator should now be fully closed and the shift actuator should be in neutral position.
11. Positioning is completed once the neutral lamp goes ON. Push-pull cables are now ready for installation to engine & marine gear as per engine manual.
12. Refer to the figures below for details about adjusting cable stroke according to stopper positions



aim to avoid hard stop:
return spring force, or 10N-20 N



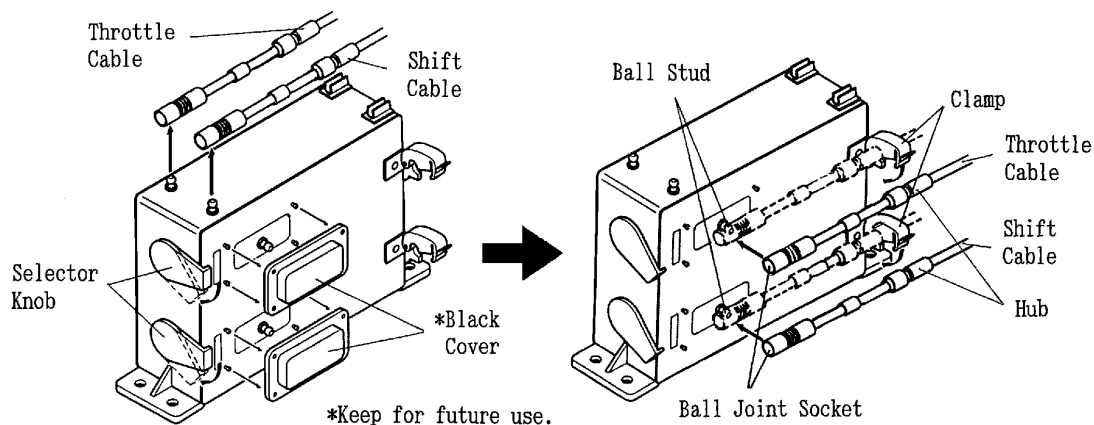
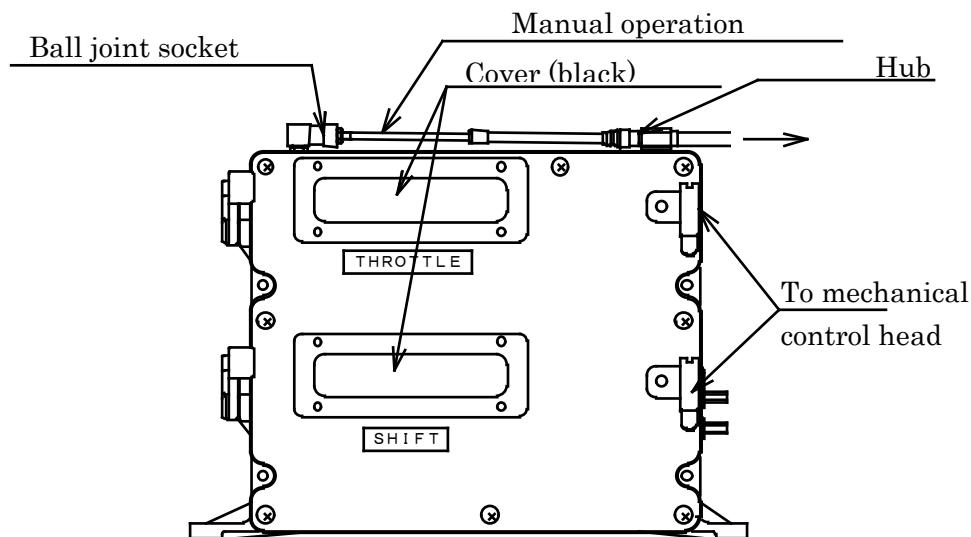
ACTUATOR MANUAL OPTION (OPTION)

WARNING

Activate manual operation only in cases of emergency such as electrical source failure.
Use for immediate return to shore

Instructions:

1. Install the mechanical control head and push-pull cable according to the instruction manual of the optional mechanical control head.
2. Install ball joint socket to the output end of the push-pull cable and fix it to the actuator.
3. Remove the black cover and expose the ball stud.
4. Tilt the selector knob fully in the arrow direction.
5. Remove the cable from the position and install its ball joint socket onto the ball stud and the hub onto the clamp.
6. The actuator can then be operated manually via the mechanical control head levers.
7. Return the selector knob to the original position after manual operation is no longer necessary.

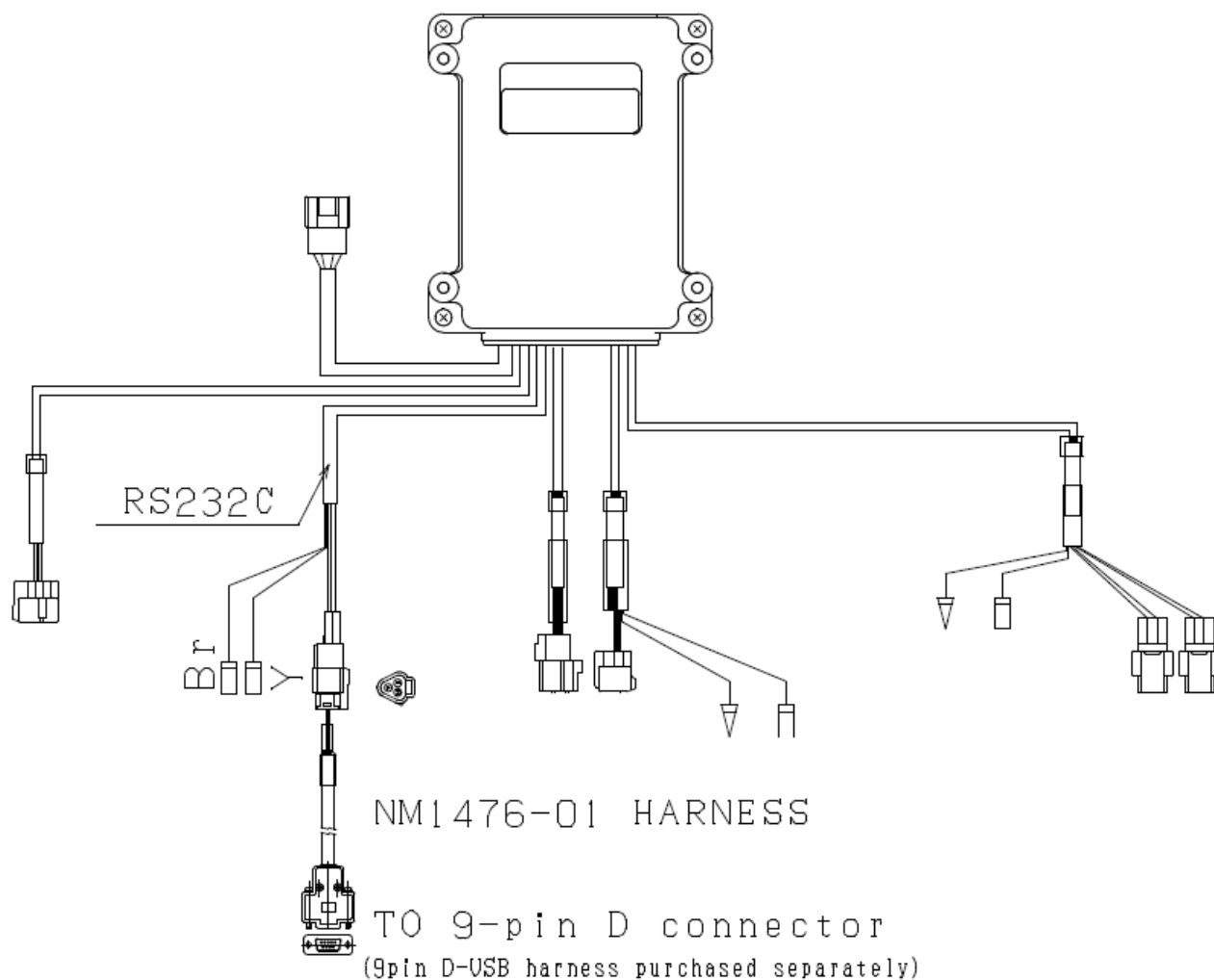


SYSTEM SETTINGS

Instructions: System settings software is used to set the control unit for optimum compatibility with engine and gear. KE-XG Settings Tool software file package software can be downloaded via NHK MEC Corp. website: <https://www.nhkmec.com/en/product/download/>

You will also need a separately purchase standard USB to 9-pin D-connector serial adapter harness to connect to your PC in order to communicate with the KE-XG control unit. If necessary for your purchased adapter, download and install the driver onto your PC.

First, connect one end of harness NM1476-01 to control unit RS232C connection and the other end to the separately purchased USB –serial adapter; then connect the other end of NM1476-01 harness to your PC USB port.



Next, open KE-XG Settings Tool software on your PC; click on Config Setting, then select USB port ID to activate. The settings menu top page provides pull down menu for each KE-XG system settings. Select the options that are compatible with your engine & gearbox installation; refer to engine manual if necessary.



Config Setting

System : KE-4XG Initialize config settings

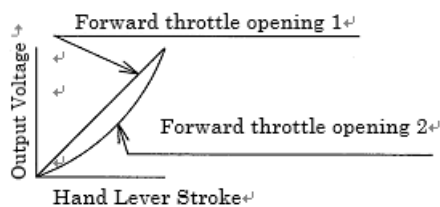
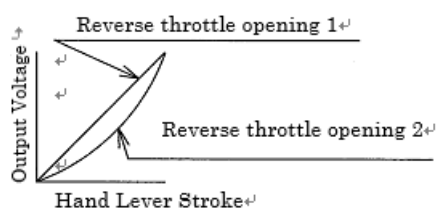
Config Setting	Operational value	Set value
<input type="text" value="Shift pause"/>	0seconds	0seconds
<input type="text" value="Direction of shift operation"/>	PULL	PULL
<input type="text" value="Throttle delay"/>	0seconds	0seconds
<input type="text" value="Reverse throttle opening"/>	Non-Linear1	Non-Linear1
<input type="text" value="Forward throttle opening"/>	Linear	Linear
<input type="text" value="Direction of throttle movement"/>	PULL	PULL
<input type="text" value="3 or 4 engines"/>	Lever tracks when PORT/STBD shift outputs m...	Lever tracks when PORT/STBD shift outputs m...
<input type="text" value="Reverse stroke setting"/>	60%	60%
<input type="text" value="Backward shift stroke"/>	34mm	34mm
<input type="text" value="Forward shift stroke"/>	34mm	34mm
<input type="text" value="Forward throttle stroke setting"/>	64.0mm	64.0mm

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SYSTEM SETTINGS (CONT'D)

Guidelines:

- Shift pause: delays shock effect if control lever is suddenly operated from throttle to neutral
- Direction of shift operation: push or pull to go forward
- Throttle delay: delays shock effect if control lever is suddenly operated from neutral to throttle
- Direction of throttle operation: push or pull to open throttle
- 3 or 4 engines: activate to have shift outputs of inner engines match outer engines
- Reverse (backward) stroke: select % of full forward throttle stroke setting
- Reverse (backward) shift stroke: distance stroke for reverse shift operation
- Forward shift stroke: distance stroke for forward shift operation
- Forward throttle stroke: distance stroke for throttle opening
- Throttle openings: select desired throttle opening based on curves below



Once you have completed your selection of settings, close the menu, close Settings Tool software and disconnect NM1476-01 harness from the KE-XG control unit. KE-XG control system is now ready for operation.

ALARM CODES

In case of a system operation fault, the failure code is indicated via the forward/neutral/reverse LED's flashing frequency on control head(s) plus optional buzzer.

LED's Flashing Frequency	Possible Cause	Check / Countermeasure	Manual Reference
1 * Shift Actuator Signal	①Shift actuator and control unit not connected properly. ②A. Shift actuator harness: 1 output line damaged / shorted -> system still operates ②B. Shift actuator harness: 2 output lines damaged/short -> system no longer operates ③Shift actuator set to manual operation.	①Reconnect the shift actuator to control unit. ②A. Consult dealer for replacement item at earliest convenience. ②B. Consult dealer for replacement item immediately. ③Set system to NEUTRAL and rotate selector knob to electronic operation.	Pages 14 & 22
2 ** Throttle Actuator Signal	①Throttle actuator and control unit not connected properly. ②A. Throttle actuator harness 1 output line damaged -> system still operates ②B. Throttle actuator harness: 2 output lines damaged -> system no longer operates ③Throttle actuator set to manual operation.	①Reconnect the throttle actuator to control unit. ②A. Consult dealer for replacement item at earliest convenience. ②B. Consult dealer for replacement item immediately. ③Set system to neutral and rotate selector knob to electronic operation.	Pages 14 & 22
3 *** Control Head	①Control head 6-pole harness loop not properly connected. ②1 output line damaged → system still operates. ③2 output lines damaged → system no longer operates.	①Reconnect 6-pole harness loop(s). ②Consult dealer for replacement item at earliest convenience. ③Consult dealer for replacement item immediately.	Pages 13 & 18
4 **** Shift Actuator	①Push-pull cable installed without proper positioning. ②Shift actuator stroke exceeding stroke of the gear clutch. ③Shift actuator set to manual operation. ④Loose push-pull cable. ⑤Loose clutch connection or clutch load too heavy for shift actuator. ⑥No motor motion	①Perform proper cable positioning & initialization of the shift actuator. ②Reduce shift actuator stroke. ③Set system to NEUTRAL and rotate selector knob to electronic operation. ④Fasten cable rod end, lock nuts. ⑤Verify clutch connection or clutch load (particularly outboard motor dog clutch). ⑥Consult dealer for replacement item.	Pages 32 to 34 Pages 14 & 34 Pages 32 to 34

LED's Flashing Frequency	Possible Cause	Check / Countermeasure	Manual Reference
<p style="text-align: center;">5 * * * * *</p> <p>Throttle Actuator</p>	<p>①Push-pull cable installed without proper positioning. ②Throttle actuator overloaded. ③Throttle actuator set to manual operation. ④Loose push-pull cable. ⑤Loose connection to engine. ⑥No motor motion.</p>	<p>①Perform proper cable positioning & initialization of the throttle actuator. ②Review actuator load conditions. ③Set system to NEUTRAL and rotate selector knob to electronic operation. ④Fasten cable rod end, lock nuts. ⑤Verify engine connection. ⑥Consult dealer for replacement item.</p>	<p>Pages 32 to 34</p> <p>Pages 14 & 34</p> <p>Pages 32 to 34</p>
<p style="text-align: center;">6 * * * * * *</p> <p>Power</p>	<p>①One of duplex power lines is disconnected. ②Source (battery) voltage outside of operating voltage range. ③Power harness damaged. ④Control unit power line damaged. ⑤Power activation timing offset.</p>	<p>①Connect/Activate both power lines, power sources & breakers. ②Adjust source (battery) voltage to within specified range. ③Consult dealer for replacement. ④Consult dealer for replacement item. ⑤Activate power for PORT & STBD simultaneously.</p>	<p>Page 24</p>
<p style="text-align: center;">7 * * * * * * *</p> <p>Control Head</p>	<p>Control head SEL or SYNCH switch pressed-in or shorted.</p>	<p>Reset/unlock the switch or consult dealer for replacement item.</p>	<p>Page 13</p>
<p style="text-align: center;">8 * * * * * * * *</p> <p>CANbus</p>	<p>①CANbus or T-harness damaged ②Control head or control unit defective</p>	<p>Check harnesses; consult dealer for replacement if necessary.</p>	<p>Page 21</p>
<p style="text-align: center;">9 * * * * * * * * * *</p> <p>Option Switch</p>	<p>Option switch pressed-in or shorted. I.e. Idle control switch, Triple switch or Quad switch.</p>	<p>Reset/unlock the switch or consult dealer for replacement item.</p>	<p>Pages 29 to 31</p>

Note: In the case of KE control system transfer of ownership, please make sure to include maintenance and service information

TROUBLESHOOTING

Symptom	Possible Cause	Check / Countermeasure	Reference
No operation even though power ON.	Power harness is not connected properly.	Activate both power sources & breakers	Page 24
No control head LED's ON.	①Control head hand lever not in neutral during SEL ②R/C-1 T-harness not connected to control head. ③Control head damaged	① Set hand lever to NEUTRAL position with power ON. ②Connect R/C-1 T-harness. ③Consult dealer for replacement	Pages 13 to 16
F, N, R LED light ON but shift clutch does not engage.	Push-pull cable damage	Check shift push-pull cable	Pages 32 & 33
F, N, R LED ON but engine speed does not respond	Push-pull cable damage	Check throttle push-pull cable	Pages 32 & 33
Engine does not start.	①Low battery voltage. ②SIGP harness too long.	①Charge battery. ② Shorten SIGP harness wire	Page 23
Neutral throttle operation not functional.	①Incorrect operation. ②Select switch damaged.	①Perform initial control operation ②Consult dealer for replacement	Page 16
Synchronization operation not functional.	①SYNC switch damaged ②Incorrect connection	①Contact dealer for replacement ②Verify synchronization circuit signal type & connection.	Page 16

RECOMMENDED MAINTENANCE & SERVICE

Control Head & Control Unit

- Regularly wash with fresh water to prevent corrosion
- Do not use grease (electronics parts are embedded)
- Periodically check electrical harnesses for damage; verify proper connection
- Periodically verify system response to control head lever commands by performing cycles from Rmax – R – N – R – Fmax and checking for any abnormalities

Actuators

- Regularly wash outside area with fresh water to prevent corrosion
- Apply marine grease to exposed moving parts inside
- Periodically check electrical harnesses for damage; verify proper connection
- Periodically verify system response to control head lever commands by performing cycles from Rmax – R – N – R – Fmax and checking for any abnormalities

Harnesses

- Periodically check electrical harnesses for damage; verify proper connection

Mechanical Push-Pull Cables

- Periodically check push-pull cable connections at both ends (actuator end, engine end) for looseness.
- Periodically check for smooth push-pull motion during actuator operation.
- Periodically check push-pull cable for damage & corrosion
- In the case of a ball joint type connection to cable & engine lever, carefully inspect abrasion and apply lubricant grease regularly.

Parts Replacement

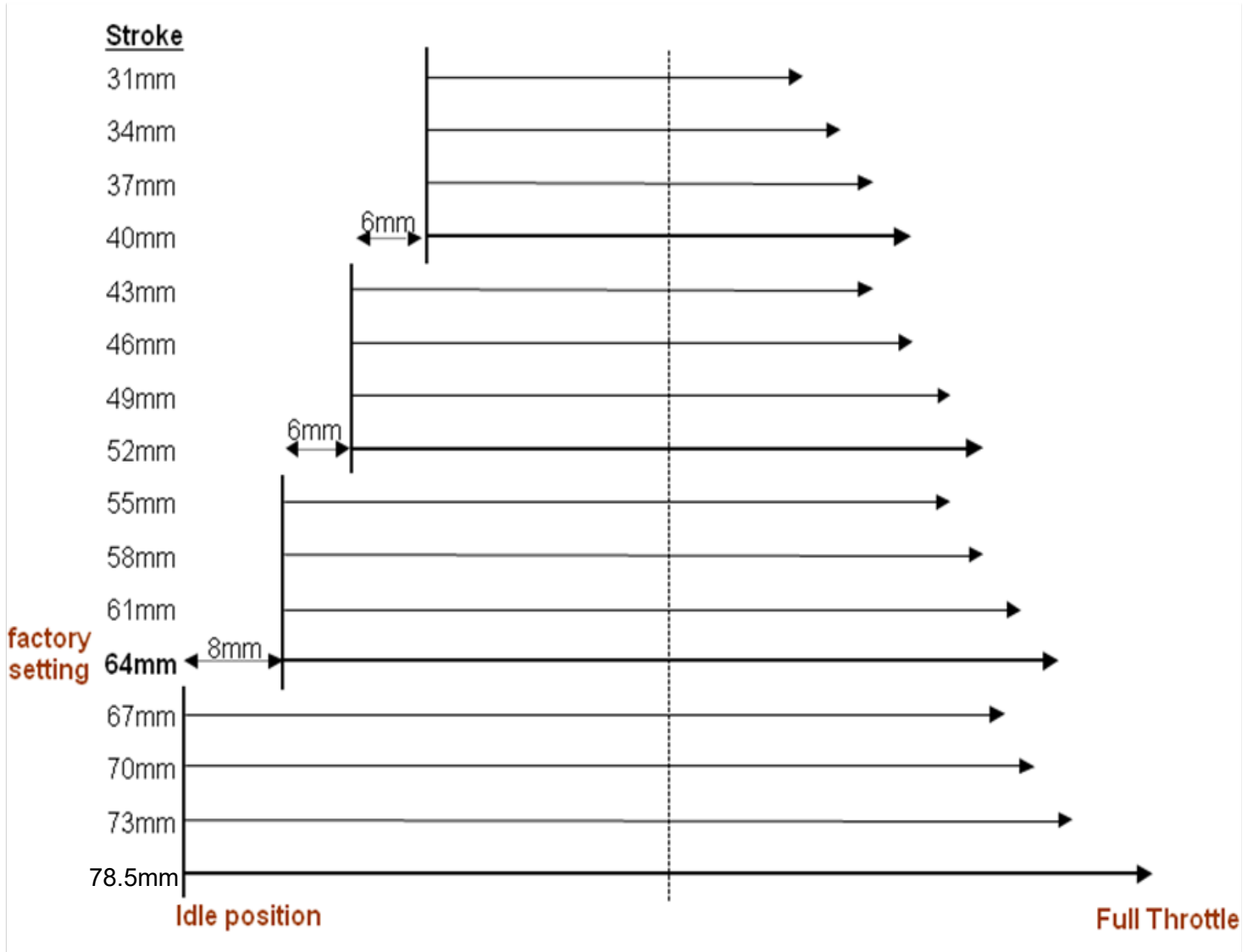
There are precision components such as sensors within KE control systems; operation can deteriorate after long term operation and/or exposure to ocean environment, UV, etc. Accordingly, the following are replacement guidelines:

- Actuator & control head: replacement after 100 000 operation cycles in standard environment; in harsher environment such as commercial or fishing, replacement after 5 years or so
- Control unit & harness: replacement 7 years or so
- Push-pull cables: replacement after 50 000 operation cycles in standard environment; in harsher environment such as commercial or fishing, replacement after 2 years or so

Note: In the case of KE control system transfer of ownership, please make sure to include maintenance and service information

THROTTLE STROKE CHARACTERISTICS

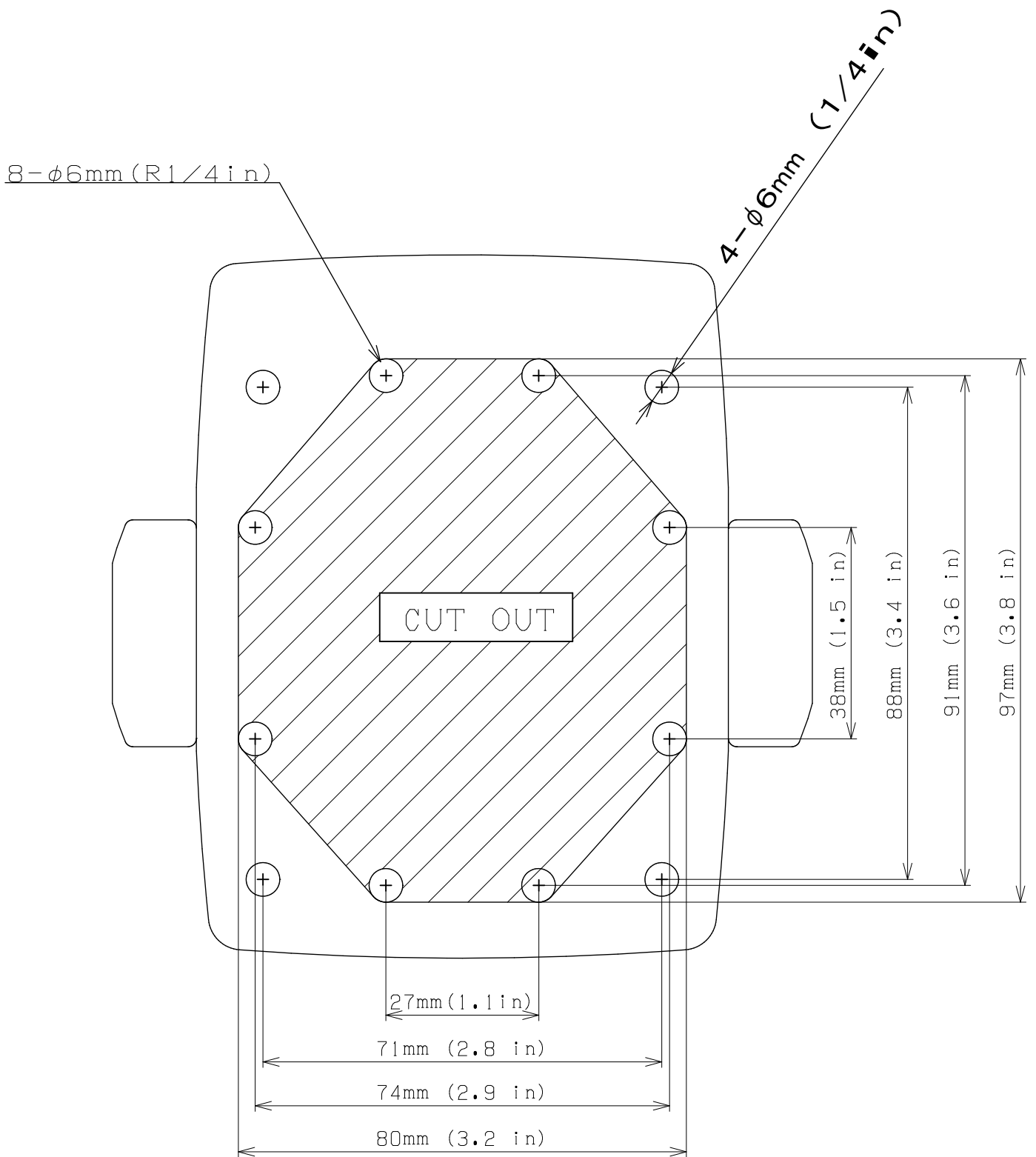
Please use the throttle actuator stroke characteristics data below as reference when determining the KE throttle actuator stroke settings and installing push-pull cable



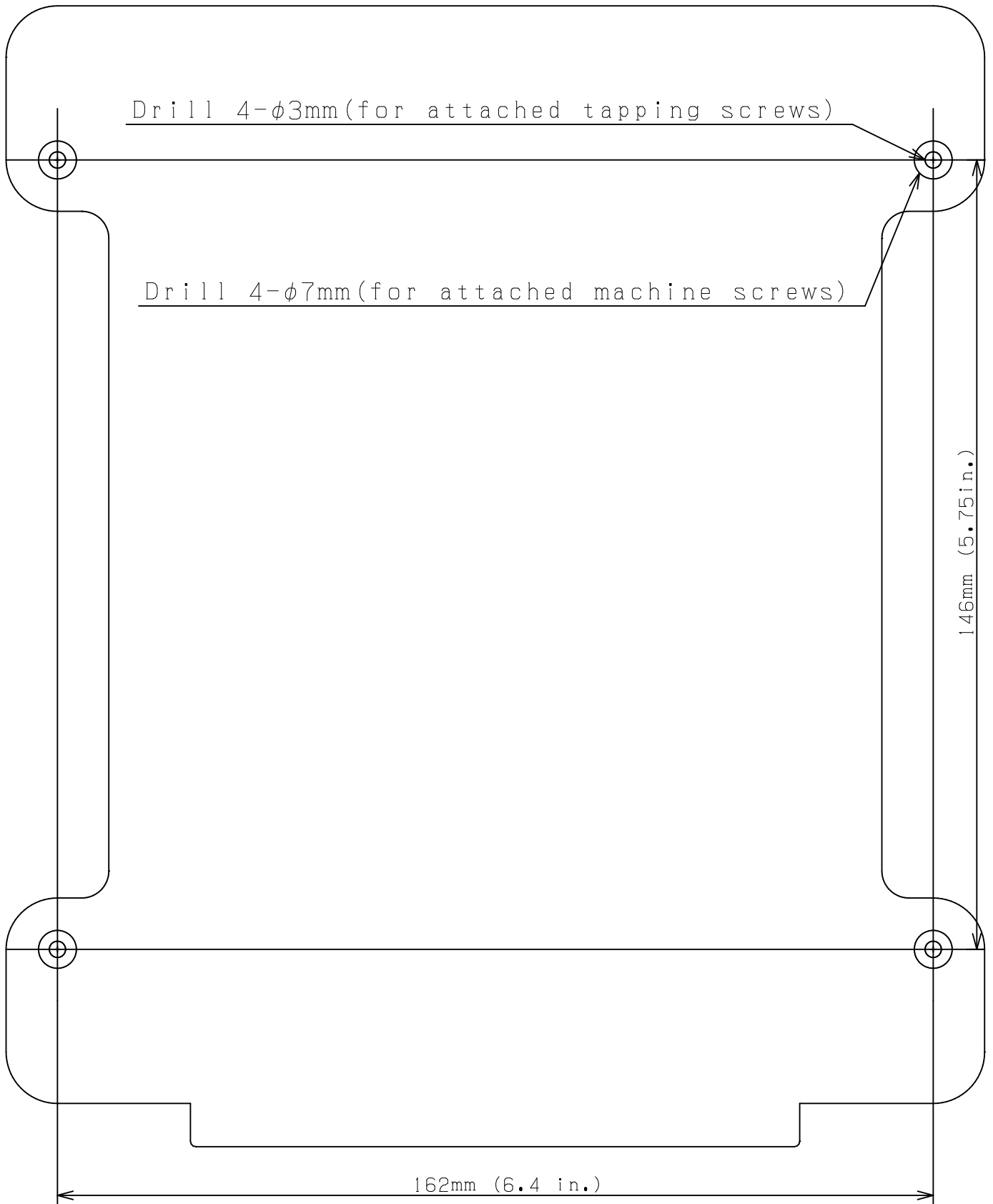
Note:

1. In order to allow a balanced stroke operation at higher stroke settings, the KE system will automatically reset the throttle actuator idle position at 40mm, 52mm and 64mm positions.
2. The KE system will also recognize over-stroke condition upon the first motion and automatically adjust the end stroke position for proper operation afterwards.

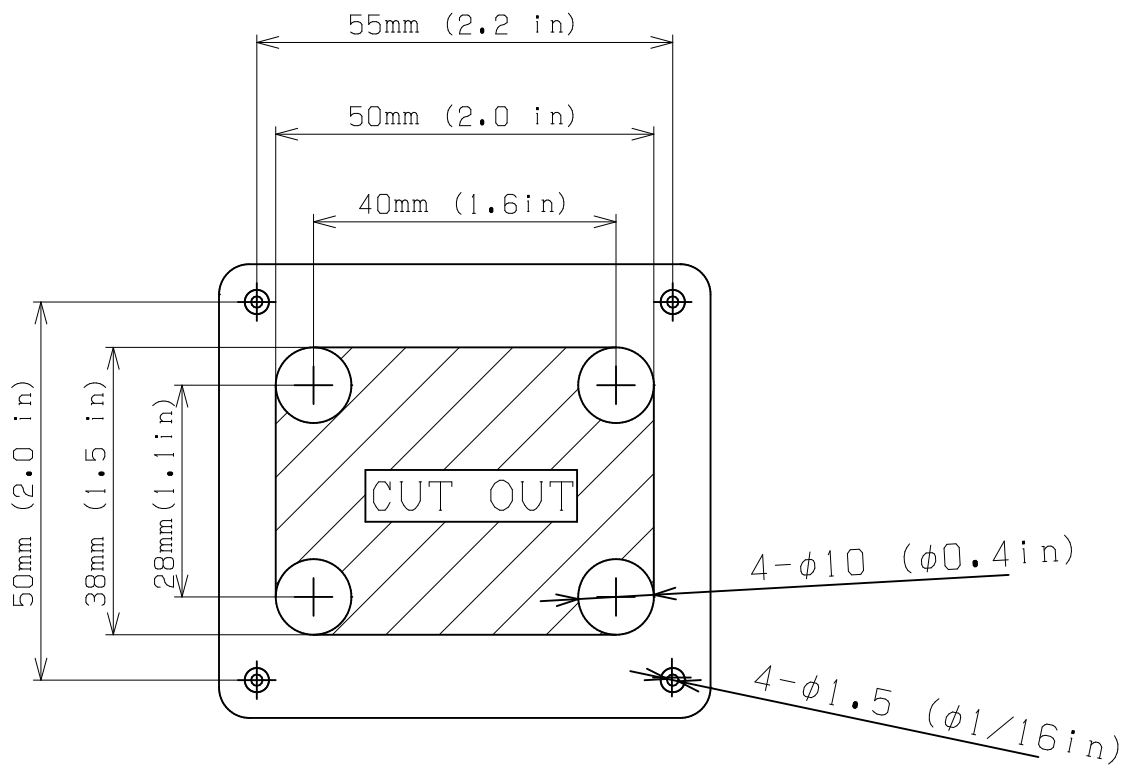
CONTROL HEAD TEMPLATE



CONTROL UNIT TEMPLATE



IDLE / TRIPLE / QUAD / SWITCH TEMPLATE



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