INSTRUCTION MANUAL

Robertson AP45

Autopilot

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NOTE!

Simrad Egersund AS makes every effort to ensure that the information contained within this document is correct. However, our equipment is continuously being improved and updated, so we cannot assume liability for any errors which may occur.

Warning

The equipment to which this manual applies must only be used for the purpose for which it was designed. Improper use or maintenance may cause damage to the equipment or injury to personnel. The user must be familiar with the contents of the appropriate manuals before attempting to operate or work on the equipment.

Simrad Egersund AS disclaims any responsibility for damage or injury caused by improper installation, use or maintenance of the equipment.

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MODIFICATION RECORD

Robertson AP45 Autopilot

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Document history	
Rev.	Action/Changes/References
September 1990	Covers the software versions V1R0, V1R1, V1R2 and V1R3. New rudder feedback RF45 included.
January 1996	Updated to software version V1R4. Major extensions of section 3 and 5. RI40 substitutes RI45. G45 included.
September 1997	Modifications due to improved protection against electro magnetic interference, page 5-1, 5-2, 5-17 and 8-1. J45A grounding page 5-21. Modification on fig. 5-29. “Soft start” function included on page 3-6. Corrected number of bushings on page 5-26 and page 5-28. Missing length group 60-100 ft included on page 6-4. Corrected text in fig. 6-2. Page 5-33: Switch position 8 and 9 changed to NMEA 0183.
October 1998	Minor corrections on following pages: 2-5, 2-6, 2-11, 2-12, 5-3, 5-8, 5-20, 5-21, 5-31, 5-33, 6-1, 7-1, 7-2, 7-4 and 8-3.
September 1999	RI40 substituted by RI9, RI101 by RI35. RF45 substituted by RF45X. S3 substituted by S35. Removed the NMEA0180, inverse polarity. RFC250 substituted by RFC35NS. New distributor list.
June 2002	Note on page 5-31 included. New distributor list.

To assist us in making improvements to this manual, we would welcome comments and constructive criticisms. Please send all such comments, in writing to:

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IMPORTANT!

An autopilot is a very useful navigational aid, but DOES NOT under any circumstance replace a human navigator.

Do not use automatic steering when:

- In heavy traffic areas or in narrow waters
- In poor visibility or extreme sea conditions
- When in areas where use of autopilot is prohibited by law

When using an autopilot:

- Do not leave the helm unattended
- Do not place any magnetic material or equipment near magnetic or fluxgate compass used in the autopilot system
  Verify at regular intervals course and position of vessel
- Always switch to Standby mode in due time to avoid hazardous situations

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1. GENERAL INFORMATION

Introduction

Today Simrad manufacture a complete range of autopilots for all types of vessels, from leisure boats up to advanced steering systems for merchant marine vessels. Our factory for these products – branded Robertson – is located in Egersund, on the south/west coast of Norway. The company's involvement in autopilots began in 1953 with equipment for the North Sea fishing fleet.

In 1982 the world's first microprocessor based autopilot, the Robertson AP100, was introduced and shortly after the AP9 and AP40 systems followed.

The AP45 autopilot described in this document is based on the experience with the AP40 and the AP9 models. A series of improvements based upon this experience has been implemented in the new model and special attention has been paid to simplified operation.

System description

The standard AP45 system consists of the following units (refer to Fig. 1-1):

1. AP45 Control Unit with accessories
2. Heading sensor
3. Rudder Feedback Unit with transmission link
4. Junction Unit

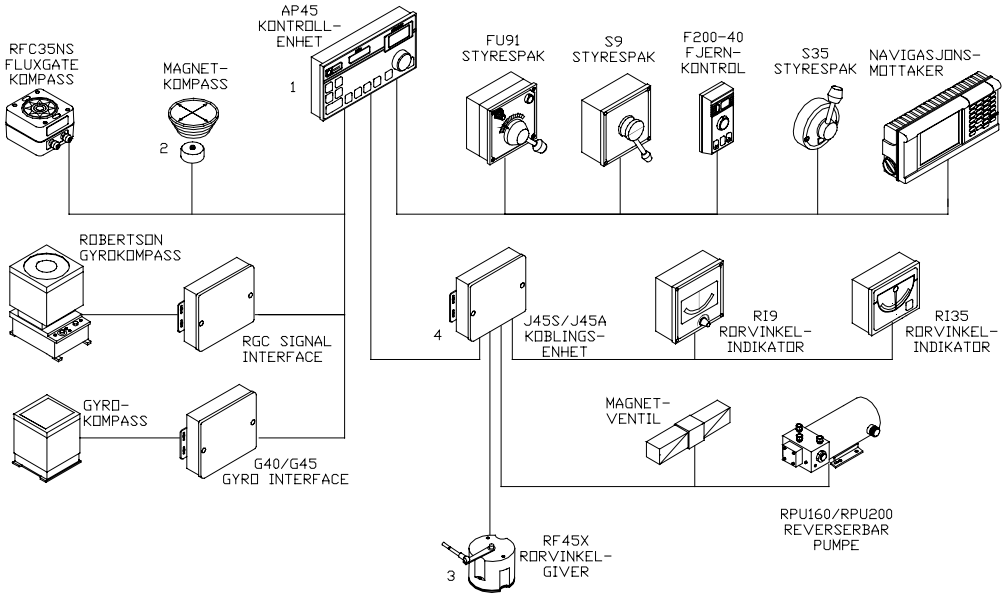


Fig. 1-1
AP45 System layout - Basic system with options

AP45 Control Unit

All settings and operation of the autopilot take place on the control unit. In addition to push buttons it has two LCD-displays and a course selector knob on the front panel. The control unit is made of seawater resistant aluminium and has a polyester coating to protect it against the environment. The main electronics are located in the control unit, and connection to other system components are by high quality connectors to facilitate reliability and easy maintenance.

Heading Sensors

The AP45 autopilot can be used with one of three different types of heading sensors:

1. Magnetic compass with CD109 Course Detector
2. RFC35NS Fluxgate compass*
3. Gyrocompass (using optional G40A or G45 Interface Unit)

*) For other types of Fluxgate Compass the FI100-40 Fluxgate Interface must be used.

CD109 Course Detector

CD109 is a magnetic sensor in moulded plastic which is mounted on the vessel's magnetic compass to transfer the heading to the control unit.

RFC35NS Fluxgate Compass

This is an electronic sense unit with NMEA- and sine/cosine output. The compass has a 0,3 m ”pigtail” cable. RFC35NS substitutes the RFC250 Fluxgate compass. RFC250 cable (P/N 20183554) is necessary at new installations.

G40A/G45 Gyro Interface Unit

The gyro interface unit is connected between the AP45 and a gyro compass. It utilises the repeater signal output from the gyro compass to generate a sine/cosine heading signal for the autopilot.

G40A to be used with stepper or geared synchro signal. G45 to be used with synchro 1:1 signal.

FI100-40 Fluxgate Interface

FI100-40 is an interface unit to be connected between the AP45 and an electronic fluxgate compass with sine/cosine output, e.g. VDO, Marinex, Sowester, Brooks & Gatehouse.

Rudder Feedback Units

RF45X Rudder Feedback Unit

This unit transmits two electrical signals proportional to the rudder angle. One signal operates as a feedback for the autopilot, the other as drive signal for rudder angle indicators. The unit is mounted close to the rudder stock and is mechanically connected to the rudder by the T45 Transmission link.

RF14XU Rudder Feedback Unit

This unit can replace the RF45 Rudder Feedback Unit in installations where a more rugged construction of the feedback unit is preferred. Besides electronic circuitry to generate feedback signals for the autopilot and rudder angle indicators it has been provided with 2 sets of limit switches. RF14XU can not drive the RI101 Rudder Angle Indicator, but all other types of Robertson indicators.

Junction units

Except for a bigger cabinet, the J45S and the J45A junction units described in this manual are identical to the previous versions, J200S-40 and J101A-40 respectively.

J45S Junction unit

The J45S Junction Unit will operate continuously running hydraulic power units with directional valves as Robertson RPU3 or similar. The unit contains a printed circuit board with terminal block, fuse, galvanic isolated solid state output to switch the solenoids and start relay for the Power Unit. All mounted in an aluminium cabinet with polyester coating.

J45A Electronic Junction Unit

The unit provides variable speed control of reversible hydraulic power units (e.g. Robertson RPU80, RPU100 RPU160 or RPU200) and mechanical power units (MRD100 or HLD2000). The unit consists of a printed circuit board with terminal block, fuse and drive electronics, mounted in the same type of aluminium cabinet as the J45S.

Optional equipment

A series of options are available for the basic AP45 system.

Remote Controls

S9 Non-follow-up (NFU) steering lever

S9 is a splash proof steering lever for bulkhead or console mounting. The unit is constructed of a machined aluminium housing. The internal mechanism of the S9 permits locking of the lever in the mid-position to avoid inadvertent operation. When connected to the AP45, the S9 can also be used to switch the mode of the autopilot when the lever is pulled out or pushed in.

FU91 Follow-Up (FU) steering lever

FU91 is a splash proof steering lever for bulkhead or console mounting. The unit has a 45-0-45 degrees dial and a Push to take command button. By positioning the lever, a desired rudder angle can be set without using a rudder angle indicator. Dimensions and design are the same as the S9, and it has a mid-position detent.

S35 Non Follow Up (NFU) Steering Lever

S35 is designed for indoor and outdoor bulkhead mounting. The lever is spring loaded to midposition. It also has a “Mode” button that is not used when connected to AP45.

F1/2 Remote Control (NFU)

F1/2 is a handheld control for push button steering, fitted with a rubber grip. It is made of cast seawater resistant aluminium and fitted with a 10 meter (30 ft.) cable.

F200-40 Remote Control

F200-40 is a multifunction hand held remote control with a 4-digit LCD display and a course selector knob to set course or rudder angle. It has push buttons for power steering, course adjustment and mode selection between power steering, dodging and auto steering. The unit consists of a PC board mounted in a splash proof aluminium cabinet fitted with a 7m (23 ft) cable connecting to the control unit.

Rudder Angle Indicators

RI9 Rudder Angle Indicator

RI9 is an analogue indicator showing the rudder position at angles up to 45 degrees on each side of midship position. The scaling is 2 degrees pr. division.

The scale illumination is adjustable by a knob on the front.

The housing is constructed of painted aluminium intended for either bulkhead or console mounting. The splash proof construction is suitable for exposed mounting locations.

RI35 Rudder Angle Indicator

RI35 is an analogue indicator showing the rudder position at angles up to 45 degrees on each side of midship position. The scaling is five degrees pr. division.

A front panel key is used for rudder zero adjustment and illumination adjustment.

The splash proof construction allows panel, bulkhead or bracket mounting in exposed locations, such as bridge wings as well as wheel house and engine room.

RI35 is delivered with a 20 meter (65 feet) cable.

2. OPERATION OF THE AUTOPILOT

General

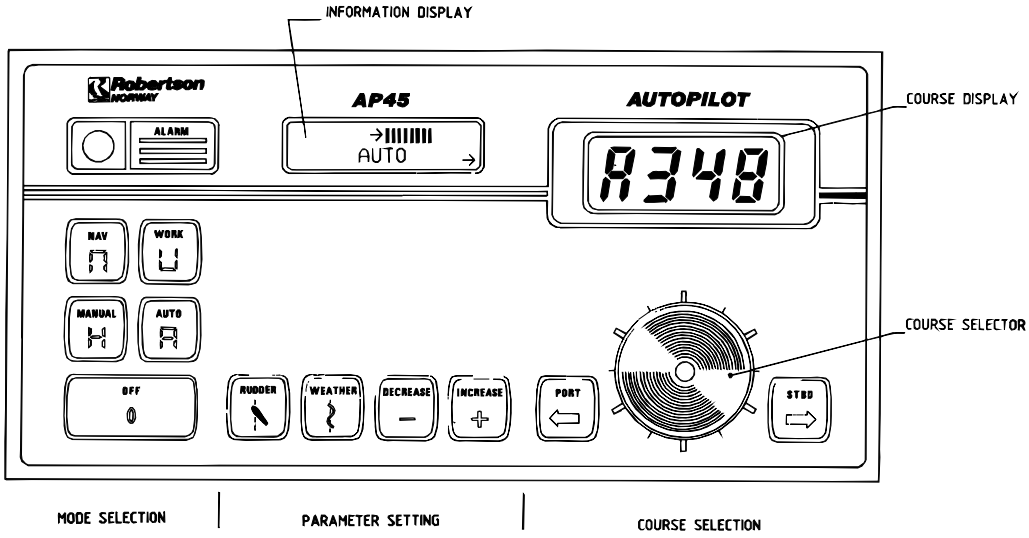


Fig. 2-1
AP45 Control Unit - front panel

AP45 autopilot is operated by means of keypad push buttons on the front panel. To facilitate operation, the buttons are marked with text and symbols. The buttons are backlighted, activated mode buttons being brighter than the others.

Course selection is made by the rotary Course Selector Knob. Course adjustments in steps of one degree can be achieved by the port or starboard push buttons.

The front panel has two LCD displays, referred to as the information display (left side) and the course display (right side). An alarm buzzer and an alarm reset button is also on the front panel.

A few simple operations like pressing a button and/or turning the Course Selector Knob is required in ordinary use of the autopilot. All other instructions and data required for the operation is stored in the autopilot at delivery from Robertson.

Front Panel

The front panel can be divided into three sections: Mode selection, Parameter setting and Course selection.

Mode selection

Together with the OFF-button and the 4 mode buttons, this section also contains an alarm buzzer and ALARM RESET-button.

MANUAL

The MANUAL button serves two purposes. It switches on the autopilot and selects manual steering mode. In this mode the Course Display gives a digital readout of compass heading, while the vessel can be steered manually by helm or steering lever(s).

AUTO

The AUTO-mode is used under normal conditions when the boat is steered automatically on a preset course.

When the AUTO-button is pressed, the autopilot selects the current vessel heading as "course to steer".

Any difference between course to steer and the vessel's actual heading will then be shown as a bargraph in the Information Display. One bar equals one degree.

Rudder commands are indicated by an arrow in the lower left or right corner of the information display depending upon which direction the autopilot commands the rudder to move.

WORK

The WORK-mode is an automatic mode to be used under operational conditions different from those normally found when a vessel is under motor power on a preset course. Examples are trawling, towing, sailing, slow speed etc.

In WORK-mode the PORT- and STBD-buttons can be used for immediate rudder off-set (trim) if necessary. This manual off-set compensates for the built-in autotrim which needs time to build up the appropriate off-set.

The Information Display shows the off-set value when the PORT- or STBD button is pressed.

Boats under sail power and some trawlers may need a rudder off-set when steered by hand. To avoid cancellation of the rudder off-set when changing to automatic steering, the WORK-mode can be selected directly from MANUAL-mode. The rudder off-set is then maintained as "on course" reference. This off-set is also maintained when changing from WORK to NAV mode.

If the AUTO-mode is selected from MANUAL-mode, the rudder is first taken to midposition before a sufficient off-set of the rudder is built-up automatically (autotrim).

A different RUDDER value may be preferred in WORK-mode as compared to that in AUTO-mode. The WORK-mode value will be stored in the AP45 memory for later use.

Note!

Pair-trawling that requires manual trim only, will also require that the autotrim be disabled. Refer to "Disengage of autotrim-function in WORK-mode", page 6-5, for specific details.

NAV

NAV-mode is used when a navigation receiver is connected to the autopilot for automatic waypoint steering. To be able to use the NAV-mode with older AP45 (below s.n. 4000), the main PCB must be equipped with the N40 Navigation Interface.

When the NAV-mode is selected, the AP45 automatically monitors the signals from the navigation system. If the signals are absent or in a different format than the data format selected in the AP45, an alarm will be given to alert the operator. See "Navigating with the AP45" page 2-5.

OFF

The autopilot is switched off by pressing the OFF-button for 2 seconds, during which time the alarm will sound. The alarm ceases when the AP45 is switched off. If the OFF-button is released before two seconds have elapsed, the autopilot will continue to operate as before and the alarm signal is automatically reset.

Rudder commands will stop as long as the OFF-button is pressed. All pre-set parameters in the autopilot are stored while the unit is switched off.

ALARM

The acoustic alarm is reset by pressing the red alarm push button.

Alarm messages shown on the information display are described under “Fault warnings”, page 2-16.

Parameter setting

General

The middle section of the AP45 control unit contains 4 push buttons and an Information Display. The display shows selected mode, deviation from set course, parameter settings and other user information. When RUDDER or WEATHER buttons are pressed, the display shows which button has been activated and to what level the value has been set by the number of bars as well as in plain figures. The display returns to normal read-out, showing the selected mode one minute after the last press on one of the buttons.

The text in the Information Display can be in one of five selectable languages: English, French, German, Spanish and Norwegian (see “Select language”, page 6-3.

Turn on

Turn on the AP45 by pressing the MANUAL button. The information display will show for approx. three seconds:

SOFTWARE V_R_ MANUAL

Then it switches to:

NON FOLLOW UP MANUAL

If the autopilot is connected to and set up for a gyrocompass with geared synchro or stepper signal, the display will show at turn on:

GYROADJUST PRESS +/-

Use the + or - button until the autopilot display shows the same heading as the gyrocompass.

Then press the MANUAL button and the display will again show:

NON FOLLOW UP MANUAL

When clear of obstacles and in open waters, steer your vessel on course and press the AUTO button.

The display will now show:

→|← AUTOMATIC

and the autopilot will automatically keep your vessel on course.

INCREASE and DECREASE

These buttons are used to alter various settings. Each time one button is pressed, the value shown on the Information Display, will increase (+) or decrease (—) by one unit. The value is also shown as a graphical bar. If a button is pressed for more than two seconds, the value will automatically increase or decrease until the button is released.

RUDDER

When the RUDDER button is pressed, the Information Display shows selected RUDDER value. The RUDDER value sets the ratio between rudder angle and heading error (p-factor).

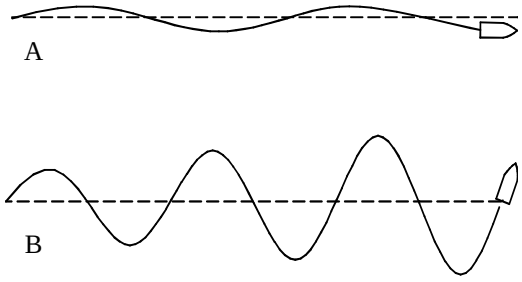
Example: If RUDDER is set to 1.0 and there is a heading error of 2 degrees, the rudder angle will be 2 degrees. (Heading error x RUDDER value = rudder angle).

The correct RUDDER setting is dependant upon the size and speed of the vessel. The RUDDER value should increase with decreasing speed.

RUDDER should be set separately in WORK-mode, to optimise the autopilot performance.

Examples of incorrect RUDDER settings:

A value which is too low gives relatively large and slow oscillations (s-ing) around set course, and several rudder commands are given in the same direction before the vessel is back on course.



A value which is too high will give quick and in worst case increasing oscillations (s-ing) around set course.

The correct setting of RUDDER will be approximately in the middle of the settings described in A and B above.

WEATHER

The WEATHER setting determines the amount of degrees the vessel may fall off the set course before any response is given from the rudder. In calm weather it should be set to OFF which means that theoretically the autopilot allows no deviation from set course. The WEATHER value should be increased with increasing sea state.

In conditions where active steering is required, (e.g. following sea condition), the value should be reduced.

Course selection

The course selection section on the autopilot consists of a course display, a course selector knob and two course adjustment buttons, PORT and STBD.

The Course Display gives a readout of actual ships heading in MANUAL-mode and set course in AUTO-, WORK- and NAV-mode. The selected mode is also shown to the left on the display by the same letter as on the mode buttons.

The course selector knob is used for major course changes in AUTO- and WORK-mode. To activate the knob it must be pressed down, released, and then turned. Clockwise turns gives a starboard course change and vice versa. One revolution on the course selector knob is equal to a 60 degree course change. If the knob is not turned within 10 seconds, it has to be pressed again.

The PORT and STBD push buttons are for minor course adjustments, pressed once gives a one degree course change in the appropriate direction. **In WORK-mode however, the buttons are used for manual rudder trim, and course changes can therefore only be made by the course selector knob.**

Navigating with the AP45

The AP45 has the capability to use steering information from an external navigator (GPS, LORAN, Plotter) to direct the boat to a specific waypoint location, or through a route of waypoints. In the NAV mode, the AP45 uses the heading sensor as it's primary source of heading for course keeping. The steering information received from the external navigator alters the set course to direct the AP45 to the destination waypoint.

Note!

Navigational steering must only be used in open waters. The process of having an external navigation receiver direct an autopilot can be a slow acting process. By selecting the NAV mode, the AP45 is set for automatic steering on the current set course and then waits for the user to accept the course change to the destination waypoint.

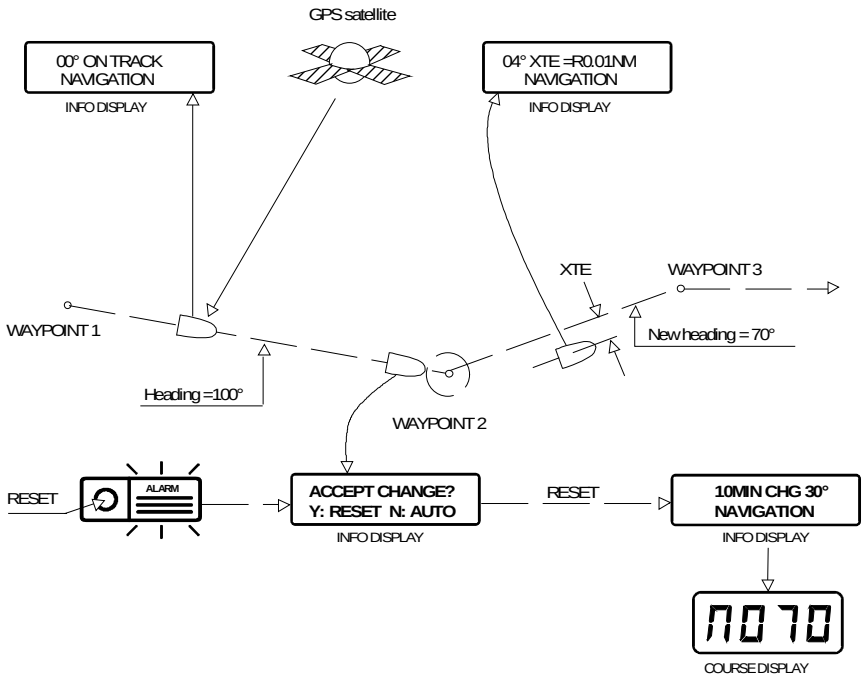
To obtain satisfactory navigation steering, the following points must be fulfilled prior to entering the NAV mode:

- The AP45 autosteering must be tested and found satisfactory.
- The navigation receiver must be operating and the navigation system (GPS, LORAN, Decca) must be in full operating mode with adequate signal characteristics for valid position and steering data.
- The magnetic compass or Fluxgate must have a minimum of deviation.
- At least one waypoint must be entered and selected as the current waypoint in the navigation receiver.

Mixed mode, XTE & CTS

The AP45 is from the factory set up to steer in mixed mode operation (CTS & XTE). This combines the straight steering capability of cross track error (XTE) steering in conjunction with the turning capability of bearing mode steering (CTS).

When operating the AP45 in NAV mode to automatically steer through a route of waypoints, it will steer to the first waypoint in the route after you accept the first waypoint as the location to steer to. When you arrive at the waypoint, you will need to verify that the upcoming course change is acceptable. Verification is performed by pressing the Alarm reset button after the alert screen is displayed. If no verification is received, the AP45 will continue on the current set course in AUTO mode.



Note!

Steering through a route of waypoints with the AP45 allows you the total flexibility for automatic waypoint sequencing, but combines the safety feature of requiring operator acknowledge for course changes in excess of 10 degrees.
If the AP45 is connected to a Nav. receiver that does not transmit a message with bearing to next waypoint, it will pick a XTE message and steer on Cross Track Error only. In that case you have to revert to AUTO mode at each waypoint and manually change set course to equal bearing to next waypoint and then select NAV mode again.

XTE mode

When the AP45 steers using cross track error only, it corrects the set course in order to keep the vessel on a straight track between two waypoints. Bearing change at waypoints must be made manually by temporarily go to Auto mode - change set course - and revert to Nav. mode.

Use the following procedure for XTE steering:

1. Enter the desired bearing line(s) to the Nav. receiver using the present position and the first waypoint or destination. Distance between waypoints should be of minimum 2-3 n.m. Otherwise there may not be sufficient time for the system to calculate the XTE, and for the autopilot to alter the course and bring the vessel onto the bearing line again.
2. Read the calculated bearing to waypoint from the Nav.receiver.
3. Select AUTO-mode on the AP45, and set the course to the waypoint showed on the navigation receiver.
   Before going to step 4, ensure that the XTE is within +/- 0.1 n.m. to avoid hazardous course change when selecting NAV-mode.
4. Select NAV-mode on the AP45. The autopilot now automatically changes the set course to reduce the Cross Track Error (XTE) to zero. The information display shows the number of degrees the autopilot has changed the set course, and the XTE in 1/100's of a nautical mile. Note that the display readout will be delayed, depending upon the NAV. FILTER setting.

Example:

05° XTE=R 0.02Nm NAVIGATION

R indicates that the vessel is located to the right of the bearing line, and L indicates to the left of the bearing line.

00° ON TRACK NAVIGATION

05° is the number of degrees course correction relative to initial set course. As the vessel approaches the bearing line, the correction value decreases and when the vessel is on track, the information display shows:

Note!

The display may show X number of degrees course correction even if it says "ON TRACK".

5. As the vessel gets within the arrival circle set on the navigational receiver, or as the vessel passes the perpendicular line to the waypoint, the receiver transmits a "data not valid" signal to the autopilot. An alarm will then activate and the course to steer will no longer be updated.

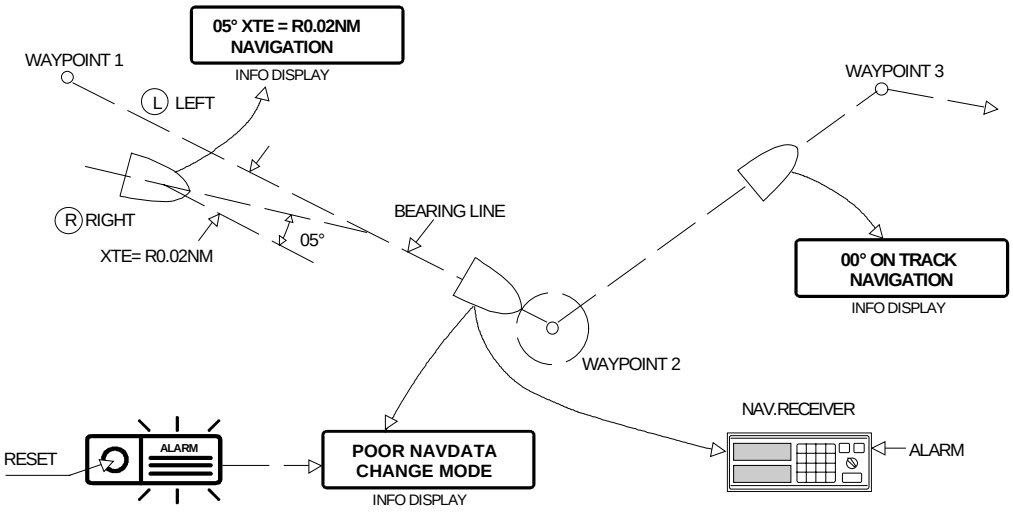
To proceed to the next waypoint, the procedure should be repeated from step 2 onwards.

Procedure:

- Reset the alarm on the autopilot and navigational receiver.
- Select "AUTOPILOT" mode on the autopilot
- Use Course Change knob/buttons on the autopilot to set the new course given by the Nav. receiver.
- Press "NAV"

NOTE!

Navigational steering is a slow acting process and the vessel normally follows the bearing line with a deviation of ±0.02 - 0.03 n.m.(40-50 meters). Higher deviation may temporarily occur due to rapid change of current, wind, speed or at start-up from a position off the track line.



Steering by bearing to waypoint (CTS)

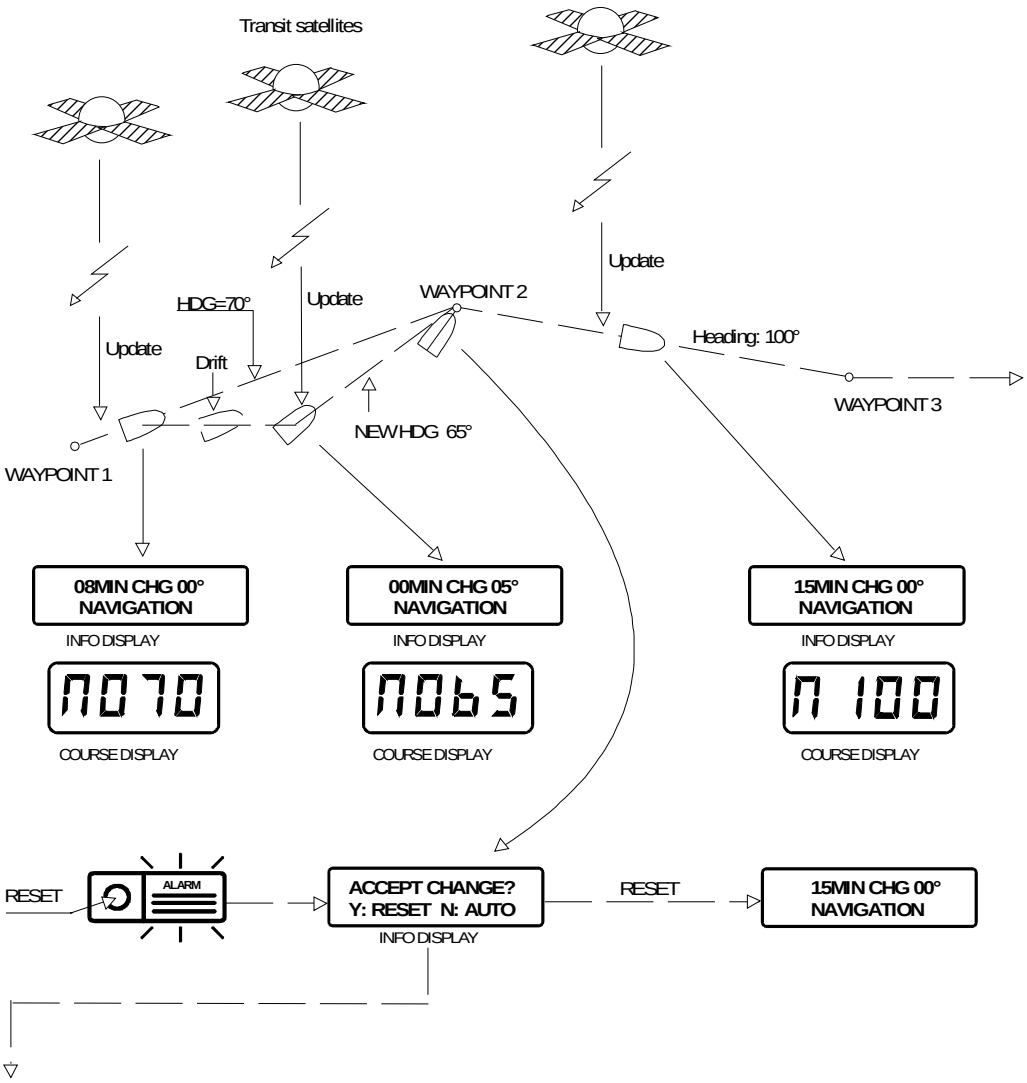
For some navigational receivers, bearing to a waypoint or course to steer is used as the steering information.

If a satellite navigator is used, it should have compass and log input to ensure proper dead reckoning between each fix.

1. Set the navigation receiver to calculate bearing to a waypoint from present position.
2. Select AUTO-mode on the AP45, and set the course selector knob to the bearing showed on the navigation receiver.
3. Select NAV-mode. The output signals from the navigation receiver will correct the course to steer to make the vessel steer towards the waypoint.
   The Information display shows time since last update and the amount of course change in degrees, while the course display shows the new course to steer.

08 MIN CHG:05°
NAVIGATION

1. If the corrections from the navigation receiver initiates a course change greater than 10 degrees, the autopilot alarm is activated and the course change has to be acknowledged using the ALARM RESET button.
   A typical sailing situation is illustrated in figure below.



Waypoint 2 has been reached. Continue as follows:

- If the heading to next waypoint, showed on the heading display, is accepted, press RESET.
  If not, press AUTOPILOT mode and continue without Nav. Steering

By pressing RESET, the new heading is automatically entered and the autopilot will turn the vessel towards the new heading.

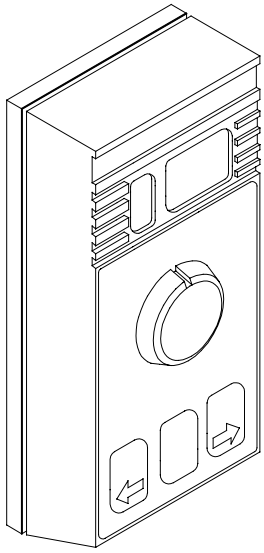
When reaching waypoint 3, repeat the same procedure.

Remote Controls General

The different types of Remote Controls that can be connected to AP45, have different way of operation, depending on the system configuration.

F200-40 Remote Control

The F200-40 hand held remote control makes it possible to remotely control the AP45 autopilot.



The following control functions are obtainable:

- Display that shows vessel heading or set course like the course display on the control unit.
- Course selection by a rotating knob
- Course adjustments by push buttons
- Mode selection
- Manual steering by course selector knob (Follow-Up)
- Manual steering by push buttons (Non-Follow-Up)

Option (selected during installation or sea trial):

- Dodging by means of course selector knob and automatic return to previous set course.

F200-40 without dodging

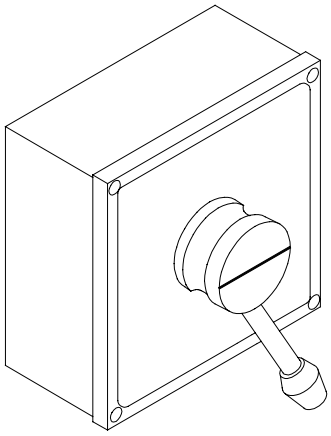
Press	AP45 Mode	Function	AP45 Display	F200 Display	
	MANUAL	NFU steering by F200 PORT/STBD push buttons	NON FOLLOW UP MANUAL	H 080	Vessel's heading
MODE	MANUAL	Follow-Up steering by F200 course selector	F200 FOLLOW UP MANUAL	F ¯ 00	Amidships, no rudder command
				F ⌈ 04	4° port rudder command
				F ⌉ 32	32° starboard rudder command
MODE	AUTO	Autosteering Course set by the AP45/F200 course selector or PORT/ STBD button on both	→ ← AUTO	A 146	Set course
MODE					

F200-40 with dodging

Press	AP45 Mode	Function	AP45 Display	F200 Display	
	MANUAL	NFU steering by F200 PORT/STBD push buttons	NON FOLLOW UP MANUAL	H 080	Vessel's heading
MODE ↓	MANUAL	Follow-Up steering by F200 course selector	F200 FOLLOW UP MANUAL	F ⁻00	Amidships, no rudder command
				F ⌈ 04	4° port rudder command
				F ⌉ 32	32° starboard rudder command
MODE ↓	AUTO	Autosteering Course set by the AP45/F200 course selector or PORT/ STBD button on both	→ ← AUTO	A 146	Set course
MODE long press	Returns to MANUAL				
MODE short press	AUTO	DODGING made by the F200 course selector	* * * * * * * DODGING	F ⁻00	Amidships, no rudder command
				F ⌈ 04	4° port rudder command
				F ⌉ 32	32° starboard rudder command
MODE		Returns to previous set course			

S9 Steering Lever

The S9 steering lever is intended for use together with e.g. AP45 Autopilot. Several units can be connected in parallel, but only if configured as alternative 1 (see next page)



Operation

Activation is achieved by pulling out the lever. The lever is spring loaded to mid position, and can be used for starboard or port rudder commands. After finishing the manoeuvres the lever will be locked when pushed back to non-operational position.

Alternative operation.

The S9 can be configured in four alternatives. At delivery from Robertson the S9 is connected for alternative 1. If alternative 2, 3 or 4 is to be used, S9 has to be modified according to the chapter “S9 Steering Lever”, page 5-26.

Note!
If a F200-40 also is connected, only alternative 1 can be used.

Alternative 1 (No resistor)

S9 Lever	AP45 Mode	Function	AP45 Displays	
IN	MANUAL	S9 locked	NON FOLLOW UP MANUAL	H 080
OUT	MANUAL	NFU steering by moving lever to left or right	NON FOLLOW UP MANUAL	H 080
IN	AUTO, WORK	S9 locked	→ ← AUTOMATIC	A 146
OUT	AUTO, WORK	Course change by moving lever	→ ← AUTOMATIC	A 146

Alternative 2 (R = 1K)

S9 Lever	AP45 Mode	Function	AP45 Displays	
IN	MANUAL	S9 locked	NON FOLLOW UP MANUAL	H 080
OUT	MANUAL	NFU steering by moving lever to left or right	NON FOLLOW UP MANUAL	H 080
IN	AUTO, WORK	S9 locked	→ ← AUTOMATIC	A 146
OUT	AUTO, WORK	Dodging made by lever	DODGING	H 080
IN	AUTO, WORK	S9 locked. Return to previous course	→ ← AUTOMATIC	A 146

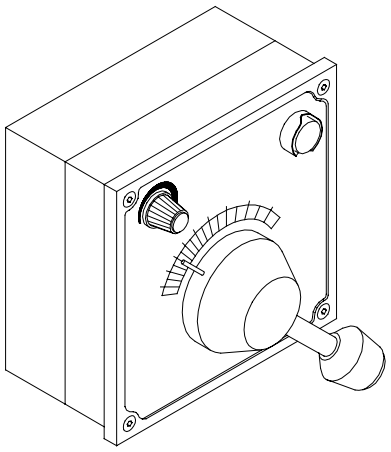
Alternative 3 (R = 3K)

S9 Lever	AP45 Mode	Function	AP45 Displays	
IN	MANUAL	S9 locked	NON FOLLOW UP MANUAL	H 080
OUT	MANUAL	NFU steering by moving lever to left or right	NON FOLLOW UP MANUAL	H 080
IN	AUTO, WORK	S9 locked	→ ← AUTOMATIC	A 146
OUT	MANUAL	NFU-steering by moving lever	NON FOLLOW UP MANUAL	H 080
IN	MANUAL Remains in manual mode until new mode has been selected on control unit.	S9 locked. Return to previous course	NON FOLLOW UP MANUAL	H 080

Alternative 4 (R = 5,1K)

S9 Lever	AP45 Mode	Function	AP45 Displays	
IN	MANUAL	S9 locked	NON FOLLOW UP MANUAL	H 080
OUT	MANUAL	NFU steering by moving lever to left or right	NON FOLLOW UP MANUAL	H 080
IN	AUTO, WORK	S9 locked	→ ← AUTOMATIC	A 146
OUT	MANUAL	NFU-steering by moving lever	NON FOLLOW UP MANUAL	H 080
IN	AUTO, WORK	S9 locked. Continues on new set course, same as vessel's heading	→ ← AUTOMATIC	A 080

FU91 Follow up Steering Lever



Operation

The FU91 is activated by operating the push to take command (PTTC) button. When in "COMMAND", the button light is switched on and the autopilot INFO display will show:

FOLLOW UP HELMSMAN

Rudder commands are made by setting the lever to the required rudder angle, wherafter the rudder will move to the commanded angle and stop.

FU91 may be connected to AP45 in two different ways. See Fig. 5-32 and Fig. 5-33

FU91 without mode switching

The lever can only be activated when the autopilot is in Helmsman mode. Pressing the PTTC button repeatedly will toggle between NFU and FU mode on AP45. See table below.

FU91 Switch	AP45 Mode	Function	AP45 Displays	
OFF	MANUAL	NFU steering by NFU lever or push button control	NON FOLLOW UP MANUAL	H 085
ON	MANUAL	Follow Up steering by moving FU91 lever to desired rudder angle as read on FU91	FOLLOW UP MANUAL	H 085
ON-OFF	AUTO	Automatic steering	* * * * * AUTO	A 080

Note!

If the Helmsman button is pressed when the FU91 is active, or if a NFU lever is operated, the autopilot will go to NFU mode even though the PTTC button light is on. However, as soon as the FU91 is operated again (lever is moved), the autopilot will resume FU mode.

For safety reason, the FU91 should always be switched to OFF when not in use.

FU91 with mode switching

The lever can be activated also with autopilot in Auto mode. Pressing the PTTC button brings the AP45 into Helmsman mode. What mode/sequence you get when pressing the PTTC button again is depending on which value of the resistor R is installed (Ref. page 5-29)

R = 1K: Auto - Dodge - Auto (previous course)

R = 3K: Auto Manual - Manual

R = 5,1K: Auto - Manual - Auto (new course)

The mode change sequence is in principle similar to S9 operation alt. 2, 3 and 4 explained at page 2-12 and 2-13.

Multiple FU91 installation

The operation of each lever is identical to above description of a single lever. Activating one FU91 will deactivate the one that was previously active.

FU91 and S9 connected to the same autopilot

It is recommended not to have both S9 and FU91 in operational condition at the same time. This may create confusion and inadvertent operation. The main rules are:

- Always put the S9 lever to locked position after use .
- Always switch the FU91 to OFF after use.

Fault warnings

The following fault warnings may be shown on the Information Display:

OFF COURSE
RESET ALARM

Course deviation is greater than selected off course alarm limit. Press the Alarm button to cancel the alarm. The alarm is automatically reset when the vessel is back within the limit.

RUDDER FEEDBACK
FAIL!

Indicates that the autopilot is not reading rudder feedback signal. By pressing the alarm reset button, the audible alarm will be reset and the autopilot will switch to a simulated signal, instead of the real. This is indicated by a flashing * * SIM * * on the information display. Repair actions should be taken when back in port.

NO RESPONSE
FROM RUDDER

If a rudder command is not executed, or the rudder moves in wrong direction, this message will be shown on the display. The reason can be a malfunction of the steering gear, or simply that the steering gear is not switched on.

NAVDATA NOT REC.
CHANGE MODE

Check that the nav. receiver is turned on and set up properly (see nav. receiver manual).

POOR NAVDATA
CHANGE MODE

Poor reception conditions or improper set-up of nav. receiver.

WRONG DATAFORMAT
NAVRECEIVER

Wrong NMEA-format selected on autopilot or transmitted by nav. receiver.

MAGN.COMP.FAIL
SELECT SENS.TYPE

FLUXGATE FAIL
SELECT SENS.TYPE

GYROCOMPASS FAIL
SELECT SENS.TYPE

All three messages indicate problems with reading the signals from the navigation receiver. If you are unable to cure the problem, the NAV-mode should not be used before a Robertson dealer has been consulted.

These alarms will be given when the autopilot is unable to detect a proper signal from the selected heading sensor. The reason can be a faulty sensor or wrong selection of sensor (See “Type of Heading Sensor”, page 6-4).

DATA FAILURE
CHECK SETTINGS

If the autopilot should lose or read erratic data stored in the memory, this alarm will be given, and the autopilot is simultaneously set to MANUAL-mode.

A selection of standard settings is then automatically entered into the memory. The standard settings will make the autopilot steer, but not to its best performance on all vessels. They should therefore be checked (See “Selection of parameter settings”, page 6-2).

If you prefer not to check the settings yourselves, enter the AUTO mode and consult your Simrad Robertson dealer when back in port.

Only if Watch alarm function is enabled. Ref. “Watch alarm”, page 5-37.

WATCH ALARM
PRESS RES BUTTON

The watch alarm warning signal is repeated every four minutes as long as AP45 is in Auto, Work or Nav mode and is reset by pressing Alarm reset button.

If you want to permanently disable the watch alarm function:

Press the hidden button above the + button entering Debug mode and then press the WEATHER button repeatedly until the information display shows SOFTWARE/RUNTIME. Press the DECREASE (-) button repeatedly (six times) until the display shows DATA FAILURE - CHECK SETTINGS. Press the ALARM RESET button and the Watch Alarm function is disabled.

Note!
This procedure is considered as a “Master reset” of the AP45 and you must therefore check all settings described under “Selection of parameter settings”, page 6-2 or consult your Simrad Robertson dealer when back in port.

For further explanation to Fault warnings, see page 7-1

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3. DESIGN AND THEORY OF OPERATION

Automatic Steering

An autopilot is an apparatus that controls the rudder of a vessel in order to maintain a selected heading.

There are different design principles for such an apparatus, but they all basically operate as shown in Fig. 3-1.

This diagram shows that the vessel's heading is supplied from the compass to a detector circuit. The detector will sense when the vessel is off course and to what side. The detected signal is amplified and directed to either energise the port or starboard solenoids, i.e. make the rudder move one way or the other.

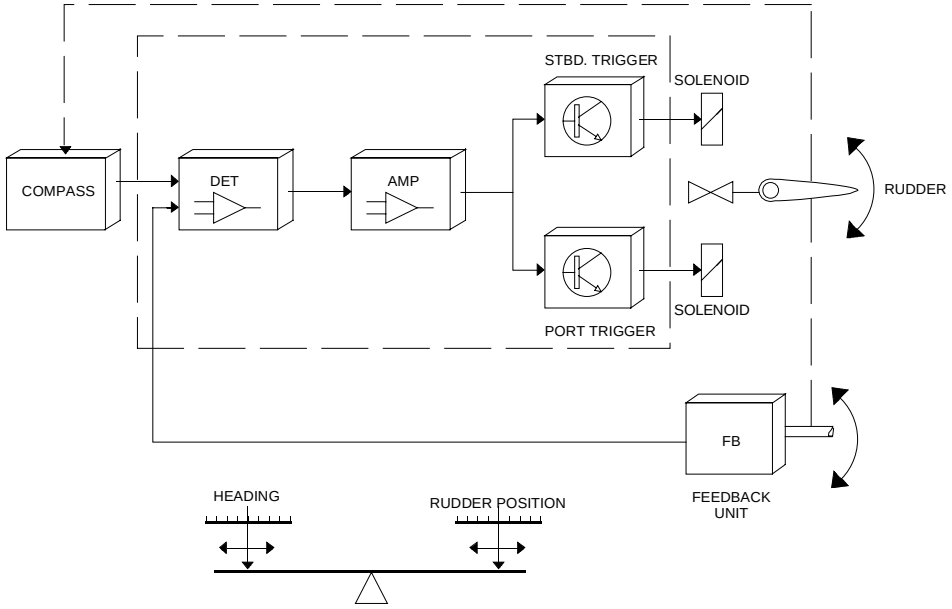


Fig. 3-1
Autopilot principle diagram

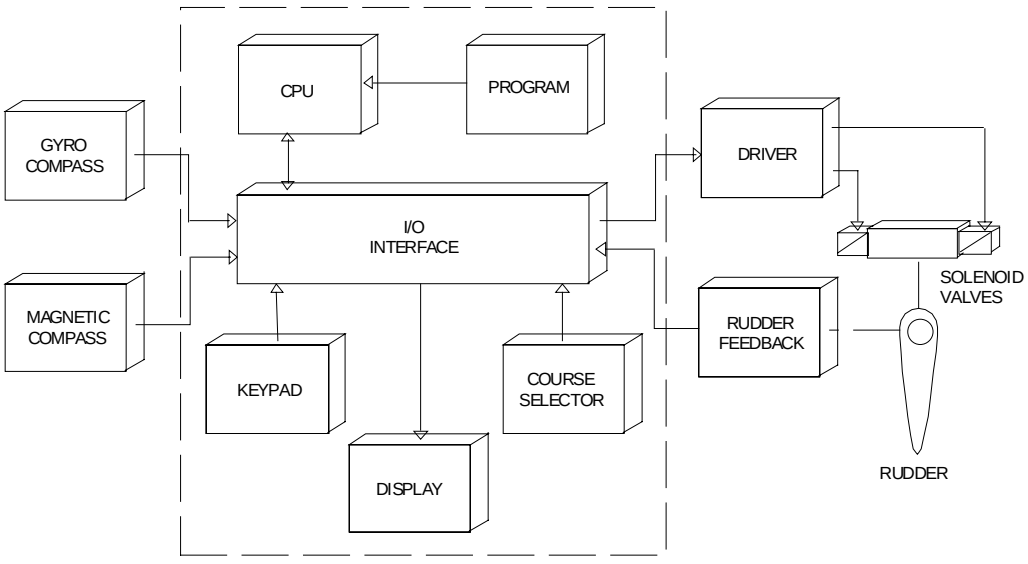


Fig. 3-2
Processor controlled autopilot

In order to stop the rudder movement, a feedback signal is produced from the feedback unit. The feedback signal will be compared with the compass signal and when there is a balance between the two, the solenoid will be de-energised. The rudder has now been moved to a position that makes the vessel turn. This turn is picked up by the compass and causes a new unbalance between the feedback signal and the error signal which energises the opposite solenoid. Now the rudder will start to move back towards the previous position, and the feedback signal will again cancel out the unbalance and de-energise the solenoid to stop the rudder.

By utilising digital technology to perform the function of an autopilot, the typical block diagram will be slightly changed. Even so, the basic operation should be recognised on Fig. 3-2.

As we know, a microprocessor can only do what it has been programmed to. This is called software. The program can be either fixed or partly adjustable to adapt the microprocessor to the individual type of vessels. In Robertson terminology this is called "setting parameters", and it will determine the performance of the autopilot.

AP45 Control Unit

The AP45 Control Unit contains two electronic boards, the Control Board and the Illumination Board. An optional navigation interface board (N40) may be supplied.

The Control Board contains the micro-computing circuitry, and a plug-in PC-board for the Course Display. The alarm circuit is also mounted on this board.

The Illumination board consists of the display backlighting- and the Information display electronics.

All interconnecting plugs for heading sensors, junction unit and remote controls are mounted on the Control Board.

The two boards are interconnected with a ribbon cable which are soldered to the illumination board and plugged into the control board.

All parameter settings and operation of the autopilot are made using the push buttons on the front panel.

CD109 Course Detector

CD109 is a magnetic compass sensor in moulded plastic. It is mounted to a vessel's magnetic compass to transfer the heading information to the control unit. The primary windings are excited by a pulsating signal. Dependant of the magnetism induced by the position of the compass card magnets (Heading), pulses of variable amplitude will be generated in the secondary sine and cosine windings. These pulses are filtered through the R/C network and amplified before entering the A/D converter.

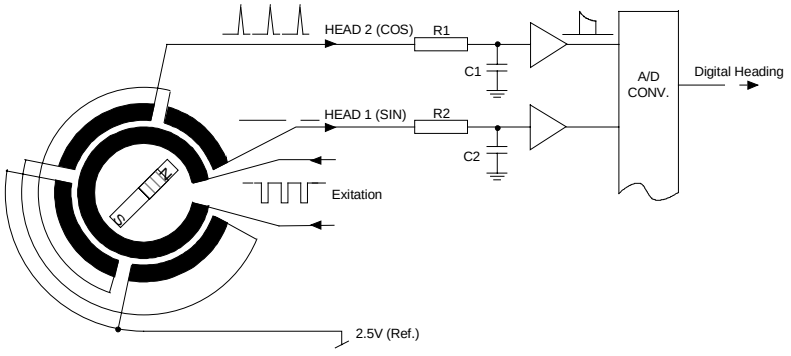


Fig. 3-3
Course Detector principle

Rudder Feedback Units

The rudder feedback unit transmits rudder angle information to the control unit and rudder angle indicators. It is mounted close to the rudder stock and mechanically connected to the rudder tiller arm by a transmission link.

RF45X Rudder Feedback Unit

The RF45X contains a circular PCB carrying all the electronics and a long life potentiometer connected to the PCB by three wires. The unit is repairable in that the electronics and the potentiometer can be replaced.

The electronics have two output circuits. One circuit outputs frequency of 3400Hz as midposition reference. It varies at a rate of 20Hz/degree, increasing when the rudder moves to port and vice versa.

The other circuit outputs a current (0.1-1.1mA), to the rudder angel indicator(s) (RI35 and RI9).

The RF45X is supplied with a fixed 4-wire, screened cable of 2 m (6 ft.). This cable is meant to be spliced in the enclosed splash-proof junction box.

The shaft of the feedback unit is free to travel 360 degrees, but only ±70 degrees from midposition are used for signal control.

The transmission link mechanically connects the feedback unit to the rudder tiller arm. It is made of stainless steel and has standard length of 450 mm.

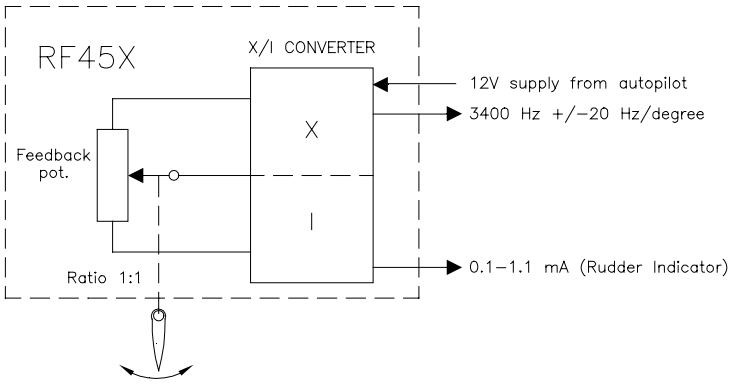


Fig. 3-4
RF45X principle

RF14XU Rudder Feedback Unit (optional)

The RF14XU Rudder Feedback Unit consists of a glass-reinforced fire inhibiting polyester housing with a mounting plate of seawater resistant aluminium. Potentiometer, limit switches and an electronic drive module are also contained in the unit. The electronic drive module comprises a voltage section and a frequency section.

The voltage section outputs a voltage to the rudder angle indicator(s) which is proportional to the rudder angle. The voltage varies ±9V with half of the supply voltage as reference. The voltage should read zero volts with the rudder in midposition.

The frequency section outputs a signal to the control unit with 3400 Hz as midposition reference. It varies at a rate of 20 Hz/degree, increasing when the rudder moves to port and vice versa.

The shaft of the Feedback Unit is free to travel 360 degrees, but only ±90 degrees from midposition are used for signal control.

RF14XU is equipped with two sets of limit switches. One set can be connected in series with the autopilot solid state switch, the other can be incorporated in an independent hand steering system, if required.

Junction Units

J45S Junction Unit

The J45S Junction Unit operates hydraulic power units with directional valves (e.g. Robertson RPU 1 and 3). It has been made for 12, 24 and 32V DC operation. The unit incorporates a printed circuit board with terminal block, fuse, polarity and over voltage protection, isolated solid state output for solenoid switching and start relay for the Power Unit, all mounted in a splash proof aluminium cabinet.

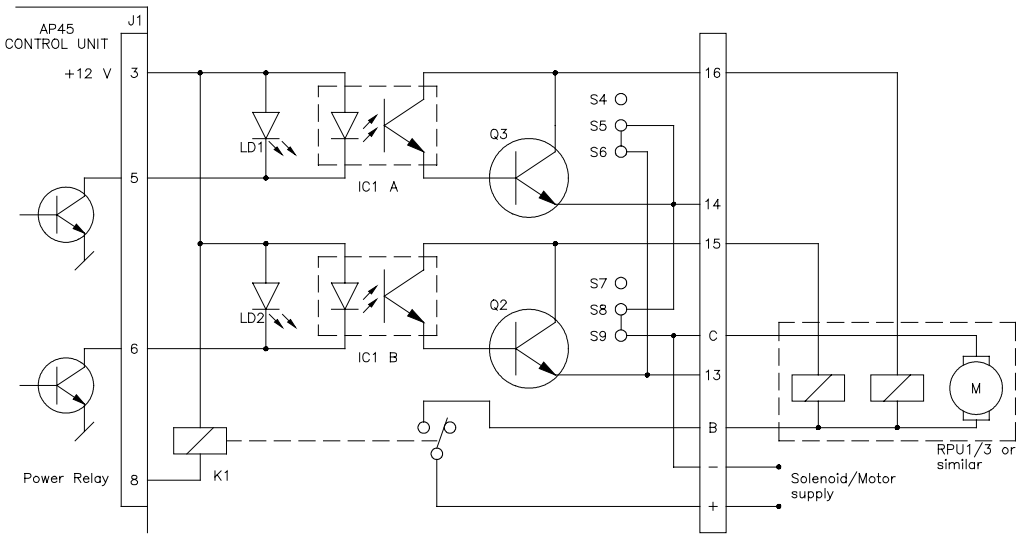


Fig. 3-5
Basic system

The J45S solid state circuit is activated from the output transistors in AP45 Control Unit and LD1/LD2 monitors the rudder commands.

Galvanic isolation is obtained by opto's IC1 A and B. Q2/Q3 switches the solenoids on/off. Relay K1 has a double function: Used as “safe relay”, breaking the solenoid supply when AP45 is switched off and starting the steering gear pump when AP45 is switched on (RPU1 and RPU3).

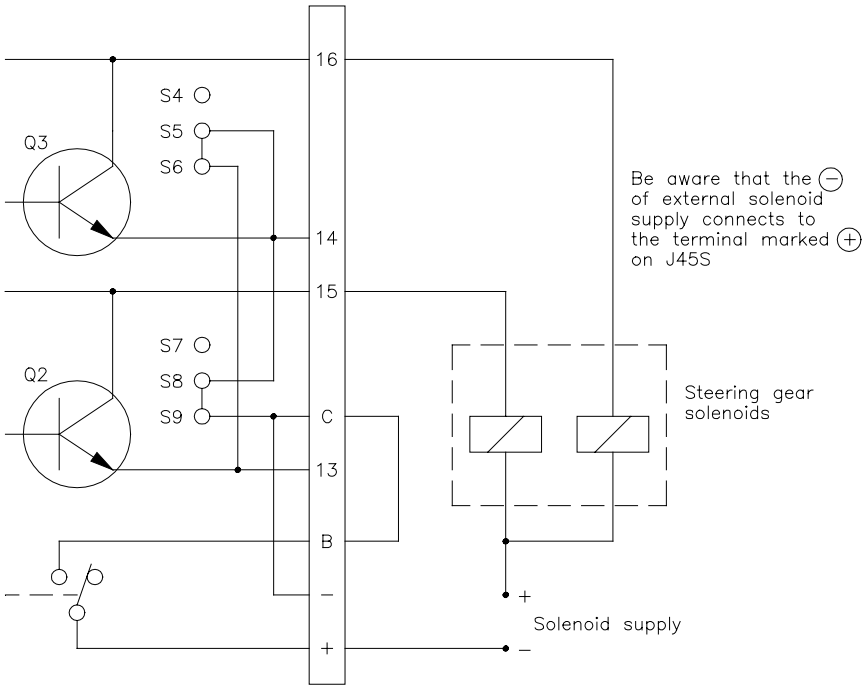


Fig. 3-6
Solenoids with positive common

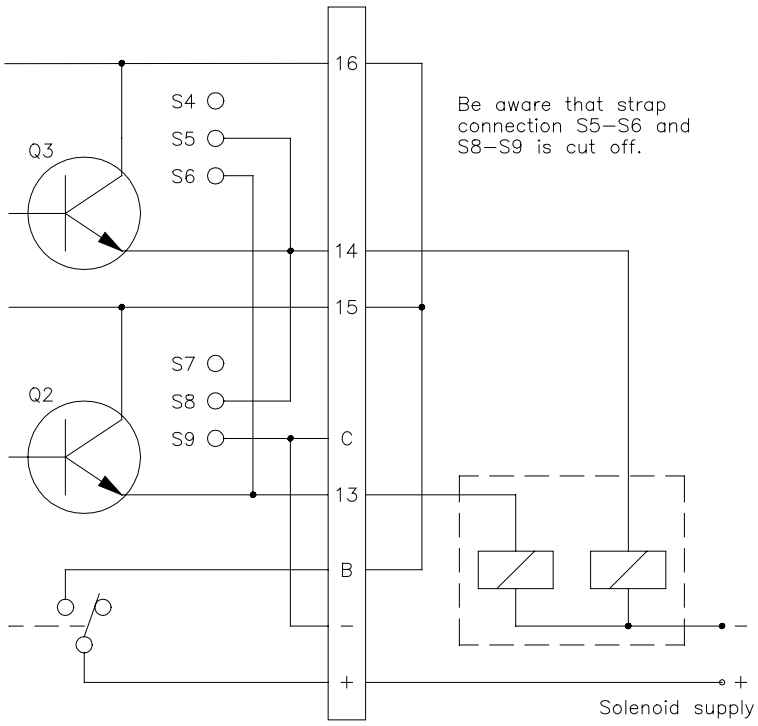


Fig. 3-7
Solenoids with negative common

J45A Electronic Junction Unit

The J45A operates reversible hydraulic power units with variable speed control (RPU80, RPU160, RPU200 and HLD2000) and reversible electro mechanical power units (MRD100). The unit consists of a printed circuit board with terminal block, fuse, motor drive electronics and reversing relay mounted in the same type of aluminium cabinet as the J45S.

Rudder commands from AP45 Control Unit to IC3 A and B makes the relay RL1 change the polarity to the motor. IC2A ensures the motor brake is switched on by T2 when there is no rudder commands from AP45. IC2A also controls a “dead time” (delay) to ensure the RL1 relay contacts have physically changed position before voltage is applied to the motor. This prevents arcing of relay contacts.

Adjusting RV1, preset speed, the output pulse width is decreased/increased, hence the voltage (RMS) to the motor is changed, adjustable 0-12V.

Connecting straps S1 and S2 provides adjustable 0-24V output for 24V drive units.

Connecting an external strap from terminal 2 to 4 will enable a “Soft start” function, which reduces the start current and is recommended for the most powerful drive units like RPU200, RPU300, HLD2000LD and MRD100.

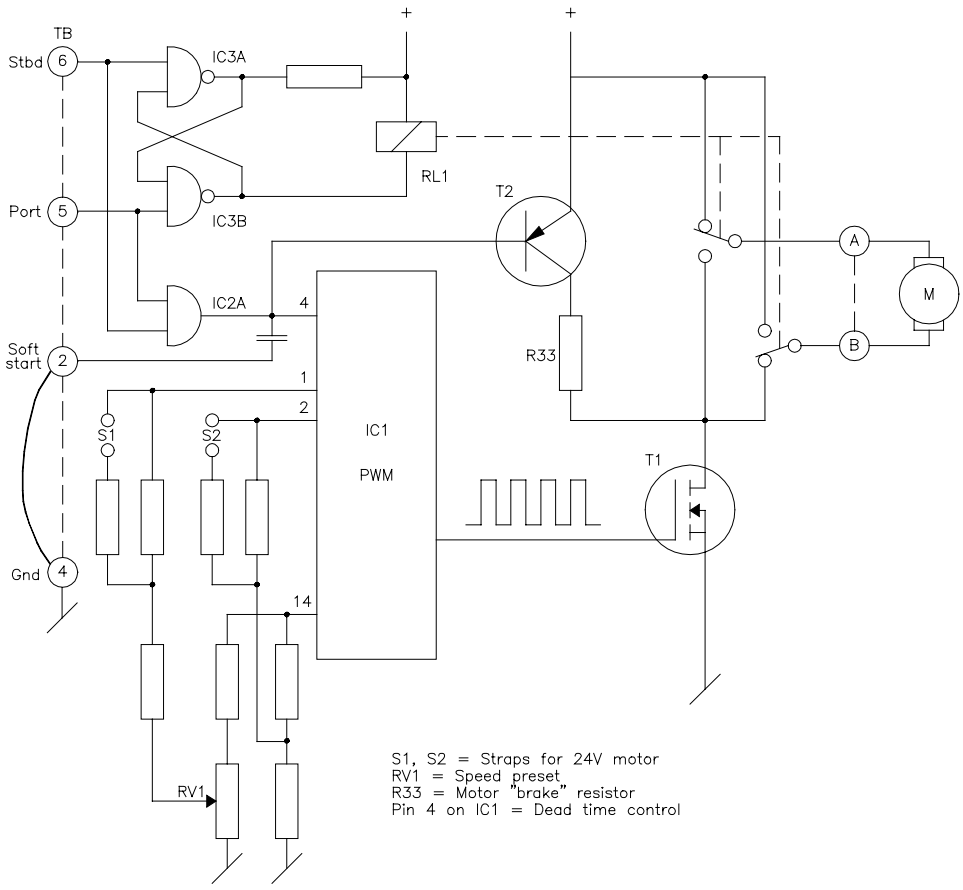


Fig. 3-8
J45A principle

4. TECHNICAL SPECIFICATIONS

AP45 Control Unit

Dimensions: .....See Fig. 4-1
Weight:.....3.0 kg
Protection:.....IP43*
Ambient temperature, storage: .....–25 - +70°C
operation: .....0 - +55°C
Safe distance to magnetic comp.: 0.3m
Maximum current consumption :.....0.6A
Input signals:
Rudder Feedback: .....3400 Hz, 20 Hz/deg.
Magnetic, Fluxgate and Gyro compass: sin/cos ±2V, 2.5V ref.
Nav.signal : NMEA 0183/180 (APA, APB, XTE, XTR, RMB, BWW, BWC, BWR, BOD, HSC).

* The IP code is an international code that deals with protection against intrusion of particles and water. IP43 means that the unit is protected against solid objects greater than 1.0 mm and against spraying water from above up to 60° from vertical. Best protection is obtained with the front mounted horizontally.

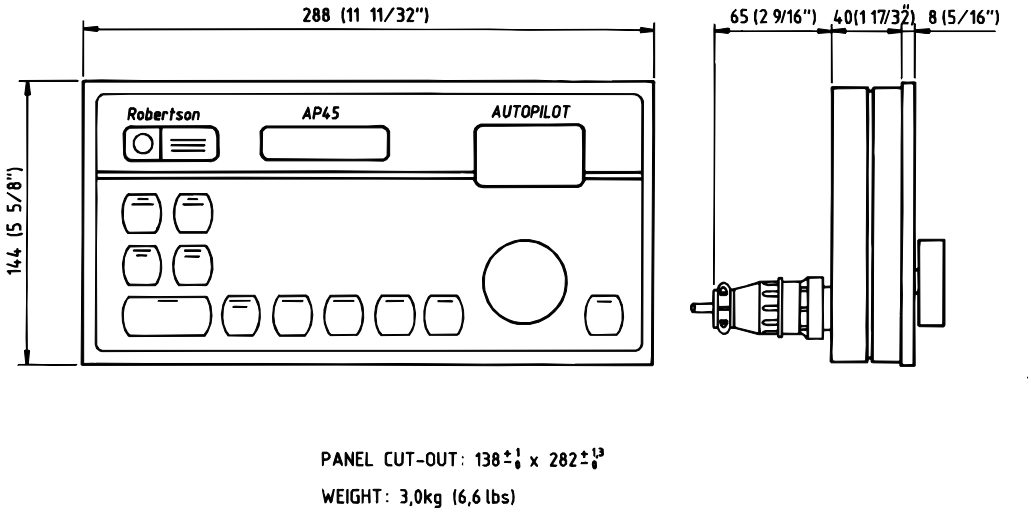


Fig. 4-1
AP45 Control Unit - dimensions

CD109 Course Detector

Dimensions: .....See Fig. 4-2
Protection:.....IP56
Ambient temperature, storage: .....–40 - +85°C
operation: .....–30 - +60°C
Cable length:.....1 m

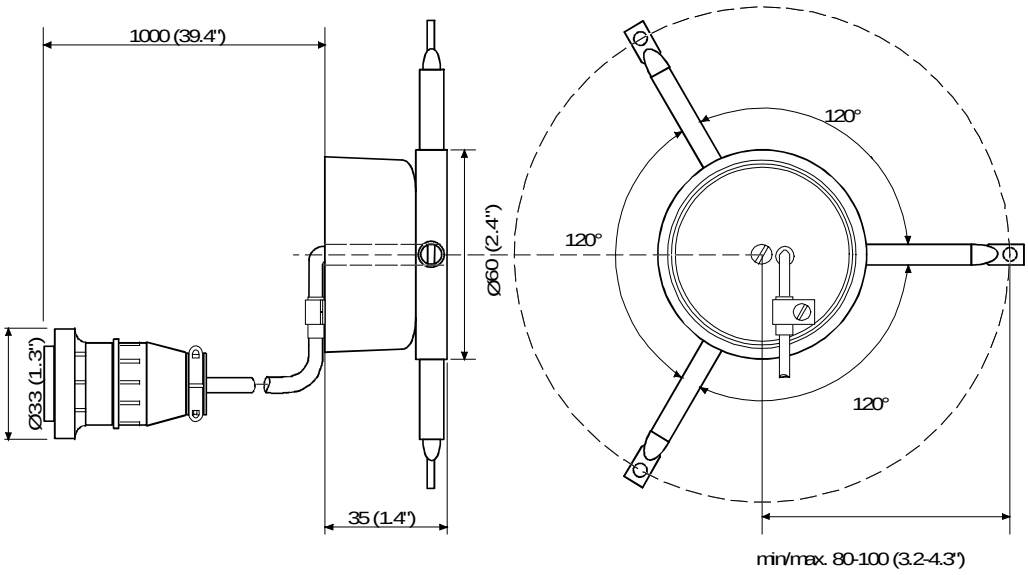


Fig. 4-2
CD109 Course detector

RFC35NS Fluxgate compass

Dimensions..... See Fig. 4-3
Heading output:..... Serial and analogue
Output format: .....NMEA183 10x/sec. and sine/cosine.
NMEA data:.....$IIHDM,x.x,m*hh<cr><If>
x.x=heading, hh = checksum
Analogue data:.....Sine/Cosine ±2V, 2.5VDC reference.
Accuracy: .....<1.25° rms
Repeatability: .....<0.2° rms
Calibration: .....Automatic
Roll & Pitch: .....±35°
Supply:.....10-29 VDC, 1 W
Temperature:
Operation: .....0 to +55°C (+32 to + 130°F)
Storage: .....–30 to +80°C (–22 to +176°F)
Protection:.....IP56
Mounting.....Deck or bulkhead
Cable supplied:.....0.3m (1 ft.) with Viking connector for Robertson autopilots (Sine/Cosine data) and N2500 NMEA Interface.

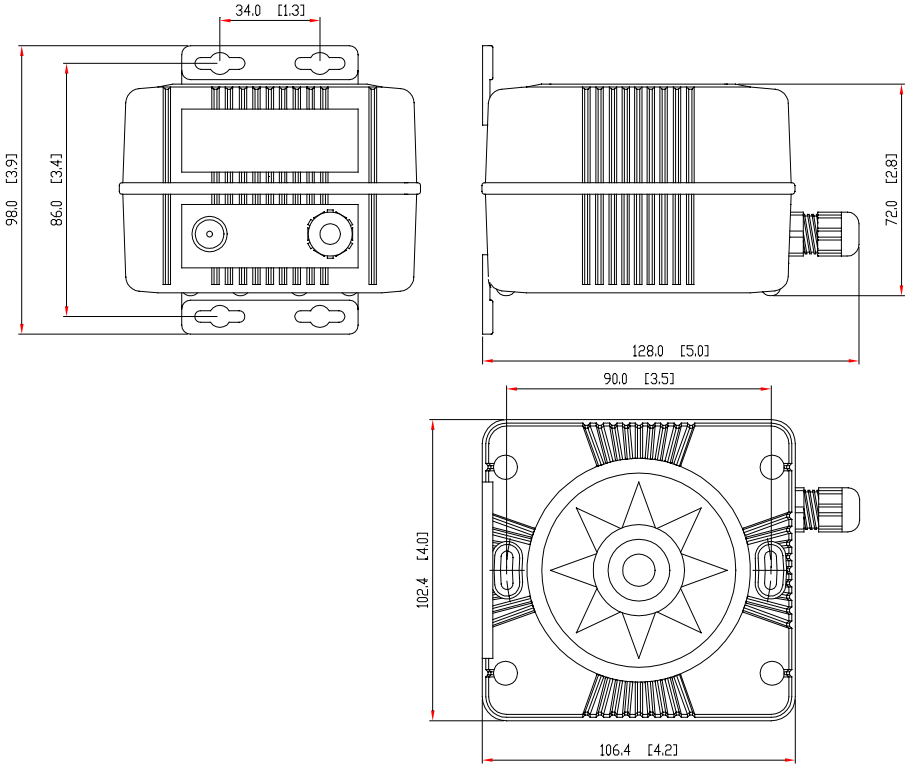


Fig. 4-3
RFC35NS - Dimensions

G40A Gyro Interface

Dimensions: .....See Fig. 4-4
Signals in .....- 6 step/degree with positive or negative common
- Synchro signal, 90:1 or 360:1, gyro excitated
- SKR80/82 current loop (9600 Baud)
Signal level in:.....- Stepper signal: 20 - 70V DC
- Synchro signal: 40 - 115V, 50 - 400Hz
Load:.....Maximum 20mA
Supply voltage:.....12V DC (autopilot supplied)
Power Consumption:.....2.4 W
Ambient temperature, storage: .....–25 - +70°C
operation: ..... 0 - +55°C

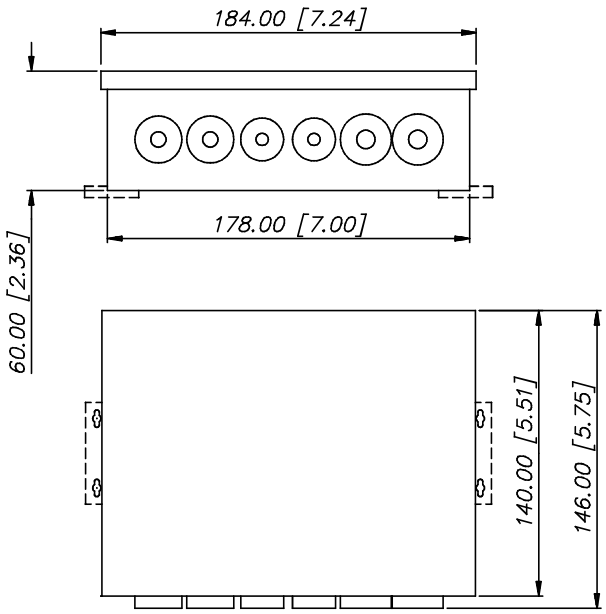


Fig. 4-4
G40A Gyro Interface - dimensions

G45 Gyro Interface

Dimensions: .....See Fig. 4-8
Signals in - Synchro signal, 1:1
Signal level in (S1, S2, S3):.....- High voltage, 80V L-L
- Low voltage, 11,6V L-L
Signal out (Synchro excitation): .....26V 400 Hz, max 5 VA
Supply voltage:.....12V DC (autopilot supplied)
Ambient temperature, storage: .....–25 - +70°C
operation: ..... 0 - +55°C

FI100-40 Fluxgate Interface

Dimensions:..... See Fig. 4-5.
Cable length: ..... 2 m (with plug)
Ambient temperature, storage:.....–25 - +70°C
operation: .....–10 - +55°C
Input signal: .....sine/cosine
Output signal:.....sine/cosine ±2V DC at +2.5V reference

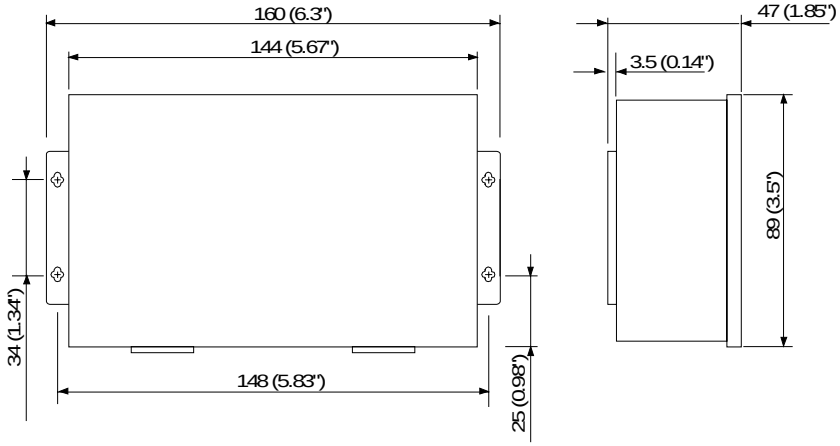


Fig. 4-5
FI100-40 Fluxgate Interface - dimensions

RF45X Rudder Feedback Unit

Dimensions: .....See Fig. 4-6.
Protection:.....IP56
Ambient temperature: .....–10 - +55°C
Operating voltage:.....12V DC (autopilot supplied)
Frequency output, Feedback: .....3400Hz (midship reference)
Port: +20Hz/degree, stbd: -20Hz/degree
Current output, Indicator.....0.1mA - 1.1mA
Capacity: .....5 indicators in series
Rudder angle: .....±45°
Cable length:.....2 m (6 ft)

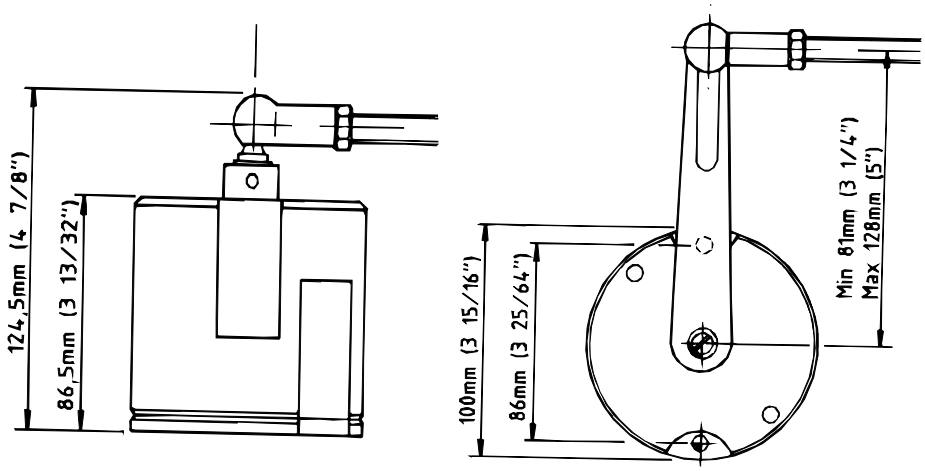


Fig. 4-6
RF45X Rudder Feedback - dimensions

RF14XU Rudder Feedback Unit

Dimensions: .....See Fig. 4-7.
Protection:.....IP56
Ambient temperature: .....–10 - +55°C
Operating voltage:.....19-40V
(Frequency section 12-40V DC)
Voltage output, Rudder indicator:.....0-18V DC (9V as midship reference)
Frequency output, Autopilot feedback:.....3400Hz (midship reference)
Port: +20Hz/degree, stbd: -20Hz/degree
Rudder indicator capacity:.....5 indicators in parallel
Rudder angle: .....+/-45° (Changeable to 60, 70 or 90°)
Limit switches: .....Adjustable from ±5 to ±160°

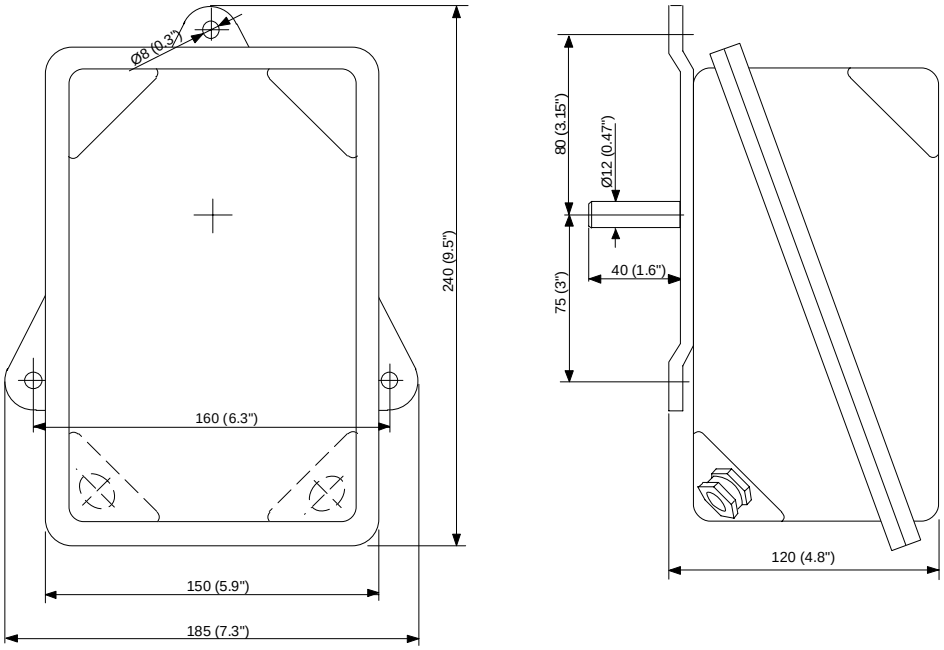


Fig. 4-7
RF14XU Rudder Feedback unit - dimensions

J45S Junction Unit

Dimensions:..... See Fig. 4-8.
Protection: IP22
Ambient temperature, storage:.....–25 - +70°C
operation: .....0 - +55° C
Safe distance to magnetic compass: .....1.5 m
Supply voltage: .....12, 24, 32V DC ±20%
Max. solenoid load:.....3A

J45A Junction Unit

Dimensions: .....See Fig. 4-8.
Protection:.....IP22
Ambient temperature, storage: .....–25 - +70°C
operation: .....0 - +55° C
Safe distance to magnetic compass: .....1.5 m
Max. motor load:.....10A continuous
20A peak
Supply voltage: .....12, 24, 32V* DC ±20%
*) For 32V DC the J101A/32V Adapter must be used.

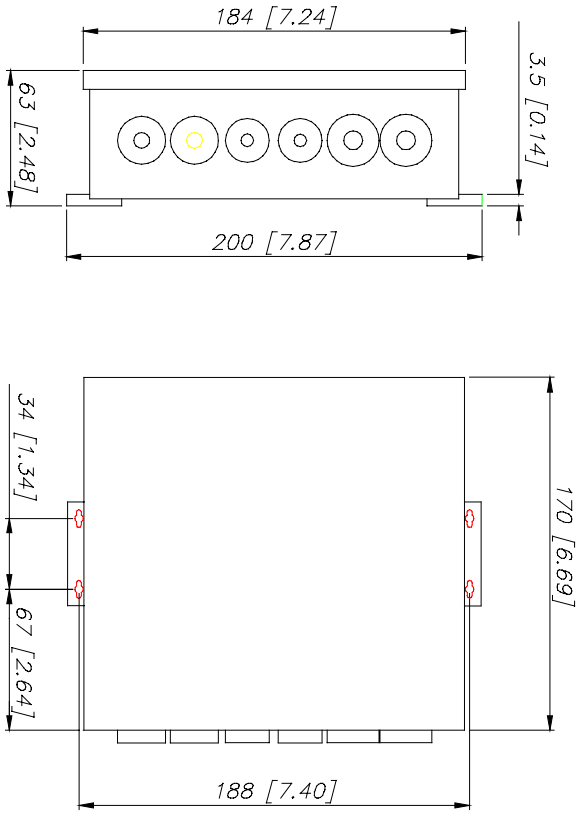


Fig. 4-8
J45S/J45A/G45 - Dimensions

S9 Steering Lever

Dimensions:..... See Fig. 4-9.
Protection: IP56
Ambient temperature: ..... –25 - +70°C
Safe distance to magnetic compass: .....0.3 m
Max. inductive load:.....4A/24V DC, 60mA/110W AC,
25mA/220V AC

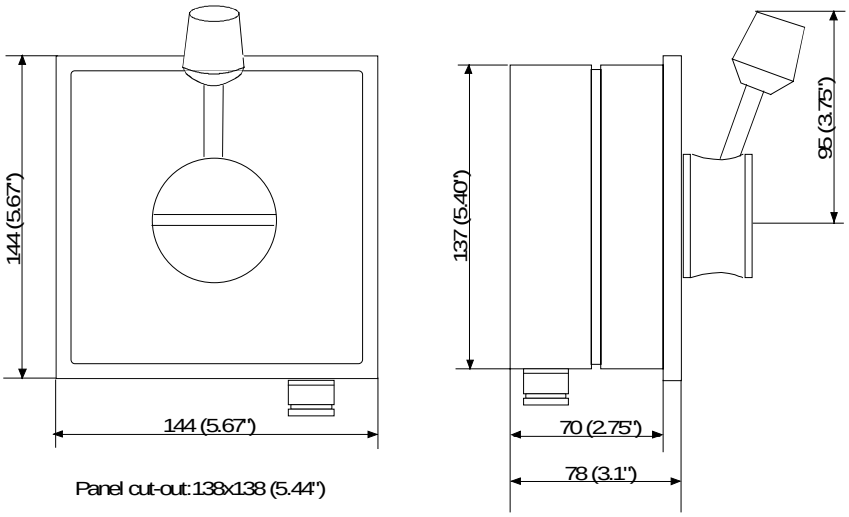


Fig. 4-9
S9 Steering Lever - Dimensions

FU91 Steering Lever

Dimensions: .....See Fig. 4-10.
Protection:.....IP56
Ambient temperature, storage: .....–25 - +70°C
operation: .....–10 - +55°C
Safe distance to magnetic compass: .....0.3 m

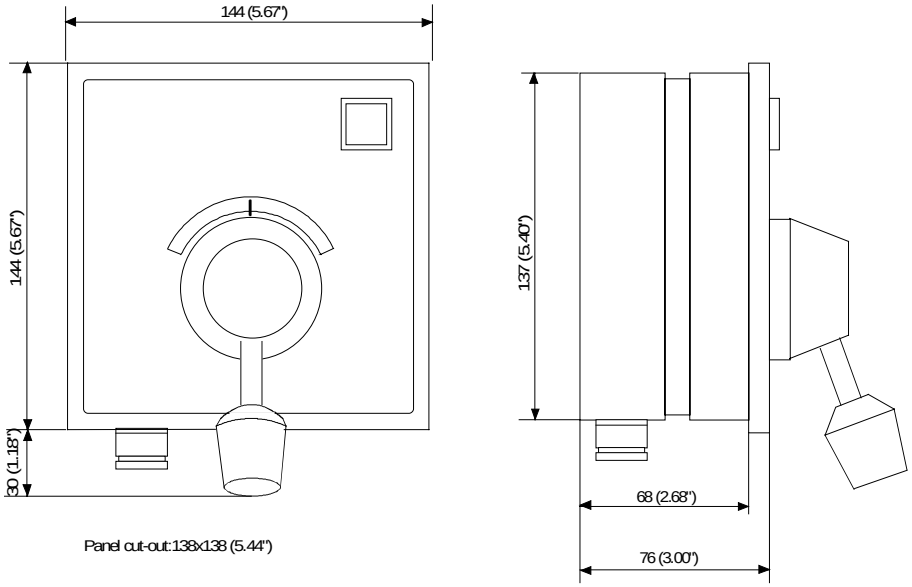


Fig. 4-10
FU91 Steering Lever - Dimensions

S35 Steering Lever

Dimensions:..... See Fig. 4-11.
Weight: ..... 1.4 kg (inclusive cable)
Max. inductive load:.....4A/24V DC, 60mA/110V AC, 25mA/220V AC
Temperature range: .....Storage: –30 to 80° C
Operation: –10 to 55° C.
Environmental protection:.....IP56
Safe distance to compass: .....0.5 m (1,6 ft.)
Power consumption (light):.....6 mA
Cable: .....10 m cable with six wires connected through bottom gland
Note! Cable gland can be moved to the back side.

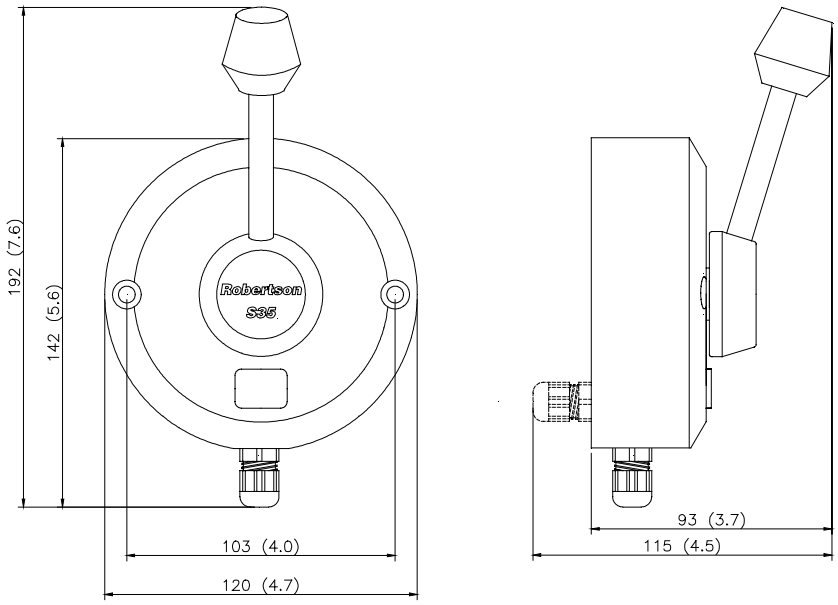


Fig. 4-11
S35 Steering Lever - Dimensions

F1/2 Remote Control

Dimensions: .....See Fig. 4-12
Protection:.....IP56
Cable length:.....10 meters (30 ft.)
Max. inductive load:.....4A/24V DC, 60mA/110W AC, 25mA/220V AC

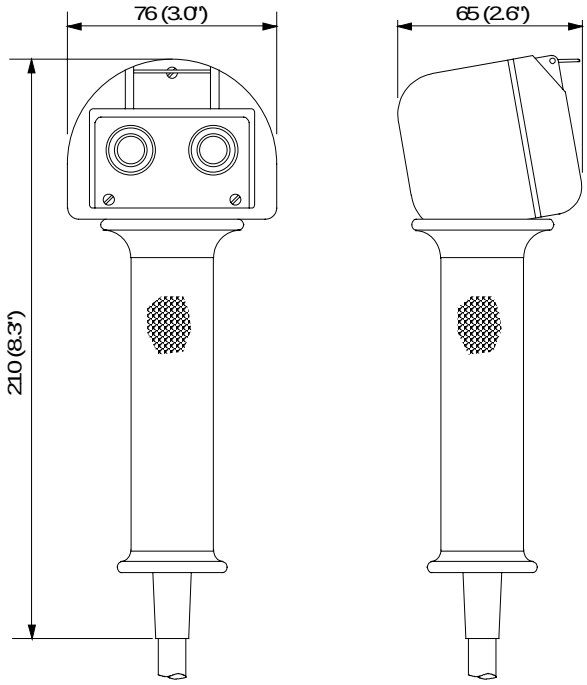


Fig. 4-12
F1/2 Remote Control - Dimensions

F200-40 Remote Control

Dimensions: ..... See Fig. 4-13.
Protection:..... IP56
Ambient temperature,
storage:..... –25 - +70°C
operation:..... 0 - +55° C
Safe distance to
magnetic compass: ..... 0.3 m
Cable length:..... 7 m (21ft.)

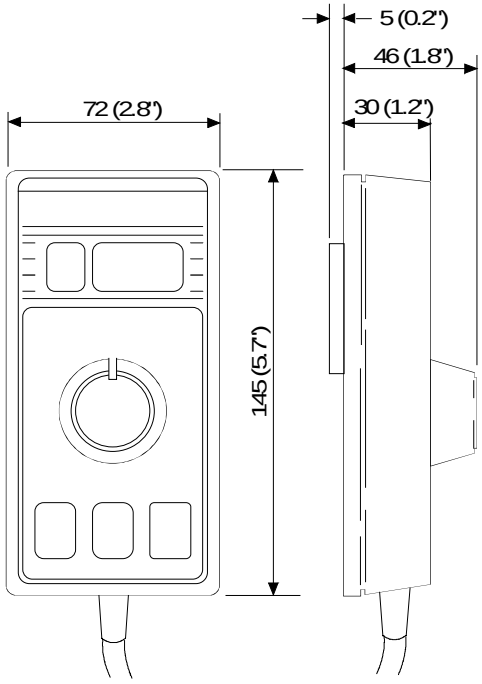


Fig. 4-13
F200-40 Remote Control Dimensions

RI35 Rudder Angle Indicator

Dimensions:	See Fig. 4-14.
Weight:	1.0 kg
Supply voltage:	12/24V DC –25%/+30%, polarity independent
Power consumption:	Max 3 W
Input signal:	Frequency 3400 Hz (midship reference), ±20Hz/degree Current: 0.1 - 1.1mA (midship 0,6mA), polarity independent
Accuracy:	±3° (Indicator alone)
Temperature range:	Storage: –30°C to +80°C Operating: –10°C to +55°C
Environmental protection:	IP56
Safe distance to magnetic compass:	0.3 m (1 ft)
Cable:	20 m, single twisted pair (not connected).
Rudder Feedback Units:	RF300 (frequency signal), RF45X (current signal)

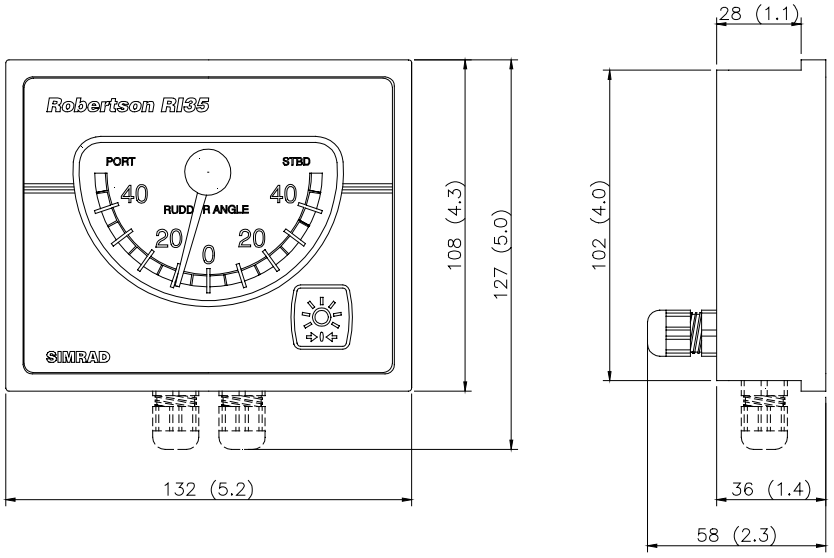


Fig. 4-14
RI35 Rudder Angle Indicator - Dimensions

RI9 Rudder Angle Indicator

Dimensions:	See Fig. 4-15.
Supply voltage:	24/32V DC ±20%
Current consumption:	Maximum 100 mA
Input signal:	Voltage (0-18V) or current (0.1 - 1.1mA)
Rudder angle:	45°-0-45° (other angles as option)
Ambient temperature, storage:	–25 - +70°C
operation:	–10 - +55°C
Protection:	IP56
Safe distance to magnetic compass:	2.6 m (9 ft.)
Rudder Feedback Units:	RF45X, RF14XU, RF14XI.

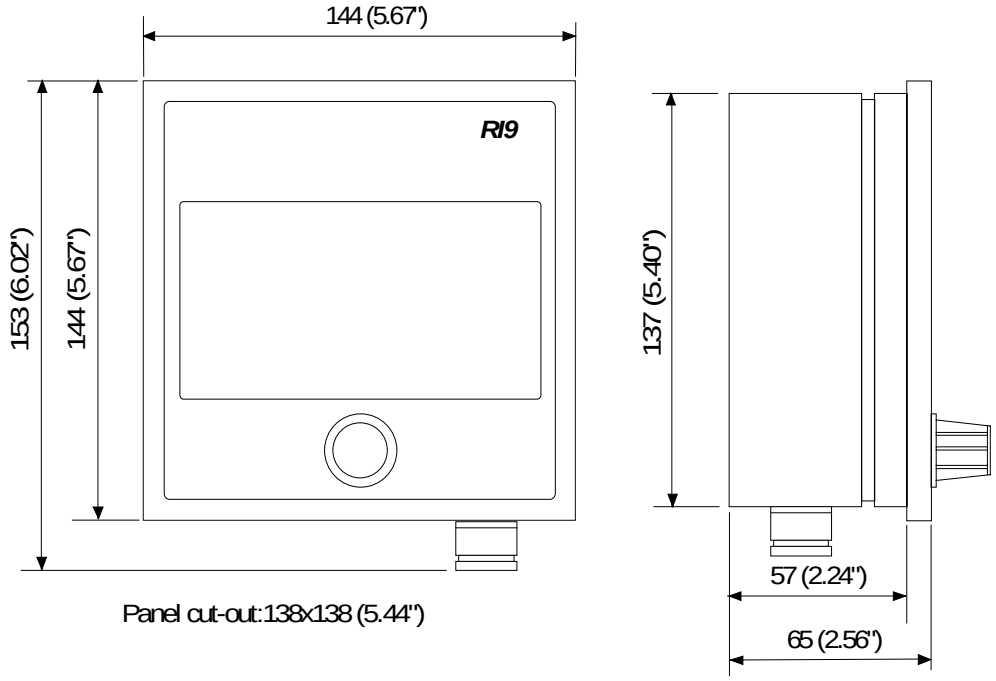


Fig. 4-15
RI9 Rudder Angle Indicator - Dimensions

5. INSTALLATION

Unpacking and handling

Care should be taken when unpacking and handling the equipment. A visual inspection should be made to check that the equipment has not been damaged during shipment and that all components and parts are present according to the packing list.

General

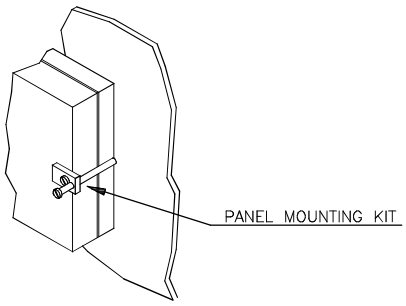
Common sense should be used when installing the units, particular attention being given to the operator's need for ease of access.

For cable layout refer to the External Cabling Diagram, Fig. 5-4.

For connection of several units to the J3 connector, refer to Fig. 5-36.

AP45 Control Unit

The unit is built to standard DIN dimensions for console mounting. Dimensions for the panel cut out are shown on Fig. 4-1. A fastening device for console mounting and a bracket for panel mounting are supplied with the equipment. The mounting bracket has four screw holes for bulkhead mounting, and the Control Unit is fitted to the bracket by two Allan screws (Fig. 5-2). A matching Allan wrench is supplied.



It is important to locate the Control Unit so that the viewing angle to the displays are between 45 and 90 degrees in both planes. When console mounting, locate the control unit as near the front edge as possible. This makes the reading of the displays easier. Avoid direct sunlight on the display.

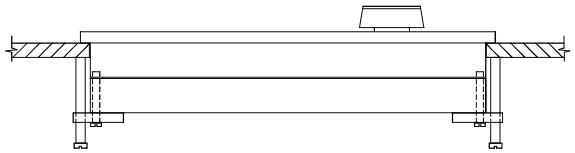


Fig. 5-1
AP45 Control Unit - Panel mount

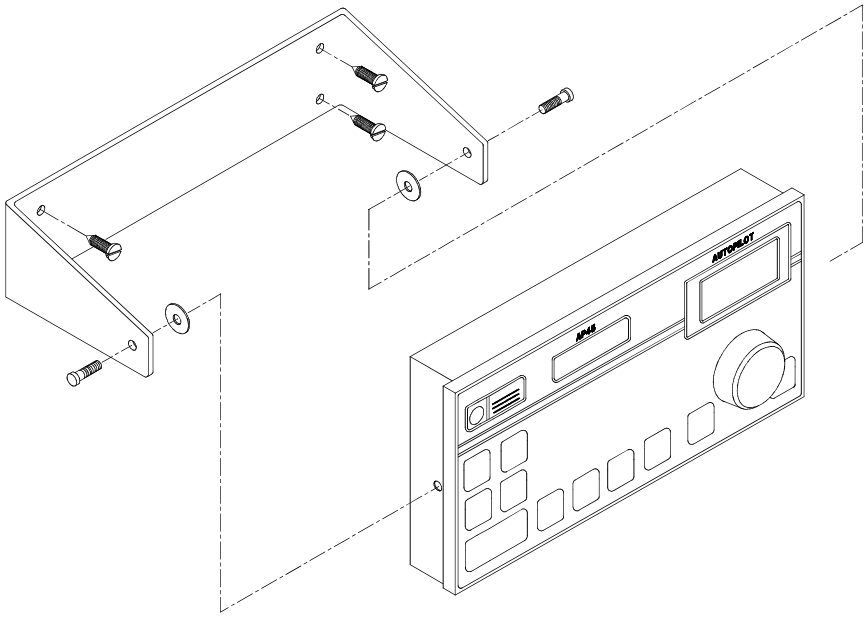
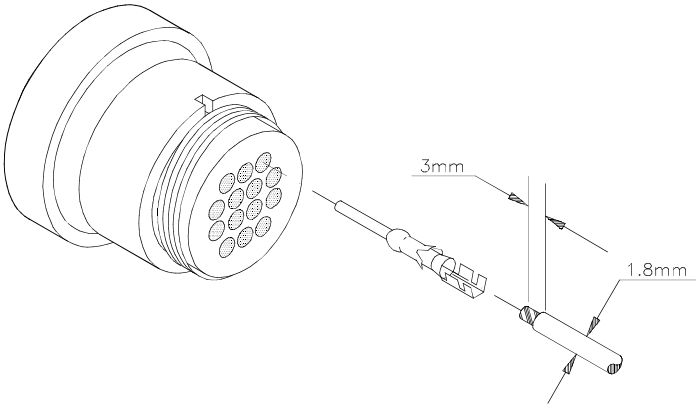


Fig. 5-2
AP45 Control Unit - Bracket mounting

Connector assemble

The cable conductors are connected to the connector block according to separate connection diagrams. The following tools are required to crimp the connector pins and sockets to the individual cable conductors.



Crimping tool :
Amp 90277-1

Extraction tool:
Amp 725840

Note!
Do not use other tools than those specified!

For protection against electro magnetic interference, all control unit connectors must be fitted with the supplied metal shell and cover.

Strip about 1 cm (0.4") of the cable insulation and pull the screen backwards to cover the insulation. Screw the connector block onto the actual control unit socket. Screw the shell onto the connector block. Fix the cable screen to the shell by a wire strap and tighten well to make sure the screen has good contact. Apply a thin layer of pure Vaseline on the shell threads. Screw the cover onto the shell until it makes good contact with the control unit cabinet.

The control unit has a ground terminal and must have a proper ground connection to the hull. The grounding wire should be as short as possible and at least 10 mm wide.

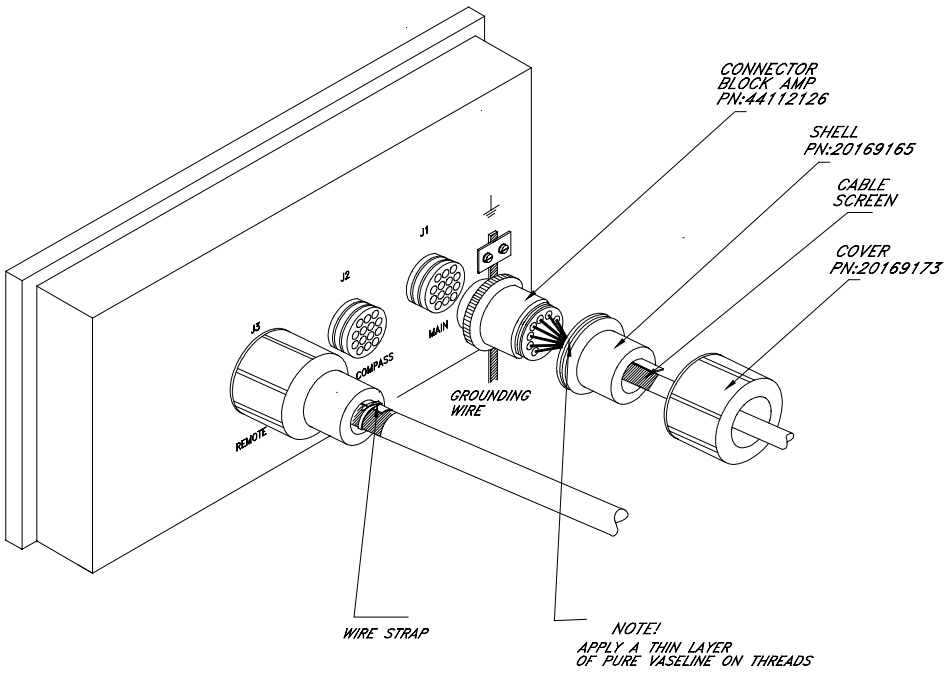
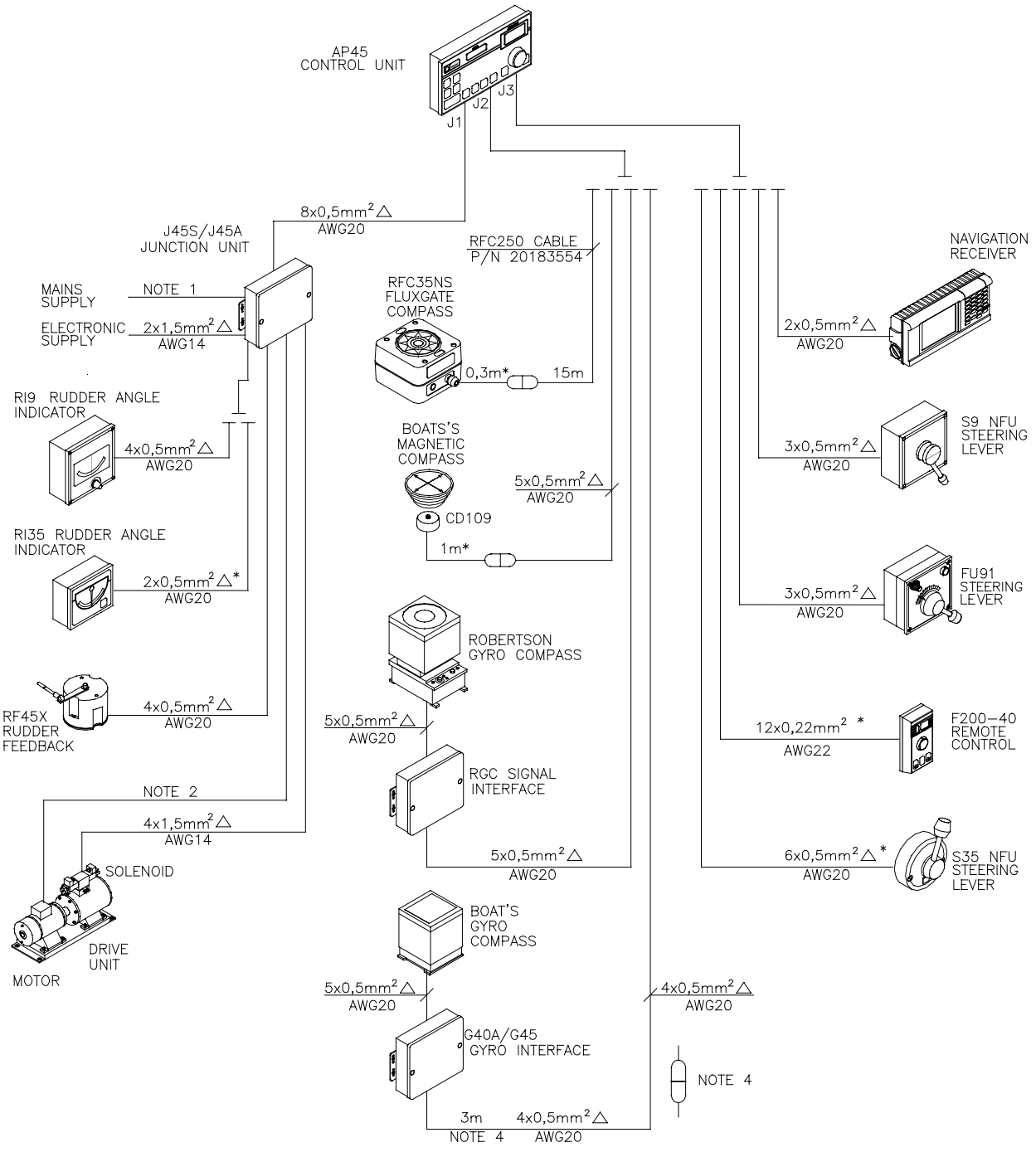


Fig. 5-3
Control unit - connector mounting



NOTE 1: SOLENOID SUPPLY ONLY: 2x1.5mm² (AWG14)
SOLENOID AND MOTOR SUPPLY: 24–32VDC 4mm² (AWG10), 12VDC 6mm² (AWG9)

NOTE 2: 24–32VDC 2x4mm² (AWG10), 12VDC 2x6mm² (AWG9)

NOTE 3: IF MORE THAN ONE UNIT IS CONNECTED TO EACH PLUG ON THE CONTROL UNIT, A JUNCTION BOX IS REQUIRED. NUMBER OF CONDUCTORS BETWEEN JUNCTION BOX AND CONTROL UNIT MUST BE PROVIDED ACCORDINGLY.

NOTE 4: G45 ONLY

△ SCREENED CABLE

* SUPPLIED WITH UNIT

Fig. 5-4
AP45 External cabling diagram

Heading sensors

General

AP45 is designed for connection to one compass only. However, a combination of two compasses are possible as CD109 and Fluxgate/Gyro has separate input pins in the J2 Compass connector. This means you can combine a magnetic compass with either a fluxgate- or a gyrocompass.

The type of heading sensor used in the standard scope of supply may vary from distributor to distributor as a result of practical experience and the preferences of their market place.

The CD109 Course Detector is fitted to the vessel's existing magnetic compass or to one particularly installed for the autopilot (“Magnetic compass”, page 5-4.).

The Robertson RFC35NS Fluxgate Compass can be connected directly to the control unit (“RFC35NS Fluxgate Compass”, page 5-6), whilst other makes of fluxgate compasses require a FI100-40 Fluxgate Interface (“FI100-40 Fluxgate Interface”, page 5-8).

If a gyrocompass is used as heading sensor, the G40A or G45 Gyro Interface is required (page 5-9).

Magnetic compass

To obtain an accurate heading from the magnetic compass, great care should be taken when determining the location of the compass.

Select a location that provides a solid horizontal mounting base, free from vibration and as close to the vessel's centre of roll and pitch as possible. It should be as far as possible from disturbing magnetic interference such as the engines, cables, transmitter antennas or other electro magnetic objects.

Note! The compass must be compensated.

Heeling error

Heeling error may be observed when the boat is rolling and pitching, causing an unstable compass card. This can be adjusted for by using a "heeling magnet" placed vertically below or above the exact centre of the compass. The magnet is normally placed with the red end up in the Northern hemisphere and the blue end up in the Southern hemisphere. The correct distance between magnet and compass can best be found during sea trials. The heeling error can also be reduced by mounting the compass close to the vessel's centre of roll and pitch.

Northerly/southerly turning error

Symptoms of northerly turning error are that the vessel is "S-ing" on northerly headings when at high latitudes. The reason for this phenomena is that the earth's magnetic fluxlines are parallel to the earth's surface only at the equator, and thus no vertical magnetic component exists. When moving further north from the equator, the vertical component of the earth's magnetic field increases.

The directional reading from a magnetic compass is based upon the horizontal component of the earth's magnetic field. This component becomes smaller and smaller with increasing latitude, while the vertical magnetic component increases. The resulting effect at high latitudes is that magnetic compasses become sluggish and appear to be unstable. These symptoms become more apparent as speed increases.

The same phenomena is experienced in the southern hemisphere, but on southerly headings and is referred to as southerly turning error.

There is no patent cure for this problem, besides making a proper installation and compensation of the compass.

CD109 Course Detector mounting

The course detector is mounted on the ship's magnetic compass to transmit a heading signal to the control unit. The mounting method will depend upon the compass design. The distance between the course detector and the compass card depends upon the magnetic momentum of the compass card magnets. A distance of 70-90 mm for a magnetic moment of 1500-2000 cgs is therefore recommended. For adjustment of signal level, see "Course Detector Alignment" page 6-2. If a non-Robertson supplied magnetic compass is used, it is advisable to consult a qualified compass adjuster for mounting of the CD109.

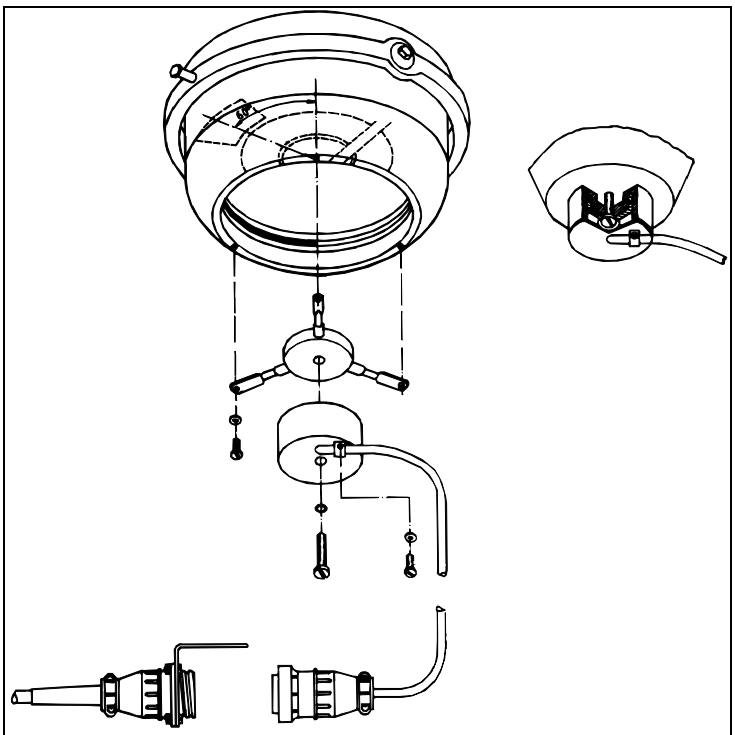


Fig. 5-5
CD109 Course detector - Mounting

For mounting instructions refer to Fig. 5-5. The course detector can be attached to the compass either by a 6 mm screw to the bottom of the compass bowl or by use of the tri-pod holder supplied with the course detector.

The course detector is also supplied with cable (1m) feed and plug. Socket and connector with bracket for extension cable are in the standard scope of supply. The extension cable is optional equipment.

The compass should be checked for free movement in the gimbals without stressing the detector cable.

The CD109 Course Detector is connected to J2 on the Control Unit, and the connection is shown on the Wiring Diagram (Fig. 5-23).

If the Course Detector is mounted up-side down on top of the compass, the sine/cosine signal on J2 pin 10 and 11 must be interchanged.

RFC35NS Fluxgate Compass

The RFC35NS (part no. 22083596) substitutes the Robertson RFC250 Fluxgate compass. It comes with a “pigtail” cable that matches the Viking connector on the RFC250 (extension) Cable part no. 20183554. The internal connection of the “pigtail” cable is shown on Fig. 5-7. Heading output is on sine/cosine and NMEA0183 formats.

Note!

On new installations together with AP45 you need the standard RFC250 Cable part no. 20183554. Cut off the Viking connector at one end and replace it with the AP45 AMP type connector (J2) as per Fig. 5-6.

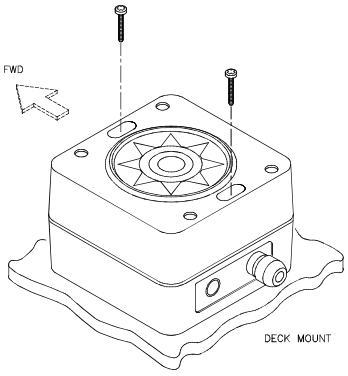
An extra cable gland is supplied for a separate NMEA cable connection if required. Disconnect the brown and blue wires to J1-2 and J1-1 and connect the separate cable instead. See Fig. 5-7.

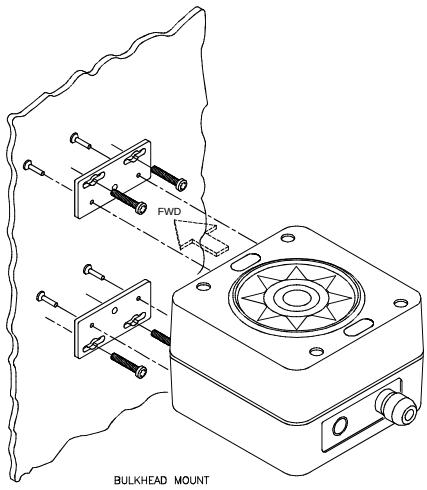
Mounting

The RFC35NS contains a magnetic fluxgate sensor and great care should be taken when deciding the mounting location.

To minimize the effect of heeling errors, installation on the fly bridge or in the mast is not recommended.

Select a location that provides a solid mounting place free from vibration and as close to the vessel's centre of roll and pitch as possible, i.e. close to the water line. It should be as far as possible from disturbing magnetic influences such as engines (min. 2 meters), ignition cables, other large metal objects and particularly the autopilot drive unit.





The RFC35NS compass must be mounted **with the cable gland pointing aft.**

Note!

The compass should be deck mounted to allow for mechanical alignment. The compass face plate on the RFC35NS is the TOP. Never mount it upside down! Level the sensor as close to horizontal as possible.

Use the supplied mounting kit and drill holes through the centre of the slots.

Connection

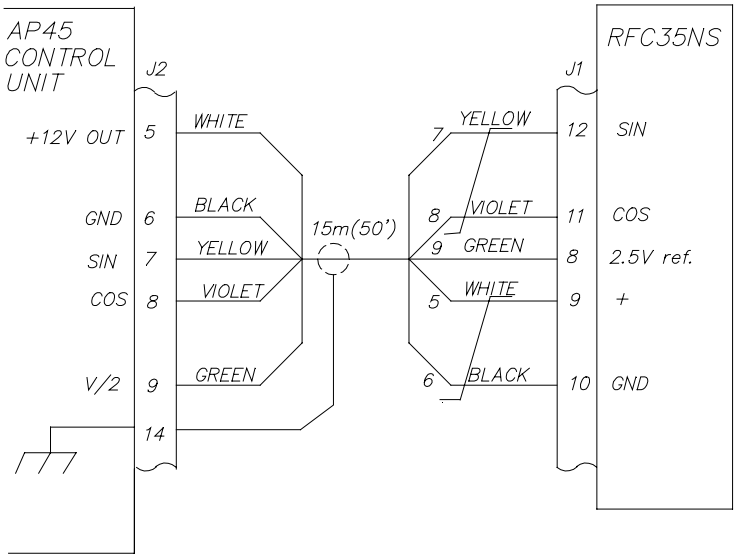


Fig. 5-6 AP45/RFC35NS - connection

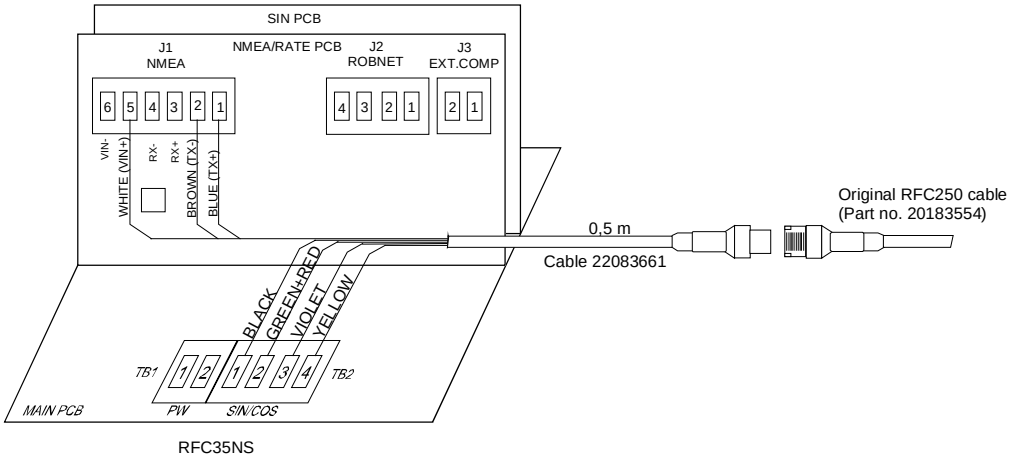
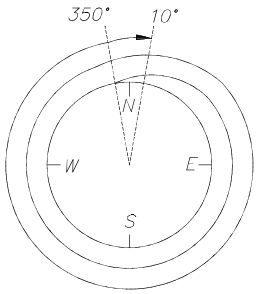


Fig. 5-7 RFC35NS - Internal connection

Calibration

The calibration is carried out by using the “RFC250 procedure”:



1. Switch on the autopilot to supply power to RFC35NS.
2. Make two 360 degree turns to starboard within 5 minutes after switch on. Make sure the boat passes 3 times through North (see figure). Ensure smooth and slow movements. A minimum of roll and acceleration will give the best result. As soon as north is passed for the 3rd time, there will be a confirmation in the autopilot display (see below).

- Provided you have an AP45 with software version V1R3 or V1R4 (latest), you will read "Fluxgate compass compensated" in the info display when the calibration is completed. Press the alarm button to reset. There will be no

confirmation in the display if the AP45 has a software revision earlier than V1R3.

Alignment

Carry out the calibration procedure, then steer the boat on a known heading or bearing. Slightly turn the heading sensor until the correct heading readout is displayed. Tighten the screws.

Note!

If you sail the boat more than 15-20° north or south of the latitude of your last calibration, the calibration procedure should be repeated. Calibration data is stored in the RFC35NS and will only be deleted when a new calibration is performed.

FI100-40 Fluxgate Interface

When connecting fluxgate compasses other than Robertson types, the FI100-40 Fluxgate Interface must be connected between the compass and the control unit.

The interface unit is bulkhead (or table) mounted with two screws.

The fluxgate compass is connected to a terminal board in the FI100-40 according to the diagram enclosed with the unit. FI100-40 is connected to J2 of the control unit according to Fig. 5-8.

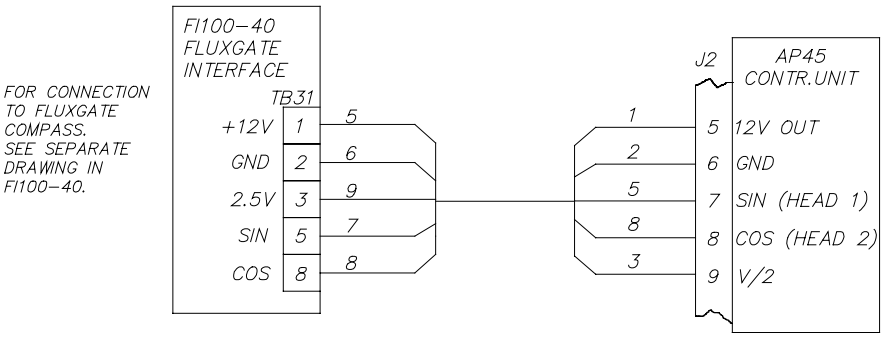


Fig. 5-8
AP45/FI100-40 Fluxgate Interface - Wiring

G40A Gyro Interface Unit

The G40A is required when a Gyro Compass with geared synchro or stepper signal output is connected to AP45. The unit shall be mounted not more than two meters from the AP45 control unit. This is to avoid voltage drop and reduce interference via the interconnecting cables.

All cable conductors are terminated in screw terminals on the G40A PCB. For cabling and connections see Fig. 5-9. For screen termination, see Fig. 5-22.

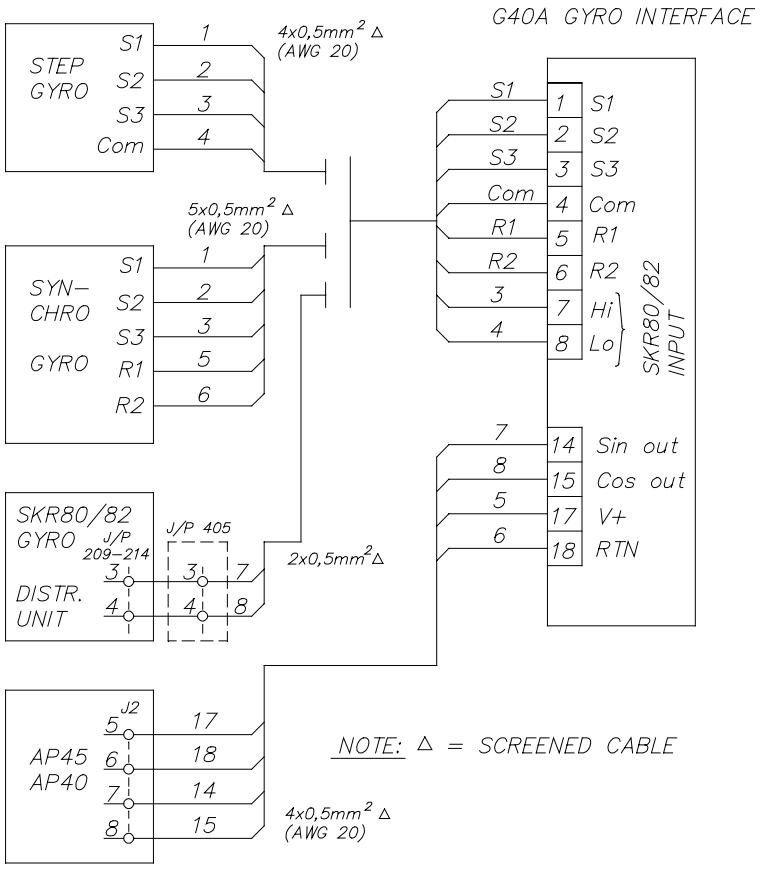


Fig. 5-9
G40A Gyro Interface Connections

There are also three plug-in straps on the PCB, one for each phase. The position of the straps makes the G40A to operate from either positive or negative step-signals. For setting of the straps, refer to Fig. 5-10. The shown strap position enables step signals with positive common. For negative common, insert strap vertically, A1-A3, A2-A4 and so on.

In addition a DIP switch is included. Switch no. 1 sets gear ratio:

360:1 = switch to 0 (OFF)

90:1 = switch to 1 (ON)

The remaining switches 2, 3 and 4 are for test purpose only and shall be 0 (OFF) for normal use. Refer to table on page 7-3.

For SKR80/82 current loop, switch no. 2 shall be set to ON, the others to OFF.

Fig. 5-10 shows the location of the switches and LED's.

The potentiometer VR1 is factory set to 2.5V reference voltage, and should not be readjusted.

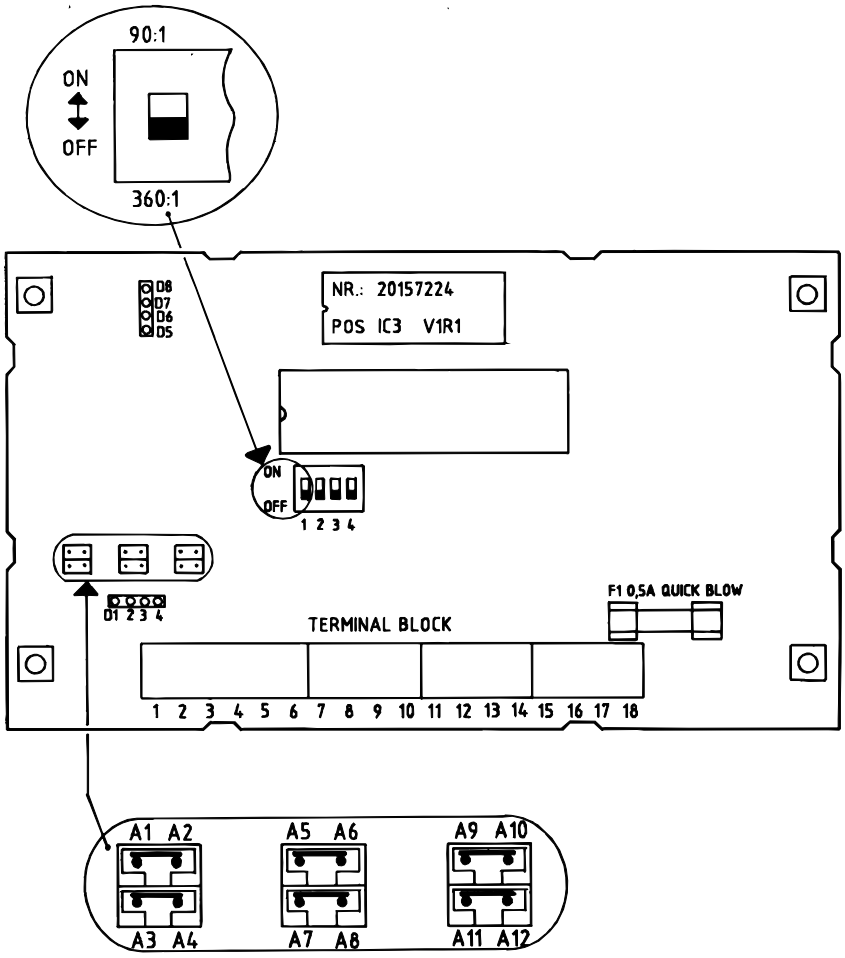


Fig. 5-10
G40A PC-board - Switch location

Power turn-on

After power turn-on, verify that the LED D8 is lit. This indicates that the regulated 5V is OK.

If step-signals are connected, the LED's D1, D2 and D3 should not be lit. If they are, pull out the plug-in straps and insert them in the vertical direction. The LEDs D5, D6 and D7 shall turn on and off in a Gray-code sequence when changing the gyro heading.

If synchro signals are connected, the position of the plug-in straps is irrelevant. However, if the read-out from the AP45 does not follow the gyro, phase S1 and S3 may have to be interchanged.

The LED D4 shows the presence of the synchro reference voltage, and the LEDs D1, D2 and D3 will turn on with variable intensity, depending on the phase voltage.

If the heading read-out has an offset, this is compensated by the “Gyro Adjust” in the “Installation loop”. See “Type of Heading Sensor”, page 6-4, for details.

Select “Gyrocompass” - “Geared/Stepper” in the AP45 Installation loop.

G45 Gyro Interface Unit

The G45 is required when a gyrocompass with 1:1 ratio synchro signal is connected to AP45.

There is separate terminals for high voltage (80V L-L) and low voltage (11,6V L-L) synchro input. Input terminals not used should be short circuited as shown in connection diagrams.

G45 can also be used for excitation of a “dead” synchro transmitter.

The unit shall be mounted within the cable length (3 m) from the autopilot control unit. In case the cable has to be extended, the 2.5V reference voltage must be checked and eventually readjusted in accordance with “TROUBLE SHOOTING”, page 7-8 to maintain the accuracy.

All cable conductors are terminated in screw terminals on the G45 PCB. For cabling and connections see Fig. 5-11.

The PCB contains four trim potentiometers which are all factory set and should normally need no readjustment.

Select “Gyrocompass” - “1:1 Synchro” in the AP45 Installation loop. See “Installation loop”.

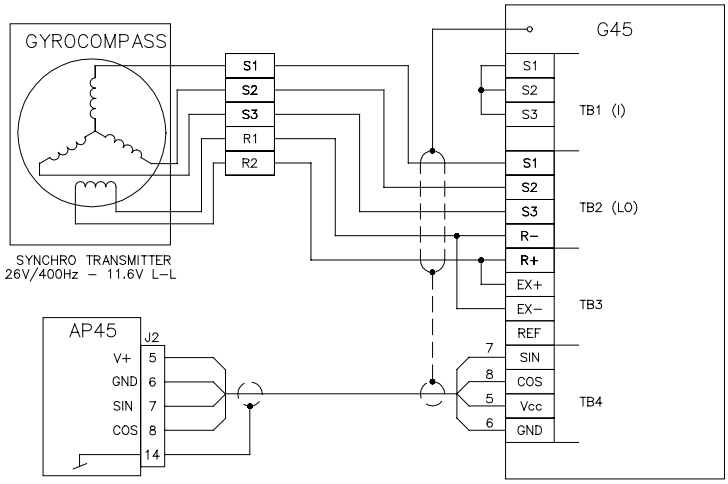


Fig. 5-11
Connection to G45 excited synchro transmitter

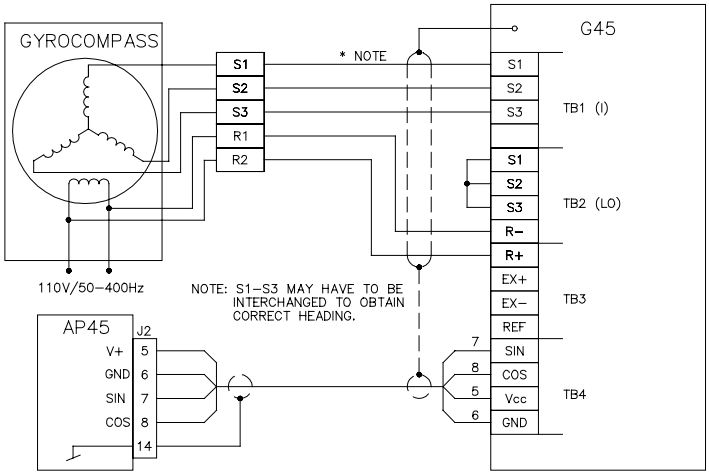


Fig. 5-12
Connection to gyro excited synchro transmitters

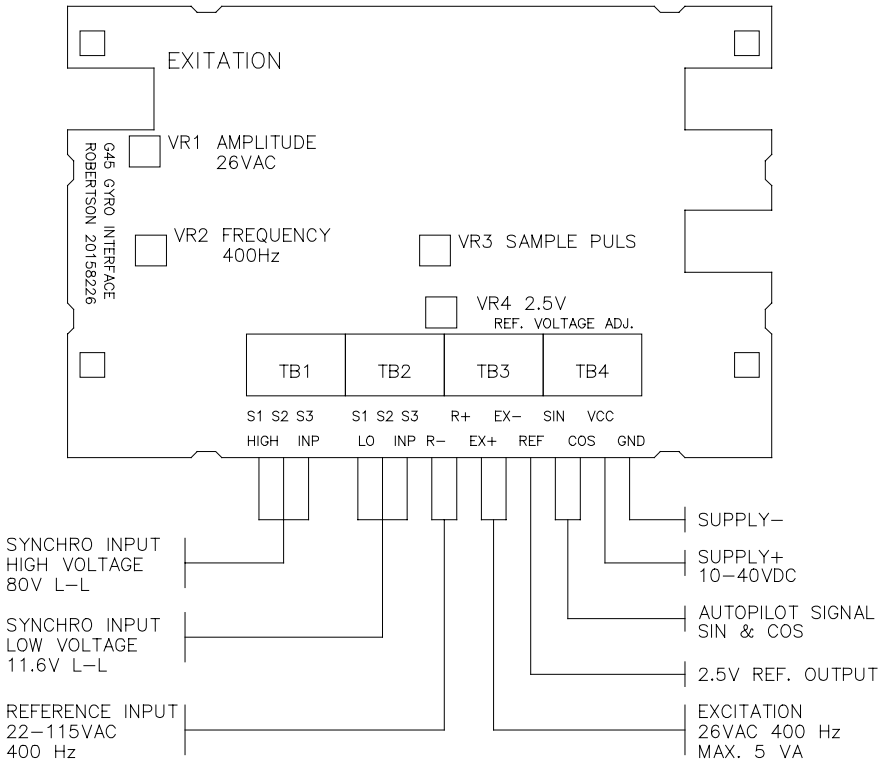


Fig. 5-13
G45 Input/output

RGC Signal Interface Unit

(Part of RGC Gyrocompass delivery)

The RGC Signal Interface Unit is designed to generate heading signals of different formats when connected to either RGC50, RGC10 or RGC11. The heading signal used by AP45 is the sine/cosine output, and the interconnection is shown in Fig. 5-14.

The unit comprises one PCB mounted in a J45A/J45S type box.

Further details, such as installation, technical specifications and eventual adjustments are described in the “RGC Interface” addendum in the RGC Gyrocompass manual.

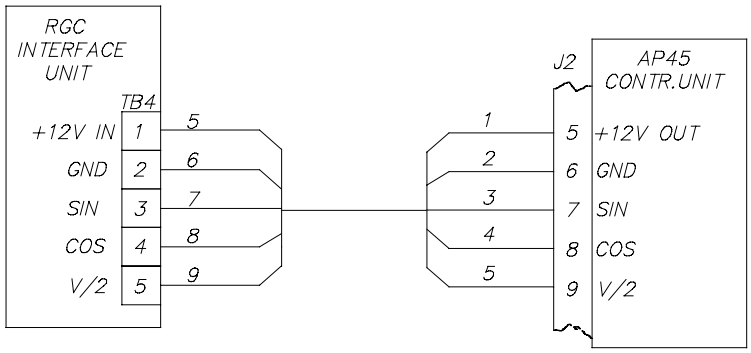


Fig. 5-14
AP45/RGC Signal Interface Unit - Wiring

Note!
Select “1:1 SYNCHRO” via the “INSTALLATION LOOP”.

RF45X Rudder Feedback Unit

The RF45X is normally mounted with the shaft pointing upwards. It can, however, also be mounted with the shaft pointing downwards if that appears to be more convenient.

NOTE!

In case of an "upside-down" installation, the two plug-in straps on the component side of the PCB have to be "turned" 90° to achieve reversed output signal. (To remove the PCB from the housing, simply grip the potentiometer and pull.

Shaft pointing up: Strap S2 to "N(ormal)"
Shaft pointing down: Strap S2 to "I(nverted)".

It should be noted that an "upside-down" installation will make any adjustment and service more convenient as the unit then can be opened without removing the unit from the mounting base.

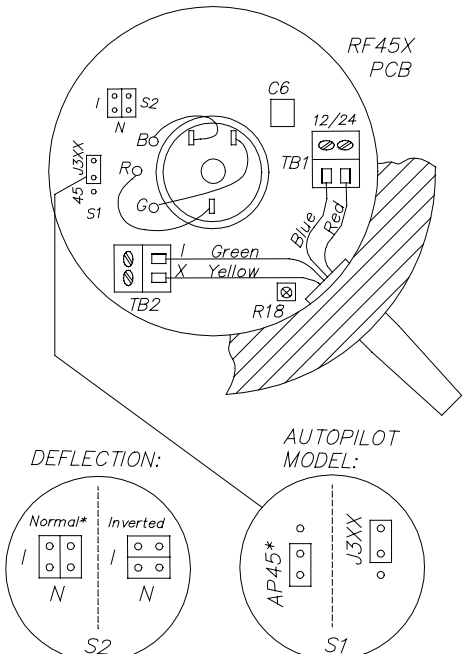


Fig. 5-15
RF45X Internal Wiring

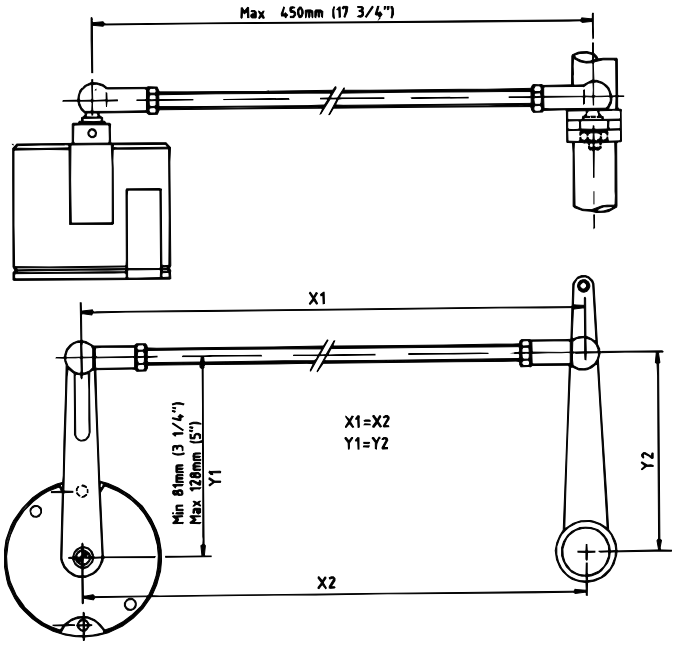


Fig. 5-16
RF45X Rudder Feedback Unit - Mounting

Use the attached template (Fig. 5-18) to drill the required mounting holes. The unit is fastened to the mounting base by the two Allen screws enclosed. (Other types of screws may be used if fastened to i.e. a wooden base.)

Make the parallelogram configuration of the transmission link (see Fig. 5-16) and fasten the link to the RF45X shaft preliminary. The transmission link can be shortened by cutting of a piece of the rod (using a hacksaw). Move the rudder

manually h.o. - h.o. and make sure the transmission link is moving freely in both directions.

Electrical connection

The cable should be connected to the junction unit according to Fig. 5-23 - Fig. 5-26. When splicing cable in the junction box, use the enclosed crimp pins on each wire of the extension cable. Otherwise the wires may be cut off at the terminal point when tightening the screw.

The screen is open in RF45X and should be connected in the junction unit.

For final alignment, see page 6-1.

RF14XU Rudder Feedback Unit

Mechanical mounting

Before installation check that the alignment mark on the mounting plate agrees with the mark on the shaft. Bring the rudder to Amidships position. The feedback unit should be mounted on a plane surface and secured by bolts through the three holes in the mounting plate. It should be linked to the rudder in accordance with Fig. 5-17. It is important that the linkage is linear, i.e. the A-a and D-d are pairs of equal length. This will give a ratio 1:1 between the rudder angle and that of the feedback unit shaft.

Note!

If the RF14XU is mounted with the shaft pointing upwards, the yellow and the blue lead to the potentiometer inside must be interchanged (See Fig. 5-20).

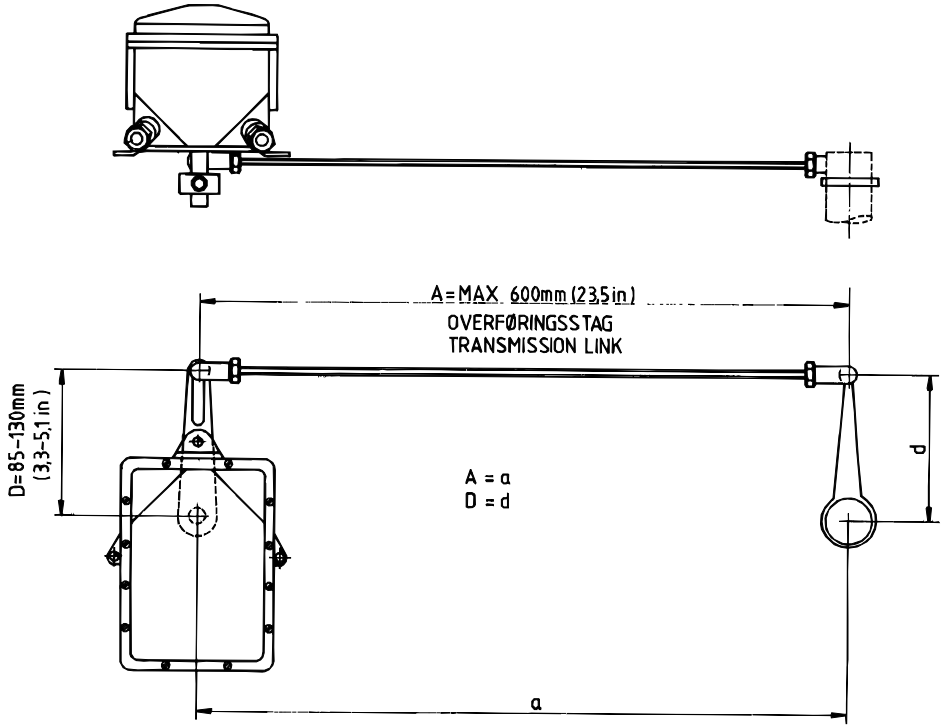


Fig. 5-17
RF14XU - Mounting

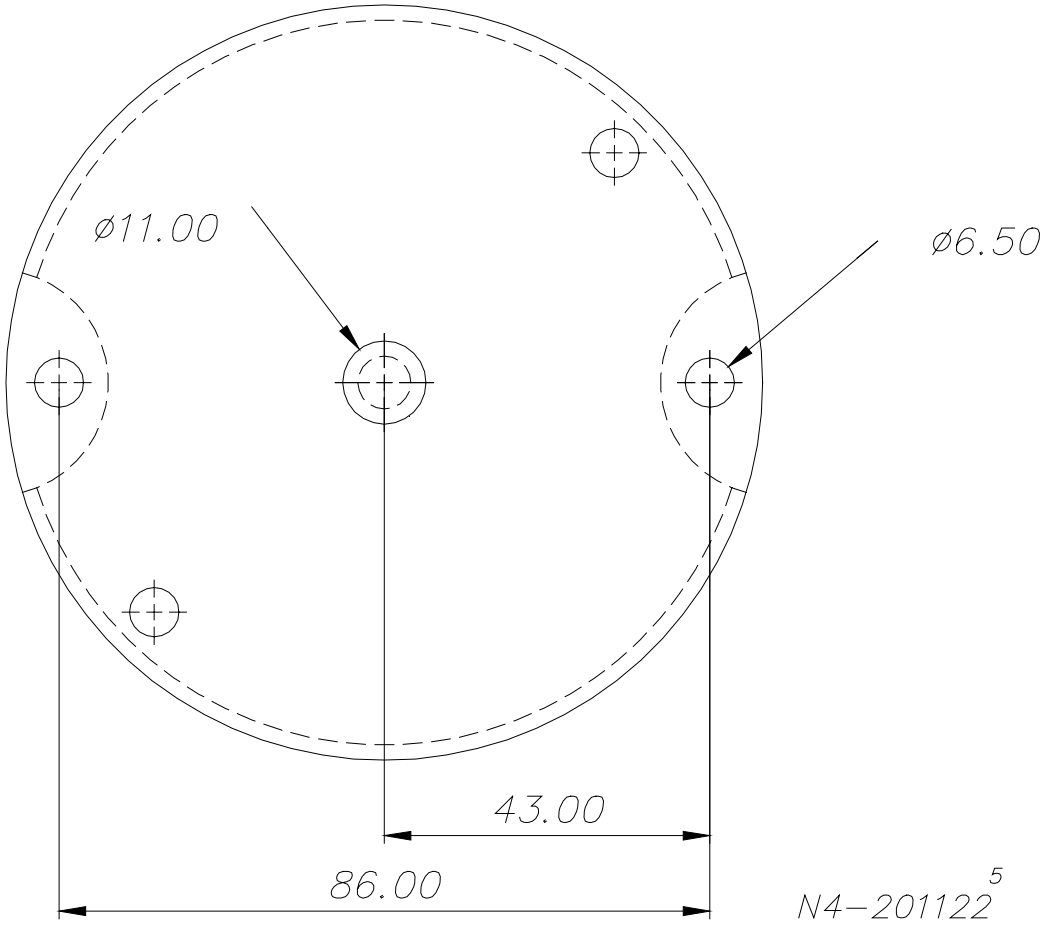


Fig. 5-18
RF45 Template
Scale 1:1

Electrical installation

Electrical connection is shown in Fig. 5-21. The cables are carried through cable glands and connected to the terminal board. If required, to avoid any mechanical damage, the cables should be run in a conduit between the rudder feedback unit and the junction unit or rudder indicator. The cable screen must be connected to the internal ground terminal. Ref. picture below.

The feedback unit has an external ground terminal and must have a proper ground connection to the hull. The grounding wire should be as short as possible and at least 10 mm wide.

The RF14XU can be powered either from the rudder angle indicator supply (19-40V DC) or directly from the autopilot junction unit. If a rudder angle indicator is connected, the RF14XU is powered from the rudder angle indicator supply. If the rudder angle indicator voltage disappears, or rudder angle indicator is not connected to the RF14XU, the feedback unit is powered directly from the autopilot. The change over is done automatically.

Note!
If RF14XU is connected to rudder angle indicators, and the indicators are powered from an unfiltered 24V supply, the enclosed 470uF capacitor should be connected across the supply. Without the capacitor, a deviation may occur between the autopilot feedback midposition reference and that of the rudder angle indicator(s).

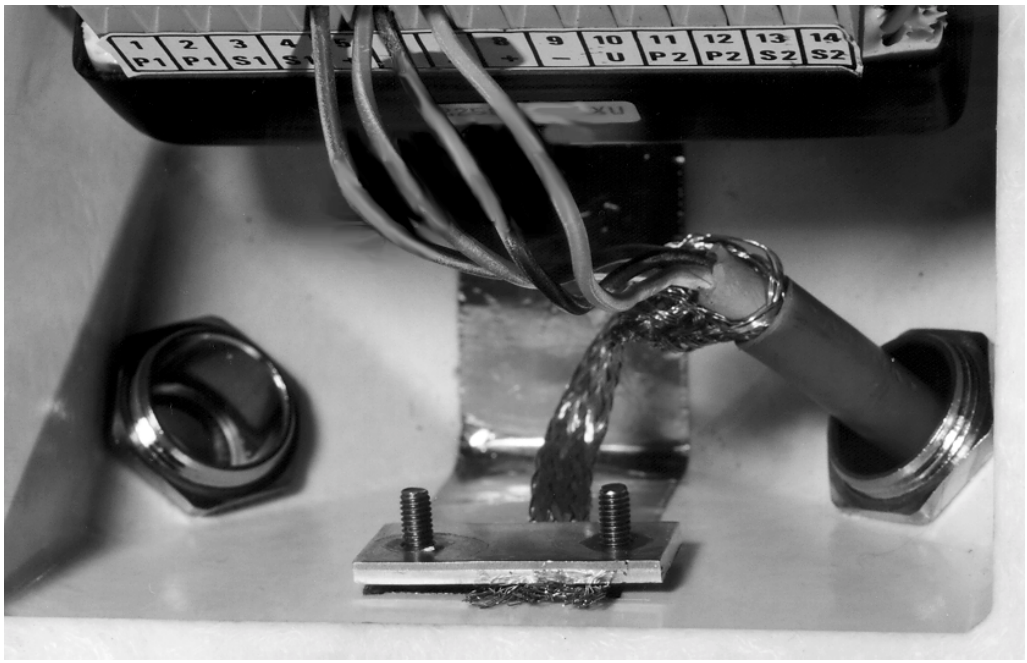
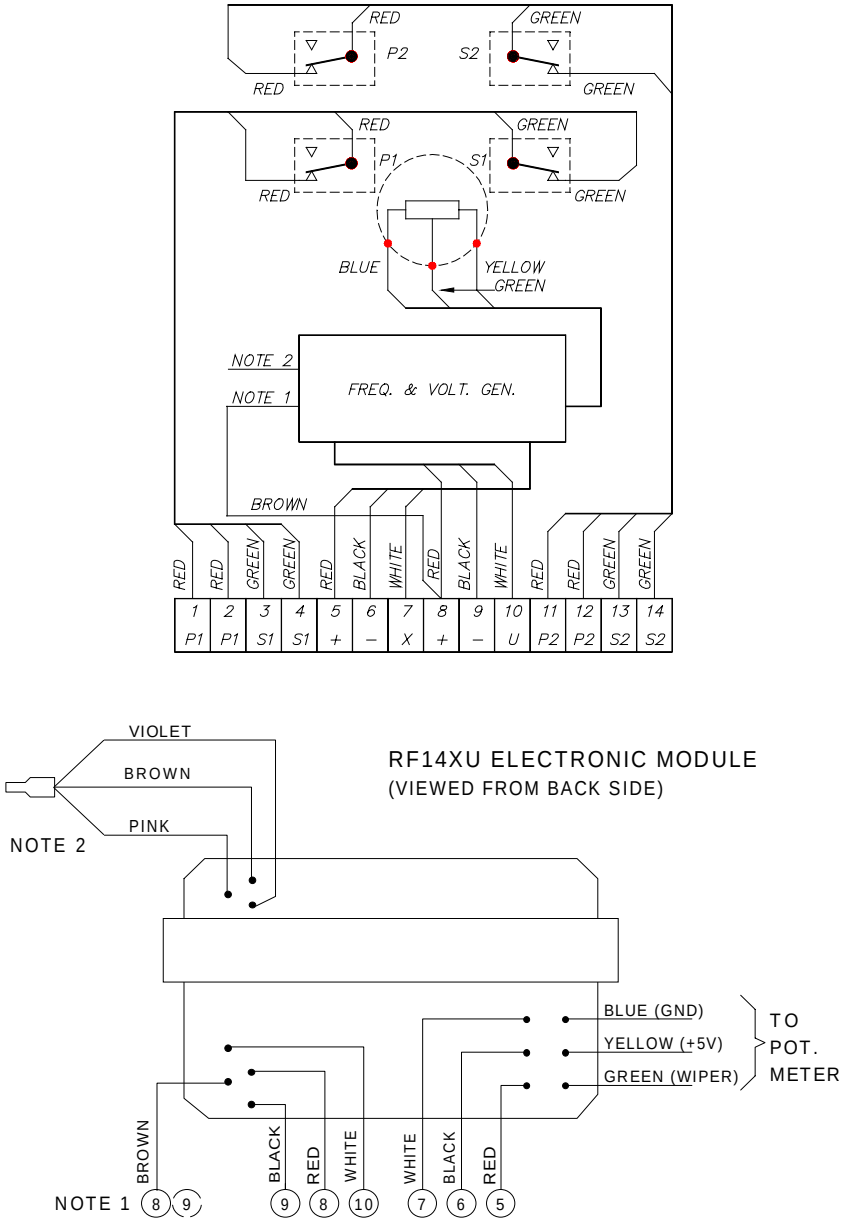


Fig. 5-19
Screen termination

Scaling of rudder angle

The RF14XU is normally delivered for ±45 degrees rudder angle (violet, brown and pink leads are not connected). For ±60 degrees, connect brown lead to terminal 10, for ±70 degrees, connect pink to terminal 10 and for ±90 degrees, connect the violet lead to terminal 10. White lead must remain connected. To invert the indicator deflection, the brown lead to terminal 8 of the RF14XU terminal board must be connected to terminal 9. See Fig. 5-20.



NOTE 1: Brown lead normally connected to (8). Move to (9) to invert the rudder indicator deflection.

NOTE 2: Normally connected for +/-45˚ rudder angle (violet, brown and pink leads are not connected). For +/-60˚ connect brown lead to terminal 10, for +/-70˚ connect pink lead to terminal 10, for +/-90˚ connect violet lead to terminal 10. White lead must remain connected.

Fig. 5-20
RF14XU Internal wiring

Final check

After installation, the cable glands must be sealed with silicon to prevent water from seeping in. Also apply silicon grease to the gasket between the bottom and top cover.

On the inside of the feedback unit cover, a piece of moisture protecting sponge is attached. The sponge produces a corrosion preventive gas, and to increase the efficiency of the gas the cover must be kept tight.

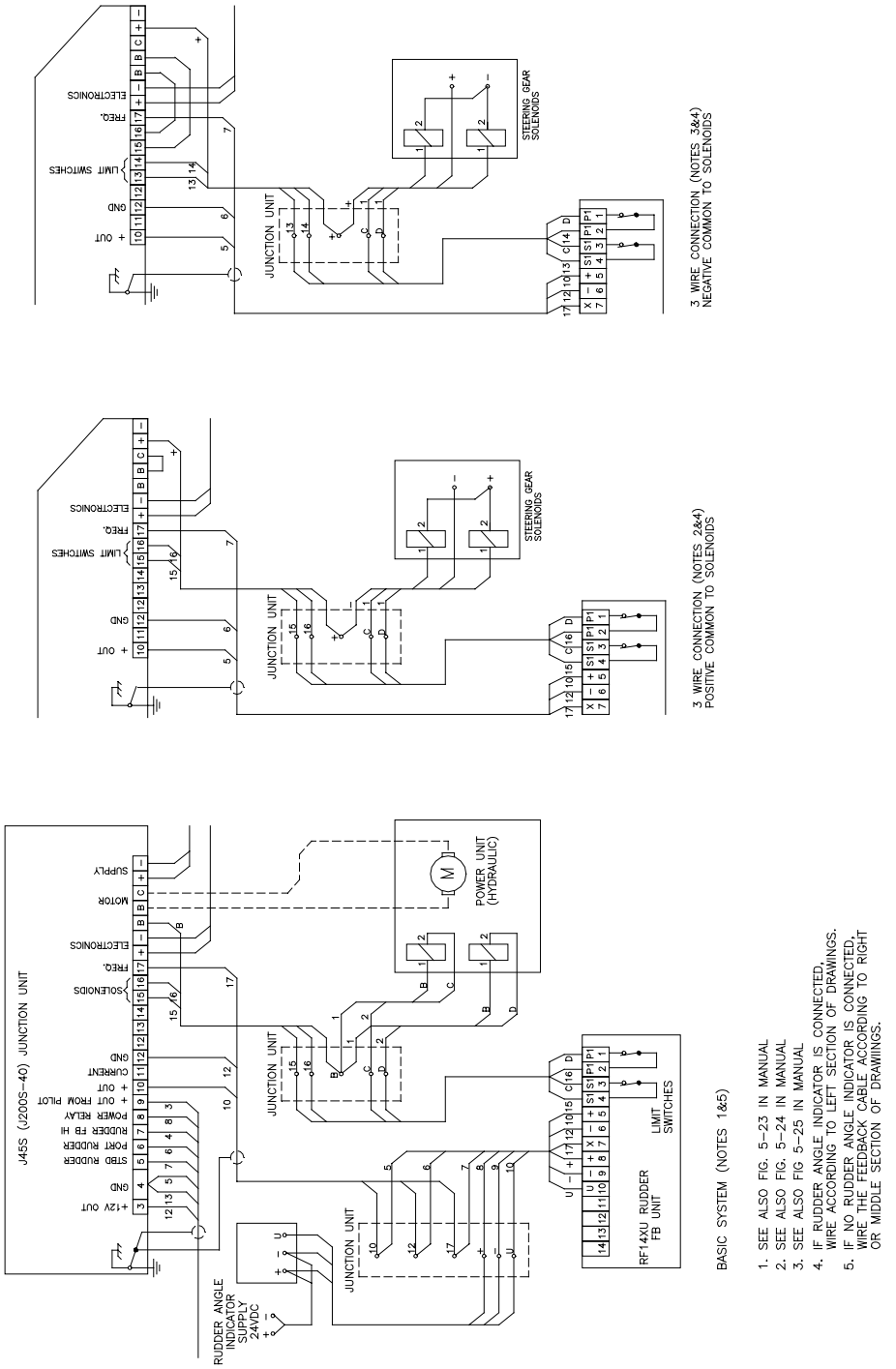


Fig. 5-21
RF14XU/J45S - Wiring

J45S Junction Unit The junction unit is made for bulkhead mounting and secured by screws. To minimise length of power cables (thus avoiding voltage drop), it should be centrally located between mains panel and power unit.

The unit has separate mains supply for the autopilot electronics and the power unit (motor/solenoids). This reduces the interference to the autopilot electronics caused by the motor switching. The power unit supply cable (mains supply) should be of at least 4 mm^2 (AWG10). The electronic supply cable should be 1,5 mm^2 (AWG14).

Cables from control unit, rudder feedback unit, power unit and mains supply should be connected to the terminal blocks according to wiring diagram fig. 5.23. Sufficient free cable should be left inside the junction unit so that the P.C. board can be removed for repair without having to disconnect the cables from the terminal board.

Note!

The J45S Junction Unit has been set for 24V DC operation and prewired from factory to drive Robertson power units with solenoid valves such as RPU3 (solenoid supply is via J45S).

If the autopilot shall operate on 12 or 32V DC, set voltage selector (plug-in strap) to appropriate position.

Check that the FB selector is in correct position (S2-S3) for frequency feedback signal.

Run two voltage feed cables as follows:

Mains input for pump motor and solenoid valves is connected to + and - terminals marked "Supply" (Cable dimensions 4.0 mm^2 - AWG10).

Autopilot (electronic) supply is connected to + and - terminals marked "Electronic" (Cable dimensions 1.5 mm^2 - AWG14).

OTHER SOLENOID CONFIGURATIONS

(Driving steering gear solenoids not Robertson supplied).

If the "Supply" cable shall feed solenoid voltage only it may be reduced to 1.5mm^2 - AWG14.

In installations where the unit shall operate solenoids with positive common, they must be connected according to Fig. 5-24. Note that minus on solenoid supply shall be connected to "+ Supply"-terminal on J45S.

If the unit shall operate solenoids with negative common, they must be connected according to Fig. 5-25. Note that terminal B must be connected to terminals 15 and 16 by external strapping. Also note that straps S5-S6 and S8-S9 on the PC-board must be cut.

Note!

(Does not apply for US-installations and only for older version of J200S-40). If the unit has a PC-board marked "Rev -" and shall operate solenoids with positive common (Fig. 5-24), there shall be no strap between terminals B and C. Instead terminal B shall be connected to both terminal 13 and 14.

J45A Junction Unit

The junction unit is made for bulkhead mounting and secured by two screws. To minimise length of power cables (thus avoiding voltage drop), it should be centrally located between mains panel and power unit.

The unit has separate mains supply for autopilot electronics and power unit motor. This reduces the interference to the autopilot electronics caused by the motor switching. The power unit supply cable (mains supply) should be of at least 4 mm^2 (AWG10) size. The electronic supply cable should be 1,5 mm^2 (AWG14).

Cables from control unit, rudder feedback unit, power unit and mains supply should be connected to the terminal blocks according to Fig. 5-26. Strip about 1 cm (0.4") of the cable's insulation and pull the screen backwards to cover the insulation. Position the straps as shown in Fig. 5-22 and tighten well to make sure the screen has good contact. Sufficient free cable should be left inside the Junction Unit so that the P.C. board can be removed for repair without disconnecting the cables from the terminal board.

Mains supply of 12V, 24V or 32V DC is connected to the MAINS + and -terminals.

The unit has been provided with a polarity test point. Connect only the mains supply conductor that are supposed to be the MAINS– (minus). Switch on the mains supply and let the other conductor get into touch with the TP1 test point. See Fig. 8-11. If the green diode D20 lights, the correct conductor is connected to MAINS– and the other conductor can be connected to MAINS+. If the red diode D21 lights the conductors must be interchanged.

A separate autopilot (electronic) + supply line is connected to terminal no. 17 (+). At 32V DC mains the external J101A/32V Adapter must be connected between the mains + and terminal 17 (ref. Fig. 5-26).

Note!
When using a RPU pump unit, the "Soft start" function should be activated by connecting a strap between terminal 2 and 4. See Fig. 3-8.

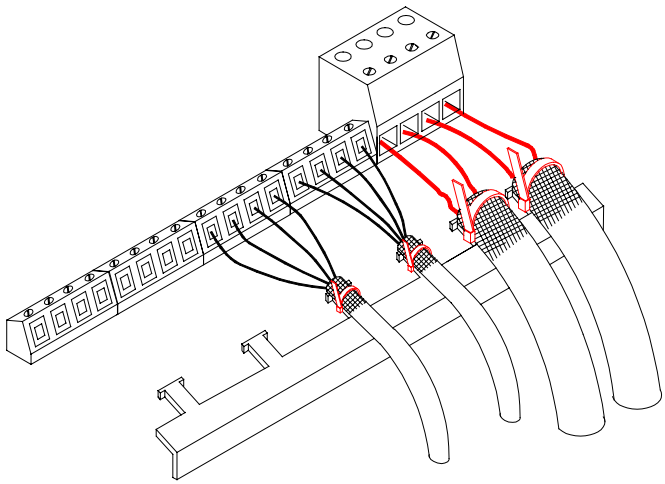


Fig. 5-22
J45A Junction Unit grounding

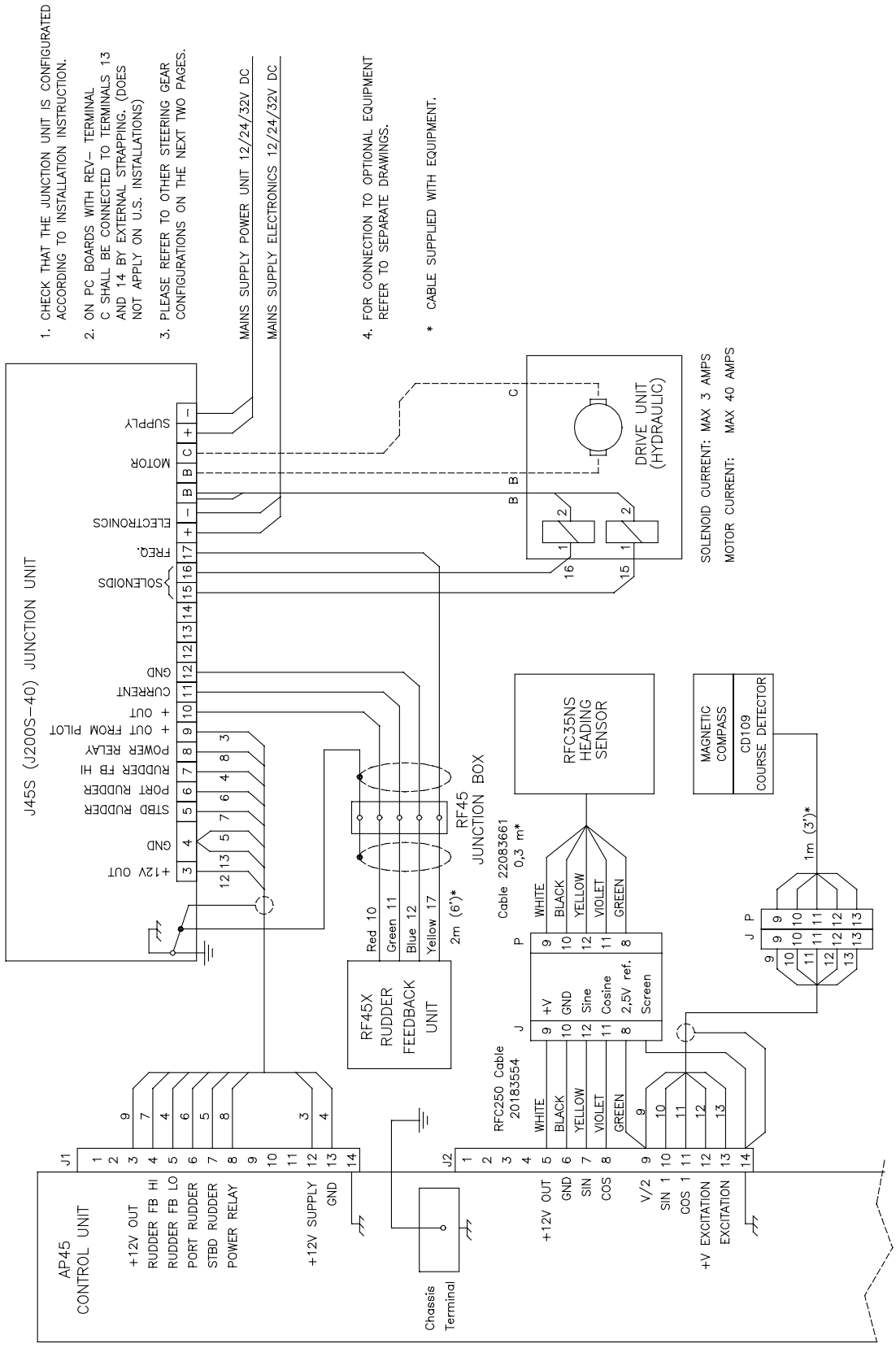


Fig. 5-23
AP45 Wiring diagram - basic system (015936H)

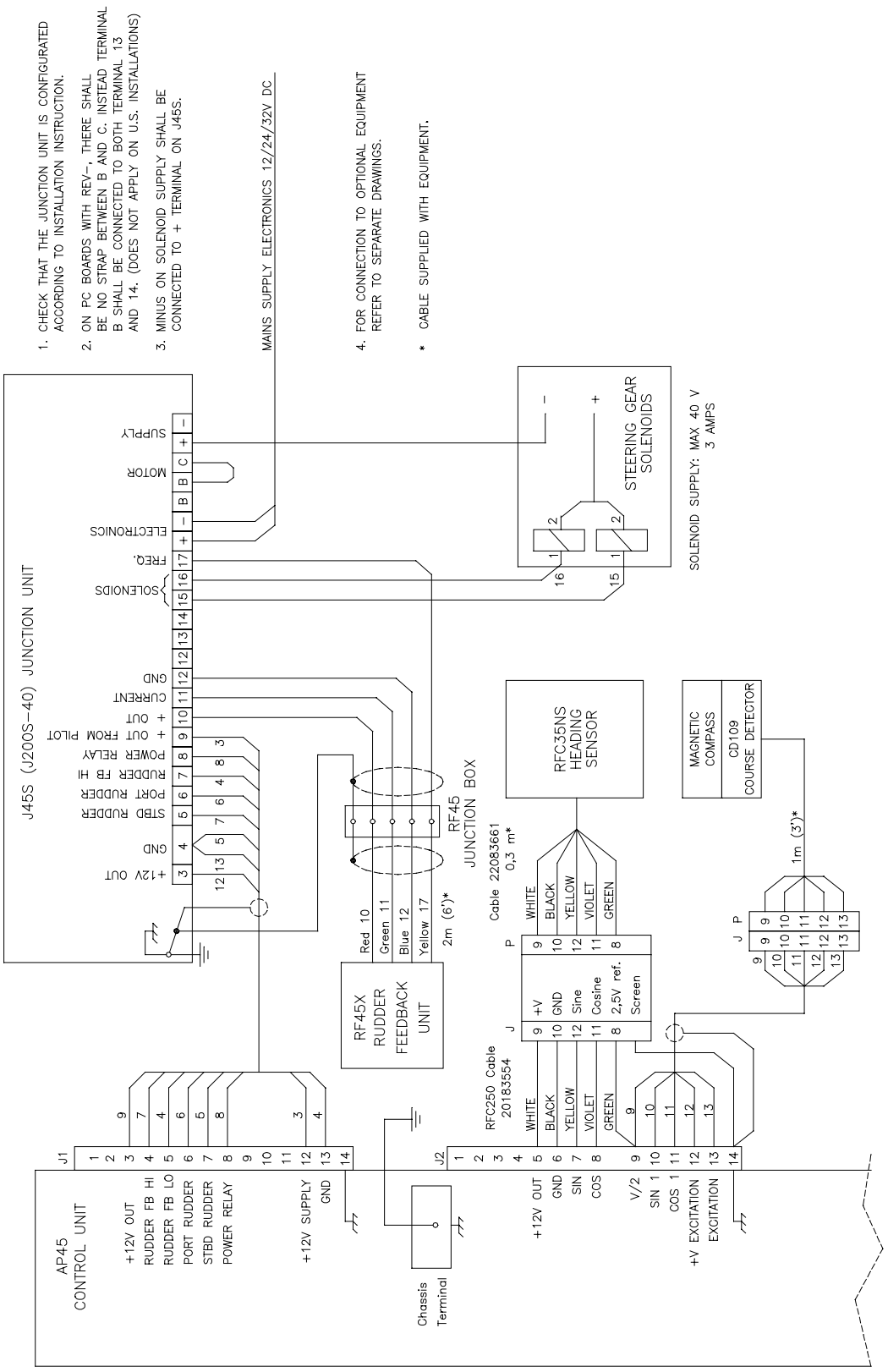


Fig. 5-24
AP45 Wiring diagram - solenoids with positive common (015936H)

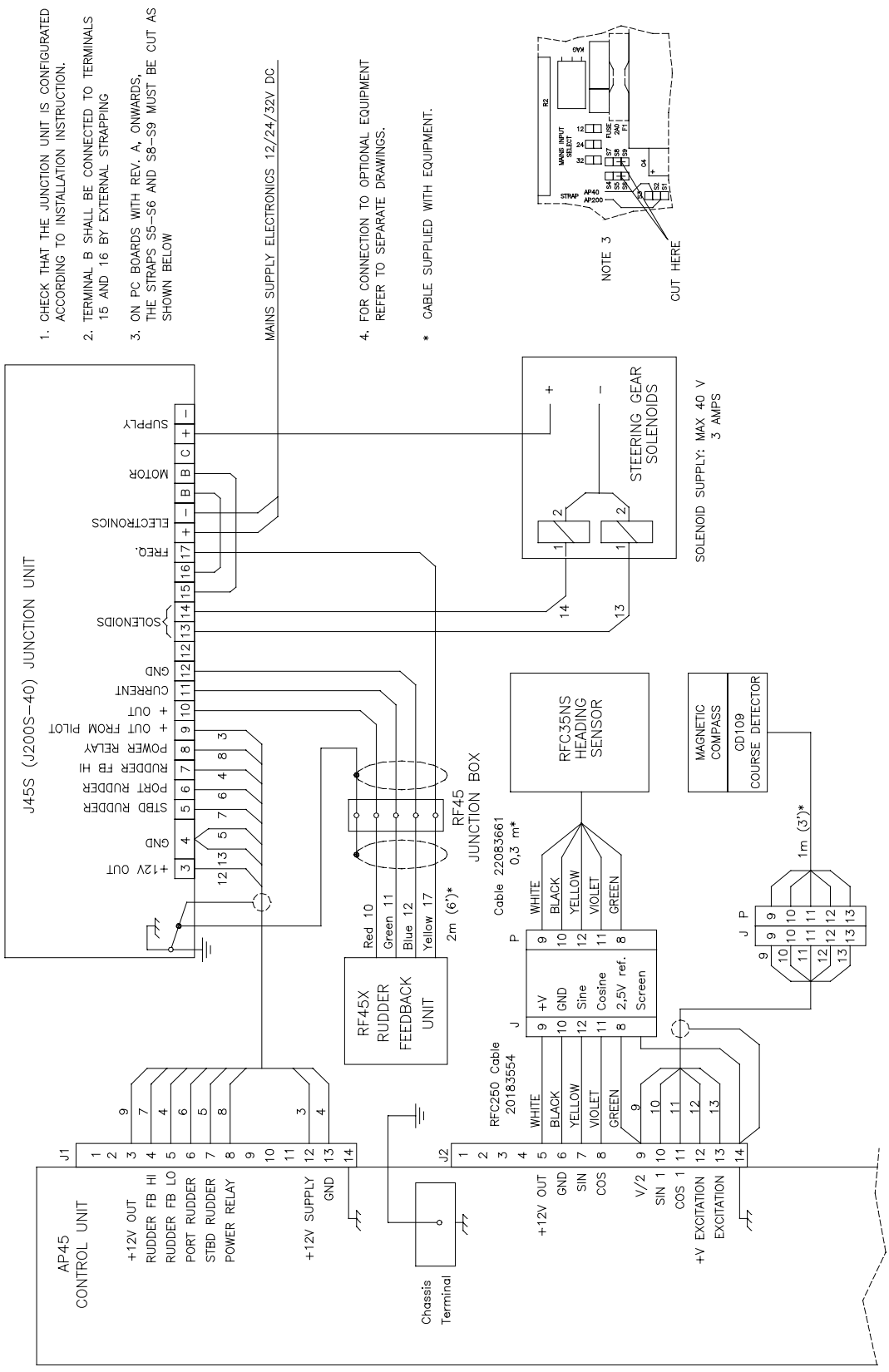


Fig. 5-25
AP45 Wiring diagram - solenoids with negative common (015936H)

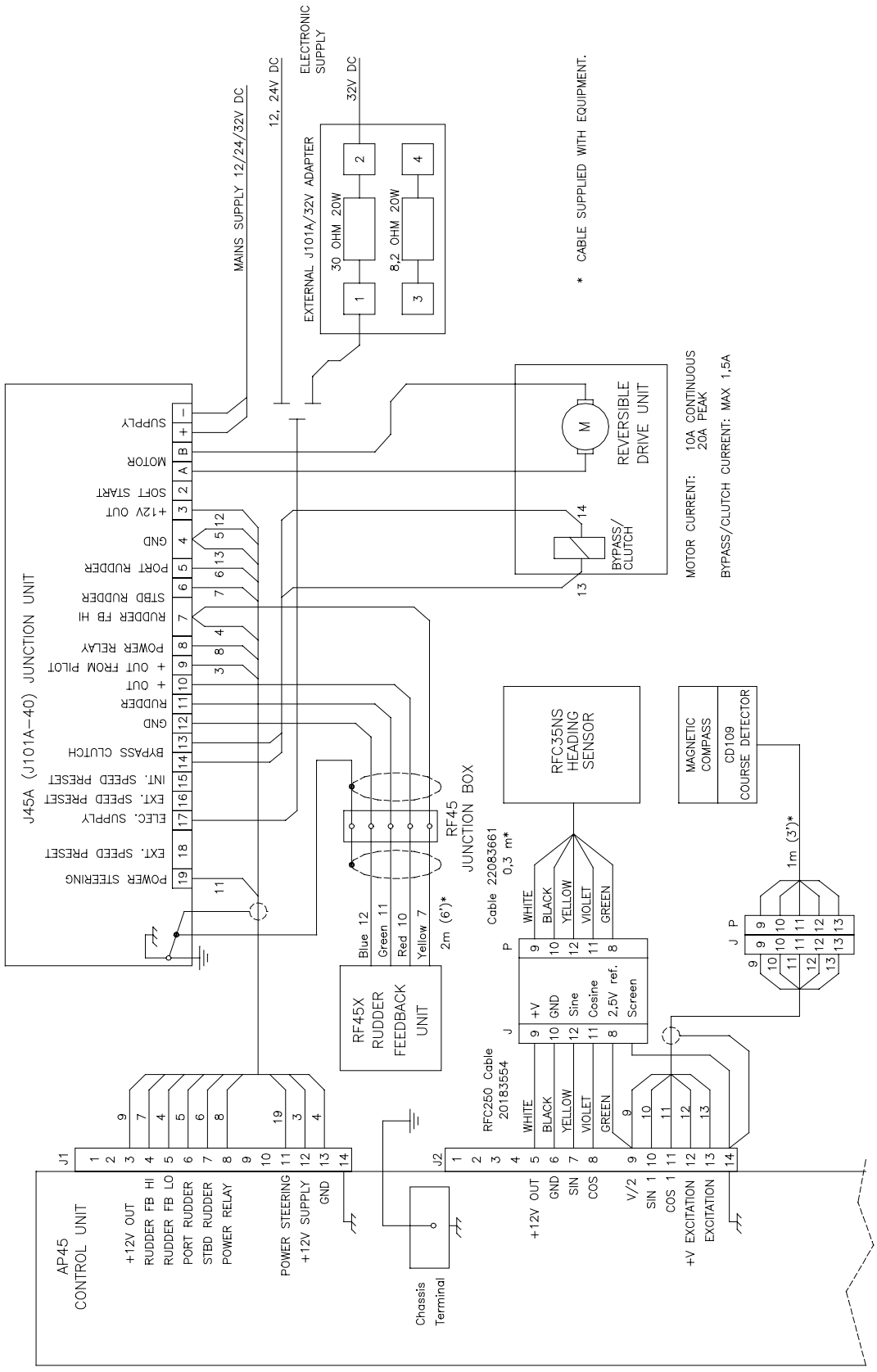


Fig. 5-26
AP45/J45 Wiring diagram

Optional equipment

F200-40 Remote Control

This unit is fixed to a mounting bracket, which is secured by four screws. F200-40 is connected to J3 on the control unit according to Fig. 5-27.

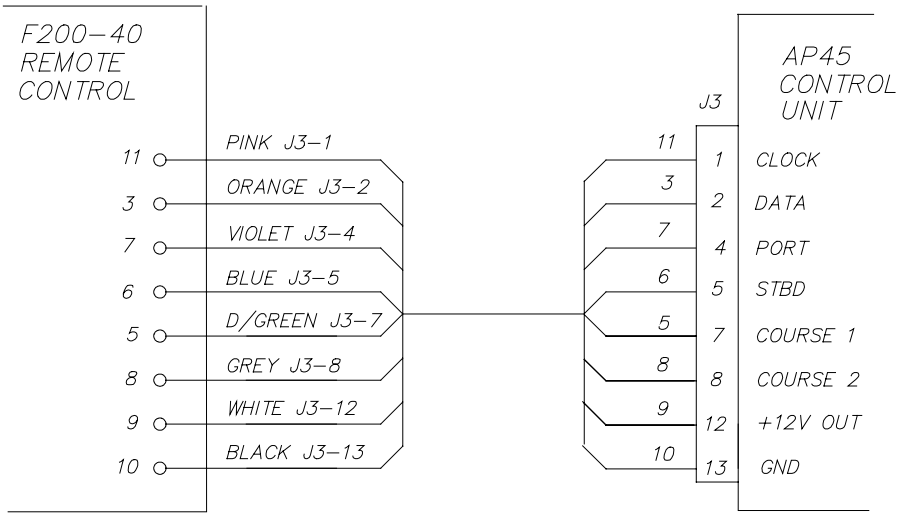


Fig. 5-27
F200-40/AP45 - Wiring diagram

S9 Steering Lever

Mounting (Fig. 5-28)

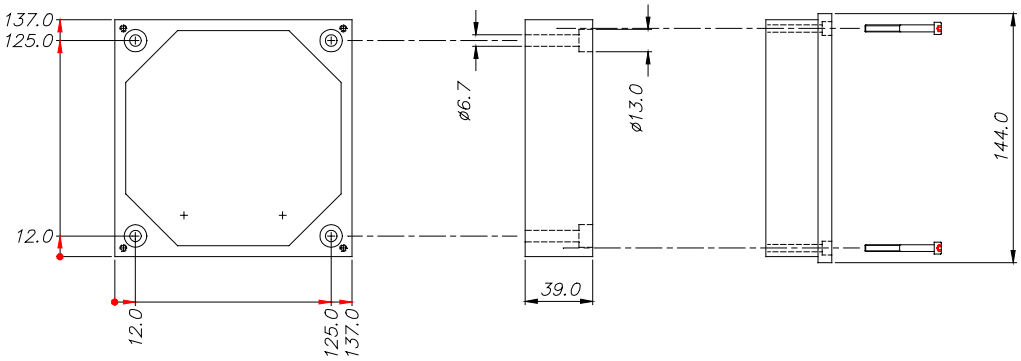


Fig. 5-28
S9 Mounting

For bulkhead mounting, use the 8 bushings enclosed with the unit. These are placed two and two against each other and the screws are put through them. Direct contact between S9 and a steel bulkhead is then avoided and corrosion is prevented. The cover plate can be turned 360 degrees for the most convenient position of cable outlet. For panel mounting use the two mounting brackets enclosed with the unit.

Electrical connection:

Connection to the AP45 Control Unit is made in accordance with Fig. 5-29.

The diagram in the cover plate shows the terminal connections in the S9 (Fig. 5-30).

For use together with AP45, four different operation alternatives can be selected by changing a resistor in S9.

The different alternatives are described on page 2-12, and are the result of connecting a resistor between terminals M and A3 in S9.

Alternative 1: No resistor mounted.
Alternative 2: 1.0 Kohm (1/4W, 5 %)
Alternative 3: 3.0 Kohm (1/4W, 5 %)
Alternative 4: 5.1 Kohm (1/4W, 5 %)

Note!
If F200-40 is connected in combination with S9, only alternative 1 can be used.

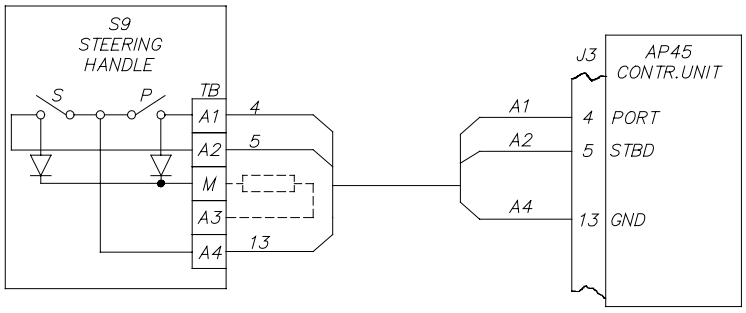


Fig. 5-29
S9/AP45 - Wiring diagram

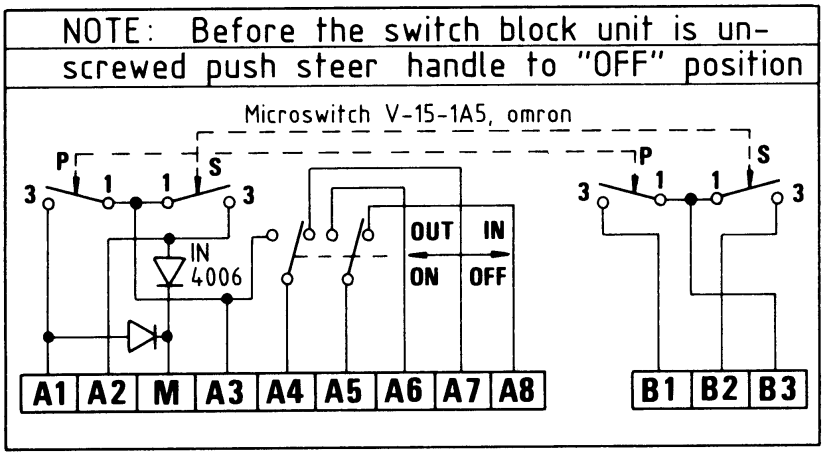


Fig. 5-30
S9 Steering Lever - internal wiring

FU91 Steering Lever

Mounting

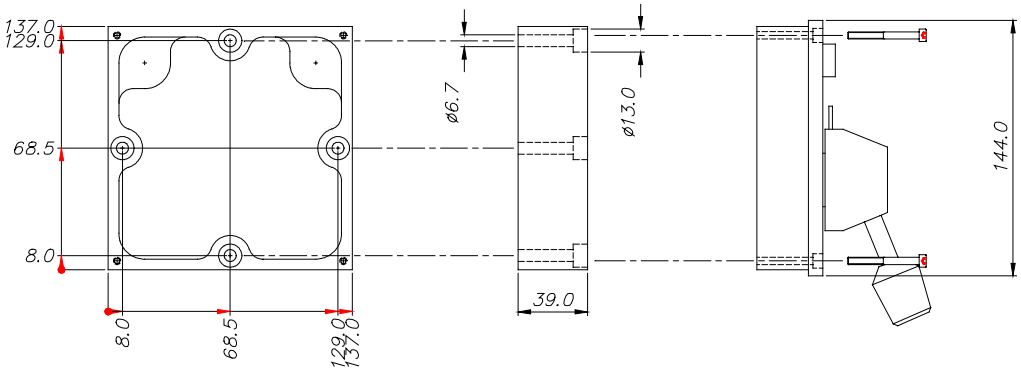


Fig. 5-31
FU91 Mounting

For bulkhead mounting, use the 8 bushings enclosed with the unit. These are placed two and two against each other and the screws are put through them. Direct contact between FU91 and a steel bulkhead is then avoided and corrosion is prevented. The cover plate can be turned 360 degrees for the most convenient position of cable outlet. For panel mounting use the two mounting brackets enclosed with the unit.

Electrical connection

There is two alternatives of connecting FU91 to AP45; without mode switching or with mode switching (similar to S9)

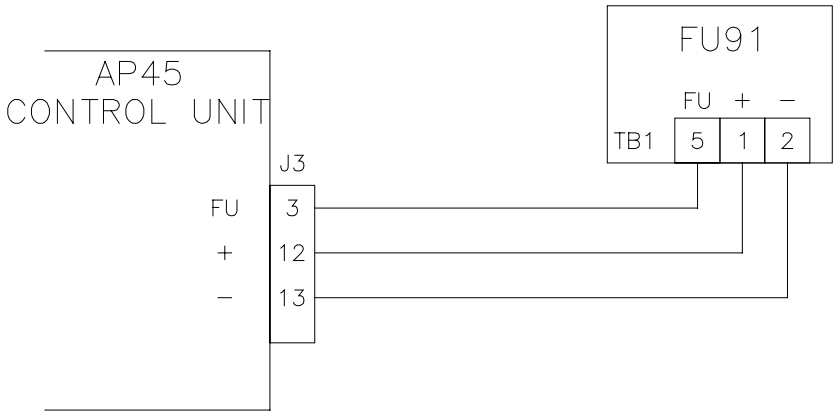


Fig. 5-32
FU91 without mode switching

See page 2-14 for operation.

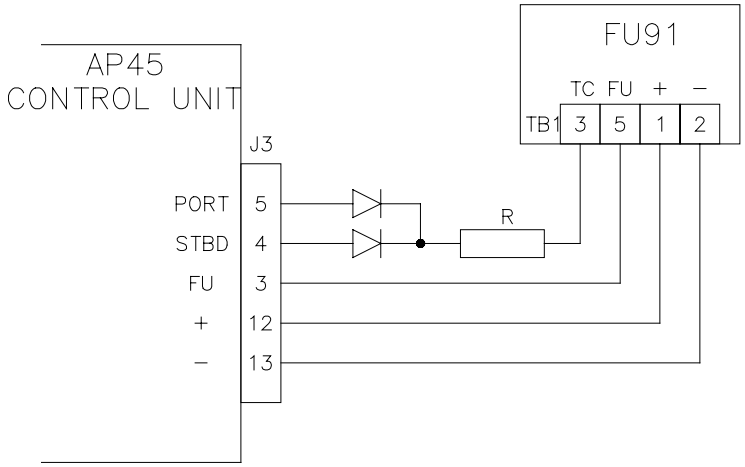


Fig. 5-33
FU91 with mode switching

The two diodes (1N4002 or similar) and the resistor can be mounted either in the AP45 J3 connector or in the FU91 terminal board. By giving resistor R different values, following mode changes are possible:

R = 1.0K: Auto → Dodge → Auto
R = 3.0K: Auto → Manual → Manual
R = 5.1K: Auto → Manual → Auto

See also page 2-14 for operation.

Multiple FU91 installation is not recommended with AP45 unless the optional FU-Junction box is used. Connections are shown in Fig. 5-34

If mode switching is required, the resistor and the two diodes must be mounted between the FU-Junction box and the AP45 Control unit.

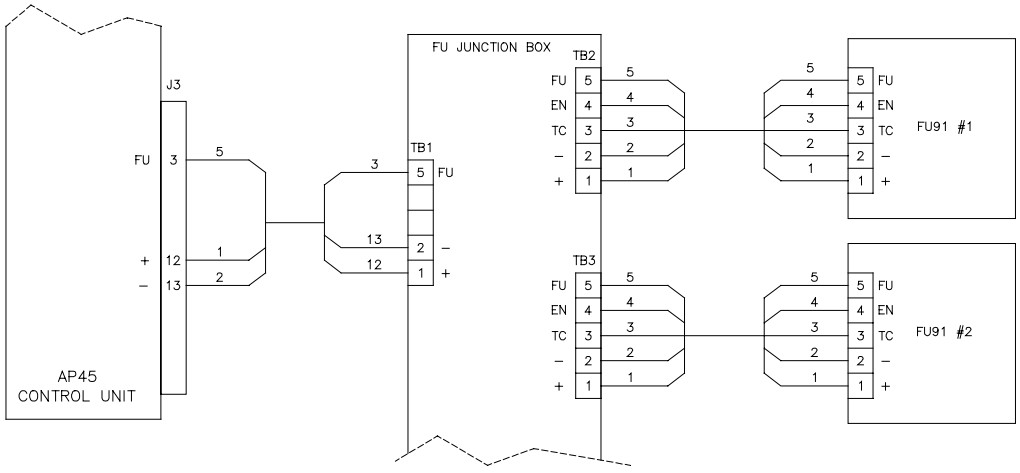


Fig. 5-34
FU91 Multiple installation

S35 Steering Lever

The unit is mounted to bulkhead or panel by two screws from the front. The cable is connected to the junction unit according to Fig. 5-35. Interchange the port and stbd wires to the screw terminals in the junction unit if necessary to make the direction of the lever movement coincide with the direction of the rudder movement.

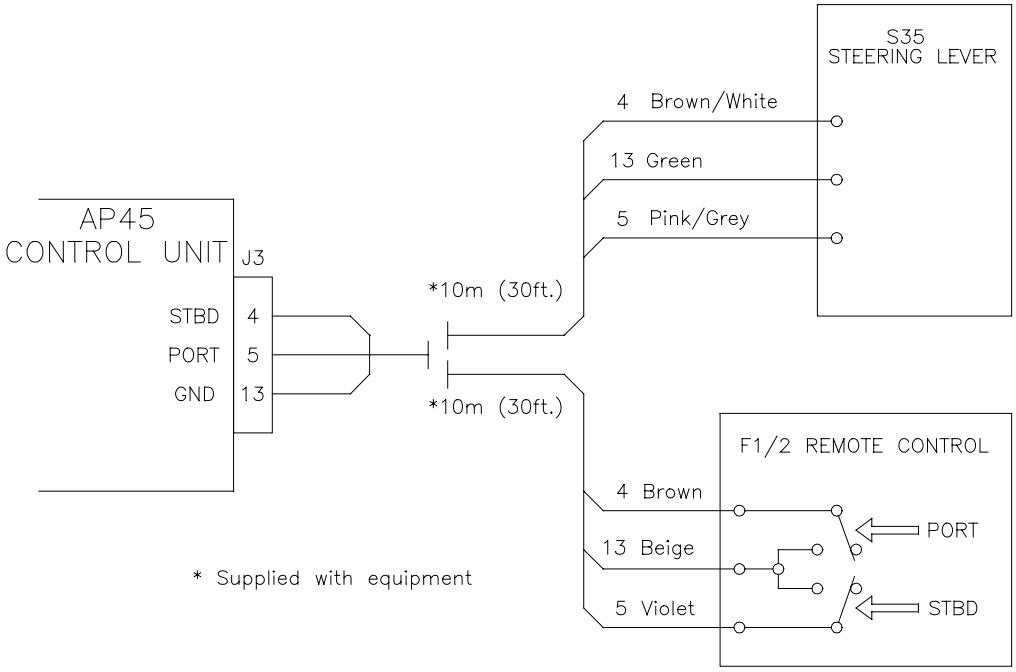


Fig. 5-35
S35, F1/2 - AP45 - Wiring diagram

F1/2 Remote Control

This handheld remote control with 10 m (30 ft.) cable is connected to the control unit as shown in Fig. 5-35.

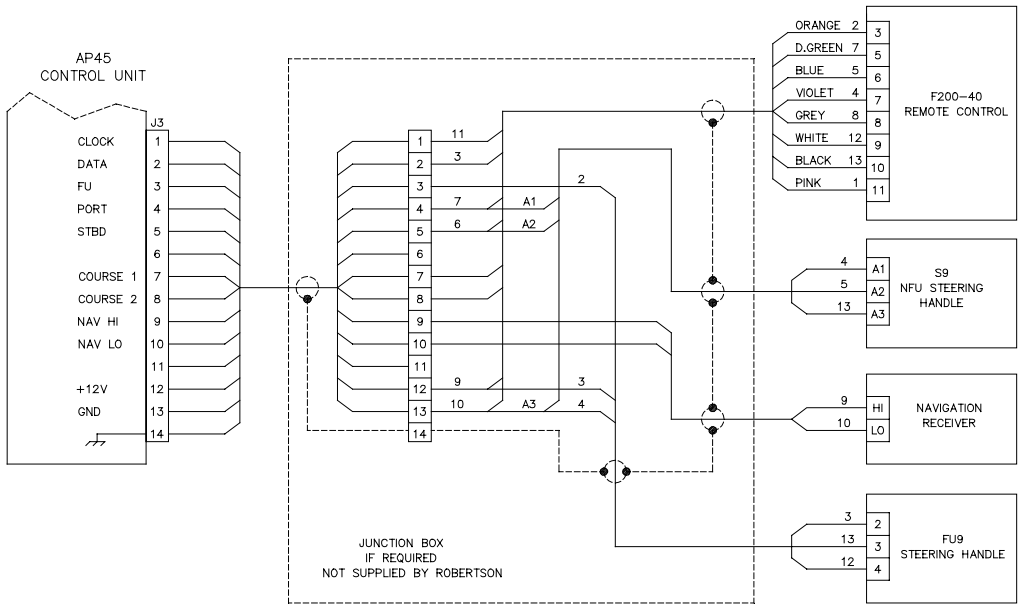


Fig. 5-36
AP45 Wiring diagram - J3 w/multiple input

RI9 Rudder Angle Indicator

The RI9 is designed for bulkhead or panel mounting, and should be placed in a location in clear view of the helmsman.

Two or more indicators may be connected in series with the rudder feedback unit.

Note!

If more than one rudder angle indicator is connected, remove the Jumper Switch S1-S2 on J45S PCB.

For electrical connection of rudder feedback unit and indicator a 3-wire cable (3 x 1,5 mm² - AWG14) should be run. See Fig. 5-37. for connection to junction unit.

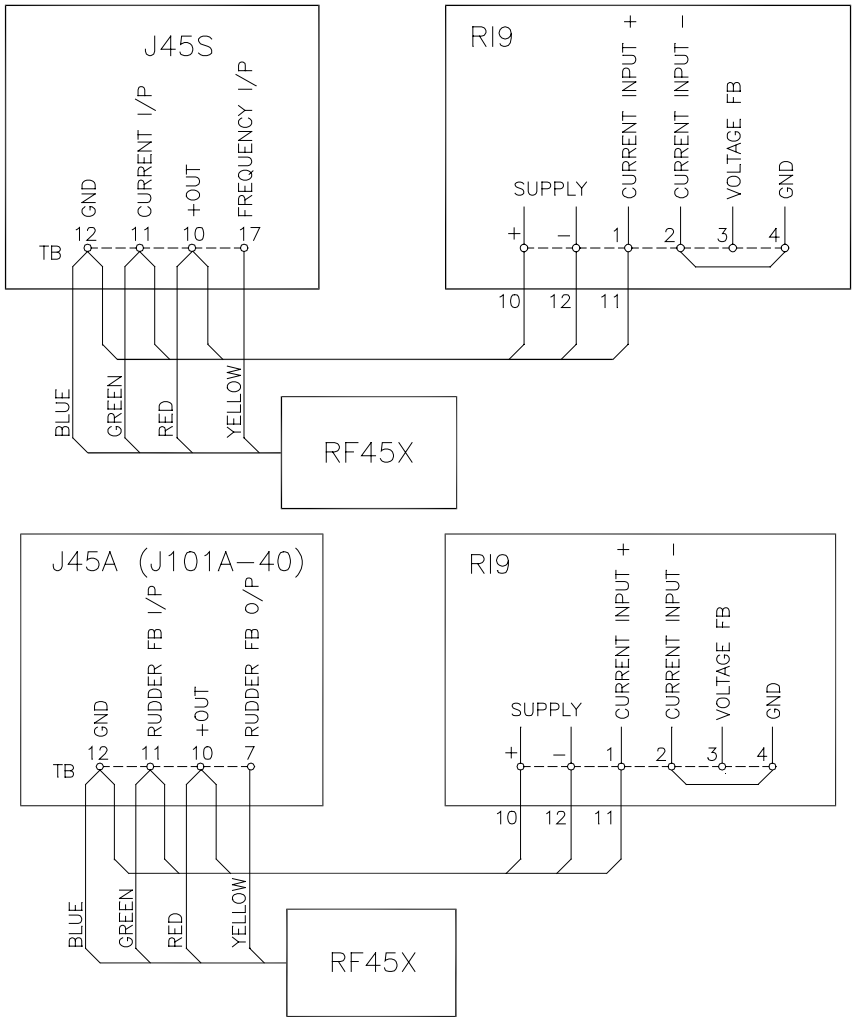


Fig. 5-37
RI9 Wiring diagram

Calibration

The RI9 indicator is calibrated for voltage input signal (RF14XU Rudder Feedback Unit) and has to be reconnected for current signal from RF45X.

This is done by opening the RI9 and move “jumper” ST3 from “U” to “I” position. See Fig. 5-38.

Note!

The “Norm”/“Inv” jumper does not affect the meter deflection for current input signal. If the meter deflection has to be reversed, it must be made in the feedback unit as described for RF45X.

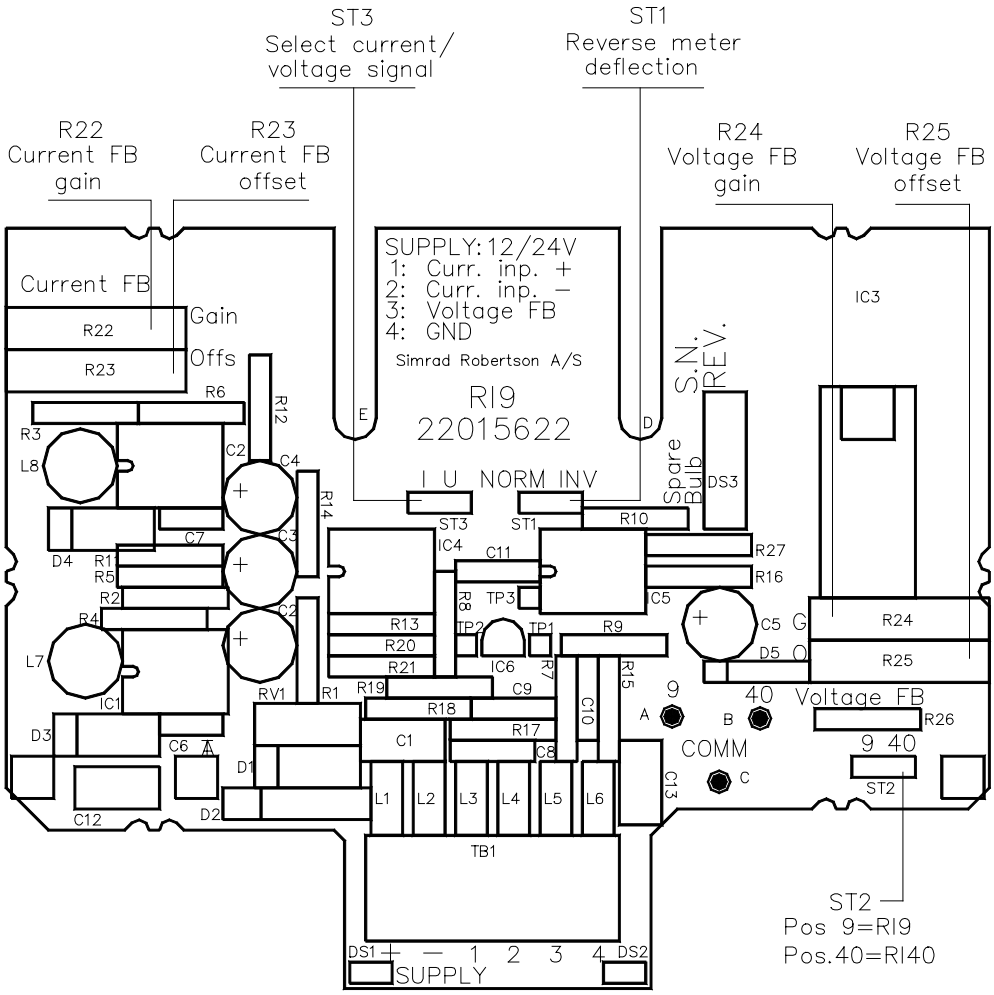


Fig. 5-38 RI9 Input signal selection

Note!

When changing from voltage to current signal (or vice versa), the indicator may have to be recalibrated. In this case, or if the Gain and Offset trimpot's for other reasons are maladjusted, the following calibration procedure should be carried out:

1. Take the rudder to midship position.
2. Use trimpot "O" (R23) to calibrate RI9 to indicate zero rudder angle.
3. Move the rudder to e.g. 40 degrees (starboard or port). Use trimpot "G" (R22) to calibrate RI9 to show the same angle as the rudder is set to (or the same angle as shown on the autopilot display in "Debug" mode).

RI35 Rudder Angle Indicator

The RI35 is designed for flush, bulkhead or bracket mounting, and should be positioned in a location in clear view of the helmsman. When the mounting location is determined, the cables should be connected to RI35 before the unit is mounted. Maximum two indicators can be connected in a system.

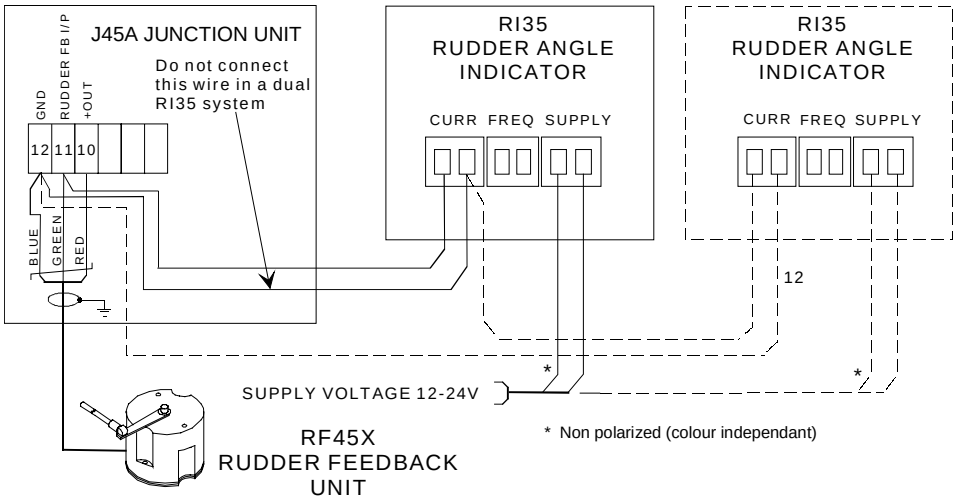


Fig. 5-39 RI35-J45A Wiring diagram

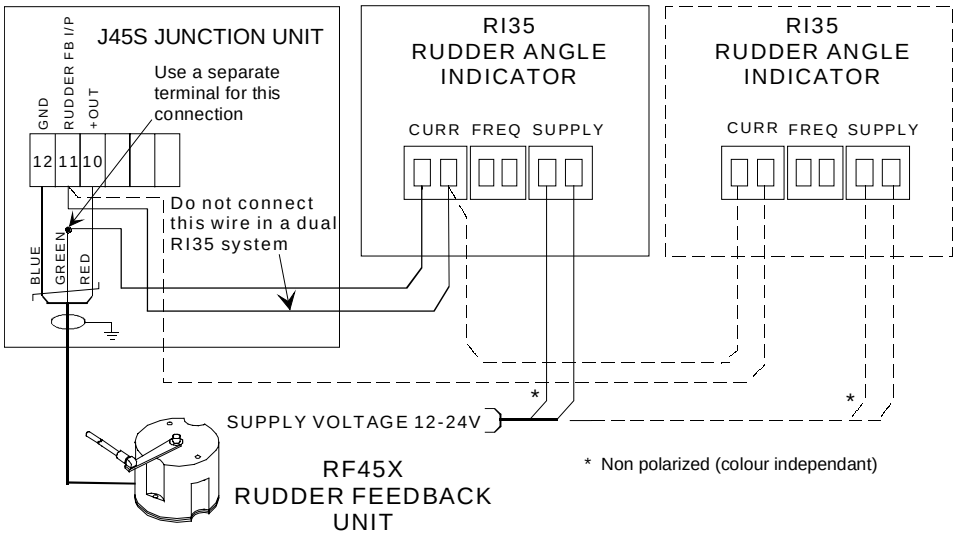


Fig. 5-40 RI35-J45S Wiring diagram

Panel mounting

- Make a panel cut-out of 126 x 102 mm.
- Use the supplied fastening device to secure the unit to the panel. See Fig. 5-41

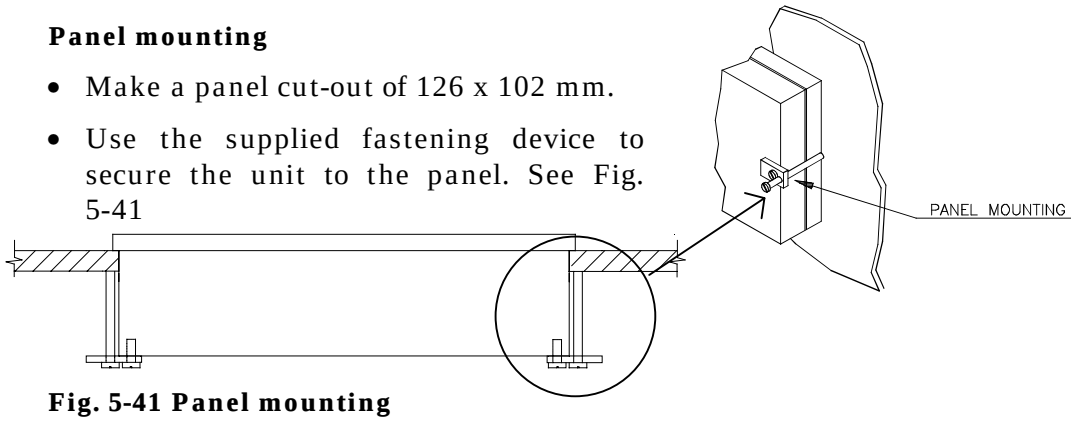


Fig. 5-41 Panel mounting

Bracket mounting

- Mount two of the bracket halves to the RI35.
- Temporarily bolt together the other two halves of the bracket to the first two halves.
- Hold the RI35 in place by hand and mark the 4 holes for the fixing screws on the mounting surface.
- Remove the RI35, drill the 4 mounting holes in the mounting surface.
- Unbolt the temporarily fitted bracket halves and secure them to the mounting surface using the self-tapping screws.
- Assemble the complete bracket again and adjust the RI35 to best viewing angle and tighten up the mounting bracket bolts.

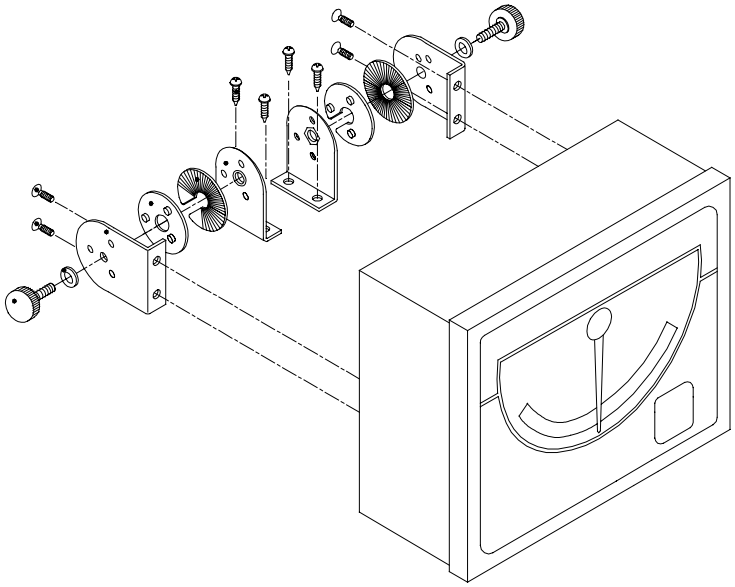


Fig. 5-42 RI35 Bracket mounting

Illumination

The scale is illuminated by internal LED's. The illumination is turned on and adjusted in three steps by the front panel key pad.

Zero adjust

Follow the instructions on page 6-1 to zero adjust the rudder feedback.

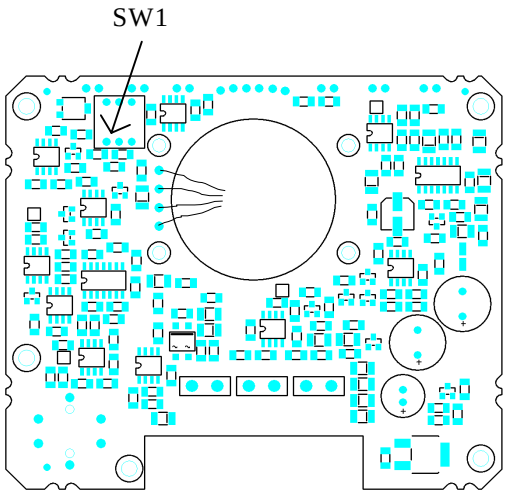
Note!

There may be a difference in the RI35 and the autopilot reading. This is normal because the autopilot zero adjust compensates for drag caused by the hull, flaps etc. If you prefer the readings to be aligned, then put the rudder amidships using the RI35 as reference, and then zero adjust the autopilot.

Reversed deflection

On installations where the feedback unit is mounted upside down, the deflection of the pointer will be reversed. To make it correct set SW1 on the PCB to the opposite position.

The first production lots did not have the SW1 switch. Instead interchange the brown and white wires going from the instrument housing to the PCB.



Connection to Navigation Receiver

The AP45 is preset to accept signals of NMEA 0183 format. For 180/182 format, please contact your Simrad Robertson dealer.

Correct NMEA format, baud rate and current loop polarity are found in the navigation receiver manual.

For older AP45's with s.n. below 4000 (Main PCBs with revision up to and including revision G), the N40 Navigation Interface must be mounted in the control unit. The N40 is plugged into the holes provided on the Main PCB (Fig. 5-43).

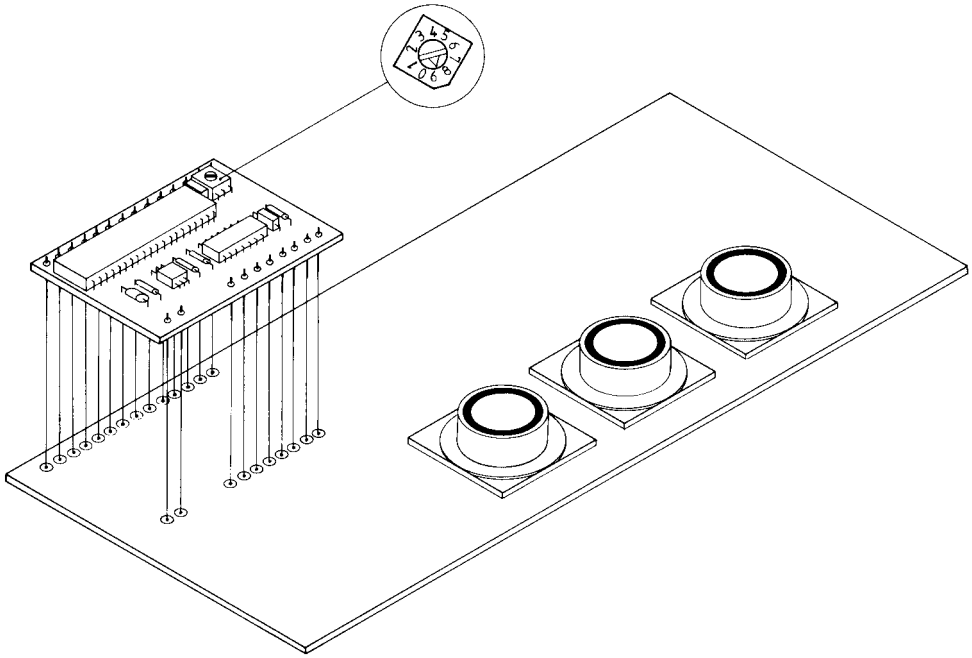


Fig. 5-43
N40 Nav. Interface mounting
(For Main PCBs with revision up to and including revision G)

The AP45 is set to correct polarity and Baud rate by putting the BCD-switch on the N40 PC-board (Fig. 5-43) in the appropriate position.

Sentences used are: APA, APB, XTE, XTR, RMB, BWW, BWC, BWR, BOD, HSC.

The AP45 automatically selects the sentence(s) to use according to the "NMEA Priority table" on page 7-8.

Position 3: NMEA 0180, standard polarity
Position 8: NMEA 0183, inverse polarity
Position 9: NMEA 0183, standard polarity

Note!
Both a hardware setting (switch or strap), and a software selection from the info-loop is necessary to select the Nav. Interface format (0180, 0183).

The NMEA format is selected under the installation loop, see page 6-5. The NMEA 0183 format accepts different sentences as per "NMEA Priority table", page 7-8.

For receivers with NMEA 0183 format that outputs both XTE and Bearing to waypoint type of nav. information, the autopilot displays the XTE information between the waypoints, and Bearing information at the waypoint.

The output from the navigational receiver is connected to AP45 J3 pin 9 and 10 (Ref. Fig. 5-44).

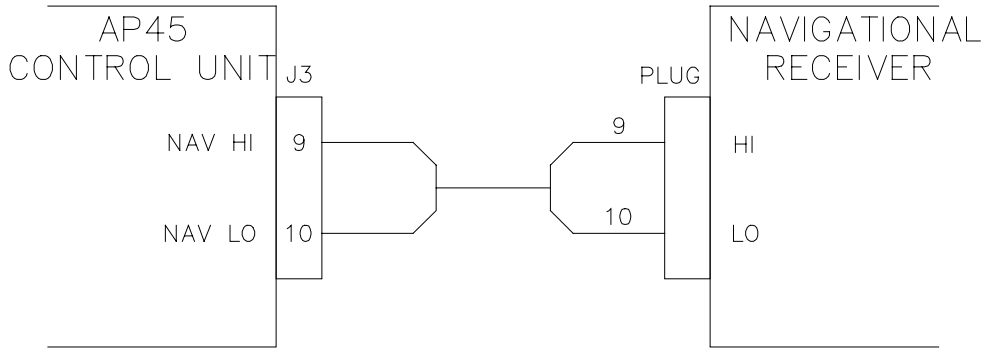


Fig. 5-44
AP45/Navigation receiver - Wiring

Watch alarm

AP45 is originally designed for connection to an external watch alarm of type WA9 which is no longer available. WA9 was connected to J1 as per Fig. 5-45

However, it is still possible to enable the built in watch alarm in AP45 by temporarily connect pin 2 of J1 (Watch al. sense) to pin 13 (Gnd). The watch alarm function can be permanently disabled again by following the procedure described in section “Fault warnings” page 2-16 and section “TROUBLE SHOOTING”, page 7-1

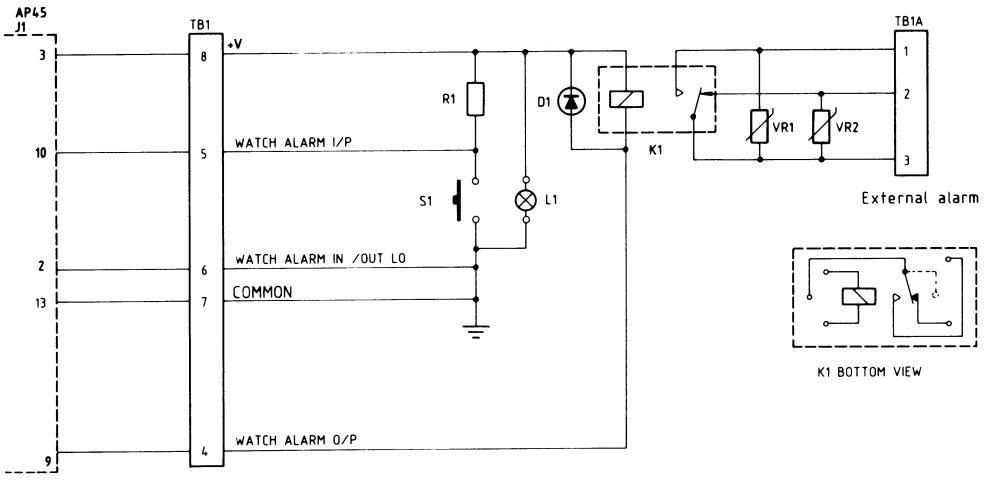


Fig. 5-45
WA9 Circuit/Wiring diagram

Note!
If pin 2 of J1 has a fixed connection to pin 13 (Gnd) it is not possible to disable the watch alarm.

6. START-UP PROCEDURE/ COMMISSIONING

After finishing the installation and interconnecting all units, check that correct power and polarity is supplied to the junction unit. See page 5-19 and 5-21.

Alignment and adaptation of the autopilot parameters to the vessel's characteristics must be carried out according to the following procedure.

Power ON

Turn on the autopilot by pressing the MANUAL button. The Information Display shows MANUAL and software version for two-three seconds after turn on:

```
PROGRAM V_R_
MANUAL
```

Then the display will show:

```
NON FOLLOW UP
MANUAL
```

Rudder Feedback Adjustment

The Rudder Feedback Unit must be adjusted to zero when the rudder is in midposition. This is done by using the DEBUG mode, which enables the rudder angle to be shown digitally on the Information Display. Use the following procedure:

a. Move the rudder to centre position.

b. Select MANUAL-mode on the Control Unit.

c. Select DEBUG-mode by pressing the hidden DEBUG button (just above the INCREASE-button) and then the WEATHER-button. The Information Display now shows (example):

```
DEBUG MODE
RUDD.ANG: S02.2°
```

S = starboard, P = port

d. Adjust for approx. zero rudder angle (less than 1.0 degree) by turning the shaft of the feedback unit after it has been loosened from the lever. Secure the lever after completion of adjustment.

e. Take the rudder 5 degrees to starboard and verify that the feedback signal is in phase by reading S05° on the information display. Repeat by taking the rudder 5 degrees to port. The display should now read P05°.

Final setting of dynamic zero position is made (via the Debug mode) under Sea Trial. Ref. page 6-6.

Direction of Rudder Movement

Press the MANUAL button and set the RUDDER value to 1.0. Take the rudder approximately 5 degrees to port or starboard using the helm or a NFU control. Press the AUTO button and verify that the rudder returns to amidships position.

If the rudder moves in opposite direction, press the MANUAL button to stop the rudder. Interchange the wires to the solenoids or motor and repeat the procedure.

Rudder speed

The rudder speed is a contributing factor to autopilot performance.

For the majority of vessels a rudder speed of 5-8 degrees pr. second is preferable (equals to 11-18 seconds h.o-h.o. time for ±45° rudder travel).

The rudder speed can easily be calculated by the following equation:

$$\frac{\text{H.O.-H.O. rudder angle in degrees}}{\text{H.O.-H.O. time in seconds}}$$

If a Robertson power unit has been installed, the speed can be adjusted in two ways dependant on the type of unit.

1. Reversible units using the J45A Junction Unit:
   By adjustment of the RV1 potentiometer.
2. Continuously running pump units (RPU-3):
   By selection between two speeds on the motor.

If a non-Robertson power unit has been installed, consult the supplier or manufacturer.

Note!

If the rudder speed can not be set within the recommended limits, perform the sea trial before any further steps are taken. Some vessels may steer satisfactory even with a rudder speed exceeding the recommended limits.

Course Detector Alignment

- Select DEBUG-mode by pressing the hidden DEBUG button (just above the INCREASE-button) and then the WEATHER-button until the Information Display shows compass signal level:

DEBUG MODE COMP.SIN: 3.26V

Turn the compass slowly 360° around. The signal level should vary between 0.5 and 4.5V. Adjustment of signal level can only be done by adjusting the distance between the compass card and the course detector.

- Select MANUAL-mode. Loosen the fastening screw and turn the course detector by hand until the display readout corresponds with the compass.
- On some installations a heading error may occur in certain compass quadrants. Turn the course detector so that the error is distributed through 360°.
- Fasten screw and finally check the readout on different headings.

Selection of parameter settings

To adapt the autopilot to the vessel's characteristics and the mechanical installations, some parameters must be set. An installation programme loop is available for this purpose. The loop is accessed by pressing the RUDDER and WEATHER buttons simultaneously. To step through the loop, press the WEATHER button, and to change the different parameters, use the + and - buttons. Refer to Fig. 6-1.

If any of the factory set parameters has been changed under Debug Adjust mode (see page 7-5), a warning will be given when stepping through the installation loop. The warning:

SPECIAL PARAMSET CHANGE?: +/-

will be shown in the information display instead of each parameter that has got a special value. This is done to avoid that the parameters are re-selected by a mistake.

To continue without further changing the special value: Press the WEATHER button.

To re-select the factory parameter setting:

- Enter the Debug mode as described on page 7-5. (Press hidden button + Weather button).
- Step through the entire debug loop until you find:

PROGRAM: V_R_ RUNTIME: ----------H

- Press - button repeatedly until alarm sounds and display shows:

DATA FAILURE ! CHECK SETTINGS

- By pressing the ALARM button and cancel the alarm the complete set of factory settings are re-selected.

Select language

The text in the Information Display can be presented in four different languages.

Select desired language by pressing the RUDDER and WEATHER button simultaneously. The display shows one of the following

* ENGLISH * F, E, D, N: +/-

languages: ENGLISH, FRANCAIS, ESPANOL, NORSK.

Press the + or - button until the desired language is shown in the display.

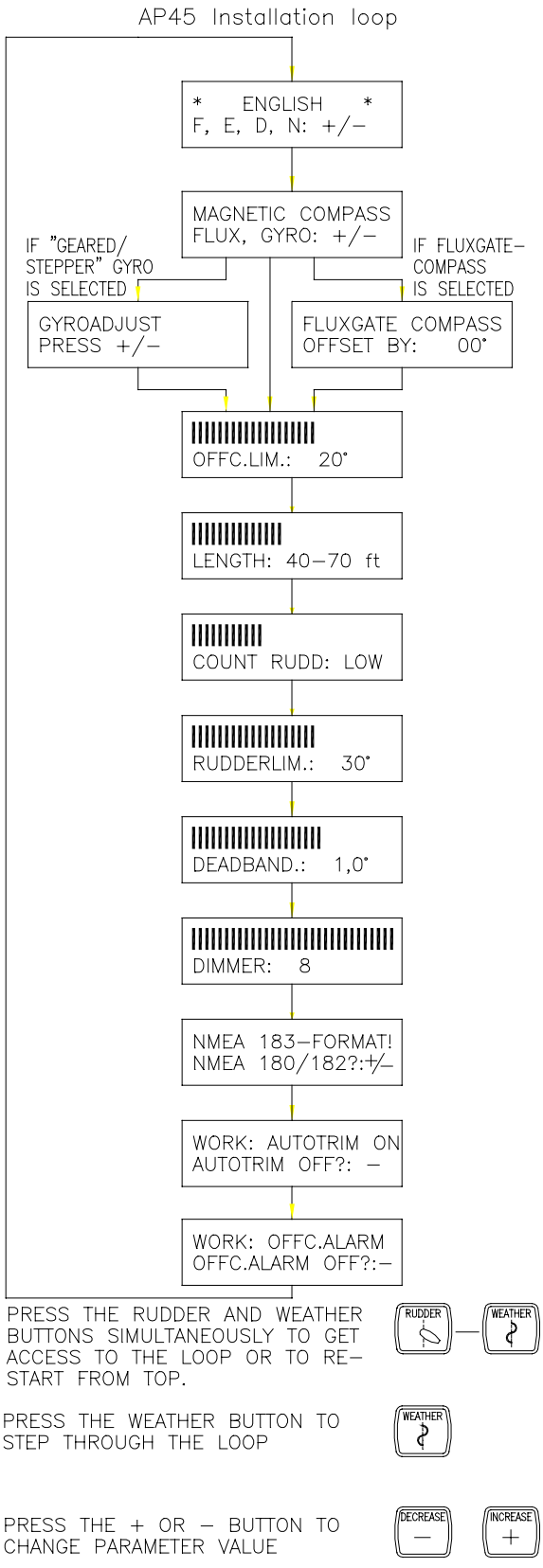
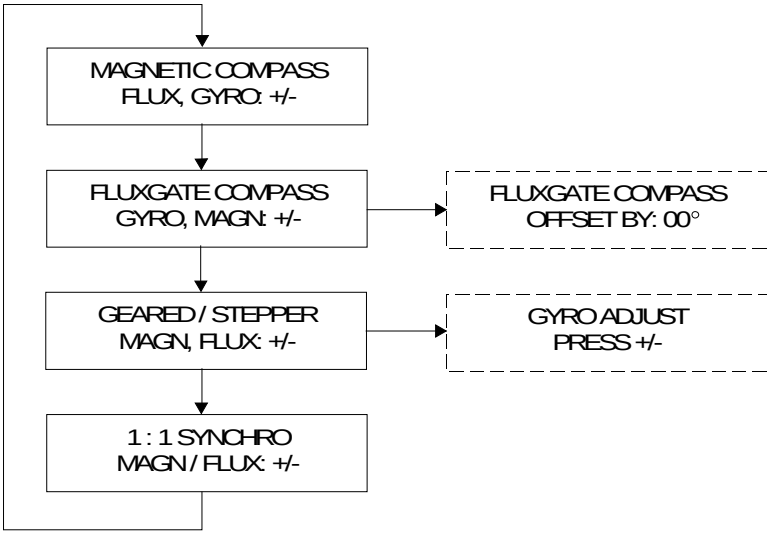


Fig. 6-1
AP45 Installation loop

Type of Heading Sensor

AP45 has been set up for magnetic compass from factory (Default setting). If connected to a fluxgate or a gyro compass - or a combination of magnetic and gyro compass, the actual compass to be used as heading reference must be selected by means of the + or - button. The compass selection will appear in following order when pressing + button:



When Fluxgate Compass or Geared synchro/Stepper gyro is selected, you will get an additional heading adjust display in the installation loop.

Fluxgate compass heading can be adjusted ±90°.

Gyro compass heading can be adjusted ±180°.

If gyrocompass has been selected, you can also turn off and on again and adjust the autopilot as described in “Parameter setting”, page 2-3.

Off Course limit

The range for the Off Course limit is ±5 to ±32 degrees in one degree step from set course. Alarm is given if the difference between set course and compass heading exceeds the limit. See “Fault warnings”, page 7-1.

```
I I I I I I I I
    OFFC.LIM.:  15°
```

Adjust for appropriate limit by means of the + or - buttons.

Vessel's length

Specification of vessel's length determines the values for autotrim, counter rudder time constant, turn initiate and turn rate. The values are based on experience realising, however, that not only the length contributes to the steering characteristics of a vessel. In some occasions, a selected length bigger or smaller than the one of a particular vessel, may give a better result.

```
I I I I I I I
    LENGTH: 40-70FT.
```

By means of the + or - button, the following lengths can be selected: Below 50 ft, 40-70 ft, 60-100 ft, 90-130 ft and above 120 ft.

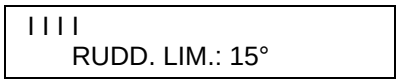
Counter rudder

The COUNTER RUDDER serves two purposes, firstly to give a smooth transition to the new heading after a major course change has been made, and secondly to enable the autopilot to stabilise the vessel on a straight course.

The COUNTER RUDDER can be set to one of four values: OFF, LOW, MEDIUM and HIGH. The best setting can only be found during a sea trial. Initial setting should be LOW.

Rudder limit

The value of the RUDDER LIMIT determines the maximum rudder movement in degrees from midship position. The range is ±5° to ±55°. The adjustment is in steps of 5 degrees, using the + or - button.



The RUDDER LIMIT should always be set approximately 5° less than the maximum rudder angle to avoid damage on the steering gear.

Rudder limit also applies when hand-steering is made by FU-steering levers.

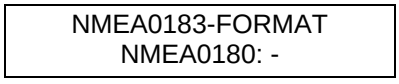
Rudder deadband

A deadband in the rudder control loop is necessary to filter out noise generated by vibration. A narrow deadband may cause the rudder to hunt, a wide deadband will create inaccurate steering.

The rudder deadband can be adjusted in steps of 0.1° from 0.2-1.6°. Adjust the deadband when the vessel is tied dockside. Find the lowest possible value that will prevent the rudder from hunting. Adjust by means of the + or - button. Counter Rudder should be off during this test.

NMEA-format

The AP45 Control Unit can be connected to navigation receivers with NMEA 0180 and/or NMEA 0183 output signal format. NMEA 0183 is the factory hardware set up. If NMEA 0180 is required, contact your local dealer for details on how to reconfigure the internal connections on Main PCB.



Refer to the nav. receiver manual and select the correct format by pressing the + or - button.

Disengage of autotrim-function in WORK-mode

In some occasions, e.g. at pair trawling, it is necessary to disengage the autotrim function in WORK-mode. This is done by pressing the DECREASE (-) button.

To engage the autotrim function, press the INCREASE (+) button.

Disengage of Off Course alarm in Work mode

WORK: OFFC. ALARM OFFC. ALARM OFF?: -

In some occasions, e.g. at very low speed, it may also be wanted to disengage the Off course alarm in Work mode. This is done by pressing the DECREASE (-) button.

Sea Trial

The purpose of the sea trial is to verify that the AP45 has been properly installed and is well performing as a result of that. A successful sea trial is dependant of the following assumptions:

- The compass is placed correctly
- The compass is compensated by an authorised compass adjuster, particularly if the vessel's magnetic steering compass is used
- Rudder hardover to hardover time is appropriate
- Rudder feedback geometry is correct
- Initial settings are in accordance with “Selection of parameter settings”, page 6-2.
- Autopilot works at the dock side.

The sea trial should take place in open waters with sufficient room for manoeuvring. It is also recommended to find a place where the sea is reasonably calm.

Note!

Do not use the PORT and STBD buttons during steps 2-4 of the sea trial.

1. Rudder Feedback centring procedure
   Enter Debug mode (Press the hidden button just above the + button and then the Weather button).
   Step through the Debug loop until you find the following text:

Centre Rudder Yes: Press Inc

   Bring the vessel up to normal cruising speed.
   Place the rudder in exact midposition where the vessel steers a straight line.

   Press Increase button and the display will show:

Rudder Feedback * centred *

   Step back through the Debug loop until you read the rudder angle, and verify that this now indicates zero.

2. Refer to the Operation section and set WEATHER to OFF and RUDDER to 1.0. Press the WORK button and disengage the autotrim function as described in “Disengage of autotrim-function in WORK-mode”, page 6-5.
3. Maintain cruising speed and keep a straight course on different headings. Refer to “RUDDER”, page 2-4, to find the best setting of the RUDDER value.

4. Make several major course changes to test the effect of the different COUNTER RUDDER settings. Refer to the figures below to find the best setting.

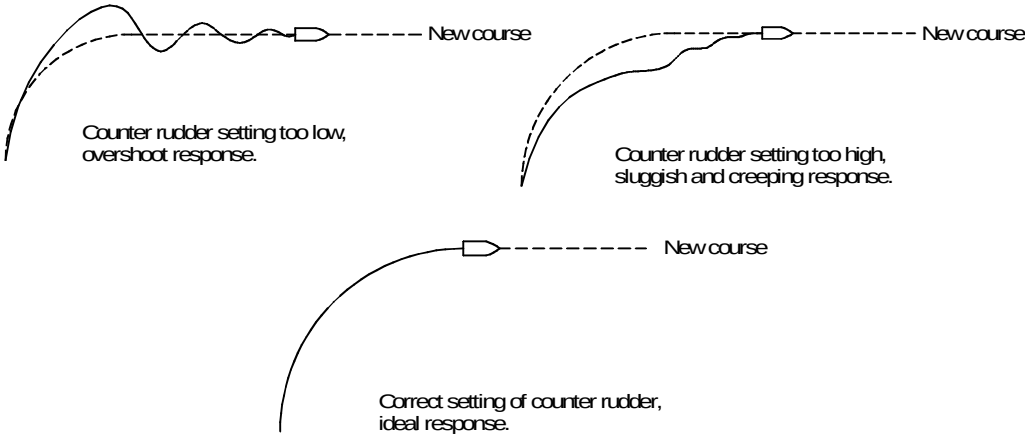


Fig. 6-2
Counter rudder settings

5. Engage the autotrim function and press the AUTO button. Demonstrate to the owner the effect of the operational controls i.e. RUDDER, WEATHER, Course Selector and PORT and STBD buttons.
6. Select WORK mode and demonstrate the manual trim using the PORT and STBD buttons. Explain and demonstrate the purpose and effect of selecting a different RUDDER value in WORK mode when going at slow speed.

If a Nav. receiver is connected, make a trial as explained in “Navigating with the AP45”, page 2-5.

7. TROUBLE SHOOTING

Fault warnings

The following fault warnings may be shown on the Information Display:

OFF COURSE RESET ALARM

Course deviation greater than selected off course alarm limit. The alarm is automatically reset when the vessel is back within the limit or cancelled by pressing Alarm reset button.

The following conditions may cause the alarm:

a. Low speed on vessel (slow acting response).

b. Extreme sea conditions (following sea).

Readjustment of the autopilot (Weather, Rudder, Counter Rudder) to improve steering performance may cure the problem. Otherwise the off course limit should be adjusted.

This fault warning may also appear due to intermittent fault on the compass signal (open connection).

RUDDER FEEDBACK FAIL!

Indicates that the autopilot is not reading any rudder feedback signal. By pressing the alarm reset button, the audible alarm will be disabled and the autopilot will switch to a simulated signal, instead of the real. This is indicated by a flashing * * SIM * * on the information display.

The autopilot will continue to steer the set course, but the steering performance is normally somewhat reduced.

The alarm is probably caused by and should be checked in the following sequence:

a. Open wire in feedback cable.

b. Defective feedback unit.

c. Defective input circuit in control unit.

When the fault is rectified, the autopilot will automatically disable the simulated rudder angle signal.

Note!

"Rudder Feedback Fail" may also be caused by a Feedback unit that has not been aligned and is outside AP45's maximum working angle of ±55°.

If a rudder command is not executed, or the rudder moves in wrong direction, this

NO RESPONSE FROM RUDDER

message will be shown on the display. The reason can be a malfunction of the steering gear, or simply that the steering gear is not switched on.

Other reasons may be:

a. Wrong connection of feedback unit (new installation only).

b. Broken feedback unit transmission link.

c. Opposite Port/Stbd output connection to solenoids or motor.

d. Sticking solenoid valve.

e. Defective drive unit motor.

NAVDATA NOT REC.
CHANGE MODE

Check that the nav. receiver is turned on and set up properly (see manual).

POOR NAVDATA
CHANGE MODE

Poor reception conditions or improper set-up of nav. receiver.

WRONG DATAFORMAT
NAVRECEIVER

Wrong NMEA-format selected on autopilot or transmitted by nav. receiver.

All three messages indicate problems with reading the signals from the navigation receiver. If you are unable to cure the problem, after having checked all connections and the nav. receiver and autopilot set-up, consult the factory or main distributor.

MAGN.COMP. FAIL
SELECT SENS.TYPE

FLUXGATE FAIL
SELECT SENS.TYPE

GYROCOMPASS FAIL
SELECT SENS.TYPE

These alarms will be given when the autopilot is unable to detect a proper signal from the selected heading sensor. The reason can be a faulty sensor or wrong selection of sensor (See “Type of Heading Sensor”, page 6-4).

The alarm will also occur if no heading sensor is connected.

CD109 COURSE DETECTOR

a. Enter the DEBUG-mode (see page 7-5) and verify that the compass sine, cosine and reference signals are correct. If not, proceed to "b".

b. Check the cable and connector for open or intermittent connection. If found OK, proceed to "c".

c. Try a new CD109.

FLUXGATE COMPASS

a. Enter the DEBUG-mode (see page 7-5) and verify that the sine and cosine signals varies with the heading between approx. 0.5 and 4.5 volts. If not, proceed to "b".

b. Check all connections between the compass and the control unit. Check the cable for a possible brake in one of the wires. If found OK, proceed to "c".

c. Try another fluxgate compass.

FI100-40 FLUXGATE INTERFACE

a. Make sure the fluxgate compass is working properly by observing it's repeater (if installed). If OK, proceed to "b".

b. Enter the DEBUG-mode (see page 7-5) and verify that the sine and cosine signals varies with the heading between approx. 0.5 and 4.5 volts. If not, proceed to "c".

c. Check all connections between the fluxgate compass and the FI100 unit and between the FI100 unit and the AP45 control unit. If found OK, proceed to "d".

d. Try a spare FI100 Fluxgate Interface PC-board.

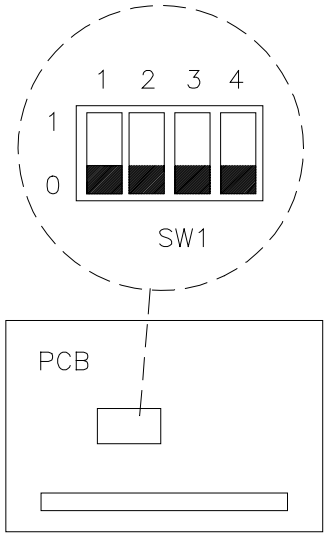
G40A GYRO INTERFACE

a. Verify that the gyrocompass is working properly.

b. Refer to “G40A Gyro Interface Unit” page 5-9. and check that the G40A is operating properly with special attention to LEDs as explained. If the unit is not working properly, check all connections to the gyro compass and the AP45 control unit. If found OK, proceed to "c".

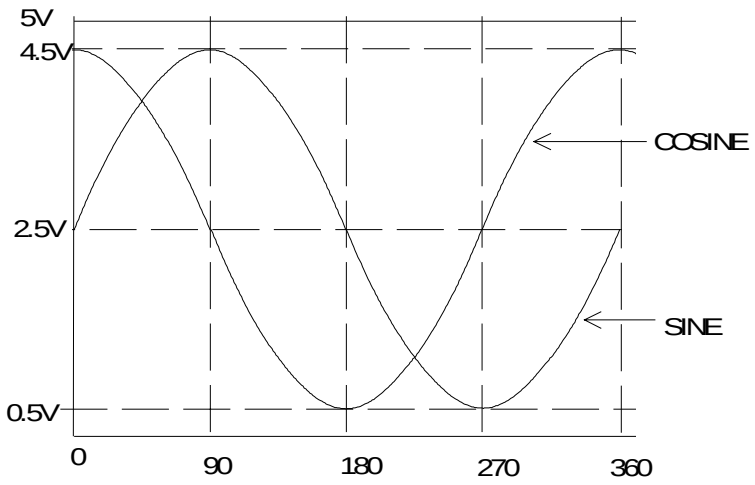
c. Check the signal transmission to AP45 by trying the different SW1 test positions. Verify the sin/cos output levels and/or the AP45 display readings are according to table.

1	2	3	4	Angle	SIN	COS
I	0	0	I	0°	2,5V	2,5V
0	I	0	I	45°	4V	4V
I	I	0	I	90°	4,5V	2,5V
0	0	I	I	180°	2,5V	0,5V
I	0	I	I	270°	0,5V	2,5V
0	0	0	I	45° STEP	–	–



d. Try a spare G40A Gyro Interface PC-board.

If the problem is still present after replacement of the heading sensor or interface, the problem most probably lies within the control unit.



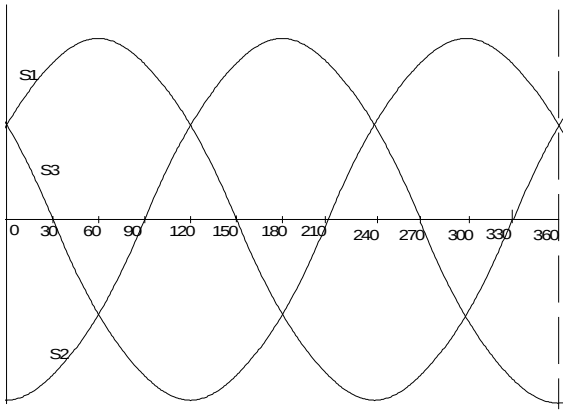
G45 GYRO INTERFACE

Readjusting procedure of 2,5V reference voltage (VR4) in case of extension of autopilot interconnection cable:

1. Disconnect S1-S2-S3 inputs.
2. Enter Debug mode in AP45. (See page 7-5).
3. Step through the loop until you find “Flux Sin” and/or “Flux Cos”.
4. Adjust RV4 until sin/cos reads exactly 2.50 V.
5. Reconnect the S1-S2-S3 inputs.
6. Verify correct heading readout on AP45 in Manual mode compared to the Gyrocompass.

Lining up Gyro Synchro transmitter:

When the transmitter is correctly installed, the S1-S2-S3 voltage levels should be in accordance with figure below.



S1-S3 = 0V at 0 and 180 degrees
S2-S3 = 0V at 60 and 240 degrees
S1-S2 = 0V at 120 and 300 degrees

I.e.: Measuring between S1 and S3 should give 0 volts when gyrocompass shows heading 000 (north).

If not, loosen the transmitter's fastening device and turn transmitter until reading is correct.

DATA FAILURE CHECK SETTINGS

If the autopilot should lose or read erratic data stored in the memory (RAM), this alarm will be given, and the autopilot is simultaneously set to MANUAL-mode. A selection of factory settings are then automatically entered into the memory. These settings should be checked before AUTO-mode is re-selected (See “Selection of parameter settings” page 6-2.).

Factory settings:

LANGUAGE:	ENGLISH
COMPASS:	MAGN. COMPASS
OFF COURSE LIM.:	20°
LENGTH:	40-70 ft
COUNTER RUDDER:	LOW
RUDDER LIMIT:	30°
DEADBAND:	1.0°
DIMMER	4
NMEA-FORMAT:	0183
AUTOTRIM IN WORK:	ON
OFF COURSE ALARM IN WORK:	ON

Front Controls:	RUDDER:	1.0 (AUTO)
		1.5 (WORK)
	WEATHER:	OFF

WATCH ALARM
PRESS RES BUTTON

The watch alarm timer circuit is enabled if an external watch alarm is connected to the control unit (J1) or enabled by grounding pin 2 (W.A. sense) of J1. Ref. “Watch alarm”, page 5-37.

The warning signal is repeated every four minutes and is reset by pressing alarm reset button or eventual external reset button (WA9 Watch Alarm).

If you want to permanently disable the watch alarm function, this can be done the following way, providing there is no external watch alarm connected or there is a permanent connection between pin 2 and 13 in J1.

Press the hidden button above the + button (entering Debug mode) and then press the WEATHER button repeatedly until the Information Display shows SOFTWARE/RUNTIME. Press the DECREASE (-) button six times until the display shows DATA FAILURE/CHECK SETTINGS. Press the ALARM RESET button and the Watch Alarm function is disabled.

Note!
This procedure is considered as a “Master reset” of the AP45 and you must therefore check all settings described in “Selection of parameter settings” page 6-2 or consult your nearest Simrad Robertson dealer.

Debug/Adjust mode

The Control Unit has a separate mode to control the content of the software addresses and the value of the variable parameters. This mode should only be used at installation and during fault finding. To enter the DEBUG-mode, first press the hidden button (just above the + button) and then the WEATHER button. The first part of the Debug mode contains readout of various signal levels. The second part (Adjust Mode) gives access to and possibility to change the factory set parameters in the program.

Step through the loop by pressing the WEATHER button.

Display text	Explanation
DEBUG MODE RUDD.ANG: S02.2°	Measured rudder angle in degrees. S = Starboard, P = port.
DEBUG MODE RUDD.COM: S02.7°	Rudder command from autopilot. S = Starboard, P = port.
DEBUG MODE HEADING: 158.9°	Compass heading
DEBUG MODE TURN: 00.2°	Measured turn rate in °/min
DEBUG MODE COMP.SIN: 3.26V	Measured sine component of compass signal.
DEBUG MODE REF.SIN: 2.45V	Reference for the sine signal.
DEBUG MODE COMP.COS: 0.89V	Measured cosine component of compass signal.
DEBUG MODE REF.COS:2.58V	Reference for the cosine signal.
DEBUG MODE FLUX.SIN:1.43V	Measured sine component of fluxgate signal.
DEBUG MODE FLUX.COS: 3.58V	Measured cosine component of fluxgate signal.
DEBUG MODE FU-INPUT:2.51V	Measured signal on Follow-Up input.
DEBUG MODE DEBUGAD: 8205[55]	Data readout directly from the RAM-address.

The AP45 software has a combination of factory set parameters related to the length of the vessel as displayed in the installation loop.

Selected length	Autotrim	Counter Rudder Time Constant	Turn Initiate	Rate of turn
0-50ft.	48 sec.	1.0 sec.	30	240°/minute
40-70ft.	64 sec.	1.0 sec.	30	210°/minute
60-100ft.	80 sec.	1.5 sec.	25	180°/minute
90-130ft.	96 sec.	2.0 sec.	25	150°/minute
120- - ft.	96 sec.	2.5 sec.	20	120°/minute

In addition the COUNTER RUDDER values (magnitude) has the following scale:

OFF = 0.0, LOW = 0.4, MED = 0.8, HIGH = 1.2

Proceeding through the DEBUG-mode you will get access to the adjustable parameters:

Adjustment of parameters is made by the + or - button. Values shown below are just examples.

Display text	**Explanation**
ADJUST MODE C.RUDD., AUTO 0.4	Counter Rudder magnitude in AUTO- and NAV-mode Adjusting range: 0,0-3,5 in steps of 0,1.
ADJUST MODE C.RUDD., WORK 0.4	Counter Rudder magnitude in WORK-mode. Adjusting range: 0,0-3,5 in steps of 0,1.
ADJUST MODE C.R.T. CONST. 1.0	Counter Rudder Time Constant in seconds Adjusting range: 0,0-3,5 in steps of 0,1.
ADJUST MODE AUTOTRIM: 48	Autotrim time constant in seconds Adjusting range: 0-256 in steps of 8.
ADJUST MODE TURNRATE: 240	Turn Rate limit in degrees pr. minute Adjusting range: 60-480 in steps of 30.
ADJUST MODE TURNINIT: 30	Turn initiate value Adjusting range: 5-40 in steps of 1.
ADJUST MODE R.LIM, M&W: 35°	Rudder limit in MANUAL- and WORK-mode Adjusting range: 5-55 in steps of 5.
ADJUST MODE R.LIM, A&N: 35°	Rudder limit in AUTO- and NAV-mode Adjusting range: 5-55 in steps of 5.
ADJUST MODE NAV. GAIN: 1.0	Nav. gain (gain in cross track steering) Adjusting range: 0,5-3,0 in steps of 0,1.
ADJUST MODE NAVTRIM: 400	Nav. trim (autotrim in cross track steering) Adjusting range: 100-1600 in steps of 50.
ADJUST MODE NAVFILT: 1.3	Nav. filter (filter of cross track data) Adjusting range: 1,1-2,5 in steps of 0,1.
ADJUST MODE NAVMODE CTS & XTE	Selection of steering mode in NAV.(XTE only, CTS only or mixed mode - CTS&XTE.

The AP45 is as a standard set up with the NMEA 0183 CTS&XTE mode.

Priority	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Mixed mode (CTS+XTE)	APB	APA	XTE+ BWW	RMB+ BWW	XTR+ BWW			
XTE mode	APB	APA	XTE	RMB	XTR			
CTS mode	APB	APA	RMB	BWC	BWR	BOD	HSC	BWW

Table 1
NMEA 0183 Sentence priority table

If one or more of the adjustable parameters are changed, the information display will initially at turn on show:

SPES. PARAMSET
MANUAL

Note!
It is not recommended to change the adjustable parameters unless deemed absolutely necessary.

NO F200-DODGING!
DODGING?: +

Enables DODGING with F200 by pressing the INCREASE (+) button. Disable is made by pressing the - button.

CENTRE RUDDER?
YES: PRESS INC

Resets eventual rudder off set by pressing INCREASE (+) button. Maximum correction ±5°. See the Sea Trial section, page 6-6, for details.

PROGRAM: V_R_
RUNTIME: 00010H

Readout of software version (i.e. V1R4) and runtime of the control unit.

When this last display appears in DEBUG-mode it is possible to:

a. Reset the runtime

b. Disable the watch alarm

c. Set up the autopilot with the factory settings as described earlier in this section.

All this will be initiated by pressing the + or - button 6 times. Then there will be an alarm and the display will show:

DATA FAILURE!
CHECK SETTINGS

Reset by pressing the ALARM button. Then step through the installation loop to check and eventually change the settings.

8. SPARE PARTS AND DRAWINGS

AP45 Control Unit

20159240		AP45 Control Unit w/installation accessories
20159224		AP45 Control Unit
20153060		Installation accessories
20159653		EMC kit type 45
20159323		AP45 board w/display board assy.
20159281	1	AP45 board assy.
20153086	2	Illumination board
20162533	3	N40 Nav. Interface board
20120622	4	Gasket for plug
20153037	5	Back cabinet
20153151	6	Front cabinet with key board
44151702	7	Screw M4x25 countersunk
20130696	8	Flat cable for Illumination PCB
20159265	9	Display board assy.
44119220	10	Potentiometer 2 Kohm VR1
44118800	11	Info-display module DMC16207
44112233	12	Voltage regulator LM317T IC3
20120580		Course selector assembly (Item 13, 14, 18)
20120572	13	Course selector
44150779	14	Set screw M4x10 A2
20120556	15	Course selector tooth wheel
20120564	16	Return spring
44149508	17	C-ring A6x0.7 A2
20104212	18	Split bushing
20120630	19	Gasket for back plate
20168415	20	Light defuser
44118958	21	Buzzer QMB LS1
44119626	22	AC Inverter NEL-D32-46 3H25 T1
44119964	23	5V regulator L487 IC8
44102655	24	Transistor BDX 34C Q2
44117778	25	Transistor VMOS 2N2222 Q1, Q2
44103091	26	Transistor 2N6388 Q8, Q9
20159315	27	EPROM 27C512 Programmed IC5
44122828	28	Voltage regulator 8V 78LO8AC IC10
44132074	29	Voltage regulator 5V LM340LAZ5 IC9
44120913	30	LCD display 4 digits
44118768	31	IC OPB 804 IC32, IC33
44120947	32	Illumination strip
44119600	33	X-tall 4,9152 MHz X1
44105955	34	Contact Amp CPC 206043-1 J1, J2, J3
44117224	35	Switch 0.25A/60V DC SW1
44119584	36	Lithium battery CR1/3N 3V
44107613	37	Spacer, rubber
44117778	38	Transistor VN2222L Q4, Q7

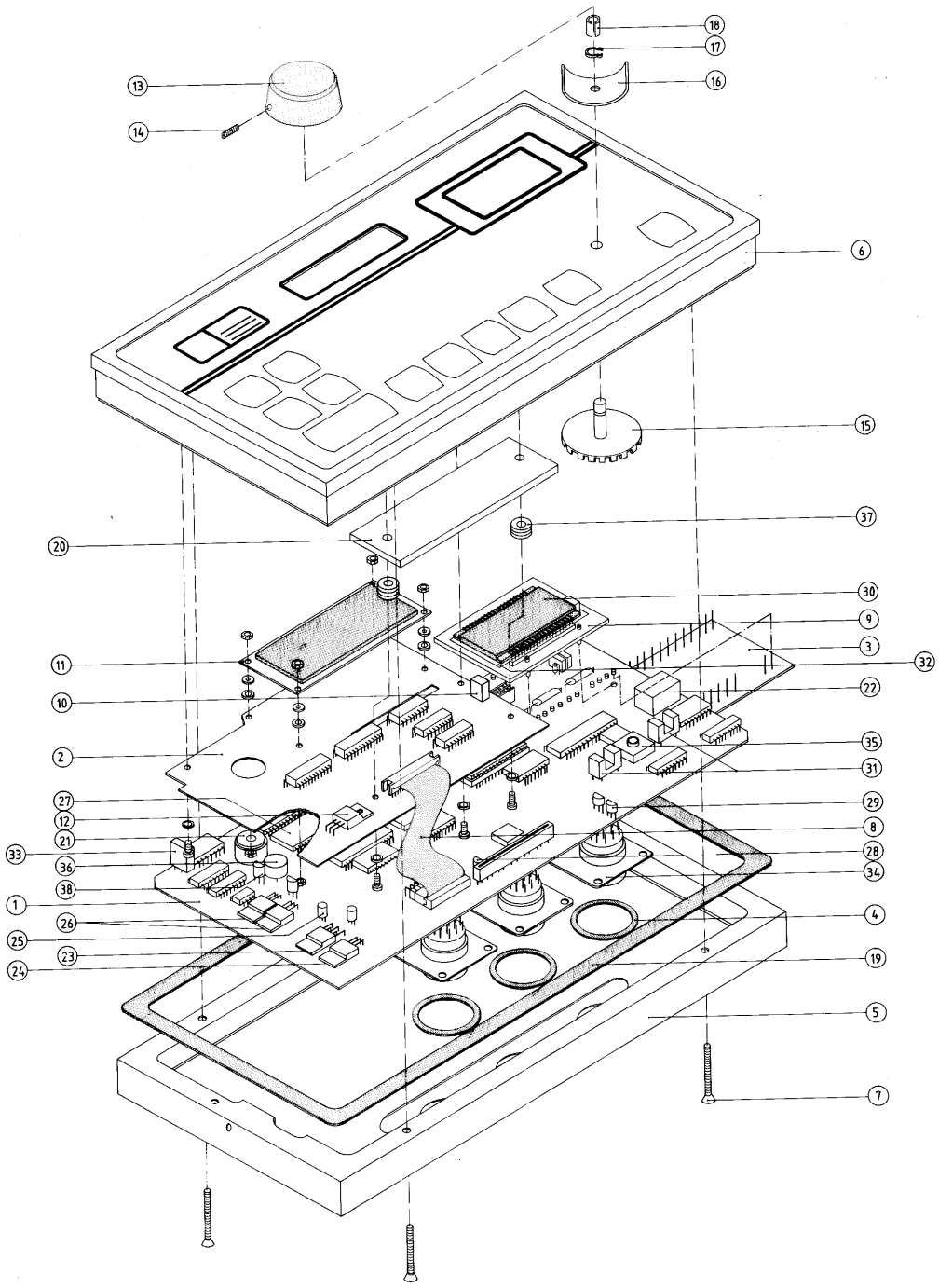


Fig. 8-1
AP45 Exploded view

Note!
Pos. 3 (N40 Nav. Interface board) is only for Main PCB with s.n. below 4000.

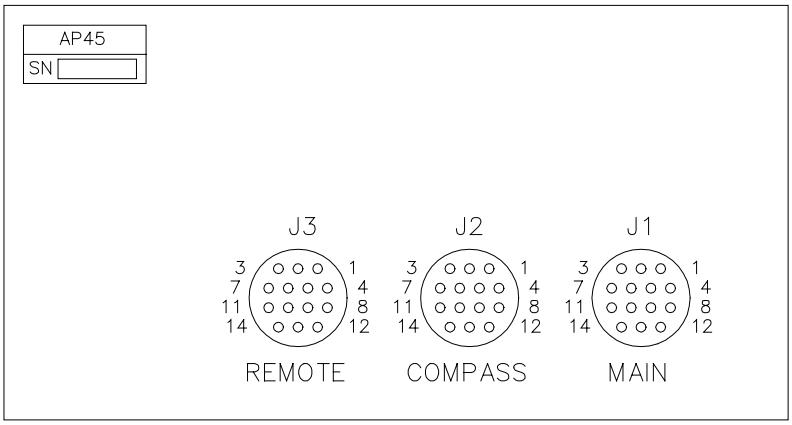


Fig. 8-2
AP45 Signal reference

J1	J2	J3
1 N.C.	1 GND	1 Clock
2 Watch alarm sense	2 N.C.	2 Data
3 +12V out	3 N.C.	3 FU
4 Rudder HI	4 +5V	4 Port
5 Rudder LO	5 +12V out	5 Stbd
6 Port relay	6 GND	6 +5V
7 Stbd relay	7 Sin (Head 1)	7 Course 1
8 Power (safe) relay	8 Cos (Head 2)	8 Course 2
9 Watch/External alarm	9 V/2	9 Nav HI
10 Watch alarm reset	10 Sin1	10 Nav LO
11 Power steering	11 Cos1	11 N.C.
12 +12V supply	12 +V Excitation	12 +12V
13 GND	13 Excitation	13 GND
14 Screen	14 Screen	14 Screen

CD109 Course Detector

20120861		CD109 Course Detector with holder
20120721	1	CD109 Course Detector
20331997	2	Holder for Course Detector
44112126	3	Connector block AMP NO 206044-1
44107217	4	Cable clamp AMP NO 206070-1
20120739	5	Cable with plug
44112134		Pin contact AMP NO 163090-0
20120853	6	Plug with bracket for extension cable
44106862		Socket contact AMP NO 163088-2
44150647	7	Washer
44151066	8	Screw M6x30
44149011	9	Washer M3
44149102	10	Screw M3x8
44108199	11	Cable clamp

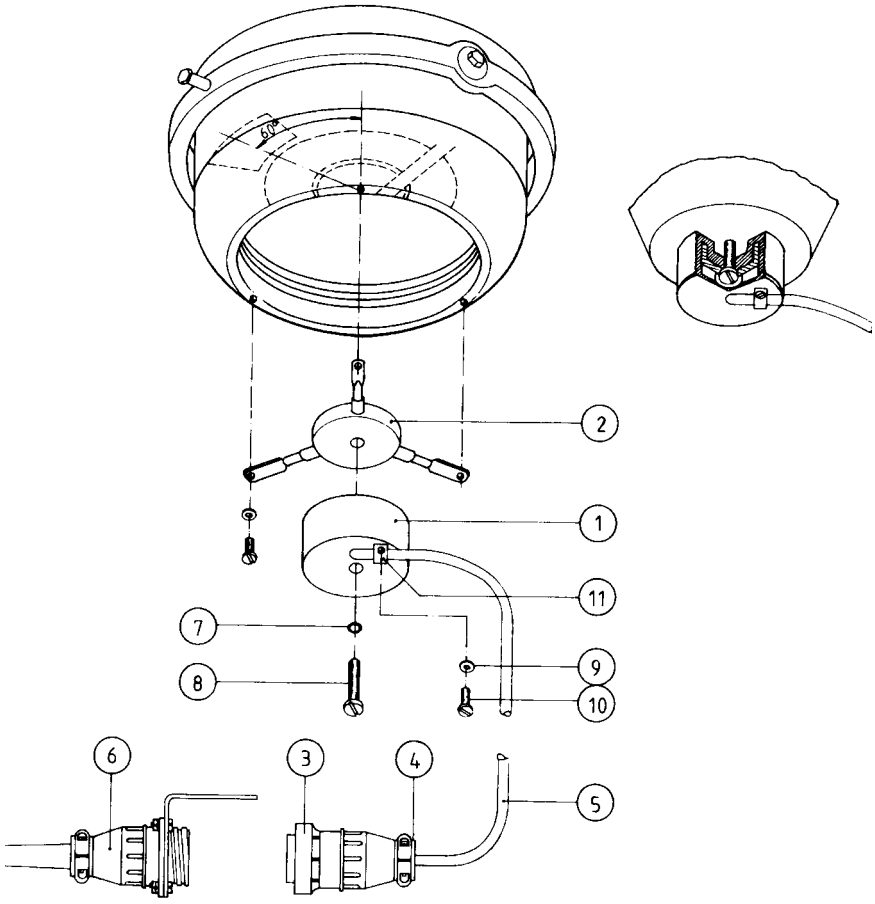


Fig. 8-3
CD109 - Spare parts

G40A Gyro Interface	20157202	G40A Gyro Interface Unit
	20157228	G40A PC-board assy.
	44103638	Fuse 0.5A/250V 5x20mm F1
	44122406	Trim pot. multiturn 10K VR1
	44123792	Capacitor (tantalum drop) 1mF/35V C5, C6, C7
	44111409	Capacitor 4.7mF/35V C18, C20, C37
	44116812	Diode 1N4006 D10, D13, D14
	44115566	Diode ref. 2.5V D12
	44132199	LED Network 8xRed D1-D8
	44120871	Transistor IRFD110 Q1
	44116788	IC 5V regulator LM340AT-5 IC16
	44116798	IC 5V regulator 78L05 K9
	44132074	IC 5V regulator LM340LAZ5 IC9
	44106623	IC opto-coupler CNY17-2 IC10, IC11, IC12, IC13, IC14
	44118529	IC Dual Op-amp LM358 IC6
	20157244	IC EPROM 27C32 IC3 V2R1
	44116739	X-tall 6 MHz X1
	44126068	DIP-switch KSD04 SW1
	44122604	Plug-in strap

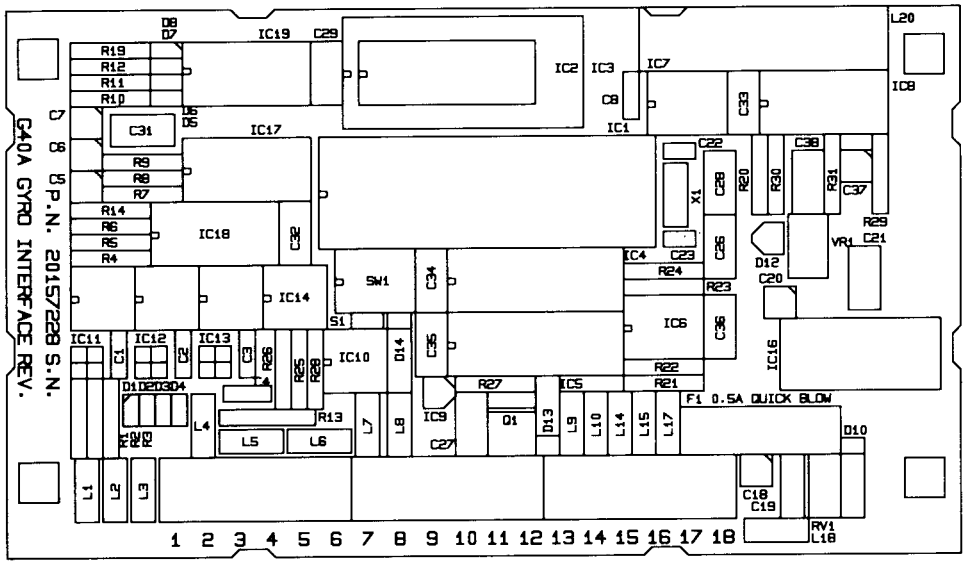


Fig. 8-4
G40A Component reference

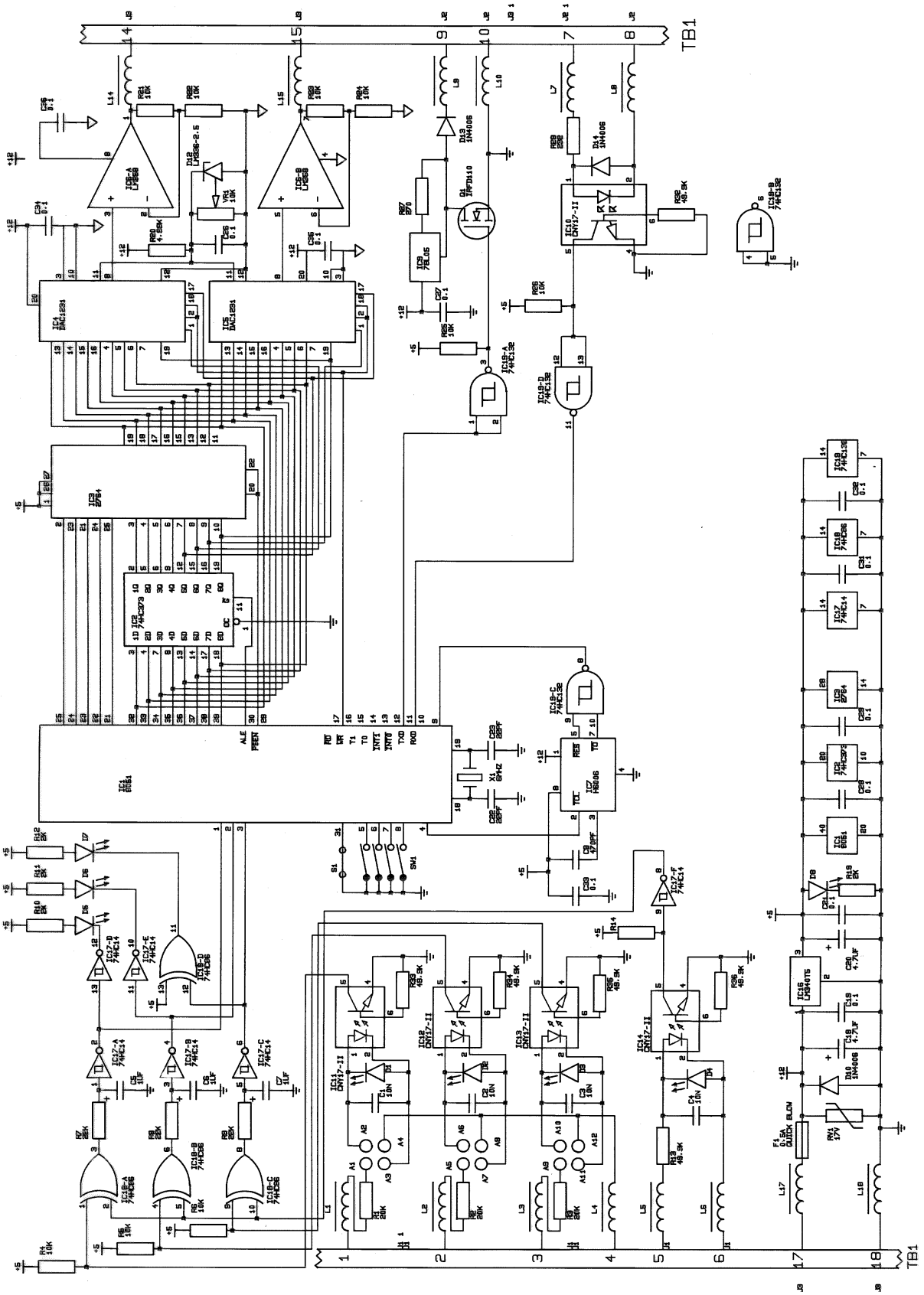


Fig. 8-5
G40A Circuit diagram

G45 Gyro Interface	20158200	G45 Gyro Interface (1:1 SYNC)
	20158226	G45 PCB ass'y
	20158283	G45 Cable w/ plug
	20158242	G45 Coil, L2
	20158259	G45 Filter, L4
	44157287	Trimpotmeter VR3
	44158319	Capacitor EL 470MFD 63V, C3
	44158327	Capacitor EL. 470MF 63V, C21
	44123685	Capacitor EL. 1000MF 25V, C27
	44127553	Capacitor 10MF/50V, C5,6,9,13,29
	44116812	Diode 1N4006, D18
	44103422	Diode 1N4148, D2,3,8,10-12
	44104123	Diode MR851, D5
	44115566	Diode LM336 Z 2.5, D14
	44155174	Zener diode RD 14 15V 0.5W, D4,6,7,9,13
	44157188	Transistor 2N4403, Q1
	44103893	IC CA324G / LM324J, IC7
	44126738	IC LM 311 N/CA 311 E, IC6
	44157832	IC LM675T Bipol OP AMP, IC1
	44158707	IC ME5535N MOS Dual OP AMP, IC5
	44112233	IC Voltage regulator LM317T, IC8
	44157824	IC LT1071T Switch regulator, IC2
	44154300	IC 8038 Waveform generator, IC9
	44118727	IC Analogue gate 4066 CP, IC4
	44119097	Diode LED Green HLMP0504, D1
	20158267	Transformer G45, T1
	44120624	Ferrite Bead Inductor, L1,3
	44114551	Terminal Block 4P 1.5MM2 16A, TB1-6
	44111409	Capacitor 4,7MF 35V, C28
	44118529	IC Dual OP AMP LM358 DIL 8, IC3
	44109411	Trimpotmeter 10K, VR1,2,4

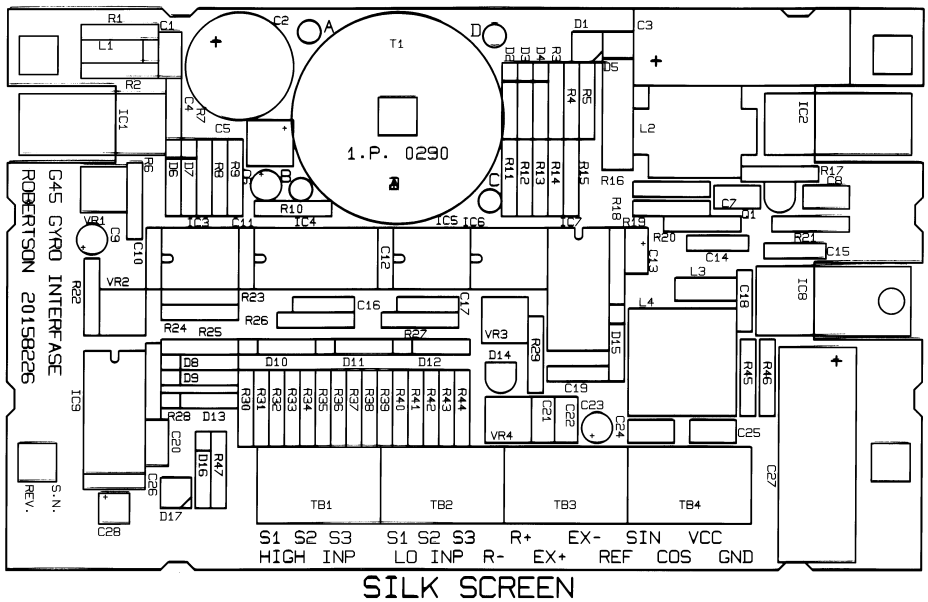


Fig. 8-6
G45 Component reference

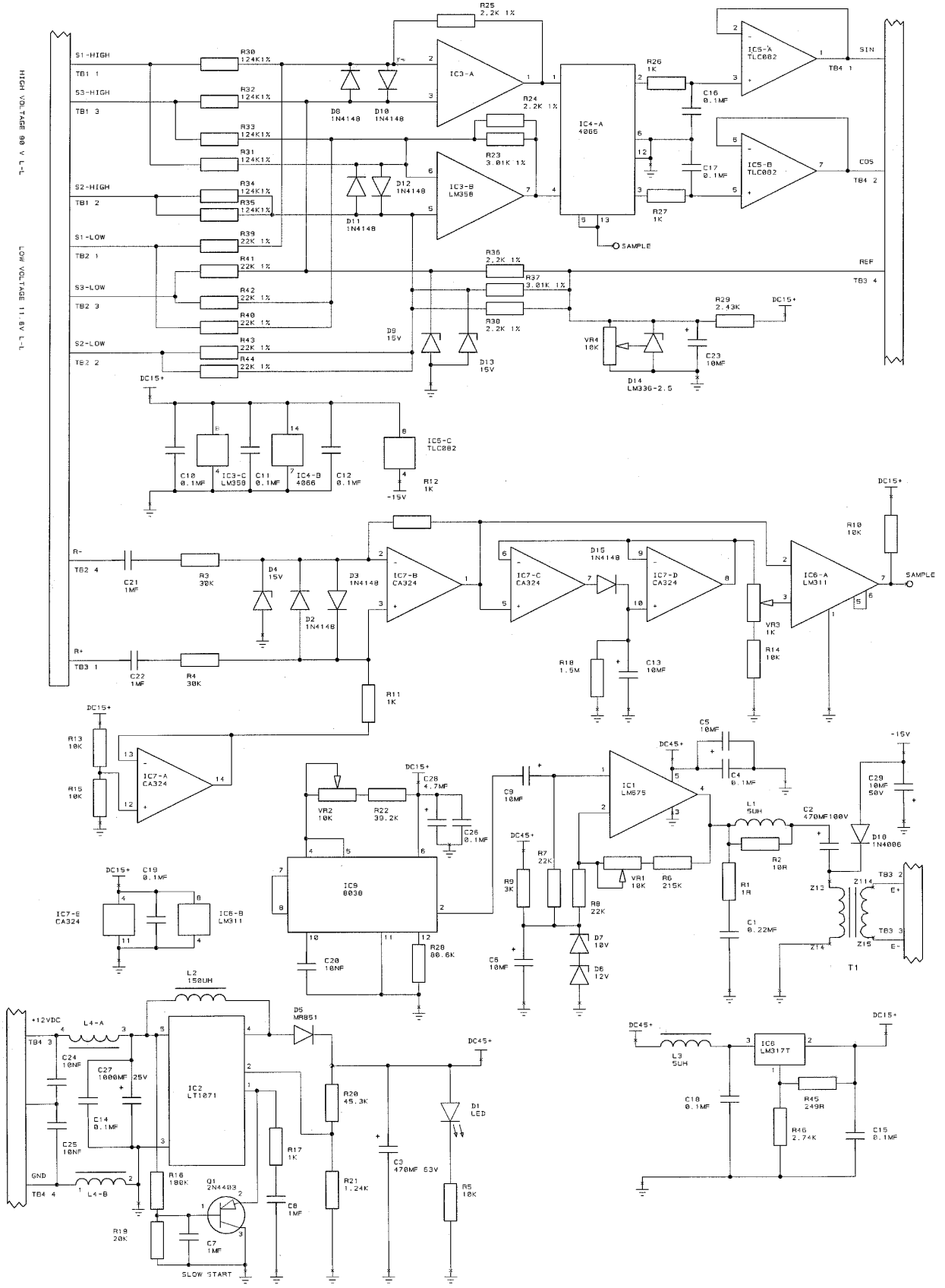


Fig. 8-7
G45 Circuit diagram

FI100-40 Fluxgate Interface	20155008		FI100-40/VDO Fluxgate Interface
	20155206		FI100-40/Marinex Fluxgate Interface
	20155404		FI100-40/ Brooks & Gatehouse Fluxgate Interface
	20107017		FI100-40 PC-board complete
	20107025		Cable for VDO connection w/VDO plug
RF45X Rudder Feedback	22011282		RF45X Rudder Feedback Unit w/ transmission link
	22011290		RF45X Rudder Feedback Unit
	22011183		RF45 Transmission Link
		44156644	Transmission rod M8x50
		44157097	Ball joint socket
		22504039	Transmission lever
	22011217		Mounting kit
	22011266		RF45X Board Ass'y with potentiometer
RF14XU Rudder Feedback Unit	22501647		RF14XU Rudder Feedback Unit w/transmission link
	22501654		RF14XU Rudder Feedback Unit
	22504005		Transmission Link
	44132306		Ball joint
	22500300		Shaft coupling
	22500458	1	Gasket
	22501605	2	Electronic XU drive module
	44105120	3	Actuator
	44105146	4	Limit switch
	4418388	5	Potentiometer 5 Kohm
	44132033	6	Corrosion inhibitor sponge
	22500284	7	Activator block
	22500276	8	Activator disc

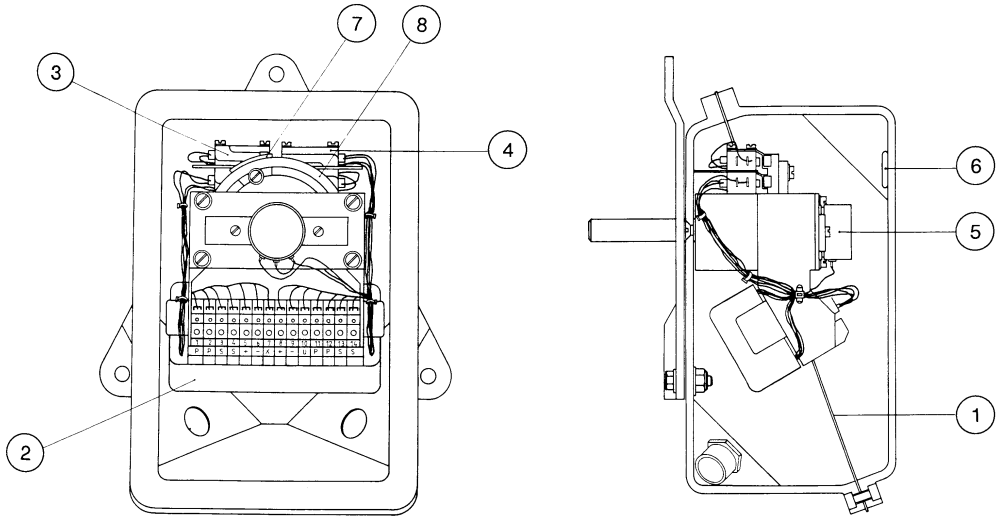


Fig. 8-8
RF14XU - Spare parts

J45S Junction Unit	21102579	J45S Junction Unit
	21102827	PC-board complete
	21100144	Relay socket complete, K1
	44155539	Relay 12V/40A 1 pole
	44133684	Line filter 250V/3A, FL1
	44110989	Capacitor 22mF/20V, C11, C12
	44111177	Capacitor 220mF 40V C4
	44104123	Diode MR851, D3, D4, D5, D8
	44116812	Diode IN4006, D6, D7
	44104156	Diode BZX 79B16 D2
	44106474	Thyristor 2N6394, SCR1
	44115384	Diode zener D4 15V 1W, D1
	44103000	Transistor 2N2907A, Q4
	44103091	Transistor 2N6388, Q1,2,3
	44115160	Diode LED Red SPR5531, D1,2
	44118735	IC Optocoupler PC829, IC1
	44103653	Fuse 2A/250V 5x20mm, F1
	44114171	Heatzink insulator FOR Q1,2,3
	44122604	Plug-in strap

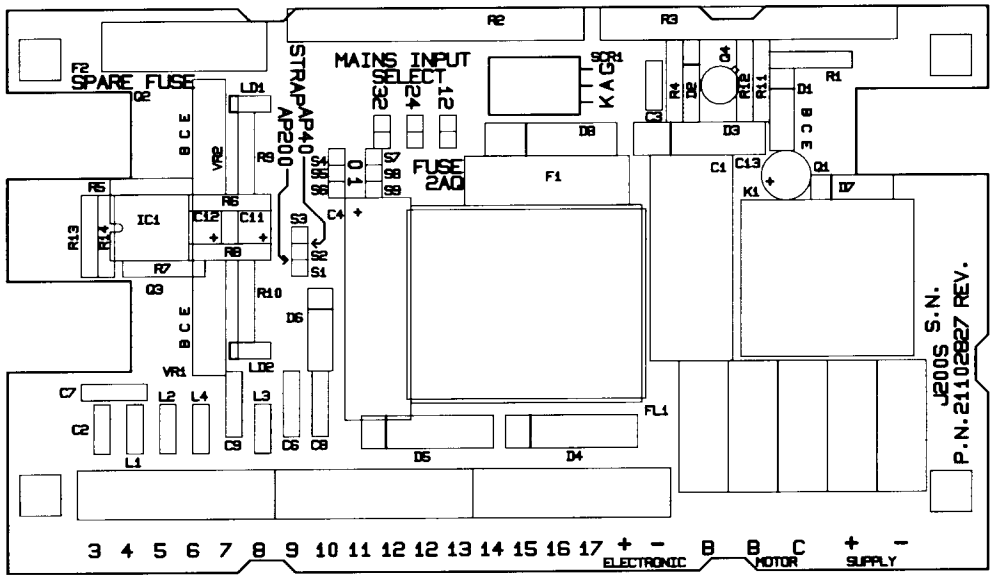


Fig. 8-9
J45S Component reference

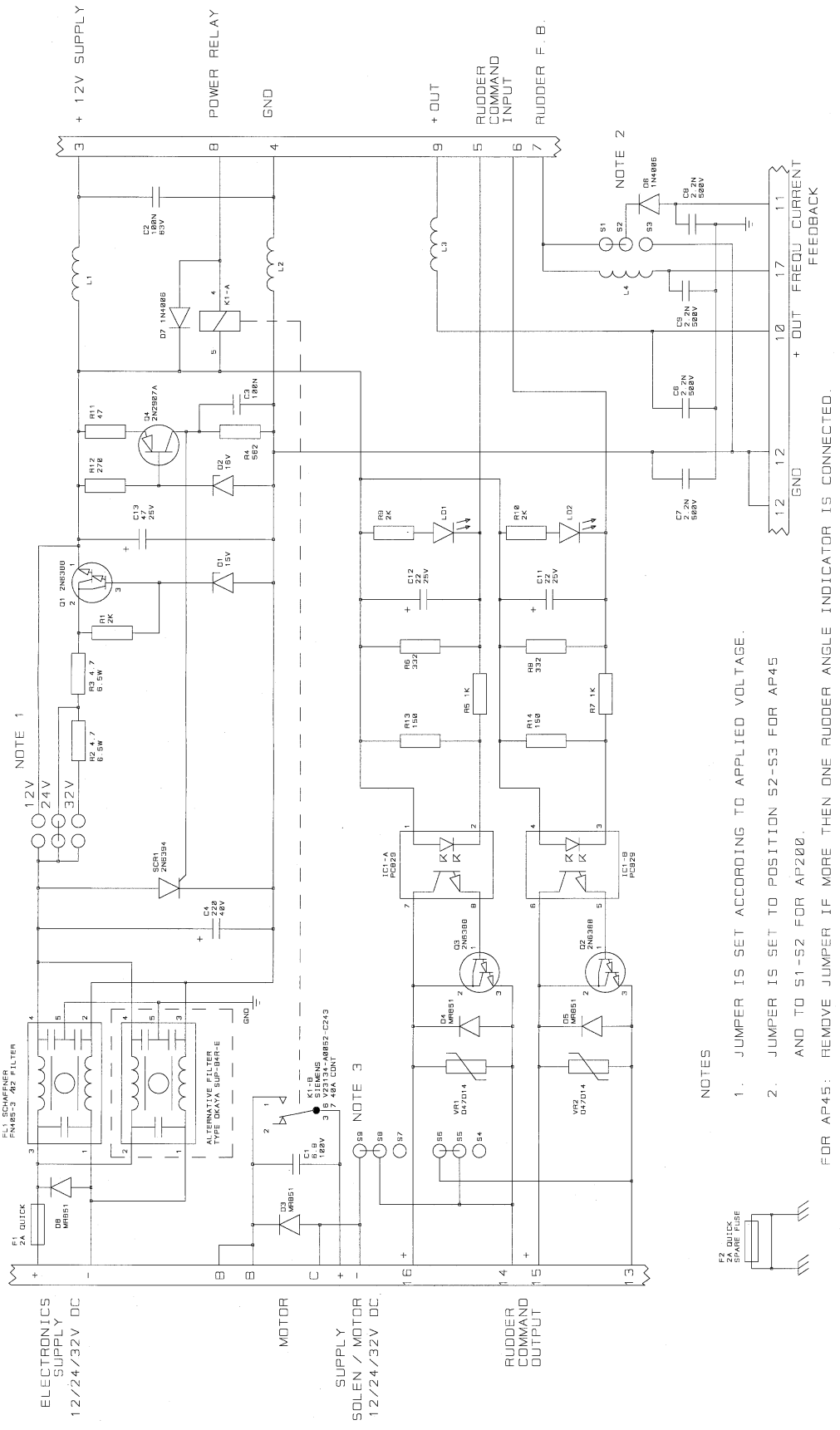


Fig. 8-10
J45S Circuit diagram

J45A Junction Unit	21102611	J45A Junction Unit
	21099981	J101A-40 Junction Unit
	21099908	J45A PCB ass'y
	44115434	Trans. BDW94A Darlington, T2
	44114734	Relay 12V, RL1
	44114874	Transistor BUZ 14 MOS 50V 39A, T1
	44103091	Transistor 2N6388, T5
	44112233	Voltage regulator LM317T, IC4
	44114841	Zener diode BZX 61 C43, D4
	44109213	Zener diode BZX 61 C12, D5
	44103026	Transistor 2N2222A, T6
	44118164	Transistor 1RF9521, T8
	44103257	Zenerdiode BZW55B7V5, D13, D14

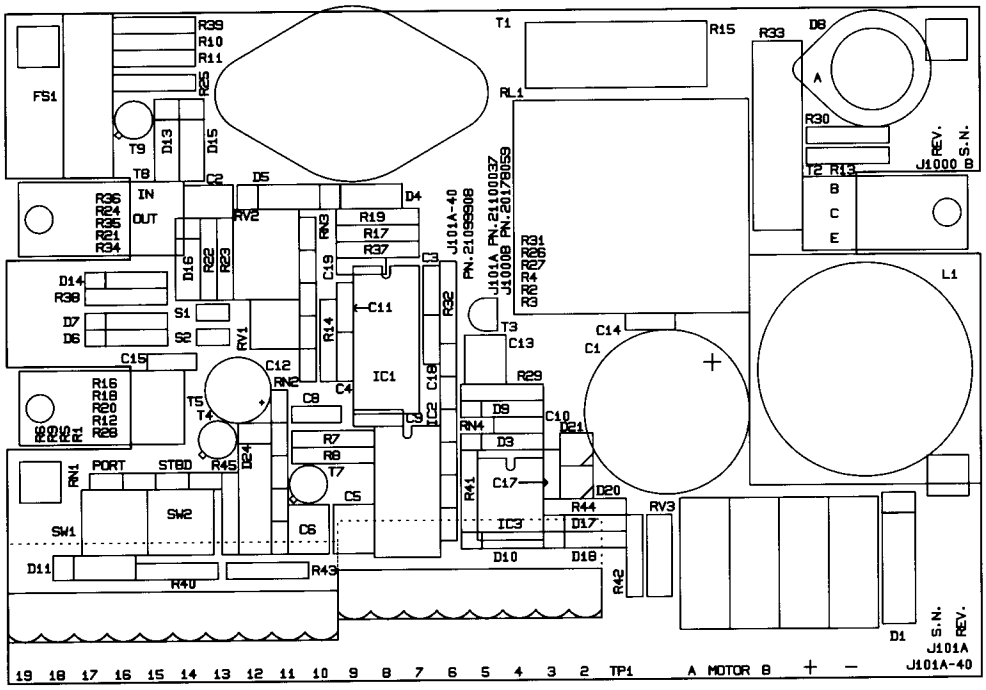


Fig. 8-11
J45A Component reference

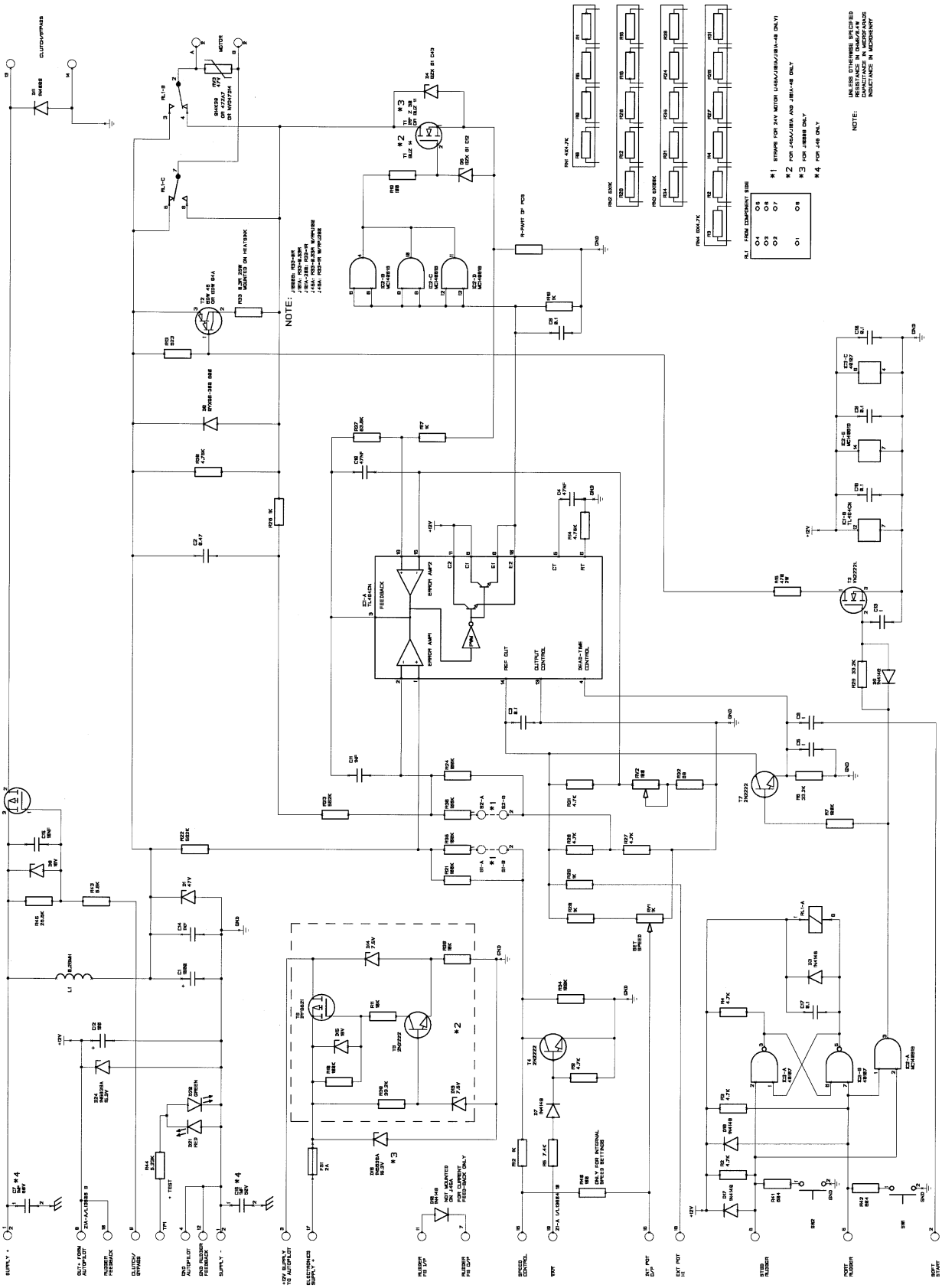


Fig. 8-12
J45A Circuit diagram

F200-40 Remote Control	20171377	F200-40 Remote Control w/mounting accessories
	20171385	F200-40 Remote Control
	20156410	Cable (7m) with AMP-plug
	20103859	Mounting accessories
	20171286	PC-board ass'y
	44116754	LCD displays 4 digits
	44115160	Light emitting diode SPR5531 D2, D3
	20104220	Control knob assembly (COURSE)
	20104253	Toothed wheel with shaft
	44117224	Push button switch SW1, SW2, SW3 (MPD)
	20103784	Actuator for SW1, SW2, SW3
	44190114	Gasket O-ring 3 mm
	44116796	Voltage regulator LM340 LAZ 5 IC1
	20171328	F200 front panel (keypad)

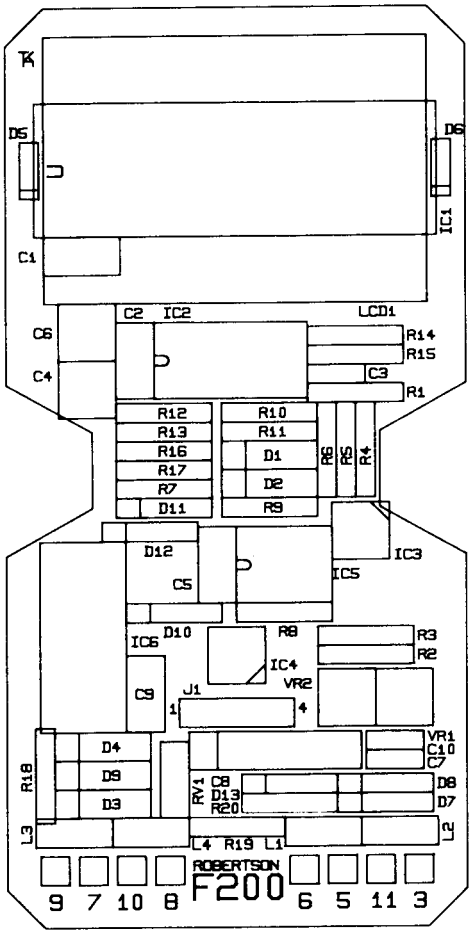


Fig. 8-13
F200-40 Component reference

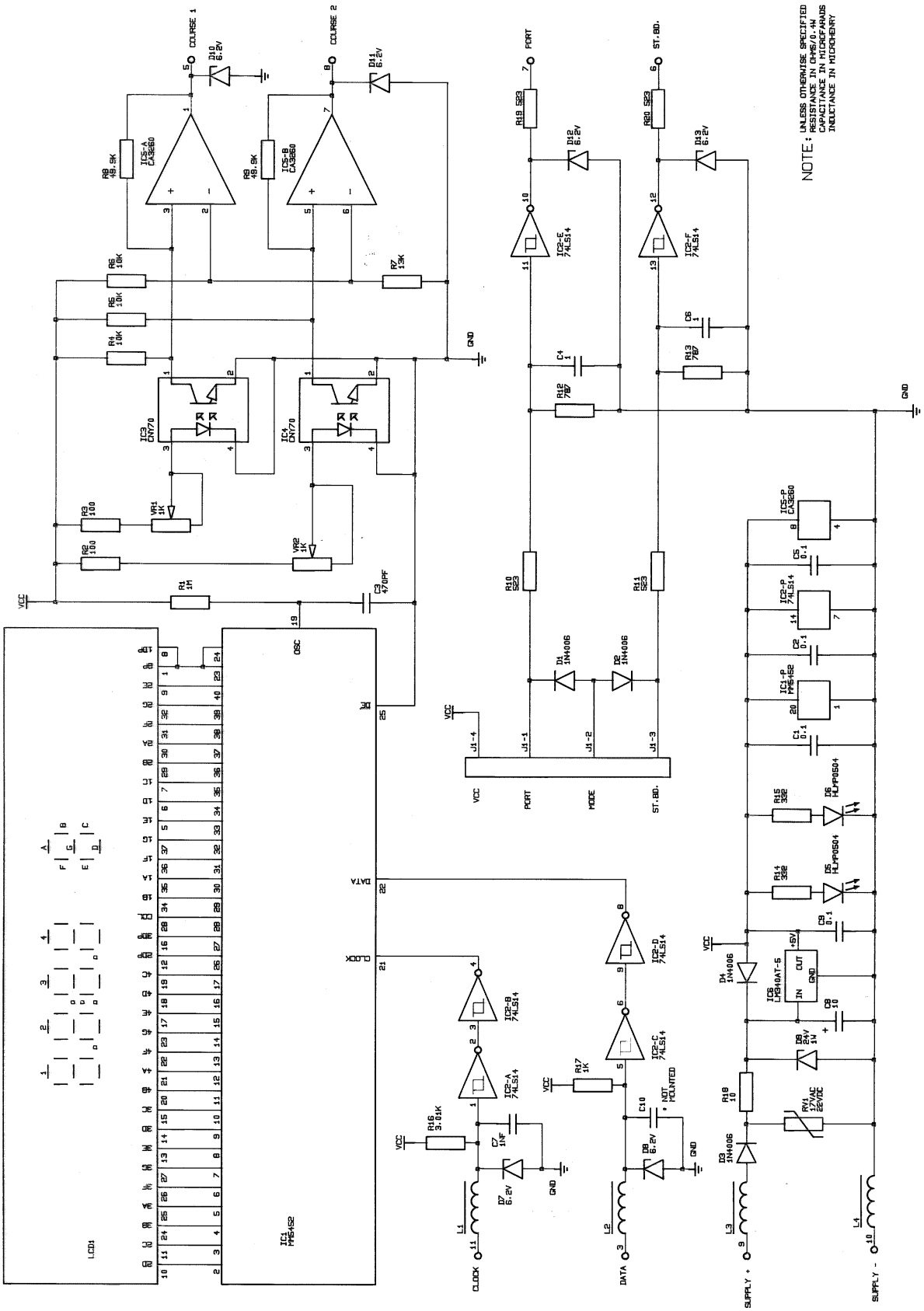


Fig. 8-14
F200-40 Circuit diagram

S9 Steering Lever	23601800	S9 Non Follow Up steering lever
	23601859	Lever with actuator shaft
	44125631	Cable gland PG16
	44190114	Gasket O-ring 3mm 0.6m
	23601875	Coil spring
	44153872	Steel ball 0.5 mm
	23601834	Centring spring
	44125599	Microswitch V-15-1A5
	44116812	Diode 1N4006
S35 Steering Lever	23241144	S35 PCB Assy
	44125599	Micro switch
	23240096	Spring
	44190114	Gasket
	44140796	Cable gland
FU91 Steering Lever	23603004	FU91 Steering Lever
	23603020	FU91 Front Panel 45 DEG.
	23603137	FU9X Handle ass'y w/actuat. shaft
	23600703	Handle
	44155497	Handle Knob
	23603061	FU9X Window (X2)
	23603087	FU9X PCB ass'y
	23603129	FU9X Zero point bracket
	44158442	Latching switch
	44158459	Lamp lense, Green
	44158467	Lamp 14V/80mA
	44158475	Element
	44125631	Cable Gland PG16 MF
	44190114	Gasket, Neoprene Dia 3 mm, 560 mm
	44158418	Dimmer potentiometer, 2.2K
	22013221	RF100 potentiometer with leads
	23603053	FU9X cogwheel
	23603277	FU91/92 PTTC switch ass'y

RI9 Rudder Angle Indicator	22015655		RI9 Rudder Angle Indicator
	22015663		Mounting kit
	22015662	1	Printed Circuit Board Assy (PCB)
	22015671	2	Instrument
	22015028	3	Window
	44117687	4	Light Bulb 12V 40mA
	44155620	5	Potentiometer, 2.2K
	44107423	6	Nut Cover
	44149995	7	Dimmer Knob
	44108496	8	Cap
	22015606	9	Front panel plate
	22015721	2	Instrument scale 60 degrees
	22015697	2	Instrument scale 70 degrees
	22015705	2	Instrument scale 90 degrees

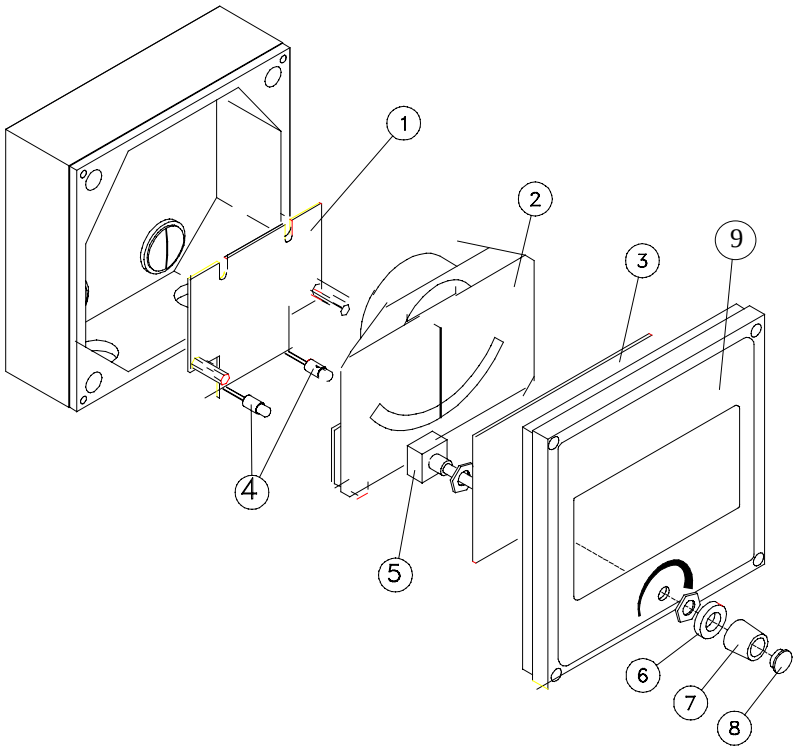


Fig. 8-15
RI40 Exploded view

RI35 Rudder Angle Indicator	22082929	Installation accessories
	22083265	RI35 Cable
	22083216	RI35 Board assy (PCB)
	22083273	RI35 Front Housing
	22083208	RI35 Back Cover
	44164135	Blind plug
	44140796	Cable gland
	44141174	Seal (o-ring)

9. Sales and service worldwide (150502)

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Soremar
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The above companies represent only main importers. Each country is in addition served by a network of local service outlets.

Some importers represent only specific market segments according to the following codes:
Professional:
Coastal and Fishery market
MarineLine:
Leisure market

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