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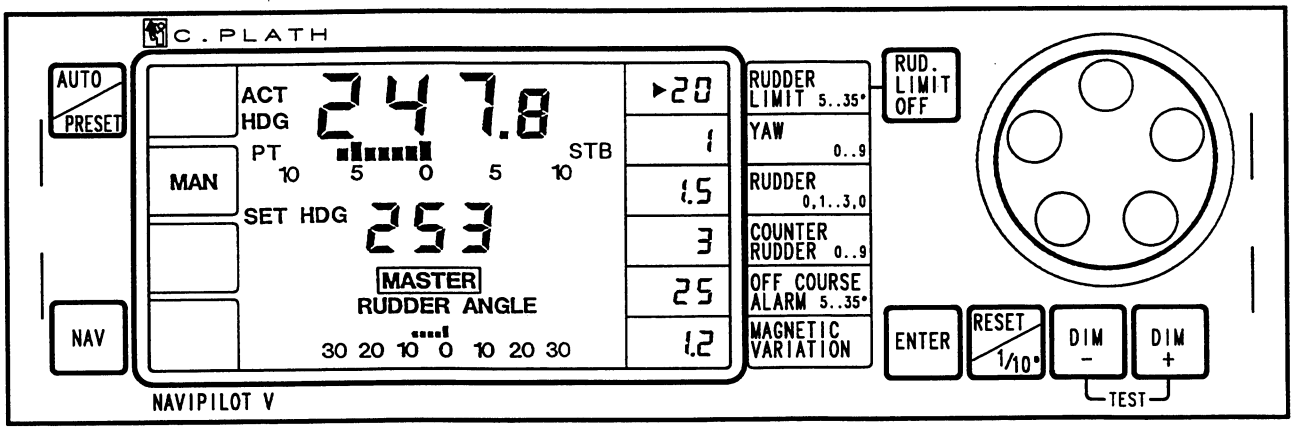
OPERATOR, TECHNICAL AND SERVICE MANUAL



NAVIPILOT V

MARINE AUTOPILOT SYSTEM

incorporating

VOYAGE DATA RECORDER

09 JAN 96 REV I

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1. DESCRIPTION

1.1 Introduction

NAVIPILOT V is a general-purpose, multifunction, microprocessor controlled marine autopilot. Created with computer aid to provide high fuel economy and low operational demands, NAVIPILOT V is suitable for application on all classes of ships ranging from small yachts to the largest supertanker.
The very modern design includes a tailor-made and clearly laid out transflective liquid crystal display, which permanently indicates all data required by contemporary navigation demands:

* actual heading (digital)
* heading difference ±10° analogue
* set heading (course to steer)
* rudder angle (analogue ±35°)
* steering mode (Auto/Man/Nav)
* Parameters for:
  - rudder limit
  - yaw
  - rudder
  - counter rudder
  - off course alarm
  - magnetic variation

Changes to parameters and the set heading (course to steer) are carrired out by a single anlogue cardinal control disk.

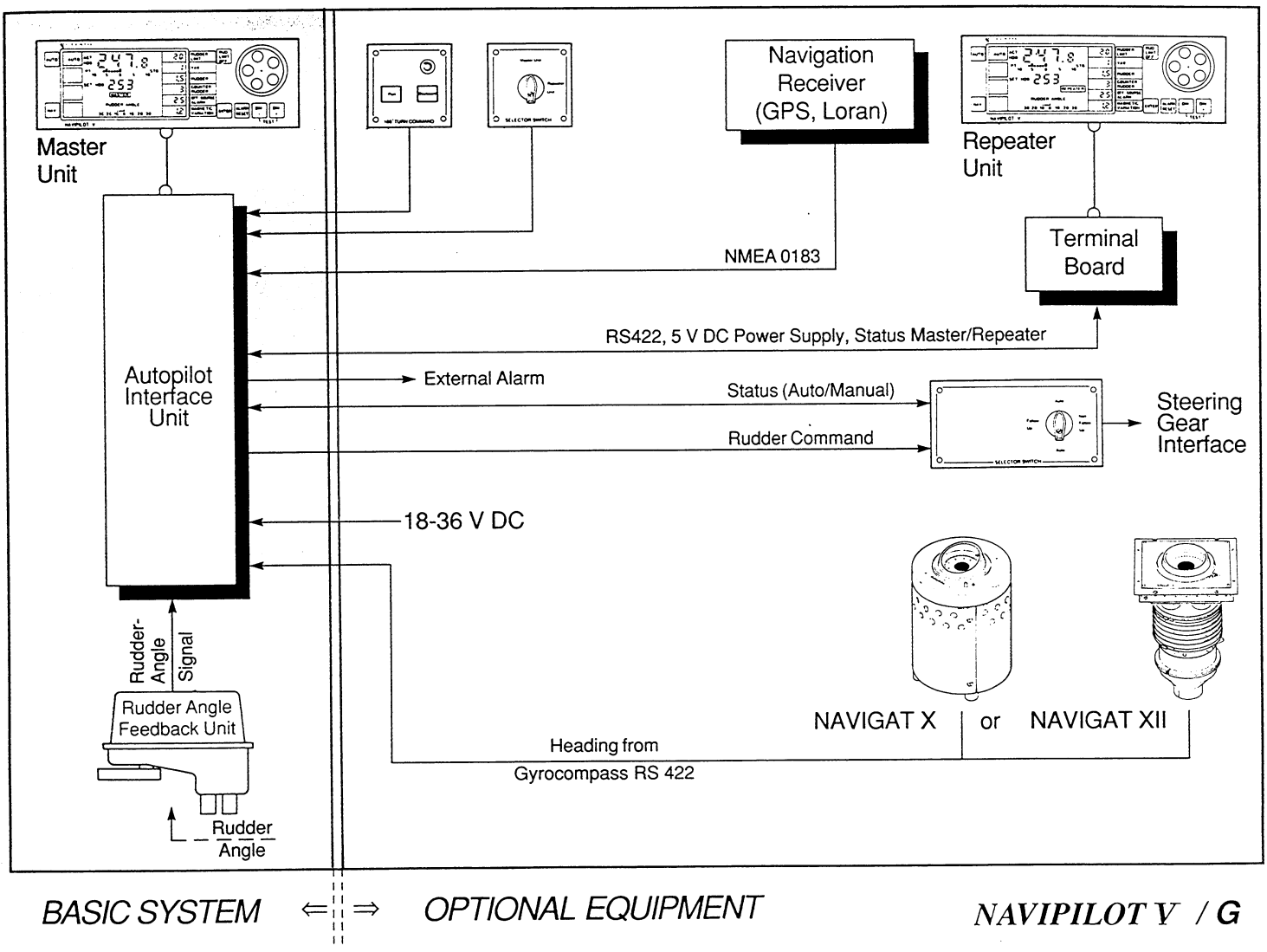
1.2 Major Features

* Clearly arranged Liquid Crystal Diplay.
* Logically arranged sealed foil keyboard.
* Analogue selection of set heading and all relevant parameters by means of an ergonomically designed cardinal control disk, safeguarded against unintentional operation.
* Digital PID contoller with nonlinear weather control.
* Built-in test equipment (BITE).
* Gyrocompass, magnetic compass and electronic compass inputs.
* Intergrated independent off course alarm.
* A maximum of twenty (20) remote autopilot repeaters can be linked to the master autopilot control unit.
* Permanent magnetic compass heading output.
* Analogue output for thruster control, rudder propellers and water jets.
* Complies with IMO Resolution A.342(IX).
* Operational data remains stored if a power failure occurs.
* Front plate dimensions to DIN standard.

1.3 System Configurations

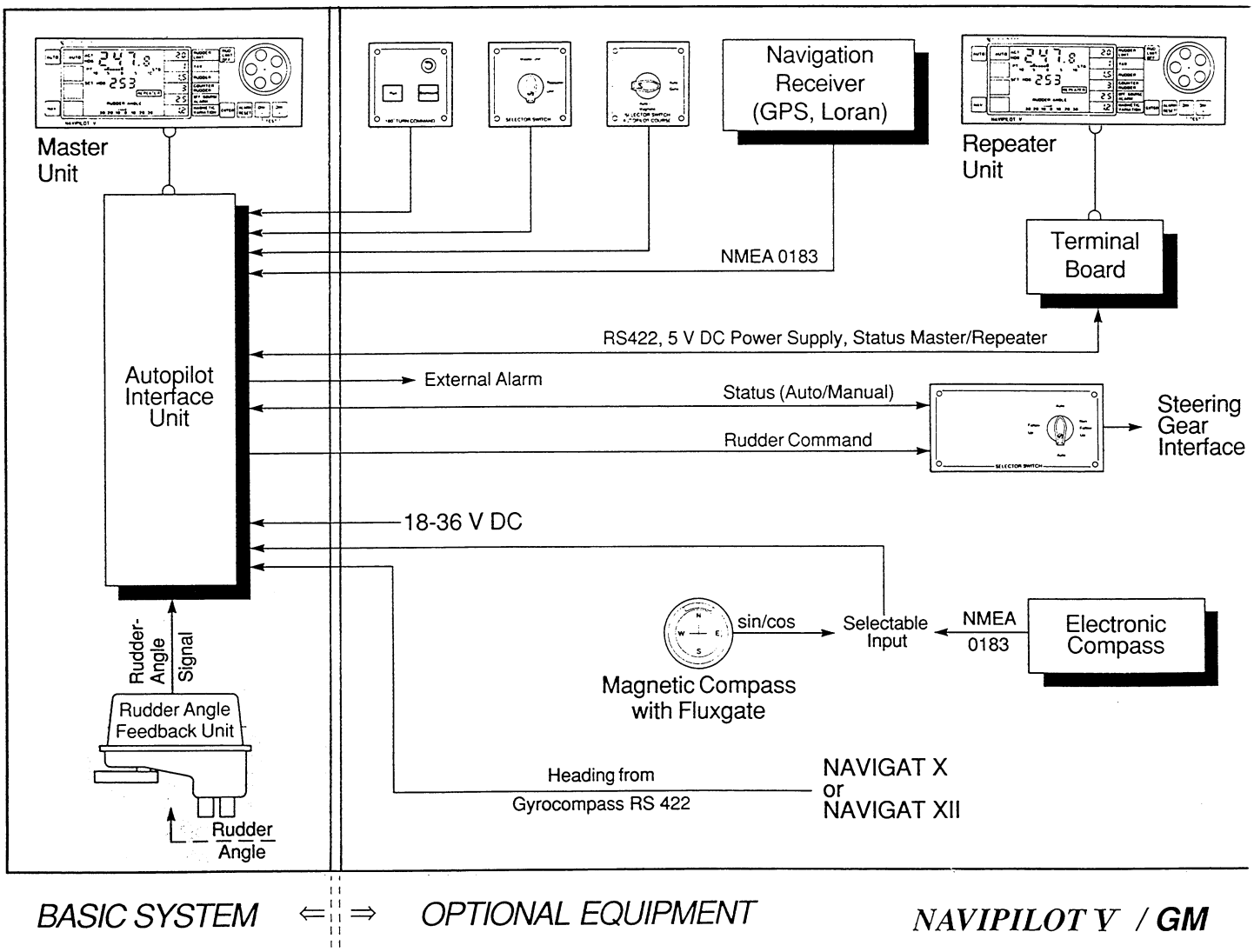
1.3.1 NAVIPILOT V / G

This version accepts a gyrocompass heading input only and is intended for ships with not equipped with a transmitting magnetic compass system.



1.3.2 NAVIPILOT V / GM

GM denotes that this version features inputs for both gyrocompass and magnetic compass heading information. This is today's most widely-used configuration because the autopilot will operate on the heading information from the magenetic compass should failure of the gyrocompass occur. During the normal opertational mode, the headings from both gyrocompass and magnetic compass are processed in the **independent course monitor** [complies with IMO Res. A.342 (XI)] integrated in NAVIPILOT V / GM.



BASIC SYSTEM ⇐ ⇒ *OPTIONAL EQUIPMENT* ***NAVIPILOT V / GM***

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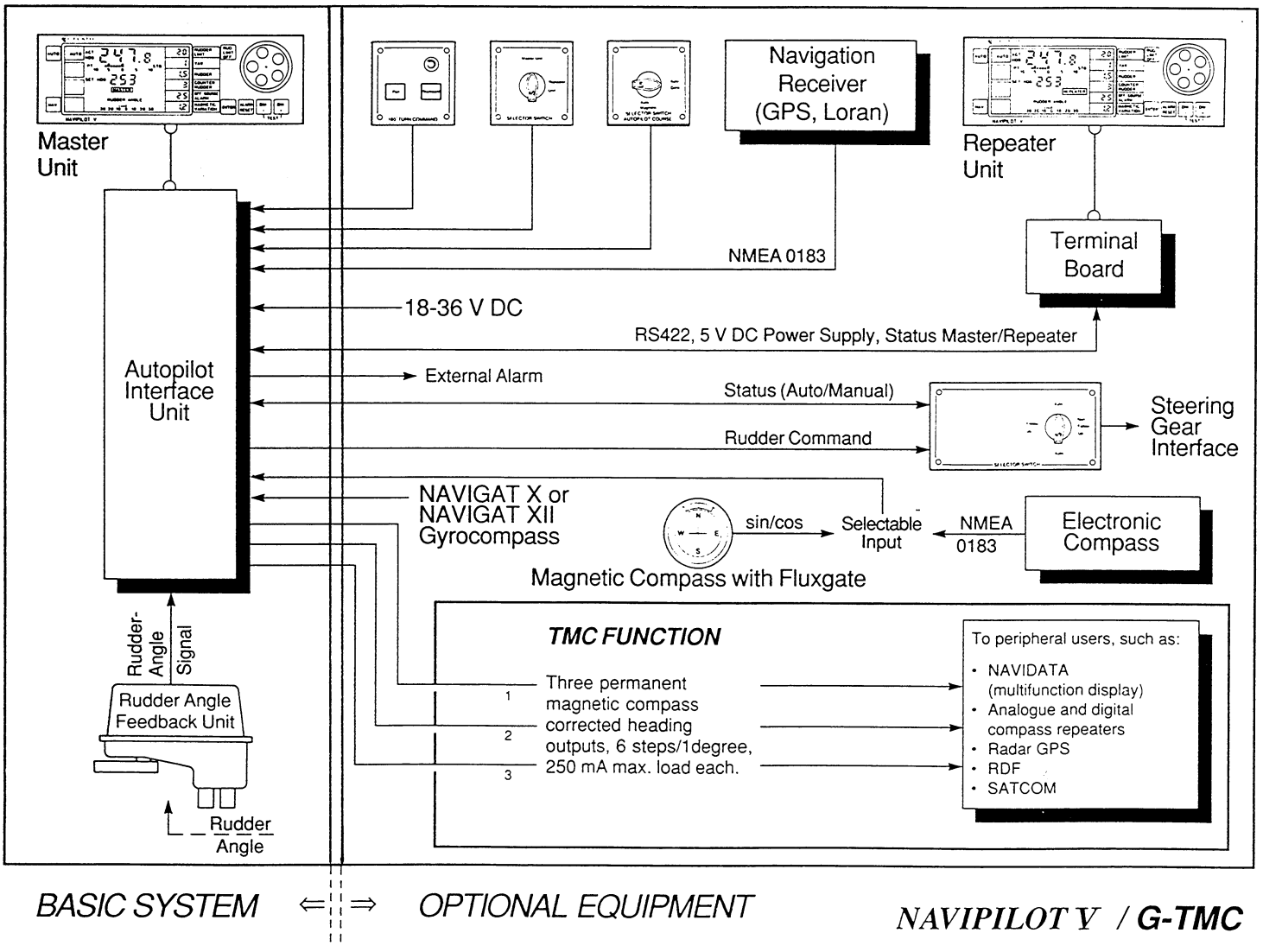
1.3.3 NAVIPILOT V / G-TMC

In addition to the features of the GM version, the G-TMC configuration provides the Operator with threes permanent and separate outputs of the magnetic compass heading in the format of 6 steps per one degree of azimuth.
In the event of a gyrocompass failure, all major receivers of the gyrocompass heading, such as radar, Satcom, GPS and digital repeaters, can be switched over immediately to the heading from the magnetic compass.



BASIC SYSTEM ⇐⇒ OPTIONAL EQUIPMENT

*NAVIPILOT V / **G-TMC***

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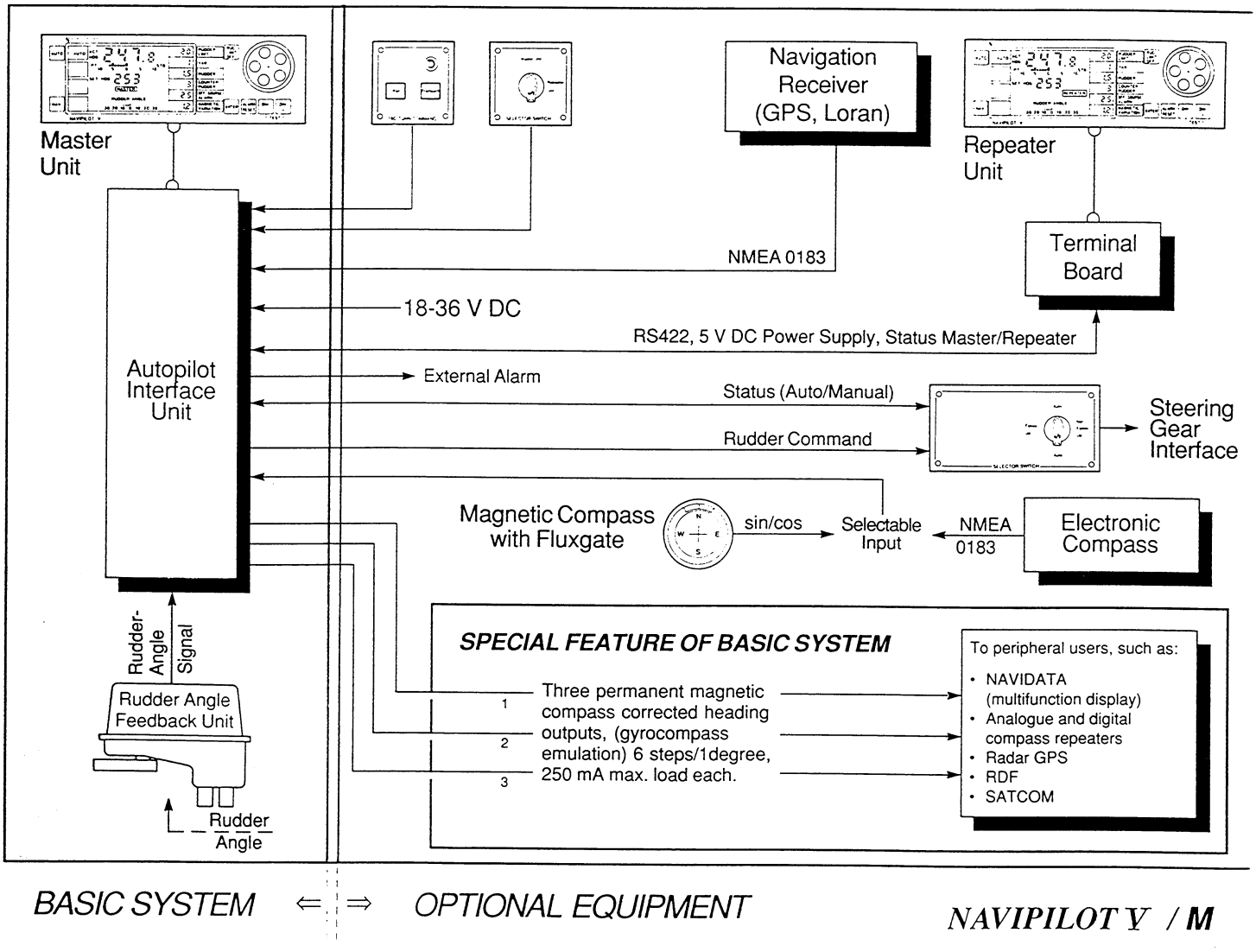
1.3.4 NAVIPILOT V / M

The M version of NAVIPILOT V has been conceived for those who do not consider the installation of a complete gyro-compass system to be cost-effective, but still require a heading reference for distribution to peripheral equipment, for example, heading repeaters, plotting tables, radar, GPS and Satcom. For this purpose, NAVIPILOT V / M provides three separate magnetic compass heading outputs, each in the format of 6 steps per one degree of azimuth. Furthermore, the integrated magnetic compass heading correction table coupled with the magnetic variation parameter facility result in an emulated gyrocompass true north heading output.



1.4 System Function

The actual heading signal supplied by a gyrocompass, a transmitting magnetic compass through a fluxgate or an electronic compass is contiuously compared with the set heading - manually set up on the digital display on the autopilot. When the actual heading coincides with the set heading, the two values are equal and there is no differential. If the vessel deviates from the set heading, or if the set heading is changed, the resultant differential is picked off and fed to a digital computing circuit operating on the three-term controller (PID) principle. A microprocessor processes ther differential signal and generates an output or command signal made up of three components:

a) the component proportional to set heading error (P).
b) the component representing the integral sum of the set heading error with respect to time (I).
c) the component reperesenting the rate of change or derivative of the set heading error.

Positioning the rudder is achieved by a trigger circuit, which is initiated whenever a difference exists between the autoplilot command signal and a rudder position signal derived from a feedback transmitter coupled to the rudder shaft. The rudder is moved in such a direction as to null out the error.
By varying the parameters displayed on the righthand side of the display accordingly, it is possible to "tune" the autopilot to suit the prevailing conditions such as weather, seaway and state of loading.

1.5 Technical Data

AUTOPILOT

Ambient temperature range	operation	-10°C to +70°C
	storage	-25°C to +70°C
Protection grade	installed	IP 56 to DIN 40050
	not installed	IP 43 to DIN 40050
Minimum magnetic clearance (installed) to		
standard magnetic compasses		≤ 0.30 m
steering magnetic compasses		≤ 0.30 m
Vibration	fulfills curve 1 of the specifications of Germanischer Lloyd and IEC 945	
Humidity	fulfills the specifications of Germanischer Lloyd	

Electromagnetic compatability minimum clearance of antennas and their power supply lines for marine radio areas between 1.6 MHz and 30 MHz at a transmission power of 1.5 kW	≥ 1.5 m
The clearance to VHF antennas, their power supply lines and radar appliances is not restricted.	
Radio interference classification in accordance with VDE 0871 Radio Iterference Suppression of Radio Frequency Equipment for Industrial Purposes and VDE 0875 Radio Interference of Electrical Appliances and Systems and IEC 945	K
Front plate dimensions	288 mm x 96 mm to DIN standard
Depth	35 mm approx.
Weight	1 kg approx.
Front plate	sealed keyboard, illuminated
Display	liquid crystal, illuminated
Power input	24 VDC (18 V to 36 V)
Max. ripple content	4 V pp, extreme values should not exceed 40 V or fall below 19 V
Power consumption	10 W max.
Reverse polarity protection	built-in
Cable connections	D-type plug connectors
Potentiometer in rudder angle feedback unit Total resistance Potentiometer in fllow-up handwheel	±10 V ±45° rudder angle 2 K Ohm ±10 V ±45° rudder angle
Fluxgate coil for magnetic compass	sine/cosine, supplied by c. plath
Electronic compass	through NMEA 0183 interface

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NMEA 0183 navigation interface	waypoint steering (sentence selectable) from GPS, Satnav, Loran C and others
Status signals	auto, manual, nav, master, repeater
Gyrocompass input	standard is RS 422 (Navigat X/Mod.7 & Mod.10 and NAVIGAT XII/Mod.7 & Mod.10)
Option	6 steps / 1 degree or synchro 1:360
OUTPUTS	
Outputs to Steering Engines	
DC Output	
Switching transistors	two for port two for starboard
Type	switched plus or minus
Voltage	18 V DC to 110 V DC
Rating	2.0 A max.
or	
AC Output	
Solid-state AC relays	two for port two for starboard
Voltage	110 V AC to 240 V AC
Rating	1 A max.
and	
Output to proportional steering engine valve (option)	max. three 220 mV DC/° rudder angle (isolated output)
Output Alarms and Interfaces	
Serial output interface	RS 422 for connection to autopilot repeaters and multifunction display NAVIDATA
External off course alarm	Potential-free contact
Maximum current	2.0 A
Maximum voltage	250 V

180° turn command	port and starboard
Power failure alarm	visible and audible and potential-free contact max. current 2 A max. voltage 250 V
Magnetic compass heading or Electronic compass heading	3 outputs each 6 steps/degree, 0.25°

AUTOPILOT INTERFACE UNIT

Dimensions	120 mm x 300 mm x 400 mm
Weight	8 kg
Cable connections	screw-down terminals

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2. OPERATION

2.1 Foreword

The NAVIPILOT V Autopilot System has been developed and manufactured with the aid of the most modern technology and therefore incorporates many functions and features which were not available in previous autopilots. Consequently, the terminology associated with autopilot systems has been changed and expanded to cover the demands of state-of-the-art technology. The major terminology modifications are:

Actual Heading (previously Heading)
Set Heading (previously Course)
Set Course

Actual Heading is the horizontal direction in which a vessel points at any time and in relation to geographic north or magnetic north.

Set Heading is the angle between geographic or magnetic north and the direction in which a vessel is to be steered by the autopilot.

Set Course is the angle between geographic or magnetic north and the direction over ground in which a vessel is to be steered by the autopilot from way point to way point in combination with, for example a GPS receiver.

2.2 General

In restricted waterways manual steering is recommended, and particularly so in conditions of poor visibility. Switching from manual steering to autopilot steering is possible at all times, regardless of whether the autopilot is to hold the existing set heading or carry out a change in the set heading.
Optimisation of the settings (the fine tuning) according to prevailing conditions of wind, sea and draught is carried out after the autopilot system has been initialized.

NOTE: When switching from manual steering to autopilot control, the actual heading of the vessel is taken as the set heading at the moment of switch-over so as to rule out unwanted or erroneous changes in the vessel's heading when the steering mode is switched to Autopilot.

2.3 Controls

After the **Setup Procedure** (see page 3-02) has been completed, the autopilot will be ready to steer a ship accurately and efficiently to preset heading without the aid of a helmsman. In order to carry out this task, the autopilot provides the operator with the following controls.

AUTO
PRESET Press to switch from **NAV**igation interface steering mode (e.g. way point navigation with GPS) back to the **AUTO**pilot steering mode.
Press for preset heading function.

NAV Press to receive the set heading for the autopilot in the **NAV**igation interface mode from a GPS or Loran C receiver, for example.
Press to confirm waypoint changes.

ENTER Press to store the following parameters:

RUDDER LIMIT	range: 5°, 10°, 15°, 20°, 25°, 30°, 35° see Setup Procedure for maximum rudder angle.
YAW	range: 0 to 9
RUDDER	range: 0.1, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, 2.5, 3.0
COUNTER RUDDER	range: 0 to 9
OFF COURSE ALARM	range: 5°,10°, 15°, 20°, 25°, 30°, 35°
MAGNETIC VARIATION	range: 99.9° west to 99.9° east

RESET
1/10°
a) switches off the audible alarm
b) press to display tenths of a degree when selecting the set heading with the control disk

DIM − decreases illumination intensity

DIM + increases illumination intensity

NOTE: See Setup Procedure for basic illumination settings.

DIM − **DIM +** when pressed simultaneously, initiate self-test function.

ENTER RUD. LIMIT OFF when pressed in sequence, switch the rudder limit off.

CONTROL DISK turn clockwise (cw) or counterclockwise (ccw) to set parameters and change the set heading; press simultaneously ALARM RESET to select tenths of a degree.

AUDIBLE ALARM VISUAL ALARM an audible alarm and a visual alarm are actuated for the following reasons:

a) the off course limit has been exceeded.

b) gyrocompass/magnetic compass heading difference.

c) power failure.

d) gyrocompass failure.

e) magnetic compass failure.

f) when the Setup Procedure is actuated in the autopilot steering mode.

g) when the NAVigation interface mode is selected in the manual steering mode.

2.4 Storing Parameters

2.4.1 General

The autopilot provides the Operator with the following six parameters to enable him to optimize the performance of the autopilot to suit the prevailing wind, sea and draught conditions.

RUDDER LIMIT range: 5°, 10°, 15°, 20°, 25°, 30°, 35°

NOTE: See Setup Procedure for maximum rudder angle.

YAW range: 0 to 9

RUDDER range: 0.1, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, 2.5, 3.0

COUNTER RUDDER range: 0 to 9

OFF COURSE ALARM range: 5°,10°, 15°, 20°, 25°, 30°, 35°

MAGNETIC VARIATION range: 99.9° west to 99.9° east

Before the parameters are stored for the vessel concerned, it is recommended that the information contained on the following pages with regard to the various parameters be studied.

2.4.2 Parameter Storing Procedure

The above mentioned parameters may be changed in the autopilot steering mode as well as in the manual steering modes.
NOTE: Press **AUTO** to exit the parameter storing procedure at any time.

1. Press **ENTER** to initiate the storing procedure. The RUDDER LIMIT value will flash to request an input.

   NOTE: Parameter values will flash for 10 seconds. If the parameter is not changed in this period, it will cease to flash and the storing procedure will have to be initiated again by pressing **ENTER**

2. Turn the control disk cw or ccw to bring the RUDDER LIMIT to the required value.

   NOTE: See the Setup Procedure and the SETUP TABLE for maximum rudder limit.

3. Press **ENTER** to store the RUDDER LIMIT. The YAW value will flash to request an input.

4. Turn the control disk cw or ccw to bring the YAW display to the required value.

5. Press **ENTER** to store the YAW value. The RUDDER value will flash to request an input.

6. Turn the control disk cw or ccw to bring the RUDDER display to the required value.

7. Press **ENTER** to store the RUDDER value. The COUNTER RUDDER value will flash to request an input.

8. Turn the control disk cw or ccw to bring the COUNTER RUDDER display to the required value.

9. Press **ENTER** to store the COUNTER RUDDER value. The OFF COURSE ALARM value will flash to request an input.

10. Press **ENTER** to store the OFF COURSE ALARM value. The MAGNETIC VARIATION value will flash to request an input.
    The correction range is from 99.9° west to 99.9° east.

11. Turn the control disk cw or ccw to bring the MAGNETIC VARIATION display to the required value.

12. Press **ENTER** to store the MAGNETIC VARIATION value. The MAGNETIC VARIATION display will cease to flash to indicate that the parameter storing procedure has been completed.

NOTE: Single parameters may be changed by pressing **ENTER** repeatedly to "jump" to the required parameter, which may be changed by turning the control disk as described above. To exit to the normal operation mode after changing a single parameter, press **AUTO**

2.5 The Effects and Uses of the Various Control Parameters

2.5.1 Rudder

The Rudder parameter has ten positions and controls the rudder deflection from the smallest rudder angle (0.1) to the largest rudder angle (3.0). The effect of the Rudder parameter under unvarying conditions is as follows:

Position	Heading Deviation	Approximate Rudder Angle
0.1	1°	0.1
0.2	1°	0.2
0.3	1°	0.3
0.5	1°	0.5
0.7	1°	0.7
1.0	1°	1.0
1.5	1°	1.5
2.0	1°	2.0
2.5	1°	2.5
3.0	1°	3.0

NOTE: This table is for normal conditions only.

The above values are given only as a guide. It will be appreciated that owing to the autopilot frequency response characteristics, the rudder angles which result under actual dynamic conditions will be different to those which correspond to static conditions.
Weather conditions permitting, the autopilot is to be operated with the Rudder parameter at the position 0.3, 0.5, 0.7, or 1.0.
Experince has shown that during harbour cruising the Rudder parameter should be increased to the next higher setting. In the event of rough seas from abaft, the Rudder parameter should be increased. It may also be necessary to increase the Yaw parameter. Cruising at half or slow speed also requires an increase of the Rudder parameter. During changes in the set heading when cruising with a deck cargo only (high center of gravity) particular attention is to be paid to the rudder limit, see 2.8.

2.5.2 Yaw

The Yaw parameter has a range from 1 to 9 and varies the responsiveness of the autopilot. In fair weather the Yaw parameter should be set to 2, which affords a relatively tight yaw control. Yaw value *1* achieves the highest accuracy in maintaining the set heading.
Under unfavourable weather conditions with increasing yawing, a higher Yaw value is recommended. The effect of the Yaw parameter under static conditions can be expressed as follows:

Yaw Range No.	Attenuation of Rudder Activity over a Range of:
0	± 0°
1	± 0.5°
2	± 1°
3	± 2°
4	± 3°
5	± 4 °
6	± 5°
7	± 6°
8	± 8°
9	± 10°

The table shows the Yaw range numbers with reference to associated freedom of yaw in degrees.
These values are given only as a guide, since owing to its frequency response characteristics, the autopilot has a smaller freedom of yaw under the dynamic conditions dependent on the ship's movements than those which correspond to static conditions.

2.5.3 Counter Rudder

The counter rudder control provides the operator with a range of settings from 0 to 9 for adjusting the effect of the vessels rate of turn to suit the autopilot control process. The maximum effect is obtained at setting 9.
Cruising with low counter rudder (setting 1) may result in the ship zig-zagging around the set heading and cause overshoot during course changes.
A high counter rudder setting supresses such oscillations and prevents overshoot during course changes. On the other hand, a high counter rudder setting in rough seas results in frequent rudder movements because the attempts to force corrections of the fast turning movements of the ship within swells. If rudder movement is too frequent, it is recommended that the yaw setting be increased rather than reducing excessively the counter rudder setting.
Basically, it is a case of determining the settings which keep rudder movement at a minimum and the ship to the set heading with the required accuracy. If the vessel shows a tendency to overshoot during course changes, the counter setting is too low. If course changes are effected too slowly, the counter rudder setting is too high.

If the vessel is oscillating excessively about the set heading and is not yawing due to extreme sea conditions, the counter rudder setting is to be increased. If the steering engine then responds too frequently, the yaw setting is to be increased.
A vessel cruising under load generally requires more counter rudder than a ship in ballast.

2.5.4 Gain and Counter Rudder

Gain is the coarse setting for the COUNTER RUDDER parameter, see 2.4.2 Parameter Storing Procedure.
The Gain value (range 30 to 300) is entered during the Setup Procedure, see 3.5.
During autopilot initialization, the COUNTER RUDDER parameter is to be set to 5 so as to enable the operator to make changes in both directions.
If sea trials result in a COUNTER RUDDER value lying at the top or bottom of the scale, the gain setting may be changed in the Setup Procedure to bring the COUNTER RUDDER value back to the center of the scale.
An example: Counter Rudder (CR) = 1
Gain = 150
Required CR value = 5

Formula: $Gain_{new} = Gain_{old} + 6 \times (CR_{old} - CR_{new})$

$Gain_{new} = 150 + 6 \times (1-5) = 126$

i.e. the settings CR = 5 and Gain = 126 produce the same counter rudder effect.

2.6 Off Course Alarm

In the off course alarm function the autopilot compares the heading references ACT HDG and SET HDG with the current threshold of the off course alarm function and activates audible and visual alarms when this threshold is exceeded. The off course alarm range is: 5°, 10°, 15°, 20°, 25°, 30°, and 35°.
When the autopilot receives both gyrocompass and magnetic compass headings, it will automatically compare these headings with each other and when a deviation in excess of the the current off course alarm threshold is detected, it will actuate audible and visual alarms.
The actuation of an external off course alarm (in a remote alarm panel, for example) may be delayed by a preset delay function. The time delay range is 0 through 300 seconds in increments of 10 seconds.
To program the time delay for the off course alarm, see step 17 in *3.5 Setup Procedure.*

2.7 Magnetic Variation

The magnetic compass display can be corrected for magnetic variation (also called magnetic declination). Magnetic variation is the angular deviation of a magnetic compass, uninfluenced by local causes, from the true north and south. The variation differs at different points on the earth's surface and at different times of the year. The applicable magnetic variation correction value can be taken from the sea chart applicable to the area in question.
Proceed as follows to store the applicable correction value.

1. Press **ENTER** repeatedly until the MAGNETIC VARIATION display value flashes.

2. Turn the control disk cw or ccw to bring the display to the required correction value.
   The correction range is from 99.9° west to 99.9° east.

3. Press **ENTER** to store the correction value and return to the normal autopilot operation mode.

2.8 Rudder Limit Off

The RUDDER LIMIT selected during the parameter storing procedure remains active until the key **RUD. LIMIT OFF**

is pressed to deactivate this rudder limit, whereby the RUDDER LIMIT display defaults to the maximum rudder limit selected in the Setup Procedure (see Setup Procedure and the SETUP TABLE).
To return to the original RUDDER LIMIT value, press **ENTER**. The RUDDER LIMIT display will flash to request an input.
Turn the control disk cw or ccw to bring the display to the RUDDER LIMIT required. RUDDER LIMIT range is 5°, 10°, 15°, 20°,25°, 30°, 35°.
Press **AUTO** to store the RUDDER LIMIT value and to exit to the normal autopilot operation mode.

NOTE: A flashing arrow will appear on the lefthand side of the RUDDER LIMIT display when the selected rudder angle has been reached.
Counter rudder is not limited during changes in course.

2.9 Preset Heading

In autopilot operation (and in a manual steering mode) a new set heading may be preset and taken over exactly at the point in time when it is required.

Procedure

1. Press **AUTO** the display will flash to request an input.

2. Using the control disk, the PRE-SET HeaDinG to the next required set heading.

   The displays SET HDG and PRE-SET HDG will be displayed alternately. PRE-SET HDG will flash, SET HDG will not flash.

3. As soon as the PRE-SET HeaDinG is required, select autopilot control if a manual steering mode is selected, see *2.10*, and press **AUTO** to takeover immediately the PRE-SET HeaDinG as the new SET HeaDinG.

2.10 Switchover to Autopilot Control

1. If the steering engine has two different speeds, select the slower speed.

2. Turn the steering mode selector switch to the "AUTO" position.

3. Use the control disk, set the required set heading.

4. Observe the operation of the autopilot by noting how the ship takes up the set heading. For this purpose, the autopilot is provided with an analogue display of the difference between the actual heading and the set heading (see *3.5 Setup Procedure*).

2.11 Synchronization of the Autopilot ACTual HeaDinG Display with the Heading of the Gyrocompass (serial interface only, C.PLATH or NMEA format)

1. Select a manual steering mode.
2. Read the warning label on the gyrocompass Electronic Power and Control Unit (EPCU).
3. Press the green sychronization switch on the EPCU. The heading display on the autopilot will flash and gyrocompass compass card system will turn to bring the north symbol to the lubber line (maximum duration 40 sec.) where it will remain.
4. Press again the green synchronization switch on the EPCU. The compass cards will return to the current heading.The flashing heading display on the autopilot will also show the current heading from the gyrocompass. When the heading display on the atopilot ceases to flash, synchronization is complete.

2.12 Synchronization of the Autopilot ACTual HeaDinG Display with the Heading of the Gyrocompass (6 steps and synchro outputs only)

To synchronize the autopilot ACTual HeaDinG display with the gyrocompass and/or magentic compass, proceed as follows.

1. Select a manual steering mode.
2. Press simultaneously the keys **ENTER** **DIM** **+**
3. The ACTual HeaDinG display will flash.
4. Turn the control disk cw or ccw to bring the ACTual HeaDinG display to the heading displayed by the compass in question.
5. Press **ENTER** to takeover the the new ACTual HeaDinG. Synchronization is complete and the display will cease to flash.

2.13 Override Function

When the autopilot is operated in the NAVigation interface mode, the control disk provides the operator with an override function. When the control disk is turned, the autopilot switches immediately to the **AUTO** steering mode to enable the operator to carry out an immediate change to the set heading. Press **NAV** to return to the NAVigation interface steering mode.

2.14 Display of the Current Software Revision Number

1. Select a manual steering mode.
2. Press simultaneously the keys **ENTER** **RESET** **1/10°** **DIM** **-**
   to enter the setup procedure.
3. Press **AUTO** to exit the setup procedure. The current software revision number will be shown in the display for approximately two seconds.

C. PLATH
NAVIGATION · AUTOMATION

3 INSTALLATION AND INITIALIZATION

3.1 General

Before the autopilot can be used to steer a ship, a number of basic parameter settings have to be carried out which depend on the size of the ship in question, the requirements of the operator and the configuration of the peripheral equipment. Entering and storing these basic parameter settings is called the **Setup Procedure,** see 3.5.

3.2 Before Installation

Before installation of the autopilot, the dip switches in block K1 on the computer PCB have to be set according to whether the function of the autopilot is intended to be that of a **Master** or **Repeater** Unit. Normally, these dip switches are set by the manufacturer according to the customer's order. However, before installation, the position of these switches should be checked.

MASTER:	K1	REPEATER:	K2
	1 off		1 off
	2 off		2 off
	3 off		3 off
	4 off		4 off
	5 off		5 off
	6 on		6 on
	7 on		7 on
	8 on		8 off

Dip Switch Block K1 on Computer PCB

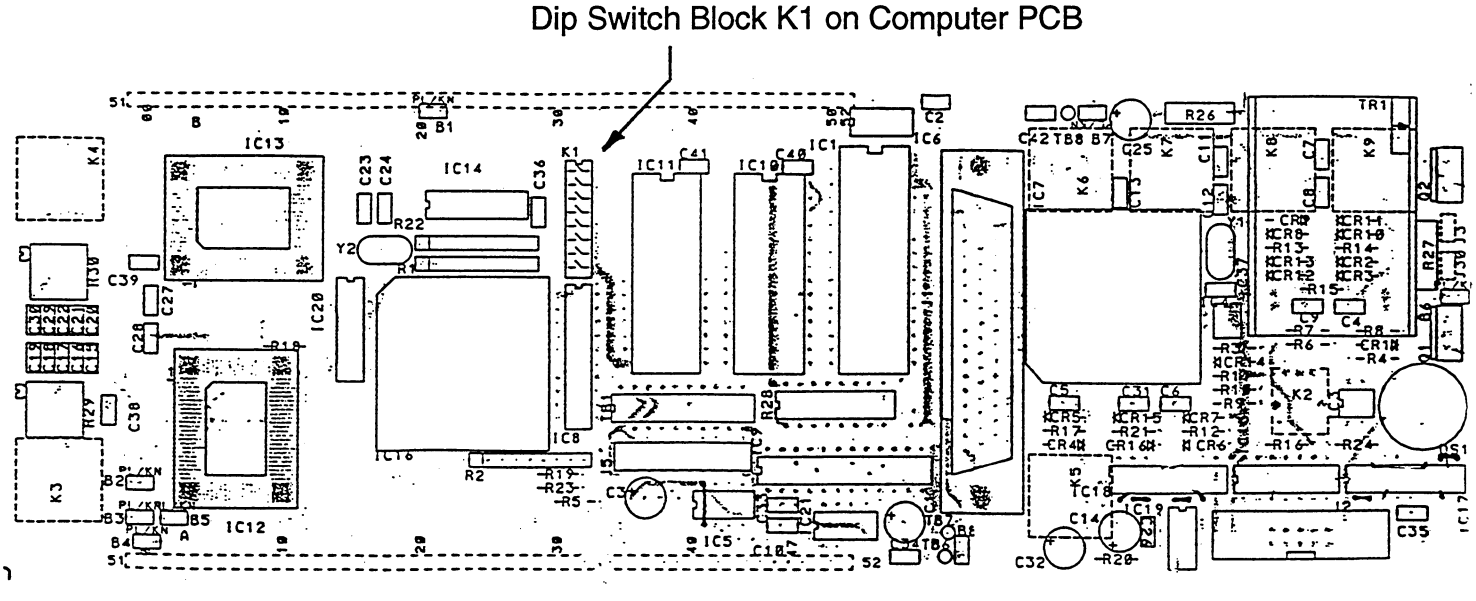

Figure 3-01 Computer PCB

3.3 Installation

1. Install the components of the autopilot system in accordance with the drawings, diagrams and documents provided by the manufacturer.

2. Carry out all wiring work in accordance with the manufacturer's interconnection diagram. Do not yet energize the system.

3.4 After Installation

1. Bring the steering mode selector switch into the MANUAL position.

2. Energize the autopilot system. The autopilot will perform a self-test. After the self-test has been completed (approximately 5 sec.) the autopilot will display the heading of the compass currently selected as the heading reference (gyrocompas or magnetic compass) for the autopilot.
   To indicate the manual steering mode, the autopilot will show **MAN** on the left-hand side of the display, see Fig. 3-02.
   The Setup Procedure for the basic operational parameter settings may now be carried out, see 3.5.

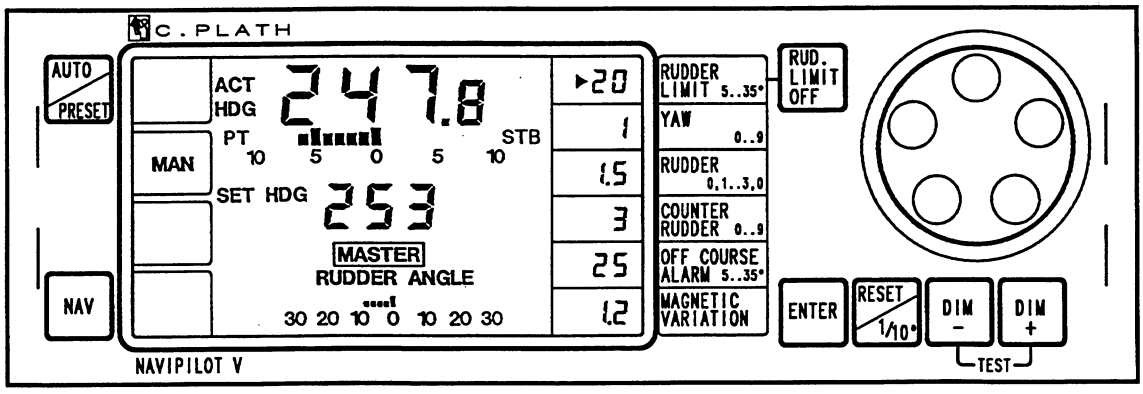

Figure 3-02 Normal Operational Display

3.5 Setup Procedure

NOTE: During the Setup Procedure, magnetic compass repeaters will remain stationary.

1. Initiate the setup procedure by pressing simultaneously the keys
   ENTER RESET DIM
   1/10° -

   The display will change to ***t A U***
   1 0

   The tau value (in this case 10) will flash. This is a request for the input of the ship's time constant factor (tau). The time constant factor can be determined with the aid of the NOMOGRAM , see section 3.7.

   NOTE: To exit the Setup Procedure before completion press **AUTO**

2. Using the NOMOGRAM, determine the time constant factor (tau) for the ship in question, see section 3.7.

3. For future reference, enter the time constant factor (tau) in line 1 of the SETUP TABLE in section 3.6.

4. Turn the control disk (normally used to select the set heading i.e. course to steer) cw or ccw to bring the display to the required tau value.

5. Press **ENTER** to store the time constant factor.
   The display will change to
   GAIn
   80

   a gain value will be displayed. Gain is the coarse setting for the parameter COUNTER RUDDER. The gain value will flash to request an input . The gain value range is from 30 to 300. For initilization purposes enter a gain value of 80. For calculation of the final gain value, see *2.5.4 Gain and Counter Rudder.*

6. Record the gain value in line 2 of the SETUP TABLE in section 3.6.

7. Turn the control disk cw or ccw to bring the display to a gain value of 80.

8. Press **ENTER** to store the gain value. The display will change to one of the following NMEA sentence formats.

No. 0	***O F F***	NMEA	interface switched off.
No. 1	***H S C***	HSC	steering heading command.

No. 2	***b o d***	BOD	bearing to destination waypoint from origin waypoint.
No. 3	***A P A***	APA	autopilot format A.
No. 4	***A P b***	APB	autopilot format B.
No. 5	***C t S***	CTS	course to steer.
No. 6	***P C T***	PCTS	precision course to steer.
No. 7	***b P I***	BPI	bearing to point of interest.
No. 8	***b u r***	BWR	bearing to selected waypoint rhumbline.
No. 9	***b u c***	BWC	bearing to selected waypoint great circle.
No. 10	***I n S*** **1**	INS 1	integrated navigation system 1 (C.PLATH general).
No. 11	***I n S*** **2**	INS 2	integrated navigation system 2 (C.PLATH chart plotters NAVIPLOT I & II).
No. 12	***I n S*** **3**	INS 3	integrated navigation system 3 (C.PLATH special).
No. 13	***I n S*** **4**	INS 4	integrated navigation system 4 (C.PLATH special).
No. 14	***I n S*** **5**	INS 5	integrated navigation system 5 (C.PLATH special).

The display will flash to request the input of the NMEA sentence format, see section 5 for interface specifications.
The autopilot provides the operator with 13 different NMEA sentence formats for interfacing the autopilot to GPS receivers, Loran, integrated navigation system, etc.

NOTE: If the autopilot is to be operated in the **NAV** steering mode, i.e. in which the set heading information for the autopilot is provided by a GPS receiver, Loran, integrated navigation systems, etc., turn the control disk through approximately a further 360° after selecting the NMEA sentence format so that ***NAV*** appears flashing in the lower

left-hand corner of the display. This indicates that when in the **NAV** mode, the autopilot will sound an alarm when it receives a new set heading. Takeover of the new set heading is carried out by pressing the **NAV** key.

NOTE: If an NMEA sentence format is not required, select ***OFF.***

9. Enter the required NMEA sentence format in line 3 of the SETUP TABLE in section 3.6.

10. Turn the control disk cw or ccw to bring the display to the required NMEA sentence format, with or without the **NAV** function.

11. Press **ENTER** to store the NMEA sentence format.

NOTE: If one of the following sentence formats is stored BOD, APA, APB, BPI, BW, BUC, INS 1 through INS 5, the display will change to

SEns (sensitivity)
0

a) A number will flash to request an input of the NMEA sensitivity.

NOTE: NMEA sensitivity controls the rate at which cross track error (XTE) is corrected - faster for small vessels, slower for large vessels. The sensitivity values produce an asymptotic approach to the track. If the operator considers that the approach is too slow, he should select a higher sensitivity value corresponding to a shorter ship's length.

NOTE: The set heading offset is limted to 75°. The sensitivity values from 10 to 20 are only to be used in combination with highly accurate navigation receivers such as differential GPS.

The following table provides sensitivity values and set heading offset information.

NMEA Sensitivity	Set Heading Offset [°] at XTE = 0.01 nm	NMEA Sensitivity	Set Heading Offset [°] at XTE = 0.01 nm
20	75	9	1.5
19	75	8	1.0
18	50	7	0.75
17	30	6	0.5
16	20	5	0.30
15	15	4	0.20
14	10	3	0.15
13	7.5	2	0.10
12	5.0	1	0.08
11	3.0	0	0.05
10	2.0		

b) Enter the required NMEA sensitivity value in line 4 of the SETUP TABLE in section 3.6.

c) Turn the control disk cw or ccw to bring the display to the required MNEA sensitivity value.

d) Press **ENTER** to store the NMEA sensitivity value.

12. The display will change to

r u d
3 5

The number will flash to request the input of the required maximum rudder angle. The maximum rudder angle range is 20°, 25°, 30°. 35°.

13. Enter the required maximum rudder angle in line 5 of the SETUP TABLE in section 3.6.

14. Turn the control disk cw or ccw to bring the display to the required maximum rudder angle.

15. Press **ENTER** to store the required maximum rudder angle.
The display will change to

r u d

2 2 0 INTERFACE

RUDDER ANGLE
I
30 20 10 0 10 20 30

The number will flash to request the input of the scale factor (mV) of the input signal from the rudder angle potentiometer in the feedback unit.
The scale factor for a maximum rudder angle range of ±45° is 220 mV/°.
The scale factor for a maximum rudder angle range of ±70° is 141 mV/°.
The scale factor for other rudder angle ranges and for non C.PLATH feedback units will have to be determined accordingly.

15a. Enter the rudder angle scale factor in line 6 of the SETUP TABLE in section 3.6.

15b. Turn the control disk cw or ccw to bring the scale factor to the required value.

15c. Press **ENTER** to store the scale factor.
The display will change to

0
O C A

The number will flash to request the input of a time delay for the external **O**ff **C**ourse **A**larm. The time delay range is 0 through 300 in increments of 10 seconds. If the **O**ff **C**ourse **A**larm is switched off within the time delay period, the external alarm will not be actuated.

16. Enter the external off course alarm time delay in line 6A of the SETUP TABLE in section 3.6

17. Turn the control disk cw or ccw to bring the external off course alarm time delay to the required value.

18. Press **ENTER** to store the off course alarm time delay.
The display will change to **I.oM**

I . o M will flash to request the input of the format for the magnetic compass display, i.e. with or without tenths of a degree: I . oM or I M.

19. Enter the format of the magnetic compass display in line 7 in the SETUP TABLE in section 3.6.

CONTINUED ON PAGE 3-07

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20. Turn the control disk cw or ccw to bring the magnetic compass display to the required format .

21. Press **ENTER** to store the required format for the magnetic compass display.
The display will change to ACT HDG ***OFF M***

OFF will flash to request the selection of the input signal format from the magnetic compass. The formats available are

OFF for no magnetic compass input signal.

SIn sine or cosine input.
cos

0183 for input through the NMEA 0183 interface.

tESt input format 6 steps per degree of azimuth

22. Enter the magnetic compass input signal format in line 8 in the SETUP TABLE in section 3.6.

23. Turn the control disk cw or ccw to bring the display to the required magnetic compass input signal format.

24. Press **ENTER** to store the magnetic compass input signal format.
The display will change to ACT HDG ***6YrO***
P96

The number will flash to request the selection of the input signal format from the gyrocompass. The formats available are

OFF for no gyrocompass input signal.

6 for input format 6 steps per degree of azimuth (step motor).

12 for input format 12 steps per degree of azimuth (synchro 1: 360).

P 9 6	serial input format through RS422 in C.PLATH format 9600 baud.
L 9 6	serial input format through RS422 in Lehmkuhl (Scandinavian Micro Systems) 9600 baud.
L 1 2	for Lehmkuhl input format 12 steps per degree of azimuth.
1 8 3 NMEA	for input through the NMEA 0183 heading interface.
n t NMEA	for input from the compass monitor NAVITWIN II .

NOTE: If, after selection of the RS422 input signal format, the alarm INTERFACE FAILURE HDG is given and the ACT HDG value flashes after the setup procedure has been completed, it may be necessary to synchronize the serial heading interface output of the gyrocompass: refer to the gyrocompass manual.

25. Enter the gyrocompass input format in line 9 of the SETUP TABLE in section 3.6.

26. Turn the control disk cw ccw to bring the display to the required gyrocompass input signal.

27. Press **ENTER** to store the gyrocompass input signal format.
The display will change to

An
RUDDER ANGLE
I
30 20 10 0 10 20 30

An = for analogue steering engines. Indicates the set rudder angle on an analogue display (when a rudder angle signal is not available from the feedback unit).

or

bb
RUDDER ANGLE
I
30 20 10 0 10 20 30

bb = for bang bang steering engines. Indicates the current rudder angle on an analogue display from the rudder stock.

NOTE: If a voyage data recorder is used with an analogue steering system to record the actual rudder angle direct from a feedback unit, select ***bb*** (for bang bang) otherwise the rudder angle will not be recorded.

The dispaly will flash to request the slection of the format of the rudder angle display.

28. Enter the required rudder angle display format in line 10 of the SETUP TABLE in section 3.6.

29. Press **ENTER** to store the rudder angle display format. The display will change to

    CAL M correction of magnetic compass heading **OFF**.
    OFF

    or

    CAL M correction of magnetic compass heading **ON**.
    on

    The display will flash to request whether or not the magnetic compass heading is to be corrected.

    NOTE: If the autoūpilot is used in combination with the compass monitor NAVITWIN II, select OFF and use the correction table in NAVITWIN II.

30. Enter the magnetic compass display format - corrected or not corrected - in line 12 of the SETUP TABLE in section 3.6.

31. Turn the control disk cw or ccw to bring the display to the required magnetic compass display format.

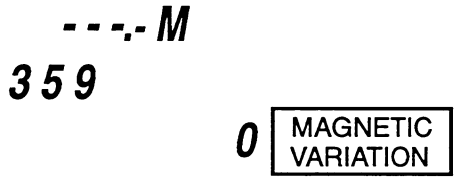
32. Press **ENTER** to store the magnetic compass display format.

    NOTE: If the corrected (ON) magnetic compass display format is stored, the display will change to

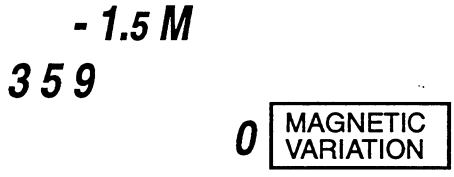
    0.0 M
    000
    0 MAGNETIC VARIATION

    This is a request for the input of a correction table for the magnetic compass display. A correction table is necessary because the function of a fluxgate pickoff, mounted below the compass, is not exactly linear, which leads to minor deviations between the actual magnetic compass heading and the magnetic compass heading displayed on the autopilot.
    Compare at regular intervals (e.g. every 10 degrees) the actual magnetic compass heading with the magnetic compass display on the autopilot. Make a note of any deviations and at which headings and store these in the correction table as follows:

a) Press **DIM** or **DIM** to bring the magnetic compass heading display
- **+**
to the heading to which a correction value is to be applied e.g. 359°

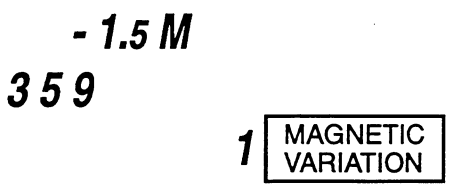


b) Turn the control disk cw or ccw (cw for plus values, ccw for minus values) to bring the correction value display to the required correction value, e.g. minus 1.5 degrees:



NOTE: The correction value range is from -20° to +20°.

c) Press **RUD. LIMIT OFF** to store the correction value.



NOTE: A reference number will be alloted to each correction value and the associated heading. The reference number (in this case 1) is displayed in the lower inj the lower right-hand corner of the display next to the legend **MAGNETIC VARIATION**.

Correction values may be deleted by pressing **RESET 10°**

d) Press **DIM** or **DIM** to proceed to the next magnetic compass heading
- **+**
to which a correction is to be applied.

e) Turn the control disk cw or ccw to bring the correction value display to the next correction value applicable to the above heading.

f) Press **RUD.** to store the correction value.
LIMIT
OFF

g) Continue as described above until all required magnetic compass headings and their correction values have been stored in the correction table.

NOTE: The headings and their associated correction values can be scrolled by pressing and holding down **DIM** or **DIM**
- **+**

h) Enter the magnetic compass headings and their associated correction values in the *Correction Table for the Heading from the Magnetic Compass* in 3.11.

i) Press **ENTER** to exit the correction table function.

NOTE: Exit the correction table at any time by pressing **ENTER**

The display will change to

PLOt
on

or

PLOt
OFF

The display will flash to ask if an output to a plotter/printer is required. The autopilot may be supplied with a voyage data recorder which provides the operator with a graphic record of heading and rudder angle, and other operational data. Select **ON** if a voyage data recorder is to be supported by the autopilot.
See section 4 of this manual for further information on the voyage data recorder.

33. Turn the control disk cw or ccw to bring the display to **ON** or **OFF** as required.

34. Press **ENTER** to store the selection. If **ON** is selected, the display will change to

SPd
60

The number (in this case 60) will flash to request an input of the required paper feed speed. The paper feed speed range is 60mm/h, 150 mm/h and 600 mm/h.

35. Enter the paper feed speed in line 13 of the SETUP TABLE in section 3.6.

36. Turn the control disk cw or ccw to select the required paper feed speed.

37. Press **ENTER** to store the paper feed speed. The display will change to

HdG
30

The number (here 30) will flash to request an input of the range in which the heading of the vessel is to be plotted. The ranges available are ±30° and ±180° over the same width of paper.

38. Enter the heading range in line 14 of the SETUP TABLE in section 3.6.

39. Turn the control disk cw or ccw to select the required heading range.

40. Press **ENTER** to store the heading range. The display will change to

rud
9

The number will flash to request an input of the rudder angle recording range. The rudder angle recording ranges availble are ±9°, ±45° and ±70°.

41. Enter the required rudder angle recording range in line 15 of the SETUP TABLE in section 3.6.

42. Press **ENTER** to store the rudder angle recording range. The display will change to

YEAr

94

The number will flash to request an input of the required year.

43. Turn the control disk cw or ccw to bring the display to the required year.

44. Press **ENTER** to store the year. The display will change to

non

6

The number will flash to request an input of the required month.

45. Turn the control disk cw or ccw to select the required month.

46. Press **ENTER** to store the required month. The display will change to

dAY

1

The number will flash to request the input of the day's date.

47. Turn the control disk cw or ccw to select the required date.

48. Press **ENTER** to store the date. The display will change to

Hr

12

The number will flas to request an input of the required time (GMT or local) in hours.

49. Turn the control disk cw or ccw to select the required time in hours.

50. Press **ENTER** to store the time in hours. The display will change to

nin

24

The number will flash to request an input of the time in minutes.

51. Turn the conrol disk cw or ccw to select the required time in minutes.

NOTE: After a blackout or power failure of the autopilot, the time and date will have to be reset.

52. Press **ENTER** to store the time in minutes. The display will change to

LCdL
000

The number will flash to request an input of the minimum illumination intensity of the liquid crystal display. The range of the minimum illumination intensity is from 000 to 049.

53. Turn the control disk cw or ccw to select the minmum illumination intensity.

54. Enter the minimum illumination intensity value in line 16 of the SETUP TABLE in section 3.6.

55. Press **ENTER** to store the minimum illumination intensity value. The display will change to

LCdH
000

The number will flash to request an input of the maximum illumination intensity of the liquid crystal display. The range of the maximum illumination intensity is from 051 to 099.

56. Turn the control disk cw or ccw to select the maximum illumination intensity.

57. Enter the maximum illumination intensity value in line 17 of the SETUP TABLE in section 3.6.

58. Press **ENTER** to store the maximum illumination intensity value.

The Setup Procedure is now complete and the display will return to the normal operational mode. Beforehand, however, the display will show for a short time before returning to the normal operational display the current software revision. Shown below is an example of a software revision display:

A-2.3

rno

3.6 The SETUP TABLE

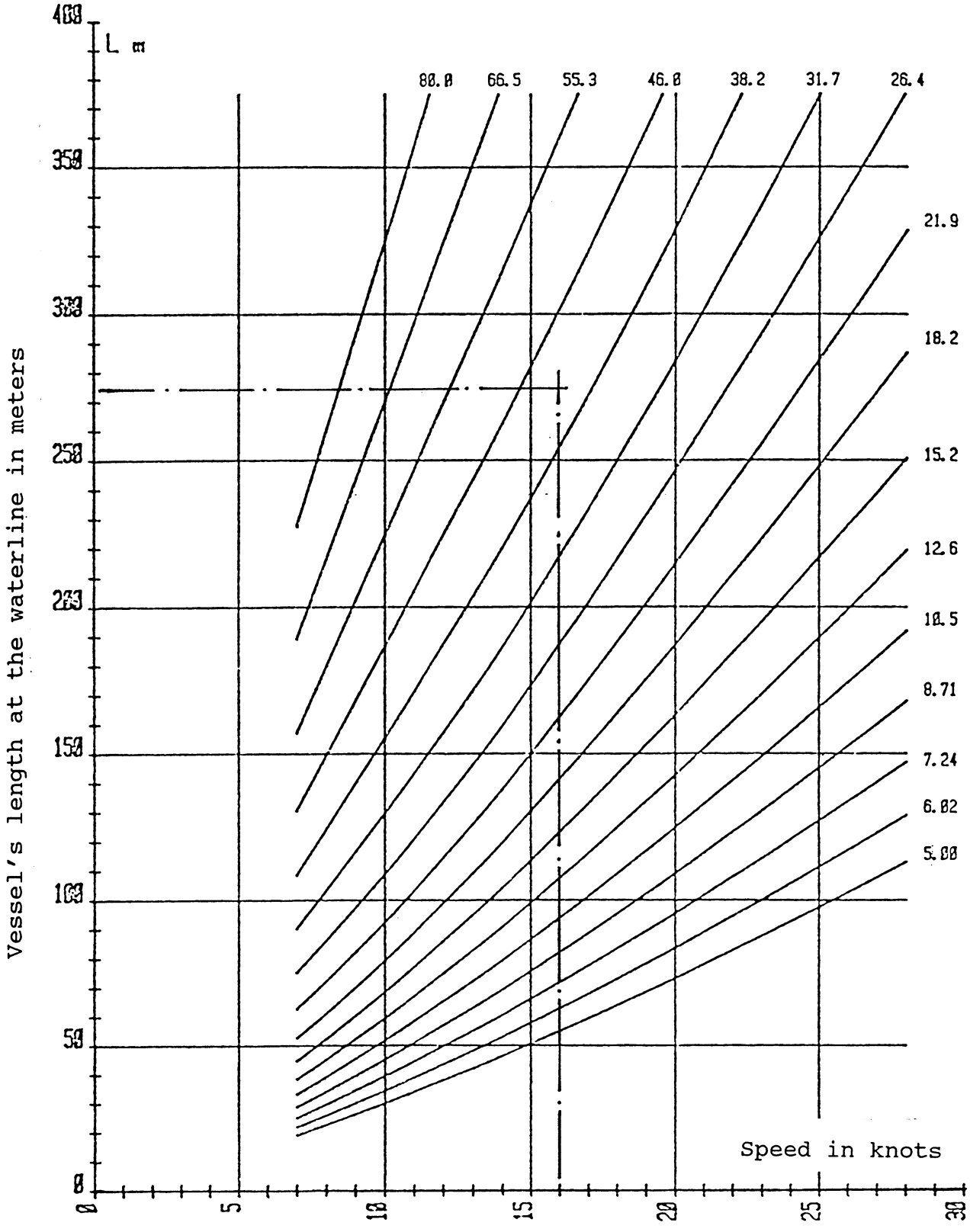
The information stored during the Setup Procedure is to be entered in this table to provide a future reference for any subsequent changes in the Setup Procedure. Enter values, designations or, accordingly, underline the selection.

Line No.	
1	Time constant factor ***t A U :*** sec.
2	Coarse setting for counter rudder ***GAIn :*** %
3	NMEA sentence format :
4	NMEA sensitivity vale ***S E n s*** :
5	Maximum rudder angle ***r u d*** :
6	Rudder angle scale factor: 220 mV/° = ±45° 141 mV/° = ±70° other
6A	External off course alarm delay ***O C A*** : sec.
7	Format of the magnetic compass display: with tenths of a degree ***1.o M*** without tenths of a degree ***1. M***
8	Input signal format from the magnetic compass:
9	Input signal format from the gyrocompass:
10	Set rudder angle: ***A n*** Current rudder angle: ***bb***
11	*Not applicable.*
12	Magnetic compass display format: **corrected** **not corrected**
13	Paper feed speed: **60** mm/H **150** mm/h **600** mm/h
14	Heading recording range: **±30°** **±180°**
15	Rudder angle recording range: **±9°** **±45°** **±70°**
16	Minimum illumination intensity ***L C d L :***
17	Maximum illumination intensity ***L C d H :***

3.7 The Tau Nomogram

NOTE: The tau nomogram may only be used for determining the time constant (tau) for displacement vessels. For other types of ships, the time constant is to be determined empirically.

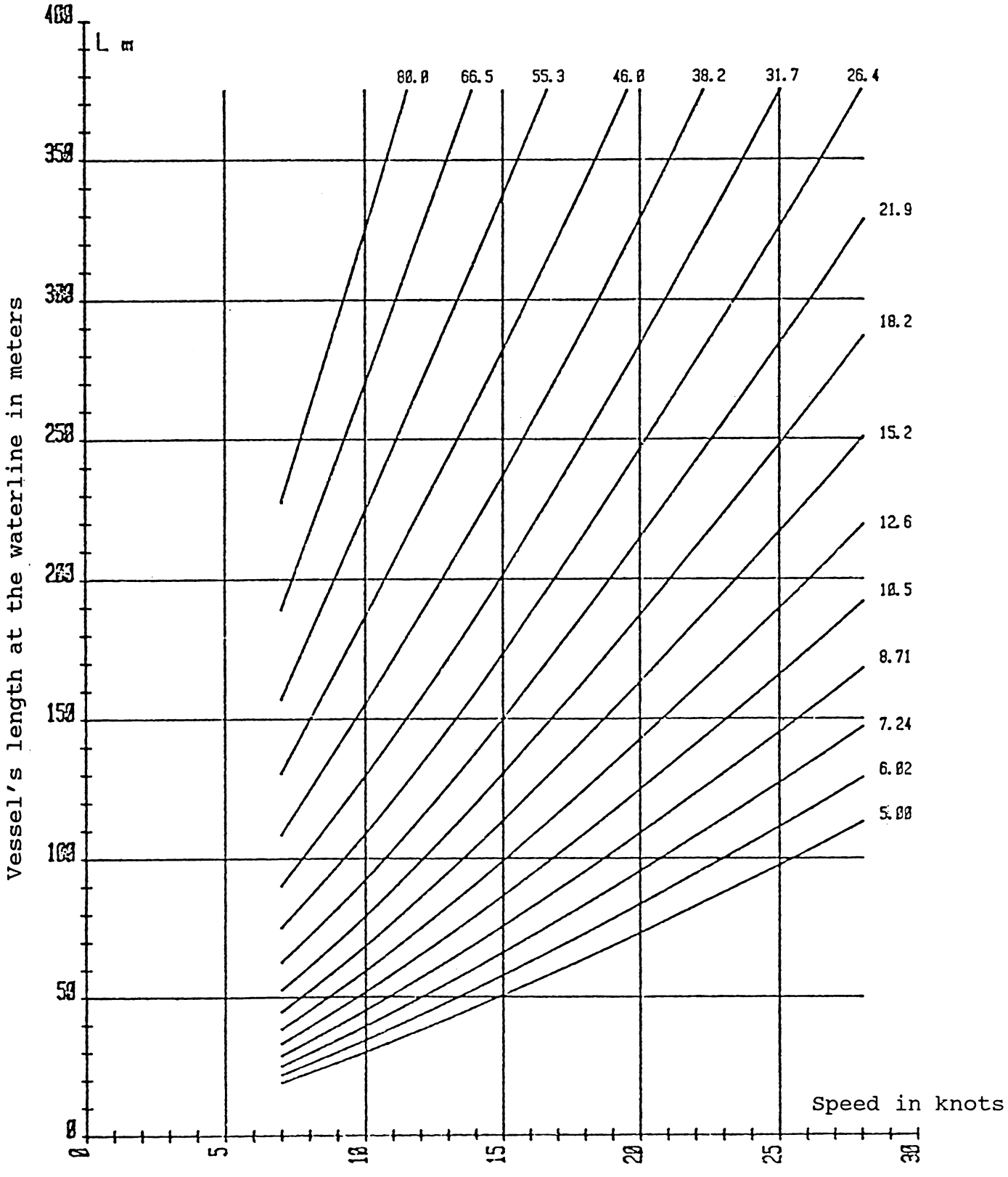
During the Setup Procedure (see page 3-02) a request is made for the input of the time constant (tau) of the vessel concerned.
The time constant (tau) is determined by entering in the Tau Nomogram on page 3-18 the length of the vessel in meters at the waterline and the average cruising speed. The intersection of these two values results in the time constant (tau) which is to be entered in the Setup Procedure. An example of how to determine the time constant (tau) for the vessel concerned is shown on the following page.
NOTE: Enter the time constant (tau) in the SETUP TABLE in line 1 in section 3.6 for future reference.



Vessel's length at the waterline in meters: 275 m
Vessel's average cruising speed in knots : 16 kts

The time constant (tau) is 42.1
Round off all values to the nearest whole number, in the above example 42.

Working Example of the Tau Nomogram



The Tau Nomogram

3.8 Autopilot Error Codes

When an alarm is given (e.g. INTERFACE HDG) press **ALARM 1/10°** to switch off the audible alarm.
To view the associated error code number, simultaneously press and hold down **DIM +** and **DIM -** the error code number will appear in the *SET HDG* display.

The error code number will be displayed as long as **DIM +** and **DIM -** remain pressed.

NOTE: During this time make a note of the error code number, as it will not be possible to view the error code number for a second time without deenergizing and re-energizing the autopilot.

As soon as **DIM +** and **DIM -** are released, the error code number will disappear.
If **DIM +** and **DIM -** are pressed again, either the next error code number (when more than one than one fault is present) will be shown in the *SET HDG* display or three times the eight - *888* - to indicate the end of the list of error code numbers. Further attempts to view again the error code numbers by pressing **DIM +** and **DIM -** will result in *888* being shown in the *SET HDG* display and it will be necessary to deenergize and re-energize the autopilot in order to see again the error code numbers.

The error code numbers are listed on the following page.

NOTE: If error code 78 is displayed, deenergize the autopilot to cancel the alarm. After a time elapse of 15 seconds, re-energize the autopilot.

TIMEOUT VALUES

Count	Waiting Time in Seconds	Interface
30	15	Start of NMEA reception
20	10	NMEA NAV mode messages
16	8	PLATH ACT HDG RS 422 gyrocompass
10	5	NMEA ACT HDG messages
10	5	Remote unit timeout

Error Code	Error	Cause/Correction
	FATAL ERRORS	
128	divided by 0	program error / switch off , switch on
129	stack overflow	
130	EEPROM write error in Setup data	write cycles exceed limit, replace EEPROM
131	Stack underflow	
132	5 volt < 4.75 or > 5.25 volt	check power supply
133	12 volt < 11.0 or > 13.0 volt	check power supply
134	spare	
135	spare	
136	spare	
137	message buffer overflow	program error
138	process nonexistent	
139	spare	
140	EEPROM parameter write error	last alternative block written, replace EEPROM
141	network receivers timeout	failure in network to repeaters
142	display overflow	program error (number too large for display)
	NON-FATAL ERRORS	
065	spare	
066	GYRO INTERFACE FAILURE (HHH or LLL)	
067	spare	
068	keyboard repeat error	key is jammed
069	program error	process status switching error
070	EEPROM process overrun	timing error
071	spare	
072	spare	
073	voltage error in sin/cos from magnetic compass	sin/cos voltage at A/D converter illegal
074	spare	
075	spare	
076	timeout NMEA interface	no valid (error-free) NMEA sentence received
077	timeout RS 422 compass interface	no valid (error-free) compass sequence received
078	timeout LOCAL NET	repeaters
079	heading difference between gyro and magnetic compass exceeds off course alarm	
080	timeout NMEA magnetic (RS 422)	
081	spare	
082	Lehmkuhl LR 40 alarm state	
083	Lehmkuhl LR 40 phys i/o	
084	Lehmkuhl LR 40 Timeout	
085	timeout NMEA gyrocompass RS 422	
086	spare	
	WARNINGS	
001	unable to write in EEPROM	
002	unable to read from EEPROM	
003	operating error incorrect function	short flash of text *FAILURE*
004	RS 422 NMEA checksum error	short flash of *NMEA INTERFACE FAILURE*
005	RS 422 Compass checksum error	short flash of *HDG INTERFACE FAILURE*
006	device error RS 422 compass received	short flash of *HDG INTERFACE FAILURE*
007	180° turn still active	short flash of *FAILURE*, turn still > 180°, wait
008	incorrect operation mode for 180° turn	short flash of FAILURE, change mode e.g. MAN to AUTO
009	gyro out signal overflow	change in course too fast (rate of turn)
010	spare	
011	RS 422 NMEA magnetic compass checksum/format error	
012	5 volt failed	
013	12 volt failed	
014	compass change in AUTO/NAV mode	

3.9 Power-Up Test

During Power-Up of the autopilot, several tests are carried out automatically. The test numbers are shown in the SET HDG window and the associated error codes in the ACT HDG window.
If an error is detected during the power-up test, the test number and the associated error code are displayed permanently. The test program will continue, regardless of an error, when **ENTER** is pressed.

During the power-up test, the following functions are checked.

1. ROM checksum test.
   ROM test failed: audible alarm sounds continuously.

2. RAM read and write test.
   RAM test failed: audible alarm on/off/on/off .....

3. For visual test purposes, all display segments of the liquid crystal display are shown for approximately 3 seconds.

4. Display of the software release number in the ACT HDG window and of the sub-release code in the MAGNETIC VARIATION window.

5. Test No. 1 Volt Test:
   0 : supply voltage o.k.
   5 : 5 volt outside specified range.
   12 : ±12 volt outside specified range.

6. Test No. 2 Keyboard Test:
   0 : no key pressed.

   Key code for pressed or jammed key(s):
   1 key AUTO
   2 key NAV
   4 key RUDDER LIMIT OFF
   8 key ENTER
   16 key ALARM 1/10°
   32 key DIM -
   64 key DIM +

   If more than one key is jammed, the error codes are added, for example:
   Code 66 = 64 + 2, i.e. jammed keys are DIM - and NAV.

7. Test No. 3 Serial Communication
   0: UART o.k.
   1: input /output error local net.

   Additional display of the remaining storage capacity of the EEPROM in the window MAGNETIC VARIATION:
   0: no use of alternative memory.
   1 - n: after write errors, use of alternative memory for the nth time.

8. Test No. 4 Input/Output Port Configuration (only at the controller):
   0: port values read are plausible.
   1: function AUTO selected at power-up.
   2: no legal function read.

NOTE: The software revision number is also displayed when the SETUP procedure is exited (reset).

To read the software revision number, press and hold down in sequence the keys **ENTER** **ALARM 1/10°** **DIM -** to enter the SETUP procedure.

Press **AUTO PRESET** to exit the SETUP procedure, the software revision number will be displayed for approximately 2 seconds, the first two figures in the ACT HDH window and the third figure in the MAGNETIC VARIATION window.

3.10 Correction Table for the Heading from the Magnetic Compass

Magnetic Compass Heading	Heading on Pilot before Correction	Correction Value
10°		
20°		
30°		
40°		
50°		
60°		
70°		
80°		
90°		
100°		
110°		
120°		
130°		
140°		
150°		
160°		
170°		
180°		
190°		
200°		

Magnetic Compass Heading	Heading on Pilot before Correction	Correction Value
210°		
220°		
230°		
240°		
250°		
260°		
270°		
280°		
290°		
300°		
310°		
320°		
330°		
340°		
350°		
360°		

4. VOYAGE DATA RECORDER

4.1 General

The autopilot may be supplied with a voyage data recorder, which provides the operator with a graphic record of the vessel's course and rudder angle, and also prints at the beginning of each page, also when a parameter (e.g. off course alarm) is altered, in one horizontal status line the following operational data (from left to right):

DATE

LAT: 53 35.05N LON: 08 10.54E (only when the compass monitor NAVITWIN II is included in the system)

ST.M:N	steering mode, ***M*** = MAN, ***A*** = AUTO, ***N*** = NAV
HDG:G	heading source, ***G*** = gyro, ***M***= magnetic
SET-HDG:000.0	set heading at the time of recording
RL:35	rudder limit: 35°
YAW:1	yaw parameter: 1
RUD:1.5	rudder parameter: 1.5
CRUD:7	counter rudder parameter: 7
OCA:35	angle for external off course alarm: 35°
TAU:10	the ship's time constant factor tau
GAIN:110	coarse setting for counter rudder
TIME	over the time column

4.2 Operational Data

Paper feed speeds: 60 mm/h
150 mm/h
600 mm/h

Heading recording range: ±30° or ±180° } over the same width of paper.

Rudder angle recording range: ±9°, ±45° or ±70°

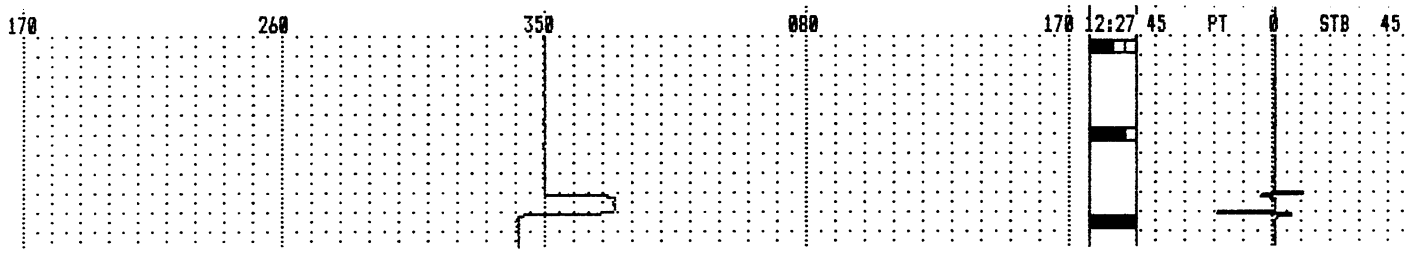
For selection of the above, refer to the autopilot Setup Procedure in section 3 of this manual.

C. PLATH
NAVIGATION · AUTOMATION

4.3 Paper Feed Speeds and Rudder Angle Ranges

4.3.1 60 mm/h Paper Feed Speed, ±45° Rudder Angle Range

A paper feed speed of 60 mm/h and a rudder angle range of ±45° are recommended for normal operational conditions.
Time increments are 15 min. each.

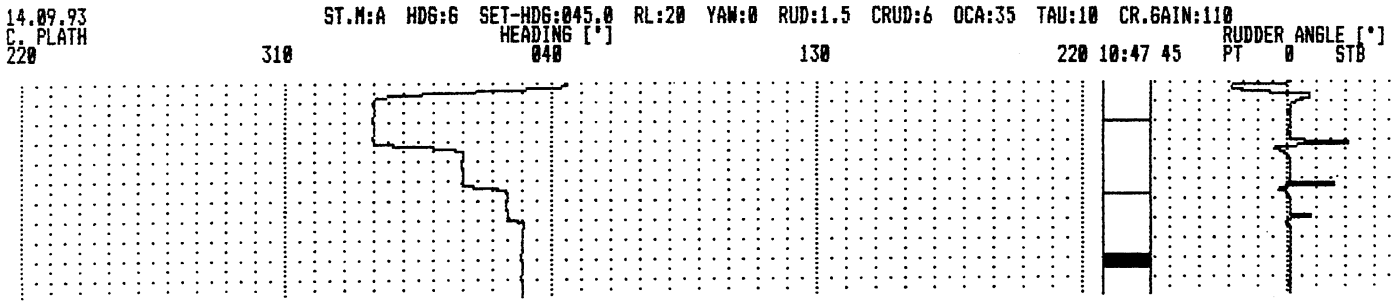


Please Note:

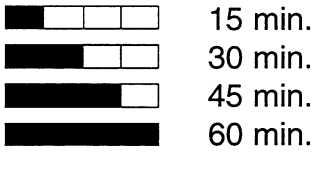
15 min.
30 min.
45 min.
60 min.

4.3.2 150 mm/h Paper Feed Speed, ±45° Rudder Angle Range

Provides increased resolution for the course recording.
The rudder angle range remains the same as in 4.3.1.
Time increments are 5 min.



Please Note:



15 min.
30 min.
45 min.
60 min.

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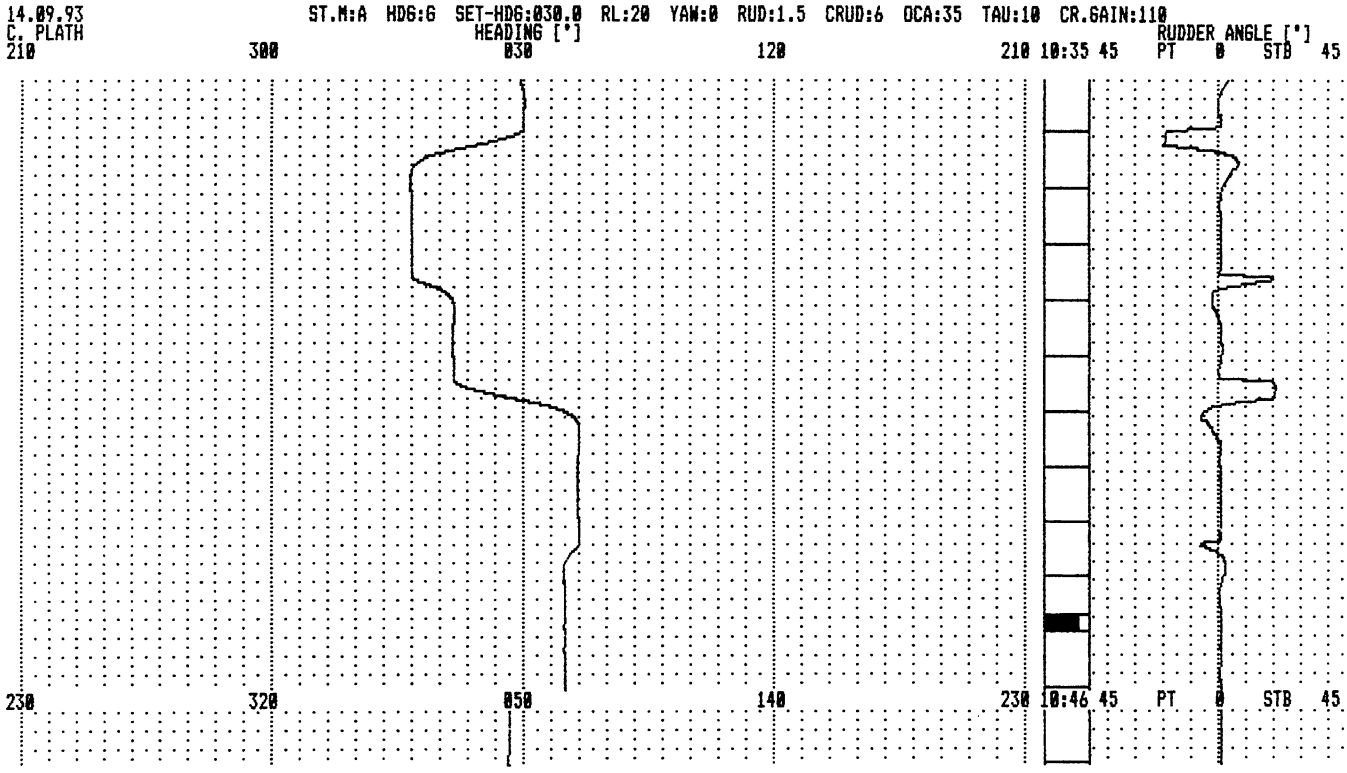
4.3.3 600 mm/h Paper Feed Speed, ±45° Rudder Angle Range

Provides a high resolution course recording.
Time increments are 1 min.



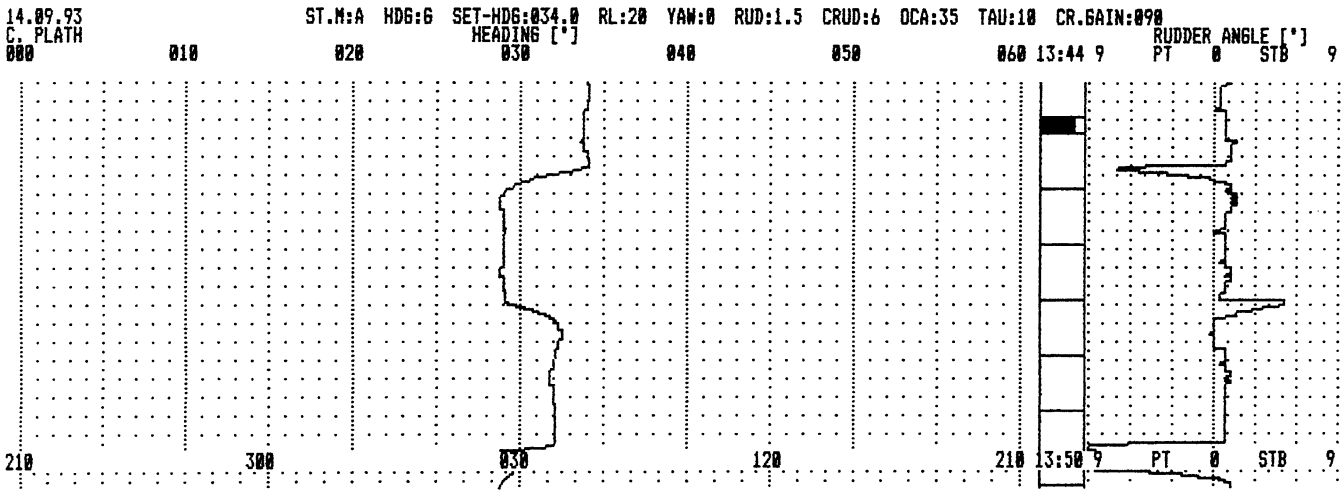
Please Note:

15 min.
30 min.
45 min.
60 min.

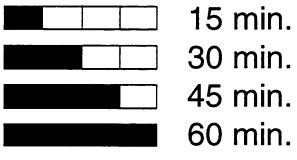
4.3.4 Zoom Function

In order to analyze in detail the vessel's steering characteristics (in both autopilot and manual steering modes) the zoom function provides the operator with the following high resolution recording ranges:

- paper feed speed 600 mm/H
- course recording range ±30°
- rudder angle range ±9°
- time increment 1 min.

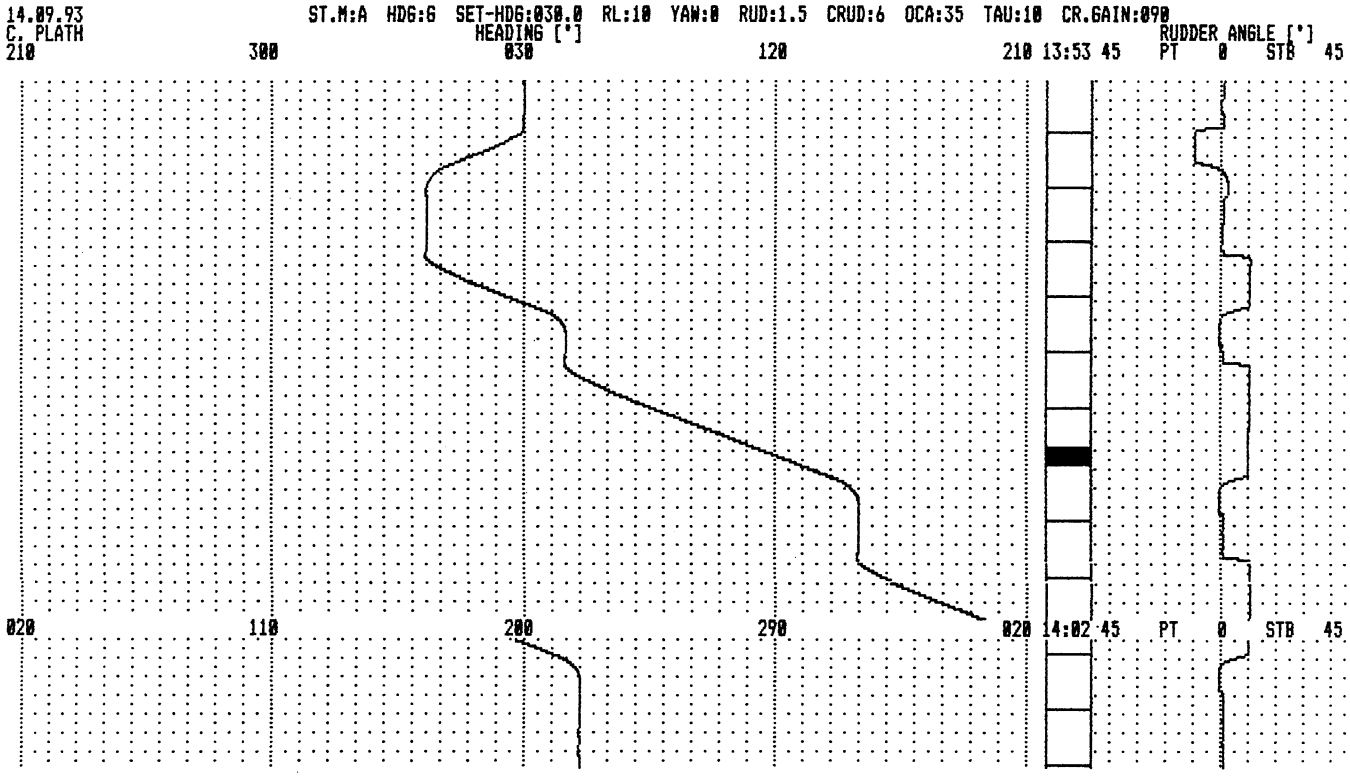


Please Note:



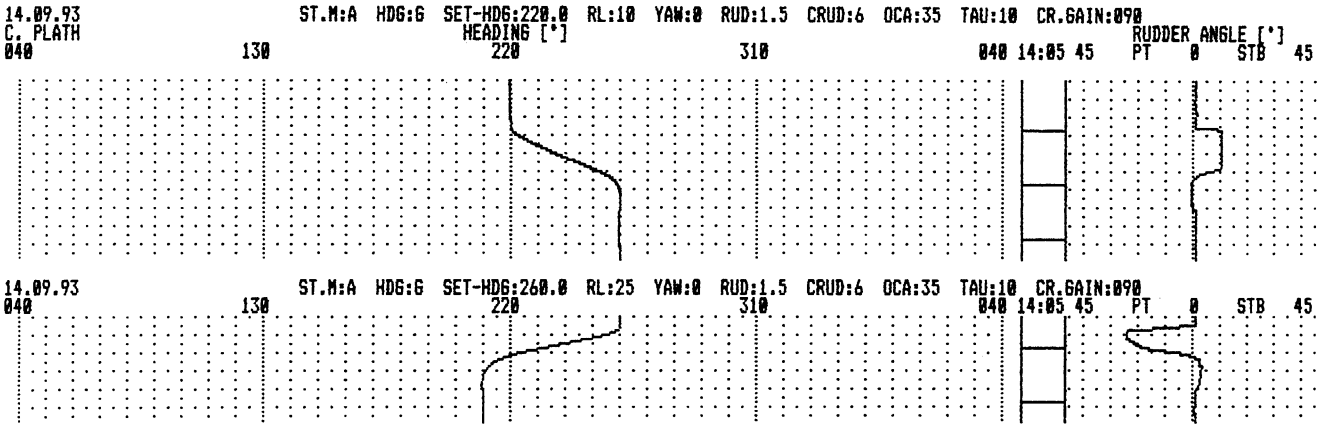
4.3.5 Scale Shift

When the course recording line reaches the margin of the scale, the voyage data recorder automatically shifts the scale to bring the course recording line back into the center of the scale, see example below.



4.3.6 The Status Line

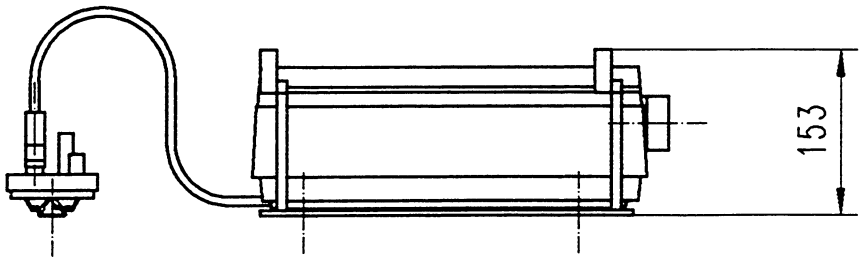
The status line is printed at the beginning of each new page, and additionally when a steering parameter is altered, e.g. RL (rudder limit) from 10° to 25° as shown in the example below.



4.3.7 Time Printout

The time printout by the Voyage Data Recorder is dependent on the electronic clock in the autopilot or the compass monitor NAVITWIN II (when part of the system) according to which is used to supply information to the voyage data recorder.
At regular intervals the time printout is to be compared with the current time and amended when necessary.
The time is amended by correcting the time display in the setup procedure of either the autopilot or the compass monitor NAVITWIN II. Refer to the section covering the setup procedure in the relevant operator's manual.

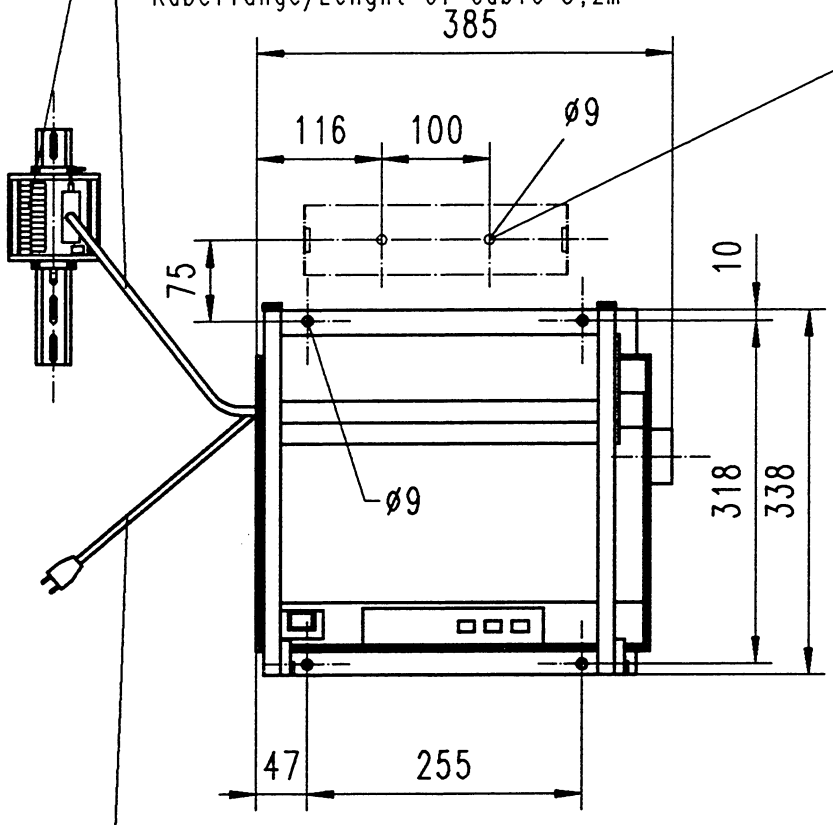
NOTE: After a blackout or power failure of the autopilot and/or compass monitor, the time and date will have to be reset. Refer to the section covering the setup procedure in the relevant operator's manual.



Maße für Klemmleiste
siehe Blatt 2
Dimensions for
Terminal Board see Page 2

C.Plath Lieferung/C.Plath delivery

Kabellänge/Lenght of cable 3,2m



nur erforderlich bei
Wandmontage(Papierhalter)
Only required for
wall mounting(paperholder)

Empfohlener Einbau
siehe Blatt 3
Recommended method of
installation see Page 3

Kabellänge/Lenght of cable 2,3m

Gewicht/Weight 8 kg.

CAD

REV	MOD.NO.	DATE	NAME
AC	99761	09.06.97	Ho.
AB	99734	07.03.97	Ho.
AA	-	29.11.94	Kie

Maßstab/SCALE: /

	DATE	NAME
DRAWN	29.11.1994	Kie
CHD		
DOS	NMHBSNEE	

4805m031.dxf

Zeichnungs Nr./Drawing No.
4805-0112-03

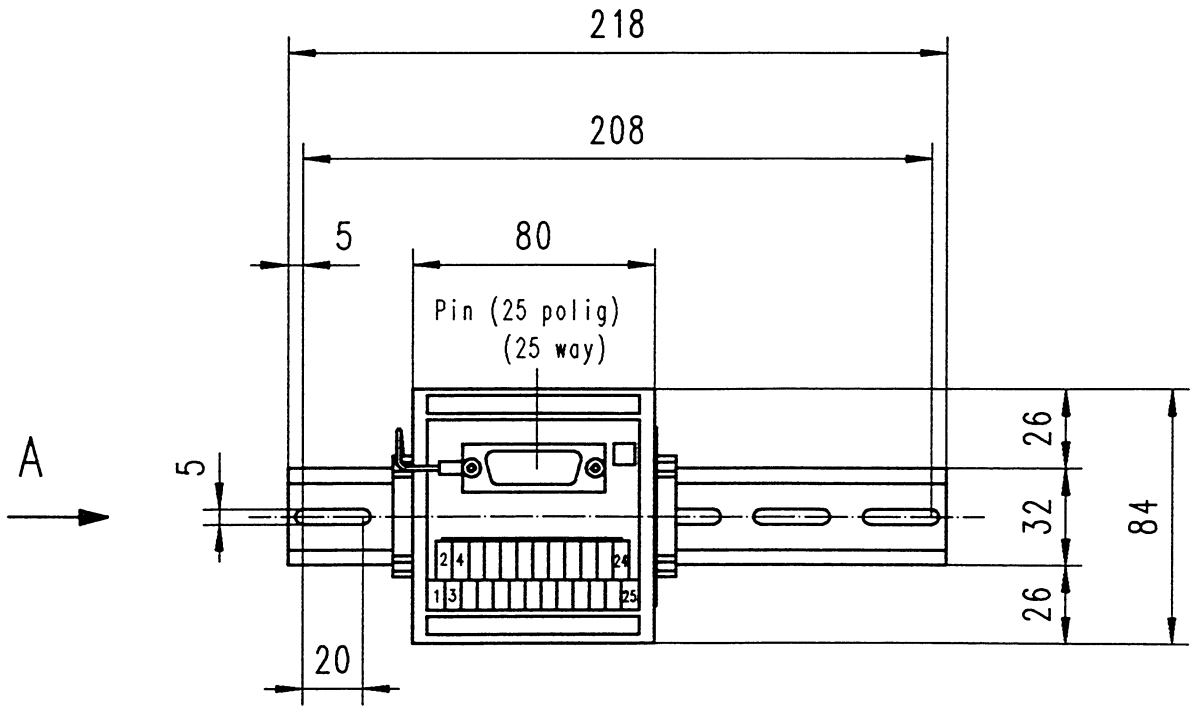
C. PLATH HAMBURG

Lager Nr./STOCK NO. 74489

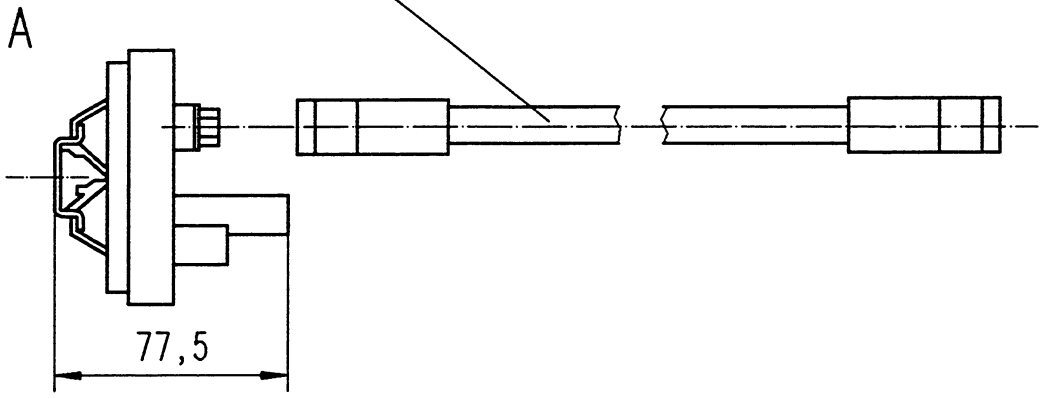
Maßzeichnung / DIMENSION DRAWING
Fahrdatenschreiber
Voyage Data Recorder

REPLACEMENT FOR:

Blatt SHEET 1
Blattz. SHEETS 3



Kabellänge 3,2m (C.Plath Lieferung)
Length of cable 3,2m (C.Plath delivery)



Gewicht/Weight 0,6 kg.

CAD

REV	MOD.NO.	DATE	NAME
AC	99761	09.06.97	Ho.
AB	99761	09.06.97	Ho.
AB	99734	07.03.97	Ho.
AA	-	29.11.94	Kie

		DATE	NAME
DRAWN	29.11.1994	Kie	
CHD			
DOS	NMHBSNEJ		

Maßstab/SCALE: /

4805m032.dxf

Zeichnungs Nr./Drawing No.: 4805-0112-03

C. PLATH HAMBURG

Lager Nr./STOCK NO.

Maßzeichnung / DIMENSION DRAWING

Fahrdatenschreiber
Voyage Data Recorder

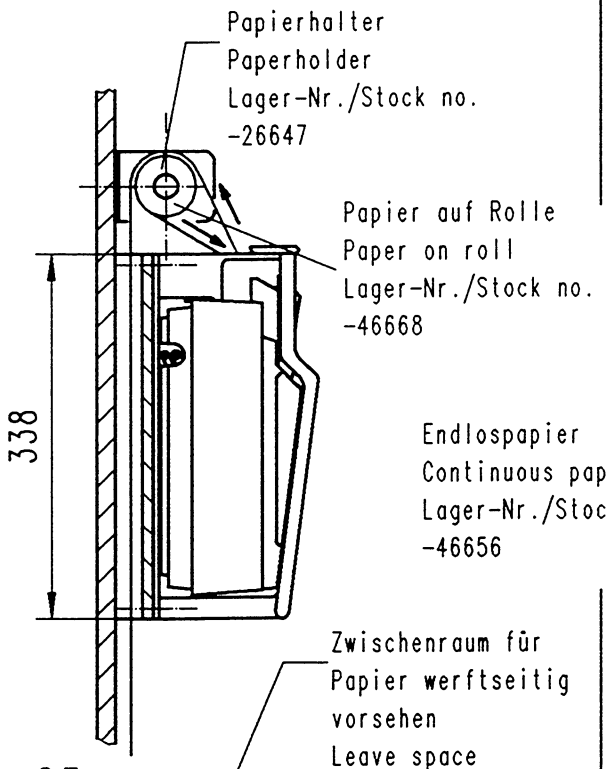
Klemmenleiste
Terminal Board

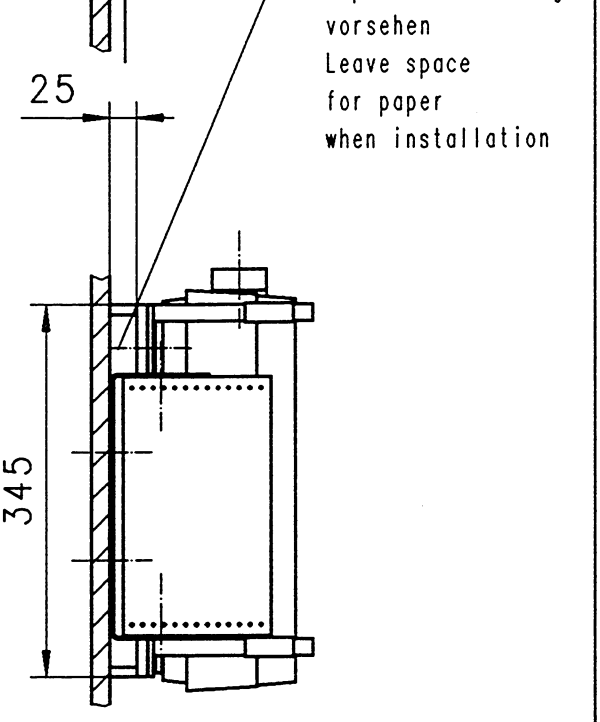
REPLACEMENT FOR:

Blatt SHEET 2

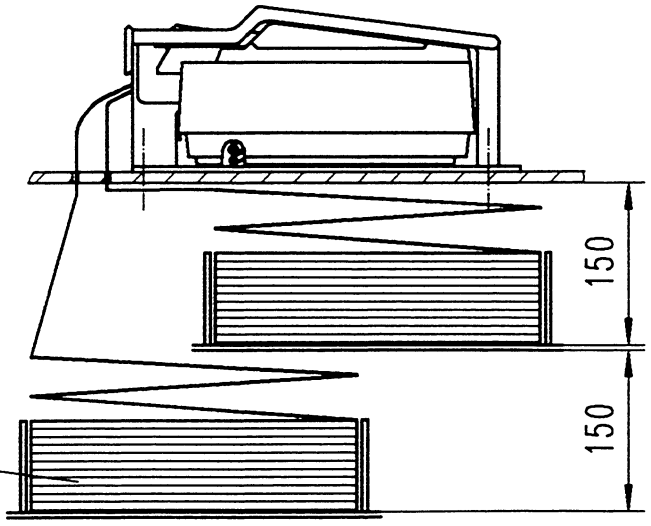
Blattz. SHEETS 3

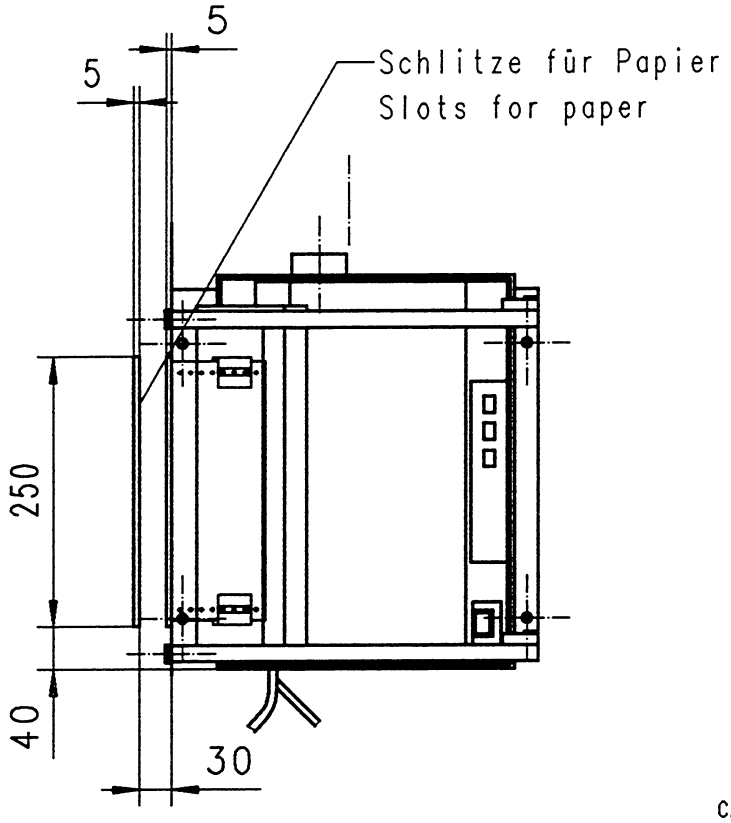
Wand Montage
Wall mounting





Tisch Montage
Desk mounting





CAD

				Maßstab/SCALE		DATE	NAME
				/	DRAWN	29.11.1994	Kie
					CHD		
				4805m033.dxf	DOS	NMHBSNDW	
				Zeichnungs Nr./Drawing No.			
AC	99761	09.06.97	Ho.	4805-0112-03			
AB	99734	07.03.97	Ho.	C. PLATH HAMBURG			
AA	-	29.11.94	Kie	Lager Nr./STOCK NO.			
REV	MOD.NO.	DATE	NAME				

Maßzeichnung / DIMENSION DRAWING

Fahrdatenschreiber
Voyage Data Recorder

Empfohlener Einbau
Recommended method
of installation

REPLACEMENT FOR:

Blatt SHEET 3
Blattz. SHEETS 3

LITTON

C.PLATH

NAVIGATION-AUTOMATION

Number	Rev.	sheet: 01
4658-0120-01	AA	of: 01

Description : INTERFACE SPECIFICATION, VERZEICHNIS

INTERFACE SPECIFICATIONEN FÜR NAVIPILOT V

4658-0120-02 NAVIPILOT V

4658-0120-03 NAVIPILOT V - INS

Serial-Interface-Specification:

1. Navigation-Receivers (NAV):

Format: NMEA 0183
Baudrate: 4800 bps
Data bits: 8
Parity bits: none (disabled)
Stopbits: 1 or 2
Checksum: CS or no CS accepted

1.1 $--HSC,x.x,T,x.x,M*CS<CR><LF>

1.2 $--BOD,x.x,T,x.x,M,c--c,c--c*CS<CR><LF>
$--XTE,A,A,x.x,a,N*CS<CR><LF>

1.3 $--APA,A,A,x.x,a,N,A,A,x.x,a,c--c*CS<CR><LF>
└ M or T

1.4 $--APB,A,A,x.x,a,N,A,A,x.x,a,c--c,x.x,a,x.x,a*CS<CR><LF>

1.5 $--CTS,xxx,T*CS<CR><LF>

1.6 $--PCT,xxx.x,T*CS<CR><LF>

1.7 $--BPI,,,a,,a,x.x,T,x.x,M,,N,c--c*CS<CR><LF>

1.8 $--BWR,,,a,,a,x.x,T,x.x,M,,N,c--c*CS<CR><LF>

1.9 $--BWC,,,a,,a,x.x,T,x.x,M,,N,c--c*CS<CR><LF>

2. Electronic Compass (Heading magn.):

2.1 $--HDM,x.x,M*CS<CR><LF> update rate < 200 ms

3. Remote Units:

Format: RS422 C. Plath specific
Baudrate: 9600 bps
Databits: 8
Parity bits: none (disabled)
Startbits: 1
Stopbits: 2

Protocol Data : Heading Gyro, Heading Magnetic,
Set Heading, Speed, LCD-Data

4. Heading/Ruder Angle-Printer:

Format: RS422 C. Plath specific

Serial - Interface - Specification

NAVIPILOT V <———> INS

Baudrate : 4800 bps
Data bits : 8
Parity bits : none (disabled)
Stopbits : 1

Format : NMEA 0183

NAVIPILOT V ——> INS
Driver : RS 422

Autopilot System Data

Transmission rate : 1 protocol per second

```
$AGASD,x.x,x.x,a,x.x,A,,,x.x,x,x,A*hh<CR><LF>
```

- `x.x` (1st) → Commanded course-to-steer, degrees
- `x.x` (2nd) → Actual vessel heading, degrees
- `a` → M = Magnetic, T = True
- `x.x` (3rd) → Off-course limit, degrees (unsigned)
- `A` (1st) → Off-course status
- `x.x` (4th) → Rudder limit, degrees (unsigned)
- `x` (1st) → Rudder response, 0-9, 0 = small deadband, tight control
- `x` (2nd) → Gain setting, 0-9, 0 = low gain
- `A` (2nd) → Status : all data

Navigation Status Data

Transmission rate : 1 protocol per second

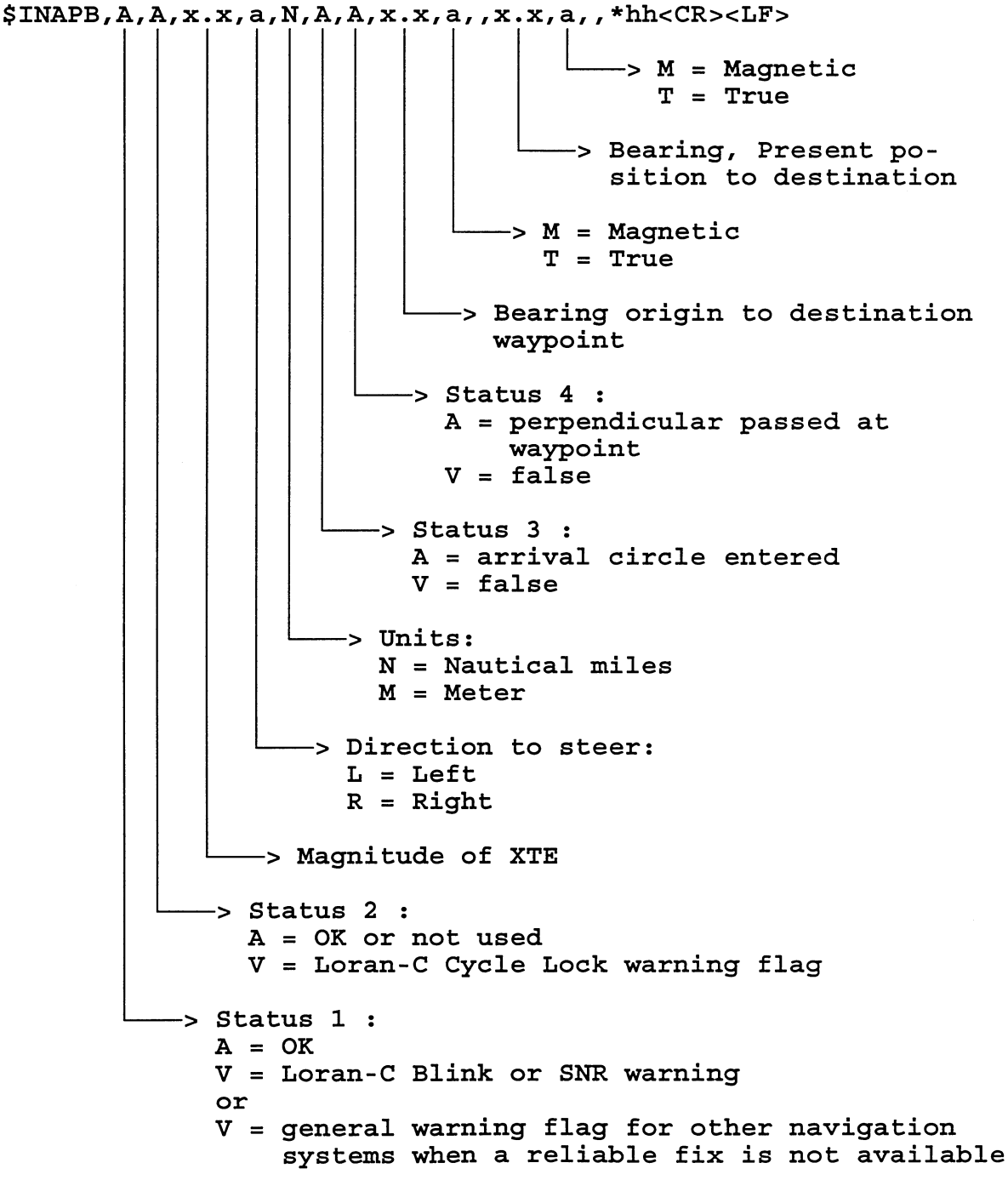
```
$PPNSD,A,A,,,,,,*hh<CR><LF>
        |  |
        |  └──> Steering status:
        |       A = OK
        |       V = NAV - FAILURE
        |
        └─────> Steering mode status:
                A = Steering mode NAV
                V = Steering mode AUTO/MANUAL
```

These protocols are transmitted continuously in the steering modes AUTO and NAV.

INS ——> NAVIPILOT V Driver : RS 422

Autopilot Sentence "B"

Transmission rate : 1 protocol per second



If GPS fails status byte 1 is set to 'V' and XTE is no longer available. In this case the 'bearing origin to destination waypoint' (track course) without XTE is used for 'NAV-SET-COURSE' of NAVIPILOT V.

Time to Wheel-Over Point

Transmission rate : 1 protocol per second

```
$PPTTW,m.ss,A*hh<CR><LF>
          |    |
          |    |
          |    |----> Status:
          |           A = 3-6 Minutes before Wheel-Over Point
          |               three Messages valid
          |           V = in all other cases invalid
          |
          |----> Time:
                 ss = Seconds
                 m  = Minutes
```

Navigation Status Data

Transmission rate : 1 protocol per second

```
$PPNSD,,A,W,,,,,*hh<CR><LF>
          | |
          | |----> NAV switch-over status:
          |         W = Steering to the preselected waypoint
          |         E = End of track
          |
          |----> Steering status:
                 A = OK
                 V = NAV - FAILURE
```

These protocols are transmitted continuously in steering mode NAV.