SIMRAD
A KONGSBERG Company

TP10, TP20 & TP30 Tillerpilot
Service Manual

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TP10, TP20 & TP30 Tillerpilot
Introduction

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1   INTRODUCTION TO THE TP10, TP20 & TP30 TILLERPILOTS

The TP10, TP20 and TP30 Tillerpilots combine highly sophisticated electronics with advanced software and powerful mechanical drives to provide accurate and reliable steering performance under a variety of different conditions with minimal current consumption.

TP10 - is suitable for tiller steered sailing yachts up to 10M (34 Ft) in length.

TP20 - offers the same facilities as the TP10 and is fully NMEA compatible. Options offered include connection to an external compass via the proprietary high speed CANBUS interface and also to a wind sensor or navigational receiver via the inbuilt NMEA0183 input. Additional remote control facilities are also available using the HR20 hand remote or the HC30 hand controller.

TP30 - offers the same facilities as the TP20 with an improved re-circulating ball screw drive and is suitable for tiller steered sailing yachts up to 12.8M (42 Ft) in length.

The main components of the Tillerpilot are described below:

1.1 Electronics PCBs

a.   TP10 PCB (TP10 only)   E03181
b.   TP30 PCB (TP 20 & TP30)   E03178

1.2 Mechanical Components

a.   General Assy : TP10   E03504
b.   General Assy : TP20   E03505
c.   General Assy : TP30   E03506

TP10, TP20 & TP30 Tillerpilot
Calibration

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2   CALIBRATING THE TP10, TP20 AND TP30

Excerpts from the TP10 operation manual (also applies to the TP20 & TP30 models)

3.2 Calibration Mode

To adjust the Gain and Seastate settings of the Tillerpilot (refer to sections 2.5 & 2.6), it is necessary to enter Calibration Mode, which can be done whilst the Tillerpilot is in either Standby or Autopilot Mode.

Press and hold the **TACK** key, followed by the **CAL** key (Fig 3.3). The Starboard green LED will illuminate to indicate that the pilot is in Gain Mode. To toggle between Gain and Seastate Mode, press the **TACK** key (Fig 3.4). The Port red LED will illuminate to indicate Seastate Mode.

3.3 Adjusting Gain

When Gain Mode is selected (indicated by the Starboard green LED illuminated), the Cal LED will flash and a repeated sequence of beeps will be heard. The number of flashes and beeps in the sequence indicates the level of the Gain setting.

To increase the Gain press the **Starboard** key the required number of times, to a maximum level of 9 (Fig 3.5). To decrease the Gain press the **Port** key the required number of times, to a minimum level of 1.

For example, if the Gain was set at 4 (indicated by a sequence of four flashes of the Cal LED and four beeps), and the Gain needed to be increased to 7, pressing the **Starboard** key three times would adjust the Gain accordingly. The Cal LED would then flash seven times and seven beeps would be heard.

3.4 Adjusting Seastate

When adjusting Seastate (indicated by the Port red LED illuminated), the Seastate level is indicated by the number of audible beeps and flashes of the Cal LED. No beeps or flashes of the Cal LED indicates that the Tillerpilot is set to automatic seastate (see section 2.6).

To switch from Manual to Auto Seastate and increase the Seastate level, press the **Starboard** key the required number of times to a maximum level of 9. To decrease the Seastate press the **Port** key the required number of times, to a minimum level of **0** - which will switch the Tillerpilot back to Auto Seastate.

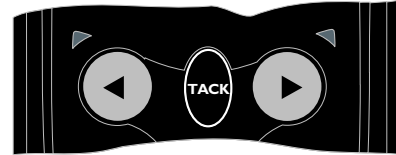**To confirm Gain/Seastate settings and return to Standby Mode, press the CAL key.**
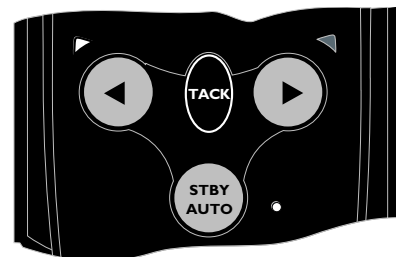

Fig 3.3 - Entering Adjust Mode

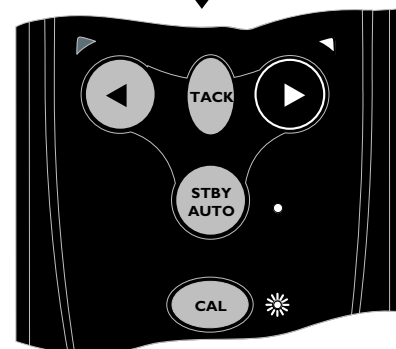

Fig 3.4 - Toggling between Adjust Gain and Seastate

Fig 3.5 - Increasing Gain level

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Excerpts from the TP10 operation manual ctd - (also applies to the TP20 & TP30)

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5.2 Auto Compass Calibration

Although the Tillerpilot internal compass is extremely accurate, for long distance sailing it may be necessary to calibrate the compass, to compensate for any deviations caused by objects surrounding it on board the vessel.

With the vessel motoring along slowly (2-3 knots) in calm conditions and the Tillerpilot in Standby Mode, press the **Starboard** key a number of times to induce a slow clockwise rotation of the vessel. Press and hold the **TACK** key, followed by the **Port** and **Starboard** keys simultaneously to enter Auto Compass Calibration Mode (Fig 5.1). The Port and Starboard LEDs will both light. Allow the vessel to turn through a minimum of $1^1/_4$ turns (450º) in approximately two minutes, during which time the fluxgate compass will automatically calibrate itself.

Fig 5.1 - Auto Compass Calibration

If the rate of turn or the boat speed is too high, the Port LED will flash (Fig 5.2) indicating that it is necessary to either slow the boat or decrease the angle of turn. If the rate or turn or boat speed is too slow the Starboard LED will flash, indicating that it is necessary to either increase

Fig 5.2 - Rate of turn too fast

the boat speed or increase the angle of turn. A short beep will indicate that the calibration has been successful, and the Tillerpilot will return to Standby Mode. If the calibration has been unsuccessful after a period of four minutes, a long beep will sound. Try again carefully following the above directions.
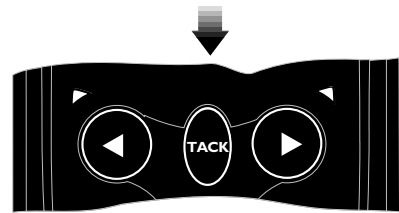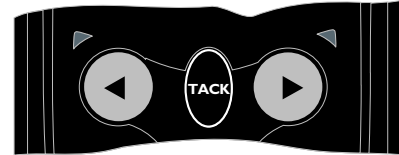
Page 15

TP10, TP20 & TP30 Tillerpilot
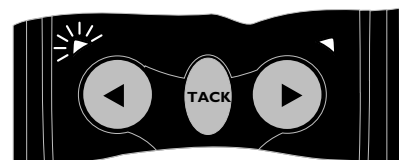# Assembly Instructions

3   ASSEMBLY INSTRUCTIONS

3.1 General Assembly : TP10

Motor and Drive Assembly.   Refer to drawing **E03504** The Bottom Case Assembly is supplied fitted with appropriate cables. Refer to detail in the drawing and insert the Push Rod Seal E00747, which has a taper inner bore, into the case with the larger bore of the seal facing outwards. Fit "O" Ring 190026, spacer E02870 and End Cap E02495 and push home. Fit Retainer E03084 and secure with 2 screws 200002 to hold the end cap, ensuring it is pushed fully in when the two screws are tightened. Using a small brush, grease the 'trough' area and the bore which houses the seal, O ring and spacer. Insert the Drive Assembly E03264 ensuring that the bearing slots into the bearing housing and the drive belt 280027 is fitted around the pulley. Insert the Motor Assembly E02788 fitted with front and rear Motor Mounts E02502 and E02503 ensuring that the blue wire is uppermost, the motor sits snugly into the bottom of the retaining slot and the drive belt is engaged over the motor drive pulley. Check that the motor, belt and drive screw assembly move freely. Fit Bearing Clamp E02497 on two Nylon Spacers 200115, one on each screw 200137, into the case bottom and secure the bearing with the two screws. Refer to the diagram below and check that the belt tension is within +/- 3mm.

Total belt movement - 6mm

±3mm
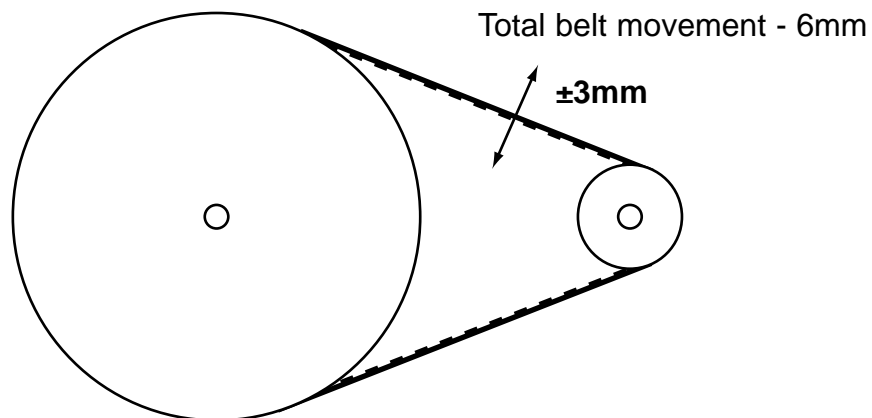
Fit the Tiller Connector E02607 into the end of the Push Rod E02522 and screw in, finger tight.

Hall Effect PCB,   Fit the Hall effect PCB onto the 2 pillars using 2 nylon washers 200037 as spacers between the pillars and the PCB, and 2 screws 200139.

Main PCB.   Feed the power, motor and feedback leads through the 2 grommets 190036 and the appropriate grommet in the PCB Assembly cover and solder the connections to the PCB. Refer to drawing and push PCB Assembly firmly onto the four bosses in the PCB Cover E02680. Clip the compass Assembly E02637 into the Drilled PCB Cover E02680, it can only be fitted one way round, ensuring that the lugs on the compass assembly line up with the 2 holes in the PCB cover and push in. Refer to drawing E02587 and ensuring that the wires from the compass to the connector lay over the PCB, insert plug into the socket on the PCB. Ensure all wires are clear of, and not fouling the PCB cover seal, and position the PCB Cover complete with the PCB and compass into the Case Top Assembly E02612. Screw down the PCB cover with 6 screws 200139 and fully tighten. Position the two grommets into case top, and push home into the two slots. Wrap the 'Wits' fixing 200196 around the cable loom, and using a screw 200139 fix into the top cover.

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Main Seal. Fit the pivot pin into the square section at the rear of the prepared bottom case ensuring that the pin hangs out of the case with the notch on the pivot facing towards the operating rod of the Tillerpilot. Fold the metal pin into its recess in the lower case. Position the Case Seal E02498 onto the case bottom ensuring it is pushed fully into the grooved housing. Carefully lift the case seal from around the area of the pivot pin and using a cotton bud apply Dow Corning 1205 Primer 260029 to the case.   Fill a small hypodermic syringe with Dow Corning 3140 Silicone sealant 260001 and run a small bead of sealant completely around the case seal in the area of the square as shown below:

Sealant to be applied in this area
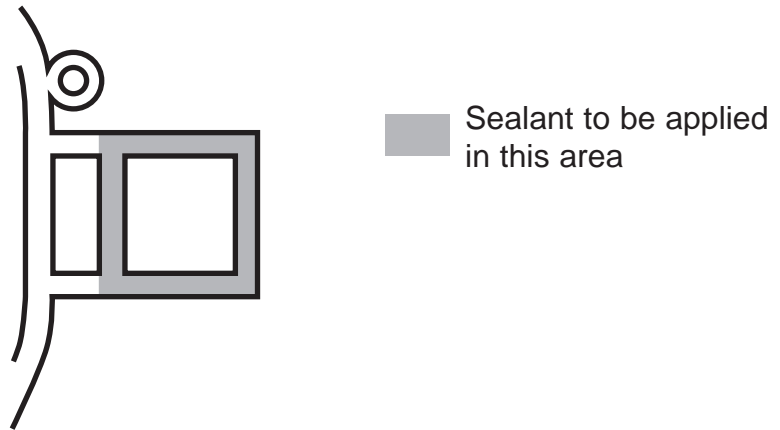
Refit the seal onto the case.

Final Assembly. Carefully position the case top onto the bottom ensuring that the case seal is correctly located all round, squeeze the top and bottom halves of the case together, and fit the 10 screws 200088.   Tighten down evenly all round in the sequence shown below:
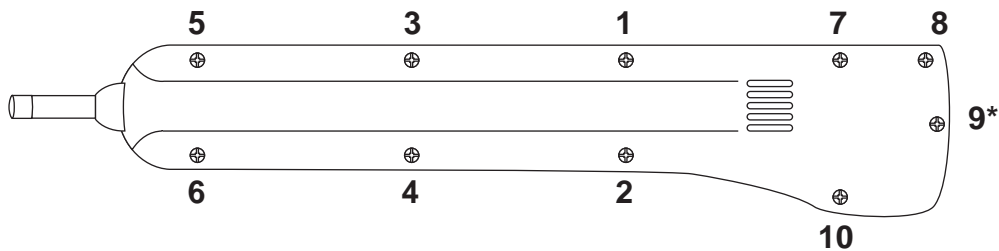
Tighten case screws in sequence 1 to 10

* Note - *At screw No.9, stop and check lip on top case is correctly located into bottom case before fully tightening up.*

Post Assembly Test. Remove the Tiller Connector E02607 and push the Tillerpilot Test Syringe Part No. **TP-SRY** over the end of the Push Rod E02522. Depress the syringe piston and release, the piston should return to its original position indicating that the integrity of the case seal has not been compromised during fitting. Remove the Test Syringe and refit the Tiller Connector.

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3.2 General Assembly : TP20

Refer to Drawing No. **E03505**. Assembly is identical to the TP10 with the following exceptions:

Main PCB E03718. The Main PCB is populated differently to facilitate the processing of NMEA data.

Case Bottom. The case bottom includes a third wiring (communications) loom to carry NMEA data.

PCB Cover E02681. The PCB Cover is drilled with a third access point and grommet to accept the NMEA data leads.

3.3 General Assembly : TP30

Refer to Drawing No. **E03506**. Assembly is identical to the TP20 with the following exception:

Drive Assembly E02618. The Drive Assembly employs a re-circulating ball screw. The assembly is held in place by the metal mounting plate sitting in the mounting slots in both top and bottom cases and drive belt tension is adjusted by the inclusion of spacing shims E02754 as required.

TP10, TP20 & TP30 Tillerpilot
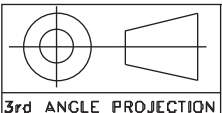# Mechanical Assembly Drawings

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4   MECHANICAL ASSEMBLY DRAWINGS

4.1 General Assembly : TP10   (E03504)

4.2 General Assembly : TP20   (E03505)

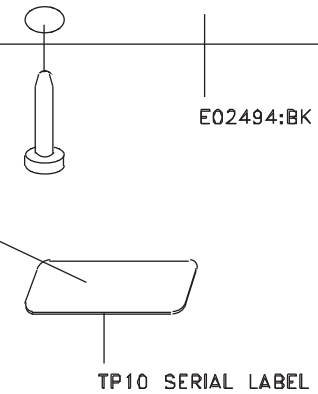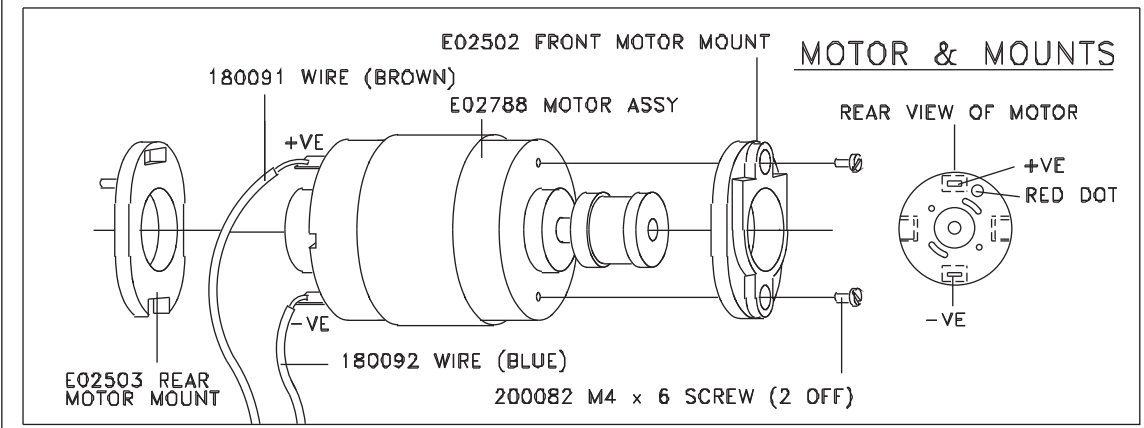**4.3 General Assembly : TP30   (E03506)**

DRAWN IN ACCORDANCE WITH BS 308

3rd ANGLE PROJECTION

E03507 TP10 CASE TOP ASSEMBLY

E03181 WP/TP/10/100 PCB ASSEMBLY

CABLE ROUTE

E01952 VENT ASSY

190036 GROMMET
POT IN PLACE USING
260058 ARALDITE 2018

200025 CABLE TIE
(DOUBLE WRAPPED)
180090 CABLE

200026 CABLE TIE
(2 off)

E02501 PIVOT PIN
(Note Orientation)

190036 GROMMET
(2 OFF)

200196 FIXING

E02650 GROMMET
30mm

PCB CONNECTIONS

E02651 GROMMET

200139 SCREW
(3 OFF)

E03184:TP HALL EFFECT PCB

200137 SCREW (2 OFF)

E02497:BK BEARING CLAMP

280027 BELT

200115 SPACER (2 OFF)

E03264 DRIVE ASSEMBLY

GREASE REBATE

MOTOR & MOUNTS
(SEE BELOW)

E02494:BK CASE BOTTOM

200281 SCREW (10 OFF)

E02637 COMPASS ASSY

E02499 INTERNAL SEAL

190042 'O' RING (4 OFF)

E02680:BK DRILLED PCB COVER

200139 SCREW (6 OFF)

E02498 MAIN CASE SEAL

200002 SCREW (2 OFF)

E03084 RETAINER

190016 'O' RING

(ORIENTATION)

E02870 SPACER

E02495:BK END CAP

E02522 PUSH ROD

E00111 TILLER CONNECTOR

E00747 SEAL

MOTOR & MOUNTS

E02502 FRONT MOTOR MOUNT

180091 WIRE (BROWN)

E02788 MOTOR ASSY

+VE

REAR VIEW OF MOTOR

+VE
RED DOT

−VE

E02503 REAR MOTOR MOUNT

180092 WIRE (BLUE)

200082 M4 x 6 SCREW (2 OFF)

TP10 SERIAL LABEL

DO NOT SCALE | IF IN DOUBT ASK

Mod.No.	Iss.	Date:	Modifications
1375	3	14/9/99	E03184:TP WAS E03184
1312	2	3/3/99	200281 (10 OFF) WERE 200088

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Drawn: BPL
Date: 3/3/99
Checked: Date:
Approved: Date:

Material:

Finish:

COMPUTER GENERATED DRAWING
MANUAL MODIFICATION INVALIDATES CAD FILE.

Model: TP10

Tolerances + & −	ALL DIMENSIONS mm
0. = 0.50	
0.0 = 0.25	SIMRAD NAVICO 1999
0.00= 0.10	
ANG. = 0.5°	SHT. 1 OF 1

Title: GENERAL ASSEMBLY

Date: 27/11/98
Original Scale: NTS

Drg No.: E03504
Issue 3

DRAWN IN ACCORDANCE WITH BS 308

3rd ANGLE PROJECTION

E03508 TP20 CASE TOP ASSEMBLY

E03178 WP/TP/20/30/200CX/300CX PCB ASSEMBLY

CABLE ROUTE

E01952 VENT ASSY

190013 GROMMET
POT IN PLACE USING
260058 ARALDITE 2018

200025 CABLE TIE
(DOUBLE WRAPPED)

E02620 CABLE ASSY

200026 CABLE TIE
(2 off)

E02501 PIVOT PIN
(Note Orientation)

190036 GROMMET
(2 OFF)

200196 FIXING

E0265D GROMMET

30mm

PCB CONNECTIONS

E02637 COMPASS ASSY

E02499 INTERNAL SEAL

190042 'O' RING (4 OFF)

E02681:BK DRILLED PCB COVER

200139 SCREW (6 OFF)

E02498 MAIN CASE SEAL

200002 SCREW (2 OFF)

E03084 RETAINER

190016 'O' RING

E02870 SPACER

(ORIENTATION)

E02651 GROMMET

200139 SCREW
(3 OFF)

E03184:TP HALL EFFECT PCB

200137 SCREW (2 OFF)

E02497:BK BEARING CLAMP

280027 BELT

200115 SPACER (2 OFF)

E03264 DRIVE ASSEMBLY

GREASE REBATE

MOTOR & MOUNTS
(SEE BELOW)

E02495:BK END CAP

E02522 PUSH ROD

E00111 TILLER CONNECTOR

E00747 SEAL

E02494:BK CASE BOTTOM

200281 SCREW (10 OFF)

MOTOR & MOUNTS

E02502 FRONT MOTOR MOUNT

180091 WIRE (BROWN)

E02788 MOTOR ASSY

REAR VIEW OF MOTOR

+VE

+VE
RED DOT

−VE

E02503 REAR MOTOR MOUNT

180092 WIRE (BLUE)

200082 M4 x 6 SCREW (2 OFF)

TP20 SERIAL LABEL

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	1312	2	3/3/99	200281 (10 OFF) WERE 200088
DO NOT SCALE	IF IN DOUBT ASK	Mod.No.	Iss.	Date:	Modifications

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+44 1843 290290

Drawn: BPL	Checked:	Approved:	Tolerances + & −	ALL DIMENSIONS mm
Date:3/3/99	Date:	Date:	0. = 0.50	SIMRAD NAVICO 1999
Material:			0.0 = 0.25	
	COMPUTER GENERATED DRAWING MANUAL MODIFICATION INVALIDATES CAD FILE.		0.00= 0.10	
	Model: TP20		ANG. = 0.5°	SHT. 1 OF 1
Finish:				

Title: GENERAL ASSEMBLY

Date: 27/11/98

Original Scale: NTS

Drg No.: E03505

Issue 3

DRAWN IN ACCORDANCE WITH BS 308

3rd ANGLE PROJECTION
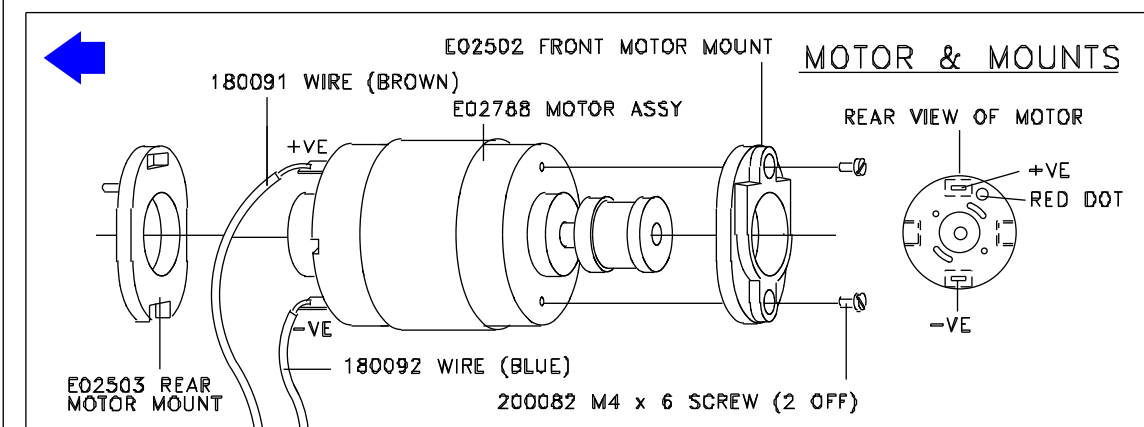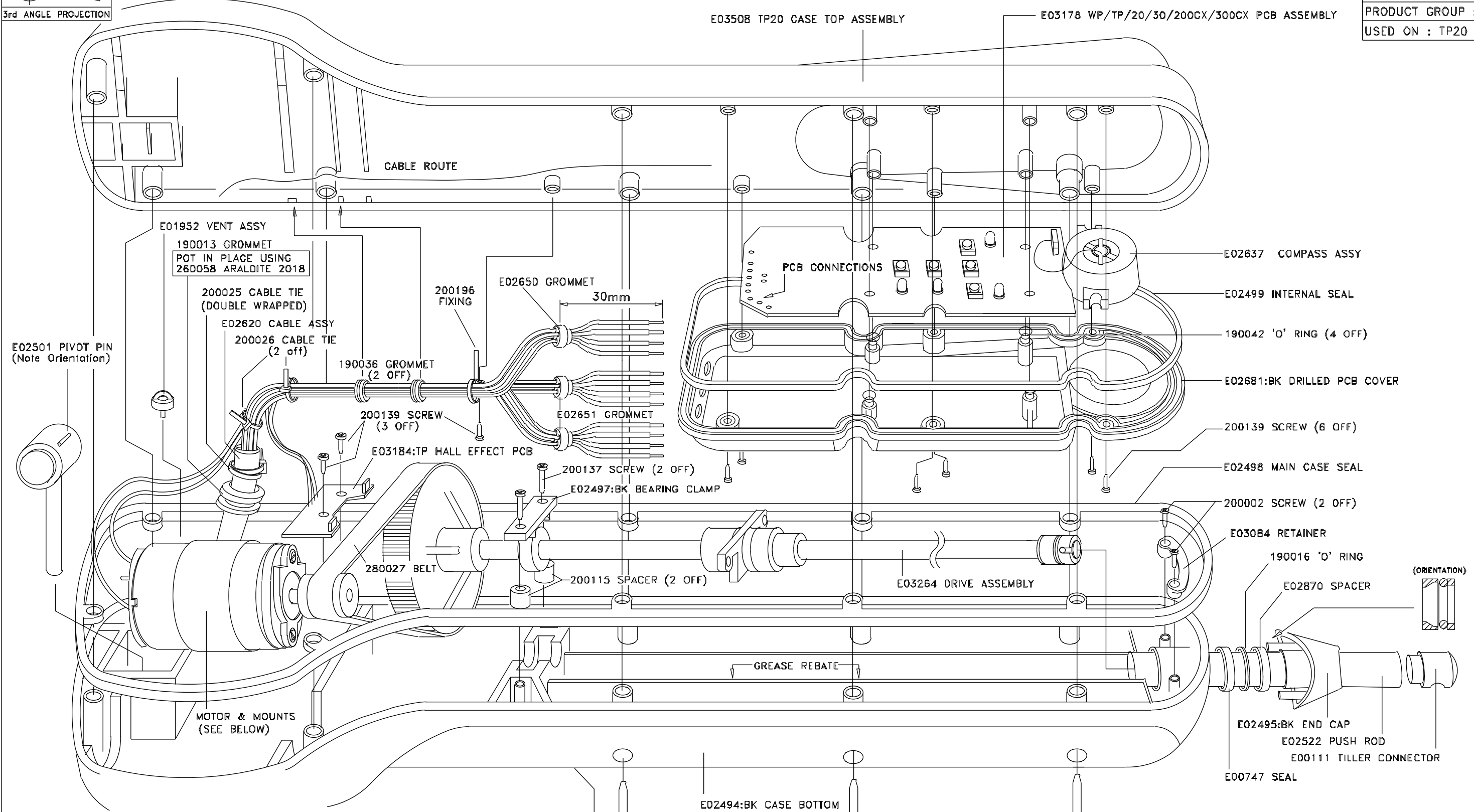
DRG No.:
E03506

PRODUCT GROUP : 810

USED ON : TP30

E03509 TP30 CASE TOP ASSEMBLY

E03178 WP/TP/20/30/200CX/300CX PCB ASSEMBLY

CABLE ROUTE

E01952 VENT ASSY

190013 GROMMET
POT IN PLACE USING
260058 ARALDITE 2018

200025 CABLE TIE
(DOUBLE WRAPPED)

E02620 CABLE ASSY

200026 CABLE TIE
(2 off)

E02501 PIVOT PIN
(Note Orientation)

190036 GROMMET
(2 OFF)

200139 SCREW
(3 OFF)

E03184:TP HALL EFFECT PCB

200196 FIXING

E02650 GROMMET

30mm

E02651 GROMMET

PCB CONNECTIONS

E02637 COMPASS ASSY

E02499 INTERNAL SEAL

190042 'O' RING (4 OFF)

E02681:BK DRILLED PCB COVER

200139 SCREW (6 OFF)

E02498 MAIN CASE SEAL

200002 SCREW (2 OFF)

E03084 RETAINER

190016 'O' RING

E02870 SPACER

(ORIENTATION)

280027 BELT

E02618 DRIVE ASSEMBLY

E02754 SPACING SHIM

GREASE REBATE

E02495:BK END CAP

E02522 PUSH ROD

E00111 TILLER CONNECTOR

E00747 SEAL

MOTOR & MOUNTS
(SEE BELOW)

E02494:BK CASE BOTTOM

200281 SCREW (10 OFF)

TP30 SERIAL LABEL

E02502 FRONT MOTOR MOUNT

MOTOR & MOUNTS

180091 WIRE (BROWN)

E02788 MOTOR ASSY

REAR VIEW OF MOTOR

+VE

+VE
RED DOT

−VE

−VE

E02503 REAR MOTOR MOUNT

180092 WIRE (BLUE)

200082 M4 x 6 SCREW (2 OFF)

1375	3	14/9/99	E03184:TP WAS E03184
1312	2	3/3/99	200281 (10 OFF) WERE 200088
Mod.No.	Iss.	Date:	Modifications

DO NOT SCALE | IF IN DOUBT ASK

| Drawn: BPL | Checked: | Approved: | Tolerances + & − | ALL DIMENSIONS mm |
| Date: 3/3/99 | Date: | Date: | 0. = 0.50 | SIMRAD NAVICO 1999 |

Material:

COMPUTER GENERATED DRAWING
MANUAL MODIFICATION INVALIDATES CAD FILE.

Model: TP30

Finish:

		0.0 = 0.25
		0.00= 0.10
		ANG. = 0.5°	SHT. 1 OF 1

Date: 27/11/98 | Original Scale: NTS

Title: GENERAL ASSEMBLY

Drg No.: E03506 | Issue 3

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TP10, TP20 & TP30 Tillerpilot
Circuit Descriptions

5 CIRCUIT DESCRIPTIONS

5.1 Tillerpilot TP10 PCB Assembly

Introduction.   The PCB Assembly is a generic item which can be used for Wheelpilots WP10 and WP30 and for Tillerpilots TP10, TP20 and TP30. The different versions are created by applying different components to the common PCB. The circuit diagram for the TP10 PCB is given in Drawing No. **E03371**.

Supply and Regulation.   The TP10 is designed to work from a 12 V source. Protection against incorrect polarity is provided by D1 and D4. Capacitors C1and C3 are used as reservoirs to hold up the supply voltage and reduce any supply dips. Protection against over-voltage spikes is provided by Resistor R2 and Zener Diode ZD1 and Regulator REG1 provides a 5V regulated supply.   Transient Voltage Suppresser TVS1 protects the MOSFET drive transistors, TR10 to TR13, from voltage spikes greater than +16V.

Microprocessor.   Light Emitting Diodes LED1 to LED4 are driven from the microprocessor IC2 Ports P0.0 and P0.2 to P0.4 and turn OFF when the line goes HIGH via the transistor switches TR2 to TR5. When the transistors are off, resistors R32, R34, R36 and R38 provide a low current path for the LEDs to provide low level night illumination. The Audio Resonator AR1 is self resonating and switches ON when Port P0.5 goes HIGH via the transistor switch TR1 and resistors R59 and R60. The control key lines on Ports P4.0 to P4.4 are normally pulled to +5V via resistors R7 to R11 and are "scanned" by the microprocessor to detect if any of the switches have been operated and pulled the line LOW.

The Links, L1, L2 and L3, are used to configure the Microprocessor to either Wheelpilot or Tillerpilot operation and to model versions 10, 20 or 30 in accordance with the table below:

Model	TP 10	WP 10	TP 20	TP 30	WP 30
Link 1	N /C	N /O	N /C	N /C	N /O
Link 2	N /C	N /C	N /C	N /O	N /O
Link 3	N /C	N /C	N /O	N /O	N /O

N / C -   Normally Closed (soldered)
N / O -   Normally Open (unsoldered)

Microprocessor Reset. Integrated Circuit IC6 is an integrated reset generator for the microprocessor which produces a reset LOW pulse of approximately 50mS duration at switch on and whenever a 5v supply failure occurs. In addition to the reset provided by IC6, the microprocessor has a built in watchdog timer which will create a reset if a software crash occurs for any reason.

Non-Volatile Memory (NVM). Integrated Circuit IC3 provides 1Kbit of E^2 memory for the retention of important data after power down.

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Fluxgate (Compass). Two anti-phase signals are provided from microprocessor Ports P1.7 and P1.6. These signals are buffered by TR15 and TR16 to provide a higher current drive to the excitation coil of the fluxgate. A reference voltage level of +2 volts is provided by R46 and R53 decoupled by C53. The 2 coils, mounted at right angles, provide output signals proportional to the sine and cosine of the Earth's magnetic field. These signals are fed via the electronic switch IC9, to 2 dual slope integrating analogue to digital converters IC7 and IC 8 plus associated components. The outputs of the comparator IC7 are fed to the microprocessor Ports P1.4 and P1.5 which provide input capture facilities. Accurate timing of the conversion is kept by the microprocessor to provide simultaneous precision analogue to digital conversion of both sine and cosine signals to avoid errors created by multiplexing the inputs.

Motor Drive. The motor drive signals (MDRIVE_A and MDRIVE_B) are generated from the microprocessor at Ports P0.7 and P0.6, these lines being LOW when there is no drive and HIGH to drive. The drive outputs control IC10 and IC11 which are comparators set at threshold levels of +4V and +1V produced by the resistor network R71, R72 and R73. The comparators invert the signals and provide the current to switch the MOSFETs in stages which prevents both P and N channel MOSFETs on the same side of the "H-bridge" configuration, (i.e. TR10 and TR11 or TR12 and TR13), being partially switched on at the same time. When there is no drive, both N-channel MOSFETs TR11 and TR13 are switched on giving a direct short across the motor to the 0V line thus providing active braking

Feedback. Mechanical movement is sensed by 2 Hall Effect devices mounted on the Hall Effect PCB (Drawing E03182 refers). The devices are triggered by rotating magnets mounted in the pulleywheel of the Tillerpilot drive assembly to produce quadrature style feedback. The 2 feedback signals, FB1 and FB2 which are at logic levels, are connected to microprocessor ports P1.1 and P1.2.

EMC. Capacitors with values of 100pF, 100nF and 1nF are extensively used to decouple noise from switched data lines. Two A.C. coupled connections labelled "CHASSIS" , routed via capacitors C63 and C64, were provided for interconnection to the internal metalwork for EMC purposes. Tests have confirmed that connection is not required.

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5.2 Tillerpilot 20 / 30 PCB Assembly

Introduction.   The PCB Assembly is a generic item which can be used for Wheelpilots WP10 and WP30 and for Tillerpilots TP10, TP20 and TP30. The different versions are created by applying different components to the common PCB. The circuit diagram for the TP20 / 30 and WP30 PCB is given in Drawing No. **E03372**.

Supply and Regulation. The TP20 and TP30 are designed to work from a 12 V source. Protection against incorrect polarity is provided by D1 and D4. Capacitors C1and C3 are used as reservoirs to hold up the supply voltage and reduce any supply dips. Protection against over-voltage spikes is provided by Resistor R2 and Zener Diode ZD1 and Regulator REG1 provides a 5V regulated supply. Transient Voltage Suppresser TVS1 protects the MOSFET drive transistors, TR10 to TR13, from voltage spikes greater than +16V.

Microprocessor. Light Emitting Diodes LED1 to LED4 are driven from the microprocessor IC2 Ports P0.0 and P0.2 to P0.4 and turn OFF when the line goes HIGH via the transistor switches TR2 to TR5. When the transistors are off, resistors R32, R34, R36 and R38 provide a low current path for the LEDs to provide low level night illumination. The Audio Resonator AR1 is self resonating and switches ON when Port P0.5 goes HIGH via the transistor switch TR1 and resistors R59 and R60. The control key lines on Ports P4.0 to P4.4, normally pulled to +5V via resistors R7 to R11, are "scanned" by the microprocessor to detect if any of the switches have been operated and pulled the line LOW.

NMEA data in is optically isolated by IC5 and then fed into Port P2.4 of the microprocessor. Transistors TR6, TR7 and TR8 and components D6, D7, D8, R17, R18 and R19 form a switch, protected from high voltages, driven from Port P0.1 of the microprocessor.   The switch is used to apply the synchronisation pulse (HR200_SYNC) to the NMEA line for products employing a Hand (Remote) Controller.

The Links, L1, L2 and L3, are used to configure the Microprocessor to either Wheelpilot or Tillerpilot operation and to model versions 10, 20 or 30 in accordance with the table below:

Model	TP 10	WP 10	TP 20	TP 30	WP 30
Link 1	N / C	N / O	N / C	N / C	N / O
Link 2	N / C	N /C	N / C	N / O	N / O
Link 3	N / C	N / C	N / O	N / O	N / O

N / C -   Normally Closed (soldered)
N / O -   Normally Open (unsoldered)

Microprocessor Reset. Integrated Circuit IC6 is an integrated reset generator for the microprocessor which produces a reset LOW pulse of approximately 50mS duration at switch on and whenever a 5v supply failure occurs. In addition to the reset provided by IC6, the microprocessor has a built in watchdog timer which will create a reset if a software crash occurs for any reason.

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Non-Volatile Memory (NVM). Integrated Circuit IC3 provides 1Kbit of E^2 memory for the retention of important data after power down.

Fluxgate (Compass). Two anti-phase signals are provided from microprocessor Ports P1.7 and P1.6. These signals are buffered by TR15 and TR16 to provide a higher current drive to the excitation coil of the fluxgate. A reference voltage level of +2 volts is provided by R46 and R53 decoupled by C53. The 2 coils, mounted at right angles, provide output signals proportional to the sine and cosine of the Earth's magnetic field. These signals are fed via the electronic switch IC9, to 2 dual slope integrating analogue to digital converters IC7 and IC 8 plus associated components. The outputs of the comparator IC7 are fed to the microprocessor Ports P1.4 and P1.5 which provide input capture facilities. Accurate timing of the conversion is kept by the microprocessor to provide simultaneous precision analogue to digital conversion of both sine and cosine signals to avoid errors created by multiplexing the inputs.

Motor Drive. The motor drive signals (MDRIVE_A and MDRIVE_B) are generated from the microprocessor at Ports P0.7 and P0.6, these lines being LOW when there is no drive and HIGH to drive. The drive outputs control IC10 and IC11 which are comparators set at threshold levels of +4V and +1V produced by the resistor network R71, R72 and R73. The comparators invert the signals and provide the current to switch the MOSFETs in stages which prevents both P and N channel MOSFETs on the same side of the "H-bridge" configuration, (i.e. TR10 and TR11 or TR12 and TR13), being partially switched on at the same time. When there is no drive, both N-channel MOSFETs TR11 and TR13 are switched on giving a direct short across the motor to the 0V line thus providing active braking

Feedback. Mechanical movement is sensed by 2 Hall Effect devices mounted on the Hall Effect PCB (Drawing E03182 refers). The devices are triggered by rotating magnets mounted in the pulleywheel of the Tillerpilot drive assembly to produce quadrature style feedback. The 2 feedback signals, FB1 and FB2 which are at logic levels, are connected to microprocessor ports P1.1 and P1.2.

EMC. Capacitors with values of 100pF, 100nF and 1nF are extensively used to decouple noise from switched data lines. Two A.C. coupled connections labelled "CHASSIS" , routed via capacitors C63 and C64, were provided for interconnection to the internal metalwork for EMC purposes. Tests have confirmed that connection is not required.

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5.3 Hall Effect PCB.

Introduction. The Hall Effect PCB is a generic item which can be used for both Tillerpilots TP10, TP20 and TP30 and Wheelpilots WP10 and WP30. For Tillerpilots, the Hall Effect devices are mounted vertically into the PCB and horizontally for Wheelpilots. The circuit diagram for the Hall Effect PCB is given in Drawing No. **E03182**.

Feedback. Two Hall Effect sensors HE1 and HE2 are mounted on the Hall Effect PCB and sense the rotation of 2 small bar magnets mounted 1800 apart in the pulley wheel. This produces a quadrature feedback output, at logic levels, FB1 and FB2. The PCB is powered from the host unit +5V regulated supply, the line being filtered by C1, and signals FB1 and FB2 are fed back to the microprocessor via pull-up resistors on the host unit PCB.

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TP10, TP20 & TP30 Tillerpilot
Circuit Diagrams

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6   CIRCUIT DIAGRAMS

6.1 Circuit Schematics

TP10 / WP10 PCB Circuit Diagram   E03371

TP20 / 30 & WP30 PCB Circuit Diagram   E03372

Hall Effect PCB Circuit Diagram   E03182

6.2 Component Lists and Layouts

TP10 PCB Assembly Detail   E03181

TP20 / TP30 PCB Assembly Detail   E03178

Hall Effect PCB Assembly Detail   E03184
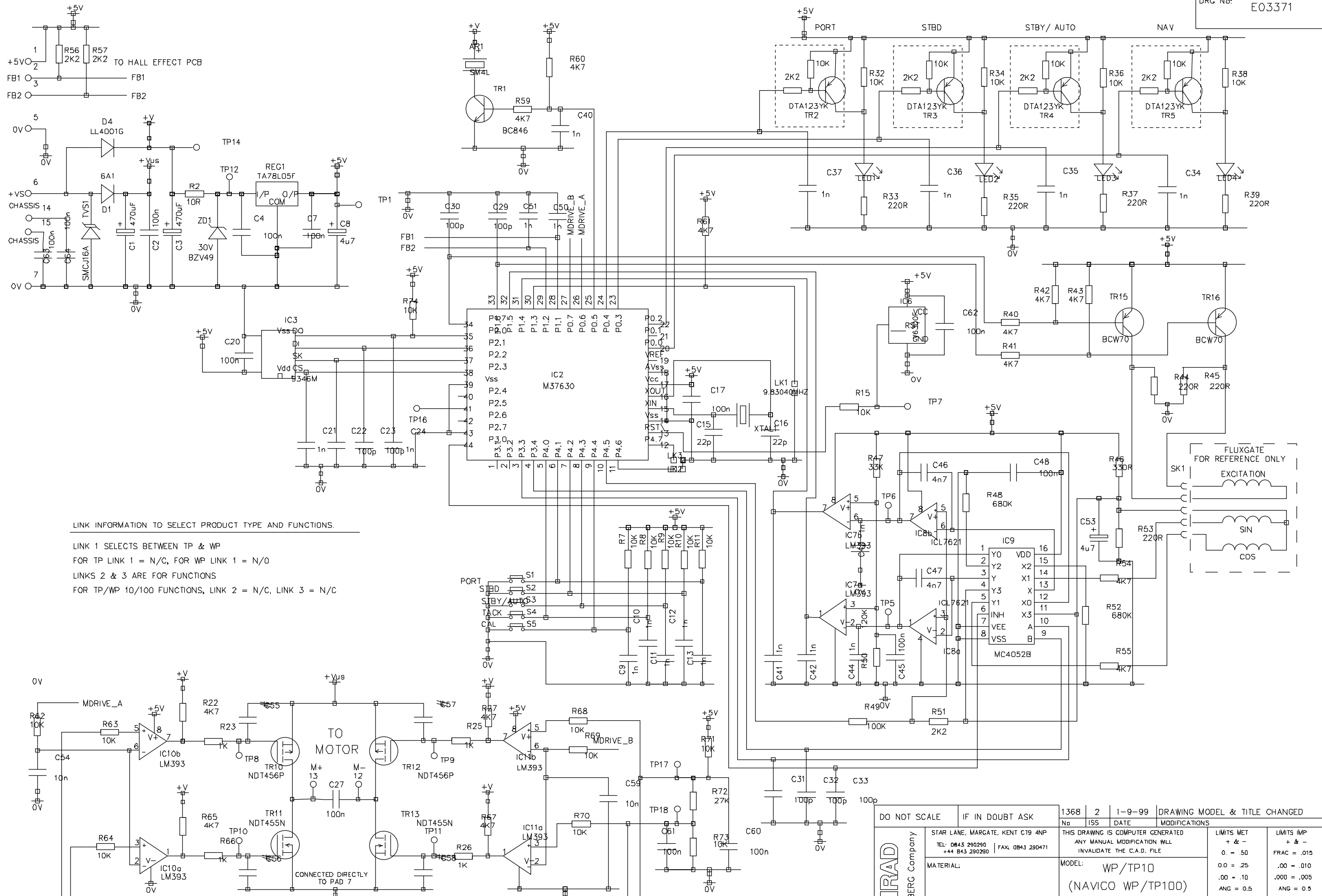
LINK INFORMATION TO SELECT PRODUCT TYPE AND FUNCTIONS.

LINK 1 SELECTS BETWEEN TP & WP
FOR TP LINK 1 = N/C, FOR WP LINK 1 = N/O

LINKS 2 & 3 ARE FOR FUNCTIONS
FOR TP/WP 10/100 FUNCTIONS, LINK 2 = N/C, LINK 3 = N/C

NOTE:- # PROVISION MADE FOR FITTING CAPACITORS
FOR EM EMISSIONS

FLUXGATE
FOR REFERENCE ONLY

TO HALL EFFECT PCB

CONNECTED DIRECTLY
TO PAD 7

TO MOTOR

DO NOT SCALE	IF IN DOUBT ASK	1368	2	1-9-99	DRAWING MODEL & TITLE CHANGED
		No	ISS	DATE	MODIFICATIONS

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MATERIAL:

MODEL:
WP/TP10
(NAVICO WP/TP100)

LIMITS MET	LIMITS IMP
+ & -	+ & -
0. - .50	FRAC = .015
0.0 = .25	.00 = .010
.00 = .10	.000 = .005
ANG = 0.5	ANG = 0.5

DRAWN BY:
R.F.
DATE: 12-5-98

CHECKED:
DATE:

APPROVED:
DATE:

DATE:
1-9-99

SCALE:

TITLE:
PCB CIRCUIT DIAGRAM

DRG No:
E03371

ISSUE:
2

DRG No: E03371

LINK INFORMATION TO SELECT PRODUCT TYPE AND FUNCTIONS.

LINK 1 SELECTS BETWEEN TP & WP
FOR TP LINK 1 = N/C, FOR WP LINK 1 = N/O
LINKS 2 & 3 ARE FOR FUNCTIONS
FOR TP/WP 20/200CX, LINK 2 = N/C, LINK 3 = N/O
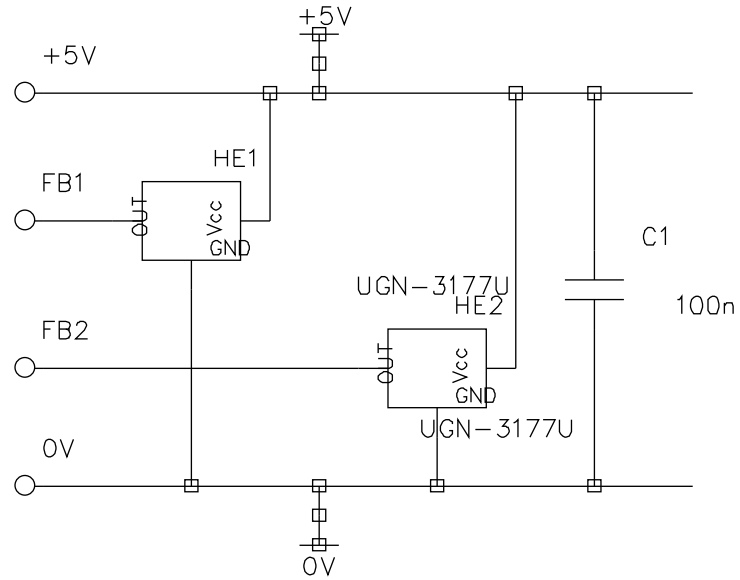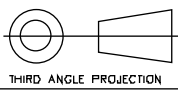FOR TP/WP 30/300CX, LINK 2 = N/O, LINK 3 = N/O

TO HALL EFFECT PCB

+5V
R56 2K2
R57 2K2
FB1
FB2

CHASSIS
CANL
CANH
NMEA+
NMEA-

D4 LL4001G
TP14
TP12
REG1 TA78L05F
I/P O/P COM
D1 6A1
TVS1 SMCJ16A
ZD1 30V BZV49
C1 470uF
C2 100n
C3 470uF
C4 100n
C7 100n
C8 4u7
C5 100n

IC3 9346M
Vss DO
DI
SK
Vdd CS

IC5 PC357
D2 BAS16
D7 D1F60
D8 D1F60
R13 470R
R12 4K7
TR7 SO642
TR6 SO692
TR8 BAV99
D6 BC846
R17 1K
R18 1K
R19 4K7
R110 100K

IC1 PCA82C250T
REF RX
BUS Vcc
BUS GND
RES TX

AR1 SM4L
TR1 BC846
R59 4K7
C40 1n
R60 4K7

IC2 M37630

PORT   STBD   STBY/AUTO   NAV
2K2 10K R32 10K 2K2 10K R34 10K 2K2 10K R36 10K 2K2 10K R38 10K
DTA123YK TR2 DTA123YK TR3 DTA123YK TR4 DTA123YK TR5
C37 1n LED1 R33 220R C36 1n LED2 R35 220R C35 1n LED3 R37 220R C34 1n LED4 R39 220R

IC6 VCC GND
R42 4K7 R43 4K7 TR15 TR16
C62 100n R40 4K7 BCW70 BCW70
R41 4K7
R44 220R R45 220R

R61 4K7
R74 10K

HR200_SYNC
VREF AVss Vcc XOUT XIN Vss RST P4.7
C17 100n C15 22p XTAL C16 22p LK1 9.8304MHZ

R15 10K TP7

FLUXGATE FOR REFERENCE ONLY
SK1 EXCITATION
SIN
COS

IC7b LM393 IC8b ICL7621
R47 33K C46 4n7 C48 100n R48 680K
IC7a LM393 IC8a ICL7621
C47 4n7 R50 20K
R49 0V R51 2K2

IC9 MC4052B
Y0 VDD
Y2 X2
Y   X1
Y3 X0
Y1 X3
INH A
VEE B
VSS
R52 680K
R53 220R C53 4u7
R54 4K7
R55 4K7
R46 330R
R100K

C30 100p C29 100p C51 1n C50 1n
MDRIVE_B MDRIVE_A
FB1 FB2

C26 1n C21 1n C22 100p C23 100p C24 1n
C14 100n C18 1n C19 1n

S1 PORT
S2 STBD
S3 STBY/AUTO
S4 TACK
S5 NAV
R7 10K R8 10K R9 10K R10 10K R11 10K
C9 1n C10 1n C11 1n C12 1n C13 1n

C41 1n C42 1n C44 1n R50 C45 100n

MDRIVE_A
R62 10K R63 10K C54 10n
IC10b LM393
R22 4K7 R23
TR10 NDT456P TR11 NDT455N
TO MOTOR
M+ 13 C27 100n M- 12
TR12 NDT456P TR13 NDT455N TP11
R25 R27 4K7 R68 R69 10K MDRIVE_B
IC11b LM393
R26 1K R70 10K
IC11a LM393
R71 10K
R24 R67 4K7
R65 4K7 R66
R64 10K
IC10a LM393
CONNECTED DIRECTLY TO PAD 7

R72 27K R73 10K
C59 10n C60 100n C61 100n
C31 100p C32 100p C33 100p

HR200_SYNC
TP17 TP18

NOTE:- # PROVISION MADE FOR FITTING CAPACITORS FOR EM EMISSIONS

+5V

+5V

HE1

FB1

OUT Vcc
GND

UGN-3177U

FB2

HE2

OUT Vcc
GND

UGN-3177U

C1

100n

0V

0V

THIRD ANGLE PROJECTION

SURFACE MOUNT COMPONENTS

ITEM	QTY	PART No	COMP REF	DESCRIPTION
1	1	E03370	–	PCB DRILLED
2	1	100125	R2	1206 10R
3	4	100128	R23,R25,R26,R66	1206 1K
4	3	100129	R51,R56,R57	1206 2K2
5	13	100131	R22,R27,R40,R41,R42,R43,R54 ,R55 R59,R60,R61,R65,R67	1206 4K7
6	19	100132	R7,R8,R9,R10,R11,R15,R32,R34 R36,R38 ,R62,R63,R64,R68,R69 ,R70 R71,R73 ,R74	1206 10K
7	7	100133	R33,R35,R37,R39,R44,R45,R53	1206 220R
8	1	100136	R50	1206 120K
9	1	100140	R49	1206 100K
10	1	100141	R46	1206 330R
11	2	100142	R48,R52	1206 680K
12	1	100216	R47	1206 33K
13	1	100219	R72	1206 27K
14	1	110104	C53	4u7 SM ELECT
15	2	110109	C46,C47	1210 4n7
16	18	110115	C9,C10,C11,C12,C13,C21 ,C24,C34 C35,C36,C37,C40,C41,C42,C43 ,C44 C50,C51	0805 1n
17	2	110116	C15,C16	0805 22p
18	7	110118	C22,C23,C29,C30,C31,C32,C33	0805 100p
19	13	110128	C2,C4,C7,C17,C20,C27,C45,C48 ,C60 C61 ,C62,C63,C64	0805 100n
20	2	110138	C54,C59	0805 10n
21	1	110169	C8	4u7 SM ELECT
22	1	120038	ZD1	BZV49 30V
23	1	120040	D4	LL4001G
24	1	120079	TVS1	SMCJ16A
25	2	130055	TR11,TR13	NDT455N
26	2	130056	TR10,TR12	NDT456P
27	1	130028	TR1	BC846
28	2	130029	TR15,TR16	BCW70
29	4	130053	TR2,TR3,TR4,TR5	DTA123YK
30	1	140068	IC8	7621
31	3	140069	IC7 ,IC10,IC11	LM393
32	1	140070	IC9	MC4052B
33	1	140077	IC3	NMC9346
34	1	140092	REG1	TA78L05F
35	1	140147	IC6	V6300F
36	1	160066	XTAL1	9.83040MHz
37	5	210019	S1,S2,S3,S4,S5	SM_SWITCH
38	1	E03398	IC2	PROG'D MICRO UNPROGRAMMED PART No IS 140163
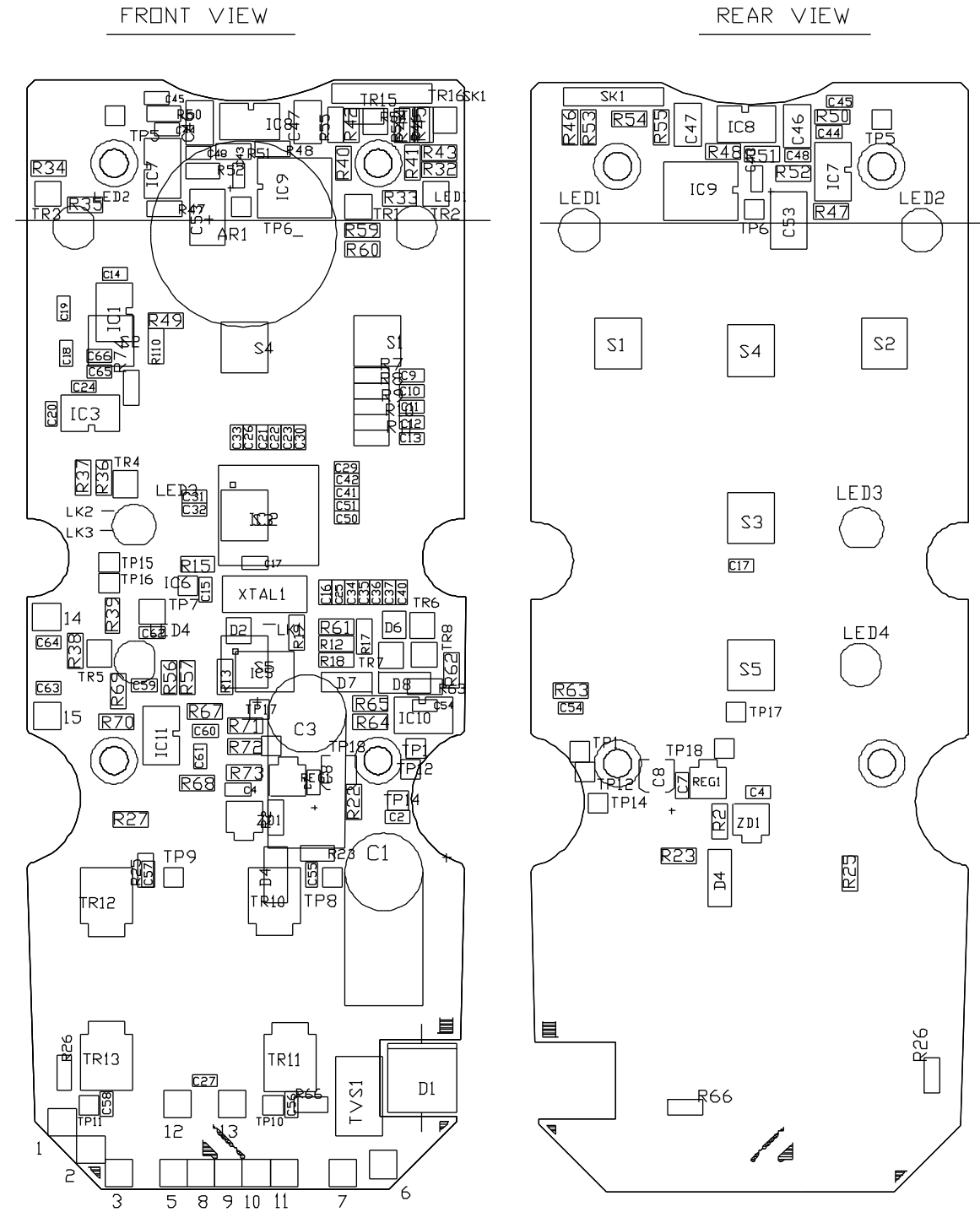
CONVENTIONAL MOUNT COMPONENTS

ITEM	QTY	PART No	COMP REF	DESCRIPTION
39	2	110110	C1,C3	470UF 25V ELECT
40	3	120010	LED1,LED3,LED4	L-53EC RED LED
41	1	120011	LED2	EBG5504S LED GREEN
42	1	120041	D1	6A1
43	1	160028	AR1	SM4L
44	0.25	170078	SK1	SKT STRIP 20 WAY

* C55,C56,C57,C58 NOT FITTED

C65,C66 REFER TO CIRCUIT DIAGRAM   E03371 FOR INTENDED PURPOSE.

FRONT VIEW

REAR VIEW

LINK INFORMATION TO SELECT PRODUCT TYPE AND FUNCTIONS.

LINK 1 SELECTS BETWEEN TP & WP

FOR TP LINK 1 = N/C, FOR WP LINK 1 = N/O

LINKS 2 & 3 ARE FOR FUNCTIONS

FOR TP/WP 10/100 FUNCTIONS, LINK 2 = N/C,LINK 3 = N/C

			MODIFICATIONS
1368	4	1-9-99	DRAWING MODEL & TITLE CHANGED SEE MOD No. 1203
1203	3	12-5-98	
1100	2	6-11-97	C25,26 REMOVED,C62,C63,C64 ADDED
No	ISS	DATE	MODIFICATIONS

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MATERIAL:

MODEL:
WP/TP10
(NAVICO WP/TP100)

	LIMITS MET	LIMITS IMP
	+ & -	+ & -
0. = .50		FRAC = .015
0.0 = .25	.00 = .010
.00 = .10	.000 = .005
ANG = 0.5	ANG = 0.5

DRAWN BY: R.F.   DATE: 12-5-98

CHECKED: DATE:

APPROVED: DATE:

DATE: 1-9-99

SCALE: N.T.S

TITLE:
PCB ASSEMBLY
DETAIL

DRG No: E03181

ISSUE: 4

SURFACE MOUNT COMPONENTS

ITEM	QTY	PART No	COMP REF	DESCRIPTION
1	1	E03370	–	PCB DRILLED
2	1	100124	R13	1206 470R
3	1	100125	R2	1206 10R
4	6	100128	R17,R18 ,R23,R25,R26 ,R66	1206 1K
5	3	100129	R51,R56,R57	1206 2K2
6	15	100131	R12,R19,R22,R27,R40,R41 ,R42,R43 R54,R55,R59,R60,R61 ,R65,R67	1206 4K7
7	19	100132	R7,R8,R9,R10,R11,R15,R32,R34,R36 R38,R62,R63,R64,R68,R69 ,R70 ,R71 R73,R74	1206 10K
8	7	100133	R33,R35,R37,R39,R44,R45,R53	1206 220R
9	1	100136	R50	1206 120K
10	2	100140	R49,R110	1206 100K
11	1	100141	R46	1206 330R
12	2	100142	R48,R52	1206 680K
13	1	100216	R47	1206 33K
14	1	100219	R72	1206 27K
15	1	110104	C53	4u7 SM ELECT
16	2	110109	C46,C47	1210 4n7
17	20	110115	C9,C10,C11,C12,C13,C18,C19,C21 C24,C25,C26,C34,C35,C36,C37 C40,C41,C42,C50,C51	0805 1n
18	2	110116	C15,C16	0805 22p
19	7	110118	C22,C23,C29,C30,C31,C32,C33	0805 100p
20	2	110124	C43,C44	0805 150p
21	14	110128	C2,C4,C7,C14,C17,C20,C27,C45,C48 C60,C61,C62,C63,C64	0805 100n
22	2	110138	C54,C59	0805 10n
23	1	110169	C8	4u7 SM ELECT
24	1	120036	D2	BAS16T
25	1	120038	ZD1	BZV49 30V
26	1	120040	D4	LL4001G
27	1	120043	D6	BAV99
28	2	120070	D7,D8	D1F60
29	1	120079	TVS1	SMCJ16A
30	2	130055	TR11,TR13	NDT455N
31	2	130056	TR10,TR12	NDT456P
32	2	130028	TR1 .TR8	BC846
33	2	130029	TR15,TR16	BCW70
34	1	130049	TR6	SO692
35	1	130050	TR7	SO642
36	4	130053	TR2,TR3,TR4,TR5	DTA123YK
37	1	140068	IC8	7621
38	3	140069	IC7 ,IC10,IC11	LM393
39	1	140070	IC9	MC4052B
40	1	140075	IC5	PC357
41	1	140077	IC3	NMC9346
42	1	140092	REG1	TA78L05F
43	1	140096	IC1	PCA82C250T
44	1	140147	IC6	V6300F
45	1	160066	XTAL1	9.83040MHz
46	5	210019	S1,S2,S3,S4,S5	SM_SWITCH
47	1	E03398	IC2	PROG'D MICRO UNPROGRAMMED PART No. IS 140163
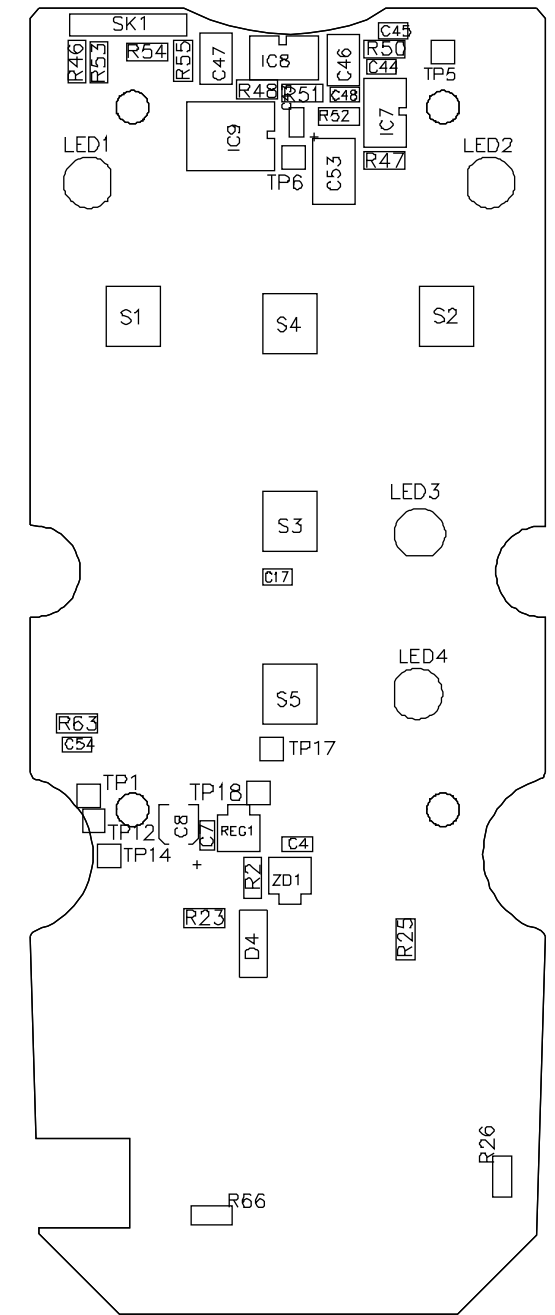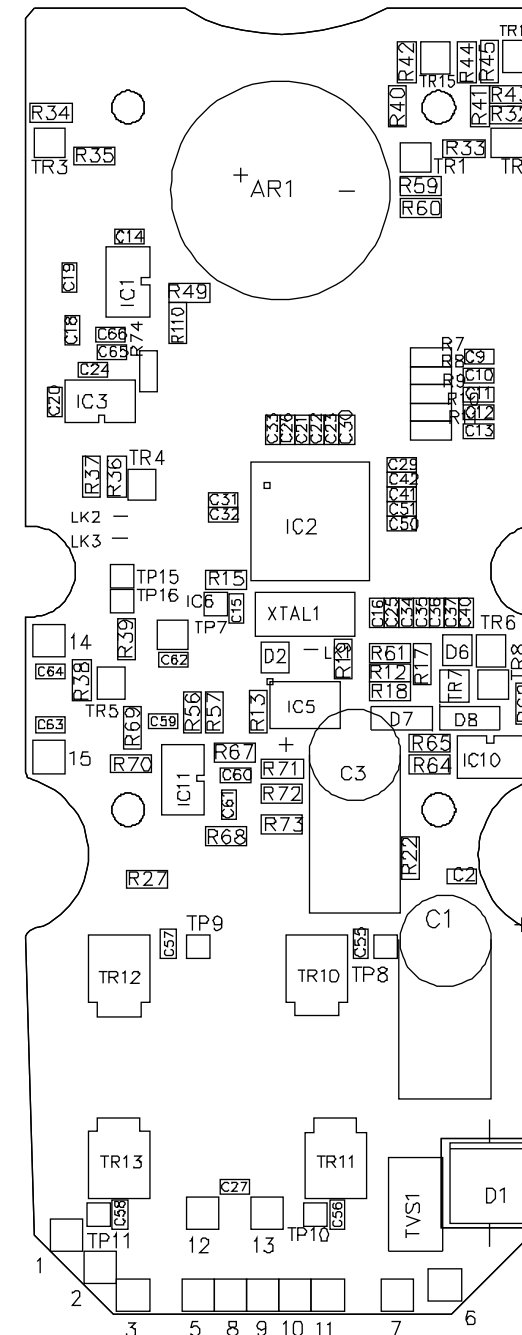
CONVENTIONAL MOUNT COMPONENTS

ITEM	QTY	PART No	COMP REF	DESCRIPTION
48	2	110110	C1,C3	470UF 25V ELECT
49	3	120010	LED1,LED3,LED4	L-53EC LED RED
50	1	120011	LED2	EBG5504S LED GREEN
51	1	120041	D1	6A1
52	1	160028	AR1	SM4L
53	0.25	170078	SK1	STRIP 20 WAY

C55,C56,C57,C58 NOT FITTED

C65,C66 REFER TO CIRCUIT DIAGRAM

E03372 FOR INTENDED PURPOSE.

LINK INFORMATION TO SELECT PRODUCT TYPE AND FUNCTIONS.

LINK 1 SELECTS BETWEEN TP & WP
FOR TP LINK 1 = N/C, FOR WP LINK 1 = N/O
LINKS 2 & 3 ARE FOR FUNCTIONS
FOR TP/WP 20/200CX, LINK 2 = N/C, LINK 3 = N/O
FOR TP/WP 30/300CX, LINK 2 = N/O, LINK 3 = N/O

HE2

HE1

C1

FB1 | +5V | 0V | FB2

CONVENTIONAL MOUNT COMPONENTS

ITEM	QTY	PART No	COMP REF	DESCRIPTION
1	1	E03183	–	PCB DRILLED
2	1	110001	C1	100n CERAMIC DISC
3	2	140010	HE1,HE2	UGN3177U

NOTE:– PART No. E03184:TP, HE1,HE2 MOUNTED VERTICALLY.

PART NO. E03184:WP, HE1,HE2 MOUNTED HORIZONTALLY.

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TP10, TP20 & TP30 Tillerpilot
Programming & Configuration

7   PROGRAMMING AND CONFIGURATION

For further details of normal operation please refer to the appropriate user manual - **TP10** or **TP20/TP30**.

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3   Configuration

3.1 Porthand Mounting

Although the Tillerpilot is factory preset for Starboard side mounting, it is possible to reconfigure it for mounting on the Port side of the cockpit, to facilitate easy installation on most types of yacht.

With the power off, hold down the **CAL** and **TACK** keys and switch on the power. Either the Port or Starboard LED will illuminate, depending on the current mounting configuration. Press the **PORT** key to select Port side mounting. The Port LED only will remain illuminated to indicate selection. Confirm selection and exit to Standby Mode by pressing **CAL**. (Fig 3.2).

To select Starboard mounting, repeat the above procedure, but press the **Starboard** key instead of **Port.**

POWER ⬇ ON

Fig 3.2 - Configuring for Port mounting
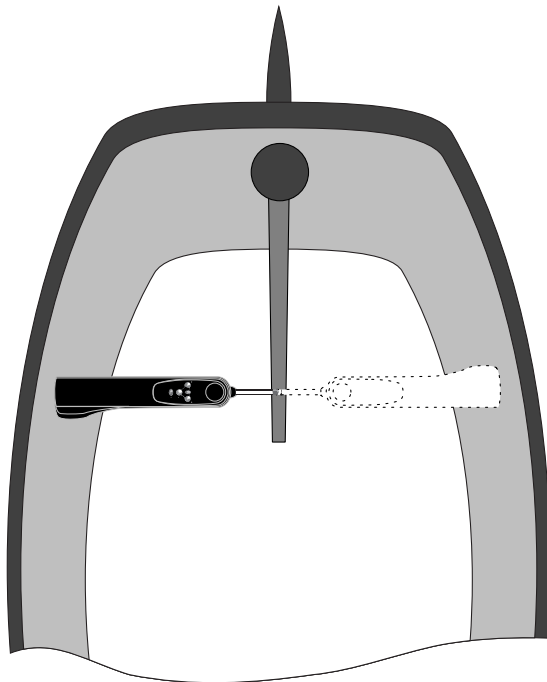
Fig 3.1 - Starboard and Port mounting options

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TP10, TP20 & TP30 Tillerpilot
Fault Finding

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8   FAULT FINDING

8.1 Common User Faults.

Excerpt from TP10 manual -

5.3 Fault Finding

Symptom	Probable Cause	Remedy
When engaged, the pilot immediately applies a large helm angle and increases course error.	* Tillerpilot is configured for Porthand setting but installed on Starboard side (or vice versa).	* Refer to section 3.1.
After functioning normally course is suddenly lost and the Tillerpilot goes into Standby Mode.	* Power interrupted briefly, or low voltage. * Cable from battery to socket too small. * Intermittent connection.	* Increase size of cable. * Check all connections. * Charge batteries. * Uprate batteries.
Helm is hard over and alarm is continuously on.	* Steerage way insufficient to control course, or sails are aback. Pulsing is a correct safety feature when tiller is at full travel.	* Reset the vessel on course and re-engage pilot.
Power supply is live, but pilot is not on.	* Pilot is wired incorrectly.	* Check wiring of pilot (see section 4.2).

Page 15

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Common User Faults ctd

Excerpt from TP20/TP30 manual -

6.2 Fault Finding

Symptom	Probable Cause	Remedy
When engaged, the pilot immediately applies a large helm angle and increases course error.	Tillerpilot is configured for Porthand setting but installed on Starboard side (or vice versa).	* Refer to section 4.1.
After functioning normally course is suddenly lost and the Tillerpilot goes into Standby Mode.	* Power interrupted briefly, or low voltage. * Cable used to socket too small. * Intermittent connection.	* Increase size of cable. * Check all connections. * Charge batteries. * Uprate batteries.
Helm is hard over and alarm is continuously on.	* Steerage way insufficient to control course, or sails are aback. Pulsing is a correct safety feature when tiller is at full travel.	* Reset the vessel on course and re-engage pilot
Power socket is live, but pilot is not on.	* Socket is wired incorrectly.	* Check wiring of socket (see section 5.2).
Loss of course under Sail To Wind Mode.	* Apparent wind has become too light to give a consistent direction.	* Change to Compass Mode.
Cannot select Sail To Wind Mode.	* Masthead unit is not connected. * Corus system is not switched on. * Required NMEA sentence not being transmitted.	* Fit ATM601 Masthead Unit. * Check Corus Monocable connections. * See section 5.5.
Cannot select NavLock Mode.	* Navigational receiver not connected. * No waypoints have been programmed. * Wrong NMEA format is being used.	* Check NMEA interface connections. * Check NMEA0183 format is being transmitted by navigational receiver.

Autotack function not working.	* Pilot is in NavLock Mode.
	* Pilot is in Steer To Wind Mode and
	   a) apparent wind is >90°
	   b) autotack being attempted is in the wrong direction.
		* Exit NavLock.
		* Luff up until apparent wind is less than 90°.

Pilot exits NavLock before waypoint is reached.	* Cross Track Error has exceeded 1.21 Nm.	* Reset the vessel on course and re-engage NavLock.

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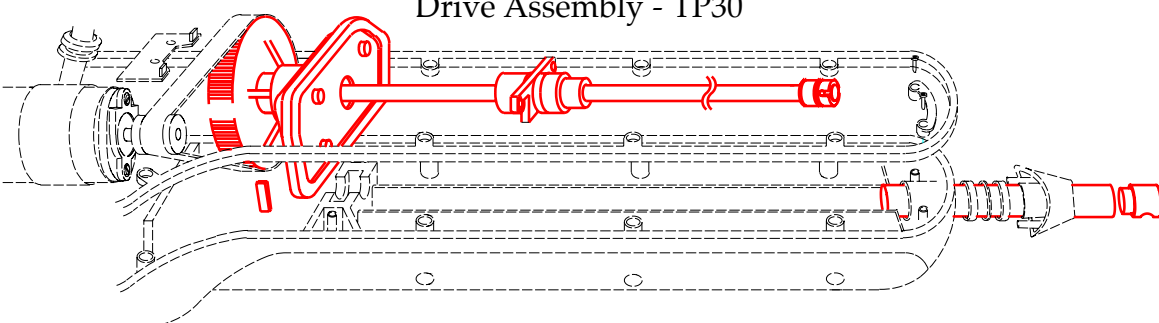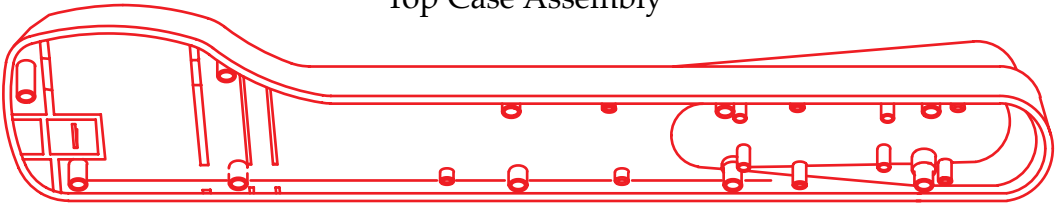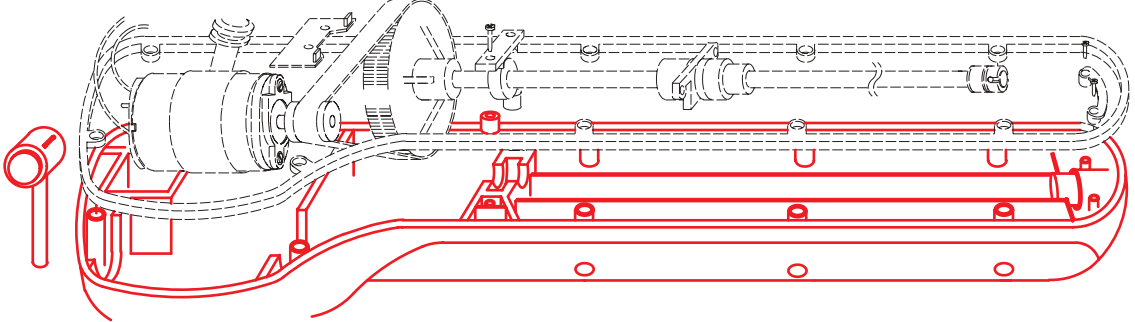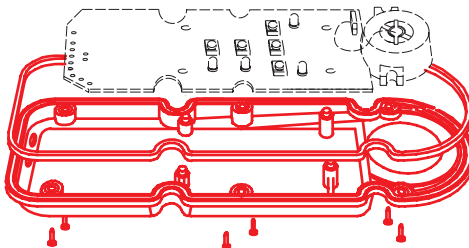## 8.2 Common Technical Faults.

None yet identified.
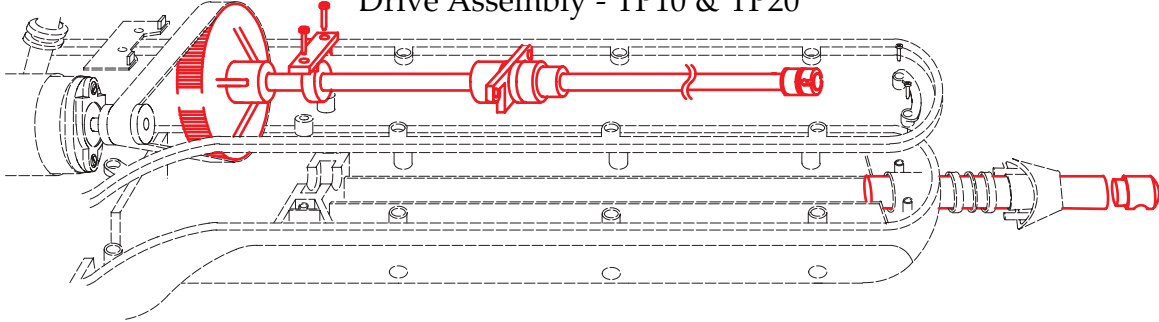
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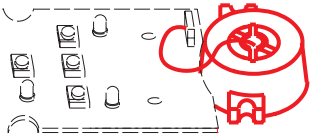A KONGSBERG Company

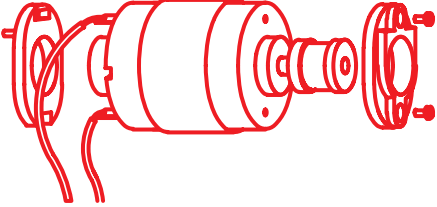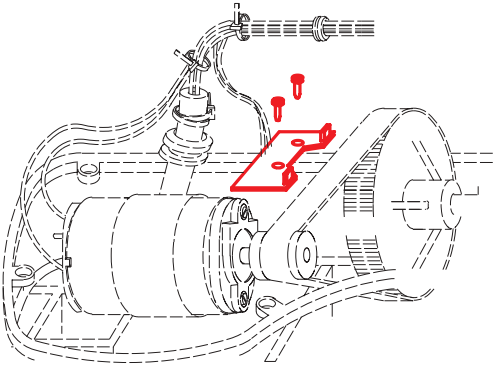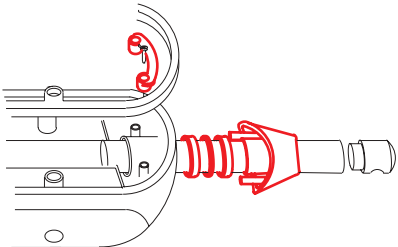# TP10, TP20 & TP30 Tillerpilot
Spares Packs
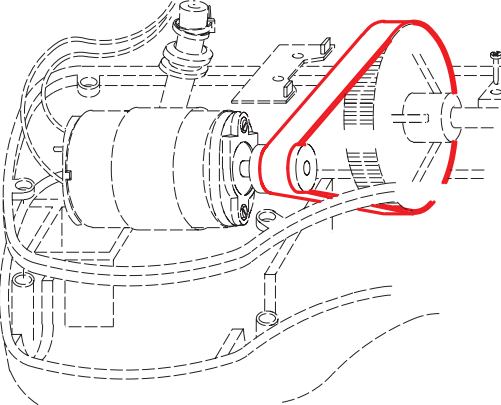
Simrad Navico Spares Packs **SIMRAD**

Product - Tillerpilots TP10, TP20, TP30

Part No.	Description
TPPK1	Drive Assembly - TP10 & TP20
TPPK22	Drive Assembly - TP30
TP10 - **TPPK2** TP20 - **TPPK16** TP30 - **TPPK20**	Top Case Assembly
TP10 - **TPPK25** TP20 & TP30 - **TPPK3**	Bottom Case Assembly, Cable Loom & Pivot Pin
TP10 - **TPPK4** TP20 & TP30 - **TPPK17**	PCB Cover & Seal
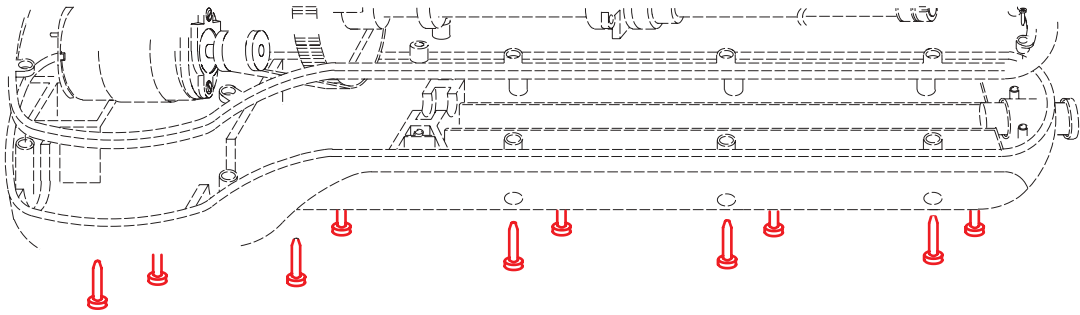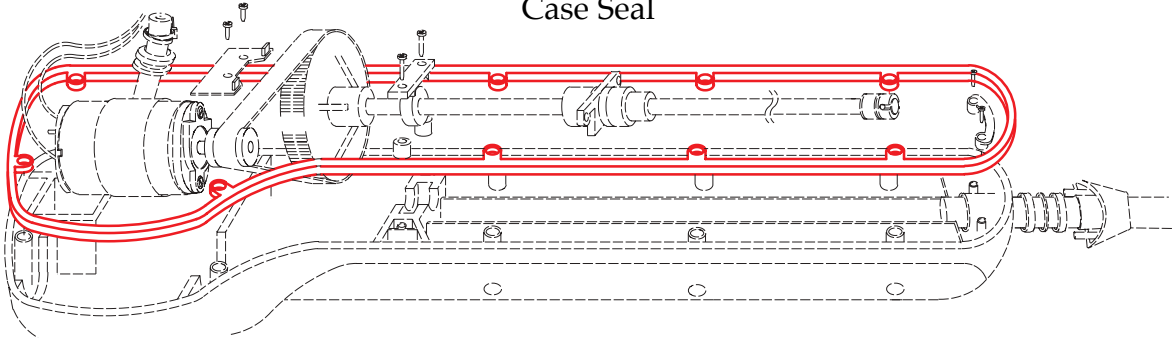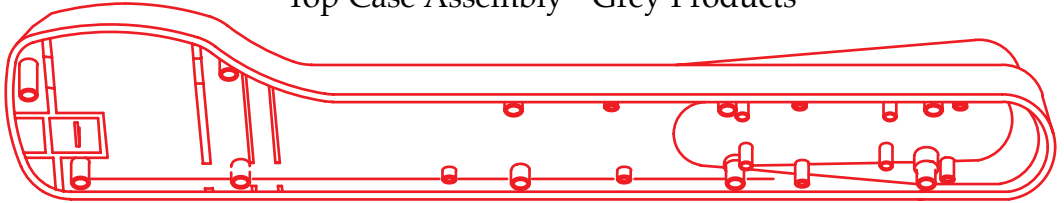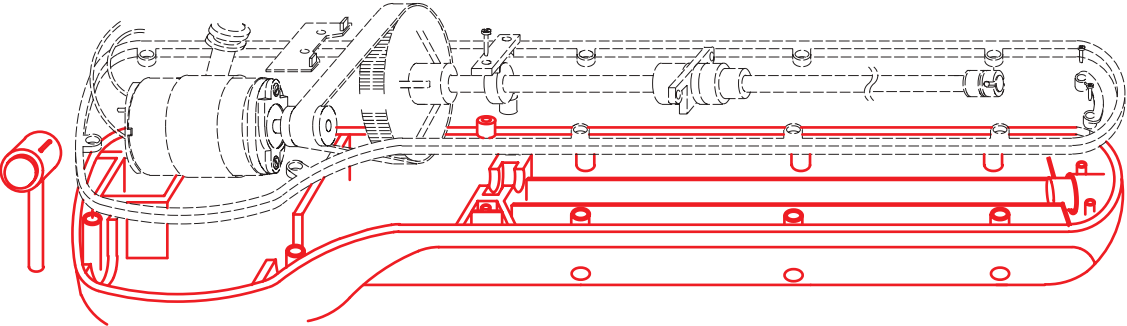
Simrad Navico Spares Packs **SIMRAD**

Product - Tillerpilots TP10, TP20, TP30

Part No.	Description
TPPK6	Fluxgate Assembly
TPPK7	Mounting Pin, Cup& Connector
TPPK8	Motor Assembly
TPPK9	Feedback Kit
TPPK10	Drive Belt
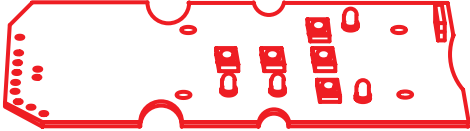
Simrad Navico Spares Packs

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Product - Tillerpilots TP10, TP20, TP30

Part No.	Description
TPPK11	Case Screws
TPPK12	End Cap, Retainer & Seals
TPPK13	Case Seal
TP100 - **TPPK14** TP200CX - **TPPK24** TP300CX - **TPPK23**	Top Case Assembly - Grey Products
TPPK15	Bottom Case Assembly & Pivot Pin - Grey Products

Simrad Navico Spares List   **SIMRAD**

Product - Tillerpilots TP10, TP20, TP30

Part No.	Description
See below	PCB Assembly

Tillerpilot PCB Assembly Variants

The Tillerpilot PCB assembly variants can be divided into 3 groups -

1. Feedback produced from the motor back emf

2. Feedback produced from a Hall Effect sensor PCB assembly

3. Introduction of Surface Mount microprocessor

Pilot Version PCB Assy	TP100 Back emf E02549	TP200CX Back emf E02550	TP300C Back emf E02550	TP300CX Back emf E02550	TP100 Hall Effect E03181	TP200CX Hall Effect E03178	TP300CX Hall Effect E03178
General Assy Drawing No.	*E02587*	*Not Issued*	*E02616*	*E02616*	*E03299*	*E03262*	*E03300*
Circuit Diag Drawing No.	*E02549*	*E02550*	*E02550*	*E02550*	*E03179*	*E03176*	*E03176*
Serial Numbers	*to PE8817*	*to PB1483*	*to MI2954*	*MK3143-OD6414*	*PE8818-*	*PB1484-*	*OD6415-*

Pilot Version PCB Assy	TP10 SMD Micro E03181	TP20 SMD Micro E03178	TP30 SMD Micro E03178
General Assy Drawing No.	*E03504*	*E03505*	*E03506*
Circuit Diag Drawing No.	*E03371*	*E03372*	*E03372*
Serial Numbers	*OL7653-*	*OL1384-*	*OL7190-*