LX160

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LX Navigation d.o.o.
Tkalska 10 SLO 3000 Celje
+ 386 3 490 46 70
+ 386 3 490 46 71
support@lxnavigation.si
http://www.lxnavigation.si

1. Contents

2. Introduction

The LX160 is an electrical vario meter and final glide calculator with the ability to receive NMEA sentences from an external GPS device (COLIBRI, LX20, LX400, GARMIN …). This way the LX160 calculates a final glide to a point selected on the GPS device. The LX160 calculates the wind component. Without the external GPS device, the LX160 functions like a normal electrical vario meter with final glide calculation. The pilot just enters the parameters (distance, wind component, altitude of target point, polar). This instrument is made on the LX5000 principle, so all the mathematics about final glide calculations are the same as the LX5000.

This manual will teach you about the device, its functions and all the advantages. Please read it carefully before you install the device. The best way to learn basic and more advanced functions about the LX160 is to turn it on at home and go step by step through this manual. We have done our best to achieve, as little handling during the flight as possible, if the on-ground preparation has been optimal.

The manufacturer doesn't take the responsibility for possible mistakes or misprints in this text and gives no guarantee for accuracy of this manual.

This manual has been written with the greatest care and we have done our best to avoid any mistakes but with all respect please check any doubtful statement and let us know. We would be very grateful and we thank you in advance for any comment.

Our address:

LX Navigation d.o.o.
Tkalska 10 SLO 3000 Celje
+ 386 3 490 46 70 **+ 386 3 490 46 71**
support@lxnavigation.si **http://www.lxnavigation.si**

1. Check list

- 1 x LX160
- 1 x LX160 cable
- 1 x LCD indicator + 1 x LCD cable
- 1 x Speaker
- 1 x LX160 Manual

2. Technical data

Operating voltage:	9-16V
Nominal voltage:	12V
Current consumption:	110mA at 12V (LX160 + LCD indicator)
Operating temperature:	from -10°C to +60°C
Storing temperature:	-20°C to +70°C

3. Description of switches

Figure 1 Switches

ON/OFF:

Switches power on or off.

SC/VARIO/AUTO: (mode selector)

- SC is speed command mode
- VARIO mode
- AUTO mode

MC:

After MC switch is activated the upper number shows the MC. After App. 1 second this disappears. With a short press MC increase/decrease for 0.1, with a long press MC increase/decrease for 0.5.

BUGS:

- upper position (2) 10% glide ratio degradation (*default*)
- middle position (BUGS) 0% glide ratio degradation (*default*)
- lower position (1) 5% glide ratio degradation (*default*)

BALLAST:

- upper position is full ballast (2) +20% of min. load (*default*)
- middle position is without ballast (BAL)
- lower position with half of ballast (1) +10% of min. load (*default*)

FILTER: (vario filter)

- upper position (2) 3 seconds-*default* (very strong filter)
- middle position (FIL) 0.5 seconds-*default* (almost no filtering)
- lower position (1) 1.5 seconds-*default* (weak filter)

AUDIO VOLUME:

With a long press the volume increases/decreases faster, with short press volume is increased/decreased slower.

4. LCD indicator

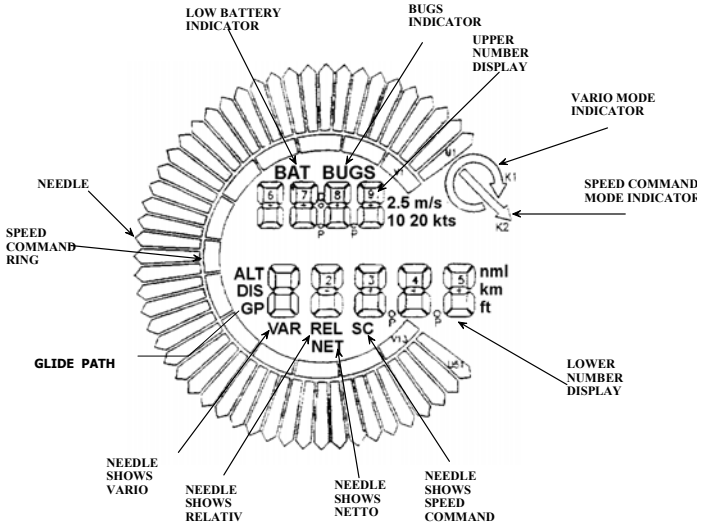


Figure 2 LCD indicator

The unit is powered from LX 160 via 485 cable. On the back there are two SUB D 9P connectors, which are completely parallel. Both could be used like inputs or like outputs for other units (LCD). 485 protocol is delivering data strings **for four independent LCD vario** settings. Which data string will be accepted is defined using different positions of the DIP switches on the backside. There are no other settings on the unit.

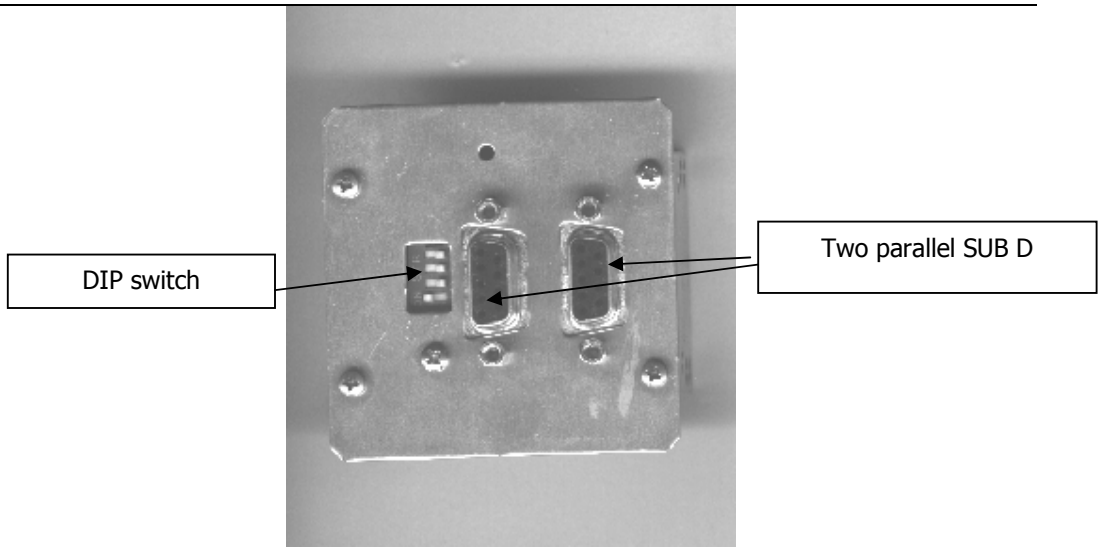


Figure 3 Rear side of LCD indicator

Address	Switch 1	Switch 2	Switch 3	Switch 4
1	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	OFF	OFF	ON	OFF
4	OFF	OFF	OFF	OFF
PROHIBITED!	OFF	OFF	OFF	ON

5. Pneumatic

On the rear side of ***LX***160 are three probes.

- On **TE** probe is connected total energy or static, if we havent total energy. If static is connected, vario is not compensated. Electronic compensation is necessary.
- **Pst** is static pressure needed for speed.
- **Ptot** must be connected on total pressure in nose of glider (pitot). If this probe is not connected properly, instrument will not work good. (on speed depends all important calculations like glide path, speed commad, netto relativ, polar…)

Figure 4 Rear side of LX160

6. Power on

After powering up the **LX**160, wait app. 40 sec. to warm up the sensors. On the LCD indicator we will see displayed **LX**160 and the number of version.

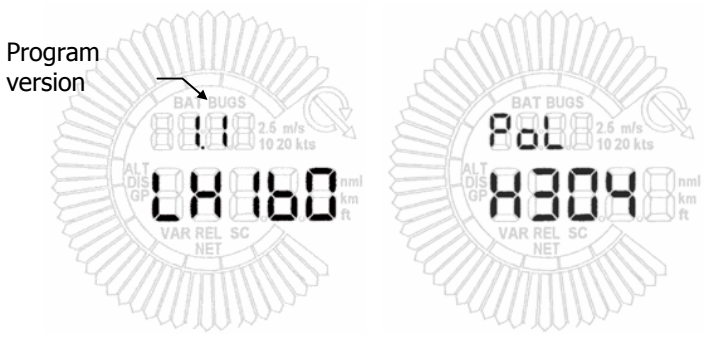


Figure 5 After power on

7. Two main working modes

The **LX**160 has two main modes: VARIO and SC (speed command) mode. In the vario mode the needle displays vario, the upper number displays average. **Only if airspeed is present average is displayed.** The lower number display is decided by the user in the "INDIC" set-up menu.

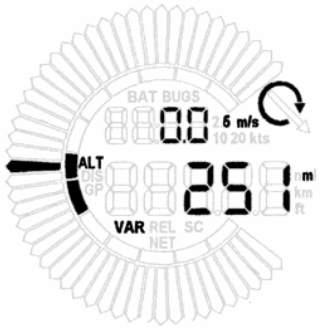


Figure 6 Vario mode

In SC mode, the needle displays SC, other information is selected by the user, the same as in the vario mode.

Figure 7 SC Mode

The SC ring (inner ring) always displays SC value, no matter in which mode the **LX**160 is in.

Settings for VARIO mode and SC mode are different

Warning!

Altitude, which is displayed on the lower number is always set on zero (QFE) after power on. In case you switch off the instrument during flight, the old QFE remains if IAS is greater than 40km/h

7.1. Set-up menus

We get to the set-up menu by pressing up the MC+ and VOL+ together.
The LCD indicator will display the first set-up menu. With the MC switch we can change between the set-up menus. Values in set-up menus can be changed with the VOL switch .

7.2. CONP (wind component)

In first setting menu we are setting wind component in units which are selected in units table

Figure 8 Wind component

Wind conponent = TAS – GS

7.3. DIST (distance)

In this menu we are setting the distance to target point. With long press of VOL switch, distance will increase/decrease for 10 units. Short press of VOL will increase/decrease the distance for 1 unit. For GPS information, the lower number is available. Information about GPS and distance is changed every second.

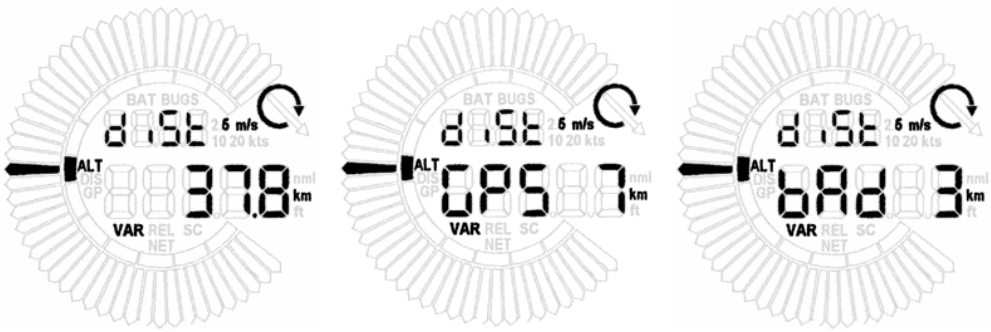


Figure 9 Distance to target point

7.4. TARG (target altitude)

In target menu we can set the altitude of the target. In case, that we have altitude on altimeter (ALT), set on QFE, and we want to fly back to our home airport (same as take off), TARG must stay on 0. If the altitude on the LX160 is set on QNH, we need to set the altitude of target. In that case we can make a final glide to each point selected, if we know it's altitude.

Figure 10 Target altitude

7.5. ALT (altitude)

Menu for setting altitude on QFE, QNH before take off or for correcting altitude during flight. It's pilot decision what kind of altitude will be displayed (QFE or QNH).

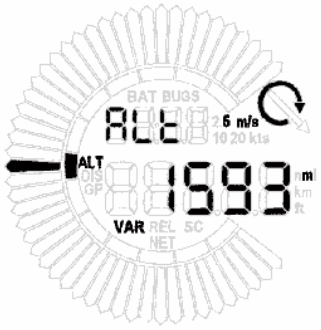


Figure 11 Altitude set-up

7.6. RES (altitude reserve)

In this menu we are setting the altitude reserve. If the altitude reserve will be 200m, that means, the final glide will be calculated 200m above the target point.

Figure 12 Altitude reserve

7.7. GPS

In this menu we enable or disable receiving of NMEA sentences from a GPS device. Default is NMEA receiving is enabled. If we want to correct some calculated parameter (distance, wind component), we must first disable NMEA, because if NMEA is enabled a GPS data is valid, we are not able to change these two parameters. When we disable receiving of NMEA both parameter values remain. Receiving of the NMEA can be enabled back at any time. If the GPS device is not connected on the **LX**160, or the GPS data is not valid, this menu has no use. (GPGGA, GPRMC, GPRMB)

Figure 15 GPS data valid

Figure 13 NMEA is disabled, NMEA data isn't detected

Figure 14 NMEA is disabled, NMEA data is detected

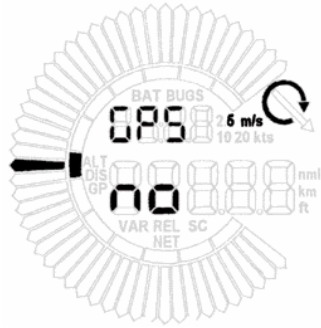


Figure 16 GPS data isn't valid

7.8. PASS (password)

If we enter the correct password, we have access to some special functions and settings.

Figure 17 Password menu

Passwords:

- 04670 System set up menu
- 01049 Automatic calibration of speed and vario on zero

This menu can be disabled. (*Ch. 8.10*) IAS >50 $^{km}/_{h}$

8. System set-up menu

8.1. POL (polar)

The **LX**160 contains a database of polars. We can choose from 85 different types of polars (table). If the polar is set to index 0 (USER). The pilot can set the polar parameters (a,b,c and wing loading kg/m2)

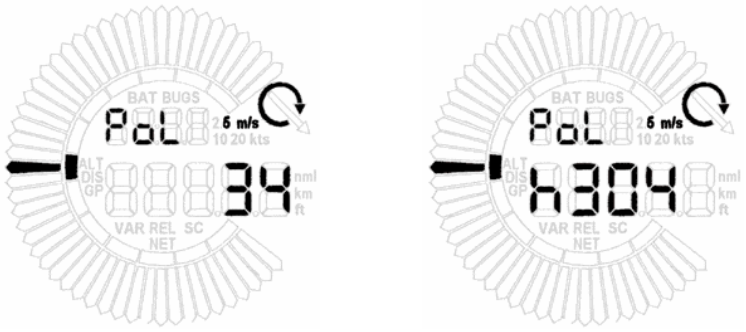


Figure 18 Polar

1	ASH 25	33	DIMONA	65	NIMBUS4D
2	ASH 25E	34	DISCUS	66	NIMBUS4T
3	ASH 26	35	DUODISC	67	NIMBUS4M
4	ASH 26E	36	G102CLUB	68	NIMB.4DM
5	ASK 13	37	G103ACRO	69	NIMB.4DT
6	ASK 21	38	H205	70	NIMBUS4M
7	ASK 23	39	H304	71	PHOEBUSA
8	ASTIR C	40	HORNET	72	PHOEBUSB
9	ASW 15	41	JANTAR2B	73	PHOEBUSC
10	ASW 17	42	JANT.ST2	74	PIK 20E
11	ASW 19	43	JANT.ST3	75	PUCHACZ
12	ASW 20	44	JANUS 3	76	S-10
13	ASW 20	45	JANUS B	77	SF26
14	ASW 22	46	JANUS C	78	SF27M
15	ASW 24	47	JANUS C	79	SF27
16	ASW 27	48	JEANSAS	80	SF34
17	CIRUS 18	49	LS 1CD	81	SPEED AS
18	CIR.L26	50	LS 1	82	CIRRUS 75
19	CIRUS ST.	51	LS 3 17	83	ST.LIBELLE
20	CL.ASTIR	52	LS 3	84	SZD 51-1
21	DG100	53	LS 4	85	SZD 53-1
22	DG200	54	LS 6	86	TWINAS 2
23	DG300	55	LS 7	87	TWINAS 1
24	DG400	56	LS 8	88	TWINAS 3
25	DG400/1	57	MININIM	89	VENTUS
26	DG500 M	58	MISTRAL	90	VENTUS
27	DG500/2	59	MOSQUIT	91	VENT.A16
28	DG500 T	60	NIMBUS2	92	VENTUS B
29	DG600	61	NIMBUS2C	93	VENT.B16
30	DG600/17	62	NIMBUS3	94	VENT.C17
31	DG800/15	63	NIMBUS3D	95	VENTUS C
32	DG800/18	64	NIMBUS4		

8.2. POLa,b,c,load (polar parameters)

If polar is set on index 0 (USER), then ***LX***160 uses for calculating of glide path this four parameters, which can be set by user in this four menus, where Pola is parameter a, Polb is parameter b, Polc is parameter c and load is wing load of glider (kg/m2). Use POLAR.EXE program for calculate a,b,c parameters.

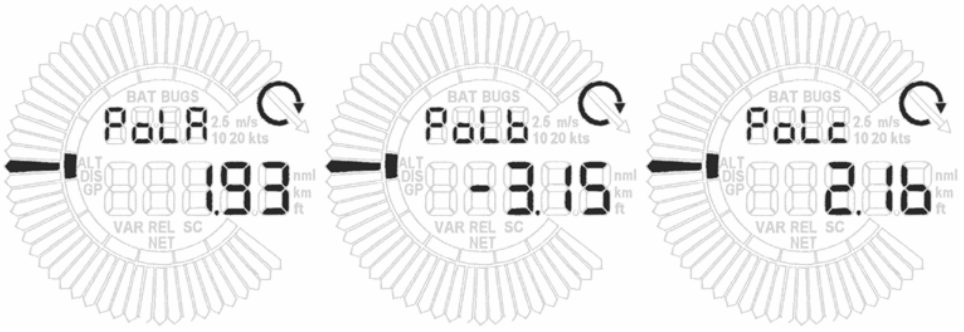


Figure 19 Polar parameters

8.3. ConP (wind method)

Two wind modes are available. Automatic (Wind component) and Fixed (set by user)

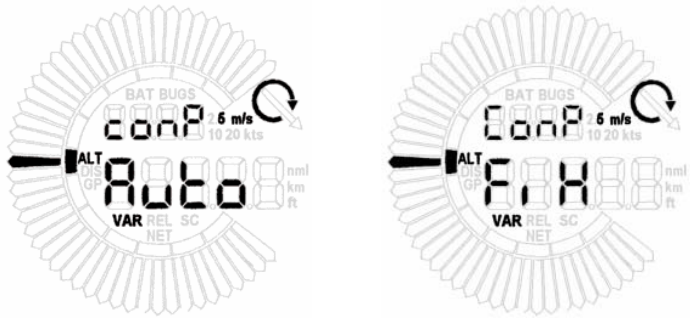


Figure 20 Wind methods

8.4. IND1..4 (indicators settings)

In this menu we can set, what will be displayed on the LCD indicator. We can make settings for four different indicators (depends on the address switches on the back side of LCD indicator). For each indicator we have prepared 10 templates (watch table below)

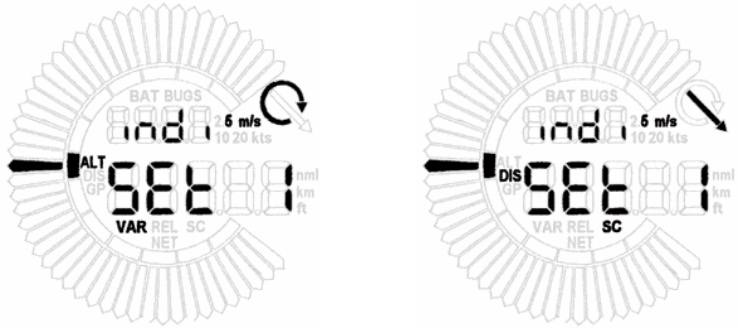


Figure 21 Indicator setting

mode	VARIO			SC		
	needle	Lower number	Upper number	needle	Lower number	Upper number
SET0	VARIO	DIST	INT	SC	GP	INT
SET1	VARIO	GP	INT	SC	GP	INT
SET2	VARIO	DIST	INT	SC	DIST	INT
SET3	VARIO	GP	INT	SC	DIST	INT
SET4	VARIO	GP	INT	NETTO	DIST	INT
SET5	VARIO	GP	INT	RELATIV	DIST	INT
SET6	VARIO	ALT	INT	SC	GP	INT
SET7	VARIO	ALT	INT	SC	DIST	INT
SET8	VARIO	ALT	INT	VARIO	DIST	INT
SET9	VARIO	DIST	INT	SC	GP	INT
SET10	VARIO	GP	INT	NETTO	GP	INT
SET11	VARIO	GP	INT	RELATIV	GP	INT
SET12	VARIO	GP	INT	VARIO	DIST	INT
SET13	VARIO	GP	INT	VARIO	GP	INT
SET14	VARIO	ALT	INT	NETTO	ALT	INT
SET15	VARIO	ALT	INT	RELATIV	ALT	INT

GP – glide path ; SC – SPEED COMMAND; INT - average

8.5. UNIT (measuring units)

We can choose between four types of unit settings (European, English, American, Australian). We can see them on table.

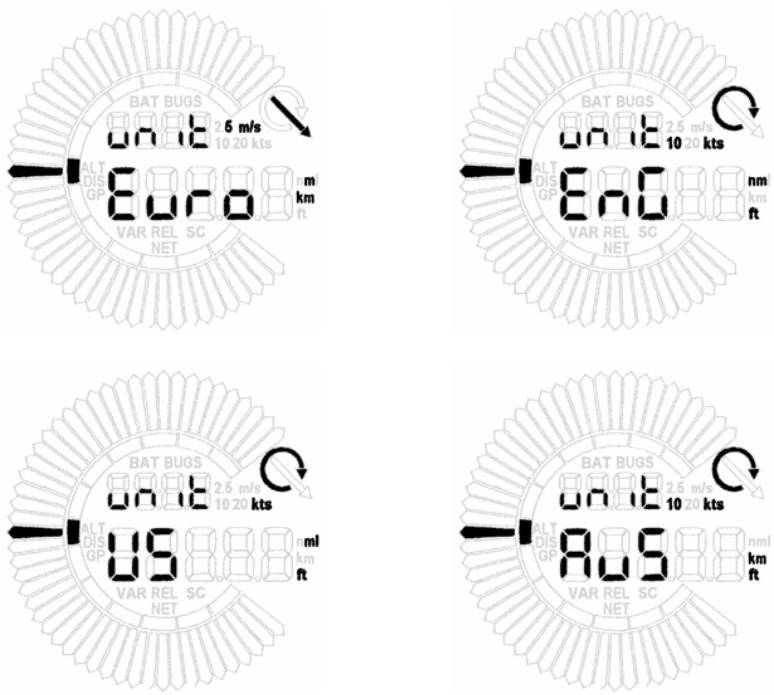


Figure 22 Units setting

	Euro	En	US	Aus
altitude	**m**	**ft**	**ft**	**m**
vertical speed	**m/s**	**kts**	**kts**	**kts**
wind speed	**km/**	**kts**	**mp**	**kts**
IAS	**km/**	**kts**	**mp**	**kts**
distance	**km**	**nm**	**ml**	**nm**

8.6. ScSp - (SPEED COMMAND Speed)

In this menu we can set the speed at which the LX160 will switch from VARIO to SC mode if AUTO SC is enabled.

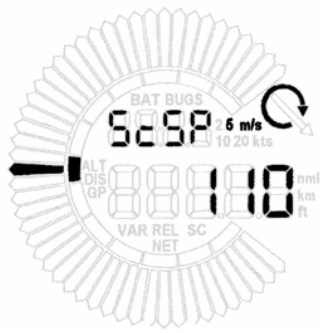


Figure 23 SC speed

8.7. Teco (total energy compensation)

If we have the LX160 set-up for pneumatic TE, (connected to a TE probe), TE compensation is set to 0%. In case, that we have connected to static pressure, TE must be user selected from 0% to 150%.

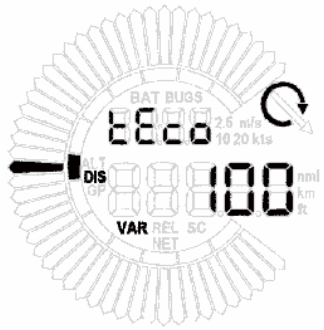


Figure 24 TE compensation

8.8. tabS (SC TAB)

SC mode with no audio information in area $\pm 1.5^{m}/_{s}$

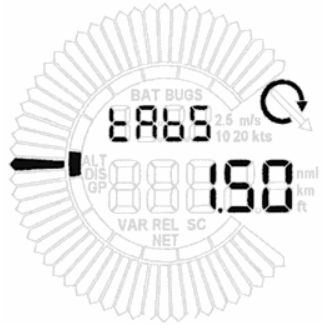


Figure 25 SC mode with no audio information

8.9. INT (vario integrating time)

Time of integration (average vario) can be set in this menu. Time range is from 1 to 40 seconds

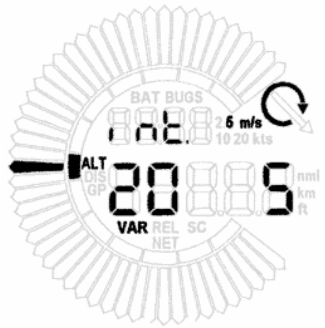


Figure 26 Integrator time

8.10. PASS (disable/enable)

During flight we can enable or disable PASS menu in set-up menu.

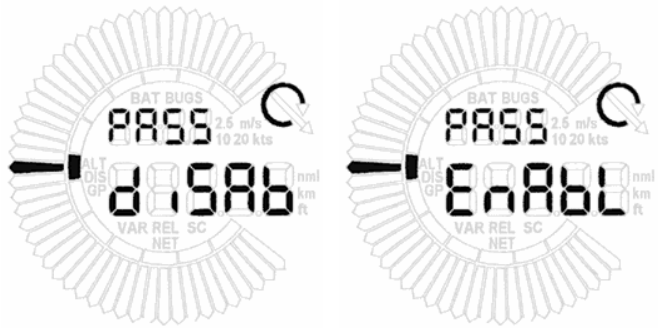


Figure 27 Access to PASS menu during flight

8.11. Sc (on/off)

Inverts external SC input

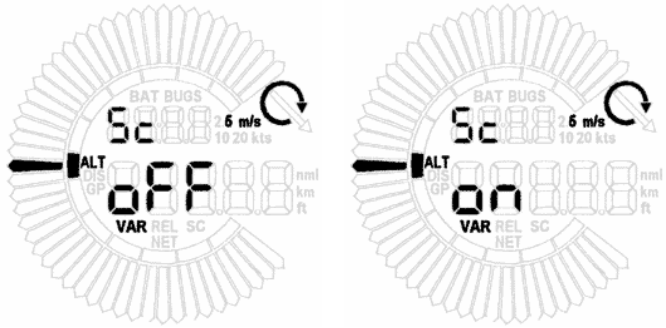


Figure 28 Inverting Speed Command input

8.12. Batt (battery voltage)

Figure 29 Battery voltage

8.13. Output for WinPilot

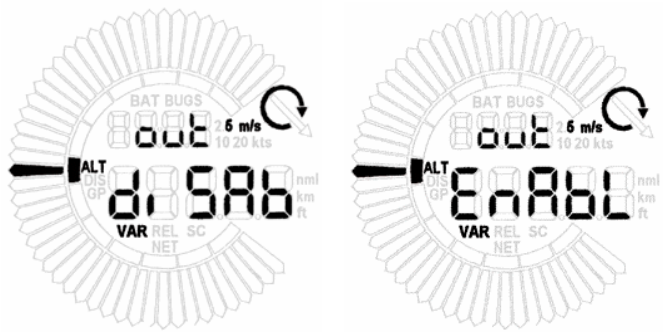


Figure 30 Enable or disable output for WinPilot

8.14. Fil

For each switch position (0, 1 and 2 of FIL switch), different filter constants can be set. Filter constant unit is a second.
Range: from 0 to 5 seconds.

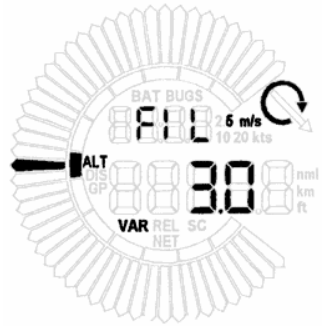


Figure 31 Vario filter setting

8.15. Bal

Ballast settings for all three positions of BAL switch can be set.
Range: 1.0 to 1.5 (overload constant)

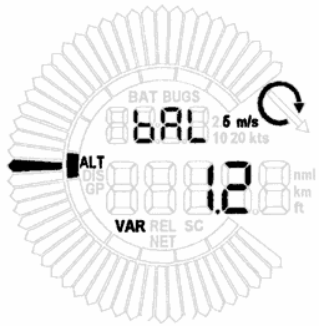


Figure 32 Ballast setting

Example:
Glider weight without ballast + pilot = 360kg
Maximum takeoff weight = 450kg
Ballast weight = 80kg

$$\text{overload\_constant} = \frac{weight + ballast}{weight}$$

8.16. Bugs

Bug settings can be inserted in percents (%). That means glide ratio degradation in %.
Range: 0% to 30% glide ratio degradation.

Figure 33 Bugs - glide ratio degradation setting

8.17. Final glide calculation

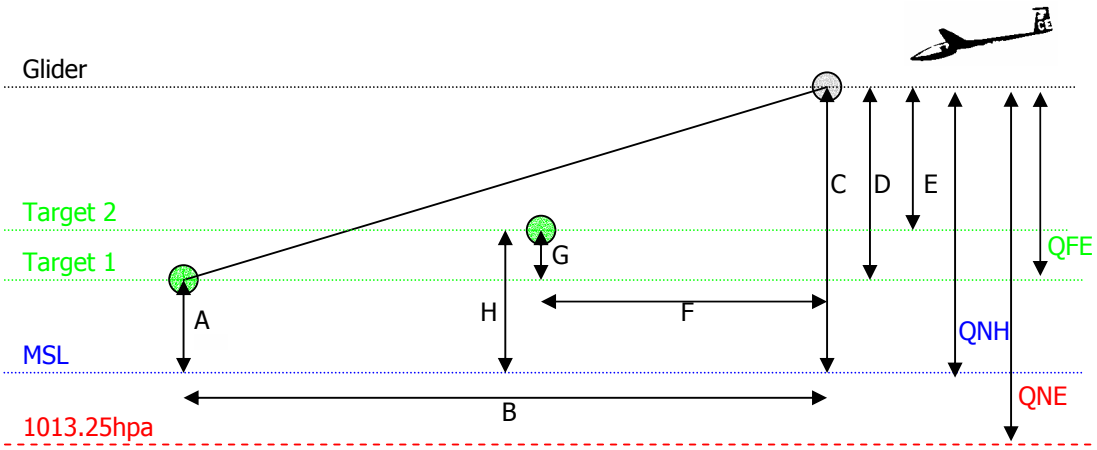


Figure 34 Final glide

Example 1:

If navigaltion will be always on our home airfield (where we take off ***Target 1***).

After power on ***LX***160 altitude and target altitude (elevation) are set on 0 m(ft) - (QFE). Glide path will be calculated always to 0m.

Altitude on ***LX***160 is D

Example 2:

We are flying task. Before take off, altitude on ***LX***160 should be set on airfield elevation QNH ***(A)***. Altitude on instrument is ***(C)***. If we navigate on airfield ***(Target 1)***, target altitude on ***LX***160 must be set on ***Target 1*** elevation ***(A)***, if ***Target 2*** is our turning point, target alt must be set on elevation of Target 2 ***(H)***.

Result is always glide path (GP). If GP is positive, means we have reserve. If it's negative we'll not reach the target. We must raise up until GP will not be positive. Glide path function is calculated from following parameters:

- polar
- McCready
- altitude
- target altitude
- disatance to target
- wind component

9. Some special functions

9.1. Initialisation of memory

If settings on the LX160 are unusual (e.a. distance is negative), we can set all values back to the default settings. This action can be done, if we switch off the instrument, push down VOL and MC together and switch the instrument on. On the LCD we will see a message "data init".

Figure 35 Initialisation of memory

10. Wiring extension for WinPilot

LX160 with version 2.0 supports communication with WinPilot CE software. For old units with versions lower than 2.0, a firmware update and wiring upgrade is necessary.

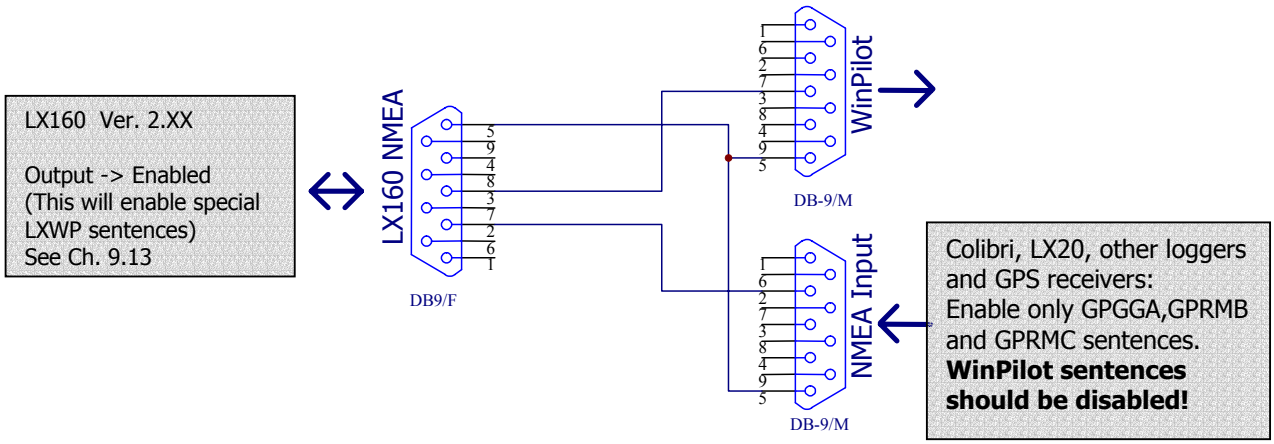


Figure 36 Wiring extension

11. FAQ - frequently asked questions

Q: Why does the LCD blink ?

Figure 37

A: Check indicator cable. Check, if **LX160** works.

Q: **LX160** can't receive GPS data.
A: Check if GPS device is connected correctly. Check if GPS device transmits correct data (**GPGGA, GPRMC, GPRMB sentences**)

Q: Vario in **LX160** is very slow. SC doesn't work properly.
A: Check if probes are connected properly

Q: What means that message?

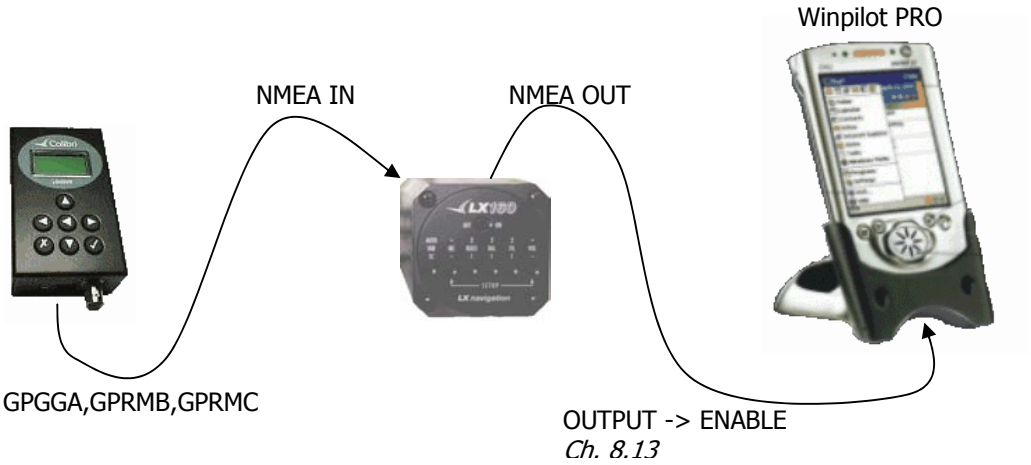
Figure 38

A: Program data in eprom is damaged or socket for eprom is damaged. Insert new eprom or check socket and pins on it.

Q: Can you tell me how to zero the vario?
A: In password menu enter:01049 and waituntil autozero procedure is finished.

Q: My glider is not on the polar list of **LX160**. How can I calculate aPolA,PolB and PolC parameters?
A: Use **LXpolar** program in **LXe**. It's available on our web.

Q: How to connect Winpilot with combination of LX160 and Colibri?

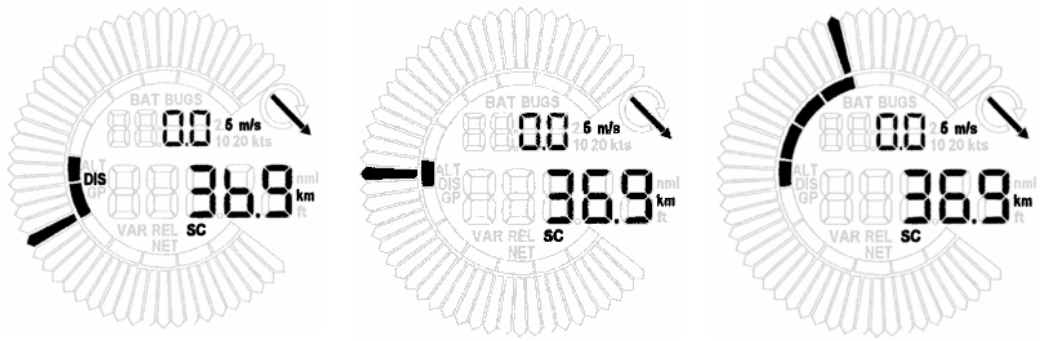


Ch. 8.13

A:

Q: What does the instrument display look like when I am:

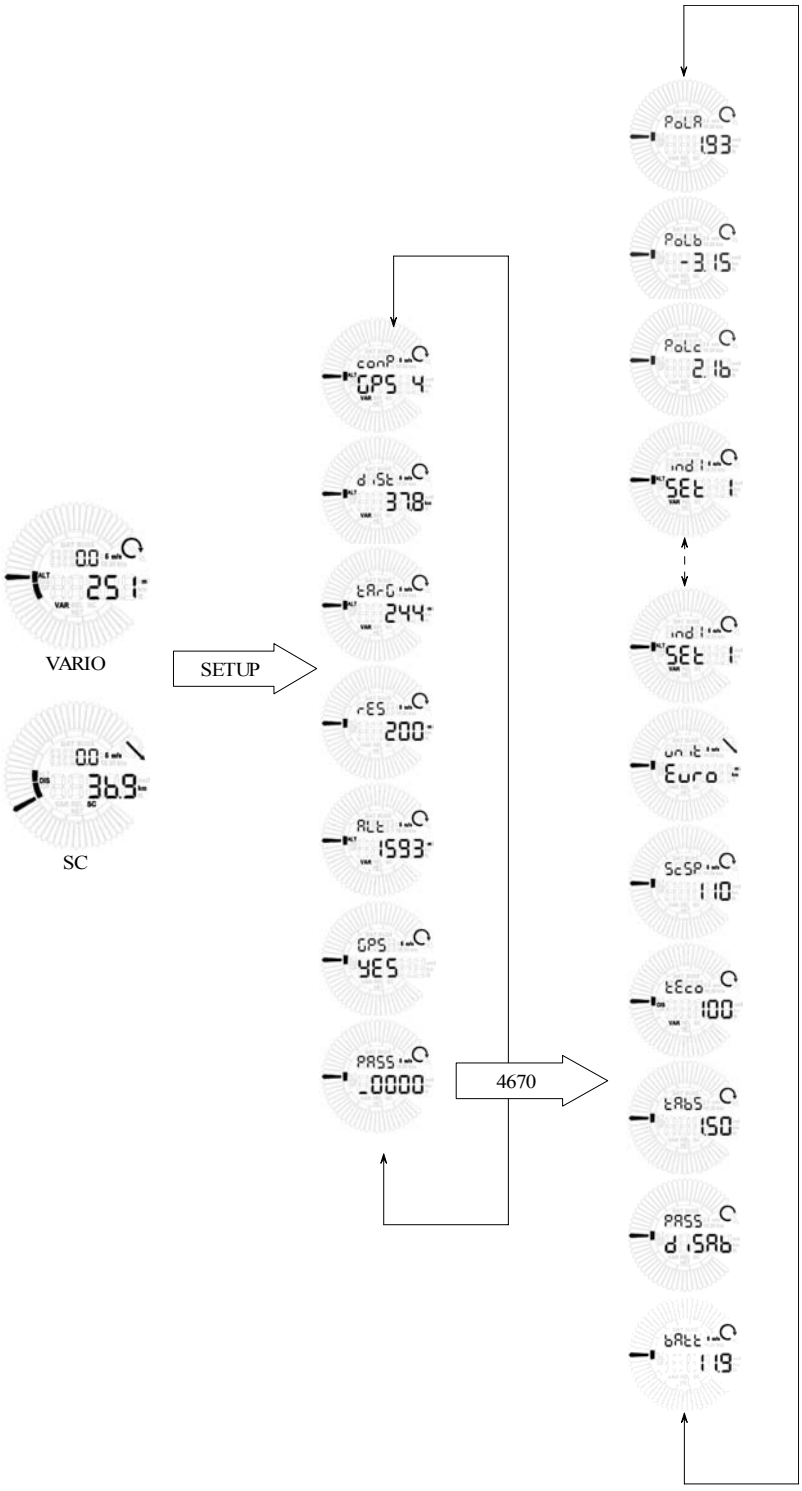
Flying too slow | Flying at the right speed | Flying too fast



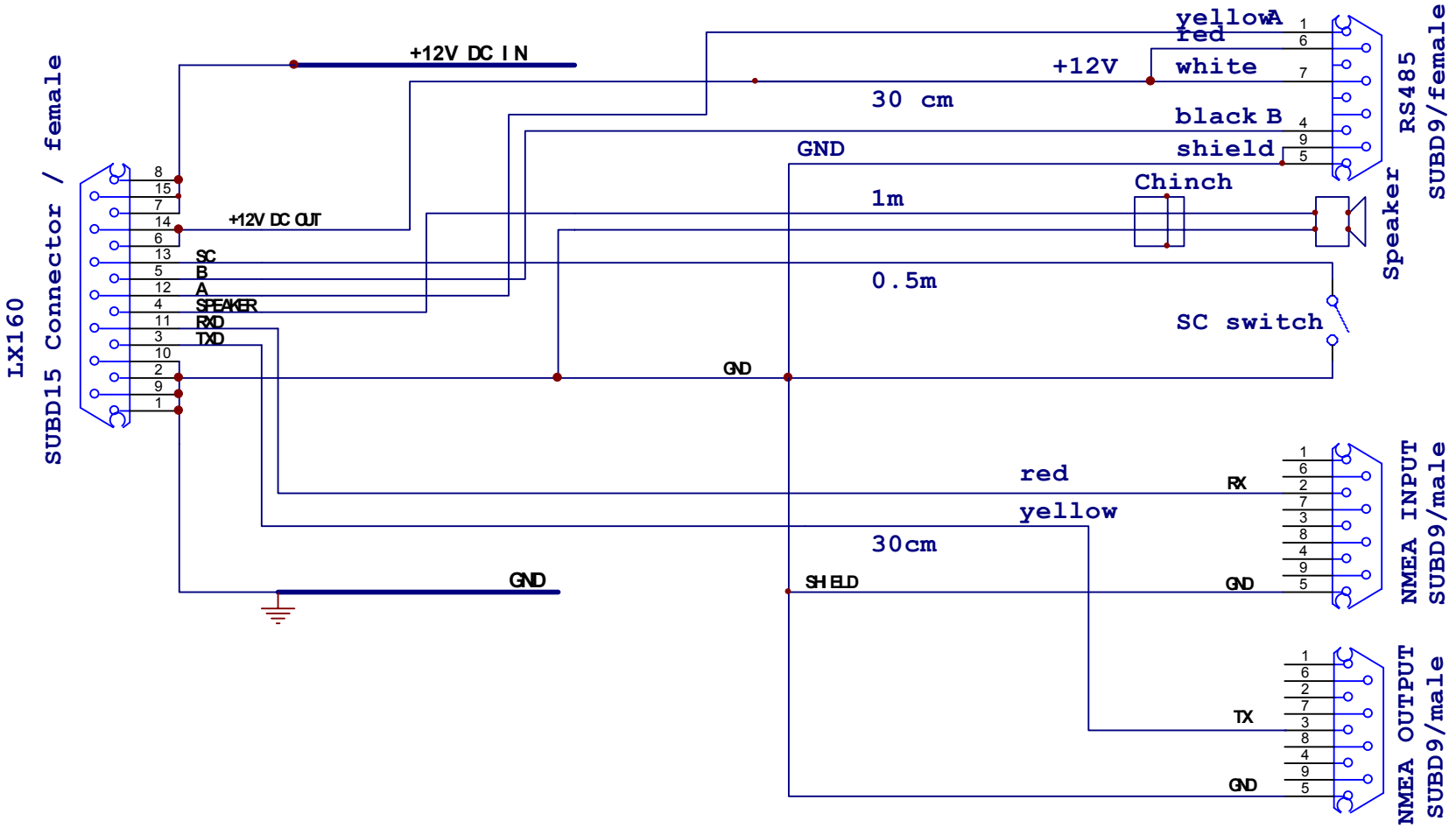
A: The upper display (average) remains at 0.0 no matter what climb or sink rate you have.
Q: If airspeed is not present average remains on 0.0. Check if **Ptot** proble is connected properly. It should be connected to »**NOSE**«

12. Appendix

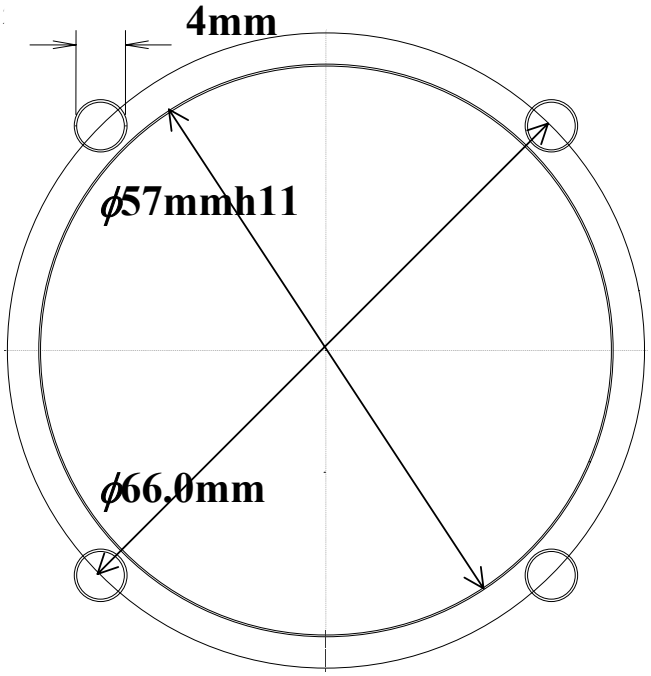
12.1. Tree structure



12.2. Wiring


LX160
SUBD15 Connector / female
+12V DC IN
+12V DC OUT
SC
B
A
SPEAKER
RXD
TXD
GND
GND
30 cm
+12V
yellow
red
white
black
B
shield
GND
1m
Chinch
0.5m
SC switch
Speaker RS485
SUBD9/female
red
yellow
30cm
RX
GND
SHIELD
NMEA INPUT
SUBD9/male
TX
GND
NMEA OUTPUT
SUBD9/male

12.3. Drilling Plan



Drawing not to scale.

The cutout needed for the lcd indicators conforms to standard with 2 1/4"

12.4. Pins

1	GND
2	GND
3	TXD
4	SPEAKER
5	RS485 B
6	+12V DC OUT
7	+12V DC IN
8	+12V DC IN
9	GND
10	GND
11	RXD NMEA
12	RS485 B
13	SC
14	+12V DC OUT
15	+12V DC IN

12.5. Revision History

Version	Date	Description
v1.3		- added SC TAB setting and Enable/disable password
v1.35	11.04.1999	- added auto distance function, if NO NMEA (in SC mode)
	02.05.1999	- Added SC/VARIO Volume, it writes in eeprom, on set-up exit. - Added INT time in set-up
	05.05.1999	- corrected parameters of DG300 polar
	17.05.1999	- Wind method corrected
V 1.36	19.05.1999	- eeprom corrections
V 1.37	24.05.1999	- Units are stored in eeprom ENG, US, AUS and EURO. - New function SC ON/OFF
V 1.38	24.09.1999	- Added Circling detect - Wind component is calculating only when is detected circling
V 1.39	01.04.2000	- Two new settings for LCD indicator - User can set a wind method (Component or fixed)
V 2.00	28.11.2000	- LX1160 supports WinPilot
V 2.01	01.01.2001	- LX1160 supports WinPilot Pro (*Ch. 8.13*)
V 2.1	1.1.2002	- User defined BUGS, BAL and Vario FIL settings (*Ch. 8.14;8.15;8.16*) - New polar parameters a,b,c (*Ch. 8.1*)
	22.1.2002	- Corrected wiring schematics in manual (*Ch.12.2*)
	7.2.2002	- Added: *How to connect Winpilot with…* (*Ch.11*)
	9.5.2002	- Corrected Ch.7, Added FAQ
V 2.12	9.12.2002	- Two new LCD settings added

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