

LX 166

V1.1

Vario/NavigationSystem

User Manual



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1 System Description

The system consists of two 57 mm air norm units. **LX 166 controller** unit is main unit of the system and controls Vario unit which is a slave and is not capable to operate as stand alone. The **Vario unit** has also audio and is powered from LX 166 main unit. The communication between both units is realized via LX 485 system bus. All connections are plug_and_play.



Vario unit doesn't have any controls and is completely under LX 166 Main unit control. LX 166 Main unit has one **multifunctional rotary switch**, six **push buttons** and a **graphic display**.

GPS input is realized via 6 P telephone type connector, which is compatible with Colibri, LX 20 and also with Flarm units. The baud rate of GPS source doesn't matter as, the unit is capable to synchronize automatically. Minimum two NMEA data sentences (GGA and RMC) are necessary for basic operation.

The unit has built in **real time clock**, so the logbook information will remain also when flying without GPS.

1.1 PDA Connection

The unit has a special port to connect with PDA. Data and 5V power are available on 9P SUB D connector which is positioned on the back side of the unit. The cable is delivery included (LX 1638 or 1636). If Flarm is taken as GPS source **also collision relevant** data will be sent toward PDA.

1.2 Options

1.2.1 Bluetooth interface

LX Bluetooth Interface is capable to be connected to PDA port and to send data by air. After using of cable, 5V DC voltage will supply PDA at the same time.

1.2.2 Secondary Vario Indicators

This solution makes possible to connect another vario indicator to the system. This solution is mainly used in double seaters. All connections are plug_and_play. Generally it is possible to connect unlimited number of vario indicators after using of LX 485 slitting units.

1.3 Technical data

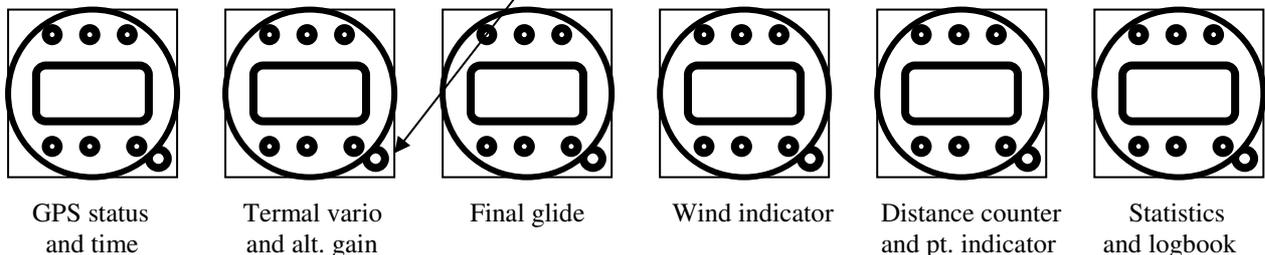
- Power: 8-16 V DC, consumption 150 mA @ 12V, without audio
- Pressure transducer technology
- GPS input, automatically synchronization to GPS source at 4800, 9600, 19200, 34800 or 155200 bps
- PDA port; 5V and data (Flarn data also included)
- System extensions; double seater configuration
- Bluetooth Option
- High resolution graphic display (32x97 dots)
- Real time clock
- Weight: 550 gr
- Size: 57 mm air norm, LX 166 depth 80 mm connectors included, Vario unit depth 140 mm incl. connector

2 Description of Controls

To operate the unit one rotary switch and 6 push buttons are available.

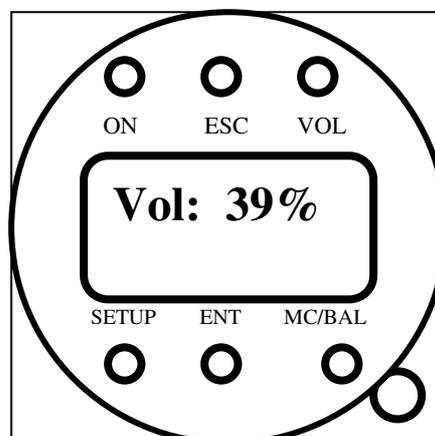
2.1 Rotary Switch function

The switch is capable to be rotated **clockwise** and also opposite and doesn't have limitation. The main function of the switch is to switch between **modes of operation**. During edit the switch is used as **Up/down** selector to make possible fast and effective inputs. LX 166 has **6 modes** of operation and all of them are **selectable exclusively** after rotation of Mode Selector switch.



2.1.1 Rotary Switch function in Edit

If the rotary switch is used after pressing of VOL, MC/BAL or SETUP push button, the function of the rotary switch is **temporary altered**. Rotating of the switch makes possible to ensure comfortable inputs of mentioned parameters. Immediately after edit procedure is terminated the switch becomes Mode Selector automatically.



Example of Audio volume adjustment after using of VOL button and Rotary Switch

2.2 Push Buttons

There are 6 push buttons positioned on the LX 166 front panel. Their functions are as follows:

-**ON/OFF** to switch the unit on and off

-**ESC** to close edit procedures, is not active during normal operation

-**VOL** to adjust audio volume

-**MC/BAL** to input MC, ballast or “Bugs”, double click will activate ballast input and triple click will enable “Bugs” input

-**ENTER** is a multifunctional button:

- during operation in **Final glide** mode; each press will change from Home destination to TP destination received by GPS
- will insert one additional point, in **Distance counter** mode
- in Setup enables inputs of parameters

-**SETUP** will change over to Setup, where different settings and system settings are possible

Note!

For detailed description see further paragraphs.

3 Switching ON

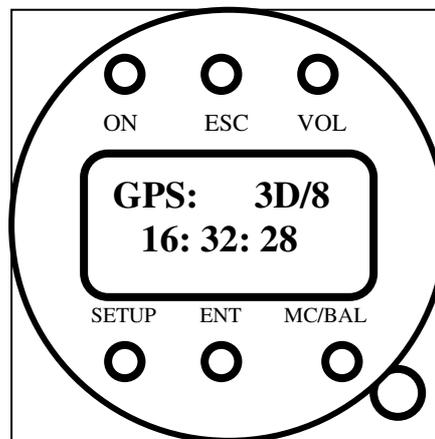
After a short press on ON/OFF button the unit will start with booting. Following sequences will run automatically:

- LX 166 **program version** display
- Active **polar** display
- Searching for GPS** source baud rate

The unit will search for GPS data on several speeds, if GPS data won't be found the unit will change into first navigation page and display a very typical message NO GPS.

Note!

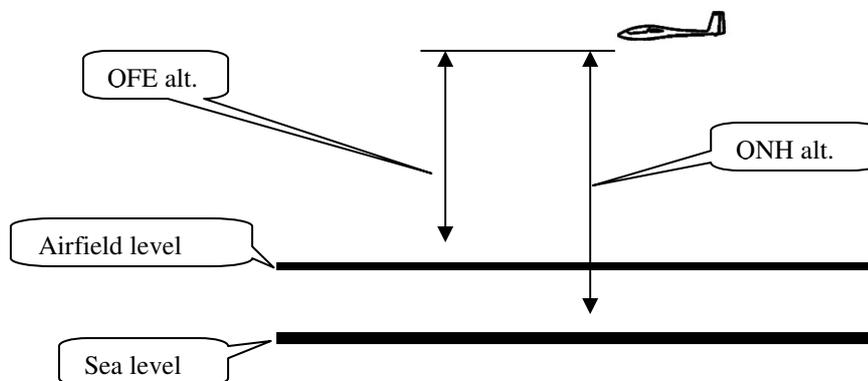
The unit can be set to QNH or QFE altitude, this is done in SETUP. Having setting **QNH active**, an obligatory airfield elevation input request will follow. For more see further paragraphs.



LX 166 ready after booting

3.1 QNH and QFE flying

Flying QNH means that LX 166 will indicate altitude above sea level. This is exclusively possible after airfield elevation input after power on. QFE flying means that the take off **airfield elevation will be taken as zero level** and all altitude readings during flight will be indicated above this reference.



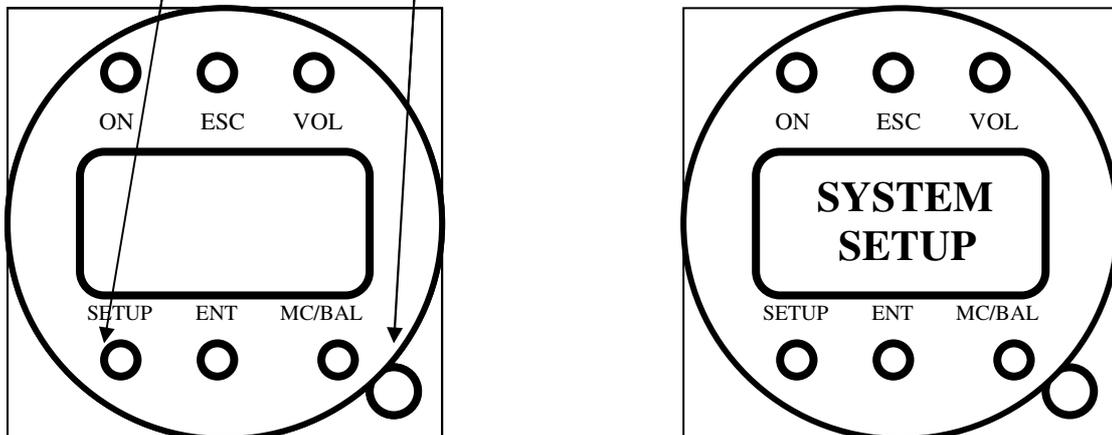
Flying QNH is more flexible than QFE flying. It is important to point out that GPS data doesn't include destination elevation data, so the pilot has to input **destination elevation** in case of landing out of take off airfield, to get real final glide data information.

Note!

It is suggested to use QNH method by cross country flights, QFE is quite comfortable by local flights.

4 SETUP

After a press on **SETUP** button the setup menu will open and inputs of several data will be possible. There are eight pages available after using of **Mode Selector**. The last page is designated as **System Setup** and after using of this selection system parameters can be updated, for instance polar, units ...

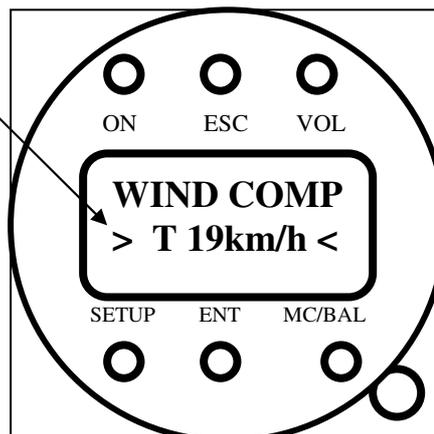
**Note!**

After jump into Setup a time out is activated and after no action for more than 3 seconds the unit jumps automatically out of Setup. In fact the last used navigation page will become active.

4.1 Setup Pages

After press on **SETUP** button always the first page of Setup menu will become active. Selection of other pages is possible after rotation of **Mode Selector** clockwise.

Inputs are possible exclusively after press on **ENTER**; this action is visualized with two special characters located on **the left and right** edge of the display.

**Note!**

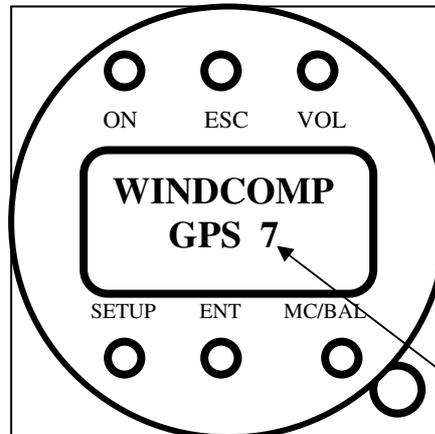
During this status time out is not active.

Following pages can be selected: Wind Component, Target Distance, Target Elevation, Safety Altitude, Vario Filter, PDA Port, Transfer, System Setup.

4.1.1 Wind Component input

Important!

This action is possible only without GPS connection or if Wind method is set to FIX. Having GPS connection the wind is calculated automatically and also taken in final glide account.



Input is executed after **ENTER** and rotation of **Mode Selector**. The situation after **GPS signal** is present.

4.1.2 Target Distance

This input makes possible to input the distance from actual position till landing. This will ensure the pilot to have useable final glide data even, if there is no GPS signal. During final glide the distance reduction will run automatically when SC is active, based on speed.



This input isn't active after LX 166 is coupled with GPS. The distance is replaced with GPS status data.

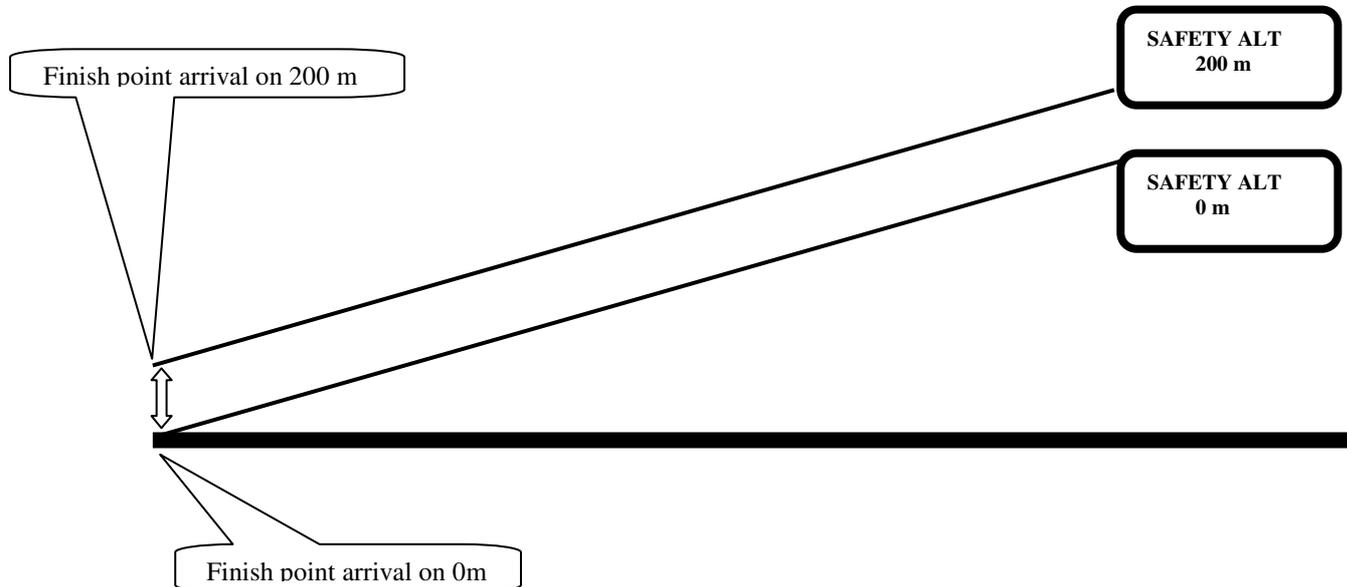
4.1.3 Target Elevation input

This input makes possible to realize **final glide** to any airfield. After using of QNH method the input should be simple the **elevation of the landing place**. During QFE operation it is possible to arrange final glide only to home airport, target input isn't possible.



4.1.4 Safety Altitude

If the pilot wants to arrive over the finish point on predefined altitude, this value in m or ft should be input in this menu. The final glide will be simple sifted adequately.



4.1.5 Vario Filter

The vario needle and also audio can be more or less filtered. The pilot has possibility to adjust his personal setting from 0 up to 5s. 0 s means no filtering and 5s means maximum.

VAR FILT
> 3.1 s <

4.1.6 PDA Port

LX 166 is capable to supply PDA with GPS and Flarm data. The baud rate (communication speed) at which LX 166 will send data toward PDA can be defined in this menu.

4.1.7 Transfer

LX 166 is able to establish direct connection between PDA and GPS source, for instance Colibri. After Transfer enable a **direct** communication way PDA GPS source will be established. The units can communicate without any LX 166 influence.

4.1.8 System Setup

System Setup is **second level** of Setup and mainly consists of glider data and also of some system configuration data, as for instance TE compensation method. It is recommended to pass this menu after first installation.

4.1.8.1 Polar

Nearly all glider polars are stored in the LX 166 memory and selectable in this menu. In case that there is no polar to be found, a **user** polar input is possible. User input consists of three parameters a,b and c which can be easily calculated after using of LXe PC program.

4.1.8.2 Wind Met (wind calculation method selection)

The unit is able to calculate wind direction and speed. After AUTO is set an automatic wind calculation process will start. It is important to point out that AUTO method needs GPS connection. The wind calculation is based on ground speed difference during circling. To get first result it is necessary to make two full turns, afterwards the updates will follow continuously during circling. There is no wind update during straight flight. Selection FIX, disable automatic wind calculation and requests manual input of wind component, see 4.1.1.

4.1.8.3 Units

The unit is capable to operate with several sets of unit's combination. Following sets may be selected:

	Euro	Eng	US	Aus
altitude	m	ft	ft	m
vertical speed	m/s	kts	kts	kts
wind speed	km/h	kts	mph	kts
IAS	km/h	kts	mph	kts
distance	km	nm	ml	nm

4.1.8.4 Alt. Method

As mentioned before the system may operate by QNH (altitude indication over sea level NN) or by QFE. After QFE setting the take off airfield level will be taken as zero level and all altitude indications will correspond to this level. QFE selection is suggested only for local flights, as there is no way to adapt final glide to another airfield.

4.1.8.5 Var Range

This setting defines range of the vario needle and averager.

4.1.8.6 Smart Vario

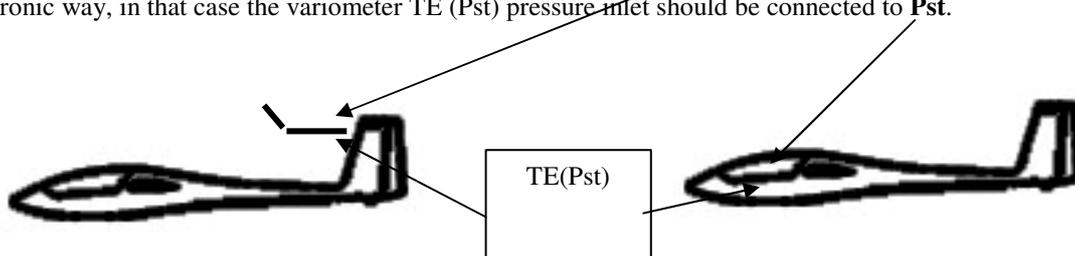
“Smart Vario” is an additionally filter which can be cascaded to vario filter described in 4.1.5. In fact this filter limits the vario needle deflection speed. More input means the needle deflection speed will slow down.

4.1.8.7 Int. Time

The avergaer integration time can be set from 1 up to 40 seconds. Default setting is 20 seconds.

4.1.8.8 TE Compensation, TE Filter

The variometer TE compensation can be realized after using of **TE probe** usually installed on the glider tail, or electronic way, in that case the variometer TE (Pst) pressure inlet should be connected to **Pst**.



Pneumatic TE compensation **requests** TE COMP setting 000%, TE filter doesn't matter. After using of electronic way some tuning will be necessary.

The electronic TE compensation can be fine tuned during flight with the following procedure. It is essential that this is only done in smooth air; it is not possible to tune the TE accurately when it is thermic.

- Select 100 % and default TEF
- Accelerate up to approximately 160 km/h (75 kts) and keep the speed stable for a few seconds
- Rapidly reduce the speed to 80 km/h (45 kts)

Observe the vario indicator needle during the maneuver. At 160 km/h the vario will indicate about -2 m/s (-4kts). During the speed reduction the vario should move towards zero and should never exceed zero (slightly positive indications are acceptable). If the vario shows a climb, then the compensation is too low, increase the TE%; and vice versa. Try another zoomie to assess the change and make further adjustments if necessary.

The **TEF** (TE filter) is the compensation delay. Larger numbers will increase the delay and vice versa. During the first test is recommended to use TEF 4.

Electronic TE is only effective when the pitot and static sources are co-located and the pneumatic lines to the instrument are approximately the same length. The best sensor to use is the combined pitot/static Prandtl tube. If problems are experienced with the electronic TE compensation, then the most likely cause is the glider's static source. The static source can be checked by plumbing the pneumatic tubes for electronic compensation and then setting the **TE**: to 0%. In still air, accelerate to approximately 160 km/h and slowly reduce the speed. Observe the vario indicator. If the static source is good, then the vario should immediately start to move to show a climb. If the needle firstly shows increased sink and then moves to a climb, the static source of the glider is unsuitable and there is no way to provide successful TE compensation electronically. The use of a dedicated and accurate fin mounted pitot/static source such as a Prandtl tube might help.

4.1.8.9 SC TAB

This function is active exclusively during Speed Command mode and defined dead area of audio by correct speed. The window is defined with SC needle deflection.

4.1.8.10 SC INPUT

To activate SC mode and vice versa usually a toggle switch is used. This setting defines criteria which will activate SC mode of operation. Closed or open contact can be used. Setting ON will arrange change over to SC after switch will close and vice versa. The switch should be wired to Vario unit wire marked as SC.

4.1.8.11 SC Speed

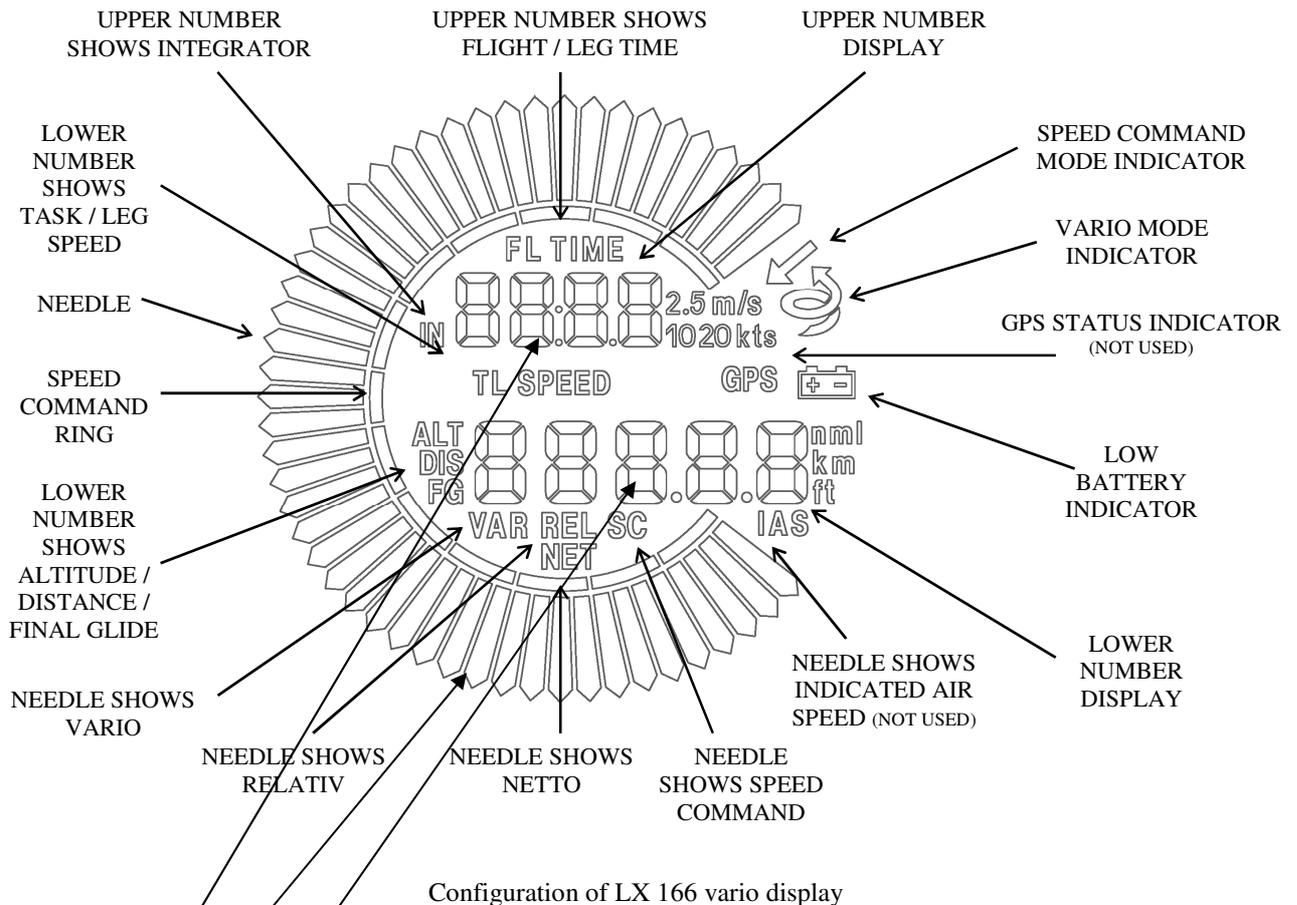
SC mode can be also activated automatic way after reaching change over **speed** which is defined in this menu. GPS selection will activate SC after a straight flight will be detected and vario mode will be set after circling will be detected.

Note!

Manual change over has a priority, if used will overdrive automatic settings.

4.1.8.12 Vario Indicator Setting

LX 166 Vario unit uses a custom LCD as vario needle indicator, additionally there are some additionally symbols and two numerical indicators. LX 166 is capable to drive also secondary indicators which are bus connected. These are not simple repeaters but can be different configured, as each unit can have different address. All units having the same address will also indicate the same. There are four different addresses to be chosen, from address 1 to address 4. LX 166 vario unit has always **address 1**.



Note!

The indicator may be configured separately for vario mode and for SC mode.

VAR NEEDLE (needle configuration in vario mode): VARIO, SC., NETTO, RELATIV
VAR LOW NR (lower number indicator in vario mode): Altitude, Distance, Final glide, TAS,
VAR UP NR (upper number indicator in vario mode): Average, Time, Flight time,

The same procedure is valid for SC mode. Having secondary indicators connected to the system bus, repeat the procedure for other addresses, if used.

4.1.8.13 NMEA Output

LX 166 has a special output realized as 9P SUB D connector which is positioned on the back side of the unit and **clearly marked as PDA**. This output is used to supply PDA units with NMEA data and also 5V power. NMEA can also include Flarm data, if Flarm is taken as a GPS source for the system. A suitable cable (1638 or 1636) is part of delivery.

Important!

Never connect any LX bus connectable unit to PDA marked connector, the unit will be **damaged**.

Disabled means no data sent toward PDA.

5 System Configurations

There are three configurations possible:

- without GPS source connected
- connected to GPS source but without connection to PDA
- connected to GPS source and with PDA connection

5.1 Operation without GPS

This is a completely stand alone operation. The system hasn't GPS data and therefore is not able to deliver any useable data to PDA, so the connection of PDA doesn't have any sense.

Final glide can be executed exclusively after manual input of the target distance.

5.2 Operation with GPS

This mode of operation makes the system much more applicable and also the information given by the system is absolute reliable.

5.2.1 GPS Sources

GPS source is connected via **6P telephone type** connector which is positioned on the back side of the unit. There is also **12V power** for GPS available. Connector pin out corresponds to Colibri, LX 20, Flarm and VL, so mentioned units can be connected plug and play to LX 166. Connection via delivery included cable will also power GPS.



Any other GPS source which delivers NMEA data strings is also acceptable, for that case an open wire cable is delivery included.

5.2.1.1 NMEA data strings

NMEA data sent from GPS source should correspond to **NMEA 183** standard. The unit is capable to receive also Flarm **collision avoidance** data strings and to send them toward PDA. As mentioned before LX 166 is able to receive MNEA data at several baud rates and the **synchronization** is carried out after every power on.

Following basic data strings are expected by LX 166:

- GPGGA
- GPRMC

Both sentences **should** be present; otherwise position information will not be complete. After receiving of GGA and RMC the LX 166 isn't able to serve as final glide calculator, as there is no information about the distance. So called **GPRMB** data sentence includes **distance information**. Usually this sentence should be enabled in GPS source.

5.3 Operation with GPS and PDA

This kind of operation makes the system extremely flexible and user friendly. GPS should supply GGA and RMC data, RMB is appreciated, as presence of this data will make possible final glide calculation also on LX 166. If Flarm is taken as a GPS source also collision avoidance data sentences will be received by LX 166. LX 166 does simple resend GPS and Flarm data toward PDA. Additionally data strings (LXwp) including also information about pressure altitude, TAS and vario are sent toward PDA.



Note!

LX 166 is also capable to **receive some commands** from PDA. This feature depends on PDA program. See You Mobile users should enable LX 1600 as Device in Setup/Hardware.

5.4 System extensions

LX 166 has a free 485 marked connector which makes possible to connect secondary vario displays for double seaters.

6 Flying with LX 166

It is absolute necessary to know the configuration of LX 166 and to respect limitations which are connected with different configurations.

6.1 Power on and elevation set

6.1.1 Using of QNH method

If the unit is set to QNH, local elevation should be set, otherwise the unit will not **boot finally** and following display will remain.



Offered is the elevation which was used during previous flight. If the glider is situated always on the same airfield this figure should be only checked and simple confirmed with **escape**. If the figures don't match field elevation a **correction** should be done. After field elevation input also the altitude reading of **Vario unit will change**, to match field elevation set in LX 166.

Note!

After using of QNH method, the target elevation input is necessity, otherwise final glide will be wrong.

Note!

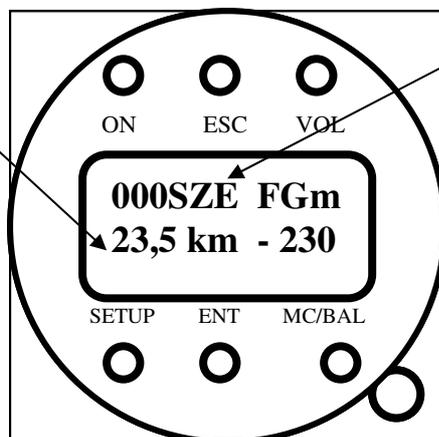
It is obligatory to check polar after power on, if the polar is not correct a change should happen.

6.1.2 Using of QFE method

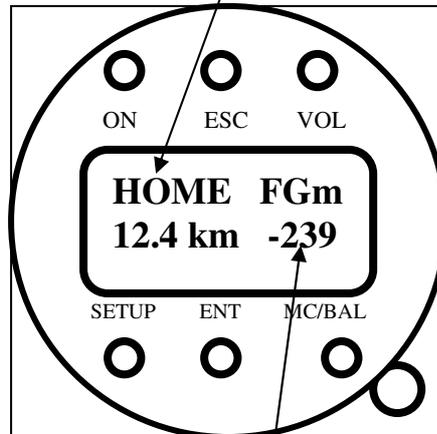
After QFE method has been set in Setup, there will be no **SET ELEVATION** request after power on and the unit will jump into GPS mode without any command. The Vario unit altitude indicator will also be zeroed. After using of this method the final glide will be realistic only to home airfield.

6.2 Navigation with LX 166

LX 166 is able to offer basic navigation data after connection with GPS is realized. The navigation data are shown in third navigation page. If the unit receives also RMB data sentences, which include **name** and the **distance** to the destination, both will be shown in the third navigation page automatically.



If there is no RMB data present, navigation to **take off airfield** is always available. Take off airfield is designated as HOME.



Note!

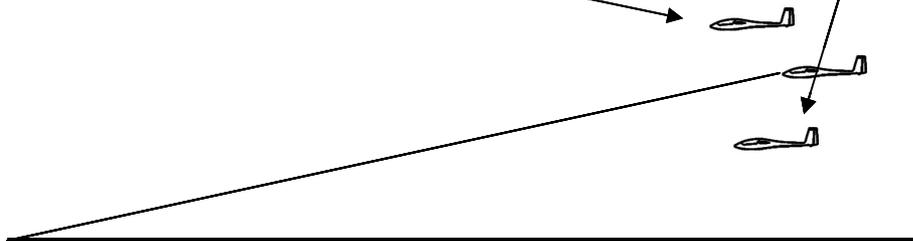
Change over from **Point** navigation to Home is possible after short press on **Enter** and vice versa.

6.3 Final glide calculator

The final glide calculation with GPS connection is based on following parameters:

- MC setting
- bugs setting
- distance
- polar
- safety altitude
- wind

LX 166 calculates and shows **altitude difference** to final glide. Indication - **xxxx** meters means below final glide and **positive indication** shows position above final glide line. Safety altitude input only shifts the final glide adequate.



Note!

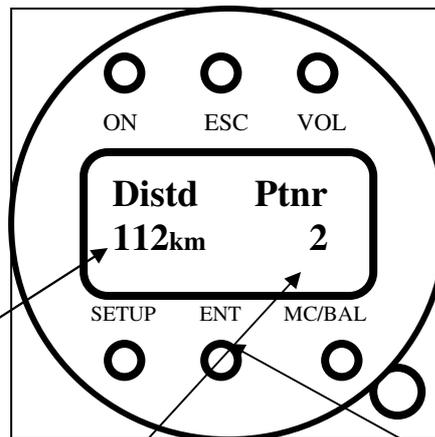
After input of safety altitude the final glide should be performed with zero altitude difference reading, to arrive on safety altitude. Wind component for final glide will be calculated from wind indicated in wind display; this is valid, if GPS signal is present. By no GPS manual input will be taken in account.

6.3.1 Final glide calculator without GPS connection

In that case the pilot should input the distance and the wind component manually and to switch to SC. During SC the distance will reduce on TAS base. It is important to point out that the pilot has to check the distance periodically and to compare with the map.

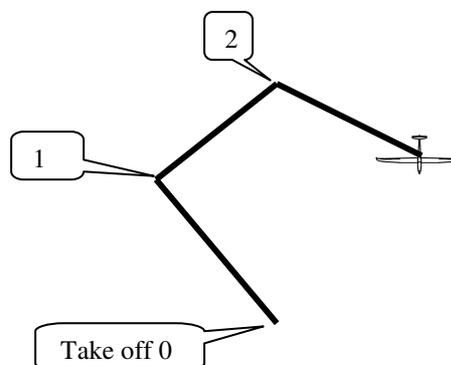
6.4 Distance measuring

This function is active only after GPS is coupled to LX 166. After take off the position is memorized and taken as a reference point. The display has two items.



Distance day shows flown distance from take off until actual position. To keep the distance measuring realistic, the pilot should mark **significant points** of his flight.

This is in fact setting of virtual turn points. To mark a new point is necessary to press **Enter**. It is not possible to set two points to close, after such an attempt a message will inform about this.

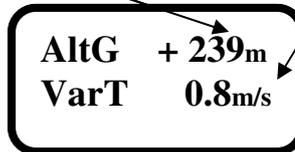


Distance done indication is 0-1 plus 1-2 plus 2 until actual position.

6.5 Altitude Gain and Termal Averager

LX 166 is capable to detect circling or straight away status of the glider. If circling is detected altitude gain counter is started and **altitude gain is continuously** present in upper left corner of the display.

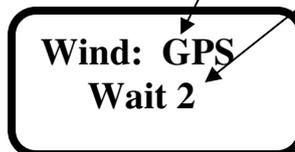
Altitude gain divided with the time spent by circling is **total average climbing** of one circling period.



AltG + 239m
VarT 0.8m/s

6.6 Wind Calculation

The unit is able to calculate wind exclusively after having **GPS connection**. The calculation is based on GS (ground speed) changes during circling after wind influence. It is necessary to make **two full circles** to get first result, after the updates happens continuously during climbing period, there is no update during straight flight. Circling is detected automatically.



Wind: GPS
Wait 2

After successful wind calculation following screen will appear.

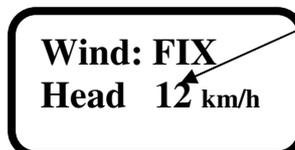


Wind : GPS
230° 12km/h

Note!

The wind data shown in this menu will be also taken in account by final glide calculation.

If the unit doesn't feel GPS signal, the pilot has to input manually the actual wind component. This is to be done in Setup/Wind Comp. There is tail wind and head wind input possible. **Tail** or **head** wind component inputs are clearly marked on the display.



Wind: FIX
Head 12 km/h

Note!

It also possible to enable manual wind input during GPS connection. In that case this should be enabled in System Setup/Wind Met.

6.7 Statistics and Logbook

The unit has built in real time clock, which ensures correct time information also without GPS connection.

6.7.1 Logbook

After the glider will land, Logbook will replace flight statistics data. The data of the last four flights will present on the display.

02.07.09	2:55
03.07.09	3:15
03.07.10	4:20
03.07.11	6:20

6.7.2 Flight Statistics

After flight is detected the Logbook will change to flight duration display.

7 Installation

The space requirement for the system installation is two 57 mm standard air norm cut outs. As LX 166 unit uses one rotary switch the lower right fixing hole should be extended to 6.5 mm. Before inserting the unit, the **knob** and special **M6 nut** should be removed.



Installation of Vario unit doesn't require any additionally works.

7.1 Cables and wires

7.1.1 Power Supply

Power input is realized via **two wires** coming out of the unit, the red one is Plus and blue one is Minus (ground). The unit power supply range is from 10 up to 16 V DC.

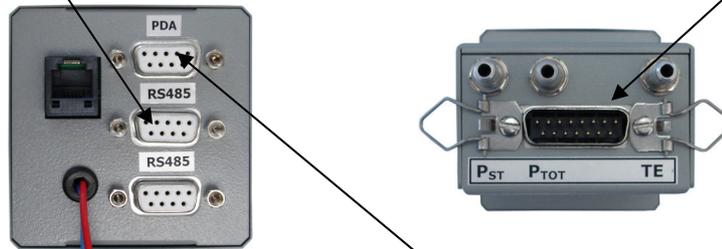


Caution!

There is no fuse built into the unit. It is absolute necessary to use an external fuse 1A.

7.1.2 Vario unit connection

In Vario unit package is a cable set with speaker. The cable set consists of one cable having one **15 P SUB D** connector, one 9P SUB D connector, SC isolated wire and speaker connector. The 9P connector should be inserted in one of two **485 marked** plugs of LX 166. SC wire may be connected to a toggle switch or switch mounted on flaps mechanism. Switch active status can be adjusted in System setup/SC input.



Caution!

It is strongly prohibited to insert 9P connector into PDA plug, this will damage Vario unit.

7.1.3 PDA connection

PDA connection can be realized via LX 1636 or 1638 cable, which should be inserted into **PDA plug**. The cable is delivery included. LX 166 sends data toward PDA and also supplies PDA **with 5V**.

7.1.4 Connection of optionally secondary vario indicators

System extension with additionally LCD vario indicators (DIG VAR 5) is absolutely easy and plug and play, after using of free 485 ports.

7.1.5 GPS connection

GPS should be connected exclusively via 6P telephone type connector. A 6P-6P telephone type cable is also delivery included. Connection to following units is plug_and_play.

- LX 20 2000
- Colibri
- Flarm
- VL

Above mentioned units are also powered from LX 166. This is not valid for LX Flarm Red Box which requires its own power supply.

For other units an open wire cable variant is also delivered.

Baud rate adaptation is done automatically after power on.

7.2 Pneumatic connections

The unit has three pressure inputs. A **label** situated close to the input designates its function.



P_{st}, static pressure input

P_{tot}, total pressure input (Pitot)

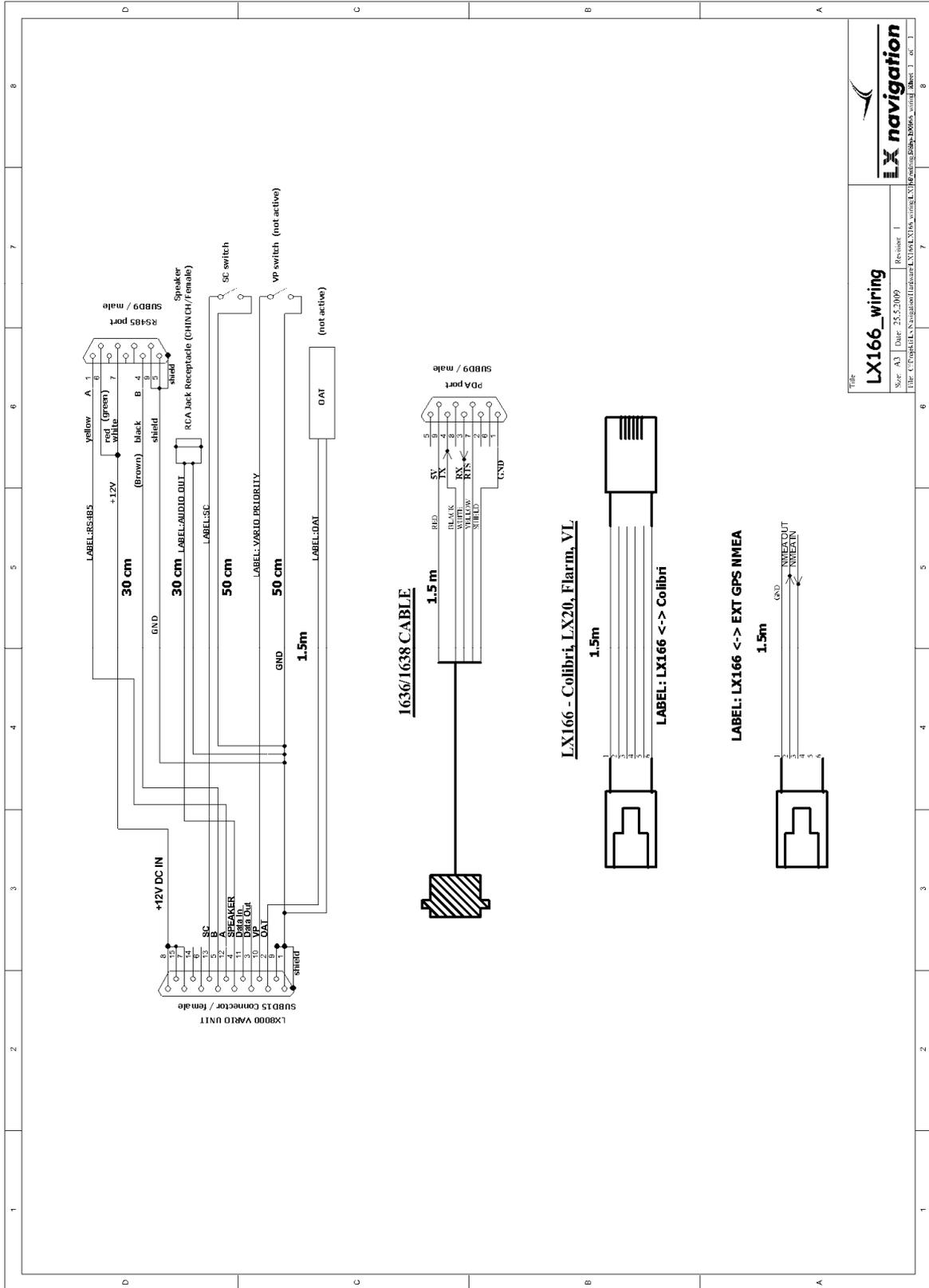
TE, total energy probe, or static

Important!

After using of **electronic type** of TE compensation, TE should be connected to **static** pressure source. See 4.1.8.8.



8 Wiring diagram

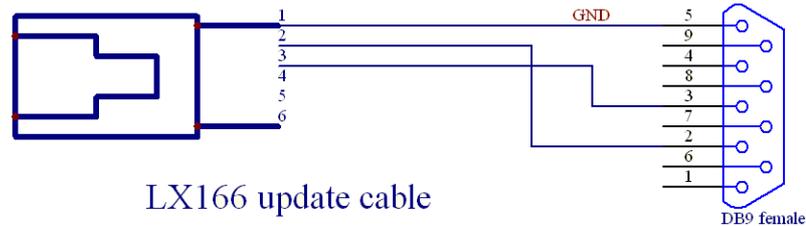


9 Firmware update

The update of LX 166 firmware is also possible after using of special LX tools (LX Bootloader). All tools are available on www.lxnavigation.si.

HW requirements:

- Windows running PC (Win 98 or Win XP).
- LX 166 **update cable** or a combination of **Colibri PC adapter** extended with null modem cable or **LX 232 cross cable**.

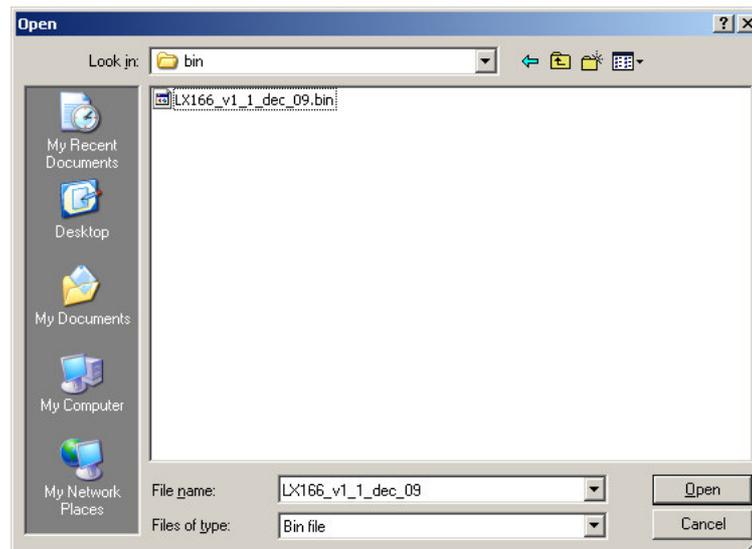


9.1 The procedure

- LX 166 should be OFF
- Run LX Bootloader
- Turn LX 166 ON and below screen should appear



- **Browse** to find **LX166_vxx.hex** file



Click on **Program** and wait until programming will finish



- Click on **RUN** after **Finish** message

10 Revision history

Version	Date	Captures changed
1.0	September 2009	New done
1.1	December 2009	Firmware update procedure added

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