Introduction

It is assumed that an existing autopilot has electronically failed (most common) and that the mechanical drive motor is still serviceable or repairable

L.G.B mk 4 system takes its direction reference directly from Course Over Ground data as output from most standard gps units which repeat every second'

This course is then compared with the desired set course and a correction is then generated which is then Averaged, damped and scaled to "blip" relays to move the rudder servo motor in the desired direction. No rudder position reference unit is necessary

LGB detects when power is switched on (auto) and resets the set course to the current course over the ground (cog) this is a very simple way to use an autopilot

(**hand steer to desired heading then flip the switch to hold that course).**

Course changes are best made by flipping the switch to maual (off) steering to new course retrim the sails then flip switch to hold present course

By using this method any standing helm (trim ,offset) call it what you like, will allread be included in rudder position calks.

Otherwise the trim function will *slowly* apply an offset to compensate, this may take up to 30 seconds depending on trim settings,

Small changes to course may be made by clicking set course buttons on screen

The LGB computer programme can be minimised to run in the background while other programs are running eg a chart plotter (with suitable com port sharing software)

Configuring gps and computer Comports

Communication ports (9 pin"D" Rs232 connectors) are serial data in/out and have a long history if reliability and flexibility ,Several comports may be supported simultaneously therefore they are assigned (by windows) a number ,a built in hardware port would be no 1 etc however usb has superseded rs232 and many modern computers do not have the hardware to support comports, but can support virtual ports (internal modems etc) and hardware adapters

To use LGB autopilot you will need at least one comport (9 pin"D" Rs232 connector) these are conveniently available as a serial to USB adapters. This will be the output to connect to the LGB autopilot.

The input (GPS) comport may be ether

1 Mouse type USB GPS these popular units are simplest to install (the driver creates a virtual com port)

USB has a limit to max length of extension leads unless an expensive active lead is used.

Therefore hardware serial connection (rs232) is recomended

2 Use a rs232 adapter, 15M extension has been used successfully used with Global Sat MR350' This option will allow any rs232 or nmea gps to be connected

Due to relaxed implementation of the signal standards (rs232 is +and – and nmea is 0 and +) many serial adapters will directly connect to a nmea bus (but not guaranteed)

Note; Global Sat MR350' requires a +5volt supply this conveniently taken from ether a unused PS2 soket or and unused usb socket using manufacturers adapter leads

To find comport numbers look in control panel/system/ / hardware tab /device manager then click on the cross next to com ports(com and lpt).If you have the hardware/or adapter installed or a mouse type gps details of port numbers will be found here.

. These numbers must be set later in the lgb programme as the input and output port numbers .

Fitting the LGB mk 4 relay unit

It is assumed that an existing autopilot has electronically failed (most common) and that the mechanical drive motor is still serviceable or repairable. And that the L.G.B Mk4 is used as a backup.

If LGB is to be installed as a new primary installation then a third party supplied drive unit will be required.

also electrical DIY experience is assumed

The l.G.B Mk4 can be located near existing drive unit or next to existing drive unit (this will

keep the heavy current wires as short as possible)

if LGB is used as a backup It is recommended that a multi plug/socket is inserted between existing control unit and the drive motor so that a quick swap can be made

System requirements to use Mk4 interface and program

Nmea data for GPS reference must be taken from a source (gps antenna) located a minimum of 3 meters forward of the centre of lateral resistance (pivot point) to prevent errors due to initial yaw in the wrong direction' this is most conveniently done using a rs232 gps such as the global sat 320' USB gps

Computer configured with windows xp (vista seems to have problems with virtual comports?) to receive nmea data via a comport (hardware, virtual, or usb) if you use pc as a plotter then you probably already have this set up

Serviceable rudder drive unit up to 25amps (12v and 24 v versions available)

If motor is over 25amps heavy duty relays may be slaved to drive the motor. lgb relays are rated at 80 amps with resistive load but are de rated for inductive loads

Location of equipment

L.G.B Mk4 requires heavy gauge wires are required between unit and the drive motor.

And a light gauge4 core wire to the computer, this is not critical and may be any length and joints are OK

Therefore mount the LGB unit close to the existing autopilot control unit in a convenient dry protected place

Or next to rudder drive motor

If the L.G.B. Mk4 is used as a backup to existing unit then

It is essential that the orange and green wires are not permanently connected to the motor (the non energised relay configuration presents a short circuit to the motor and will damage the output of an existing control unit

The GPS antenna must be **forward** of the centre of lateral resistance (pivot point) and as

low as possible ,to prevent errors due to initial yaw in the wrong direction, the further forward the better performance , as this includes yaw and change in direction and results in a very definite change in signal. + 4m is ok +6m is excellent this is most conveniently done using a rs232 gps such as the global sat 350?'

Good result were obtained by temporarily "blue tacking" the receiver to the underside of the forward Perspex hatch

A blue tooth connected gps is a possibility but the test transmitter was low power and would not reliably penetrate two wooden bulkheads

Connecting the L.G.B. Mk 4

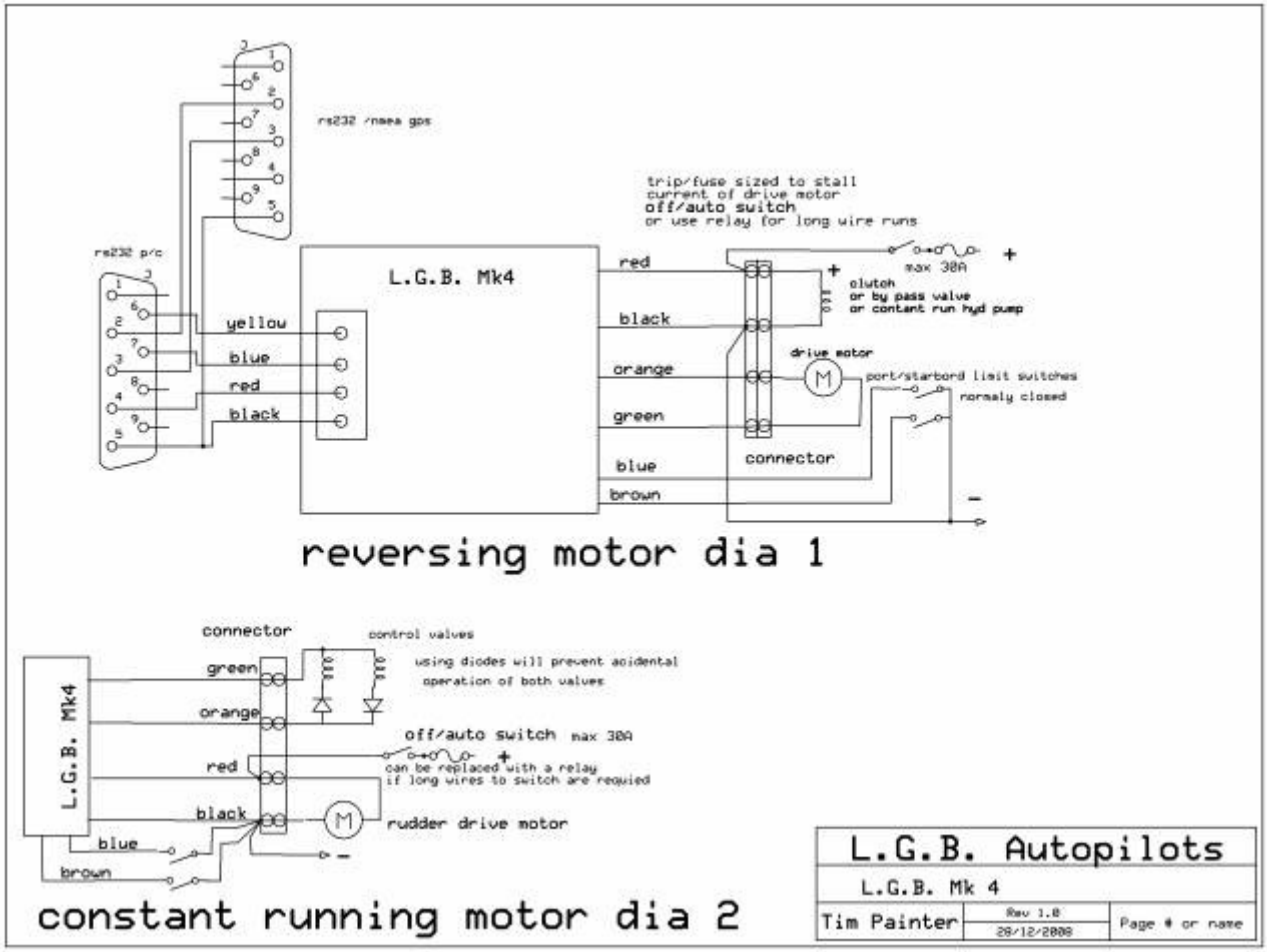
Simply connect the orange and the green wire to the drive motor and red and black to the clutch.check that clutch voltage is the same as the supply as it may be different.

Connect neg power to the black wire

Connect pos power from a suitably fused supply (this can be the same source that supplied original autopilot) to a single pole switch sited near the wheel

This switch is the only control and is used to switch between hand (off) to auto (on) Switching on performs a reset to synchronise set course with current Course Over Ground and engages the clutch/hydraulic valve

switch wires carry full motor current , if wires are longer than say 3 meters it may be more convenient to slave the switch with a relay near the LGB and use thinner wires to the switch



Common drive types are:

A Reversing motor. diagram 1

Linear (screw jack which looks like a hydraulic ram) with electric clutch ,

Rotary chain drive or belt with electric clutch

Hydraulic with bypass valve with mechanical steering, connect valve to clutch wires

Hydraulic with no electric bypass valve all hydraulic steering, omit clutch wiring

B constant running pump diagram 2

using solenoid valves to control the flow of oil to a hydraulic ram, connect motor to clutch

If motor requires a field supply (non permanent magnet type) connect to clutch supply

Rudder limit switches

Robust limit switches with normally closed contacts are recommended to prevent damage to motor or rudder mechanism when powering into the stops when full rudder stroke is demanded This occasionally happens when speed is very slow , however software design stops excessive commands at low speeds to minimise demands for full lock problems

Limit switches on rudder are a preferred option But drive units with built in over run slipping

clutches or pressure relief valve may omit limit switches.

Limit switches may already be incorporated in the drive unit or an existing rudder ref unit (neco among others)

The most convenient way to fit limit switches is to clamp a striker to the rudder shaft and use lever type switches to allow an over run but not flip back when hand steering

Wire switches to the brown and blue wires then to ground (neg)

Setting up

After wiring installation test direction of rudder movement and most **importantly** verify correct operation of the limit switches as follows

Run programme joy stick (spanner icon) and chose the com port that the LGB is connecter to

With power not connected to lgb test out put communication by clicking + or - buttons and verify that green or rd led lights. OK so far?

Now centre wheel (the real one) Check leds off

Briefly turn on power (switch to auto) there should be no drive activity!!

If there is drive activity then disconnect power immediately. If all is well by clicking +1 or -1buttons , the drive should briefly pulse

Did the drive move in the correct direction? + for a starboard turn?

No? Then reverse green and orange wires to the motor

Now verify that the switch which the striker is approaching will kill the drive

Manually hold one switch over and click +1 or -1 The drive should not move toward this switch if it dose then reverse the blue and brown wires and re test.

If all is ok then check other switch noting that it is possible to drive away from a tripped limit switch

If all is well check that hand steering doesn't drive the striker past the switch and releasing it.

Verify on screen that power box indicates 1 or 0 in response to auto /off switch and that reset= yes

Ok GOOD the most difficult part is over

Tech stuff

Related data is sent continuously in “sentences” the start of which is identified with a string of characters eg

$GPRMC then follows data words between comas which in sequence contain cog ,sog, lat , long etc and then it is repeated every second

$GPVTG contains cog sog true and magnetic.

To verify that ether sentence is present use ether software which came with the gps or HyperTerminal configured for comport used 4800 baud

Alternatively heading reference may be taken from a fluxgate compass or wind direction nmea data With a small modification to the programme

(VTG or RMC sentences)

Note if lat and log are required to be displayed"RMC" must be chosen

Tuning in LGB Mk4

Tuning in means adjusting various parameters to match those of the boat. boat length, boat weight, rudder drive speed, rudder size, and antenna position all contribute to a tuning characteristic. this tuning is not critical or sensitive and a wideband of settings will work once these settings are set they are then saved to a file called apsettings7 and the next time lgb is started these saved settings will be used .If setting get way off click default settings should get you back in to the playground

Saved settings can be changed at any time just click save settings and old ones will be over written

Initial tuning is best done in calm weather conditions as waves or wind will mask any slight improvements.

O.K. steps to tune in are:

1 Set damping and trim to 0, set correction to 1, set rudder gain to .25, set averaging to 0

2 Steer a constant course at cruising speed (min usable speed is about .8 kn) and verify that the cog is roughly constant look at the numbers or the boat animation

north is up ok? Look around you for traffic Switch on power to lgb (auto) .switch of

(manual) to regain hand steering .verify power box indicates auto and set course and gog are the same.

3 Increase rudder gain until course becomes unstable ("S" turns this is also called "hunting" this is because the rudder is moving to much compared to the error

now back off rudder gain until there is just a slight waviness about the desired course this will show on the pen recorder as a wavy red line

4 look around for traffic ,click +or-10 deg twice to demand a 20 deg course change the aim is to produce a crisp change of course with only a slight over shoot

with the damping set low the first attempt will probably over shot and oscillate several times before settling on course

increase damping until performance is satisfactory . Setting damping high will cause the system will be slow to respond to corrections

5 The rudder gain may be tweaked up a bit more now for tighter course keeping (more drive activity) or reduced for a looser response (but lower more drive activity

6 The trim gain applies standing helm or offset to slowly adjust for changing out of trim conditions eg increasing wind change in sail trim.

If set to low final course may not be achieved or may slowly drift off course. Or if to high a very slow oscillation may develop

Trim also includes the effects of rudder drive not retuning to centre after a big displacement rudder drive is controlled simply by timing , if it takes longer to deflect the rudder than to return to centre the effect is the same as an out of trim condition generally undersize motors will need more trim gain

That's it !! Click on save settings

Normaly averaging works best when set to 0 but if the antenna is positioned high , any heavy rolling will indicate a wavy course and the rudder will try to chase the roll .

increasing averaging will reduce this but make the response sluggish.

deadband set higher will also reduce roll chasing as will a lower ruddergain setting