

## Application of TF03 UART in PixHawk (ArduPilot Firmware)

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www.benewake.com Benewake (Beijing) Co., Ltd. TF03 can directly be connected with the serial port of PixHawk. TF03 can be interfaced with flight controller for the purpose of altitude holding or obstacle avoidance. This document is suitable for PixHawk adopting ArduCopter V3.6.2 or higher firmware (or any other board flashed with ArduCopter).

**Note**: The default mode of LiDAR is **Standard** output mode and it needs to be used instead of PIX mode for firmware V3.6.2 or above, if PIX mode is chosen by mistake please switch it back to standard mode by sending command (refer to manual for command).

## 1. TF03 Settings:

The default communication of TF03 is UART. So you don't need to make any changes in the interface settings.

## 2. PixHawk Connection:

See the wiring details in PixHawk manual and TF03 manual; we take the example of PixHawk1 for connecting LiDAR.

## **Obstacle Avoidance:**



Figure 1: Schematic Diagram of Connecting TF03 to TELEM2 Interface (Serial Port2) of PixHawk

#### Some key hints about TF03 connector and supply voltage:

1. The default connector of TF03 is Molex (JST) with 1.25mm pitch. If your flight controller needs



some other connector like GH 1.25 then you will need to replace Molex connector with GH 1.25 connector in order to match it with your flight controller's connector.

- 2. If TF03 faces down, please take care the distance between lens and ground, it should be larger than TF03's blind zone (10cm)
- 3. Power source should meet the product manual requirements: 5V±0.5V and peak current of 180mA (for LiDAR V1), while 5V~24V and peak current of 150mA (for LiDAR V2). It is advised to power the LiDAR separately rather than powering through flight controller.

## 3. Parameters Settings for Obstacle Avoidance:

Connect the flight controller to MP. Select [Full Parameter List] in the left from the below bar-[CONFIG/TUNING].

Find and modify the following parameters:

#### Common settings for obstacle avoidance:

AVOID\_ENABLE= 3 [if 3 = UseFence and UseProximitySensor doesn't work then try with 2 = UseProximitySensor]

AVOID\_MARGIN = 4 [can be increased according to user's requirement]

 $PRX_TYPE = 4$ 

#### Settings for TF03:

SERIAL2\_PROTOCOL = 9 [Rangefinder option]

SERIAL2\_BAUD = 115 [Choose the current LiDAR baud rate, if haven't been changed, the default baud rate 115200 should be selected, that is 115]

RNGFND1\_TYPE = 19 [Same option with TF02] (ArduCopter V4.0.0, choose the 27 [Benewake TF03])

RNGFND1\_MIN\_CM = 20 [It can be changed according to real demands and should be bigger LiDAR than non-detection zone, unit is cm]

RNGFND1\_MAX\_CM = 5000 [It can be changed according to real demands but should be smaller than effective measure range of LiDAR, unit is cm]

RNGFND1\_GNDCLEAR = 20 [expressed in cm, depending upon mounting height of the module and should be bigger LiDAR than non-detection zone]

RNGFND1\_ORIENT=25 [TF03 real orientation]



Upon setting of these parameters, click [Write Params] on the right of MP to write parameters.

If the error message "Bad LiDAR Health" appears, please check if the connection is correct and the power supply is normal. Please turn-off completely the flight controller after configuring the parameters, otherwise changes will not take place. If your battery is connected to your flight controller, please disconnect it as well.

How to see the target distance from the LiDAR: press Ctrl+F button in keyboard, the following window will pop out:

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Warning Manager	Create custom audio warnings		siti					
Follow Me	use a nmea gps to follow me		Streamcombi					
NMEA	outputs the may location in nmea		Inject GPS					
MicroDrone	outputs the may location in microdrone format		FFT					
Mavlink	mirrors the mavlink stream received by mp		TD					
Param gen	regenerage the param info used inside mp		religent					
Lang Edit	translation language editor		pixhawk					
OSDVi deo	overlay the hud into your recorded videos		QNH	VISION POSITION				
Moving Base	show an extra icon on the map of your current		Sequence					
Shp to Poly	convert shp file ot a polygon file		Swarm					
	output the may location into xplanes	nk In	vlo					
Swarm	multi mav swarm interface		estream					
Follow the leader	follow the leader swarm		Aze Man					
MAVSerial pass	create a exclusive passthrough to the gps		Data					
	remove all apm drivers		faram gen					
Sort TLogs	sort tlogs into there type and sysid			NOTOR OCTPUTS				
rip all fw	download all current fw's		zigning	-				
Inject GE	add custom imagery to mp		calib					
Clear Custom Maps	wipe custom imagery		mharra	3D 67302				
structtest	struct conversion speed test		sphere					
DashWare			log					
arm and takeoff	quad: arm and takeoff		extract					
gimbal test	run the gimbal pointing algo		gns intect	MRS				
map logs	create map jpg's for all tlogs in a dir		Proximity	TERRAIN				
logindex	tlog browser		Swarm					
007.1	logdownload ReSort All	CRAT	Custom DTED					
Gol test	DEM scp logs Cust	COM GUAL						

See next page.



Click button *Proximity*, the following window will appear:



The number in green color means the distance from LiDAR in obstacle avoidance mode, the number refreshes when the distance changes or window opens, closes, zooms in or zooms out, and this distance will not be influenced in Mission Planner, the version available at the time writing this tutorial is v1.3.72.

Attach: If TELEM 2 port has been used, SERIAL4/5 interface can be used, the other setting are same.

## 4. Configuration Descriptions of Mission Planner:

Connect flight controller to MP, Select [Full Parameter List] in the left from the below bar [CONFIG/TUNING]. Find and modify following parameters:

SERIAL4\_PROTOCOL = 9 SERIAL4\_BAUD = 115

Upon setting of these parameters, the other parameters are same as Mission Planner configuration description of TF03 for the purpose of Obstacle Avoidance or Altitude Holding, then click [Write Params] on the right hand side of the software.





*Figure 2*: Schematic Diagram of Connecting TF03 with SERIAL4/5 Interface (Serial Port 4/5) of Pixhawk

# 5. Mission Planner Configuration Description of TF03 for the Purpose of Altitude Hold:

Connect the flight controller to MP. **Note**: the installation height should be greater than non-detection zone. Select [Full Parameter List] in the left from the below bar- [CONFIG/TUNING]. Find and modify the following parameters:

SERIAL2\_PROTOCOL = 9 [Rangefinder option] SERIAL2\_BAUD = 115 [Choose the current LiDAR baud rate, if haven't been changed, the default baud rate 115200 should be selected, that is 115]

RNGFND1\_TYPE = 19 [Same option with TF02] (ArduCopter V4.0.0, choose the 27 [Benewake TF03])

PRX\_TYPE = 0 [on equal to 4 also gives the value if RNGFND1\_ORIENT = 25]

RNGFND1\_MIN\_CM = 20 [It can be changed according to real demands and should be bigger

LiDAR than non-detection zone, unit is cm]

RNGFND1\_MAX\_CM = 7000 [It can be changed according to real demands but should be smaller than effective measure range of LiDAR, unit is cm]

RNGFND1\_GNDCLEAR = 20 [expressed in cm, depending upon mounting height of the module and should be bigger LiDAR than non-detection zone]

#### RNGFND1\_ORIENT = 25 [Facing downward]

Upon setting of these parameters, click [Write Params] on the right of the software.

If the error message "**Bad LiDAR Health**" appears, please check if the connection is correct and the power supply is normal.

How to see the altitude value from LiDAR sensor: double click the area of the Mission Planner, see the following picture:



Select option *sonarrange*, see following picture:

🖳 Display This								×
accel_cal_x	✓ az3	ch11out	ch7out	gimballng	gz	my	remnoise	ter_space
accel_cal_y	AZTOMAV	ch12in	🗖 ch8in	gpsh_acc	🗖 gz2	my2	remotesnrdb	🔤 timeInAir
accel_cal_z	battery_cell1	ch12out	ch8out	gpshdg_acc	gz3	my3	remrssi	timeInAirMinSec
accelsq	battery_cell2	ch13in	ch9in	gpshdop	HomeAlt	mz	roll	🔤 timesincelastshot
accelsq2	battery_cell3	ch13out	ch9out	gpshdop2	horizondist	mz2	rpm1	toh
accelsq3	battery_cell4	ch14in	climbrate	gpsstatus	hwvoltage	mz3	rpm2	tot
airspeed	battery_cell5	ch14out	orit_ADA	gpsstatus2	i2cerrors	nav_bearing	rssi	turnrate
alt	battery_cell6	ch15in	current	gpsv_acc	KIndex	nav_pitch	rxerrors	vertical speed
alt_error	battery_kmleft	ch15out	current2	gpsvel_acc	lat	nav_roll	🗌 rxrssi	vibex
altasl	🗖 battery_mahperkm	ch16in	DistFromMovingBas	groundcourse	lat2	noise	satcount	vibey
altasl2	battery_remaining	ch16out	DistRSSIRemain	groundcourse2	linkqualityges	opt_m_x	satcount2	vibez
altd100	battery_temp	ch1in	DistToHome	groundspeed	lng	opt_m_y	satcountB	vlen
altd1000	battery_usedmah	ch1 out	distTraveled	groundspeed2	lng2	packetdropremote	servovoltage	vx 🗌
altoffsethome	battery_usedmah2	ch2in	ekfcompv	gx 📃	load	🔲 pidachieved	sonarrange	🗌 уу
ADA 📃	battery_voltage	ch2out	ekfflags	<b>g</b> x2	local snr db	pidD	sonarvoltage	vz.
aspd_error	battery_voltage2	ch3in	ekfposhor	<b>g</b> x3	<pre>mag_declination</pre>	piddesired	speedup	watts
asratio	ber_error	ch3out	ekfposvert	ΕΥ	mag_ofs_x	🗖 pidff	SSA	wind_dir
ax	boardvoltage	ch3percent	ekfstatus	g√2	mag_ofs_y	🗖 pi dI	target_bearing	wind_vel
ax2	brklevel	ch4in	ekfteralt	<b>□</b> <sub>€</sub> y3	mag_ofs_z	🔲 pi dP	targetairspeed	wp_dist
ax3	campointa	ch4out	ekfvelv	gyro_cal_x	magfield	pitch	targetalt	wpno
ay ay	campointb	ch5in	ELT oMAV	gyro_cal_y	magfield2	press_abs	targetaltd100	xtrack_error
ay2	campointe	ch5out	🗖 fixedp	gyro_cal_z	magfield3	press_temp	ter_alt	yaw
ay3	ch10in	ch6in	freenem	gyrosq	mx	radius	ter_curalt	
az	ch10out	ch6out	GeoFenceDist	gyrosq2	<b>mx</b> 2	raw_press	ter_load	
az2	ch11in	ch7in	🔲 gimballat	gyrosq3	mx3	raw_temp	ter_pend	



The altitude distance from the LiDAR will be displayed in Sonar Range (meters), see the following picture:



