# **Application of TF02-Pro IIC in PixHawk** (ArduPilot Firmware)

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www.benewake.com Benewake (Beijing) Co., Ltd. TF02-Pro can be used with PixHawk for the purpose of obstacle avoidance and Altitude Hold.

## 1. TF02-Pro Settings:

Note: If there are fluctuations in readings then set the **frame rate** to 250Hz, see the details in chapter 6.2 for "frame rate" and changing the communication interface in table-8.

The default communication of TF02-Pro is UART. IIC and UART uses the same cable, so please set TF02-Pro to IIC communication first, see detail commands in product manual.

We take two TF02-Pros as an example in this passage and set the address 0x10 and 0x11 separately.

# 2. PixHawk Connection:

See the connection details in PixHawk manual and TF02-Pro manual; we take the example of PixHawk1 for connecting LiDARs.

# **Obstacle Avoidance:**



Figure 1: Schematic Diagram of Connecting TF02-Pro to I2C Interface of PixHawk

## Note:

 Default cable sequence of TF02-Pro and PixHawk is different, please change it accordingly (SDA and SCL wires need to be interchanged). Look at the pinout of controller, pin configurations are starting from left to right:

Pin	Signal	Volt			
1 (red)	VCC	+5V			
2 (blk)	SCL	+3.3 (pullups)			
3 (blk)	SDA	+3.3 (pullups)			
4 (blk)	GND	GND			

- 2. IIC connector should be purchased by user
- 3. If TF02-Pro faces down, please take care the distance between lens and ground should be larger than TF02-Pro's blind zone (10cm)
- 4. If more TF02-Pros need to be connected (10 LiDARs can be connected), the method is same.
- Power source should meet the product manual demands:5V±0.5V, larger than 200mA (peak is 300mA)\*number of TF02-Pro

## 3. Parameters settings:

#### Common settings for obstacle avoidance:

AVOID\_ENABLE= 2 [if 3 = UseFence and UseProximitySensor doesn't work in IIC then choose 2 = UseProximitySensor]

 $AVOID_MARGIN = 4$ 

 $PRX_TYPE = 4$ 

#### Settings for first TF02-Pro:

RNGFND1\_ADDR = 16 [Address of #1 TF02-Pro in decimal]

RNGFND1\_GNDCLEAR = 15 [Unit: cm, depending upon mounting height of the module and should be larger LiDAR than non-detection zone]

RNGFND1\_MAX\_CM = 400 [It could be changed according to real demands but should be smaller than effective measure range of LiDAR, unit is cm]

RNGFND1\_MIN\_CM = 30 [It could be changed according to real demands and should be larger than LiDAR non-detection zone, unit is cm]

RNGFND1\_ORIENT = 0 [#1 TF02-Pro real orientation]

RNGFND1\_TYPE = 25 [TF02-Pro IIC same as TFmini-Plus IIC and TFmini-S IIC]

#### Settings for second TF02-Pro:

RNGFND2\_ADDR=17 [Address of #2 TF02-Pro in decimal]

RNGFND2\_GNDCLEAR=15

RNGFND2\_MAX\_CM=400

RNGFND2\_MIN\_CM=30

RNGFND2\_ORIENT = 4 [#2 TF02-Pro real orientation]

RNGFND2\_TYPE = 25 [TF02-Pro IIC same as TFmini-Plus IIC]

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

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:

🛃 temp	-	-	×
Geo ref images	Geo Refrence photos NO GUNO		- 04
Warning Manager	Create custom audio warnings SitL 30 MCCE		
Follow Me	use a numea gps to follow me		
NMEA	outputs the may location in numea Inject GPS MASMALTE PRESSURE		
MicroDrone	outputs the may location in microdrone format FFT DEFFERENTIAL PRESSNE		
Mavlink	mirrors the mavlink stream received by mp		
Param gen	regenerage the param info used inside mp	06.0	
Lang Edit	translation language editor pixhawk		
OSDVideo	overlay the hud into your recorded videos QNN		
Moving Base	show an extra icon on the map of your current		
Shp to Poly	convert shp file ot a polygon file		
	output the may location into xplanes nk In vlc ANCILAR MATT CONTROL		
Swarm	multi may swarm interface		
Follow the leader	follow the leader swarm		
MAVSerial pass	create a exclusive passthrough to the gps Data z altitud control.		
	remove all apm drivers		
Sort TLogs	sort tlogs into there type and sysid		
rip all fw	download all current fw's	04.5	
Inject GE	add custom imagery to mp calib		
Clear Custom Maps	wipe custom imagery		
structtest	struct conversion speed test	014	
DashWare	log Nic2	Dia	
arm and takeoff	quad: arm and takeoff coverage		
gimbal test	run the gimbal pointing algo		
map logs	create map jpg's for all tlogs in a dir		
logindex	tlog browser Swarm estense worke		
GST test	DEM logdownload Rebort All Custom GDAL Custom DTED LOGING		

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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.

# **Altitude Hold using IIC Interface:**

Connect the flight control board to mission planar, Select [Full Parameter List] in the left from the below bar-[CONFIG/TUNING]. Find and modify the following parameters:

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

RNGFND1\_ADDR = 16 [Address of #1 TF02-Pro in decimal]

RNGFND1\_GNDCLEAR = 15 [Unit: cm, depending upon mounting height of the module and should be larger LiDAR than non-detection zone]

RNGFND1\_MAX\_CM = 400 [It could be changed according to real demands but should be smaller than effective measure range of LiDAR, unit is cm]

RNGFND1\_MIN\_CM = 30 [It could be changed according to real demands and should be larger than LiDAR non-detection zone, unit is cm]

RNGFND1\_ORIENT = 25 [#1 TF02-Pro real orientation, this parameter is must for altitude hold]

RNGFND1\_TYPE = 25 [TF02-Pro IIC same as TFmini-Plus IIC and TFmini-S IIC]

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

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

Select option *sonarrange*, see following picture:

💀 Display This								×
accel_cal_x	🗸 ez3	ch11out	ch7out	gimballng	Ez Ez	my	remnoise	ter_space
accel_cal_y	AZTOMAV	🗖 ch12in	🗖 ch8in	gpsh_acc	gz2	my/2	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	crit_AOA	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> t2	localsnrdb	🔤 pi dD	sonarvoltage	vz.
aspd_error	battery_voltage2	ch3in	ekfposhor	🔤 gx3	mag_declination	piddesired	speedup	watts
asratio	ber_error	ch3out	ekfposvert	EV EV	mag_ofs_x	pi dff	SSA	wind_dir
ax	boardvoltage	ch3percent	ekfstatus	g√2	mag_ofs_y	🗖 pi dI	target_bearing	wind_vel
ax2	🔤 brklevel	ch4in	🔤 ekfteralt	<b></b> gy3	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	- campointc	ch5out	🗌 fixedp	gyro_cal_z	magfield3	press_temp	ter_alt	yaw
ay3	ch10in	ch6in	freemem	gyrosq	mx	radius	ter_curalt	
az	ch10out	ch6out	GeoFenceDist	gyrosq2	mx2	raw_press	ter_load	
az2	chllin	ch7in	🔲 gimballat	gyrosg3	<b>mx</b> 3	raw_temp	ter_pend	

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

picture:



