

# Configuring TFmini-Plus with IIC Interface on Ardupilot Flight Stack using PixHawk1 Flight Controller

www.benewake.com Benewake (Beijing) Co., Ltd. TFmini-Plus can be connected with the IIC port of PixHawk1. It can be interfaced with flight controller for the purpose of **Altitude Holding** or **Obstacle Avoidance** (both will be explained in this document). At the time of writing this document the controller used was PixHawk1 flashed with ArduCopter V4.0.4. But this document can be used with other flight controllers running with different ArduCopter firmware versions with slight modification in parameter names and choosing the right port on flight controller.

## 1. **TFmini-Plus Settings**:

Note: If there are fluctuations in readings then set the **frame rate** to 250Hz otherwise don't need for it. Please see the details of "frame rate" and changing the communication interface in Section-7.4 table-11.

Standard output mode of LiDAR should be used instead of PIX mode in the latest firmwares. PIX mode was only required for the firmware versions older than Arducopter V3.6.2.

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

We take two TFmini-Plus as an example (for obstacle) avoidance in this tutorial and set the address 0x10 and 0x11 separately.

#### Note :

1. Default cable sequence of TFmini-Plus and PixHawk1 are 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 TFmini-Plus faces down, please take care the distance between lens and ground should be larger than TFmini-Plus's blind zone (10cm)
- 4. If more TFmini-Plus 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 140mA\*number of TFmini-Plus



# 2. PixHawk1 Connection:

See the connection details in PixHawk1 manual and TFmini-Plus manual, we take example for connecting PixHawk1 flight controller:



Figure 1: Schematic Diagram of Connecting Two TFmini-Plus to I2C Interface of PixHawk1

# 3. Parameters settings (Obstacle Avoidance):

Connect the flight control board to Mission Planar. Select [CONFIG/TUNING] and then click on [Full Parameter List] in the left from the below bar. Find and modify the following parameters:

Flight Modes GeoFence	Roll/Pitch Sensitivity: Slide to the right if the copter is sluggish or slide to the left if the copter is twitchy.
Basic Tuning	0.1350 🚖
Extended Tuning	0.05 0.5
Standard Params	
Advanced Params	
User Params	
Full Parameter List	
Full Parameter Tree	
Planner	



#### Attention: distance between UAV margin and LiDAR should be larger than LiDAR non-detection zone.

#### **Common settings:**

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

AVOID\_MARGIN=4

PRX\_TYPE=4

#### **Settings for first TFmini-Plus:**

RNGFND1 ADDR=16 [Address of #1 TFmini-Plus in decimal]

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

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

RNGFND1 ORIENT=0 [#1 TFmini-Plus real orientation]

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

#### Settings for second TFmini-Plus:

RNGFND2\_ADDR=17 [Address of #2 TFmini-Plus in decimal]

RNGFND2\_MAX\_CM=400

RNGFND2 MIN CM=30

RNGFND2\_ORIENT=1 [#2 TFmini-Plus real orientation]

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

Upon setting of these parameters, click [Write Params] on the right of mission planner to finish. After writing the parameters you need to power off the controller and then turn it on to apply the setting changes.

If the error message "**PreArm: check the proximity sensor**" appears, please check if the connection is correct, the power supply is normal and have you restarted the controller. Also check it whether you have changed the mode from **Standard mode** to **Pix mode** while the firmware is **3.6.2 or higher** if yes then the same error will encounter.





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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Geo ref images	Geo Refrence photos			30 5780	i	Pawaan I L	04.U
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		10				
Lang Edit	translation language editor		pixhawk	OFFICIL PLOT			
OSDVideo	overlay the hud into your recorded videos		QNH	VESION POSITION			
Moving Base	show an extra icon on the map of your current		Sequence				
Shn to Poly	convert shp file ot a polygon file		Swarm				
	output the may location into xplanes	nk In	vlc				
Swarm	multi mav swarm interface	-	estroop				
Follow the leader	follow the leader swarm		Sant ean				
MAVSorial pass	create a exclusive passthrough to the gps		Data				
	remove all apm drivers		l'aram gen	XY POSITION CONTROL			
Sort TLogs	sort tlogs into there type and sysid		cust	Notice Artests			
rin all fu	download all current fw's		signing				
Triest GE	add custom imagery to mp		calib	RC RECEIVER			
Clear Custon Mans	wipe custom imagery						
crear custom maps	struct conversion speed test		sphere				
Torollow			mag calb log				
Dasmare	guad: arm and takeoff		extract				
arm and takeoff	run the simbal pointing also		gns inject				
gimbal test	create man ing's for all tlogs in a dir		Proximity	TERRAIN			
map Togz	tlog browser		FOLLOW	BETTERSE NOTOR			
Logindex	trad provider		Swarm				
GST test	DEM Sop logs Cust	om GDAL	Custom DTED				



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



The number in green color means the distance from LiDAR in obstacle avoidance mode (it doesn't mean the real time distance from LiDAR and will not be influenced in Mission Planner. The mission planner version at the time of writing this tutorial was v1.3.69.

### 4. Parameters settings (Altitude Hold):

Connect the flight control board to Mission Planar. Select [CONFIG/TUNING] and then click on [Full Parameter List] in the left from the below bar. Find and modify the following parameters:





**Note**: If RNGFND1 and RNGFND2 are already configured then use RNGFND3 or other as Altitude Hold Sensor.

RNGFND1\_ADDR=18

RNGFND3\_TYPE = 25 [TFmini-Plus IIC option]

RNGFND3\_MIN\_CM = 30 [It could be changed according to real application requirement and should be greater LiDAR than non-detection zone, unit is cm]

RNGFND3\_MAX\_CM = 300 [It could be changed according to real demands but should be smaller than effective measure range of LiDAR, unit is cm]

RNGFND3\_GNDCLEAR = 15 [expressed in cm, depending upon mounting height of the module and should be greater LiDAR than non-detection zone]

RNGFND3\_ORIENT=25 [facing down]

Upon setting of these parameters, click [Write Params] on the right of mission planner to finish. After writing the parameters you need to power off the controller and then turn it on to apply the setting changes.

If the error message "**Bad LiDAR Health**" appears, please check if the connection is correct, the power supply is normal and have you restarted the controller? Also check it whether you have changed the mode from **Standard mode** to **Pix mode** while the firmware is 3.6.2 or higher if yes then the same error will encounter.



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



Select option *sonarrange*, see following picture:

🛃 Display This									Х
accel_cal_x	🗸 az3	d	h11out	ch7out	gimballng	gz gz	my	remnoise	ter_space
accel_cal_y	AZToMAV	_ c.	h12in	ch8in	gpsh_acc	gz2	my2	remotesnrdb	timeInAir
accel_cal_z	battery_cell1	d	h12out	ch8out	gpshdg_acc	gz3	my3	remrssi	timeInAirMinSec
accelsq	battery_cell2	d	h13in	ch9in	gpshdop	HomeAlt	mz	roll	timesincelastshot
accelsq2	battery_cell3	d	h13out	ch9out	gpshdop2	hori zondi st	mz2	rpm1	toh
accelsq3	battery_cell4	c.	h14in	climbrate	gpsstatus	hwvoltage	mz3	rpm2	tot
airspeed	battery_cell5	c.	h14out	crit_AOA	gpsstatus2	i2cerrors	nav_bearing	rssi	turnrate
alt 🗌	battery_cell6	c.	h15in	current	gpsv_acc	KIndex	nav_pitch	rxerrors	vertical speed
alt_error	battery_kmleft	d	h15out	current2	gpsvel_acc	lat	nav_roll	rxrssi	vibex
altasl	📕 battery_mahperkm	c.	h16in	DistFromMovingBas	groundcourse	lat2	noise	satcount	vibey
altasl2	battery_remaining	d	h16out	DistRSSIRemain	groundcourse2	linkqualitygos	opt_m_x	satcount2	vibez
altd100	battery_temp	c.	hlin	DistToHome	groundspeed	lng	opt_m_y	satcountB	vlen
altd1000	🗖 battery_usedmah	c.	hlout	distTraveled	groundspeed2	lng2	packetdropremote	servovoltage	vx
altoffsethome	battery_usedmah2	c	h2in	ekfcompv	gx	load	🗖 pi dachi eved	sonarrange	🗌 ту
AOA 📃	battery_voltage	c.	h2out	ekfflags	gx2	🗌 localsnrdb	🗖 pi dD	sonarvoltage	٧z
aspd_error	battery_voltage2	c.	h3in	ekfposhor	gx3	mag_declination	piddesired	speedup	watts
asratio	ber_error	c.	h3out	ekfposvert	∎ ¢v	mag_ofs_x	pi dff	SSA	wind_dir
ax	boardvoltage	c.	h3percent	ekfstatus	<b>≣</b> ø⁄2	mag_ofs_y	🔤 pi dI	target_bearing	wind_vel
ax2	brklevel	c.	h4in	ekfteralt	<b>gy</b> 3	mag_ofs_z	🗖 pi dP	targetairspeed	wp_dist
ax3	campointa	d	h4out	ekfvelv	gyro_cal_x	magfield	pitch	targetalt	wpno
ay ay	campointb	c.	h5in	ELT oMAV	gyro_cal_y	magfield2	press_abs	targetaltd100	xtrack_error
ay2	campointc	_ c	h5out	🗖 fixedp	gyro_cal_z	magfield3	press_temp	ter_alt	yaw
ay3	ch10in	d	h6in	freenen	gyrosq	mx	radius	ter_curalt	
az	ch10out	c.	h6out	GeoFenceDist	gyrosq2	mx2	raw_press	ter_load	
az2	ch11in	d	h7in	gimballat	gyrosq3	<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:



