

Configuring TF03 with UART Interface on Ardupilot Flight Stack using Cube Orange Flight Controller



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www.benewake.com Benewake (Beijing) Co., Ltd. **Note**: This document is applicable to Cube Orange and Cube Black flight controllers. The interfaces available that can be used to connect TF03 are the same on both flight controllers.

TF03-100, TF03-180 and TF350 can be interfaced with the one of the serial ports of Cube Orange flight controller. There are four serial ports which can be used to interface devices having UART port. The following port mapping shows hardware (left) and software (right) serial port mapping:

- TELEM1 > SERIAL1
- TELEM2 > SERIAL2 (used in this tutorial)
- GPS1 Port > SERIAL3
- GPS2/UART4 > SERIAL4

TF03 can be interfaced with flight controller for the purpose of Altitude Hold or Obstacle Avoidance. At the time of writing this document the controller used was Cube Orange flashed with ArduCopter V4.0.7. 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. For choosing right port, please refer to the hardware and software serial port mapping of flight controller.

Example for connecting TF03 to Cube Orange:



Figure 1 Schematic Diagram of Connecting TF03 with TELEM 2 Interface (Serial Port 2) of Cube



The same procedure can be followed for other serial ports like TELEM1/GPS1/UART4 by looking at the pin out details given below:

	1	1		Te co	Pin #	Name	Dir	Wire Color	Description
Pin #	Name	Dir	Wire Color	Description	1	VCC_5V	in	red	Supply to GPS from AP
1	VCC_5V	out	red / gray	Supply to GPS from AP	2	GPS_RX	in	black	3.3V-5.0V TTL level, TX of AP
2	MCU_TX	out	yellow / black	3.3V-5.0V TTL level, TX of AP	3	GPS_TX	out	black	3.3V-5.0V TTL level, RX of AP
3	MCU_RX	in	green / black	3.3V-5.0V TTL level, RX of AP		SCL	in	black	3.3V-5.0V I2C1
4	MCU CTS (TX)	out	gray / black	3.3V-5.0V TTL level or TX of AP	5	SDA	in/out	black	3.3V-5.0V I2C1
	,	out			6	BUTTON	out	black	Signal shorted to GND on pres
5	MCU_RTS (RX)	in	gray / black	3.3V-5.0V TTL level or RX of AP	7	BUTTON LED	out	black	LED Driver for Safety Button
6	GND	-	black	GND connection	8	GND		black	GND connection

Pin #	Name	Dir	Wire Color	Description
1	VCC_5V	out	red / gray	Supply to GPS from AP
2	MCU_TX	out	yellow / black	3.3V-5.0V TTL level, TX of AP
3	MCU_RX	in	green / black	3.3V-5.0V TTL level, RX of AP
4	SCL	out	gray / black	3.3V-5.0V I2C2
5	SDA	in	gray / black	3.3V-5.0V I2C2
6	GND	-	black	GND connection

Figure 2 Pinout description of available serial ports on Cube

Note: 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.

a) Mission Planner configuration description of TF03 for the purpose of altitude hold

Connect the flight control board to Mission Planar. Attention: the installation height should be larger than non-detection/blind zone of LiDAR.



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Select [CONFIG/TUNING] and then click on [Full Parameter List] in the left from the below bar. 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 = 27 [TF03 UART option]

RNGFND1_MIN_CM = 30 [It could be changed according to real application requirement and should be greater LiDAR than non-detection zone, unit is cm]

RNGFND1_MAX_CM = 500 [It could be changed according to real application requirement and should be smaller than effective measure range of LiDAR, unit is cm]

RNGFND1_GNDCLEAR = 15 [expressed in cm, depending upon mounting height of the module and should be greater LiDAR than non-detection zone]

RNGFND1_ORIENT=25 [facing down]

PRX_TYPE=0

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. Switch it back to **Standard mode** by sending command from the manual of LiDAR.

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								×
accel_cal_x	🗸 az3	chilout	ch7out	gimballng	gz	ny	remnoise	ter_space
accel_cal_y	AZToMAV	ch12in	ch8in	gpsh_acc	gz2	ny2	remotesnrdb	timeInAir
accel_cal_z	battery_cell1	ch12out	ch8out	gpshdg_acc	gz3	my3	remrssi	timeInAirMinSec
accelsq	battery_cell2	ch13in	ch9in	gpshdop	HomeAlt	nz	roll	🔤 timesincelastshot
accelsq2	battery_cell3	ch13out	ch9out	gpshdop2	horizondist	mz2	rpm1	toh
accelsq3	battery_cell4	ch14in	climbrate	gpsstatus	hevoltage	mz3	rpm2	tot
airspeed	battery_cell5	ch14out		gpsstatus2	i2cerrors	nav_bearing	rssi	turnrate
alt	battery_cell6	ch15in	current	gpsv_acc	KIndex	nav_pitch	rxerrors	verticalspeed
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	🗌 linkqualitygos	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	pi dachi eved	sonarrange	∎ ту
AOA	battery_voltage	ch2out	ekfflags	🔲 gx2	localsmrdb	pi dD	sonarvoltage	vz.
aspd_error	battery_voltage2	ch3in	ekfposhor	gr3	mag_declination	piddesired	speedup	watts
asratio	ber_error	ch3out	ekfposvert	ຍ	mag_ofs_x	pi dff	SSA	wind_dir
ax	boardvoltage	ch3percent	ekfstatus	■ ø⁄2	mag_ofs_y	pi dI	target_bearing	wind_vel
a x2	brklevel	ch4in	ekfteralt	a 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 yaw
ay3	ch10in	ch6in	freemem	gyrosq	mx	radius	ter_curalt	
az	ch10out	ch6out	GeoFenceDist	gyrosq2	mx2	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:



B) Mission Planner configuration description of TF03 for the purpose of Obstacle Avoidance

Although TF03 is long range sensor and in most cases it is used for Altitude Hold but there are some cases where obstacle avoidance is required at long range especially for high speed drone. So in such cases TF03 can be used for obstacle avoidance. Connect the flight control board to MP. Attention: distance between UAV margin and LiDAR should be larger than LiDAR blind zone. Go to [CONFIG/TUNING] tab and select [Full Parameter List] on the left side. Find and modify the following parameters:

AVOID_MARGIN = 5 [Unit: m, set obstacle avoidance distance as required]

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 = 27 [TF03 UART option]

RNGFND1_MIN_CM = 30 [It could be changed according to real application requirement and should be greater LiDAR than non-detection zone, unit is cm]

RNGFND1_MAX_CM = 700 [It could be changed according to real application requirement and should be smaller than effective measure range of LiDAR, unit is cm]

RNGFND1_ORIENT = 0 [It depends on the LiDAR's real installation direction, 0~7, 24=Up and

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25=Down (total ten) are supported up till now, see details in MP]

PRX_TYPE=4 [Rangefinder should be selected for proximity sensor in obstacle avoidance mode]

AVOID_ENABLE= 3 [If 3 = UseFence and UseProximitySensor doesn't work, could choose 2 = UseProximitySensor]

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

If the error message "**PreArm: check the proximity sensor**" appears, please check if the connection is correct, the power supply is normal and you have restarted the controller.



How to see the target distance measured by the LiDAR: (distance from LiDAR in obstacle avoidance can't be displayed in *sonarrange* option) press Ctrl+F button in keyboard, the following window will pop out:

🚽 temp						\times
Geo ref images	Geo Refrence photos					
Warning Manager	Create custom audio warnings		SITL			
Follow Me	use a nmea gps to follow me		streamcombi			
NMEA	outputs the mav location in nmea		Inject GPS			
MicroDrone	outputs the may location in microdrone format		FFT			
Mavlink	mirrors the mavlink stream received by mp		TD		Dis	
Param gen	regenerage the param info used inside mp		reboot	OPTICAL FLOW	Dia	
Lang Edit	translation language editor		pixhawk	VISION POSITION	Dis	
OSDVi deo	overlay the hud into your recorded videos		QNH		Dis	
Moving Base	show an extra icon on the map of your current		Sequence		En	
Shp to Poly	convert shp file ot a polygon file		Swarm			
	output the may location into xplanes	nk In	vlc			
Swarm	multi mav swarm interface		gstream			
Follow the leader	follow the leader swarm		Age Map			
MAVSerial pass	create a exclusive passthrough to the gps		Data			
	remove all apm drivers		Faram gen cust			
Sort TLogs	sort tlogs into there type and sysid		signing			
rip all fw	download all current fw's		opticaltiov	RC RECEIVER	Dis	
Inject GE	add custom imagery to mp		calib	3D GYR02	Dis	
Clear Custom Maps	wipe custom imagery		sphere	3D ACCEL2	Dis	
structtest	struct conversion speed test		mag calb			
DashWare			log			
arm and takeoff	quad: arm and takeoff		extract			
gimbal test	run the gimbal pointing algo		Proximity	AHRS		
map logs	create map jpg's for all tlogs in a dir			TERRAIN		
logindex	tlog browser		Swarm			
	logdownload Rebort All	00040	Custom DTED			
GST test	DEM scp logs Cust	om GDAL				



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 v1.3.76.

♦ Attach: If TELEM2 port has been used, GPS2/UART4 and TELEM1/SERIAL1 interfaces can also be used, the other settings are same

Configuration Descriptions on Mission Planner:

Connect flight control board to MP, Select [Full Parameter List] in [CONFIG/TUNING] tab. Find and modify following parameters:

For GPS2/UART4:

SERIAL4_PROTOCOL = 9 (LiDAR)

 $SERIAL4_BAUD = 115$

For TELEM1:

SERIAL1_PROTOCOL = 9 (LiDAR)

 $SERIAL1_BAUD = 115$

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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 of the software to finish.

Important Note: If you have configured protocol type (SERIALX_PROTCOL: X can be 1, 2, 3, 4 etc.) for more than one UART ports as **9**: **Rangefinder** but you have connected LiDAR to only single UART port then it will give **Bad LiDAR Health error**. So you need to configure only those UART ports as **9**: **Rangefinder** to which you will connect LiDAR. In other words we can say that if the number of serial ports configured as **9**: **Rangefinder** is less than the number of connected LiDARs then Bad LiDAR Health will occur.

