

Table of Contents

	NAVIGATION/DOCUMENT CONVENTIONS.....	III
	Table of Contents.....	vii
1	Introduction.....	1
	ABOUT THE MANUAL.....	1
	OTHER MANUALS IN THIS SERIES.....	2
	TERMINOLOGY USED	3
	ABOUT THE MP2128 ^{HELI2}	4
	Helicopter Flight Control Modes.....	4
	Pilot In Control (PIC).....	4
	Computer In Control (CIC).....	4
	UAV Mode.....	4
	Arcade Modes.....	4
	RPV mode.....	5
	Flybarless Rotor Heads.....	5
	Multirotor aircraft	5
2	Installation.....	7
	REQUIRED EQUIPMENT	7
	STEP 1: PREPARE FOR INSTALLATION	7
	STEP 2: INSTALL MP2128 ^{HELI2} AND MODULES ONTO HELICOPTER.....	9
	GPS Antenna	10
	Transition Cable Location.....	10
	Antenna Location	10
	GPS Antenna Position.....	11
	Pressure Altimeter sensor.....	11
	AGL Module	11
	Compass	11
	RC Helicopter Gyro	12
	Flybarless Controllers	15
	Governors.....	18
	RC Autopilot Bypass Devices	19
	Radio Modems	19
	Power On	20
3	Post Installation Checks.....	21
	Yaw Gyro Test.....	21
	GPS.....	21
	Ultrasonic Altimeter (AGL)	21
	Connectors	22
	Calibrate the Compass.....	22
	Vibration Analysis.....	22

4	Servo Configuration	25
	ABOUT SERVO ASSIGNMENTS	25
	Setting Heli Mode	25
	Multirotor Modes	29
	Servo Settings	29
	SERVO ADJUSTMENTS SECTION	30
	ASSIGN SERVOS SECTION	31
	SERVO LOCKING SECTION	31
	MISCELLANEOUS SECTION	32
5	Helicopter Feedback Loops	33
	PID LOOPS USED IN HELICOPTERS	33
	Multirotor PID loops	33
	Rate Control Feedback Loops	33
	RATE FEEDBACK LOOPS	34
	FEEDBACK LOOP CONFIGURATION IN THE MP2128 ^{HELI} / ^{HELI2}	37
	I term Windup	37
	Position Hold	38
	Forward Flight	40
	Arcade Modes	43
	Altitude Hold	49
6	Flight Control Modes	50
	ABOUT FLIGHT CONTROL MODES	50
	Flying Through Waypoints	50
	CIC Arcade Modes	52
	Attitude Arcade Mode	52
	CIC Velocity Arcade Mode	54
	CIC Position Arcade mode	55
	CIC Altitude Arcade mode	56
	Manual Throttle/Collective Control	56
	All Arcade Modes	56
	RPV Mode	56
	HELICOPTER CONTROL WHEN GPS IS LOST	57
	GPS Signal Quality	58
7	Takeoff and Landing	61
	TAKEOFF CAUTION	61
	AUTONOMOUS TAKEOFF	62
	Checking Sensors for erroneous Data	62
	Take off Command Sequence	63
	AUTONOMOUS LANDING	65
	Circuit Command	66
	Circuit options	66
	Fly to landing point – Shown in the datalog viewer as “flying to entry point” – Circuit state field 1112 = 1	68
	Descend – Shown in the datalog viewer as “descending” – Circuit state field 1112 = 2	68
	Descend with AGL – Shown in the datalog viewer as “descending” – Circuit state field 1112 = 2	68
	Reduce throttle – Shown in the datalog viewer as “cutting throttle” – Circuit state field 1112 = 3	69
	Cut throttle – Shown in the datalog viewer as “cutting throttle” – Circuit state field 1112 = 369	69
	Circuit complete – Shown in the datalog viewer as “complete” – Circuit state field 1112 = 469	69
	Descent Stages	69
	Manual Engine Cut	71

8	Setting Parameters	73
	CONFIGURATION WIZARD	73
	CONFIGURING SETUP FIELDS	76
	Throttle Settings	76
	Using the Ultrasonic Altimeter (AGL)	77
	Landing Gear Switches	78
	Using only Throttle to determine Off Ground	78
	Changing Desired Altitude	79
	Waypoint Navigation Related	80
	CIC Arcade Mode Selection	81
	Ch 5 Switch Configuration	82
	Configuring a three – position mode switch	84
	Helicopter Status Monitor Plug-in	86
	ARCADE MODE FIELDS	87
	CIC Velocity Arcade Mode	87
	Position Hold Arcade Mode	88
	Altitude Hold Arcade Mode	88
	Configuring New Altitude Hold Parameters	89
	Old Altitude Hold Mode	93
	Hover Mode	94
	Velocity from hover offset gains & Overshoot	94
	Attitude, velocity, and position estimates	96
	GPS Antenna Position	97
	CONTROL MODE TRANSITIONS	98
	On / Off Ground Transitions	98
	Other Transitions	100
	CONFIGURING LOOK-UP TABLES	102
	Pitch curve	102
9	Flight Testing & PID Tuning	103
	BEFORE STARTING	103
	TEST THE HELICOPTER ON THE GROUND	103
	Tips on vibration and data log analysis	105
	TEST FLY HELICOPTER MANUALLY (PIC MODE)	106
	PID LOOP TUNING	112
	SETTING GAINS	113
	Adjusting gains in HORIZON ^{mp}	113
	ADJUST THE INNER PID FEEDBACK LOOPS	115
	Descent test	120
	ADJUST THE ALTITUDE HOLD FEEDBACK LOOPS	120
	Check throttle operation	121
	Before Flight	121
	To adjust altitude hold gains	121
	Guidelines for Throttle from Z Velocity	123
	ADJUST THE VELOCITY & POSITION HOLD FEEDBACK LOOPS	123
	Configure	123
	Prepare	124
	Check swash plate operation	124
	Check Heli Staus Monitor	124
	Velocity Loop Tuning	125
	Position Hold Tuning	126
	To adjust position hold gains	126
	AUTONOMOUS TAKEOFF	127
	CIC Testing – Fully autonomous flight	128

	FLYING TO WAYPOINTS.....	128
	FLYING THROUGH WAYPOINTS	130
	AUTONOMOUS LANDING	130
	Ground Effect	131
	Landing.....	131
10	Helicopter Commands	133
	FLIGHT COMMANDS	133
	CALCULATION COMMANDS	137
	THREAD COMMANDS.....	138
	RESTRICTED COMMANDS	138
	COMMANDS ONLY IN 3.7 DEVELOPMENT CODE.....	138
	Notes on Heli Commands	142
	ARMING AND DISARMING	143
	Armed field resets	143
	Armed options [Field 6932]	143
	Disable throttle until armed.....	143
	Disable takeoff until armed.....	143
	Disable 'off ground' until armed.....	144
	Disable fatal error 'tail wag' if UAV armed.....	144
	Set fatal error if UAV takes off before arming.....	144
11	Helicopter Fields	145
	SETUP FIELDS	146
	Installation Configuration.....	146
	Takeoff	151
	Flight.....	152
	Navigation	154
	Landing.....	155
	Multirotor fields.....	156
	Autorotation Setup Fields.....	157
	PID LOOP FIELDS – HELI-SPECIFIC.....	158
	Autorotation PID Fields	158
	STATE FIELDS	161
	Autorotation Fields	163
	Kalman Filter Estimates	163
	Heli Command State	166
	DATALOG FIELDS	168
12	Multirotor Modes & Rate Loops	169
	ABOUT MULTIROTOR MODES.....	169
	PID Loops.....	169
	VRS CONFIGURATION.....	169
	Servo mixing.....	169
	Quad Rotor A	170
	Quad Rotor B	170
	Tri-Rotor Coaxial with 6 motors.....	171
	QuadRotor +.....	172
	Octo Rotor A	172
	Multi Rotor – mode 34	172
	Servo Settings.....	173
	Speed controller support.....	173
	333Hz Update Mode	174
	I2C Controllers	174

	Fast loop Multiplier	174
	400 Hz Update Mode	175
	400 Hz Control Loop Gyro Filters	176
	HyperTerminal Raw Sensor Report	176
	Banked turns during high speed flight	176
	MULTIROTOR MIXING MODE	177
	Hex-rotors	177
	Hex-rotor Values	180
	WIRING FOR MOTOR ESC UNITS	182
	MULTIROTOR WIRING DIAGRAMS	184
13	Multicopter simulations	187
	ABOUT	187
	QUADROTOR A SIMULATION	187
	QUADROTOR B SIMULATION	187
	QUADROTOR + SIMULATION	188
14	Multicopter Setup	189
	TERMINOLOGY	189
	BEFORE FLIGHT	189
	ESC Braking	190
	ESC Ranges	191
	Verify Sensors	193
	MULTIROTOR STEP-BY-STEP GAIN TUNING GUIDE	193
	Inner Loops	193
	Datalog & Status Monitor Analysis	194
	Outer Loops	194
	Datalog & Status Monitor Analysis	195
	Troubleshooting	195
	Appendices	197
A.	Troubleshooting	198
	SETUP	198
	AGL	198
	SERVO NOISE	199
	TAKEOFF	199
	FLIGHT	200
	OTHER ISSUES	201
	MULTIROTOR SPECIFIC TROUBLESHOOTING	202
	TAKEOFF	202
	FLIGHT	203
	Other Tips	205
	Anti Wind up limits	205
	Gain signs	205
	Introduction to Rate loops	205
	Overshoot	206