

Manual Transition Flight Design Sketch

Taxonomy

✔ with x being the channel number. Parameters HEAR-[A][x], HEAR-[B][x], etc. are tunable parameters in HEAR FC with x being optional parameter index, A and B are arbitrary captions to organize parameters set.

✔ are tunable parameters in PX4 with x being optional parameter index, and A is arbitrary caption to organize parameters set.

FB: Feedback action

FF: Feedforward action (i.e. open-loop)

RC-D: commanded directly through RC.

General

Let CH8 be the mode selection switch, pos 1 (low): VTOL mode; pos 2 (mid or high): plane mode. Safety: CH11 is kill switch Minimum M1 command must prevent ESC stall. Speed is obtained from pitot tube and GPS.

Physical Asset assignment

Reference	Function	Pixhawk Pin	Signal Source
M1	Front Motor	AUX 1	OFFBOARD MAVLink 1
M2	Rear Motor R	AUX 2	OFFBOARD MAVLink 2
M3	Rear Motor L	AUX 3	OFFBOARD MAVLink 3
S4	Canard R	AUX 4	OFFBOARD MAVLink 4
S5	Canard L	AUX 5	OFFBOARD MAVLink 5
S6	Vane R	AUX 6	OFFBOARD MAVLink 6
S7	Vane L	AUX 7	OFFBOARD MAVLink 7
S8	M1 Tilt Servo	AUX 8	OFFBOARD MAVLink 8
S9	Rudder R	MAIN 1	RC YAW
S10	Rudder L	MAIN 1	RC YAW
S11	Aileron R	MAIN 2	RC ROLL
S12	Aileron L	MAIN 2	RC ROLL
S13	Elevator R	MAIN 3	RC PITCH
S14	Elevator L	MAIN 3	RC PITCH

Reference	Function	Pixhawk Pin	Signal Source
S15	Steering	MAIN 4	RC AUX 1
S16	Door RF	MAIN 5	RC AUX 2
S17	Door RR	MAIN 5	RC AUX 2
S18	Door LF	MAIN 5	RC AUX 2
S19	Door LR	MAIN 5	RC AUX 2

Actuation PX4 settings

Maximum/Minimum limits for each actuator are set in the QGC. See QGC screenshots below.

RC Channel assignment

See "Systems/RC/general.json" for updated HEAR configuration.

RC Channel	PX4 Assignment	Used in HEAR FC	Futaba T14SG Assignment
CH1	RC ROLL	Yes	J1
CH2	RC PITCH	Yes	J2
CH3	RC THROTTLE	Yes	J3
CH4	RC YAW	Yes	J4
CH5			
CH6		Yes (CH_number_for_forward_motion)	RS
CH7			
CH8	RC AUX 2	Yes (CH_number_for_switch_vtol_mode)	SA
CH9			
CH10	RC AUX 1		LD
CH11	Kill switch		SF
CH12			

VTOL Mode

CH1: Throttle commanding M1, M2, M3 (FF). M1 is the frontal motor.

CH2: Yaw commanding the vanes differentially (FB) (HEAR-YAW_VANES_RANGE_MAX), and canard differentials (FF) (HEAR-YAW_CANARD_DIFF_RANGE_MAX); rudder together (FF) (RC-D).

CH3: Roll commanding M2 and M3 in a differentially (FB), AND ailerons differentially (FF) (RC-D).

CH4: Pitch commanding M1 and (M2+M3) differentially (FB), elevators together (FF) (RC-D), canard together (FF) (HEAR-PITCH_CANARD_RANGE_MAX). Both elevators and canards are differential (PX4 settings).

CH6: Forward lateral commanding vanes (FF) (range HEAR-FWD_RANGE_MIN - HEAR-FWD_RANGE_MAX | parametrized angles HEAR-FWD_RANGE_ANGLE_RAD_EXTREMUM), frontal servo (FF) (range HEAR-FWD_RANGE_MIN - HEAR-FWD_RANGE_MAX), and canard (canard phase leads frontal servo phase by a factor of HEAR-CANARD_FWD_SCALE ≥ 1) in the same direction . Frontal servo angle theta modifies M1 thrust by $M1 = M1 * \cos(\theta)$.

Plane mode

At the event of transition

The frontal servo drives M1 to HEAR-PLANE_FRT_SERVO_TILT. The canard is also trimmed to HEAR-PLANE_FRT_SERVO_TILT.

M2 and M3 are switched off.

Doors of M2 and M3 closed (RC-D).

Vanes closed HEAR-PLANE_VANES_CLOSED_TILT

Post-transition control

CH1: Throttle directly commanding M1. No front servo angle compensation.

CH2: Yaw commanding rudder together (FF) (RC-D).

CH3: Roll commanding ailerons differentially (FF) (RC-D).

CH4: Pitch commanding elevators together (FF) (RC-D), and canard together (FF) (HEAR-PITCH_CANARD_RANGE_MAX). Both elevators and canards are differential (PX4 settings).