



Development Report

Yamaha Velocity Stack Control

DEV-RPT-007_02

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Introduction

Yamaha R1 and R6 motorcycles are fitted with drive by wire (DBW) and variable height velocity stacks. Both these devices use DC servo motors and, as such, must be controlled by an H Bridge electronic circuit.

As MoTeC M800/M880 ECU's (herewith referred to as 'the ECU') have only one H Bridge it is normally necessary to use an additional control unit for one of the servo motors (a MoTeC DBW4).

This document describes how the ECU can be setup to control variable velocity stacks without the use of the dedicated H Bridge circuitry (Aux1 and Aux2), thus leaving the H Bridge free to run the DBW.

Pre-requisites

In order to run this system the following ECU inputs, outputs and parameters must be available.

- ☐ Two spare auxiliary outputs from Aux5 to Aux8 (for this example document we will use Aux7 and Aux8).
- ☐ One spare auxiliary/ignition/injector output (for this example document we will use Aux3).
- ☐ One spare AT input (for this example document we will use AT4).
- ☐ Both ECU general purpose timers.

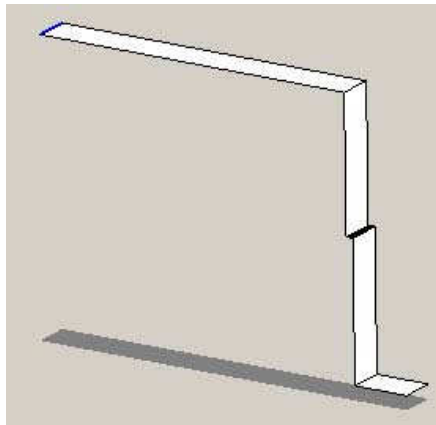
Auxiliary Output – Stack Control Table

- ❑ Pick an unused Auxiliary output and set it up as an Aux table.

Auxiliary Out 3		
Parameter	Value	Function
Function	3	Press F1 for details

- ❑ Setup the table parameters as shown across.

Auxiliary Out 3 - Aux Table		
Parameter	Value	PwM / Switched
PwM / Switched	1	Output Control Type
Output Mode	0	
Polarity	1	0 : PwM (Pulse width Modulated)
Frequency	10	1 : Switched
Minimum Duty Cycle	0	
Maximum Duty Cycle	100	
Hysteresis	1	



- ❑ Setup the output table with 'Engine RPM' on the x axis.
- ❑ Set the table values to 100 to keep velocity stacks in the lowered position.
- ❑ Set the table values to -100 to keep velocity stacks in the raised position.
- ❑ Create a crossover region with breakpoints every 100rpm.
- ❑ Populate a 400rpm area with 1 (see table below) to provide hysteresis.

Aux Table 3									
RPM	0	14100	14200	14300	14400	14500	14600	17000	
	100	100	1	1	1	1	-100	-100	

- ❑ The aux output will now raise the stacks at 14500rpm and lower the stacks at 14100rpm.
- ❑ Wire the auxiliary output directly into a spare AT input (in this case AT4).

AT Input – Timer Setup

The servo motor is controlled by the two general purpose ECU timers.

- ❑ Setup the two timers to count when the AT input switches (this is the AT input that is controlled by the Aux table).
- ❑ Note that the two timers are setup the same but different logic control parameters.

Timers		
Parameter	Value	Timer 1 Selection
Timer 1 Selection	37	Specifies which status flag should be used to activate the timer. Press F1 for details.
Timer 1 Logic Polarity	1	
Timer 1 Max	0.40	This timer is a general purpose timer. The corresponding channel "Timer 1" can be used as an input to any table.
Timer 2 Selection	37	
Timer 2 Logic Polarity	0	
Timer 2 Max	0.40	

34	:	Switch	Input 1	<AT1>	Active
35	:	Switch	Input 2	<AT2>	Active
36	:	Switch	Input 3	<AT3>	Active
37	:	Switch	Input 4	<AT4>	Active
38	:	Switch	Input 5	<AT5>	Active
39	:	Switch	Input 6	<AT6>	Active

Auxiliary Output – Servo Motor Control

- Pick two unused auxiliary outputs and set them both up as Aux tables i.e. Function = 3.

Auxiliary Out 7		
Parameter	Value	Function
Function	3	Press F1 for details

- Setup the table parameters as shown across.
- Both tables have the same parameters.

Auxiliary Out 7 - Aux Table		
Parameter	Value	PWM / Switched
PWM / Switched	1	Output Control Type
Output Mode	2	
Polarity	1	0 : PWM (Pulse width Modulated)
Frequency	10	1 : Switched
Minimum Duty Cycle	0	
Maximum Duty Cycle	0	
Hysteresis	0	

- Setup the two output tables with Timer1 on the x axis and Timer2 on the y axis.
- Populate the tables as shown i.e. all 0 except for when shown.

Aux Table 7												
Tmr1 s		0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
Tmr2 s	0.00	100	100	100	100	0	0	0	0	0	0	0
	0.10	0	0	0	0	0	0	0	0	0	0	0
	0.20	0	0	0	0	0	0	0	0	0	0	0
	0.30	0	0	0	0	0	0	0	0	0	0	0
	0.40											
	0.50											
	0.60											
	0.70											
Aux Table 8												
Tmr1 s		0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
Tmr2 s	0.00	100	0	0	0	0	0	0	0	0	0	0
	0.10	100	0	0	0	0	0	0	0	0	0	0
	0.20	100	0	0	0	0	0	0	0	0	0	0
	0.30	100	0	0	0	0	0	0	0	0	0	0
	0.40	0	0	0	0	0	0	0	0	0	0	0
	0.50	0	0	0	0	0	0	0	0	0	0	0
	0.60	0	0	0	0	0	0	0	0	0	0	0
	0.70	0	0	0	0	0	0	0	0	0	0	0
	0.80	0	0	0	0	0	0	0	0	0	0	0
	0.90	0	0	0	0	0	0	0	0	0	0	0
	1.00	0	0	0	0	0	0	0	0	0	0	0


AT Input – Fuel Control

To provide additional fuel when the velocity stacks lift it is possible to use the ECU's built in 'Nitrous' strategy.

- ☐ Set the AT4 to be the 'Nitrous' function.

Nitrous	
Parameter	Value
Request Method	1
Output Method	0
Hysteresis	0.0
Minimum Throttle	0
Activate RPM	0
Stage 1 - Start Delay	0.05
Stage 1 - Attack	0.05
Stage 1 - Decay	0.02
Stage 1 - Recover Delay	0.00
Stage 2 - Start Delay	0.00
Stage 2 - Attack	0.00
Stage 2 - Decay	0.00
Stage 2 - Recover Delay	0.00
Stage 3 - Start Delay	0.00
Stage 3 - Attack	0.00
Stage 3 - Decay	0.00
Stage 3 - Recover Delay	0.00

- ☐ Set the Request Method = 1 i.e. digital input active.
- ☐ Set the Start Delay i.e. delay from request.
- ☐ Set the Attack i.e. ramp rate to full fuel enrichment.
- ☐ Set the Decay i.e. rate at which fuel switches off when exiting Nitrous.

Nitrous Stage 1 Fuel Enrich 3D (% of IPU)												
		RPM	14000	14200	14400	14600	14800	15000	15500	16000	16500	17000
TP %	0.0	0	0	0	0	0	0	0	0	0	0	0
	10.0	0	0	0	0	0	0	0	0	0	0	0
	20.0	0	0	0	0	0	0	0	0	0	0	0
	30.0	0	0	0	0	0	0	0	0	0	0	0
	40.0	0	0	0	0	0	0	0	0	0	0	0
	50.0	0	0	0	0	0	0	0	0	0	0	0
	60.0	0	0	2	2	2	2	2	2	2	2	2
	70.0	0	0	2	2	3	3	3	3	3	3	3
	80.0	0	0	2	2	3	3	3	3	3	3	3
	90.0	0	0	2	2	3	3	3	3	3	3	3
	100.0	0	0	2	2	3	3	3	3	3	3	3

- ☐ Setup the output table with RPM on the x axis and throttle position on the y axis.
- ☐ Add extra fuel based on the switch over point specified in the Aux3 stack control table.

Sw In 4 (AT4)		
Parameter	Value	Function
Function	6	Press F1 for details

Wiring

- ☐ Wire Aux3 to AT4 i.e. the stack control output to the nitrous and time input.
- ☐ Wire the servo motor to Aux7 and Aux8.