Megasquirt II with V3.0 PCB – Stock Rotary CAS *Last Updated: 2/November/2007* Setting up your 2 rotor engine to use a stock unmodified Mazda Crank Angle Sensor with Megasquirt

Read through all of the steps first before beginning. Tick each part off as you go. If you have any problems, please ask on the forum as you will probably get a faster response than emailing me directly. If something isn't clear or you've found a mistake, please let me know so that I can update the guide! You can contact me by sending an email to paul@pw.cx or via PM to H4Inf on RX7Club.com or Ausrotary.com

This guide applies to:

- Megasquirt v3.0 PCB with the MS2 daughterboard fitted
- MS2Extra Firmware 1.x & 2.x
- Stock Mazda dual-wheel crank angle sensor (unmodified)
- Stock Mazda FC Leading and Trailing coil-packs



Overview

- Modify the Megasquirt hardware to accept the signals from the CAS
 - Jumper for VR Sensor tach input circuit
 - Build second VR conditioner circuit
 - Add pull-up resistors to the LED's
 - Connect outputs from the LED's to pins on the harness connector
 - Connect the VR circuit in/out to pins on the harness connector to pass through CAS signal
- Wire up the CAS to the Megasquirt
- Wire up your coil-packs to the Megasquirt
- Install the CAS and configure your Megasquirt using Megatune
- Ignition Timing notes

Preliminary checks:

- When your Megasquirt was built, did you install both the Hall/Optical/Negative coil trigger AND the VR Circuits?
 - To use the Mazda CAS, we need the VR Circuit components to be in place. If they aren't installed... well you need to install them ⁽²⁾ See V3 Assembly guide on Megasquirt.info (step 51)
 - R48 guide says 10K; schematic says 100K (as does my diyautotune.com kit). I've installed 100K
- Is your Megasquirt set-up with the VR Sensor as the tach input circuit? If not, follow the steps below:
 - Using the Mazda CAS, we need to jumper MS to use the VR sensor tach input, rather than the alternative Hall/Optical/Neg coil circuit.
 - First of all, if your board is jumpered for Hall/Opto/Negative coil tach input then you will need to remove these jumpers:
 - Remove XG1 to XG2 (near the 40pin socket)
 - Remove OPTOIN to TACHSELECT (near the db37 connector)
 - Remove TSEL to OPTOOUT (near the centre)
 - Now you need to jumper the following on the underside of the PCB to select the VR circuit
 - VRIN to TACHSELECT (near db37 connector)
 - TSEL to VROUTINV (near the centre)

Modifying your Megasquirt hardware

We need to build a second VR conditioner in order to read the Home signal from the stock CAS so that we can provide the trailing coil-pack ignitor with a coil-select signal to ensure we only fire the appropriate trailing coil. This circuit can be built into the development area of the Megasquirt PCB.

We do this using the following components. Most can be sourced at your local electronics supplier. You can get the LM1815 from diyautotune.com.

VR2 CIRCUIT COMPONENTS:

- LM1815 or equivalent (LM1815N etc.)
- 18K resistor
- 82K resistor
- 4.7K resistor
- 1M resistor
- 1K resistor
- 0.01 μF cap
- 330 pF cap (0.00033 μF)
 - 0.33 µF cap (Tantalum type polarised)

ADDITIONAL COMPONENTS:

- 0.1 uF cap
 - This may be required if your tach signal is noisy.
 - Connect from G+ to ground (G+ is a crank signal wire, which plugs in to VR2)
- 3 additional 4.7K resistors
 - \circ $\;$ These are required as pull-up resistors.
 - $\circ~$ Connect between the negative side of each LED and a +5v source.

BUILD VR2 CIRCUIT:

See above right for one possible layout you could use to install this circuit. (If using this layout, DON'T FORGET TO CUT PIN4 ON THE LM1815)

Below that is the circuit diagram to show how everything connects. Construct the circuit as per the diagram in the proto area of the v3 board and install the pull-up resistors for each LED.



Here you can see my attempt at building the circuit. It is not the neatest thing to look at on the underside, but so long as you ensure you have not missed any links, or accidentally bridged anything, you will be fine. *Double check surrounding areas for accidental bridging!*



TOP SIDE OF BOARD grd +5v o o o o grd +5v 0.33 uF IM VR2 OUT 4.7k 0.01 uF VR2 IN 82K 0.01 uF 14.7k 0.00 uF 15.0k 15

BLUE – Under-side RED – Jumper/top-side



VR2OUT TO CPU:

• If using MS2Extra 1.x firmware, connect OUT2 (VR2OUT) from the LM1812 circuit to JP4, which is on the CPU (U1) with a jumper wire. (*pictured on right*)

----- OR -----

• If using MS2Extra 2.x firmware, connect OUT2 (VR2OUT) from the LM1812 circuit to JS10 (CPU Pin 17) with a jumper wire. This pin is about halfway up on the side closer to the longer DB37 connector and probably easiest to do on the underside of the board.

4.7K PULL-UP RESISTORS ON LED's:

Now we need to install some 4.7K resistors from the negative of each LED to a +5v source. This can be done quite easily on the underside of the board as shown in the image below.

The resistors connect from the square pad of each LED to the end further away from the LED's of the 330 ohm resistors (orange-orange-brown).





VR2 INPUT & SPARK OUTPUT JUMPERS

We now need to link the VR2 input and LED outputs to pins on the harness plug, so we can easily pass the ignition input and output signals through the harness to and from the CAS and our coil-packs.

- Connect VR2 (VR2IN) to IAC2B (CAS 2 Tooth Wheel Signal IN)
- Connect LM1815 Ground to IGN (Take this from as close to the LM1815 as possible. IGN is next to the DB37 pins on the top end of the board)
- Connect IAC2A to the point between LED D14 and Q6 (Leading IGN)
- Connect IAC1B to the point between LED D15 and Q7 (Trailing Coil Select)
- Connect IAC1A to the point between LED D16 and Q8 (Trailing IGN)



Wiring up the CAS to your Megasquirt DB37 Connector

It's recommended that you use a shielded cable to connect to the CAS. Earth the shielding braid at the Megasquirt end **only**! (You can earth this to pin#9 (pins 8, 9, 10 and 11 should all be grounds and connected together))

- CAS wiring standard colours:
 - RED Main Trigger Ne+
 - GREEN Home Trigger G+
 - WHITE Main Trigger Ne-
 - WHITE/BLACK Home Trigger G-
- Main trigger (24 tooth) connection to built-in VR circuit:
 - **RED** Ne+ connects to **Pin24** of the DB37 Connector
 - WHITE Ne- connects to Pin7 of the DB37 Connector
- Home trigger (2 tooth) connection to added VR2 circuit:
 - **GREEN** G+ to **PIN31** (on the DB37 connector)
 - WHITE/BLACK G- to PIN36 (VR2 Ground)



Wiring the Megasquirt to the coil-packs

Next we need to wire up the coil packs. Remember to ensure the base of the coil-pack is connected to a good earth as the coils loop back to ground through the base.

This is inside the base of a Leading coil-pack just to show you the ignitor:



• LEADING

- +12V IGN SWITCHED: Tan wire
- GND: Runs through mount
- IGt-L: **Red** Wire
- TRAILING
 - +12V IGN SWITCHED: Tan wire
 - GND: Runs through mount
 - IGt-T trigger: **Red** Wire
 - IGs-T select: White Wire
- Leading coil-pack ignition trigger
 - o IGt-L from coil-pack connects to PIN29 on the DB37 plug
- Trailing coil-pack ignition trigger
 - o IGt-T from coil-pack connects to PIN25 on the DB37 plug
- Trailing coil-pack coil-select trigger
 - IGs-T from coil-pack connects to PIN27 on the DB37 plug

Harness Connections

You have probably seen this diagram before, or something quite like it. Note that the coils are wired up differently to other diagrams so if you have been following this guide, use this diagram, if not then double check that you are wiring things up appropriately for your setup. Depending on how you have connected jumpers, the output pins will differ and so long as the right signals make it to the right devices, everything will be ok. This is not necessarily the best way to do it. \bigcirc



Configuring Megasquirt + Setting the Timing

In this section I'll try to explain a bit about each option... As I find out more or as people request it, I will update with more information here.

Basic Setup -> Tach Input/Ignition settings

📕 Ignition Options						
General Ignition						
Trigger Offset (deg)	60.00					
Skip Pulses	3					
Ignition Input Capture	Falling Edge 📃 💌					
Trigger return not supported yet						
Spark mode(dizzy, EDIS, wheel)	Toothed wheel					
Spark Output	Going Low (Normal) 💌					
Number of coils	Wasted spark 📃					
Spark A output pin	D14 💌					
F1 <u>Fetch From ECU</u> <u>Burn To ECU</u> <u>Close</u>						

- Trigger Offset does not do anything when in wheel decoder mode. I have left mine set to **60**, however this does not affect anything.

- Skip Pulses can remain at **3**.
- If you have wired TSEL to VROUTINV, then set Ignition Input Capture to Falling Edge.
- If you have wired TSEL to **VROUT**, then set Ignition Input Capture to **Leading Edge**.
- For Spark mode, you want Toothed wheel
- Spark output should be set to Going Low
- Number of coils should be set to Wasted spark
- Spark A output pin should be set to D14 if you have been following this guide.

Basic Setup -> Trigger Wheel Settings

🗾 Trigger Wheel Settings		×				
Trigger wheel arrangement	Dual wheel	-				
Trigger Wheel Teeth (teeth)		24				
Missing Teeth (teeth)		1				
Tooth #1 Angle (deg BTDC)		5				
Wheel speed	Cam wheel	-				
Second trigger active on	Rising edge	• •				
Red settings require an MS-II reboot!						
Eetch From ECU Burn To ECU Close						

- Dual Wheel

- 24 Teeth

- Tooth #1 Angle BTDC 5 – Adjusting this number is equivalent to turning the CAS. This value is only read when the MS is powered on at first though, so we recommend you set this value then turn the CAS to line up the timing.

- Wheel Speed - Cam wheel

- Second trigger active on Rising edge

Basic Setup -> More Ignition Settings



Ensure Rotary Mode is set to Rotary on.

All of the numbers in here I have copied from other peoples setup's – I have no real scientific measurements or understanding behind them at this stage. If anyone would like to provide more info to be included, please let me know!

Installing and setting up the CAS

With your ignition off and CAS out of the engine, rotate the engine clockwise by hand until you line up the first pulley mark with the timing mark on the front cover.

Align the matching marks on the CAS housing and driven gear before sliding it into the engine and connect the harness.



Go back to Basic Setup -> More Ignition Settings and use the following settings: Fixed Advance: **Fixed timing** Timing for Fixed Advance (degrees): **-5** (The Leading mark is placed 5 degrees AFTER top dead centre)

Now start the car. Using a timing light running off either Leading coil output, rotate the CAS so that the Leading mark on the pulley lines up with the mark on the pulley. Turn off the ignition.



Looking at an uncovered CAS, it should be sitting around about here when the Leading pulley-mark lines up with the timing mark on the front cover.

Switch the Fixed Advance back to 'Use Table'

Your CAS, engine and MS are now all synced ©

Ignition Timing (THIS IS NOT A TUNING GUIDE!)

This is an ignition map I built based on the 13B stock distributor timing as specified in the factory service manual. Use this at your own risk. Just a reminder that this is not a guide on tuning and I'm no expert! Also note that the 12A dizzy has quite different advance to 13B, so it's absolutely essential that you do your research beforehand – be it for a 12A or 13B.

Remember if somehow your CAS is not synced properly, the values here may in fact be either more of less than what the engine is actually seeing. It is also worth checking through all of the MegaTune settings as there are a number that also modify your ignition timing, such as Air Temp based timing adjustments and Coolant Temp based timing adjustments. These could cause you to run higher than expected advance inadvertently.

📕 Spark	Advance Table'	1							
<u>F</u> ile <u>T</u> ools									
~~~~	deg								
100.0	0.0	4.0 8.6	13.3 17.9	22.5	23.0 23.0	23.0	23.0 23.0	23.0	
95.0	0.0	4.0 8.6	13.3 17.9	22.5	23.0 23.0	23.0	23.0 23.0	23.0	
85.0	0.0	4.0 8.6	13.3 17.9	22.5	23.0 23.0	23.0	23.0 23.0	23.0	
80.0	5.0	9.0 13.0	17.8 22.8	27.5	28.0 28.0	28.0	28.0 28.0	28.0	
70.0	10.0	14.0 <b>18.9</b>	23.5 28.0	32.5	33.0 33.0	33.0	33.0 33.0	33.0	
65.0	10.0	14.0 <b>18.9</b>	23.5 28.0	32.5	33.0 33.0	33.0	33.0 33.0	33.0	
60.0	10.0	14.0 <b>18.9</b>	23.5 28.0	32.5	33.0 33.0	33.0	33.0 33.0	33.0	
50.0	10.0	14.0 <b>18.9</b>	23.5 28.0	32.5	33.0 33.0	33.0	33.0 33.0	33.0	
45.0	10.0	14.0 <b>18.9</b>	23.5 28.0	32.5	33.0 33.0	33.0	33.0 33.0	33.0	
35.0	10.0	14.0 <b>18.9</b>	23.5 28.0	32.5	33.0 33.0	33.0	33.0 33.0	33.0	
30.0	10.0	14.0 <b>18.9</b>	23.5 28.0	32.5	33.0 33.0	33.0	33.0 33.0	33.0	
20.0	10.0	14.0 18.9	23.5 28.0	32.5	33.0 33.0	33.0	33.0 33.0	33.0	
		500 2100	2800 3400	4000	4900 5600	6300	7000 7700	8500	

## That's it for now!

When I first started with MS there was a lot of information out there, a lot of it contradictory and for different versions of MS. I compiled this guide to help people who were attracted to the low cost of the MegaSquirt system but were a bit confused as to how to go about switching over and what was required.

Please, if you find any **errors** or can think of **anything** at all that would be **worth adding** or **clarifying**, please contact me via email to <u>paul@pw.cx</u> or PM to H4Inf on RX7Club.com or Ausrotary.com.

If you have any MegaSquirt related queries, please post them up in the MegaSquirt section of RX7Club.com

Many thanks to Ken (muythaibxr) for answering many of the tough questions in the small amount of spare time he has, and everyone else on the forum who has contributed to the many information-intensive discussions! Thanks to Ben (evil inside) as well for letting me use his MS as a trial before I even touched mine and effectively got me working on sorting my mega out as well [©]