



XMS4-PH

LetRipp II

Engine Management System

MANUAL

Version 1.0



Table of Contents:

Page no:

1. INTRODUCTION.....	1
2. THE THEORY AND WHAT YOU SHOULD KNOW ABOUT IT	1
3. THE DIFFERENT P+H CIRCUITS	2
4. IDLE INJECTOR TIMING.....	4
5. PIN CONNECTIONS	6
6. WIRING.....	7
6.1 COMMUNICATIONS TO A PC	7
7. SPECIFICATIONS.....	8

Table of Figures:

Page no:

FIGURE 1. CURRENT FLOW IN PEAK AND HOLD	1
FIGURE 2. CHEAP PEAK AND HOLD CIRCUIT	2
FIGURE 3. VOLTAGE ON PEAK AND HOLD INJECTOR	2
FIGURE 4. VOLTAGE ON PEAK AND HOLD FOR SWITCH AND SWITCHED DIODE	3
FIGURE 5. PEAK AND HOLD CIRCUIT.....	3
FIGURE 6. ULTIMATE PEAK AND HOLD VOLTAGE.....	4
FIGURE 7. 2 OHM INJECTOR SPRAY	5
FIGURE 8. 16 OHM INJECTOR SPRAY	6
FIGURE 9. WIRING.....	7

1. INTRODUCTION

Congratulations on the purchase of your first XMS4-PH engine management system. This product is a leader in aftermarket engine management systems and it uses the latest 16bit technology.

The XMS4-PH series is a result of many years of development. What started in 1986 as a hobby has turned into a company that thrives on innovation and performance. With the latest technology backing our products and new features continuously being added the XMS4-PH surpasses any price or performance comparison.

The XMS4-PH uses "LETRIPP II TECHNOLOGY" and thus can be tuned by the LETRIPP II WINDOWS TUNING SOFTWARE.

2. THE THEORY AND WHAT YOU SHOULD KNOW ABOUT IT

Low impedance injectors (less than 4 Ohms) require a different activation circuit to the normal 13 Ohm injectors, because the increased current consumption heats the injector and the fuel starts boiling. This in turn causes erratic idling and lean running at power.

A secondary problem with low impedance injector is that the driving circuit may overheat and destruct.

Low impedance injectors have normally a high flow rate at a reasonable cost, and are sometimes the choice. However, a special Peak & Hold (P+H) circuit is required to operate these injectors.

Here is how it works:

The peak and hold circuit opens the injector with a high current (Peak) pulse and then switches the current down to hold the injector open. A current flow diagram, with not much detail, should look like this:

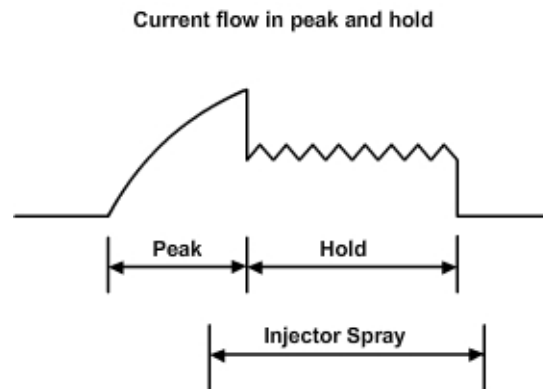


Figure 1. CURRENT FLOW IN PEAK AND HOLD

3. THE DIFFERENT P+H CIRCUITS

There are in principle 3 P+H circuits:

A) The Switch and diode

This is the cheapest method, and the worst.

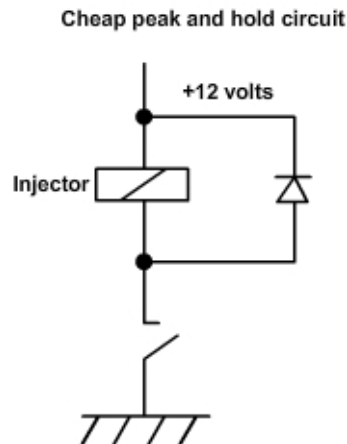


Figure 2. CHEAP PEAK AND HOLD CIRCUIT

To understand the implication one must look at the voltage on the injector and the fuel delivery implication.

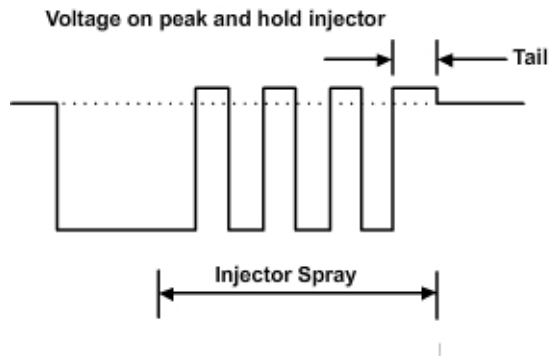


Figure 3. VOLTAGE ON PEAK AND HOLD INJECTOR

The problem is with the TAIL: It keeps the injector open for an UNDETERMINED time. That's not good! It leads to erratic idling at short injections pulses (RICH) and is shorter at longer injection (LEAN). The problem is caused by the (fly-back) diode.

B) The Switch and switched diode.

This method is more expensive.

Voltage on peak and hold for switch and switched diode

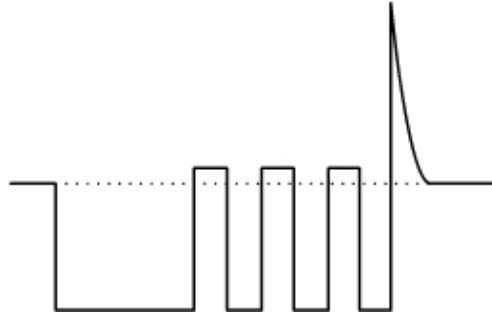


Figure 4. VOLTAGE ON PEAK AND HOLD FOR SWITCH AND SWITCHED DIODE

The second switch is closed most of the time, but open up to RELEASE the injector. This avoids the TAIL current.

Peak and hold circuit

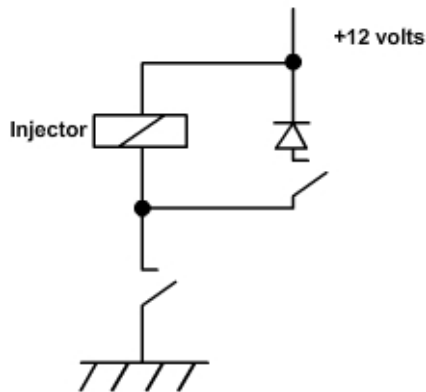


Figure 5. PEAK AND HOLD CIRCUIT

Here the TAIL is replaced by a high voltage spike, and the injector closes immediately. That's good!

C) The ultimate P+H circuit

The circuit looks like the one above, but avoids a short coming for very short injection pulses. The diode switch is operated in a very controlled manner, as can be seen on the following voltage diagram.

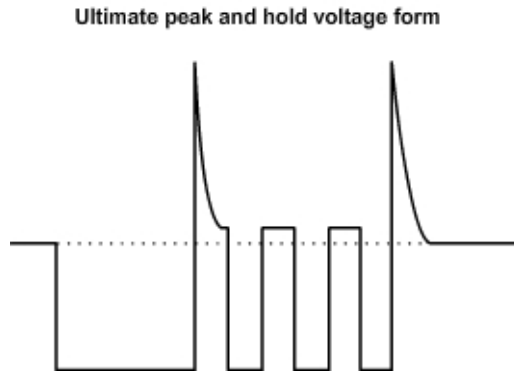


Figure 6. ULTIMATE PEAK AND HOLD VOLTAGE

Here the Injector is opened, and once open the injector magnetic field is released to a certain value. Then the hold circuit kicks in and holds the injector open. At the end of the injection the remaining magnetic energy is released and the injector closes immediately. This circuit eliminates the shortcomings of all of the above circuits.

Why is the above important?

Valid question! Yes, you can cool the fuel to prevent it from boiling and you can 'beef up' the driving circuit. But then you face another problem:

4. IDLE INJECTOR TIMING

To appreciate the problems with injector timing we need to invent a term:

INJECTION POWER TO IDLE RATIO

In short: Injection ratio. This is the ratio between the injection duty cycle at idle and at full power.

For the sake of understanding the principle we disregard the engine efficiency, and other related issues.

At full power the injector should run at lets say 85%. That is to say it is 85% of the time ON, and 15% OFF.

If an engine needs 2KW to idle and delivers 200KW at full power, then the injection ratio is 100 (200/2) and the engine should idle at 85%/100=0.85% ON. Lets assume the engine idles at 600RPM, then a injector is operated sequential every 200ms. This in turn means it is on 0.85% of 200MS=1.7MS. It is a bit short for 13 Ohm injectors, but viable! Of course, it is a very reasonable time for low impedance injectors only if the injectors operate at 85% at full power.

The thing to remember is:

Injection ratio:	100
Full power injection:	85%

What happens if you change the above numbers? Have you modified the engine perhaps?

The most likely scenario it as follows:

You have raised the power to 300KW or higher, but the idle power remains at 2KW. You have replaced the 13ohm injectors with high flow rate low impedance injectors. The result is:

Injection ratio:	300/2=150
------------------	-----------

Full power injection:		50%
This results in:	50/150	=0.33%
Injector on time:	0.33% of 200MS	=0.66MS

This injection time is too short, even for LOW IMPEDANCE injectors. The engine will not idle reliable!

What is the solution?

The engine builder has various tricks in store:

- A) Injector staging: This requires a second set of injectors, extensive mechanical alterations and a different ECU.
- B) Additional injectors in the common air inlet. This requires mechanical alteration, but is not too bad. It requires a separate injector activation circuit.
- C) Altering the fuel pressure between idle and full power. In the case of a turbocharged engine a 'progressive' fuel pressure regulator is available.
- D) Adjusting the fuel pressure so that at full power the injectors operate at 85-95% and accepting that a 400KW engine will run rich at idle. This is not as easy as it sounds!

In the above solution list D) is the best and A) is the worst.

Of course, all of this assumes that you have control over the fuelling.

Before the scientist, mathematicians and practical builders like to prove me wrong with the above generalization I admit that it can be done by paying attention to the details such as:

- 1. Injector selection
- 2. Fuel pressure and flow
- 3. ECU and drive circuit selection

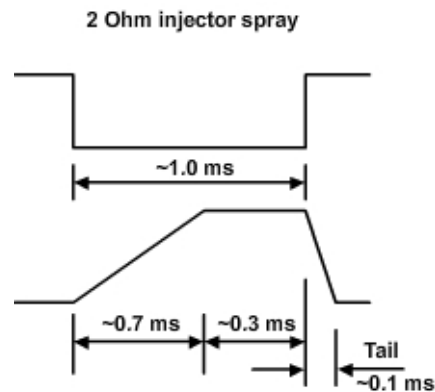


Figure 7. 2 OHM INJECTOR SPRAY

13 Ohm injector spray

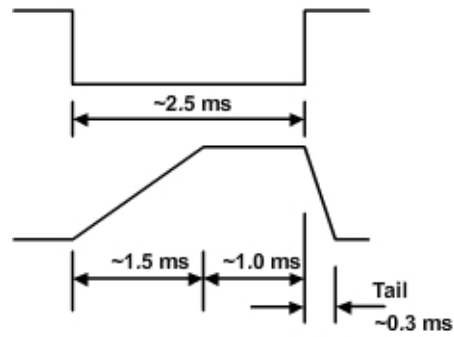


Figure 8. 16 OHM INJECTOR SPRAY

5. PIN CONNECTIONS

The unit has a 6 way input connector and 4 of 4 way injector connectors.

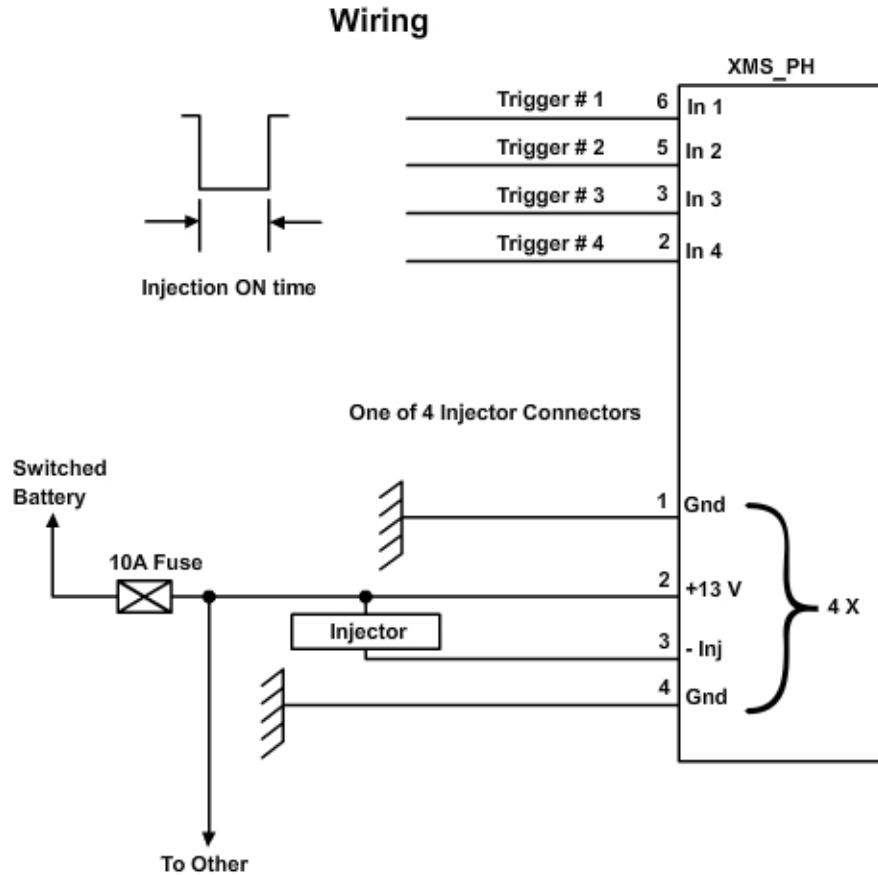
6 way pin out

Pin	Signal	Direction
1	PCR _X	Output
2	Trigger In ₄	Input
3	Trigger In ₃	Input
4	PCT _X	Input
5	Trigger In ₂	Input
6	Trigger In ₁	Input

4 Way pin out (Applicable to all)

Pin	Signal	Direction
1	GROUND	Power
2	+13	Power & Injector plus
3	Injector-	Injector negative
4	Ground	Power

6. WIRING



6.1 COMMUNICATIONS TO A PC

The unit has a fast RS232 port.

The standard LETRIPP II PC software applies. However, the communication is not required UNLESS you like to optimize the peak and hold circuit for your application, such as gas injection. The following items can be set, and the DEFAULT parameters are indicated:

Item	Default
Peak Time	0.7MS
Recovery Time	0.2MS
PWM period	0.125MS
PWM ON Time	20%
Injection Timeout	100MS

The PC software can also display the following items:

Injection ON time
RPM
Injector Utilization

The 'Injector Utilization' displays the duty cycle of the injector operation in percent. See: INJECTOR TIMING above for details.

NOTE: The Communication port wiring is not supplied!

7. SPECIFICATIONS

Max supply voltage:	15 Volts
Short term supply:	30 Volts, 0.5MS
Operating temperature:	-10 to +65 C
Max injector Peak current:	7 Amp
Short circuit protection:	yes
Short circuit current:	12-19 Amp
Connector current rating:	9 Amp
Power consumption:	<0.1 Amp
RS232 connection:	Not supplied