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Changing the Way People Think

It's no secret that E-MAG is changing the way people think about electronic ignitions. But you might not know that given the low profile our company has kept over the last two and a half years. That's how long E-MAG has been at work pioneering new ignition technologies specific to aircraft engines. Until recently, we've done no advertising, issued few press releases, and attended only a handful of air shows. It's basically been word of mouth, a web site, and occasional magazine references that keep our company selling ignitions faster than we can make them. So what's up with E-MAG?

The answer is more involved, and more interesting than you might think. E-MAG is a small company that is looking to take on the "Old Dogs" in the aircraft ignition business. That's no small task, and many would add "It's about time". Magneto have served in aircraft for a long-long (did I mention "long") time. *Some claim to have found them in rock layers alongside Clovis Points.* But time and technology are finally catching up.



We might start by recapping some of E-MAG's innovations to date, and then share some thoughts about how this technology can be used going forward.

E-MAGs "Only" Features:

E-MAG is the only self-contained electronic ignition on the market. By that we mean all components (position sensor, electronics, power backup, and coil) are contained in a single module, slightly smaller and lighter than the magneto ignitions they replace.

E-MAG is the only electronic ignition with a built-in backup power supply. All electronic ignitions are vulnerable to the loss of electrical power. E-MAG's "P" model has a brushless alternator built into the nose of the ignition. If buss voltage drops below 12 volts, the ignition automatically switches to this internal alternator which can power the ignition indefinitely. The internal alternator adds no additional wear parts to the system, and contributes a mere four ounces of added weight.

E-MAG is the only electronic ignition with **EICAD** (E-MAG Interactive Control and Display). EICAD (pronounced "i-kad") is a control set that can 1) assist with setup, 2) allow greater customization, and 3) permit communication with the cockpit or other instrumentation. It's important to note that E-MAGs can be installed and operated without using EICAD at all. So builders that are attracted by E-MAG's installation simplicity will not be disappointed. **EICAD features include** the following:

- 1) **Advance Shift** – This gives the operator a precise, repeatable, and convenient means of fine-tuning the ignition advance curve while the engine is running. Once the operator identifies the engine's best timing advance, EICAD will store that setting in the ignition. Operators then still have the option of switching between the factory

- default timing curve, and their stored curve. In all cases the firing angle is restricted by factory preset min/max limits.
- 2) **Quick-Tme** – Programmable timing index makes setting engine timing even easier (as if E-MAGs weren't easy enough already). With EICAD you simply pre-install the ignitions at any convenient attitude. Secure them for operation because you won't move them again. Then simply 1) position the engine at TDC, and then 2) click the "set timing" button on the EICAD software. There is also a manual method where you can pulse the MAP sensor to record the index (without EICAD).
- 3) **Daisy Chain** - Since aircraft engines have two ignitions, operators are required to repeat setup and configuration operations on each unit. However, E-MAGs can be wired daisy chain fashion so EICAD can issue commands to multiple ignitions simultaneously. Imagine being able to set perfect timing on two (four in the case of twins) ignitions in less than a minute.
- 4) **Tach Configuration** - Customers can use EICAD to configure the tach output signal for A) one or two pulses per revolution, and B) either a 5 or 12 volt signal. This should accommodate almost any instrument requirement.
- 5) **EICAD Status Reports** (via a built-in RS232 connection) on a range of ignition data points, including:
 - a) Computed firing angle.
 - b) Actual firing angle. (Computed and actual angles may vary momentarily while the ignition re-centers following a condition change.)
 - c) RPM
 - d) Buss voltage (As seen at the ignition.)
 - e) Manifold pressure (Coded format.)
 - f) Ignition hour meter (Read only.)
 - g) Ignition firmware version (Read only.)
 - h) Max RPM safety cutout. (A factory set rpm limiter.)
 - i) Master timing advance cap. (Set at the factory.)
 - j) Current circuit board temp.
 - k) Maximum recorded circuit board temp.

Currently, EICAD requires a PC with serial connection. However, we are working on a simple cockpit control that will



replace the lap-top (PC) altogether. While using these features is largely optional, EICAD is built-into all

current series ignitions at no additional cost. The software to operate EICAD is a free download from E-MAG's web site. It's a powerful control option that is available whenever the operator wants to use it. Best of all – its free.

So what's next? What do we plan on doing with all these nifty new tools? The surprise answer is – nothing!

We see our role in developing this ignition technology as about finished. Don't worry, we aren't going anywhere. Now we need to ramp up production to catch up with demand. And since we currently only offer ignitions for four cylinder Lycoming engines, we need to add a Continental version, six cylinder versions, and a dual "D" version. Throw in FAA certification for all the above and it's easy to see we will be busy - for a while anyway.

Even so, the "what's next" question is still very interesting. That's because we see the next wave of creativity not coming from E-MAG, but rather from you - the aviation community. And we see customers, engine shops, and OEMs each playing an important role in making it happen.

There is ample incentive for the industry to embrace new technologies that help modernize these relatively primitive engines that we all love and rely on. Now E-MAG is literally "giving" the industry a tool it's never had before (EICAD) – a simple, clean, interactive ignition platform. Clearly, E-MAG is in the business of selling ignitions. But equipping the units with EICAD is a bonus that exceeds what most builders have ever thought about, much less imagined they would have handed to them (for free).

And the more you understand about EICAD's potential, the easier it is to see the problem we (E-MAG) are facing. E-MAG is seriously outnumbered. Not so much in terms of production capability (*tall talk from a small shop with a three month backlog*), but rather in what we see as an "Integration Gap". Which simply means, just because we have a great new tool does not mean we're ready to tell everyone (in every situation) how to best use it. Don't misunderstand. A stock E-MAG is a vast improvement over a magneto, but a stock E-MAG is still rather generic in nature. It has to be in order to work on a wide variety of engines. It has not been fully optimized for any particular setup. (Clarification: EICAD's Advance Shift lets the operator shift the timing table up or down, but it does not allow the operator to optimize the underlying RPM/MAP tables themselves.)

Fortunately, one man's Integration Gap is another man's **Integration Opportunity**. It's not practical for E-MAG to try and write the ignition prescription for each and every special case user. The operative term being - "special case user". And going forward, almost everyone can be regarded as a special case user, at least in the sense they install the ignition on brand "X"

No single change will require
... as little money
... as little time
... as little effort
and have as much affect on
performance
economy
and reliability
as upgrading to electronic
ignition

model "Y" engine, with "Z":1 compression pistons, and (*sorry, ran out – back to*) "A" type of carburetor/fuel injection, with "B" type of exhaust, and "C" model of fixed pitch/CS prop, burning "D" grade avgas, except when flying to Timbuktu when they might burn "E" grade auto gas. Add to that mix the builder's interest in high altitude cruising, or CAFÉ racing, or speed racing, or aerobatics, or floats, or, or, or . . . you get the idea. While E-MAG may not be in a position to write all these prescriptions, there are a lot of engine docs out there who are equipped (and we believe itching) to do just that. They simply haven't had the necessary tools.

Yes, this is a new way of thinking about electronic ignitions. But now that the tools are available, it's time to rethink a lot of things.

Integration Opportunities:

Multi-Function Instrument Mfg.

E-MAG is making the EICAD command codes available (again free) to all interested multi-function instrument manufacturers. That way, your E-MAG can be accessed through a device you already own, or may plan to own at some point. If you are an instrument manufacturer, you probably already have a few ideas on how E-MAG data could be integrated into your system.

Maybe the initial goal is simply to display EICAD alerts, and possibly launch a response, after operator acknowledgement. It would be easy to do since your instrument already monitors other engine parameters.

- 1) "Alert" - Your P-MAG ignition is operating on internal emergency power.
- 2) "Alert"– Your engine temperatures are higher than normal. Your "Acme Engine Manager" will now retard ignition timing by three degrees in 5...4...3...2...1 seconds - Please Acknowledge.
- 3) "Alert"- Your primary tach sensor lead has failed. Your backup RPM (reported by EICAD) is 2200. [all EICAD data come over a separate serial data line.]



- 4) "Alert"– Based on your history and the conditions at hand, your manifold pressure appears off. You may have a MAP hose leak, or other engine condition.
- 5) "Alert" your ignition hour meter reads 1500 hours – time for overhaul.

OEM/Service Shops

- 1) You might welcome new ways to expand your services. Offering custom ignition configurations might give you a competitive edge. Just as important, you might not want a competitor offering a service that you don't.
- 2) Maybe you're a prop manufacturer and you find that a resonance issue can be minimized or eliminated by a timing profile that's notched at certain engine speeds and/or power settings.
- 3) As an engine shop maybe you want to lock down some of the EICAD controls (after you set it up to your liking) for warranty purposes. Maybe the customer wants them locked down for the same reason.
- 4) Customers value the engine shop being able to "dial-in" the ignition dynamically during engine test. Better yet, they'd probably like a separate check with the timing shifted for each type of fuel they plan on (or even might be) using.
- 5) Modernizing engines that are in wide use and accepted as the standard in aviation is good for the industry - in general.
- 6) *Modernizing engines to give them more power and better economy is good for the industry and good for "your" business.*

Customers "Because I Want It"

- 1) Maybe you plan on traveling to regions that don't have avgas. It would be nice to have a convenient means of calling up an alternate timing profile that's more auto-fuel friendly. OK, maybe that's not your "plan", but you might like having such a profile on hand - just in case.
- 2) Maybe the concept of interconnected intelligent devices that constantly check up on each other is simply too compelling not to do.
- 3) If there is a credible engine upgrade that will save X gallons per hour, most everyone will be interested.
- 4) Maybe you're interested (or might become interested) in CAFÉ or speed racing. Wouldn't it be nice if you could fly TO the race with one advance curve, throw a switch and then fly IN the race with a custom curve?
- 5) Maybe you'd like the ability to use one curve in winter, and a less advanced (cooler) curve in the summer.
- 6) Maybe the idea of replacing a mechanically complex device with a modern electronic ignition (one moving part) is all you need to know.

Yes, it's easy to get carried away. These are just a few examples of possible "special case" uses. No one knows if they will all pan-out. No doubt, there will be other more interesting applications we haven't yet thought of. The industry will need to sort them out. But

at least now the industry has the tools that will allow that process to begin.



Everyone in this mix has something to gain. The engines perform better. The customer spends less on fuel. The equipment is simpler and more reliable. Engine shops can provide a higher level of customization to match power plant, craft, and customer. Multi-function instruments will be able to interact in exciting new ways.

All E-MAG can do is make the tools available, price them appropriately (free works for most everybody), and extend the invitations. And as you can see, there are a lot of invitations to go around. This will be an interesting process. It's one of those rare

occasions when we all get to watch what happens when new ideas, new tools, and new opportunities are dropped unannounced (until now) into the market place. And at this stage no one, certainly not E-MAG, truly knows what the outcome will be.

So what's in it for E-MAG? Why give away all this technology?

One answer is E-MAGs business philosophy that, in part, simply says open platforms are a good idea. Good in the sense they invite more people into our tent as contributors/allies, and good in the sense that better tools in more hands will produce better results over the long run - for everyone.

The other answer comes from what we said at the beginning. E-MAG is taking on the Old Dogs in the ignition business. To do that we will have to outperform companies that are bigger, older, better known, better funded, better networked, and whose products are well entrenched. We believe E-MAG has the advantage when it comes to innovation, and we are going to press that advantage for all its worth. E-MAG can't settle for competing with incremental improvements. Our products need to be compelling. E-MAG is pushing for nothing short of a complete paradigm shift in the ignition business. In order to do that, E-MAG needs to change the way people think about electronic ignitions.



E-MAG Ignitions Models E113 and P113

Weight - 3 pounds

Length - 6.25 " from flange to back of plug wires. Coil section can be removed for remote mounting, leaving the electronics and power section at 2.25".

Control Plug Terminals:

- 1) Ground
- 2) Communication TX
- 3) Communication RX
- 4) P-Lead (kill)
- 5) 13.8 Volts thru breaker
- 6) Tach Signal Output

"P" Model includes 3 phase brushless alternator capable of powering the ignition.

Maximum draw from the aircraft electrical system 1.25 amps.

Variable timing from 20 to 39 degrees based on RPM and manifold pressure.

Multi-Strike firing during start-up (less than 200 rpm).

EICAD capable with serial capable device running free software.

- 1) Quick-Time
- 2) Advance Shift
- 3) Status Reports

