What the heck is a PV MOSFET-Driver?
(excerpts from a letter to Dionics Inc. shareholders in 2010)

"What the heck are PV MOSFET-Drivers, anyway?"
"And what makes them so special?"

Well, folks, if you really want to know, keep reading and I will attempt to make it all clear.
But first, a little background information will help.

It might be self-evident that a device called a "MOSFET-Driver" actually "drives" another device called a "MOSFET." Although the estimated annual world usage of the underlying MOSFETs is a staggering 25-billion units, the overwhelming majority of them are used in less demanding, extremely cost-sensitive commodity-type applications. You might find these commodity-type MOSFETs being used to activate a car's windshield wiper or the motor that controls its electric windows, as well as other non-critical industrial and commercial functions. This type of application would justify no more than a "cheap-and-dirty" type of MOSFET-Driver. Only a small (but growing) segment of the market needs the more valuable, high-reliability type of PV MOSFET-Driver, as manufactured by Dionics. Some of their "mission-critical" applications involve "hi-rel" military telecom, critical air-borne wing-flap motor controls, expensive automatic test equipment and large industrial power distribution systems. And high-reliability electric-car manufacturers are also looking at our PV MOSFET-Drivers for possible use in that market.

Okay, with that background information in place, we're now ready to find out "what the heck a PV MOSFET-Driver is, anyway." Read on, please.

Explaining what a PV MOSFET-Driver is really requires first explaining "what the heck" a MOSFET is.
The letters are simple.
They stand for **M**etal **O**xide **S**emiconductor **F**ield **E**ffect **T**ransistor, or "MOSFET," for short.
But that is still just high-tech alphabet-soup.
You want to know: What is It? What does it do?
Well, a MOSFET is essentially a "switch" that sends electrical energy from where it is, to where it is needed, much as a water-pipe sends water from a source to where it is needed.
But the term "switch" implies the inherent property of being either ON or OFF, with electrical energy either flowing or not flowing. Using the water-pipe example again, imagine a valve that can interrupt the water flow when closed, or permit water to flow freely when open. The water-pipe can now be seen to have three "terminals" or connections, one at each end, plus a central control-valve.
Similarly, in a MOSFET there are three terminals.
One at each end, called a Source and a Drain, and a control-valve or "Gate" in the center.
The Gate in the MOSFET does the same job as the control-valve in the water-pipe.
They both determine whether the flow (electricity or water) can take place, or not.
A MOSFET, therefore, is simply a switch that sends electrical energy from point A in a circuit to point B, depending on whether its Gate is open or closed. Now we're getting somewhere!

It’s probably starting to occur to you that the Gate is pretty important,
since it determines if the electricity will or won’t flow through the MOSFET.
And when we say we are “driving” the MOSFET, it means we are turning it ON or OFF,
which we now know means turning the Gate ON or OFF.
So we can now appreciate that a device known as a “MOSFET-Driver” is really a device that controls, or “drives”, the Gate of a MOSFET.

In theory, since a MOSFET is a switch, every single one of them needs something to determine if it is conducting electricity (ON) or not conducting electricity (OFF).
The key to that lies in control of the Gate of the MOSFET, done by applying a voltage-signal to the Gate. Uh-oh! Hold on a minute.
We just introduced a new concept, a voltage-signal to the Gate.
Where did that come from? Funny you should ask; it’s from the MOSFET-Driver!

Now before going any further, I should first make it known to you that there are several types of MOSFET-Drivers, generally three, and they vary according to price, performance and reliability.
There are some other differences, but they’re not as important as the three just named.

It might actually be easier to appreciate the differences among the three types of MOSFET-Drivers by going back to our water-pipe example. You’d be able to control the flow of water through the pipe by one of three types of control-valves. In the really low-cost, cheap-and-dirty category, consider the pipe to be nothing more elaborate than your garden-hose, and you are controlling the flow through the hose by standing on it with your foot, applying more or less weight onto the hose.
Very poor control quality -- very unsophisticated -- very unreliable, but admittedly very low in cost.
Maybe for some applications, such as watering the lawn, it is good enough. You can’t beat the price!

Now let’s go upscale a bit.
We come to a manually-controlled valve that you turn by hand to shut off the water flow, or to open it.
Much better than standing on the hose, much better control quality, and more reliable, although much more costly than just standing on the hose.
And for some intermediate reliability operations, it is still good enough.

And now let’s go to the extreme.
But it’s not a garden hose; it is a hose that is delivering hydraulic fluid to the wing-flaps of an airplane!
You need the ultimate in reliability here.
No standing on a hose, no manually cranked valve, but only a precision-designed, electrically controlled solenoid valve will do.
It will do the job superbly, with full reliability, but at a cost higher than those other alternatives.
Well, if you or a loved one is flying on that airplane, do you care about the cost?
Or is reliability almost the only consideration?
Not much to think about, is there?

Now let's translate our water-pipe comparisons to electricity –
control via MOSFETs and MOSFET-Drivers.
A cheap-and-dirty resistor would be the functional equivalent of standing on the garden-hose.
It works, after a fashion, and at very low cost, but is surely not ultra-reliable or dependable.
Still, for low cost consumer electronics, not much above toy-level,
it is probably cost effective and "good enough".
That, however, is not the ideal market-place for PV MOSFET-Drivers made by Dionics-USA, Inc.!
That is the "commodity" world, not the "reliability" world.

And now, going up another notch, we find the electrical equivalent of a hand-cranked water control-valve. This product is known as a "CMOS-type" of MOSFET-Driver.
While it does have the ability to switch faster than the Dionics-type device, the importance of that speed advantage is limited to only about 20% of the market-place.
Still subject to numerous performance malfunctions, and lacking the advantages of superior, ultra-reliable construction as used in PV-MOSFET-Drivers, it nevertheless does the job better than cheap-and-dirty resistors, but at a cost much closer to that of the PV-MOSFET-Driver.
Again, good enough reliability for many mid-level applications,
but not what you'd want controlling the current-feed in a cardiac defibrillator. Especially not yours!

Last, at the top of the reliability ladder, is the PV-MOSFET-Driver, as made by Dionics.
Reserved for those applications that simply cannot tolerate a failure, or which find that avoiding costly field repairs and/or equipment replacement far outweighs the initially higher component cost.
Ours is the high-quality, high reliability, and (for now) higher cost device, but worth the difference in the long run. More and more customers are discovering that fact.

Okay, so we build a better mouse-trap. But, what makes it better?
This part is unavoidably a bit technical, but I'll try to make it painless.
And if you're bored, remember that reading this was YOUR idea!

Let's back up for a minute to where we said that you need to apply a voltage-signal
to the Gate in order to turn on the MOSFET.
But applying a voltage-signal to the Gate is not so simple, more like ice-skating on thin ice – a bit too much weight and the ice cracks, dumping you in freezing water up to your neck.
Similarly with Gates, a bit too much voltage and the Gate structures fail,
leaving you up to your neck in destroyed MOSFETs.
And to make it clearer, as well as more ironic, even though the Gate can safely control a MOSFET that handles many Amps of current, and hundreds of volts, the Gate itself is both very delicate and very easily damaged.
And when it is, the entire MOSFET is rendered useless.
So, in case you didn't get the idea yet, it is not a good thing to put too much voltage on the Gate. In fact, just a few excess volts on delicate Gates is probably the main cause of all MOSFET failures!

So how shall we avoid this "delicate Gate" problem among MOSFET-Drivers?
Cheap-and-dirty resistors, as well as not-so-cheap-and-dirty CMOS devices are both capable of delivering excess Gate-crashing voltages, but…can you hear the Cavalry charging to our rescue?... the high-reliability PV MOSFET-Drivers made by Dionics are *INCAPABLE* of delivering any excess voltage to the Gate, guaranteed by the Laws of Physics! It's all in the construction we use, which we will discuss shortly, but its effect is similar to the absolute-safety-from-drowning that you get by ice-skating in an indoor rink.
Without the possibly thin ice of an outdoor lake, drowning physically cannot happen.
So if you can't swim, you should ice-skate only in an indoor rink,
and if your circuit-application absolutely cannot tolerate a failed MOSFET,
you'd better be driving the Gate with a PV MOSFET-Driver.

If you haven't fallen asleep yet, you should instead be getting curious about how the Dionics construction somehow makes it physically impossible to destroy the Gate of a MOSFET.
The secret lies in the PV, or photo-voltaic, nature of our device.
You've probably heard the term "photo-voltaic" before, in relation to solar cells,
wherein the light falling on a silicon diode is converted directly into electrical energy.
We are not installing panels on rooftops, but instead are making microscopically small versions of the same concept, and housing them together with tiny LED light-sources in small plastic packages.
You see, the Laws of Physics dictate that each silicon diode, in response to light falling on it,
will generate approximately ½ volt, and no more.
If we connect 20 silicon diodes in series, we will produce about 10 volts, AND NO MORE!
If the Gate structure is rated to tolerate up to 20 volts Maximum, it is clearly evident that our PV MOSFET-Driver is prevented, by the Laws of Physics, from ever damaging that Gate.
The reliability of this type of Gate-drive is both absolute and unsurpassed.
We'd be fully justified in borrowing the advertizing phrase from the World War II-era cigarette lighter known as Zippo,"the lighter that works!"

Still awake? Good, let's go a little further.

In order to build our super- reliable PV construction, we manufacture a special Integrated Circuit, or IC, using very unusual technology called Dielectric Isolation. It is a challenging and costly process, not available to many companies, and when we include a tiny LED light-source in the same package it gives us yet another advantage known as Optical Isolation.
Our more advanced monolithic ICs also include previously patent-protected "Dynamic Discharge" circuitry to rapidly turn OFF the MOSFET being driven.
Altogether, our device is both unique and almost "bullet-proof," but not without some added cost.
As a result, our devices sell for more, because they cost more to produce, yet in terms of high-reliability and total system confidence, they also offer more.
And meanwhile, we keep working on reducing our costs,
so that the reliability-premium can be reduced.

We are now coming to the fun part, so wake up.

Why are we interested in this MOSFET-Driver market,anyway?
Just how big is it?
Well, let's review how big the underlying MOSFET market is.
As stated earlier, it is estimated this year to be a staggering 25-billion units.
And note that every one of them needs something to turn it ON or OFF.

So now you also know a bit more about "what the heck" a PV MOSFET-Driver is.
Glad you asked? I certainly am.

Sincerely,

Bernard L. Kravitz, President
Dionics-USA Incorporated

P.S.:
One other thought just occurred to me… you might be wondering about competition.
Is Dionics the only one making high-reliability PV MOSFET-Drivers?
Back in 1972, when we originally "invented" the part, we were of course the only company making it.
But back then, the market for MOSFETs, much less MOSFET-Drivers, was practically non-existent.
Years later, though, as both markets developed and grew; a few companies (pretty big ones, at that) did try to duplicate our devices. The very difficult technology kept their numbers down, and although they did copy some of our construction ideas, we don't think their electrical performance has ever measured up to ours. In a sense, through their copying from us,
we taught them everything they know about PV MOSFET-Drivers, but NOT everything WE know.
I think we can then reasonably call our device "the best of the best".
So, do we have competition?
Well, sort of,… but, after consulting our growing list of satisfied, repeat-customers,
maybe the real answer will be more obvious.

For further information, please contact:

Dionics-USA Incorporated
96-B Urban Avenue
Westbury, New York 11590 USA

516-997-7474 telephone
516-997-7479 fax
info@dionics-usa.com email
www.dionics-usa.com web-site