

## FET Amplifier Accessories

### **Pulsed Drain Supplies**

*Directly switching the Drain supply, while keeping the Gate voltage unchanged, for quick amplifier switching.*

### **Gate/Drain Power Supply Sequencers**

*Protecting the amplifier from destructive Drain current until a protective Gate voltage is established.*

### **Gate Negative-Supply Voltage Converters**

*Generating a negative supply for best RF performance, when only positive supplies are available.*

### **Cascaded Amplifier, Amp/Switch Sequencers**

*Automatic time-sequenced biasing of amplifiers and switches for safe high-speed operation of wide-dynamic-range systems.*

### **Temperature-Compensating Drain Supplies and Linearizers**

*Operate at the optimal Drain and Gate voltage, for every temperature of your range.*

### **Packaging Options**

*The range goes from tiny open substrates thru bolt-down packages and entire PCB assemblies.*

### **Custom Quick-Turn Services**

*Complete in-house design, layout, and robotic equipment allow for rapid response to customer needs.*

---

Impellimax Amplifier Support components provide unique functions to boost the performance of your FET amplifier designs.

*Mix and match functions as necessary for your application. Impellimax quick-turn capabilities provide low-cost custom devices to best fit your system needs.*

## Pulsed Drain Supplies

Systems can derive benefits from being able to turn RF amplifiers on and off under logic control. Some such benefits are reduced supply demands, lower dissipation, better channel-to-channel isolation, and protection of sensitive circuits such as detectors and limiters. Problems can occur, however, if the turn-on and turn-off characteristics of the amplifiers and their bias supplies are not dealt with properly.

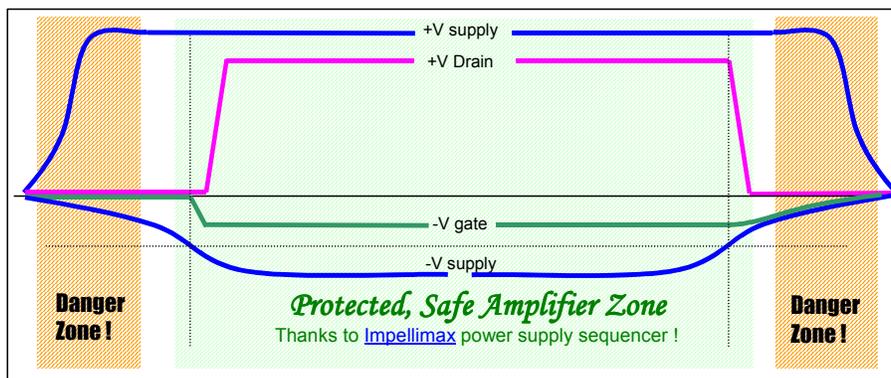
High-speed cycling of FET amplifiers at the Drain Supply can be accomplished with Impellimax Drain Pulse drivers. The Pulsed Drain driver can optionally incorporate voltage regulation and/or temperature compensating regulation. Part numbers 4102, 4106 and XXXX are of this type.

Amplifiers require some nonzero capacitance at the bias node. This capacitance obviously would limit the high-speed performance of the amplifier in pulsed mode. The easiest way of dealing with this capacitance is to “brute force” it with high capability for capacitor inrush current in the driver. Good results can be attained with this approach. It is the simplest method, and can usually be used in low- to mid-power amplifiers where the switching speed goal is 50 nsec or greater.

In cases where higher performance is needed, the Pulsed Drain driver can incorporate switched bypass capacitance. This is a slightly more exotic technique, which largely nullifies the slowing effects of a large amplifier bias capacitor.

## Gate / Drain Power Supply Sequencers

Grounded-Source FET's require a negative bias on the Gate to protect the Drain from damaging high currents. Simply powering-up such an amplifier, in the wrong order, can destroy the device or ruin it's long-term reliability. Amplifiers that are shipped to end-users without bias sequence protection are at very high risk of customer-induced damage.

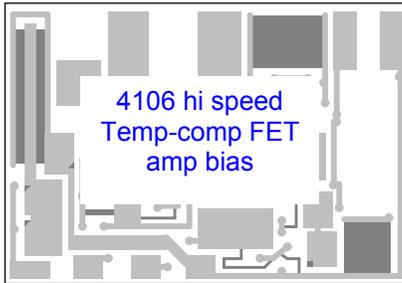


FET Supply Sequencers provide low-cost insurance against test-bench disasters due to incorrect power supply connection order and misbias. Reverse-voltage, Over-voltage, and Under-voltage protection can also be incorporated, for a truly user-friendly bullet-proof design.

High-speed switched amplifiers can rapidly switch between full-on and full-off if the Supply Sequencer is designed to accommodate this. Impellimax Sequencers draw a few milliamps of overhead current and respond to TTL command within low tens of nanoseconds.

In applications where the amplifier requires a large bias capacitor for stability, switching circuitry within the Sequencer can automatically switch this capacitor out of circuit during transitions. This eliminates the usual difficult trade-off between stability and high-speed switching.

### Temperature-Compensating Drain Supply



Size: .515 by .370 inch

Unit provides a regulated positive output voltage in the range of +.98V to +1.42V at an output current of 30mA to 114mA. The output voltage is intentionally responsive to ambient temperature over the range of -40C to +100C, to provide temperature compensation for an amplifier drain bias. The 4106 also provides wideband noise rejection and switching speed under 60 nsec in most applications.

### Gate Negative-Supply Voltage Converter

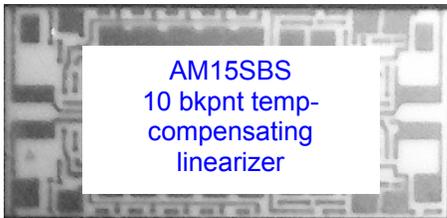


Size: .350 by .070 inch

Unit uses +12V supply to generate a regulated negative output voltage of -6.8V with very low ripple. Adjustment of output voltage to gate can be made by using an external adjustable chip resistor. Overall thickness is .065 max.

(+12V input, -6.8V output)

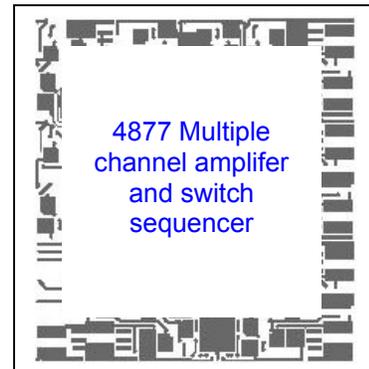
### Temperature Compensating Linearizer



Size: .500 by .235 inch

Max thickness .055. Unit has 10 breakpoints which allow for complex curvature corrections in any of various performance characteristics versus temperature. "S" shapes and other transfer functions can be realized.

### Multi-channel switch driver and Amplifier Sequencer



Size: .640 by .580 inch

Max thickness .055. Multi-channel decoded PIN switch and Amplifier channel sequencer.

## Gate Negative Supply Voltage Converters

Most commonly, negative Gate voltages are needed to allow for optimal amplifier performance, as opposed to floating-source bias arrangements. When an appropriate negative supply isn't locally available, an Impellimax DC-DC converter can be used.

Impellimax offers a wide range of DC-DC converters that are applicable to Amplifier bias requirements.

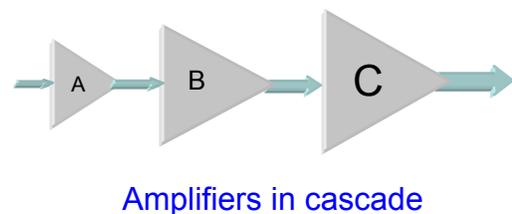
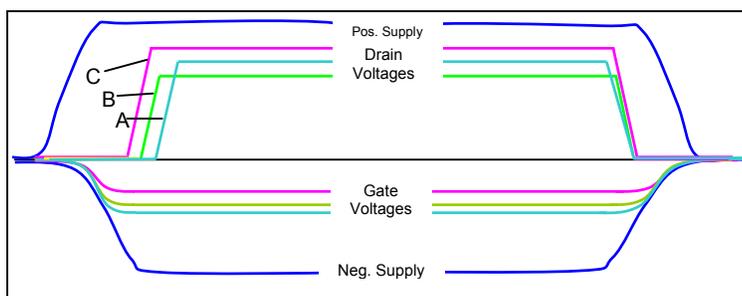
Impellimax capacitively-coupled voltage converters allow voltage conversion in a small space. They function without magnetic field interference issues and they can operate over extreme temperature ranges, which in some applications can limit the usefulness of magnetic power conversion.

In mid and high power, low-frequency amplifier designs, Gate currents can be from tens to hundreds of milliamps. At the lower end of this range, between 15 and 50 milliamps, Impellimax uses a proprietary switched-capacitor scheme which enables voltage conversion with efficiencies that nearly rival inductor or transformer designs.

Custom toroid winding allows us to create magnetically-based power converters for higher powered Amplifiers. We have designs incorporating aluminum wirebonds, positioned thru shaped magnetic regions, to create the windings within micro hybrid voltage converters. We can also use exotic materials, such as Teflon-coated gold wire, for applications where small size and high efficiency are paramount. Copper wire is still the material of choice for most of our magnetic power converters.

## Cascaded Amplifier, Amp/Switch Sequencers

In many systems, multiple amplifiers are connected in cascade for greater gain. For best reliability, it is best to sequence these amplifiers "on" in the reverse order of their connection. This sequencing guarantees that each gain stage is functional before RF power is applied from the previous stage.



Sometimes, RF switches are used in cascade with amplifiers to achieve greater dynamic range and/or multi-input switching. If unwanted amplification of the switching transient is a concern in your system, and if the switch is necessarily on the input side of the amplifier, then careful and correct sequencing of these components is required. If the RF switch is a multi-throw, then the Impellimax Sequencer can be arranged to switch the amplifier off, or into a protected mode, during the channel-to-channel switching event. This will protect the amplifier from switching transients and also will greatly reduce the amplified switching transient at the output of the amplifier.

Additionally, Impellimax switch drivers with adjustable-risetime transient control can be used to keep any transient energy to a minimum, while attaining the required switching speed.

## Temperature-Compensating Drain Supplies and Linearizers

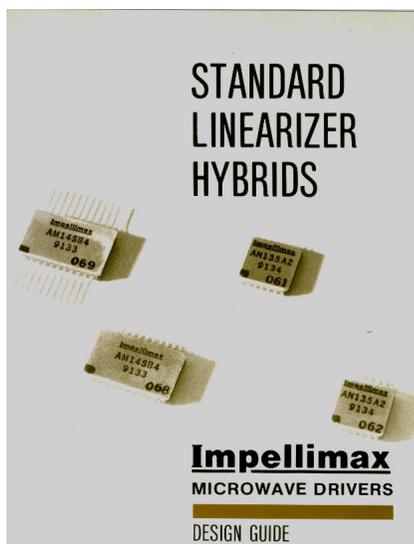
Amplifiers usually have some performance variation versus temperature, and frequently this variation can be mitigated by adjusting either the Drain voltage, the Gate voltage, or both. Frequently, a simple linear slope of output voltage vs. temperature is sufficient to provide this correction, as exemplified by the 4106.

For more complex correction curves, Impellimax linearizers can be used. Impellimax Linearizers are easily driven by a temperature sensing IC or a thermistor in a resistive divider. As the temperature changes, various breakpoints become active. These breakpoints can either cause a rise or a drop in the output voltage, depending on how they are connected. As a result of this freedom, Impellimax Linearizers can be integrated into a Drain Supply device that can have any voltage versus curve that is necessary to cancel out the temperature-induced variation in your microwave device.

Less commonly, but just as beneficially, a performance shift in a multi-function assembly can be corrected by adjustment of a varactor. Phase deltas between an amplifier channel and an adjacent attenuator channel will usually occur as the temperature is changed. Judicious use of one or more “tweak” varactors, driven by an Impellimax temperature-correcting linearizer module, can be used to almost completely nullify these effects.

Impellimax stands ready to assist in this (and other) applications. If desired, we will gladly assist you in determining the most appropriate correction methodologies for your situation. Then, based on the data that you accumulate or simulate, we will provide a solution tailored to your specific needs and mechanical constraints. As options, we can either incorporate internal laser-trimmed breakpoints (if the desired correction is similar, part-to-part) or externally adjustable. Frequently, the best situation is to have the majority of the breakpoints as pre-set, and then use one or more externally adjustable breakpoints to allow unit-to-unit optimization at the test bench.

The ability to manipulate and correct temperature-dependent performance variations can be seen to open up entirely new design topologies in multi-function systems that could never have been considered before.



Design application notes, software, and/or pre-production prototypes allow your design to proceed with confidence.

## Mechanical Options

Physically, drivers are not “one-size-fits-all”. We strive to creatively bring forth the very best system solution within the constraints given, with the lowest risk and at the lowest cost to the customer.

The simplest and most common requirement is for thinner versions of our stock drivers. This can almost always be accommodated easily, except in cases where there are tall internal components that must be designed around, or where tall sidewalls are necessary, as in the case of seam-welded hybrids. So if an outline of a standard part has a dimension that is a problem for you, please feel free to let us know what is needed, and we will do our best to make it possible.

Another common mechanical option relates to substrate (packageless) drivers. In some space-constrained microwave devices, the substrate driver can be mounted to at least partially cover the RF circuit, acting in some ways as a lid on the RF basin beneath. In such cases, we can offer backside gold metallization on the bare driver. This can cut down on moding and cavity resonances by having the driver backside function electrically as a conductive lid on the RF area.

Solderable gold pads on substrate (packageless) drivers can simplify your assembly task. Although our typical gold process is most compatible with gold or aluminum bonding and welding connections, solderable gold is available as well. This gold plating scheme has a heavy undercoating of nickel for strong and reliable solder connections.

## Custom Quick-Turn Services

Impellimax is geared to provide rapid, cost-effective solutions to microwave-support device needs. Some enabling factors include:

- Hundreds of designs immediately available and identified in a parametric database
- In-house substrate design, fabrication, and lot qualification
- Cleanrooms staffed with skilled and experienced quick-turn Hybrid Assembly specialists
- 2 in-house rapid prototyping PCB milling centers
- CNC milling center for mechanical fixtures and prototypes with 3D CAD design software
- Rapidly reconfigurable computerized test stands and software
- Several digitally-controllable full-range temperature test ovens
- Automated pick-and-place PCB population robot and IR reflow belt furnace
- Automated solder paste deposition robot
- In-house multilayer PCB design
- Several proprietary and/or patented technologies that provide unique advantages
- Searchable database of over 800 different component types in inventory
- Unique socketless Burn-in capability for rapid production of full-mil devices
- A corporate structure and mission which is innovation-oriented

## Pulsed Drain Supplies

<b>Part Number</b>	<b>Package</b>	<b>Speed</b>	<b>Comments</b>
<b>4102</b>	Substrate	10 nsec	+2V to +3V adjustable, output 60 mA, TTL input
<b>4103</b>	2	500 nsec	300 mA output, internally set Vout
<b>4104</b>	Substrate	100 nsec	+4V and +3V outputs, Differential logic input
<b>4105</b>	Substrate	100 nsec	1 Ampere output, Differential logic input
<b>4132</b>	14 DIP	50 usec	3.5 Amp output, +18 to +32V input, Short-protected

## Gate/Drain Power Supply Sequencers

<b>Part Number</b>	<b>Package code</b>	<b>Comments</b>
<b>4101</b>	Substrate	+12V, -5V supplies, adjustable output voltages
<b>4700</b>	Substrate	+/- 15V supplies, adjustable delay times
<b>4708</b>	5	+/- 15V supplies, adjustable delay times
<b>4714</b>	2	+/- 5V supplies, 80 nsec delay time
<b>4716</b>	3	+/- 5V supplies,

## Gate Negative-Supply Voltage Converters

<b>Part Number</b>	<b>Package</b>	<b>Volts In</b>	<b>Volts Out</b>	<b>Comments</b>
4036	2	- 15 V	- 36 V	Capacitively coupled, caps and diodes external
4205	Substrate	+ 5 V	- 1.3 V	Provides Gate Bias for FET, .35 by .07 size
4211	Substrate	+ 12 V	- 6.8V	Provides regulated output voltage, .35 by .07 size
4212	3	+ 15 V	- 45 V	10 mA output current, no ext components except Rset
4561	4, Thick	+ 28 V	- 15 V	Transformer isolated, 50 mA out
4562	4, Thick	+ 28 V	+/- 15V	Transformer isolated, 40 mA out each polarity

## Cascaded Amplifier, Amp/Switch Sequencers

<b>Part Number</b>	<b>Package</b>	<b>Supply</b>	<b>Comments</b>
4017	Substrate	+/- -5V	10 nsec switch, adjustable delay
5332	PCB	+8V -5V	+180 mA amplifier output, three high-speed driver channels
5337	PCB	+8V -5V	+240 mA amplifier output
4877	Substrate	+/- 10V	Multiple amplifier and switch channel sequencing

## Temperature-Compensating Drain Supplies and Linearizers

<b>Part Number</b>	<b>Package</b>	<b>Supply</b>	<b>Comments</b>
5505	PCB	+/-10V	Adjustable linearizer & regulator, large area for adj. resistors
AP17UA2	2	+/-10 V	7 breakpoint linearizer core
AM15SB3	3	+/-15 V	10 breakpoints which allow "S" and other curves vs temperature