# MTT 2001
# Vdmos vs. LDMOS
# How to Choose

Polyfet Rf Devices

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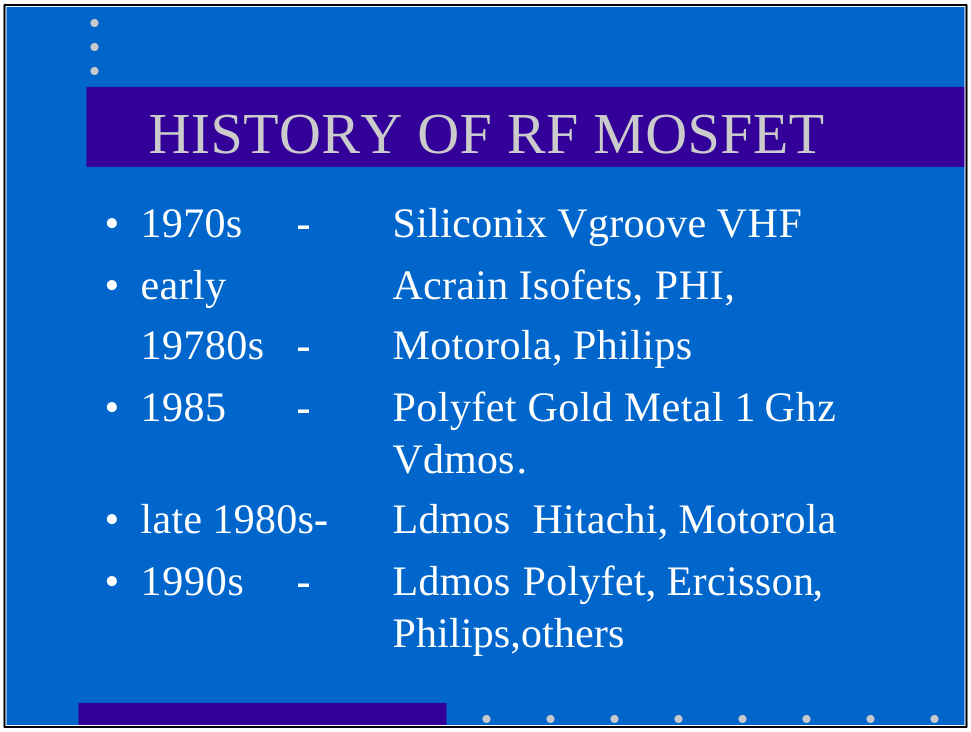
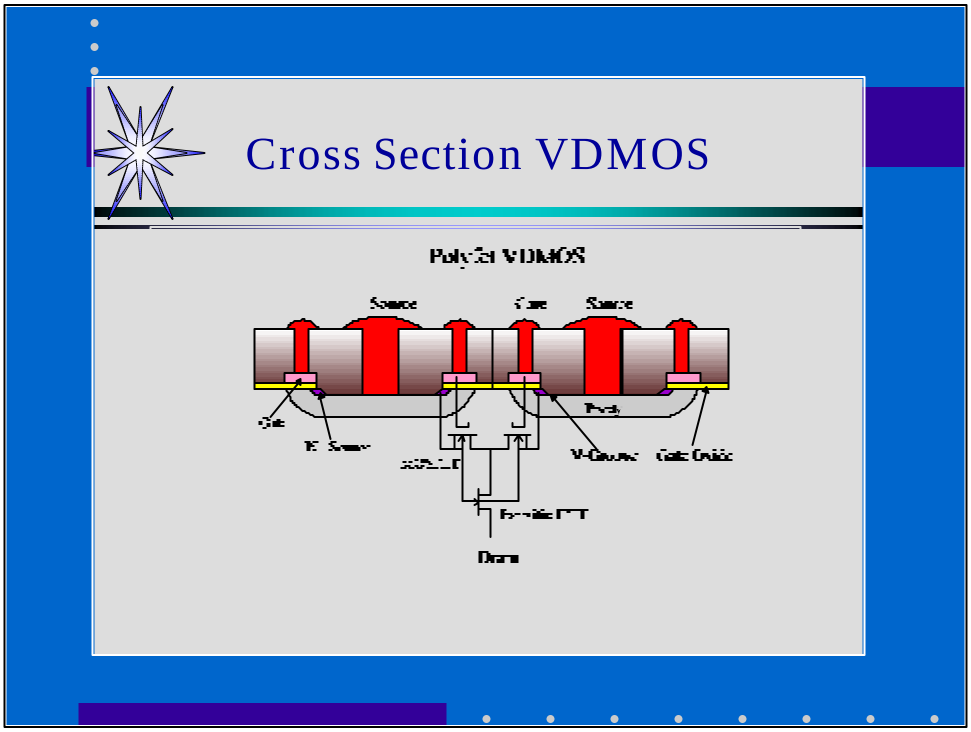
# Vdmos vs Ldmos

- History
- Technology - Process Structure Differences.
- DC Characteristics
- RF Characteristics
  - Gain, Stability, Ruggedness
- Applications
  - HF, VHF, Low UHF, High UHF, PCS

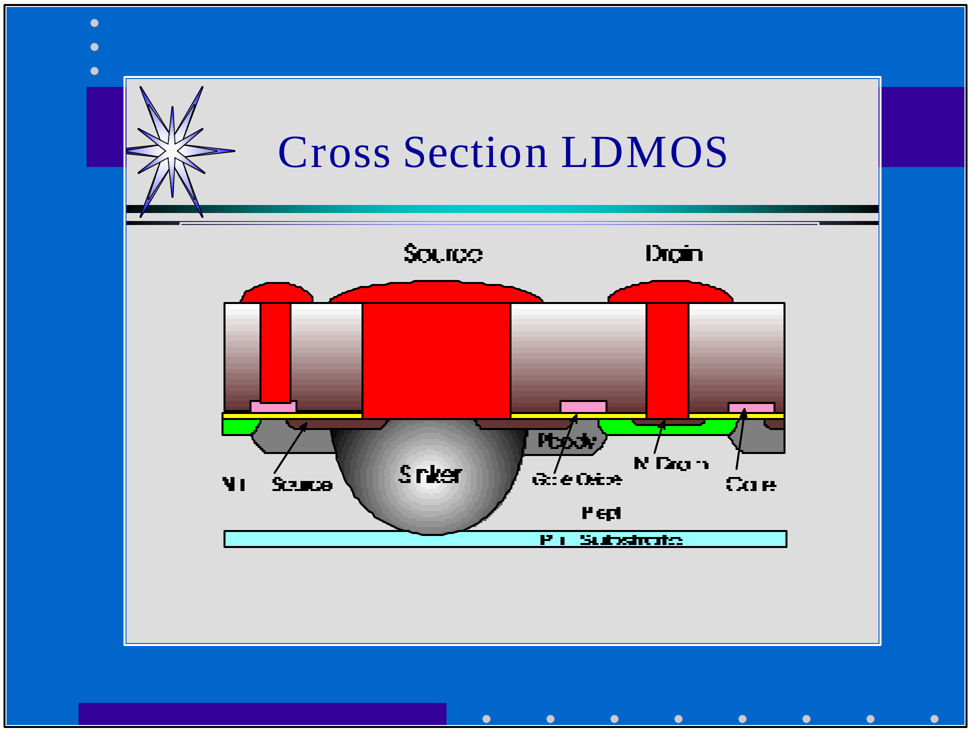
Tale of Contents



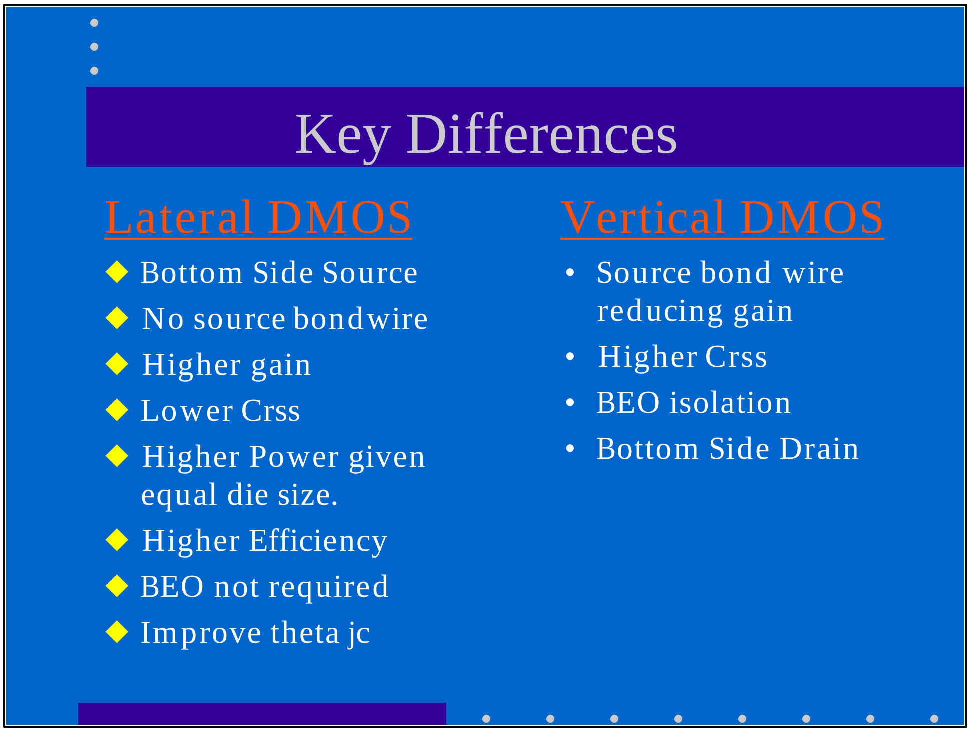

Polyfet - first in the world to introduce top metal gold for Power Rf Mosfet transistor at 1 Ghz operation.




Vertical DMOS - Current flows in vertical direction from drain to source.
Bottom side of die is drain - High Potential..




Lateral DMOS - Current flows laterally from drain to source. Bottom side of die is Source - Ground Potential.




Advantages to Ldmos. Panacea - replace all other technologies?

## DC Characteristics

- Similar between Vdmos and Ldmos in Gm and IV characteristics.
- Crss is lower in Ldmos
- Spice model represented by MOSFET with series JFET in both technologies.

Similarities in both technologies.

# Some RF Comparison

Same Silicon Area comparison

@ 1000 Mhz

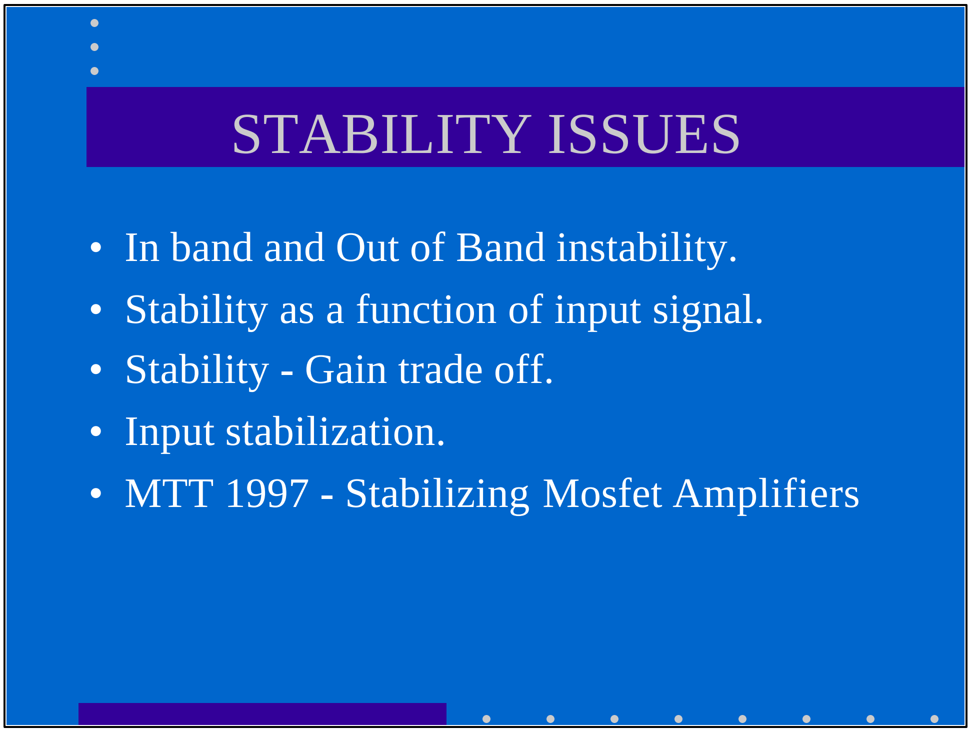
- LP801 15W 12 dB 60% AP Single Ended LDMOS
- F2012 10W 10 dB 35% AP Single Ended VDMOS

@ 500 Mhz

- LP801 20W 13 dB 70% AP Single Ended LDMOS
- F2012 15W 12 dB 45% AP Single Ended VDMOS

Superior Gain, Power Output and efficiency for Ldmos devices vs. Vdmos devices at high frequencies.

Gain and power improvements decreases with decreasing frequency.



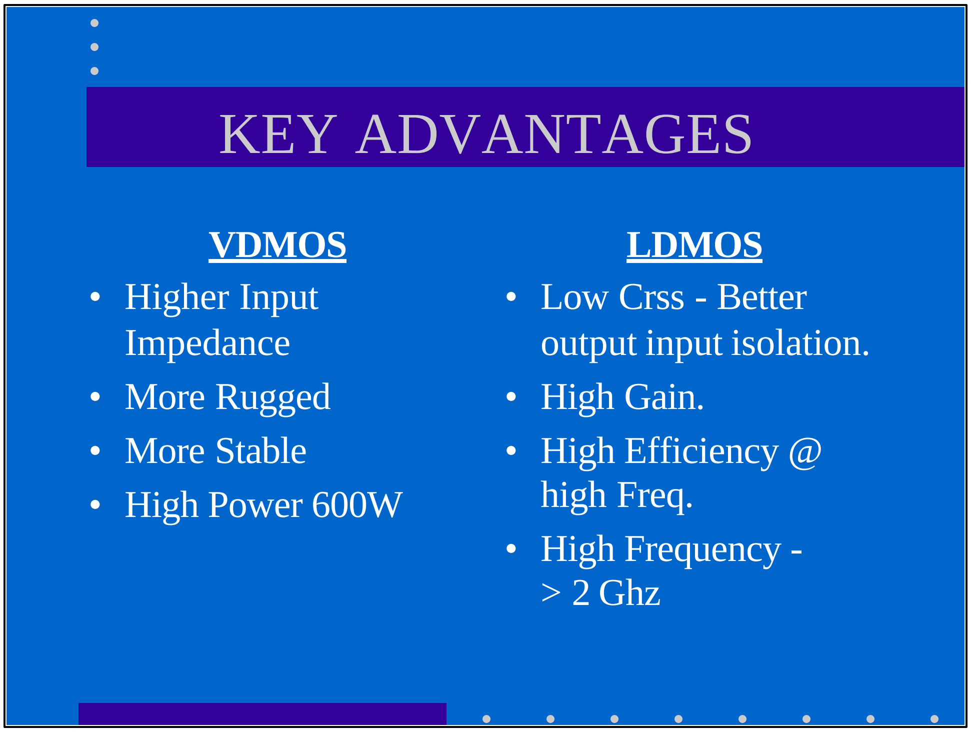

Vdmos instability is at lower frequencies and can be overcome with resistive loading of the gate circuit (1).

The fact that the forward gain of the Ldmos has increased (by processing) more than the reverse gain has decreased contributes to its instability.

In the case of the Ldmos the areas of instability extend into the operating bandwidth and beyond. If one observes the small signal S parameters it is very apparent the region's instability extend well into the Smith Chart. This cause a design challenge for RF professionals. Not only must one match into and out of the device with the proper impedances, they must also avoid crossing areas of instability and a multitude of frequencies above and below the operating frequency. Due to the nature of matching structure, it is almost inevitable that one will cross into a region of instability. As mentioned earlier, lower out of band instability can be controlled without major deterioration of performance in the operating band. Instability in the operating band and above the operating band is much more of a design challenge because there is a compromise within the band performance.

Since the Ft of the device at any instant in time varies with the drain voltage and drain current, the regions of instability change with the applied signal. The result of this effect, usually cause device failure with no apparent reason.

It must be remembered any device should be stabilized for unconditional stability both at small signal level as well as at high power. - Easier said than done.




Higher input impedance on the Vdmos allows easier broadband matching. Ldmos low input impedance resulting in high Q input match. Suitable for cellular PCS and IMT2000 band since the bandwidths are relatively narrow - 5%.

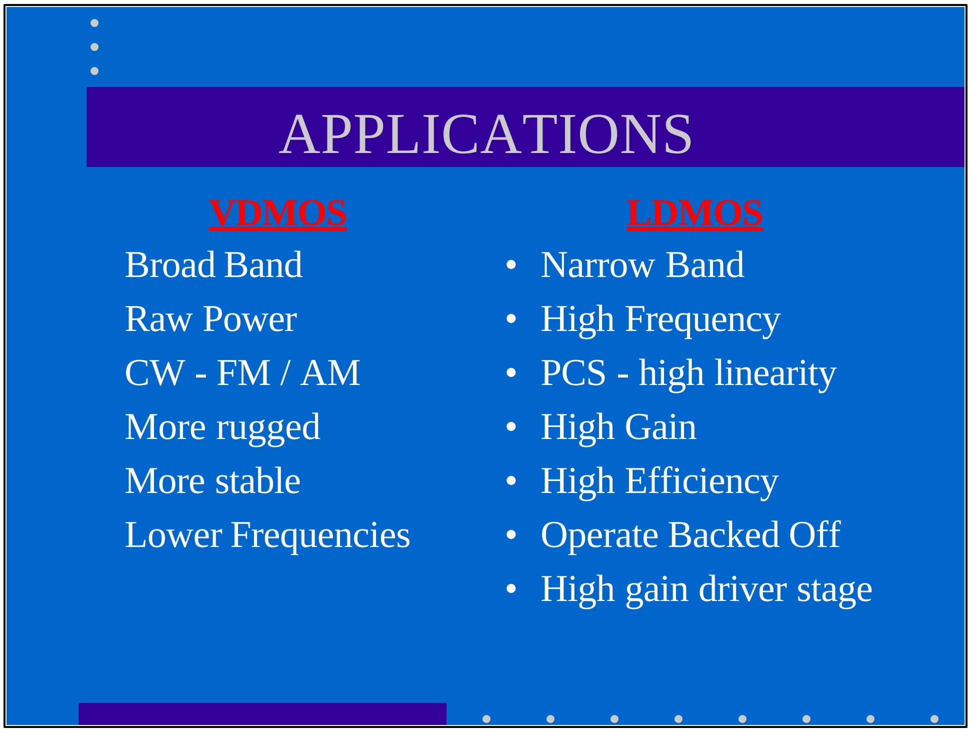
LDMOS - the only alternative Mosfet above 500 Mhz for significant power.

Stability

Even though Crss is lower, the gain is so much higher, the result is less stability in Ldmos. Can extend into and above operating band.

Broadband

Vdmos with higher input impedance and stability over a broader frequency range make it more suitable for broadbanding over several octaves




**VDMOS**

Less chance for in band oscillation and lower input Q - better match.

Best for broadband and <500 Mhz.

**LDMOS**

Better choice in narrow band and high frequency applications.

Since adequate performance can be obtained at frequencies below 500 Mhz with Vdmos devices, there is not adequate justification to use the the higher frequency of the Ldmos. The desire for higher power gain may drive a designer to use a high frequency part in a low frequency application, but a word of caution, for every decibel of additional forward gain, there is a reduction in circuit stability. Since absolute stability cannot be easily measured, the benchmark of performance is usually gain with the stability issues only becoming evident when the devices are failing for no apparent reason.


Polyfet has spent years developing both Vdmos and Ldmos devices. If we separate operating bands into HF, VHF and UHF, we can generalize on the type of technology which offers the best compromise between performance and reliability.