SSPA’s – A QRO UPDATE

The newest LDMOS devices and high power amplifiers available today
A Brief History

- **2006-2009**: first to release a 1kW LDMOS transistor, followed by four other lower power devices.

- **2010-2012**: launched industry-first portfolio of 5 extremely rugged 50 V LDMOS transistors in ceramic packaging, from 25 to 1250 W.

- **2014-2015**: complemented this portfolio with 5 transistors in plastic package, enabling lower thermal resistance.

- **2016**: launched the 1500 W MRF1K50, pushing 50 V LDMOS close to its limits of usability (higher power levels at 50V are challenging to match to 50 ohm).

- **2017**: introducing the MRFX series with the 1800 W MRFX1K80, based on new 65 V LDMOS technology developed in NXP’s internal fab. Designed for ease of use.
More Common devices available through 2016

NXP (now Ampleon and NXP)
1. BLF188XR (1.4KW) HF to ~300MHz
2. BLF578XR -1.25KW HF to ~300MHz
3. BLF184XR – 600w HF to 450MHz
4. BLF6G13L-250P – 250w to 1300 MHz

Freescale (now NXP)
1. MRFE6VP1K25 (1.25KW) HF to ~300Mhz
2. MRF13350N (350W) to 1300 MHz
3. XRF286 (60w) up to 2.5 GHz
Here are the most interesting ones available now

Ampleon (formerly NXP)
I. BLF184XR – 600w HF to 450MHz
II. BLF188XR – 1.4KW HF to ~300MHz
III. BLF189XRA - 1.5KW HF to ~300MHz *
IV. BLF189XRB - 1.9KW HF to ~150MHz *

NXP
I. MRFE6VP1K25 (1.25KW) HF to ~300Mhz
II. MFR1K50 (1.5KW) HF to ~300MHz *
III. MRFX1K80H (1.8KW, 65v) HF to ~300 MHz *
IV. MRF13750 (600W) at 1300 MHz *
## Matching ease of use

<table>
<thead>
<tr>
<th></th>
<th>MRFE6VP 61K25H</th>
<th>BLF188XR</th>
<th>MRF1K50H</th>
<th>BLF189XRB</th>
<th>MRFX1K80H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output impedance in HF in push-pull configuration ($R_L$)</td>
<td>4.0 ohm</td>
<td>3.6 ohm</td>
<td>3.3 ohm</td>
<td>2.6 ohm</td>
<td>4.7 ohm</td>
</tr>
<tr>
<td>Transformation to 50 ohm ($=50/R_L$)</td>
<td>x12.5</td>
<td>x14</td>
<td>x15</td>
<td>x19</td>
<td>x10</td>
</tr>
</tbody>
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<thead>
<tr>
<th>$f$ MHz</th>
<th>$Z_S$ $\Omega$</th>
<th>$Z_L$ optimized for $G_p$ $\Omega$</th>
<th>$Z_L$ optimized for $\eta_D$ $\Omega$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200</td>
<td>3.03 – j8.15</td>
<td>2.03 – j0.25</td>
<td>1.46 – j0.47</td>
</tr>
<tr>
<td>1300</td>
<td>4.06 – j9.52</td>
<td>1.67 – j0.92</td>
<td>1.19 – j0.95</td>
</tr>
<tr>
<td>1400</td>
<td>7.00 – j9.61</td>
<td>1.50 – j1.48</td>
<td>1.22 – j1.49</td>
</tr>
</tbody>
</table>
RF Decks (144 MHz)

BLF188 – 1250w

MRF1K50 – 1500w
1500w+ RF decks for 144 MHz
Amplifiers made using the BLF188
More amplifiers using the BLF188
Amplifiers using the MRF1K50
An Amplifier using the MRFX1K80
MRFX1K80 EME amplifier options: a remote front panel (radio room) with the amplifier body mounted under the EME antenna
The rear panel of the radio room “amplifier”
Placement of the amp at the operating position (Azores)
Measuring sun noise
So that was 2m

Let’s move along to 1296...
For 1296 – 600W+ using a single MRF13750 (50v LDMOS)
A very simple circuit layout where all the critical matching is done with transmission lines (the PC board) instead of expensive RF capacitors.

Those expensive RF capacitors don’t always hold up, but the microwave PC board substrate always does.

RF capacitors are only used in this design for DC blocking and bypassing.
Compared to the BLF13H9L750 circuit layout
The end result, a table-top 600w amplifier for 1296
Inside view, 600w 1296 amplifier
A couple examples of color schemes for the amps