# VÄSTKUSTENS MIKROVÅGSGRUPP

## Bulletin 1/83

83-01-26

Så var det då ett nytt år igen och jag ska väl försöka hålla igång VMG-bulletinen ytterligare ett år, men då måste ni hjälpa mig med bidrag. Bidragen skall handla om mikrovågor dvs 1 GHz och uppåt. På sistone har jag bara fått bidrag i form av rapporter från diverse fantastiska öppningar. Det är OK men skriv bara om anmärkningsvärda kontakter, jag orkar inte med att skriva ned rapporter i stil med Dubus. På tal om öppningar, måndagen den 24 januari hörde både SM6CEN och SM6HYG en EA6-fyr på 432.220! Snacka om DX, men nil aktivitet. Nåja, LA8AE körde långt ned i Sydtyskland på 23cm på söndagskvällen så nog var det öppet. Dock saknas närmare info om fyren på Mallorca.

NY MIKROVÅGSMANAGER

Det ser ut som om vi får en ny sådan. Joakim 6GPV har avsagt sig uppdraget och budet gick bl a till SM6HYG som har tackat ja efter moget övervägande och lite övertalning. Nu ska väl bara SSA styrelse godkänna valet. Själv kan jag inte tänka mig nån mer lämpad. Vi tackar Joakim för det jobb han lagt ned och önskar Carl-Gustaf lycka till. Visserligen är HYG mycket aktiv och kommer att ha mycket att ge själv men hela skaran av mikrovågsentusiaster måste hjälpa till. Jag tycker t ex att VHFspaltens 2 sidor i QTC är för lite och borde kunna utökas med ytterligare en, men då måste det finnas bidrag.

NYA CONTESTREGLER

I detta nummer av bullen publicerar vi EDR:s inbjudan till mikrovågstest för 1983. Kan vi inte komma överens om att försöka ta i detta och visa att vi faktiskt är aktiva och har grejor för de högre banden. Läs och pricka in i din almanacka.

INBJUDAN

SRAL:s VHF-kommitté och Turun Radioamatöörit (OH1AA/OH1AU) inbjuder till stort VHF/UHF/SHF-möte i Tuliranta ca 50km norr om Åbo (KV19b) den 10-12/6 1983. Man kommer att ägna mycket tid till Moonbounce och mikrovågor. Förhoppningsvis kommer minst lika många SM-grabbar resa dit som OH-pojkarna kom till Ånnaboda. Det blir ju inget Ånnaboda i år varför det finns all anledning att ta sig över till OH-land

gm OH1DP Hans-Erik Krokfors /CKU

OHØNC med nytt rekord på 1296 MHz?

Just i skarven av nr 6/82 fick jag ett bidrag till bullen från Sam via CEN. Nu har delar av detta redan publicerats i andra tidningar varför jag bara rapporterar om ett qso med G4KDH i AL vilket är 1537km, fantastiskt! Grattis Sam, kör hårt.

SP5CIC/SMØ och undertecknad körde ett QSO via månen på 23cm i slutet av 82. Paul kör med 4m parabol och ett LABE dual tube amp med ca 70W vid mataren. Själv hade jag inte riktigt snurr på mottageriet (FHZ lånat en pre amp) men det gick bra ändå. Jag vill slå ett slag för EME på 23cm med små antenner, det går fint.

73 SM6CKU

EXPERIMENTERENDE DANSKE RADIOAMATØRER
AFDELING AF
INTERNATIONAL AMATEUR RADIO UNION

Billund, december 1982

Testindbydelse NORDISK MICROBØLGE-AKTIVITETSTEST

EDR indbyder hermed alle amatører i Finland, Norge, Sverige og Danmark til at deltage i NORDISK MICROBØLGETEST.

| | |
|---|---|
| Tid: | Den 3.søndag i hver måned fra kl.0700 til 2000 GMT.<br>Primære tidspunkter: 0700-0900 og 1800-2000 GMT. |
| Point. | 1 point pr. km.<br>100 tillægspoint pr nyt QTH-locatorfelt. |
| Multiplier: | 1.3GHz x 1,<br>2.3 GHz x 2<br>5.5 GHz x 5<br>10 GHz x10<br>24 GHz x25 |
| Regler: | Der anvendes normal rapportering med RS(T) samt QTH locator<br>I årsresultatet medregnes minimum 3 tester og maximum<br>9 tester. Der køres ellers efter de normale Region 1 regler. |
| Logs: | Deltagerne udregner selv deres point.<br>De udfyldte og underskrevne logs sendes senest den 10. i den efterfølgende måned til:<br>Georg Landbo, OZ1FMB<br>Fasanvej 7<br>DK-7190 Billund |

Dette er fra EDR's side tænkt som endnu et forsøg på at få gang i en NORDISK MICROBØLGETEST.

Rigtig god test.

Best 73

Georg

Georg

E.D.R. REG. 1
VHF-CONTEST MANAGER
OZ 1 FMB
GEORG LANDBO
FASANVEJ 7
DK-7190 BILLUND
DENMARK

# FYR NYTT

SK6UHF ÅTER QRV!
DE FLESTA HAR VÄL MÄRKT ATT FYREN PÅ 432.925 ÄR IGÅNG IGEN. DEN ÄR PLACERAD I VALLDA NÄRA KUNGSBACKA. GÖTEBORG RADIOS SÄNDARSTATION HAR VÄLVILLIGT STÄLLT UT-RYMME TILL FÖRFOGANDE. KLÖVERBLADSANTENNEN SITTER I EN 75-METERSMAST NÄRA HAVET. VMG HAR ÖVERTAGIT FYREN FRÅN UK-6 FR O M 1983.

New UHF-beacon QRV.

CALL: SK7UHH
FREQ: 432.940 MHz
QTH: IQ23j  60m ASL
POWER: 25W ERP in 30° (Aurora warning)
2.5W ERP omni. (Tropo warning)
KEYING: A1  carrier + call + QTH

From Nov.-82, SK7UHH is QRV permanently. During july to sept. the beacon was QRV with 1W ERP (omnidirectional) for test purpose. The result was very promising from the spectacular QTH on the island of Öland. Best report during this test-period came from UA1ZAO, Alex in Murmansk. QRB around 1550km!!

The beacon is now QRV again with a permanent set up. Antennas are one 17ele CUE DEE yagi and two stacked clover-leafs. So far only 2.5W output but during early -83 a final amp will be added to increase the power to 500W ERP in 30° and 50W ERP omni. Hoping the 500W ERP will turn out to be a good aurora warning.

We are very interested in reports both on tropo and aurora. On VHF-net please call SM6CEN or SM6EAN for information. Written reports to SM6EAN or SK7CA.

SM6EAN

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VMG HAR ANSÖKT OM TILLSTÅND FÖR EN FYR PÅ 5760.800 ATT PLACERAS I VARBERG. SM6ESG STÅR FÖR ARRANGEMANGET. VI HOPPAS PÅ TELEVERKETS VÄLVILJA, MEN VÅRA 2320 MHZ-TILLSTÅND HÄNGER I LUFTEN TYVÄRR.

# VHF and UHF Low Noise Preamplifiers

By G. H. Krauss,* WA2GFP

For the past 4 years, I have been systematically designing, building and testing low-noise-figure preamplifiers (LNAs) for 30, 50, 144, 220, 432 and 1296 MHz. A very early set of results, along with historical background and basic theory, was reported earlier.[1] A full report, covering some 200 LNAs, is presented here, in "cookbook" style. The measurements were done in an engineering lab, using quality equipment; noise figure was measured using the Y technique, a solid-state noise source and calibration/measurement against a hot/cold noise source of known accuracy. Even though I believe I have removed all sources of error, the reader is cautioned to interpret all noise-figure listings as relative, with an absolute accuracy range of -0.1/0.3 dB.

The layout for the vhf GaAsFET LNAs is given in Fig.1, and for the 1296 MHz Π LNAs in Fig. 2. The remaining LNAs were all built on a single-sided pc board (see Fig. 8 of ref),[1] soldered into a fully shielded box; these LNAs differ only in (a) device used and (b) input and output circuits necessary to match the chosen device for best noise figure. I have found that only four different types of matching circuits, with values adjusted for each different band, are required for use with the full range of devices. Several possible bias circuits are also shown.

The result tables list devices, for each band, in order of increasing noise figure. The Ga and Gr figures are forward and reverse gain, respectively, when the LNA is adjusted for minimum noise figure. Generally, greater forward gain can be achieved, but the noise figure will always be worse. The difference between Ga and Gr is the gain margin Gm = -(Ga-Gr). The greater the value of Gm, the more stable the LNA, especially with a reactive bandpass filter (cavity, helical resonator and the like) in front of, or after, the preamp. LNAs with a Gm value of less than about 8 dB may be marginally stable, and one with a value less than about 3 dB will often oscillate when the T/R relay presents an open circuit at the LNA input. The noise measure M is an indication of the input noise figure of a long chain of cascaded LNAs having the same NF and Ga; it is mainly given to show the effect of LNA gain, which should be about 10 dB greater than the noise figure of the following stage. Too high a stage gain will lead to front-end overload, although it is rarely the 1st LNA that is overloaded. However, the GaAsFET devices not only have the lowest noise figures, but have relatively high (and therefore desirable) third-order output IMD intercepts ($I_3$); the $I_3$ points of some LNAs were measured and listed in the tables. Another LNA characteristic having a bearing on IMD is bandwidth (BW); most bipolar devices require extremely broad-band (BB) input circuits and substantially resistive output circuits. This leads to higher susceptibility of overload from out-of-band signals (especially near fm and TV stations!). The GaAsFETs, having a much higher input impedance for optimum noise figure, allow a higher Q input circuit to be used, although the Q cannot be too high or input loss (and noise figure) will rise.

*16 Riviera Dr., Latham, NY 12110

TO BREW AN LNA:

(1) Choose a device, based on the table data; you make the most important choices based on availability, cost and performance. A key to the manufacturers, or their agents if they do not sell direct in the U.S., is provided.

(2) For the chosen device, obtain the input and output circuits. If GaAsFET or 1296 Π, see Figs. 1 and 2. Use the best components you can obtain; remember that you want to keep input loss as low as possible.

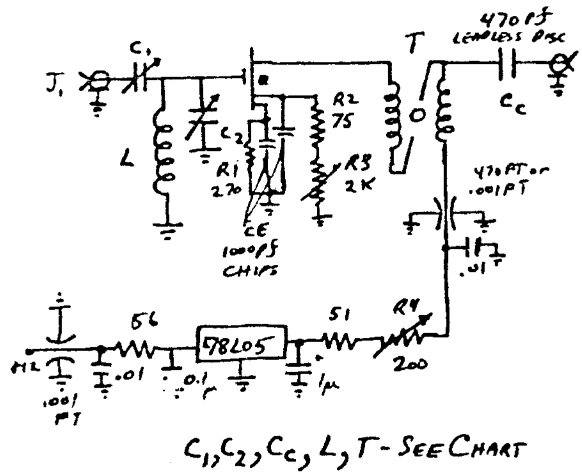
(3) Choose a bias circuit (the "active" circuit - on the right - is recommended). The GaAsFETs have their own bias circuit in Fig. 1; at 1296 MHz, a separate and well-regulated $-V_1$ supply is necessary.

(4) Use the "Universal" layout of Ref. 1, Fig. 8; the vhf GaAsFET layout of Fig. 1 or the 1296 layout of Fig. 2, to build.

(5) Tune: monitor the current into, and voltage at, the collector/drain feedthru capacitor and do not exceed manufacturer's ratings. Tune all L&Cs for maximum gain. Now, set input circuit and bias for minimum noise figure - do not touch output circuit adjustments, if any.

I would be happy to correspond with anyone concerning these, or any other, LNAs if an SASE is provided. Any leads on a reasonably accurate noise source for 2304 MHz would be appreciated.

[1]Krauss, "VHF Preamplifiers," *Ham Radio*, Dec. 1979.



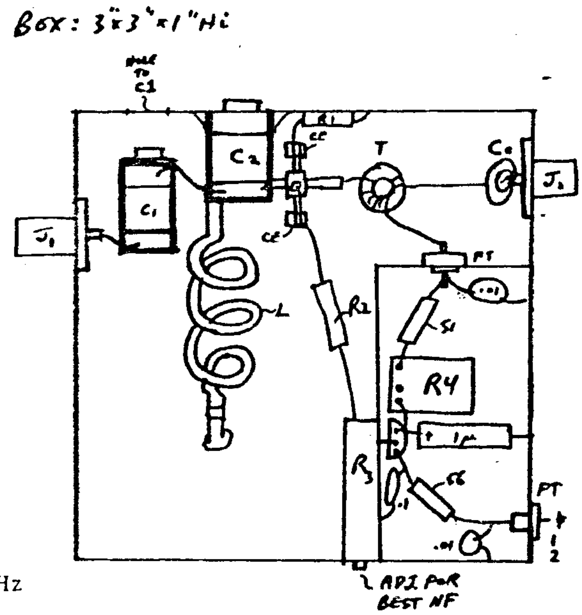
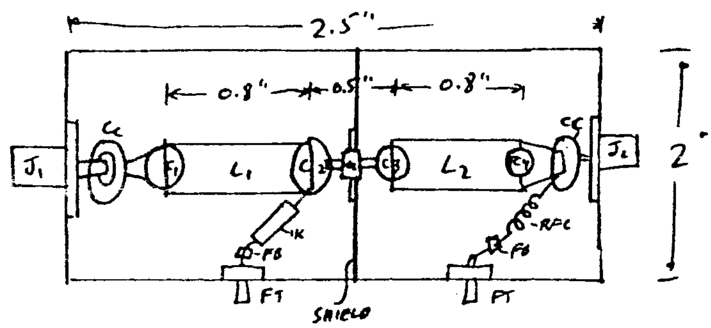
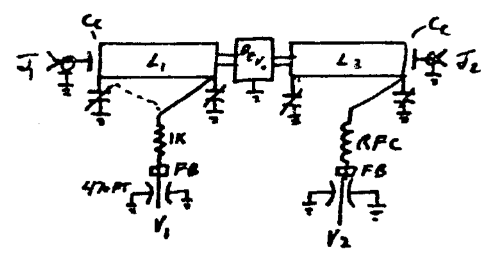




Fig. 1 - GaAsFET Preamp - 144, 220, and 432 MHz




$L_1, L_2$ - 0.8"L x 0.2" WIDE BRASS
$C_1$-$C_4$ · 0.8-10 pf PISTON
$C_c$ - 470 pf LEADLESS DISC
RFC - 4t #28 on 0.1"D DRILL

BIAS: BIPOLAR DEVICE - SOLID LINE
$V_1$ GOES TO Ⓑ, $V_2$ GOES TO Ⓐ - BIAS NTWK.
GaAsFET - BROKEN LINE (INPUT)
$V_1$ IS NEGATIVE $V_{gs}$ needed for BEST NF.
$V_2$ IS ~+3V.

Fig. 2 - 1296 MHz Π-input/output Preamp.

## 30 MHz PREAMPLIFIERS

| DEVICE | COST $ | MFGR | NF (dB.) | Ga (dB.) | Gr (dB.) | Gm (dB.) | M (dB.) | BW (MHz.) | INPUT CKT. | OUTPUT CKT. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MS300H | -10.00 | TI | 0.82 | 18.1 | -49 | 30.9 | 0.83 | BB | I | I | |
| NE41632E-2 | 3.30 | NEC | 0.94 | 25.5 | -38 | 12.5 | 0.94 | BB | IV | III | Rs=200Ω |
| | | | 1.03 | 23.5 | -34 | 10.5 | 1.03 | BB | I | I | TUNED |
| | | | 1.07 | 21.0 | -39 | 18.0 | 1.08 | BB | III | III | Rs=50Ω |
| MA42001-509 | 11.50 | MA | 1.05 | 18.0 | -33 | 15.0 | 1.06 | 10 | II | I | |
| 3N204 | 2.00 | - | 1.21 | 16.6 | -38 | 21.4 | 1.23 | 3.4 | I | I | DGFET |
| MA42014-509 | - 9.00 | MA | 1.32 | 14.0 | -48 | 34.0 | 1.37 | 30 | II | I | |
| 2N5109 | 1.25 | - | 1.44 | 14.4 | -39 | 24.6 | 1.49 | BB | I | III | LOW IMD |
| MRF901 | 1.55 | M | 1.47 | 26.2 | -34 | 7.8 | 1.47 | BB | II | IV | |
| MPF102 | 0.35 | M | 1.60 | 16.0 | -16 | *0.0 | 1.63 | 1 | I | I | FET |
| 2N4416 | 0.50 | - | 1.62 | 13.1 | -22 | 8.9 | 1.69 | 1 | I | III | FET |
| MRF904 | 1.25 | M | 1.65 | 23.0 | -34 | 11.0 | 1.66 | BB | IV | IV | |
| 40673 | 1.75 | RCA | 2.1 | 22.0 | -23 | *1.0 | 2.1 | 1 | I | I | DGFET |
| A485 | 1.75 | AMP | 2.1 | 26.7 | -49 | 22.3 | 2.1 | BB | I | III | LOW IMD |
| NE02135/37 | - 4.00 | NEC | 2.2 | 16.7 | -47 | 30.3 | 2.2 | BB | I | IV | |
| T[illegible] | 0.90 | TI | 2.6 | 14.0 | -64 | 50.0 | 2.7 | 17 | I | I | DGFET |
| A[illegible] | 1.90 | AMP | 4.5 | 22.9 | -51 | 28.1 | 4.5 | BB | I | III | LOW IMD |
| A210 | 2.25 | AMP | 6.1 | 18.3 | -46 | 27.7 | 6.2 | BB | I | III | LOW IMD |

NOTES:

Rs = source resistance
FET = field-effect transistor
DGFET = dual-gate FET
IMD = intermodulation distortion
SE = single emitter/source lead
DOE - dual, opposed emitter/source leads
BB = Broadband
A = Aertech
AMP = Amperex
AND = AND Transistors
DXL = Dexcel
HP = Hewlett Packard
M = Motorola
MA = Microwave Associates
MIT = Mitsubishi (Applied Invention, Hillsdale, N.Y.)
NEC - Nippon Electric (California Electronic Labs.)
PAN - Panasonic
RCA - RCA
SIL = Siliconix
TI = Texas Instruments

## 50 MHz PREAMPLIFIERS

| DEVICE | COST $ | MFGR | NF (dB.) | Ga (dB.) | Gr (dB.) | Gm (dB.) | M (dB.) | BW (MHz.) | INPUT CKT. | OUTPUT CKT. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MA42001-509 | 11.50 | MA | 0.95 | 15.3 | -34 | 18.7 | 0.97 | 2 | II | I | |
| NE41632E-2 | 3.30 | NEC | 0.98 | 24.0 | -32 | 8.0 | 0.98 | BB | IV | III | Rs=200Ω |
| | | | 1.07 | 22.0 | -33 | 11.0 | 1.08 | 6 | I | I | TUNED |
| | | | 1.13 | 22.0 | -35 | 13.0 | 1.14 | BB | III | III | Rs=50Ω |
| MS300H | ~ 10.00 | TI | 1.11 | 15.5 | -43 | 27.5 | 1.12 | BB | I | I | |
| MA42014-509 | ~ 9.00 | MA | 1.15 | 18.3 | -37 | 18.7 | 1.17 | BB | II | I | |
| 2N4416 | 0.50 | - | 1.37 | 13.0 | -15 | *2.0 | 1.43 | 2 | I | I | FET |
| MA42003-509 | ~ 5.00 | MA | 1.50 | 13.7 | -28 | 14.3 | 1.57 | BB | II | I | |
| 3N204 | 2.00 | - | 1.51 | 17.4 | -24.5 | 7.1 | 1.53 | 5 | I | I | DGFET |
| NE02135/7 | 4.00 | NEC | 1.55 | 15.0 | -27 | 12.0 | 1.59 | BB | I | IV | |
| MRF901 | 1.55 | M | 1.67 | 25.0 | -32 | 7.0 | 1.67 | BB | II | IV | |
| 2N5109 | 1.00 | - | 1.72 | 18.0 | -29 | 11.0 | 1.74 | BB | I | III | LOW IMD |
| MRF904 | 1.25 | M | 2.0 | 28.0 | -36 | 8.0 | 2.0 | BB | IV | IV | |
| MPF102 | 0.35 | M | 2.0 | 13.0 | -27 | 14.0 | 2.1 | 2 | I | I | FET |
| TIS-189 | 0.90 | TI | 2.1 | 20.0 | -40 | 20.0 | 2.1 | 2.2 | I | I | DGFET |
| A485 | 1.75 | AMP | 2.1 | 25.8 | -46 | 20.2 | 2.1 | BB | I | III | LOW IMD |
| U310 | 4.00 | SIL | 2.5 | 10.3 | -26 | 15.7 | 2.7 | 2 | I | I | FET |
| 40673 | 1.75 | RCA | 2.6 | 18.2 | -27 | 8.8 | 2.6 | 7 | I | I | DGFET |
| MP1006 | 11.00 | AND | 3.7 | 27.0 | -29 | *2.0 | 3.7 | BB | I | I | |
| A430 | 1.90 | AMP | 4.3 | 23.0 | -50 | 27.0 | 4.3 | BB | I | III | LOW IMD |
| A210 | 2.25 | AMP | 6.3 | 17.1 | -44 | 26.9 | 6.4 | BB | I | III | LOW IMD |

## 144 MHz PREAMPLIFIERS

| DEVICE | COST $ | MFGR | NF (dB.) | Ga (dB.) | Gr (dB.) | Gm (dB.) | M (dB.) | BW (MHz.) | INPUT CKT. | OUTPUT CKT. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MGF-1400 | 23.00 | MIT | 0.47 | 20.0 | -33 | 13.0 | 0.47 | 11 | I | III | GaAsFET I3= ① +23dBm |
| D432 | 25.00 | DXL | 0.49 | 19.6 | -29 | 9.4 | 0.50 | 18 | I | III | GaAsFET I3= ① +15dBm |
| MGF-1200 | 13.00 | MIT | 0.51 | 18.9 | -29 | 10.1 | 0.52 | 20 | I | III | GaAsFET I3= ① +17dBm |
| 3SK48 | 4.00 | PAN | 0.62 | 27.2 | -29 | *1.8 | 0.62 | BB | I | I | DGFET I3= +40dBm |
| NE21937 | 3.50 | NEC | 0.89 | 21.0 | -33 | 12.0 | 0.90 | BB | II | IV | |
| [illegible] | 7.50 | NEC | 1.00 | 22.0 | -36 | 14.0 | 1.00 | BB | I | IV | |
| NE[illegible] | 1.75 | NEC | 1.03 | 22.0 | -40 | 18.0 | 1.04 | BB | I | I | |
| MS300H | ~10.00 | TI | 1.10 | 17.0 | -36 | 19.0 | 1.12 | 36 | I | I | |
| MA42001-509 | 11.50 | MA | 1.10 | 14.0 | -42 | 28.0 | 1.14 | BB | I | I | |
| MA42014-509 | ~ 9.00 | MA | 1.12 | 20.5 | -28 | 7.5 | 1.13 | BB | I | I | |
| 3SK97 | ~ 2.00 | PAN | 1.17 | 18.9 | -23 | *4.1 | 1.18 | 21 | I | I | DGFET |
| MA42002-509 | ~ 7.00 | MA | 1.22 | 18.8 | -26 | 7.2 | 1.23 | BB | I | I | |
| [illegible] | 11.00 | AND | 1.37 | 16.6 | -28 | 11.4 | 1.40 | BB | I | IV | |
| [illegible] | ~15.00 | TI | 1.40 | 15.0 | -35 | 20.0 | 1.44 | 28 | I | I | |
| MRF901 | 1.55 | M | 1.40 | 23.0 | -28 | *5.0 | 1.41 | BB | II | IV | |
| MRF904 | 1.25 | M | 1.41 | 17.0 | -32 | 15.0 | 1.43 | BB | IV | IV | |
| NE41632E-2 | 3.30 | NEC | 1.54 | 13.7 | -32 | 18.3 | 1.63 | BB | I | I | |
| U310 | 4.00 | SIL | 1.60 | 12.0 | -27 | 15.0 | 1.69 | 2 | I | I | FET COMMON GATE |
| 3N204 | 2.00 | - | 1.64 | 15.6 | -29 | 13.4 | 1.68 | 2 | I | I | DGFET |
| MA42003-509 | ~ 5.00 | MA | 1.67 | 21.5 | -25 | *3.5 | 1.68 | BB | I | I | |
| NE02135/7 | 4.00 | NEC | 1.81 | 23.5 | -31 | 7.5 | 1.82 | BB | I | IV | |
| 2N4416 | 0.50 | - | 1.90 | 17.5 | -20 | *2.5 | 1.93 | 2 | I | I | FET |
| 2N5109 | 1.00 | - | 2.5 | 12.5 | -23 | 10.5 | 2.6 | BB | I | III | LOW IMD |
| TIS-189 | 0.90 | TI | 2.6 | 14.3 | -39 | 24.7 | 2.6 | 3.1 | I | I | DGFET |
| A485 | 1.75 | AMP | 2.6 | 24.1 | -42 | 17.9 | 2.6 | BB | I | III | LOW IMD |
| NE22235 | 4.00 | NEC | 2.8 | 17.0 | -38 | 21.0 | 2.8 | BB | I | IV | |
| 40673 | 1.75 | RCA | 3.1 | 13.9 | -31 | 17.1 | 3.2 | 14 | I | I | DGFET |
| MPF102 | 0.35 | M | 3.7 | 11.0 | -24 | 13.0 | 3.9 | 4 | I | I | FET |
| A430 | 1.90 | AMP | 4.1 | 22.0 | -47 | 25.0 | 4.1 | BB | I | III | LOW IMD |
| A210 | 2.25 | AMP | 5.7 | 17.3 | -43 | 25.7 | 5.7 | BB | I | III | LOW IMD |
| J308 | 1.00 | SIL | 6.2 | 13.0 | -18 | *5.0 | 6.4 | 4 | I | II | FET COMMON GATE |

REF: ① See Figure 1

## 220 MHz PREAMPLIFIERS

| DEVICE | COST $ | MFGR | NF (dB.) | Ga (dB.) | Gr (dB.) | Gm (dB.) | M (dB.) | BW (MHz.) | INPUT CKT. | OUTPUT CKT. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MGF-1400 | 23.00 | MIT | 0.47 | 19.9 | -28.4 | 8.5 | 0.47 | 16 | I | III | GaAsFET I3= ① +23dBm |
| D-432 | 25.00 | DXL | 0.48 | 18.4 | -27.0 | 8.6 | 0.49 | 28 | I | III | GaAsFET I3= ① +20dBm |
| MGF-1200 | 13.00 | MIT | 0.54 | 18.7 | -30 | 11.3 | 0.55 | 50 | I | III | GaAsFET I3= ① +18dBm |
| MS2110JE | ~15.00 | TI | 0.86 | 14.0 | -30 | 16.0 | 0.89 | 24 | I | I | |
| NE64535 | 7.50 | NEC | 0.96 | 19.0 | -34 | 15.0 | 0.97 | BB | I | IV | |
| MS300H | ~10.00 | TI | 1.05 | 14.5 | -26 | 11.5 | 1.08 | 40 | I | I | |
| NE73437 | 1.75 | NEC | 1.10 | 18.5 | -29 | 10.5 | 1.11 | 2 | I | I | |
| MA42001-509 | 11.50 | MA | 1.13 | 12.3 | -26 | 13.7 | 1.20 | BB | I | I | |
| 3SK97 | ~ 2.00 | PAN | 1.23 | 16.3 | -19.5 | 3.2 | 1.26 | 32 | I | I | DGFET |
| MRF904 | 1.25 | M | 1.35 | 14.5 | -28 | 13.5 | 1.39 | BB | IV | IV | |
| MA42014-509 | ~ 9.00 | MA | 1.35 | 15.1 | -26 | 10.9 | 1.39 | BB | I | I | |
| NE21937 | 3.50 | NEC | 1.36 | 13.5 | -27 | 13.5 | 1.41 | BB | II | IV | |
| MRF901 | 1.55 | M | 1.40 | 18.1 | -24 | 5.9 | 1.42 | BB | II | IV | |
| MA42002-509 | ~ 7.00 | MA | 1.44 | 14.3 | -26 | 11.7 | 1.48 | BB | I | I | |
| MP1006 | 11.00 | AND | 1.66 | 15.1 | -28 | 12.9 | 1.70 | BB | I | I | |
| NE41632E2 | 3.30 | NEC | 1.68 | 13.0 | -24 | 11.0 | 1.75 | BB | I | I | |
| 3N204 | 2.00 | - | 1.82 | 13.5 | -26 | 12.5 | 1.89 | 2 | I | I | DGFET |
| NE02135/7 | 4.00 | NEC | 1.87 | 20.8 | -30 | 9.2 | 1.88 | BB | I | IV | |
| MA42003-509 | ~ 5.00 | MA | 1.95 | 16.5 | -23 | 6.5 | 1.97 | BB | I | I | |
| 2N4416 | 0.50 | - | 2.0 | 10.0 | -20 | 10.0 | 2.2 | 4 | I | I | FET |
| U310 | 4.00 | SIL | 2.0 | 9.1 | -28 | 18.9 | 2.2 | 4 | I | I | FET COMMON GA |
| NE22235 | 4.00 | NEC | 2.1 | 29.3 | -26 | -3.3 | 2.1 | BB | I | I | |
| TIS-189 | 0.90 | TI | 2.5 | 18.0 | -23 | 5.0 | 2.6 | 5.2 | I | I | DGFET |
| A485 | 1.75 | AMP | 3.1 | 23.0 | -41 | 18.0 | 3.1 | BB | I | III | LOW IMD |
| 40673 | 1.75 | RCA | 4.3 | 15.1 | -21 | 5.9 | 4.4 | 6 | I | I | DGFET |
| 2N5109 | 1.00 | - | 4.6 | 7.9 | -21 | 13.1 | 5.1 | BB | I | III | LOW IMD |
| A430 | 1.90 | AMP | 4.9 | 20.1 | -43 | 23.0 | 5.0 | BB | I | III | LOW IMD |
| A210 | 2.25 | AMP | 5.9 | 16.0 | -59 | 23.0 | 6.1 | BB | I | III | LOW IMD |

### 432 MHz PREAMPLIFIERS

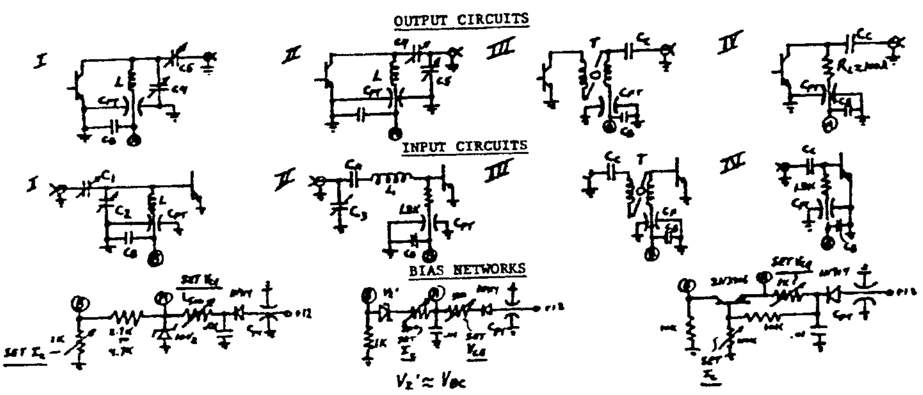
| DEVICE | COST $ | MFGR | NF (dB.) | Ga (dB.) | Gr (dB.) | Gm (dB.) | M (dB.) | BW (MHz.) | INPUT CKT. | OUTPUT CKT. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible]GF1400A | [illegible].30 | MIT | 0.39 | 18.2 | -27 | 8.8 | 0.40 | 20 | I | III | GaAsFET 13-1 +20dBm |
| [illegible] | [illegible] | [illegible] | [illegible] | 18.1 | -29 | 6.9 | 0.51 | 50 | I | III | GaAsFET 13-1 +21dBm |
| MGF1400 | 23.00 | MIT | 0.52 | 21.6 | -33 | 11.4 | 0.52 | 50 | I | II | GaAsFET 13-1 +24dBm |
| MGF1200 | 13.00 | MIT | 0.58 | 20.4 | -28 | 7.6 | 0.59 | 25 | I | III | GaAsFET 13-1 +21dBm |
| NE24483 | 35.00 | NEC | 0.75 | 15.3 | -25 | 9.7 | 0.76 | 60 | I | II | GaAsFET |
| NE64535 | 7.50 | NEC | 0.86 | 16.0 | -24 | 8.0 | 0.88 | BB | I | IV | |
| MS2110JE | -15.00 | TI | 1.07 | 20.0 | -28 | 8.0 | 1.08 | BB | I | I | |
| NE73437 | 1.75 | NEC | 1.25 | 17.1 | -25 | 7.9 | 1.27 | BB | I | I | |
| NE02135 | 4.00 | NEC | 1.27 | 11.2 | -27 | 15.8 | 1.36 | BB | I | IV | |
| MRF904 | 1.25 | M | 1.38 | 11.0 | -25 | 14.0 | 1.48 | BB | IV | IV | |
| 3SK97 | 2.00 | PAN | 1.39 | 11.5 | -12.8 | *1.3 | 1.48 | 60 | I | I | DG GaAsFET |
| MRF901 | 1.55 | M | 1.40 | 16.1 | -22 | *5.9 | 1.43 | BB | II | IV | |
| [illegible]-509 | -15.00 | MA | 1.40 | 11.3 | -19 | 7.7 | 1.49 | BB | I | I | |
| MA[illegible]510 | -17.00 | MA | 1.52 | 14.0 | -25 | 11.0 | 1.57 | BB | I | I | |
| MA42161-511 | -25.00 | MA | 1.57 | 16.3 | -26 | 9.7 | 1.61 | BB | I | I | |
| MS300H | -10.00 | TI | 1.59 | 13.2 | -25 | 11.8 | 1.66 | 40 | I | I | |
| NE22235 | 4.00 | NEC | 1.60 | 11.0 | -26 | 15.0 | 1.71 | BB | I | IV | |
| MA42001-509 | 11.50 | MA | 1.73 | 11.3 | -25 | 13.7 | 1.89 | BB | I | I | |
| NE21937 | 3.50 | NEC | 1.76 | 20.5 | -32 | 11.5 | 1.77 | BB | II | IV | |
| B[illegible] | 3.00 | AMP | 1.78 | 15.1 | -27 | 11.9 | 1.83 | BB | II | IV | |
| M[illegible] | 11.00 | AND | 1.90 | 17.7 | -28 | 10.3 | 1.93 | BB | I | I | |
| TIS-[illegible] | 0.90 | TI | 1.98 | 14.5 | -43 | 28.5 | 2.04 | 17 | I | I | DGFET |
| MP-1004 | -14.00 | AND | 2.0 | 12.2 | -34 | 21.8 | 2.1 | BB | II | I | |
| MA42142-509 | 14.00 | MA | 2.2 | 13.8 | -35 | 21.2 | 2.3 | BB | I | I | |
| BFQ-23 | 3.75 | AMP | 2.2 | 16.1 | -27 | 10.9 | 2.3 | BB | II | IV | |
| BFR-90 | 2.70 | AMP | 2.2 | 16.4 | -26 | 9.6 | 2.3 | BB | II | IV | |
| ON536 | 3.35 | AMP | 2.3 | 14.0 | -25 | 11.0 | 2.4 | BB | II | IV | |
| MP-1001 | 8.00 | AND | 2.4 | 16.5 | -23 | *6.5 | 2.5 | BB | II | IV | |
| BFR-96 | 4.30 | AMP | 3.0 | 14.6 | -23 | 8.4 | 3.1 | BB | II | IV | |
| NE4162E-2 | 3.30 | NEC | 3.7 | 10.3 | -18.5 | 8.2 | 3.9 | BB | I | I | |
| MA42003-509 | - 5.00 | MA | 4.3 | 7.7 | -23 | 15.3 | 4.8 | BB | I | I | |
| U-310 | 4.00 | SIL | 4.7 | 5.0 | -30 | 25.0 | 5.6 | 10 | I | I | FET COMMON GATE |

### 1296 MHz PREAMPLIFIERS

| DEVICE | COST $ | MFGR | NF (dB.) | Ga (dB.) | Gr (dB.) | Gm (dB.) | M (dB.) | BW (MHz.) | CKT * | CKT µ | PKG | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NE21889 | 75.00 | NEC | 0.62 | 18.7 | -27 | 8.3 | 0.63 | 40 | X | | DOE | GaAsFET |
| MGF1400 | 23.00 | MIT | 0.82 | 16.2 | -23 | 6.8 | 0.84 | 45 | X | | DOE | GaAsFET |
| NE24483 | 35.00 | NEC | 0.83 | 17.4 | -27 | 9.6 | 0.84 | 50 | X | | DOE | GaAsFET |
| D432 | 25.00 | DXL | 0.97 | 14.9 | -22 | 7.1 | 1.06 | 90 | X | | DOE | GaAsFET |
| MGF1200 | 15.00 | MIT | 1.03 | 13.6 | -21 | 7.9 | 1.07 | 60 | X | | DOE | GaAsFET |
| NE64535 | 7.50 | NEC | 1.40 | 12.0 | -16 | *4.0 | 1.48 | 60 | X | | DOE | |
| MS2110JE | -15.00 | TI | 1.49 | 12.0 | -18 | 6.0 | 1.57 | 140 | X | | DOE | |
| NE645+ MRF901 | 14.55 | - | 1.61 | 19.9 | -37 | 11.1 | 1.62 | 160 | | X | DOE | WA2AAU DES |
| ABT7701 | 25.00 | A | 1.63 | 13.8 | -27 | 13.2 | 1.69 | 120 | X | | DOE | |
| NE21935 | - 4.50 | NEC | 1.74 | 9.9 | -19.2 | 9.3 | 1.90 | 180 | X | | DOE | |
| NE21937 | - 4.00 | NEC | 1.79 | 9.8 | -13 | *3.2 | 1.96 | 100 | X | | DOE | PLASTIC |
| HXTR-6105 | 28.00 | HP | 1.81 | 12.2 | -24 | 11.8 | 1.90 | 50 | | X | DOE | µS w BPF |
| NE73437 | 3.30 | NEC | 1.92 | 6.0 | -12 | 6.0 | 2.41 | 200 | X | | DOE | PLASTIC |
| HXTR-2101 | 22.00 | HP | 2.1 | 12.0 | -21 | 9.0 | 2.4 | 50 | | X | DOE | µS w BPF |
| MRF901 | 1.55 | M | 2.3 | 10.1 | -16.5 | 6.5 | 2.6 | 120 | X | | DOE | PLASTIC Avg. of 8 u |
| | | | 2.3 | 10.5 | -16.6 | 6.1 | 2.6 | >200 | | X | DOE | PLASTIC Avg. of 2 u |
| NE22235 | 4.00 | NEC | 2.3 | 14.0 | -26 | 12.0 | 2.4 | 115 | X | | DOE | |
| BFR-91 | 3.00 | AMP | 2.5 | 7.6 | -14.0 | 6.4 | 2.9 | 100 | X | | SE | PLASTIC |
| NE02135 | 3.50 | NEC | 2.6 | 12.5 | -22 | 9.5 | 2.7 | 115 | X | | DOE | Avg. of 5 u |
| | | | 2.6 | 9.8 | -21 | 11.2 | 2.9 | >200 | | X | DOE | Avg. of 2 u |
| MRF911 | 2.00 | M | 2.7 | 7.8 | -17.4 | 9.6 | 3.1 | 150 | X | | DOE | PLASTIC |
| BFR-90 | 2.70 | AMP | 2.8 | 7.3 | -17.3 | 10.0 | 3.2 | 100 | X | | SE | PLASTIC |
| MRF901+ MRF901 | 3.10 | M | 3.1 | 18.3 | -36 | 17.7 | 3.2 | >200 | | X | DOE | PLASTIC Avg. of 7 u |
| NE02137 | 3.00 | NEC | 2.8 | 8.3 | -12.7 | *4.4 | 3.2 | 100 | X | | DOE | PLASTIC Avg. of 2 u |
| NE02135(TWO) | 7.00 | NEC | 3.0 | 16.6 | -40 | 23.4 | 3.0 | >200 | | X | DOE | |
| BFR-96 | 4.30 | AMP | 3.0 | 6.0 | -16.5 | 10.5 | 3.6 | 120 | X | | SE | PLASTIC |
| MA42162-511 | -18.00 | MA | 3.5 | 14.7 | -18 | *3.3 | 3.6 | 140 | X | | DOE | |
| MA42141-510 | -15.00 | MA | 4.2 | 7.3 | -14 | 6.7 | 4.8 | 140 | X | | DOE | |

* = CKT. of Fig. 2

µ = Microstrip layout




| F(MHz.) | C1 | C2 | C3 | CA | CB | Cc | Cft | C4 | C5 | L | L' | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | 6-[illegible] pf | 6-80 pf | 6-80 pf | 470 pf | 0.05 µf | 0.01 µf | 0.0015 µf | 6-80 pf | 6-80 pf | 15t #28 on T25-6 core | 8-10t #20 formed on 1/4-20 bolt | 10t #28 Bifilar on T37-10 core |
| 50 | 5-25 pf | 5-25 pf | 5-25 pf | 270 pf | 0.01 µf | 0.005 µf | 0.001 µf | 5-25 pf | 5-25 pf | 8t #28 on T25-10 core | 5-6t #20 1/8"D, 1/4"L | 8t #28 Bifilar on T37-10 core |
| 144 | 2-20 pf | 2-20 pf | 1-14 pf | 180 pf | 0.005 µf | 330 pf | 680 pf | 2-20 pf | 2-20 pf | 4t #18 1/4"D, 1/4"L | 4-5t #18 1/4"D, 3/8"L | 6t #28 Bifilar on T25-12 core |
| 220 | 2-20 pf | 2-20 pf | 2-14 pf | 150 pf | 0.005 µf | 220 pf | 470 pf | 2-20 pf | 2-20 pf | 3t #18 1/4"D, 1/4"L | 3-4t #12 1/4"D, 1/4"L | 4t #28 Bifilar T25-12 core |
| 432 | 1-10 pf | 1-18 pf | 1-10 pf | 100 pf | 0.001 µf | 100 pf | 470 pf | 1-10 pf | 1-10 pf | 1t #16 1/4"D or 2" of 1/8"D tube | 3-4t of lead of $C_A$, 1/8"D | 4t #28 Bifilar on T25-0 core |