

TECHNICAL NOTE DEV101
REPLACEMENT OF NEC710 GaAs
FET CHIPS WITH THE
MwT-7

The MwT-7 0.25 micron gate length MESFET chip is designed for low-noise figure with high associated gain and is ideal for broad-band or narrow-band balanced amplifier stages operating up to 26 GHz. The S-Parameters and RF specifications of this device closely match those of the NEC71000. Because of its short gate length, with optimum design of the matching circuits, the designer can achieve broadband performance superior to that available from the NEC71000. The purpose of this application note is to assist in the direct replacement of the NEC71000 with the MwT-7 in circuits already designed for the NEC device.

Figure 1 shows a direct comparison of the S-Parameters of the two chips when mounted as shown in Figure 2 for the MwT-7 and Figure 3 for the NEC71000. The chips are attached with Gold-Tin preforms to a copper rib .020 inches wide, a common configuration for hybrid microcircuit balanced amplifier stages. Note that the chips are mounted as closely as possible to the input side of the rib. This is the recommended geometry when trying to minimize input inductance from the bond wires. However, the MwT-7 chip has lower input inductance than the NEC71000. In addition, the NEC chip is larger and therefore requires a longer input-to-gate bond wire, thereby increasing the input inductance still more.

Installing the MwT-7 in a circuit designed for the NEC device will require that longer input bonds be used. Figure 4 shows the recommended mounting when directly replacing the NEC71000 with a MwT-7. The chip is attached slightly to the output side of the center of the rib and the input bond length increased to 16 mils (0.41 mm) each.

Naturally MwT cannot foresee every possible application or matching network in use with the NEC71000. Therefore, even with the repositioning as shown, minor changes in the chip position, bond wire lengths, and input and output tuning may be required. Experience has shown that this is usually within the range of on-circuit tuning capability and that hybrid circuit redesign is not necessary unless one desires to take full advantage of an optimally matched MwT-7. For example, Figure 5 shows a typical balanced gain module using NEC71000 chips. Gain from 6 to 18 GHz is typically around 6.5 dB and noise figure 6.1 db worst case. In Figure 6, the MwT-7 has replaced the NEC devices in the same circuit and slight retuning done to optimize performance. The gain is the same, in fact slightly flatter, and the noise figure 4.9 dB worst case.

However, Figure 7 shows the increase in performance possible if one uses a design optimized for the MwT-7, in this case the standard MwT-0618-7G1 module. Gain is typically over 7.5 dB and is very flat. The noise figure is under 4.2 dB from 6 to 18 GHz.

Figure 8 shows the gain, power output, and noise figure of MwT-0618-7G1 modules using various saturated drain current (I_{dss}) MwT-7 chips. This demonstrates MwT's ability to adjust the trade-off between power output at 1 dB compression (P_{1dB}) and noise figure to provide the best solution for customer applications.

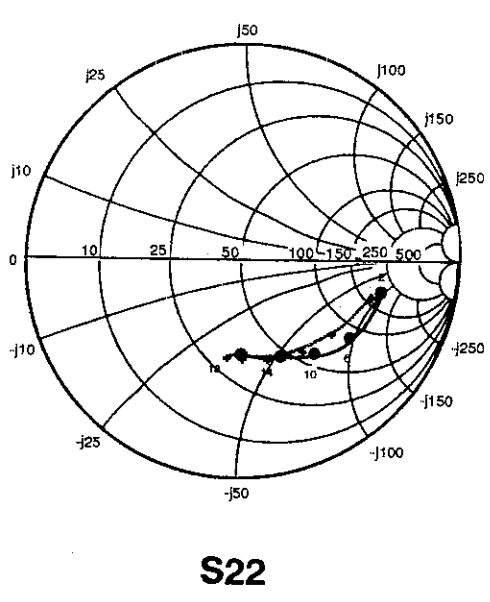
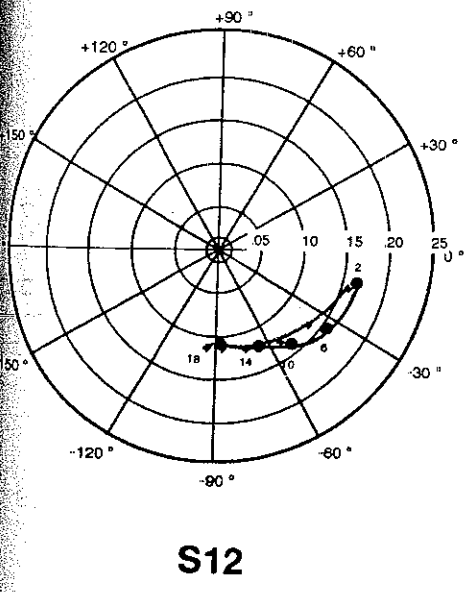
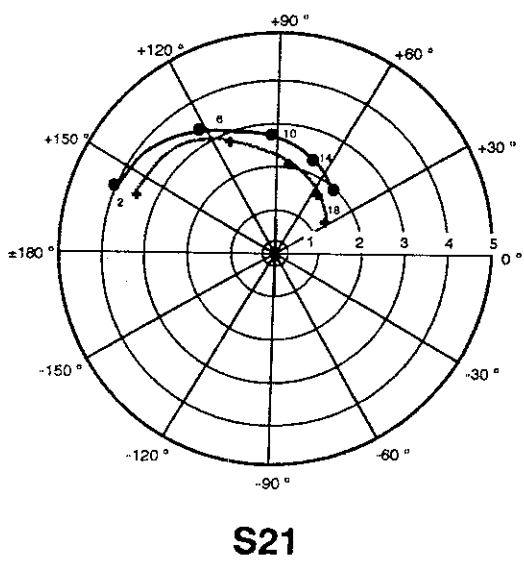
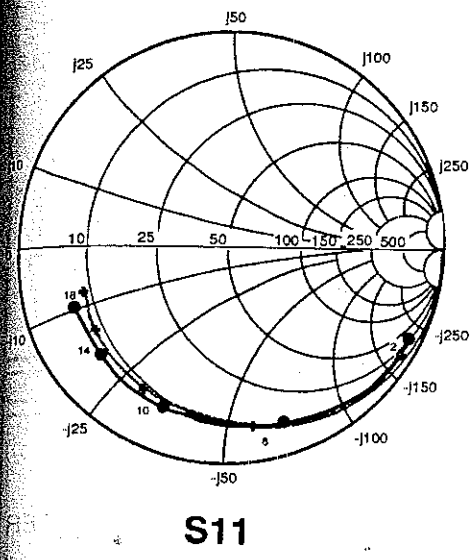
CONCLUSION

The MwT-7 FET chip can be easily substituted into hybrid circuits designed for the NEC71000 without major circuit redesign. Even better performance is possible using MwT hybrid modules optimized for the MwT-7. MwT engineers are available to assist customers in applications of the MwT-7 as well as applications for the entire family of MwT 0.25 micron gate GaAs FET devices.

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Figure 1
S-Parameter Comparison

- MWT-7, $I_{DS} = 32 \text{ mA}$
 - + NEC-710, $I_{DS} = 37 \text{ mA}$
- $V_{DS} = 4.0 \text{ V}$



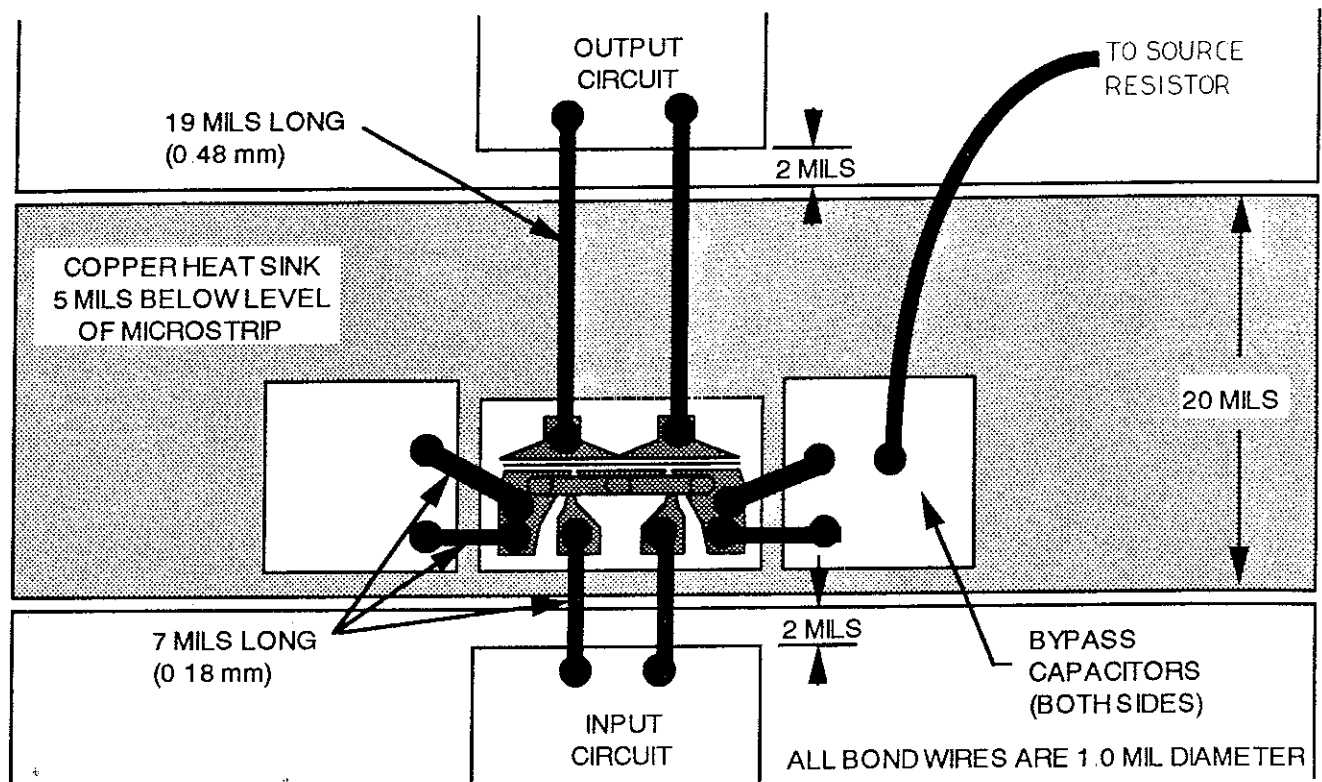


Figure 2. TYPICAL ASSEMBLY OF MWT-7 FET FOR BROADBAND BALANCED AMPLIFIER STAGES

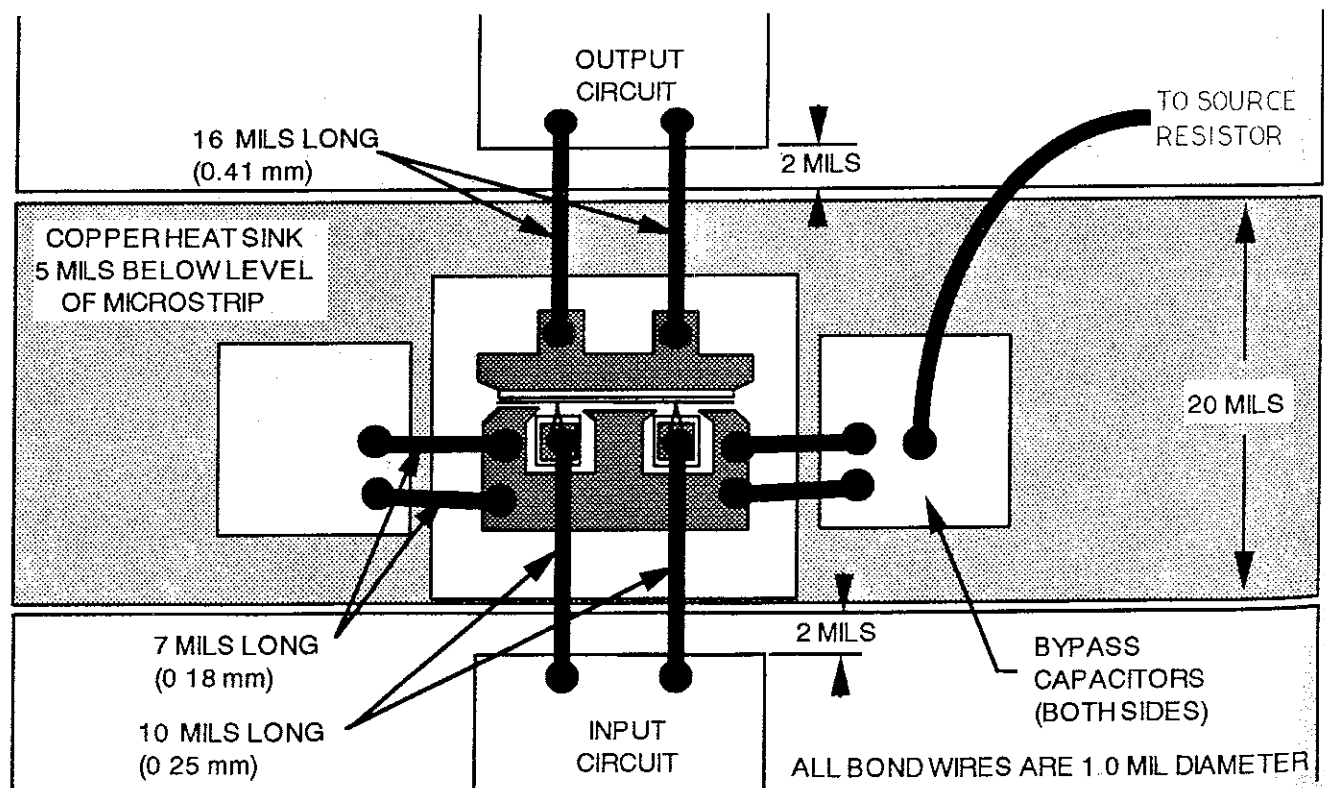
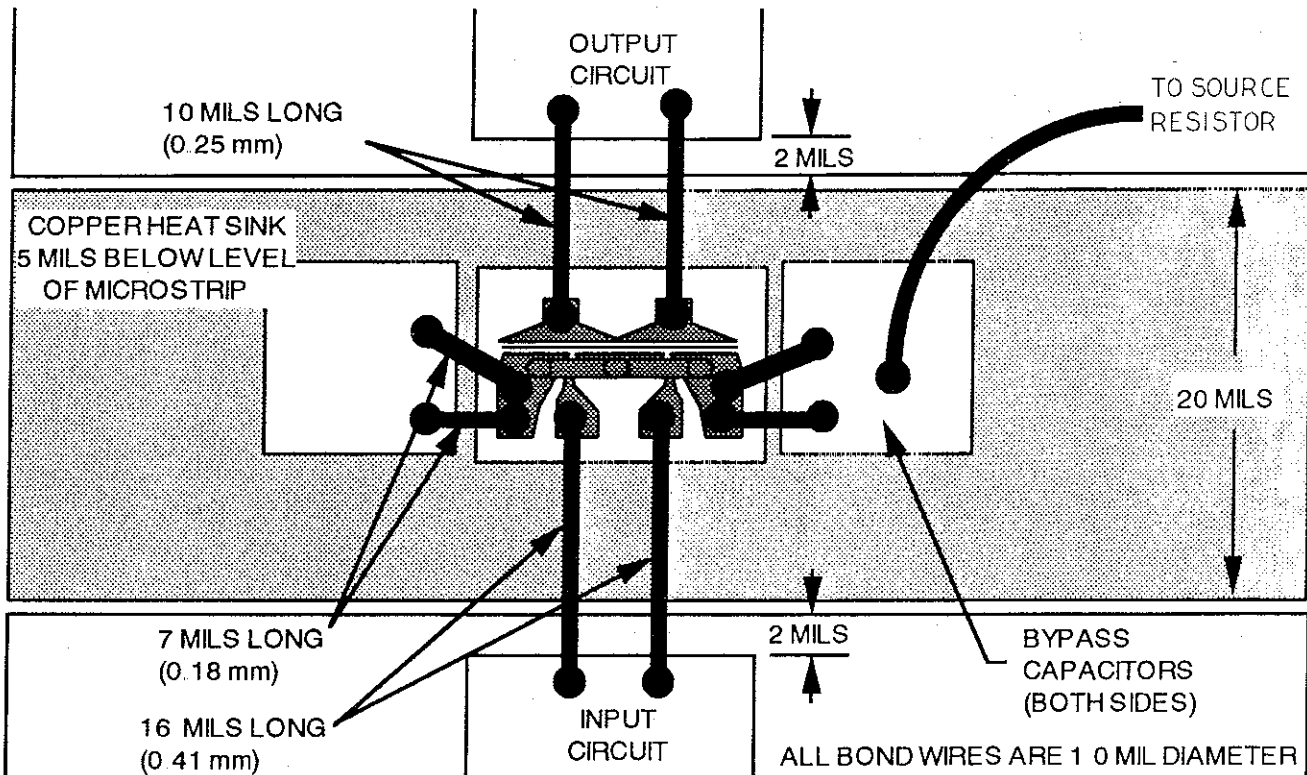
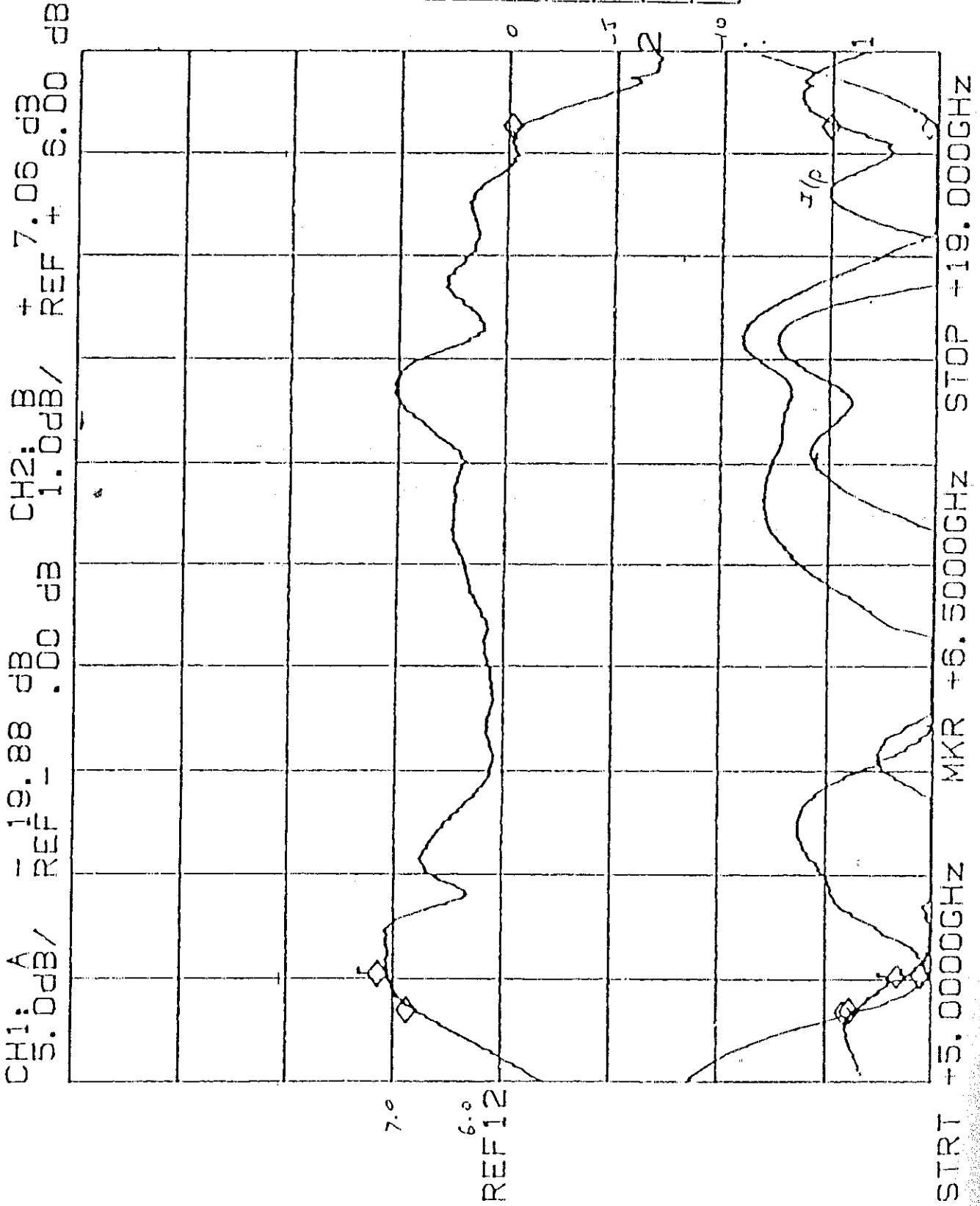


Figure 3. TYPICAL MOUNTING AND BONDING, NE-710



**Figure 4. RECOMMENDED MOUNTING AND BONDING,
MWT-7 IN PLACE OF NE-710**

Figure 5. PERFORMANCE OF 6 TO 18 GHz BALANCED AMPLIFIER
 USING NEC71000 FET CHIPS



Freq (GHz)	NF (dB)	FileB (dBm)
6.5	19.9	18.5
7	18.8	18.7
8	19.1	19.8
9	19.5	20.0
10	19.7	20.4
11	19.8	20.4
12	20.0	20.6
13	20.1	20.4
14	19.3	19.8
15	18.8	18.8
16	18.9	20.1
17	19.1	20.1
18	19.0	20.5

Figure 6. PERFORMANCE OF 6 TO 18 GHz BALANCED AMPLIFIER,
 NEC71000 CHIPS REPLACED WITH MWT-7

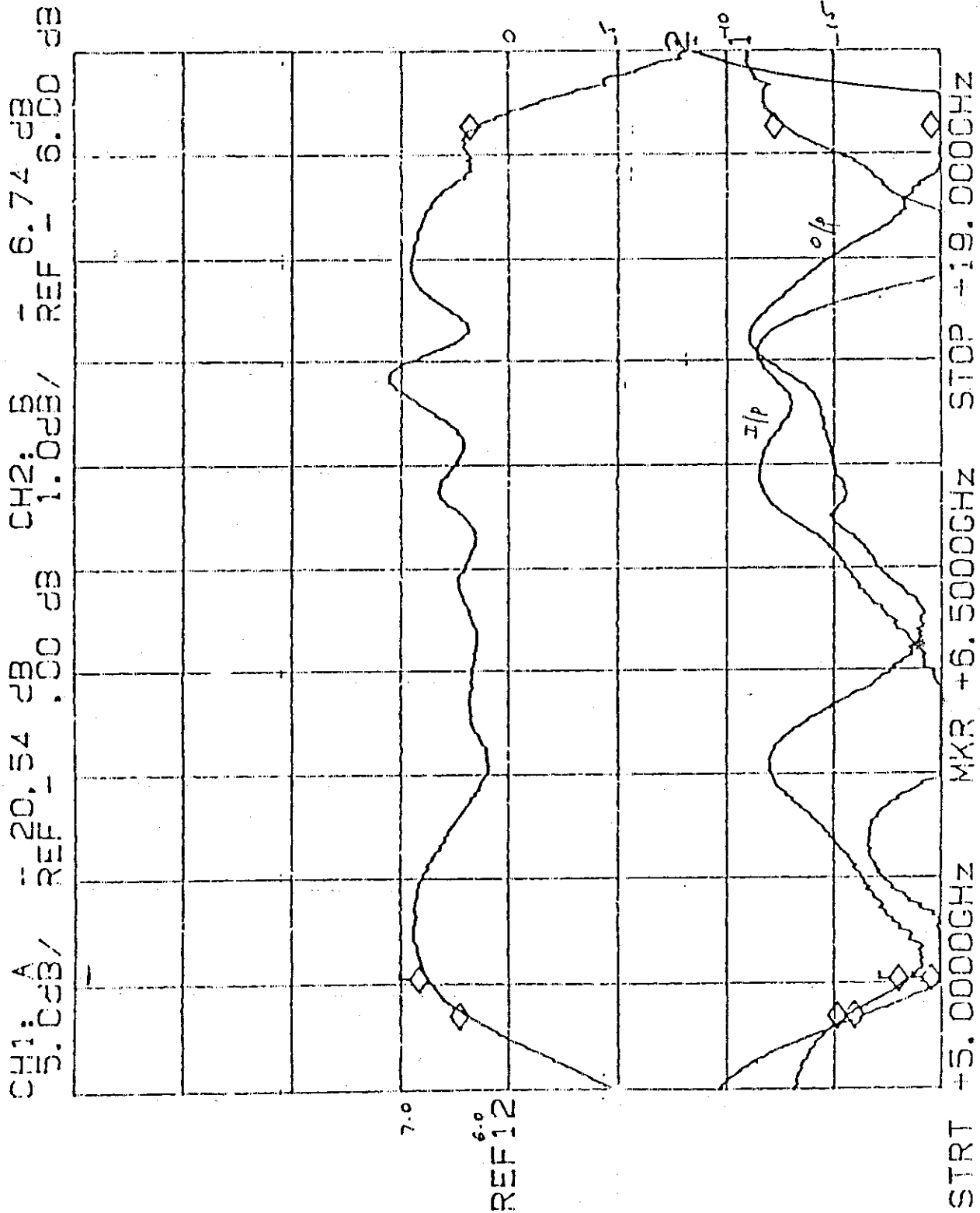
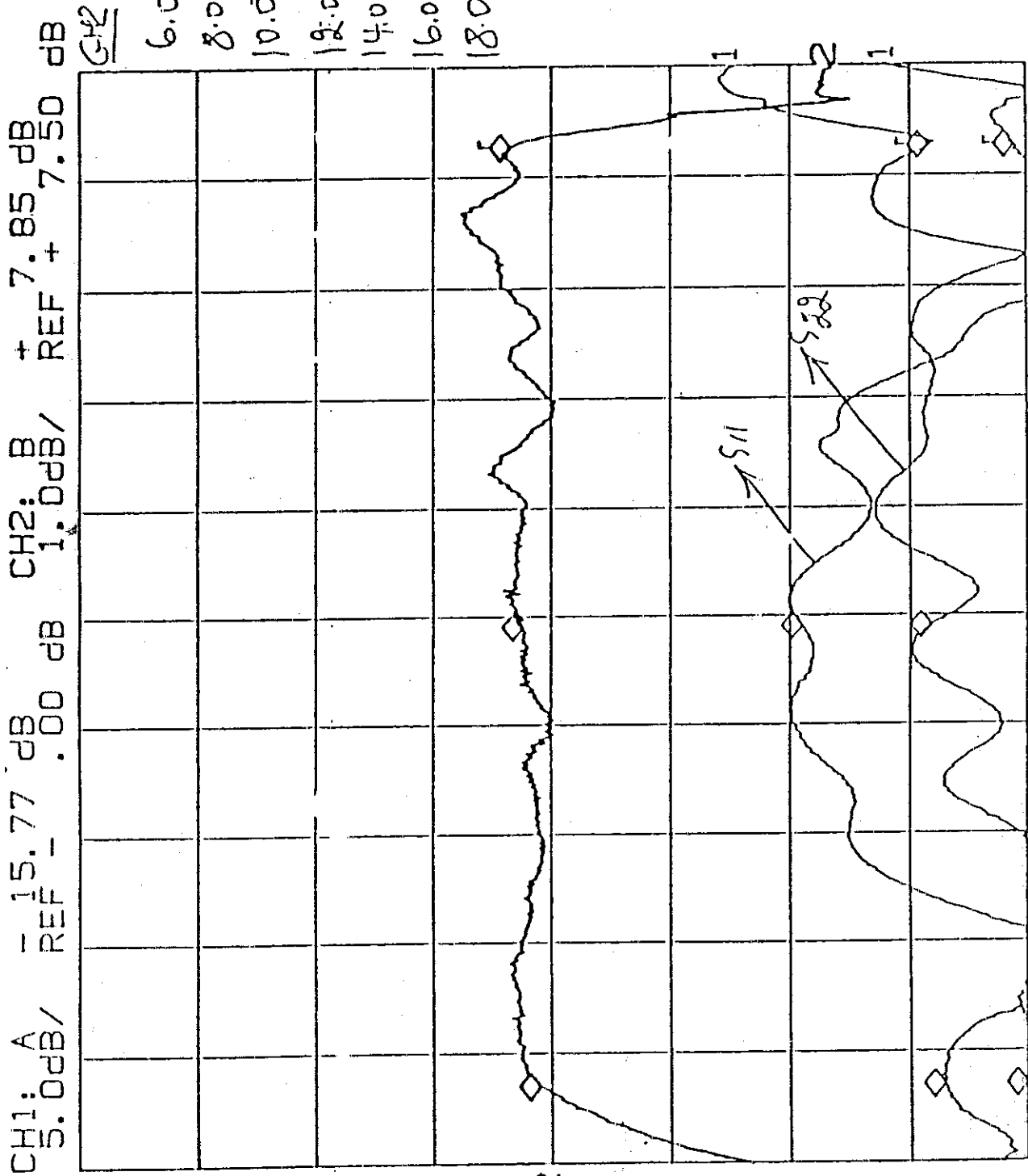


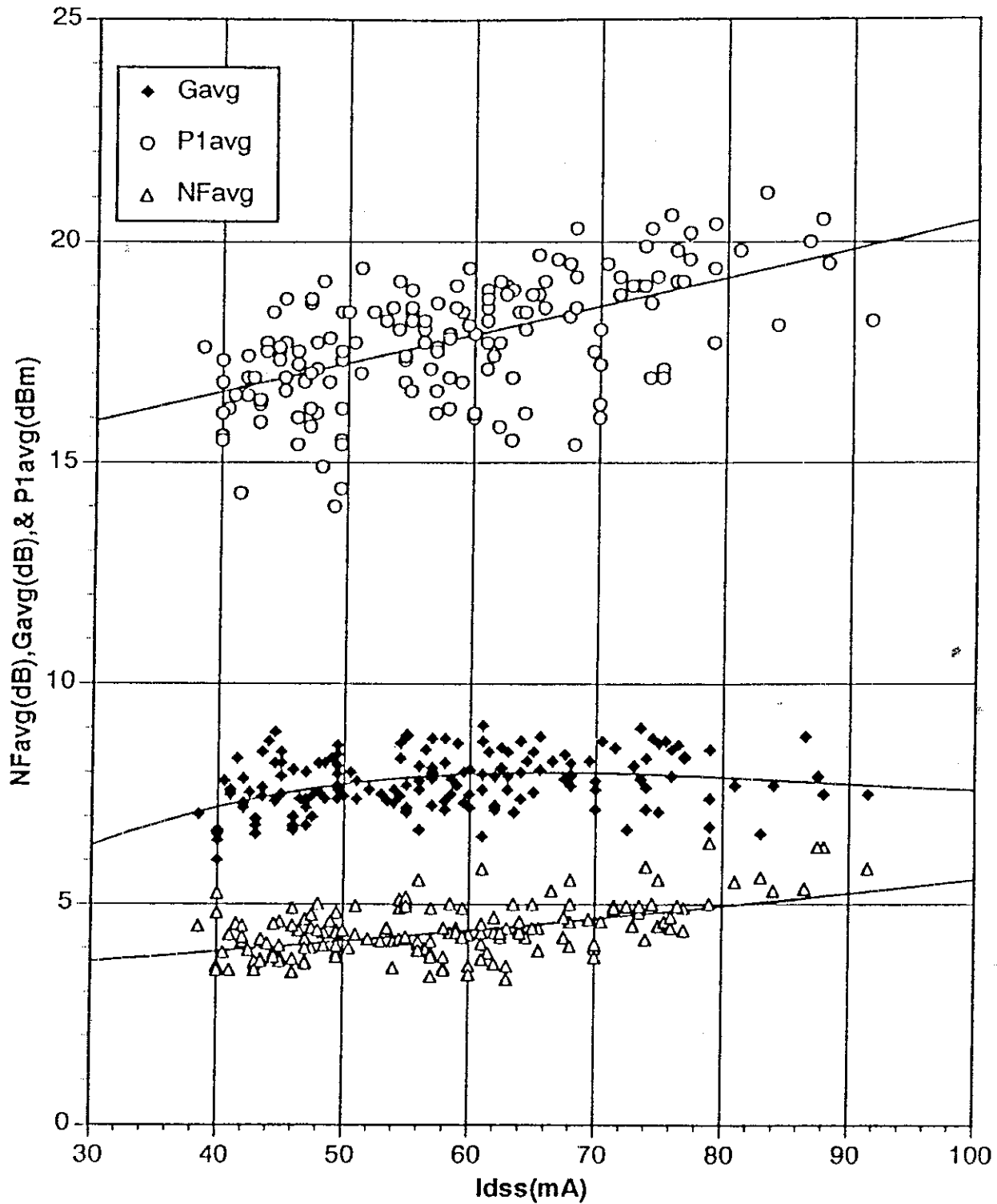
Figure 7. PERFORMANCE OF MWT BALANCED AMPLIFIER MODULE
DESIGNED FOR MWT-7 FET CHIPS



GHz	ME	PLdB
6.0	2.9	14.0
8.0	2.9	17.3
10.0	3.6	17.2
12.0	3.7	18.0
14.0	3.9	17.6
16.0	3.9	18.1
18.0	4.2	18.6

START +5.0000GHZ MKR +18.000GHZ STOP +19.000GHZ

Figure 8. MWT-7 In 6-18GHz Balanced Module
 $V_{ds} \sim 4.5V$ & $I_{ds} \sim 0.5I_{dss}$



NOTE; "avg" is average of max and min. values over 6-18 GHz.