A Technical Memo

Wideband Radio Frequency Interference in the 233 MHz band

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1 Background

Wideband radio frequency interference (RFI) has been observed in the 233 MHz band as shown in this online display of the visibility amplitudes while observing an off-source position (Fig 1). The top half above the diagonal shows the 130 MHz polarization whereas the bottom half shows the 175 MHz polarisation. The diagonal shows the self counts for both the polarizations. This is an instantaneous display for a given spectral channel. Correlated signal is picked up by the central square antennas and the nearest arm antennas (e.g W01, S01, E02) even when the antennas are pointing at an off-source position where no correlated signal is expected. The correlated signal simulates a source of strength $\sim 20-30$ Jy and is present in all the spectral channels unlike narrow-band RFI. Such wide band RFI reduces the dynamic range of the observations by increasing the rms noise in the image and hence reducing the sensitivity of the observations. This is not desirable for observations and it is necessary to determine its origin and eliminate it. We undertook a few experiments, which we describe here alongwith the results, to understand the origin of this RFI and ways to live with it till it is eliminated.

First some history. Such correlated wideband RFI was observed by the observatory about two years ago, but it was certainly absent about six months ago. Some of the remedial measures taken two years ago were:

- Sparking/arcing in power lines were checked for. Apparently a culprit was found near W01. It was not clear if the wideband RFI disappeared.
- Some of the power line insulators were replaced. It was not clear if the wideband RFI disappeared.
- The wideband RFI clearly disappeared after the rains then!

Some of the suspects this time could be:

- sparking/arcing in power lines
- the wideband (8 MHz) TV signals getting intermodulated into the observing band.
- unknown!

We conducted a few experiments in March 2003. The first experiment concentrated on determining the origin of this RFI. The second and third experiments concentrated on finding an appropriate observing method to co-exist with the RFI till it was eliminated. In this memo, we describe the experiments and the results we obtained. In summary, we did not obtain a conclusive result as to the origin of the RFI; however we found that by changing the observing band or introducing high attenuation in the default band, one can reduce the effect of this RFI on observations.

2 Experiment 1

Fig 1 shows how the wideband RFI will be manifested while observing an off-source position. The shorter baselines show finite correlation while the longer baselines where the RFI is uncorrelated show noise. Suspecting the mains power lines to be responsible for the RFI, we decided to power down the central square antennas + arm antennas and run the central square on generator supply. We sequentially turned off the power to the south, west and east arms and noted the amplitude change in the correlated signal. All this work was done towards an off-source position so as to avoid confusion with the source signal. The experiment was done by using default RF settings for the 233 MHz band i.e. the IF band 244-236 MHz. We also made sure that to examine channels which were free of narrow-band RFI. The various steps taken in the experiment with the results are listed below:

1. The power to the south arm was switched off and a drop in the correlated signal was noticed. But the signal did not disappear. On switching off power supply to the east and west arms, no change in the RFI was noticed.

2. Then we switched off the power supply to the analog, electronics and baseband laboratories. We suspect that a few of the spiky narrow-band RFI which we had noticed, but unfortunately had not kept detailed records, had subsided when the analog laboratory was switched off. However, the experiment has to be repeated before any conclusions can be drawn. There was no change in the wideband correlated signal.

3. The power supply to the laboratories was turned on. No change in the correlated signal was noticed.

4. The power supply to the arm antennas was switched on. No change in the correlated signal was noticed. It is not clear whether the drop in the correlated signal noticed in (1) was related to powering down the south arm or was coincidental.

5. The power supply to central square was switched off and the diesel generator was switched on. No change in the correlated signal was noticed.

6. Power was restored on the central square. No change in the correlated signal.

The only change we noted was in the strength of the correlated signal which was 30 counts when we started and dropped to 10-15 counts when we ended. We have no explanation for this. It could either be that the correlated signal was variable during the experiment or else some of the power lines which contribute to the correlated signal are in the south arm and hence the RFI correlation reduced when the south arm antennas were powered down.

3 Experiment 2

In this experiment, we varied the frequency of the first local oscillator and scanned through the 233 MHz RF band to check for a 'clean' band which is free from the wideband RFI. One of the possible origins of this wideband RFI is cited as the TV signal which can get get intermodulated into our observing band. The Pune TV signal is between 175 and 183 MHz. Junnar TV receives this signal and retransmits between 195 and 203 MHz. If these signals which lie outside the 233 MHz RF band beat with a narrow-band RFI, there is a possibility of them getting translated to within the 233 MHz RF band and we would observe it as a wideband RFI. However, if this is the case then the wideband RFI should have a frequency dependence depending on the translating narrow-band RFI which is beating with the TV signal. This experiment was aimed at investigating this issue. We observed an off-source position for all the frequency settings and checked the magnitude of the wideband correlated signal. Please note that the default settings for 233 MHz observations (244-236 MHz) are: LOI=310 MHz, IFBW=6 MHz, LOIV=66 MHz, BBW=8 MHz. Fig 1 shows the counts registered at an off-source position. Notice the higher counts on the central square antennas which is the signature of the wideband RFI which we are trying to remedy. The LOI frequency was changed whereas the LOIV frequency was held fixed to 66 MHz for all the following cases. The strength of the correlated RFI signal was compared to the strength obtained for the default RF settings.

1. Changed LOI to 300 MHz so that the observing band was 234-226 MHz. The correlated RFI signal was stronger.
2. Changed LOI=295 MHz so observing band was 229-221 MHz. The correlated RFI signal was stronger (See Fig 2). However note that the on-source sensitivity is down by 5 dB.
3. Changed LOI=320 MHz so observing band was 254-246 MHz. The correlated RFI signal was weaker (See Fig 3).
4. Changed LOI=325 MHz, so observing band was 259-251 MHz. The correlated RFI signal was weakest in this case (See Fig 4). The on-source sensitivity was down by 5 dB.

Summarizing, it appears that the wideband RFI is weakest in the 251 to 259 MHz band and strongest in the $221 - 229$ MHz band. In other words, the wideband

RFI gets weaker for frequencies from 220 → 250 MHz. (Subhashis Roy conducted a similar experiment the next day and confirmed the above results.) Thus observing in the band $251 - 259$ MHz seems better for reducing the effect of the wideband RFI on the data. However, our experiment does not give any information on the presence of narrow band RFI in this band. If the narrow band RFI in this band turns out to be severe then it might be a good idea to adhere to the default settings and resort to other measures. We conducted the next experiment to check out if the default observing band at 233 MHz can be used with reduced sensitivity and reduced contamination by the wideband RFI.

4 Experiment 3

Since the system temperature at 233 MHz is high (stronger background non-thermal radiation field) and RFI can be strong which can saturate the system; the normal observing procedure involves introducing a 14 dB solar attenuator in the front-end. At GMRT, a facility is provided for inserting a large attenuator in the front-end. This attenuation can either be 14 dB or 30 dB and are known as solar attenuators. In this experiment, a solar attenuator of 30dB was introduced in the path for the default 233 MHz settings (LOI=310MHz, LOIV=66MHz). 3C147 was observed. The correlation with the default 14dB solar attenuator of 0.07-0.08 (see Fig 5) dropped to 0.02 (see Fig 6) that is a drop of factor ~ 4 ie ~ 6 dB. This experiment was conducted to check if the 30 dB solar attenuator would be sufficient to kill the wideband RFI without losing sensitivity.

The off-source position with a 30 dB attenuation in the front-end (see Fig 7) shows weak signatures of the wideband correlated signal; the cross correlation of the RFI is lower by a factor 4 like the on-source correlation. Thus the results of this experiment and the previous experiment are similar. This experiment demonstrates that the default RF band can be used for observations with a 30 dB attenuator in the front end and this reduces the effect of the wideband RFI. As in the previous experiment, this does not cure the wideband RFI problem.

5 Summary

The origin of the wideband RFI in the 233 MHz band is not clear. Since the weather is fairly dry, it is likely that the cause of the RFI is in some sparking/arcing of power lines. However our control experiment to track this down was not conclusive. We, then, turned our attention to finding ways of observing in the presence of this wideband RFI and arriving at a compromise between reduced sensitivity and reduced wideband RFI. We find that the wideband RFI reduces in strength when scanning in RF from 221 to 259 MHz. The wideband RFI is strongest near 221 MHz and weakest near 259 MHz. There is a drop in sensitivity of 5dB near 221 and 259 MHz. In another experiment, we find that the wideband RFI can be reduced by introducing a solar attenuator of 30 dB in the front-end. This results in a drop of 6 dB in the sensitivity. However, in both these cases, we find that the wideband RFI also becomes weaker.

Further investigations are required for pinning down the source of this RFI. Some further experiments that can be conducted are:

- Check for the wideband RFI when power fails and the TV signals are absent.
- Repeat the experiment of running the central square on the diesel generator and the effect on the wideband correlated signal.
- Check if rains cure the problem!

(**P.S.**: Although this memo was prepared soon after the above experiments were conducted, its submission has got delayed beyond the onset of monsoon, giving us an opportunity to examine the effect of rains on the wideband RFI. Unfortunately this time, we find that the wideband RFI persists and the rains have failed to provide the solution. More experiments are being planned and conducted to trace down the source of this RFI.)

Note: The figures are in another file (**figs.ps**). The captions for the figures are given below as also the page number in the figures file.

Figure Captions:

Fig 1: This figure shows the counts registered at an off-source position for default frequency settings in the 240 MHz band. Notice that while most of the arm antennas show a few counts which is noise; the central square antennas and the nearby arm antennas show few tens of counts which is the correlated signal, the source of which we are trying to locate. (page 4 or 5)

Fig 2: Expt 2(b): Off-source counts for LOI=295 MHz; (page 8).

Fig 3: Expt 2(c): Off-source counts for LOI=320 MHz (last page in this file).

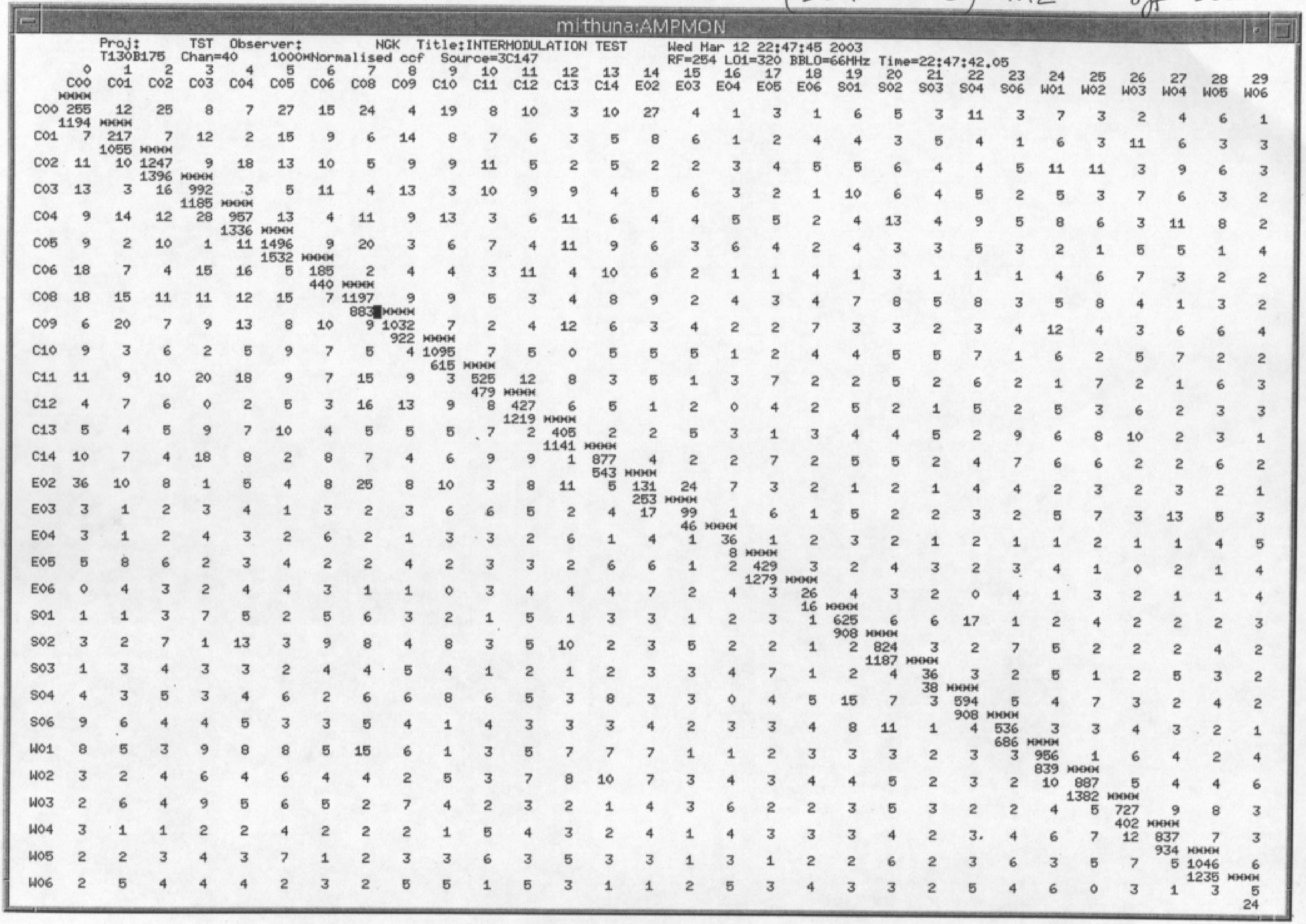
Fig 4: Expt 2(d): Off-source counts for LOI=325 MHz; (page 7).

Fig 5: Expt 3: On-source (3C147) counts with standard 14dB solar attenuator; (page 1).

Fig 6: Expt 3: On-source (3C147) counts with 30dB solar attenuator; (page 3).

Fig 7: Expt 3: Off-source counts with 30dB solar attenuator; (page 2).

(254 - 246) mHz   off source



```
     Proj:        TST  Observer:            NGK  Title:INTERMODULATION TEST      Wed Mar 12 22:47:45 2003
     T130B175  Chan=40      1000*Normalised ccf  Source=3C147                   RF=254 LO1=320 BBLO=66MHz Time=22:47:42.05
       0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25   26   27   28   29
     C00  C01  C02  C03  C04  C05  C06  C08  C09  C10  C11  C12  C13  C14  E02  E03  E04  E05  E06  S01  S02  S03  S04  S06  W01  W02  W03  W04  W05  W06
    ****
C00  255   12   25    8    7   27   15   24    4   19    8   10    3   10   27    4    1    3    1    6    5    3   11    3    7    3    2    4    6    1
    1194 ****
C01    7  217    7   12    2   15    9    6   14    8    7    6    3    5    8    6    1    2    4    4    3    5    4    1    6    3   11    6    3    3
         1055 ****
C02   11   10 1247    9   18   13   10    5    9    9   11    5    2    5    2    2    3    4    5    5    6    4    4    5   11   11    3    9    6    3
              1396 ****
C03   13    3   16  992    3    5   11    4   13    3   10    9    9    4    5    6    3    2    1   10    6    4    5    2    5    3    7    6    3    2
                   1185 ****
C04    9   14   12   28  957   13    4   11    9   13    3    6   11    6    4    4    5    5    2    4   13    4    9    5    8    6    3   11    8    2
                        1336 ****
C05    9    2   10    1   11 1496    9   20    3    6    7    4   11    9    6    3    6    4    2    4    3    3    5    3    2    1    5    5    1    4
                             1532 ****
C06   18    7    4   15   16    5  185    2    4    4    3   11    4   10    6    2    1    1    4    1    3    1    1    1    4    6    7    3    2    2
                                   440 ****
C08   18   15   11   11   12   15    7 1197    9    9    5    3    4    8    9    2    4    3    4    7    8    5    8    3    5    8    4    1    3    2
                                       883█****
C09    6   20    7    9   13    8   10    9 1032    7    2    4   12    6    3    4    2    2    7    3    3    2    3    4   12    4    3    6    6    4
                                             922 ****
C10    9    3    6    2    5    9    7    5    4 1095    7    5    0    5    5    5    1    2    4    4    5    5    7    1    6    2    5    7    2    2
                                                  615 ****
C11   11    9   10   20   18    9    7   15    9    3  525   12    8    3    5    1    3    7    2    2    5    2    6    2    1    7    2    1    6    3
                                                       479 ****
C12    4    7    6    0    2    5    3   16   13    9    8  427    6    5    1    2    0    4    2    5    2    1    5    2    5    3    6    2    3    3
                                                           1219 ****
C13    5    4    5    9    7   10    4    5    5    5    7    2  405    2    2    5    3    1    3    4    4    5    2    9    6    8   10    2    3    1
                                                                1141 ****
C14   10    7    4   18    8    2    8    7    4    6    9    9    1  877    4    2    2    7    2    5    5    2    4    7    6    6    2    2    6    2
                                                                      543 ****
E02   36   10    8    1    5    4    8   25    8   10    3    8   11    5  131   24    7    3    2    1    2    1    4    4    2    3    2    3    2    1
                                                                           253 ****
E03    3    1    2    3    4    1    3    2    3    6    6    5    2    4   17   99    1    6    1    5    2    2    3    2    5    7    3   13    5    3
                                                                                 46 ****
E04    3    1    2    4    3    2    6    2    1    3    3    2    6    1    4    1   36    1    2    3    2    1    2    1    1    2    1    1    4    5
                                                                                       8 ****
E05    5    8    6    2    3    4    2    2    4    2    3    3    2    6    6    1    2  429    3    2    4    3    2    3    4    1    0    2    1    4
                                                                                         1279 ****
E06    0    4    3    2    4    4    3    1    1    0    3    4    4    4    7    2    4    3   26    4    3    2    0    4    1    3    2    1    1    4
                                                                                                16 ****
S01    1    1    3    7    5    2    5    6    3    2    1    5    1    3    3    1    2    3    1  625    6    6   17    1    2    4    2    2    2    3
                                                                                                    908 ****
S02    3    2    7    1   13    3    9    8    4    8    3    5   10    2    3    5    2    2    1    2  824    3    2    7    5    2    2    2    4    2
                                                                                                        1187 ****
S03    1    3    4    3    3    2    4    4    5    4    1    2    1    2    3    3    4    7    1    2    4   36    3    2    5    1    2    5    3    2
                                                                                                               38 ****
S04    4    3    5    3    4    6    2    6    6    8    6    5    3    8    3    3    0    4    5   15    7    3  594    5    4    7    3    2    4    2
                                                                                                                   908 ****
S06    9    6    4    4    5    3    3    5    4    1    4    3    3    3    4    2    3    3    4    8   11    1    4  536    3    3    4    3    2    1
                                                                                                                        686 ****
W01    8    5    3    9    8    8    5   15    6    1    3    5    7    7    7    1    1    2    3    3    3    2    3    3  956    1    6    4    2    4
                                                                                                                             839 ****
W02    3    2    4    6    4    6    4    4    2    5    3    7    8   10    7    3    4    3    4    4    5    2    3    2   10  887    5    4    4    6
                                                                                                                                 1382 ****
W03    2    6    4    9    5    6    5    2    7    4    2    3    2    1    4    3    6    2    2    3    5    3    2    2    4    5  727    9    8    3
                                                                                                                                       402 ****
W04    3    1    1    2    2    4    2    2    2    1    5    4    3    2    4    1    4    3    3    3    4    2   3.    4    6    7   12  837    7    3
                                                                                                                                            934 ****
W05    2    2    3    4    3    7    1    2    3    3    6    3    5    3    3    1    3    1    2    2    6    2    3    6    3    5    7    5 1046    6
                                                                                                                                                1235 ****
W06    2    5    4    4    4    2    3    2    5    5    1    5    3    1    1    2    5    3    4    3    3    2    5    4    6    0    3    1    3    5
                                                                                                                                                       24
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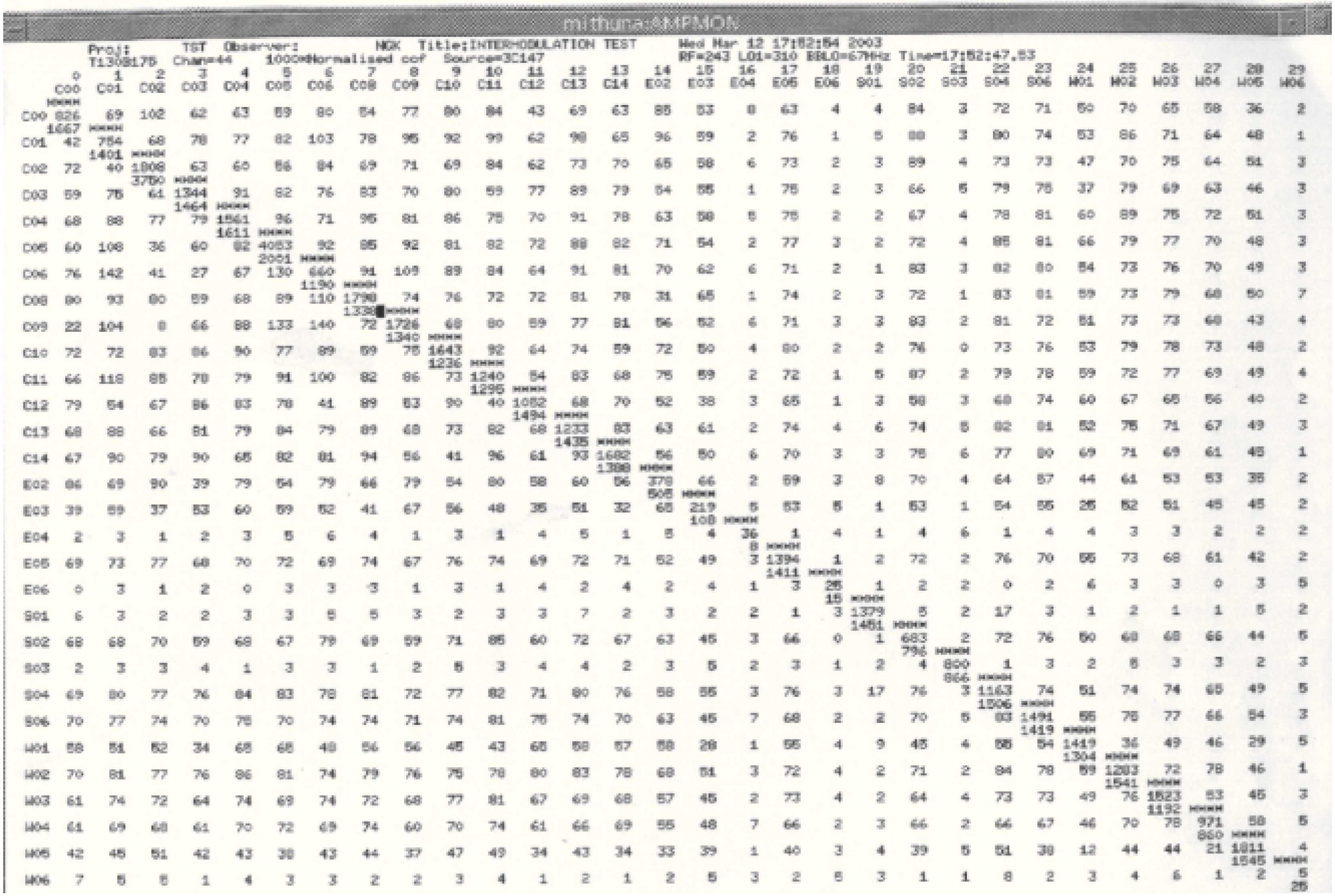
ON-SOURCE



```
        Proj:        TST   Observer:            NGK   Title:INTERMODULATION TEST      Wed Mar 12 17:52:54 2003
        T1308175   Chan=44     1000=Normalised ccf   Source=3C147                      RF=243 LO1=310 BBLO=67MHz Time=17:52:47.53
       0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25   26   27   28   29
     C00  C01  C02  C03  C04  C05  C06  C08  C09  C10  C11  C12  C13  C14  E02  E03  E04  E05  E06  S01  S02  S03  S04  S06  W01  W02  W03  W04  W05  W06
    HHHH
C00  826   69  102   62   63   59   80   54   77   80   84   43   69   63   85   53    8   63    4    4   84    3   72   71   50   70   65   58   36    2
    1667 HHHH
C01   42  784   68   78   77   82  103   78   95   92   99   62   98   65   96   59    2   76    1    5   88    3   80   74   53   86   71   64   48    1
         1401 HHHH
C02   72   40 1808   63   60   56   84   69   71   69   84   62   73   70   65   58    6   73    2    3   89    4   73   73   47   70   75   64   51    3
              3780 HHHH
C03   59   75   61 1344   91   82   76   83   70   80   59   77   89   79   54   55    1   75    2    3   66    5   79   75   37   79   69   63   46    3
                   1464 HHHH
C04   68   88   77   79 1561   96   71   95   81   86   75   70   91   78   63   58    5   75    2    2   67    4   78   81   60   89   75   72   51    3
                        1611 HHHH
C05   60  108   36   60   82 4053   92   85   92   81   82   72   88   82   71   54    2   77    3    2   72    4   85   81   66   79   77   70   48    3
                             2051 HHHH
C06   76  142   41   27   67  130  660   91  109   89   84   64   91   81   70   62    6   71    2    1   83    3   82   80   54   73   76   70   49    3
                                  1190 HHHH
C08   80   93   80   59   68   89  110 1798   74   76   72   72   81   78   31   65    1   74    2    3   72    1   83   81   59   73   79   68   50    7
                                       1338█HHHH
C09   22  104    8   66   88  133  140   72 1726   68   80   59   77   81   56   52    6   71    3    3   83    2   81   72   51   73   73   68   43    4
                                            1340 HHHH
C10   72   72   83   86   90   77   89   59   75 1643   92   64   74   59   72   50    4   80    2    2   76    0   73   76   53   79   78   73   48    2
                                                 1236 HHHH
C11   66  118   85   78   79   91  100   82   86   73 1240   54   83   68   75   59    2   72    1    5   87    2   79   78   59   72   77   69   49    4
                                                      1295 HHHH
C12   79   54   67   86   83   78   41   89   53   90   40 1052   68   70   52   38    3   65    1    3   58    3   68   74   60   67   65   56   40    2
                                                           1494 HHHH
C13   68   88   66   81   79   84   79   89   68   73   82   68 1233   83   63   61    2   74    4    6   74    5   82   81   52   75   71   67   49    3
                                                                1435 HHHH
C14   67   90   79   90   65   82   81   94   56   41   96   61   93 1682   56   50    6   70    3    3   75    6   77   80   69   71   69   61   45    1
                                                                     1388 HHHH
E02   86   69   90   39   79   54   79   66   79   54   80   58   60   56  378   66    2   59    3    8   70    4   64   57   44   61   53   53   35    2
                                                                           505 HHHH
E03   39   59   37   53   60   59   52   41   67   56   48   35   51   32   65  219    5   53    5    1   53    1   54   55   25   52   51   45   45    2
                                                                                108 HHHH
E04    2    3    1    2    3    5    6    4    1    3    1    4    5    1    5    4   36    1    4    1    4    6    1    4    4    3    3    2    2    2
                                                                                        8 HHHH
E05   69   73   77   68   70   72   69   74   67   76   74   69   72   71   52   49    3 1394    1    2   72    2   76   70   55   73   68   61   42    2
                                                                                          1411 HHHH
E06    0    3    1    2    0    3    3    3    1    3    1    4    2    4    2    4    1    3   25    1    2    2    0    2    6    3    3    0    3    5
                                                                                                 15 HHHH
S01    6    3    2    2    3    3    5    5    3    2    3    3    7    2    3    2    2    1    3 1379    5    2   17    3    1    2    1    1    5    2
                                                                                                    1451 HHHH
S02   68   68   70   59   68   67   79   69   59   71   85   60   72   67   63   45    3   66    0    1  683    2   72   76   50   68   68   66   44    5
                                                                                                          796 HHHH
S03    2    3    3    4    1    3    3    1    2    5    3    4    4    2    3    5    2    3    1    2    4  800    1    3    2    5    3    3    2    3
                                                                                                               866 HHHH
S04   69   80   77   76   84   83   78   81   72   77   82   71   80   76   58   55    3   76    3   17   76    3 1163   74   51   74   74   65   49    5
                                                                                                                   1506 HHHH
S06   70   77   74   70   75   70   74   74   71   74   81   75   74   70   63   45    7   68    2    2   70    5   83 1491   55   75   77   66   54    3
                                                                                                                        1419 HHHH
W01   58   51   52   34   65   65   48   56   56   45   43   65   58   57   58   28    1   55    4    9   45    4   58   54 1419   36   49   46   29    5
                                                                                                                             1304 HHHH
W02   70   81   77   76   86   81   74   79   76   75   78   80   83   78   68   51    3   72    4    2   71    2   84   78   59 1283   72   78   46    1
                                                                                                                                  1541 HHHH
W03   61   74   72   64   74   69   74   72   68   77   81   67   69   68   57   45    2   73    4    2   64    4   73   73   49   76 1823   53   45    3
                                                                                                                                       1192 HHHH
W04   61   69   68   61   70   72   69   74   60   70   74   61   66   69   55   48    7   66    2    3   66    2   66   67   46   70   78  971   58    5
                                                                                                                                             860 HHHH
W05   42   45   51   42   43   38   43   44   37   47   49   34   43   34   33   39    1   40    3    4   39    5   51   38   12   44   44   21 1811    4
                                                                                                                                                 1545 HHHH
W06    7    5    5    1    4    3    3    2    2    3    4    1    2    1    2    5    3    2    5    3    1    1    8    2    3    4    6    1    2    5
                                                                                                                                                        25
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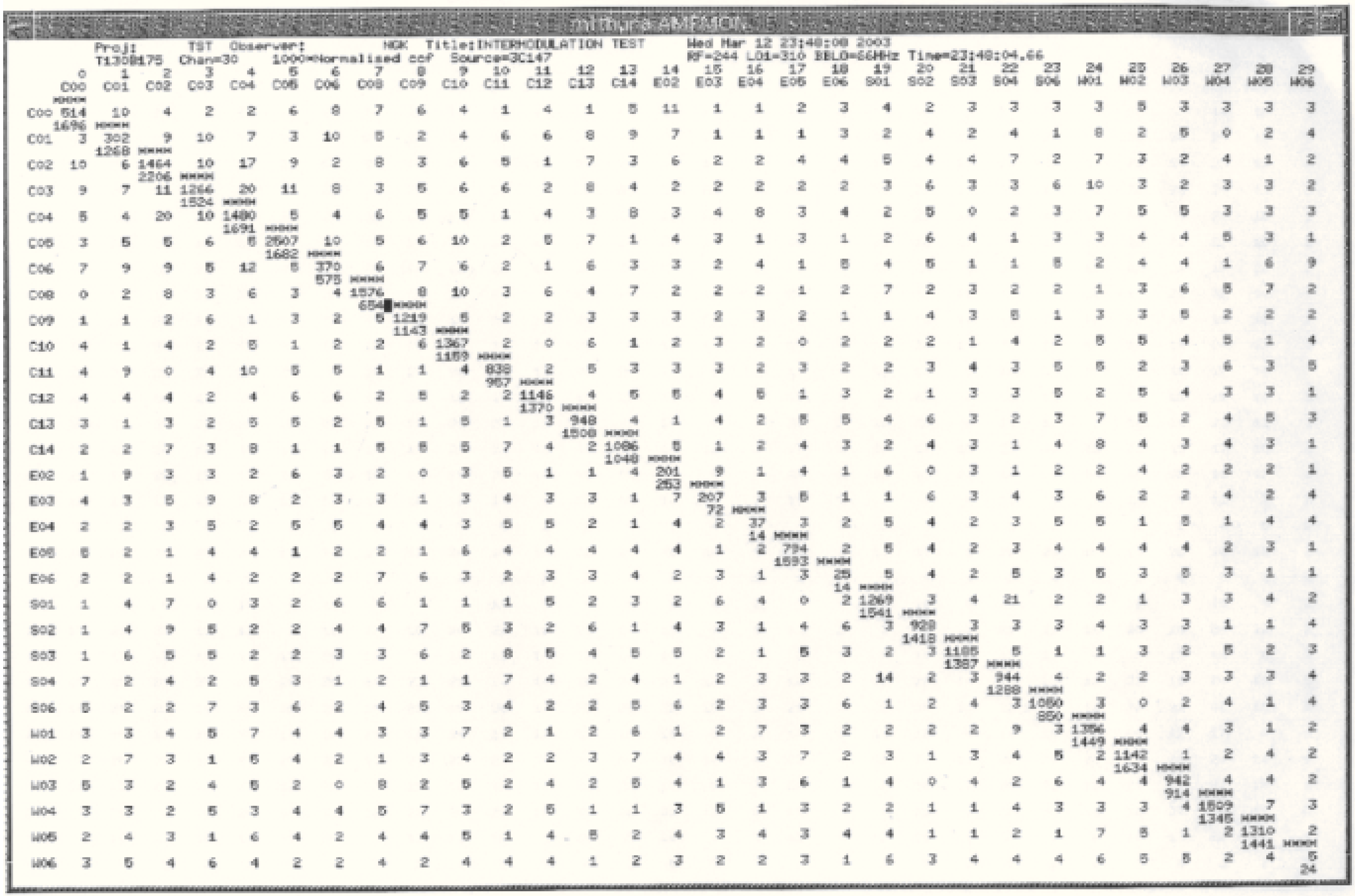
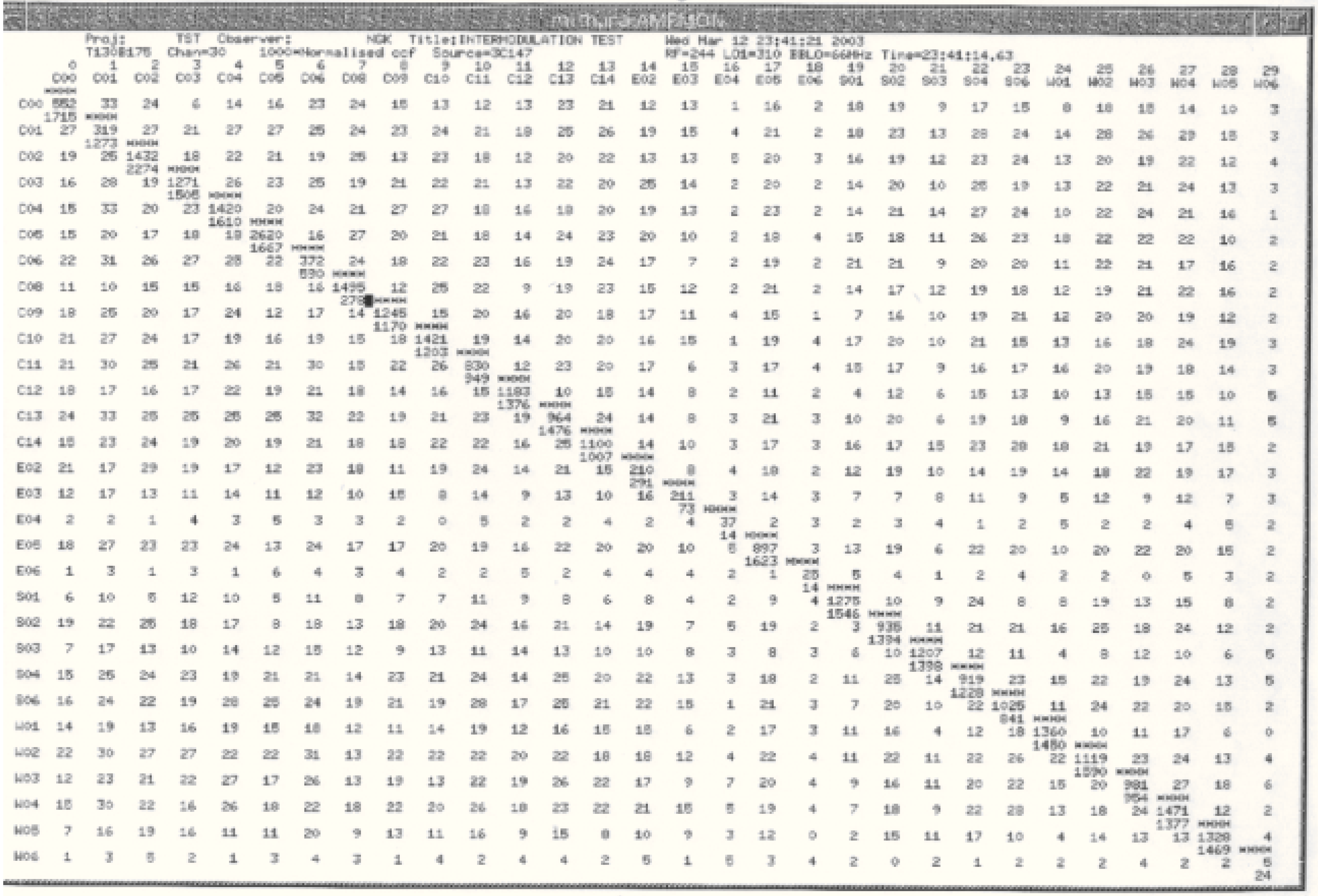
OFF-SOURCE with 30 dB solar attenuator



```
      Proj:        TST   Observer:           NGK   Title:INTERMODULATION TEST      Wed Mar 12 23:48:08 2003
      T1308175   Chan=30      1000=Normalised ccf   Source=3C147                    RF=244 LO1=310 BBLO=66MHz Time=23:48:04.66
        0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25   26   27   28   29
      C00  C01  C02  C03  C04  C05  C06  C08  C09  C10  C11  C12  C13  C14  E02  E03  E04  E05  E06  S01  S02  S03  S04  S06  W01  W02  W03  W04  W05  W06
     ****
C00   514   10    4    2    2    6    8    7    6    4    1    4    1    5   11    1    1    2    3    4    2    3    3    3    3    5    3    3    3    3
     1696 ****
C01     3  302    9   10    7    3   10    5    2    4    6    6    8    9    7    1    1    1    3    2    4    2    4    1    8    2    5    0    2    4
          1268 ****
C02    10    6 1464   10   17    9    2    8    3    6    5    1    7    3    6    2    2    4    4    5    4    4    7    2    7    3    2    4    1    2
               2206 ****
C03     9    7   11 1266   20   11    8    3    5    6    6    2    8    4    2    2    2    2    2    3    6    3    3    6   10    3    2    3    3    2
                    1524 ****
C04     5    4   20   10 1480    5    4    6    5    5    1    4    3    8    3    4    8    3    4    2    5    0    2    3    7    5    5    3    3    3
                         1691 ****
C05     3    5    5    6    5 2507   10    5    6   10    2    5    7    1    4    3    1    3    1    2    6    4    1    3    3    4    4    5    3    1
                              1682 ****
C06     7    9    9    5   12    5  370    6    7    6    2    1    6    3    3    2    4    1    5    4    5    1    1    5    2    4    4    1    6    9
                                    575 ****
C08     0    2    8    3    6    3    4 1576    8   10    3    6    4    7    2    2    2    1    2    7    2    3    2    2    1    3    6    5    7    2
                                         654█****
C09     1    1    2    6    1    3    2    5 1219    5    2    2    3    3    3    2    3    2    1    1    4    3    5    1    3    3    5    2    2    2
                                            1143 ****
C10     4    1    4    2    5    1    2    2    6 1367    2    0    6    1    2    3    2    0    2    2    2    1    4    2    5    5    4    5    1    4
                                                 1159 ****
C11     4    9    0    4   10    5    5    1    1    4  838    2    5    3    3    3    2    3    2    2    3    4    3    5    5    2    3    6    3    5
                                                       957 ****
C12     4    4    4    2    4    6    6    2    5    2    2 1146    4    5    5    4    5    1    3    2    1    3    3    5    2    5    4    3    3    1
                                                           1370 ****
C13     3    1    3    2    5    5    2    5    1    5    1    3  948    4    1    4    2    5    5    4    6    3    2    3    7    5    2    4    5    3
                                                                1508 ****
C14     2    2    7    3    8    1    1    5    5    5    7    4    2 1086    5    1    2    4    3    2    4    3    1    4    8    4    3    4    3    1
                                                                     1048 ****
E02     1    9    3    3    2    6    3    2    0    3    5    1    1    4  201    9    1    4    1    6    0    3    1    2    2    4    2    2    2    1
                                                                           263 ****
E03     4    3    5    9    8    2    3    3    1    3    4    3    3    1    7  207    3    5    1    1    6    3    4    3    6    2    2    4    2    4
                                                                                 72 ****
E04     2    2    3    5    2    5    5    4    4    3    5    5    2    1    4    2   37    3    2    5    4    2    3    5    5    1    5    1    4    4
                                                                                      14 ****
E05     5    2    1    4    4    1    2    2    1    6    4    4    4    4    4    1    2  794    2    5    4    2    3    4    4    4    4    2    3    1
                                                                                         1593 ****
E06     2    2    1    4    2    2    2    7    6    3    2    3    3    4    2    3    1    3   25    5    4    2    5    3    5    3    5    3    1    1
                                                                                                14 ****
S01     1    4    7    0    3    2    6    6    1    1    1    5    2    3    2    6    4    0    2 1269    3    4   21    2    2    1    3    3    4    2
                                                                                                   1541 ****
S02     1    4    9    5    2    2    4    4    7    5    3    2    6    1    4    3    1    4    6    3  928    3    3    3    4    3    3    1    1    4
                                                                                                        1418 ****
S03     1    6    5    5    2    2    3    3    6    2    8    5    4    5    5    2    1    5    3    2    3 1185    5    1    1    3    2    5    2    3
                                                                                                             1387 ****
S04     7    2    4    2    5    3    1    2    1    1    7    4    2    4    1    2    3    3    2   14    2    3  944    4    2    2    3    3    3    4
                                                                                                                  1288 ****
S06     5    2    2    7    3    6    2    4    5    3    4    2    2    5    6    2    3    3    6    1    2    4    3 1080    3    0    2    4    1    4
                                                                                                                        850 ****
W01     3    3    4    5    7    4    4    3    3    7    2    1    2    6    1    2    7    3    2    2    2    2    9    3 1356    4    4    3    1    2
                                                                                                                            1449 ****
W02     2    7    3    1    5    4    2    1    3    4    2    2    3    7    4    4    3    7    2    3    1    3    4    5    2 1142    1    2    4    2
                                                                                                                                 1634 ****
W03     5    3    2    4    5    2    0    8    2    5    2    4    2    5    4    1    3    6    1    4    0    4    2    6    4    4  942    4    4    2
                                                                                                                                       914 ****
W04     3    3    2    5    3    4    4    5    7    3    2    5    1    1    3    5    1    3    2    2    1    1    4    3    3    3    4 1509    7    3
                                                                                                                                           1345 ****
W05     2    4    3    1    6    4    2    4    4    5    1    4    5    2    4    3    4    3    4    4    1    1    2    1    7    5    1    2 1310    2
                                                                                                                                                1441 ****
W06     3    5    4    6    4    2    2    4    2    4    4    4    1    2    3    2    2    3    1    6    3    4    4    4    6    5    5    2    4    5
                                                                                                                                                       24
```

244-236 MHz

noihvily ↓ ON-SOURCE with 30 dB solar attenuator IF attn ↓ #11 8 dB



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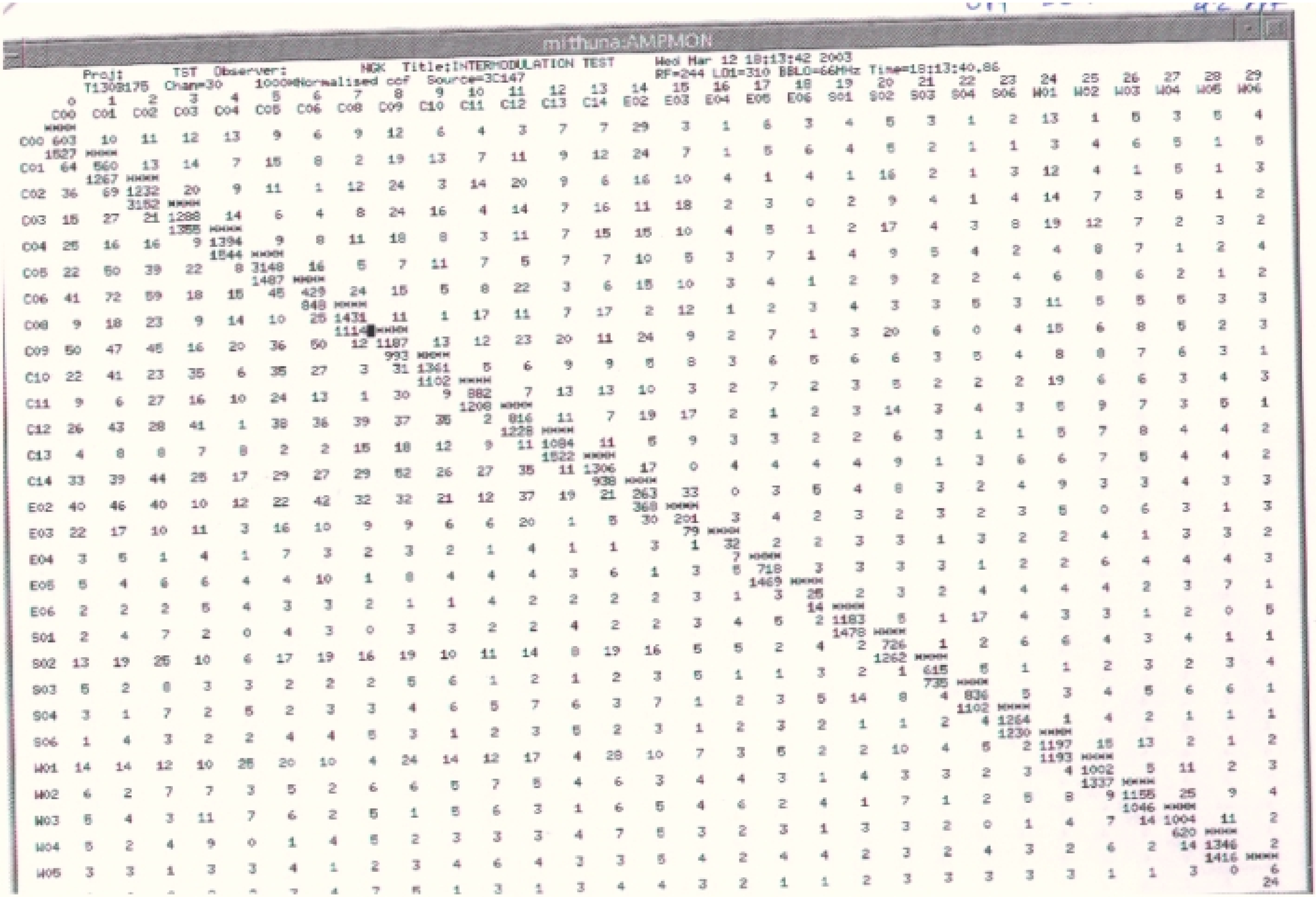
           Proj:        TST  Observer:          NGK  Title:INTERMODULATION TEST       Wed Mar 12 23:41:21 2003
           T130B175  Chan=30     1000=Normalised ccf  Source=3C147                   RF=244 LO1=310 BBLO=66MHz Time=23:41:14,63
        0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25   26   27   28   29
      C00  C01  C02  C03  C04  C05  C06  C08  C09  C10  C11  C12  C13  C14  E02  E03  E04  E05  E06  S01  S02  S03  S04  S06  W01  W02  W03  W04  W05  W06
     ****
C00  882   33   24    6   14   16   23   24   15   13   12   13   23   21   12   13    1   16    2   18   19    9   17   15    8   18   15   14   10    3
    1715 ****
C01   27  319   27   21   27   27   25   24   23   24   21   18   25   26   19   15    4   21    2   18   23   13   28   24   14   28   26   29   15    3
         1273 ****
C02   19   25 1432   18   22   21   19   25   13   23   18   12   20   22   13   13    5   20    3   16   19   12   23   24   13   20   19   22   12    4
              2274 ****
C03   16   28   19 1271   26   23   25   19   21   22   21   13   22   20   25   14    2   20    2   14   20   10   25   19   13   22   21   24   13    3
                   1508 ****
C04   15   33   20   23 1420   20   24   21   27   27   18   16   18   20   19   13    2   23    2   14   21   14   27   24   10   22   24   21   16    1
                        1610 ****
C05   15   20   17   18   18 2620   16   27   20   21   18   14   24   23   20   10    2   18    4   15   18   11   26   23   18   22   22   22   10    2
                             1667 ****
C06   22   31   26   27   28   22  372   24   18   22   23   16   19   24   17    7    2   19    2   21   21    9   20   20   11   22   21   17   16    2
                                   530 ****
C08   11   10   15   15   16   18   16 1495   12   25   22    9   19   23   15   12    2   21    2   14   17   12   19   18   12   19   21   22   16    2
                                        278 ****
C09   18   25   20   17   24   12   17   14 1245   15   20   16   20   18   17   11    4   15    1    7   16   10   19   21   12   20   20   19   12    2
                                            1170 ****
C10   21   27   24   17   19   16   19   15   18 1421   19   14   20   20   16   15    1   19    4   17   20   10   21   15   13   16   18   24   19    3
                                                 1203 ****
C11   21   30   25   21   26   21   30   15   22   26  830   12   23   20   17    6    3   17    4   15   17    9   16   17   16   20   19   18   14    3
                                                       949 ****
C12   18   17   16   17   22   19   21   18   14   16   15 1183   10   15   14    8    2   11    2    4   12    6   15   13   10   13   15   15   10    5
                                                           1376 ****
C13   24   33   25   25   25   25   32   22   19   21   23   19  964   24   14    8    3   21    3   10   20    6   19   18    9   16   21   20   11    5
                                                                1476 ****
C14   15   23   24   19   20   19   21   18   18   22   22   16   25 1100   14   10    3   17    3   16   17   15   23   28   18   21   19   17   15    2
                                                                     1007 ****
E02   21   17   29   19   17   12   23   18   11   19   24   14   21   15  210    8    4   18    2   12   19   10   14   19   14   18   22   19   17    3
                                                                           291 ****
E03   12   17   13   11   14   11   12   10   15    8   14    9   13   10   16  211    3   14    3    7    7    8   11    9    5   12    9   12    7    3
                                                                                 73 ****
E04    2    2    1    4    3    5    3    3    2    0    5    2    2    4    2    4   37    2    3    2    3    4    1    2    5    2    2    4    5    2
                                                                                      14 ****
E05   18   27   23   23   24   13   24   17   17   20   19   16   22   20   20   10    5  897    3   13   19    6   22   20   10   20   22   20   15    2
                                                                                         1623 ****
E06    1    3    1    3    1    6    4    3    4    2    2    5    2    4    4    4    2    1   25    5    4    1    2    4    2    2    0    5    3    2
                                                                                                00014 ****
S01    6   10    5   12   10    5   11    8    7    7   11    9    8    6    8    4    2    9    4 1275   10    9   24    8    8   19   13   15    8    2
                                                                                                   1546 ****
S02   19   22   25   18   17    8   18   13   18   20   24   16   21   14   19    7    5   19    2    3  935   11   21   21   16   25   18   24   12    2
                                                                                                        1334 ****
S03    7   17   13   10   14   12   15   12    9   13   11   14   13   10   10    8    3    8    3    6   10 1207   12   11    4    8   12   10    6    5
                                                                                                             1338 ****
S04   15   25   24   23   19   21   21   14   23   21   24   14   25   20   22   13    3   18    2   11   25   14  919   23   15   22   19   24   13    5
                                                                                                                  1228 ****
S06   16   24   22   19   28   25   24   19   21   19   28   17   25   21   22   15    1   21    3    7   20   10   22 1025   11   24   22   20   15    2
                                                                                                                        841 ****
W01   14   19   13   16   19   15   18   12   11   14   19   12   16   15   15    6    2   17    3   11   16    4   12   18 1360   10   11   17    6    0
                                                                                                                            1480 ****
W02   22   30   27   27   22   22   31   13   22   22   22   20   22   18   18   12    4   22    4   11   22   11   22   26   22 1119   23   24   13    4
                                                                                                                                 1590 ****
W03   12   23   21   22   27   17   26   13   19   13   22   19   26   22   17    9    7   20    4    9   16   11   20   22   15   20  981   27   18    6
                                                                                                                                       954 ****
W04   15   30   22   16   26   18   22   18   22   20   26   18   23   22   21   15    5   19    4    7   18    9   22   28   13   18   24 1471   12    2
                                                                                                                                           1377 ****
W05    7   16   19   16   11   11   20    9   13   11   16    9   15    8   10    9    3   12    0    2   15   11   17   10    4   14   13   13 1328    4
                                                                                                                                                1469 ****
W06    1    3    5    2    1    3    4    3    1    4    2    4    4    2    5    1    5    3    4    2    0    2    1    2    2    2    4    2    2    5
                                                                                                                                                       24
```

244-13 R MHz .

T/S



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    Proj:        TST  Observer:              NGK  Title:INTERMODULATION TEST      Wed Mar 12 18:13:42 2003
    T1308175  Chan=30      1000*Normalised cof  Source=3C147                    RF=244 LO1=310 BBLO=66MHz Time=18:13:40.86
        0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25   26   27   28   29
      C00  C01  C02  C03  C04  C05  C06  C08  C09  C10  C11  C12  C13  C14  E02  E03  E04  E05  E06  S01  S02  S03  S04  S06  W01  W02  W03  W04  W05  W06
     ****
C00   603   10   11   12   13    9    6    9   12    6    4    3    7    7   29    3    1    6    3    4    5    3    1    2   13    1    5    3    5    4
     1527 ****
C01    64  560   13   14    7   15    8    2   19   13    7   11    9   12   24    7    1    5    6    4    5    2    1    1    3    4    6    5    1    5
          1267 ****
C02    36   69 1232   20    9   11    1   12   24    3   14   20    9    6   16   10    4    1    4    1   16    2    1    3   12    4    1    5    1    3
               3182 ****
C03    15   27   21 1288   14    6    4    8   24   16    4   14    7   16   11   18    2    3    0    2    9    4    1    4   14    7    3    5    1    2
                    1355 ****
C04    25   16   16    9 1394    9    8   11   18    8    3   11    7   15   15   10    4    5    1    2   17    4    3    8   19   12    7    2    3    2
                         1544 ****
C05    22   50   39   22    8 3148   16    5    7   11    7    5    7    7   10    5    3    7    1    4    9    5    4    2    4    8    7    1    2    4
                              1487 ****
C06    41   72   59   18   15   45  429   24   15    5    8   22    3    6   15   10    3    4    1    2    9    2    2    4    6    8    6    2    1    2
                                    848 ****
C08     9   18   23    9   14   10   25 1431   11    1   17   11    7   17    2   12    1    2    3    4    3    3    5    3   11    5    5    5    3    3
                                        1114█****
C09    50   47   45   16   20   36   60   12 1187   13   12   23   20   11   24    9    2    7    1    3   20    6    0    4   15    6    8    5    2    3
                                              993 ****
C10    22   41   23   35    6   35   27    3   31 1361    5    6    9    9    5    8    3    6    5    6    6    3    5    4    8    8    7    6    3    1
                                                  1102 ****
C11     9    6   27   16   10   24   13    1   30    9  882    7   13   13   10    3    2    7    2    3    5    2    2    2   19    6    6    3    4    3
                                                       1208 ****
C12    26   43   28   41    1   38   36   39   37   35    2  816   11    7   19   17    2    1    2    3   14    3    4    3    5    9    7    3    5    1
                                                            1228 ****
C13     4    8    8    7    8    2    2   15   18   12    9   11 1084   11    5    9    3    3    2    2    6    3    1    1    5    7    8    4    4    2
                                                                 1522 ****
C14    33   39   44   25   17   29   27   29   62   26   27   35   11 1306   17    0    4    4    4    4    9    1    3    6    6    7    5    4    4    2
                                                                       938 ****
E02    40   46   40   10   12   22   42   32   32   21   12   37   19   21  263   33    0    3    6    4    8    3    2    4    9    3    3    4    3    3
                                                                            368 ****
E03    22   17   10   11    3   16   10    9    9    6    6   20    1    5   30  201    3    4    2    3    2    3    2    3    5    0    6    3    1    3
                                                                                  79 ****
E04     3    5    1    4    1    7    3    2    3    2    1    4    1    1    3    1   32    2    2    3    3    1    3    2    2    4    1    3    3    2
                                                                                        7 ****
E05     5    4    6    6    4    4   10    1    8    4    4    4    3    6    1    3    5  718    3    3    3    3    1    2    2    6    4    4    4    3
                                                                                         1469 ****
E06     2    2    2    5    4    3    3    2    1    1    4    2    2    2    2    3    1    3   25    2    3    2    4    4    4    4    2    3    7    1
                                                                                                14 ****
S01     2    4    7    2    0    4    3    0    3    3    2    2    4    2    2    3    4    5    2 1183    5    1   17    4    3    3    1    2    0    5
                                                                                                   1478 ****
S02    13   19   25   10    6   17   19   16   19   10   11   14    8   19   16    5    5    2    4    2  726    1    2    6    6    4    3    4    1    1
                                                                                                        1262 ****
S03     5    2    8    3    3    2    2    2    5    6    1    2    1    2    3    5    1    1    3    2    1  615    5    1    1    2    3    2    3    4
                                                                                                              735 ****
S04     3    1    7    2    5    2    3    3    4    6    5    7    6    3    7    1    2    3    5   14    8    4  836    5    3    4    5    6    6    1
                                                                                                                  1102 ****
S06     1    4    3    2    2    4    4    5    3    1    2    3    5    2    3    1    2    3    2    1    1    2    4 1264    1    4    2    1    1    1
                                                                                                                       1230 ****
W01    14   14   12   10   25   20   10    4   24   14   12   17    4   28   10    7    3    5    2    2   10    4    5    2 1197   15   13    2    1    2
                                                                                                                            1193 ****
W02     6    2    7    7    3    5    2    6    6    5    7    5    4    6    3    4    4    3    1    4    3    3    2    3    4 1002    5   11    2    3
                                                                                                                                 1337 ****
W03     5    4    3   11    7    6    2    5    1    5    6    3    1    6    5    4    6    2    4    1    7    1    2    5    8    9 1155   25    9    4
                                                                                                                                      1046 ****
W04     5    2    4    9    0    1    4    5    2    3    3    3    4    7    5    3    2    3    1    3    3    2    0    1    4    7   14 1004   11    2
                                                                                                                                            620 ****
W05     3    3    1    3    3    4    1    2    3    4    6    4    3    3    5    4    2    4    4    2    3    2    4    3    2    6    2   14 1346    2
                                                                                                                                           1416 ****
                            5    7    4    7    5    1    3    1    3    4    4    3    2    1    1    2    3    3    3    3    3    1    1    3    0    6
                                                                                                                                                     24
```
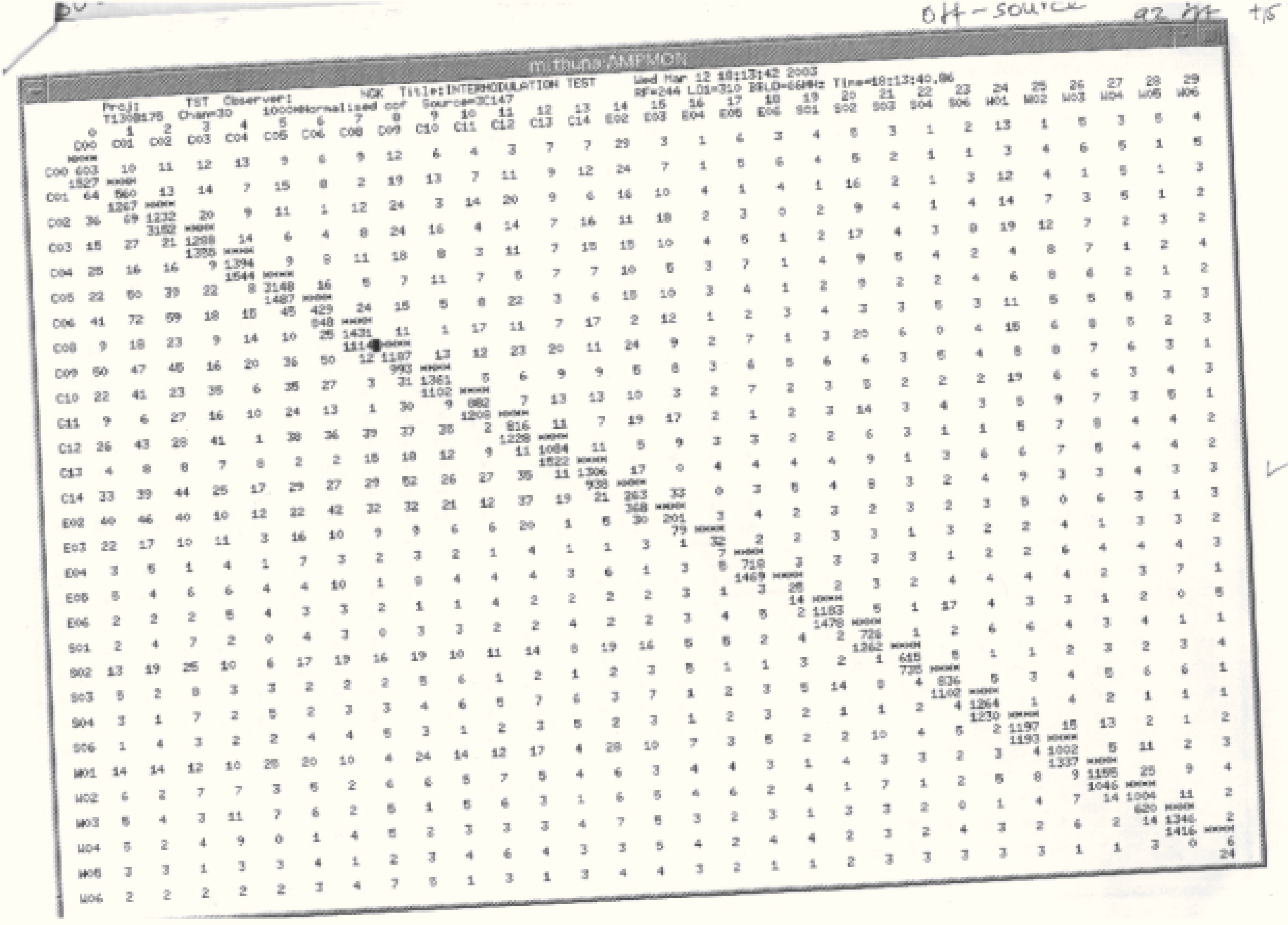

Off - source 92 MH +15°



```
mithuna AMPMON
Proj: T1308175      TST  Observer:            NGK  Title:INTERMODULATION TEST     Wed Mar 12 18:13:42 2003
Chan=30   1000*Normalised ccf   Source=3C147       RF=244 LO1=310 BBLO=66MHz  Time=18:13:40.86
      0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25   26   27   28   29
    C00  C01  C02  C03  C04  C05  C06  C08  C09  C10  C11  C12  C13  C14  E02  E03  E04  E05  E06  S01  S02  S03  S04  S06  W01  W02  W03  W04  W05  W06
C00 **** 603 1527 10 11 12 13 9 6 9 12 6 4 3 7 7 29 3 1 6 3 4 5 3 1 2 13 1 5 3 5 4
C01 64 **** 560 1267 13 14 7 15 8 2 19 13 7 11 9 12 24 7 1 5 6 4 5 2 1 1 3 4 6 5 1 5
C02 36 69 **** 1232 3182 20 9 11 1 12 24 3 14 20 9 6 16 10 4 1 4 1 16 2 1 3 12 4 1 5 1 3
C03 18 27 21 **** 1288 1355 14 6 4 8 24 16 4 14 7 16 11 18 2 3 0 2 9 4 1 4 14 7 3 5 1 2
C04 25 16 16 9 **** 1394 1544 9 8 11 18 8 3 11 7 15 15 10 4 5 1 2 17 4 3 8 19 12 7 2 3 2
C05 22 50 39 22 8 **** 3148 1487 16 5 7 11 7 5 7 7 10 5 3 7 1 4 9 5 4 2 4 8 7 1 2 4
C06 41 72 59 18 18 45 **** 429 848 24 18 5 8 22 3 6 15 10 3 4 1 2 9 2 2 4 6 8 6 2 1 2
C08 9 18 23 9 14 10 25 **** 1431 1814 11 1 17 11 7 17 2 12 1 2 3 4 3 3 5 3 11 5 5 5 3 3
C09 50 47 45 16 20 36 50 12 **** 1187 993 13 12 23 20 11 24 9 2 7 1 3 20 6 0 4 15 6 8 5 2 3
C10 22 41 23 35 6 35 27 3 31 **** 1361 1102 5 6 9 9 5 8 3 6 5 6 6 3 5 4 5 8 7 6 3 1
C11 9 6 27 16 10 24 13 1 30 9 **** 882 1208 7 13 13 10 3 2 7 2 3 5 2 2 2 19 6 6 3 4 3
C12 26 43 28 41 1 38 36 39 37 35 2 **** 816 1228 11 7 19 17 2 1 2 3 14 3 4 3 5 9 7 3 5 1
C13 4 8 8 7 8 2 2 18 18 12 9 11 **** 1084 1522 11 5 9 3 3 2 2 6 3 1 1 5 7 8 4 4 2
C14 23 39 44 25 17 29 27 29 52 26 27 35 11 **** 1306 938 17 0 4 4 4 4 9 1 3 6 6 7 5 4 4 2
E02 40 46 40 10 12 22 42 32 32 21 12 37 19 21 **** 263 368 32 0 3 5 4 8 3 2 4 9 3 3 4 3 3
E03 22 17 10 11 3 16 10 9 9 6 6 29 1 5 30 **** 201 79 3 4 2 3 2 3 2 3 5 0 6 3 1 3
E04 3 5 1 4 1 7 3 2 3 2 1 4 1 1 3 1 **** 32 7 2 2 3 3 1 3 2 2 4 1 3 3 2
E05 5 4 6 6 4 4 10 1 9 4 4 4 3 6 1 3 5 **** 710 1469 3 3 3 3 1 2 2 6 4 4 4 3
E06 2 2 2 5 4 3 3 2 1 1 4 2 2 2 2 3 1 3 **** 28 14 2 3 2 4 4 4 4 2 3 7 1
S01 2 4 7 2 0 4 3 0 3 3 2 2 4 2 2 3 4 5 2 **** 1183 1478 5 1 17 4 3 3 1 2 0 5
S02 13 19 25 10 6 17 19 16 19 10 11 14 8 19 16 5 8 2 4 2 **** 728 1262 1 2 6 6 4 3 4 1 1
S03 5 2 8 3 3 2 2 2 5 6 1 2 1 2 3 5 1 1 3 2 1 **** 645 735 5 1 1 2 3 2 3 4
S04 3 1 7 2 5 2 3 3 4 6 5 7 6 3 7 1 2 3 5 14 8 4 **** 836 1102 5 3 4 5 6 6 1
S06 1 4 3 2 2 4 4 5 3 1 2 3 5 2 3 1 2 3 2 1 1 2 4 **** 1264 1230 1 4 2 1 1 1
W01 14 14 12 10 25 20 10 4 24 14 12 17 4 28 10 7 3 5 2 2 10 4 5 2 **** 1197 1193 15 13 2 1 2
W02 6 2 7 7 3 5 2 4 6 5 7 5 4 6 3 4 4 3 1 4 3 3 3 3 4 **** 1002 1337 5 11 2 3
W03 5 4 3 11 7 6 2 5 1 5 6 3 1 6 5 4 6 2 4 1 7 1 2 5 8 9 **** 1155 1046 25 9 4
W04 5 2 4 9 0 1 4 5 2 3 3 3 4 7 5 3 2 3 1 3 3 2 0 1 4 7 14 **** 1004 620 11 2
W05 3 3 1 3 3 4 1 2 3 4 6 4 3 3 5 4 2 4 4 2 3 2 4 3 2 6 2 14 **** 1346 1416 2
W06 2 2 2 2 2 3 4 7 5 1 3 1 3 4 4 3 2 1 1 2 3 3 3 3 3 1 1 3 0 **** 6 24
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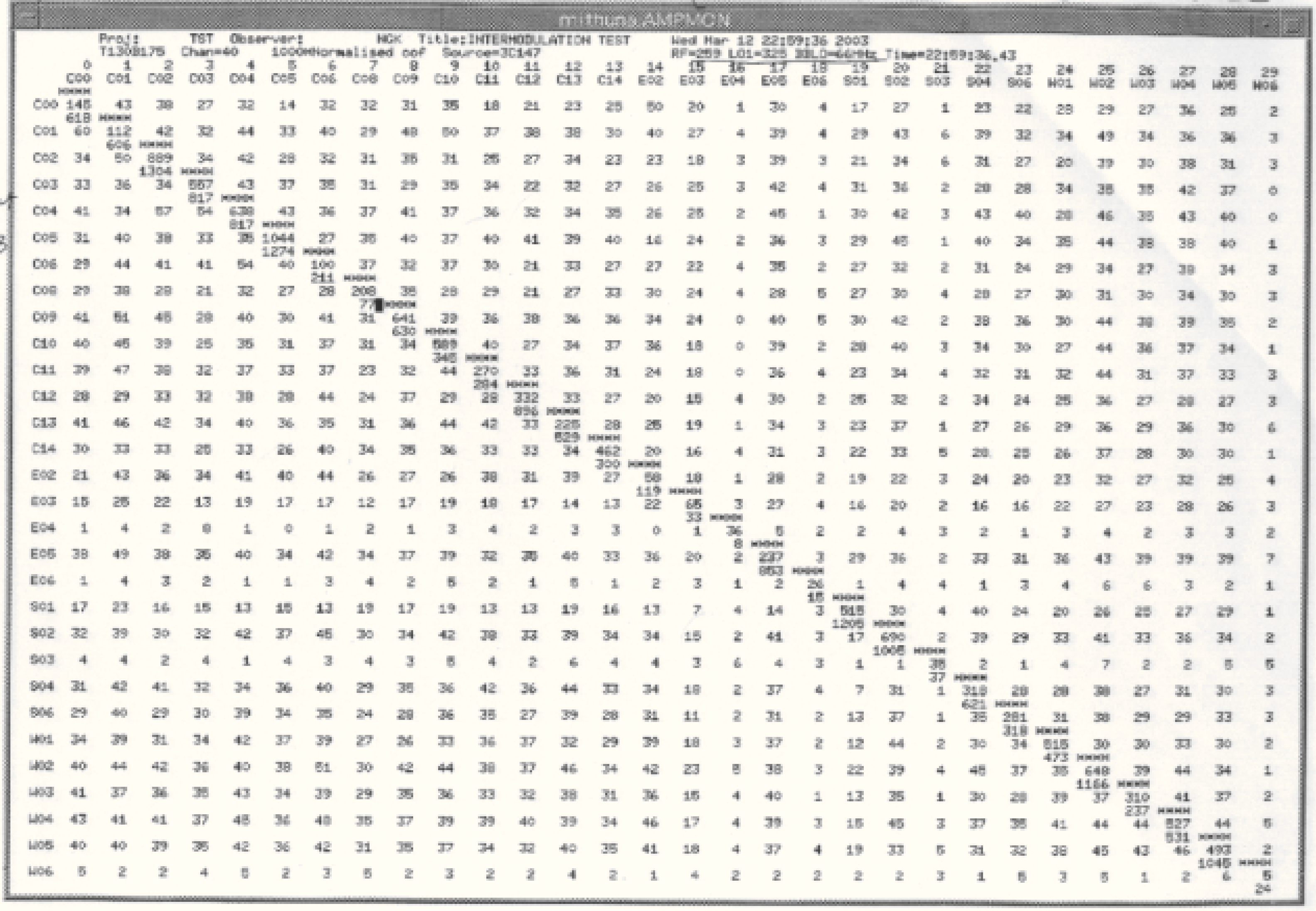
[259 - 251]

ON-source

sensitiv
↓
~3dB



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         0     1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20    21    22    23    24    25    26    27    28    29
       C00   C01   C02   C03   C04   C05   C06   C08   C09   C10   C11   C12   C13   C14   E02   E03   E04   E05   E06   S01   S02   S03   S04   S06   W01   W02   W03   W04   W05   W06
     *****
C00    145    43    38    27    32    14    32    32    31    35    18    21    23    25    50    20     1    30     4    17    27     1    23    22    23    29    27    36    25     2
       618 *****
C01     60   112    42    32    44    33    40    29    48    50    37    38    38    30    40    27     4    39     4    29    43     6    39    32    34    49    34    36    36     3
             606 *****
C02     34    50   889    34    42    28    32    31    35    31    25    27    34    23    23    18     3    39     3    21    34     6    31    27    20    39    30    38    31     3
                  1304 *****
C03     33    36    34   557    43    37    38    31    29    35    34    22    32    27    26    25     3    42     4    31    36     2    28    28    34    35    35    42    37     0
                         817 *****
C04     41    34    57    54   638    43    36    37    41    37    36    32    34    35    26    25     2    45     1    30    42     3    43    40    28    46    35    43    40     0
                               817 *****
C05     31    40    38    33    35  1044    27    35    40    37    40    41    39    40    16    24     2    36     3    29    45     1    40    34    35    44    38    38    40     1
                                    1274 *****
C06     29    44    41    41    54    40   100    37    32    37    30    21    33    27    27    22     4    38     2    27    32     2    31    24    29    34    27    38    34     3
                                           211 *****
C08     29    38    29    21    32    27    28   208    35    28    29    21    27    33    30    24     4    28     5    27    30     4    28    27    30    31    30    34    30     3
                                                 77█*****
C09     41    51    45    28    40    30    41    31   641    39    36    38    36    36    34    24     0    40     5    30    42     2    38    36    30    44    38    39    35     2
                                                       630 *****
C10     40    45    39    25    35    31    37    31    34   589    40    27    34    37    36    18     0    39     2    28    40     3    34    30    27    44    36    37    34     1
                                                             345 *****
C11     39    47    38    32    37    33    37    23    32    44   270    33    36    31    24    18     0    36     4    23    34     4    32    31    32    44    31    37    33     3
                                                                   284 *****
C12     28    29    33    32    38    28    44    24    37    29    28   332    33    27    20    15     4    30     2    25    32     2    34    24    25    36    27    28    27     3
                                                                         856 *****
C13     41    46    42    34    40    36    35    31    36    44    42    33   225    28    25    19     1    34     3    23    37     1    27    26    29    36    29    36    30     6
                                                                               829 *****
C14     30    33    33    25    33    26    40    34    35    36    33    33    34   462    20    16     4    31     3    22    33     5    28    25    26    37    28    30    30     1
                                                                                     300 *****
E02     21    43    36    34    41    40    44    26    27    26    38    31    39    27    58    18     1    28     2    19    22     3    24    20    23    32    27    32    25     4
                                                                                           119 *****
E03     15    25    22    13    19    17    17    12    17    19    18    17    14    13    22    65     3    27     4    16    20     2    16    16    22    27    23    28    26     3
                                                                                                  33 *****
E04      1     4     2     0     1     0     1     2     1     3     4     2     3     3     0     1    36     5     2     2     4     3     2     1     3     4     2     3     3     2
                                                                                                         8 *****
E05     38    49    38    35    40    34    42    34    37    39    32    35    40    33    36    20     2   237     3    29    36     2    33    31    36    43    39    39    39     7
                                                                                                             853 *****
E06      1     4     3     2     1     1     3     4     2     5     2     1     5     1     2     3     1     2    26     1     4     4     1     3     4     6     6     3     2     1
                                                                                                                  15 *****
S01     17    23    16    15    13    15    13    19    17    19    13    13    19    16    13     7     4    14     3   515    30     4    40    24    20    26    25    27    29     1
                                                                                                                    1205 *****
S02     32    39    30    32    42    37    45    30    34    42    38    33    39    34    34    15     2    41     3    17   690     2    39    29    33    41    33    36    34     2
                                                                                                                          1065 *****
S03      4     4     2     4     1     4     3     4     3     5     4     2     6     4     4     3     6     4     3     1     1    38     2     1     4     7     2     2     5     5
                                                                                                                                  37 *****
S04     31    42    41    32    34    36    40    29    35    36    42    36    44    33    34    18     2    37     4     7    31     1   318    28    28    38    27    31    30     3
                                                                                                                                       621 *****
S06     29    40    29    30    39    34    35    24    28    36    35    27    39    28    31    11     2    31     2    13    37     1    35   281    31    38    29    29    33     3
                                                                                                                                             318 *****
W01     34    39    31    34    42    37    39    27    26    33    36    37    32    29    39    18     3    37     2    12    44     2    30    34   515    30    30    33    30     2
                                                                                                                                                   473 *****
W02     40    44    42    36    40    38    51    30    42    44    38    37    46    34    42    23     5    38     3    22    39     4    45    37    35   648    39    44    34     1
                                                                                                                                                        1166 *****
W03     41    37    36    35    43    34    39    29    35    36    33    32    38    31    36    15     4    40     1    13    35     1    30    28    39    37   310    41    37     2
                                                                                                                                                               237 *****
W04     43    41    41    37    45    36    48    35    37    39    39    40    39    34    46    17     4    39     3    15    45     3    37    38    41    44    44   527    44     5
                                                                                                                                                                     531 *****
W05     40    40    39    35    42    36    42    31    35    37    34    32    40    35    41    18     4    37     4    19    33     5    31    32    38    45    42    46   493     2
                                                                                                                                                                          1045 *****
W06      5     2     2     4     5     2     3     5     2     3     2     2     4     2     1     4     2     2     2     2     2     3     1     5     3     5     1     2     6     5
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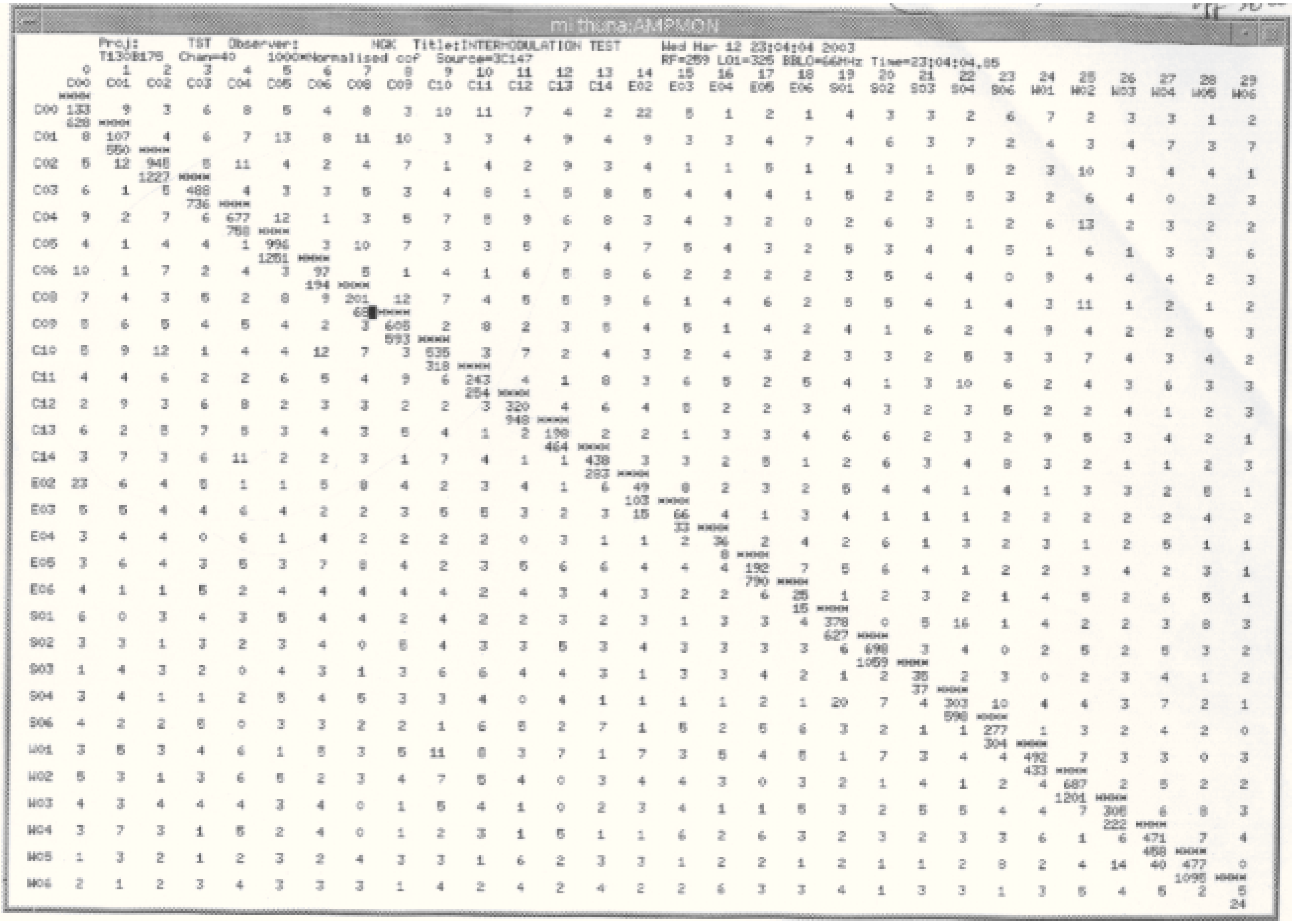

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       T1308175  Chan=40    1000*Normalised cof  Source=3C147              RF=259 LO1=325 BBLO=66MHz Time=23:04:04.85
       0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25   26   27   28   29
     C00  C01  C02  C03  C04  C05  C06  C08  C09  C10  C11  C12  C13  C14  E02  E03  E04  E05  E06  S01  S02  S03  S04  S06  W01  W02  W03  W04  W05  W06
    ****
C00  133    9    3    6    8    5    4    8    3   10   11    7    4    2   22    5    1    2    1    4    3    3    2    6    7    2    3    3    1    2
     628 ****
C01    8  107    4    6    7   13    8   11   10    3    3    4    9    4    9    3    3    4    7    4    6    3    7    2    4    3    4    7    3    7
          550 ****
C02    5   12  948    5   11    4    2    4    7    1    4    2    9    3    4    1    1    5    1    1    3    1    5    2    3   10    3    4    4    1
              1227 ****
C03    6    1    5  488    4    3    3    5    3    4    8    1    5    8    5    4    4    4    1    5    2    2    5    3    2    6    4    0    2    3
                    736 ****
C04    9    2    7    6  677   12    1    3    5    7    5    9    6    8    3    4    3    2    0    2    6    3    1    2    6   13    2    3    2    2
                         758 ****
C05    4    1    4    4    1  996    3   10    7    3    3    5    7    4    7    5    4    3    2    5    3    4    4    5    1    6    1    3    3    6
                             1251 ****
C06   10    1    7    2    4    3   97    5    1    4    1    6    5    8    6    2    2    2    2    3    5    4    4    0    9    4    4    4    2    3
                                   194 ****
C08    7    4    3    5    2    8    9  201   12    7    4    5    5    9    6    1    4    6    2    5    5    4    1    4    3   11    1    2    1    2
                                        68█****
C09    5    6    5    4    5    4    2    3  605    2    8    2    3    5    4    5    1    4    2    4    1    6    2    4    9    4    2    2    5    3
                                             593 ****
C10    5    9   12    1    4    4   12    7    3  535    3    7    2    4    3    2    4    3    2    3    3    2    5    3    3    7    4    3    4    2
                                                  318 ****
C11    4    4    6    2    2    6    5    4    9    6  243    4    1    8    3    6    5    2    5    4    1    3   10    6    2    4    3    6    3    3
                                                       254 ****
C12    2    9    3    6    8    2    3    3    2    2    3  320    4    6    4    5    2    2    3    4    3    2    3    5    2    2    4    1    2    3
                                                            948 ****
C13    6    2    5    7    5    3    4    3    5    4    1    2  198    2    2    1    3    3    4    6    6    2    3    2    9    5    3    4    2    1
                                                                 464 ****
C14    3    7    3    6   11    2    2    3    1    7    4    1    1  438    3    3    2    5    1    2    6    3    4    8    3    2    1    1    2    3
                                                                      283 ****
E02   23    6    4    5    1    1    5    8    4    2    3    4    1    6   49    8    2    3    2    5    4    4    1    4    1    3    3    2    8    1
                                                                           103 ****
E03    5    5    4    4    6    4    2    2    3    5    5    3    2    3   15   66    4    1    3    4    1    1    1    2    2    2    2    2    4    2
                                                                                 33 ****
E04    3    4    4    0    6    1    4    2    2    2    2    0    3    1    1    2   36    2    4    2    6    1    3    2    3    1    2    5    1    1
                                                                                       8 ****
E05    3    6    4    3    5    3    7    8    4    2    3    5    6    6    4    4    4  192    7    5    6    4    1    2    2    3    4    2    3    1
                                                                                         790 ****
E06    4    1    1    5    2    4    4    4    4    4    2    4    3    4    3    2    2    6   28    1    2    3    2    1    4    5    2    6    5    1
                                                                                               15 ****
S01    6    0    3    4    3    5    4    4    2    4    2    2    3    2    3    1    3    3    4  378    0    5   16    1    4    2    2    3    8    3
                                                                                                   627 ****
S02    3    3    1    3    2    3    4    0    5    4    3    3    5    3    4    3    3    3    3    6  698    3    4    0    2    5    2    5    3    2
                                                                                                       1059 ****
S03    1    4    3    2    0    4    3    1    3    6    6    4    4    3    1    3    3    4    2    1    2   38    2    3    0    2    3    4    1    2
                                                                                                               37 ****
S04    3    4    1    1    2    5    4    5    3    3    4    0    4    1    1    1    1    2    1   29    7    4  303   10    4    4    3    7    2    1
                                                                                                                   598 ****
S06    4    2    2    5    0    3    3    2    2    1    6    5    2    7    1    5    2    5    6    3    2    1    1  277    1    3    2    4    2    0
                                                                                                                        304 ****
W01    3    5    3    4    6    1    5    3    5   11    8    3    7    1    7    3    5    4    5    1    7    3    4    4  492    7    3    3    0    3
                                                                                                                             433 ****
W02    5    3    1    3    6    5    2    3    4    7    5    4    0    3    4    4    3    0    3    2    1    4    1    2    4  687    2    5    2    2
                                                                                                                                 1201 ****
W03    4    3    4    4    4    3    4    0    1    5    4    1    0    2    3    4    1    1    5    3    2    5    5    4    4    7  308    6    8    3
                                                                                                                                       222 ****
W04    3    7    3    1    5    2    4    0    1    2    3    1    5    1    1    6    2    6    3    2    3    2    3    3    6    1    6  471    7    4
                                                                                                                                            458 ****
W05    1    3    2    1    2    3    2    4    3    3    1    6    2    3    3    1    2    2    1    2    1    1    2    8    2    4   14   40  477    0
                                                                                                                                                1095 ****
W06    2    1    2    3    4    3    3    3    1    4    2    4    2    4    2    2    6    3    3    4    1    3    3    1    3    5    4    5    2    5
                                                                                                                                                        24
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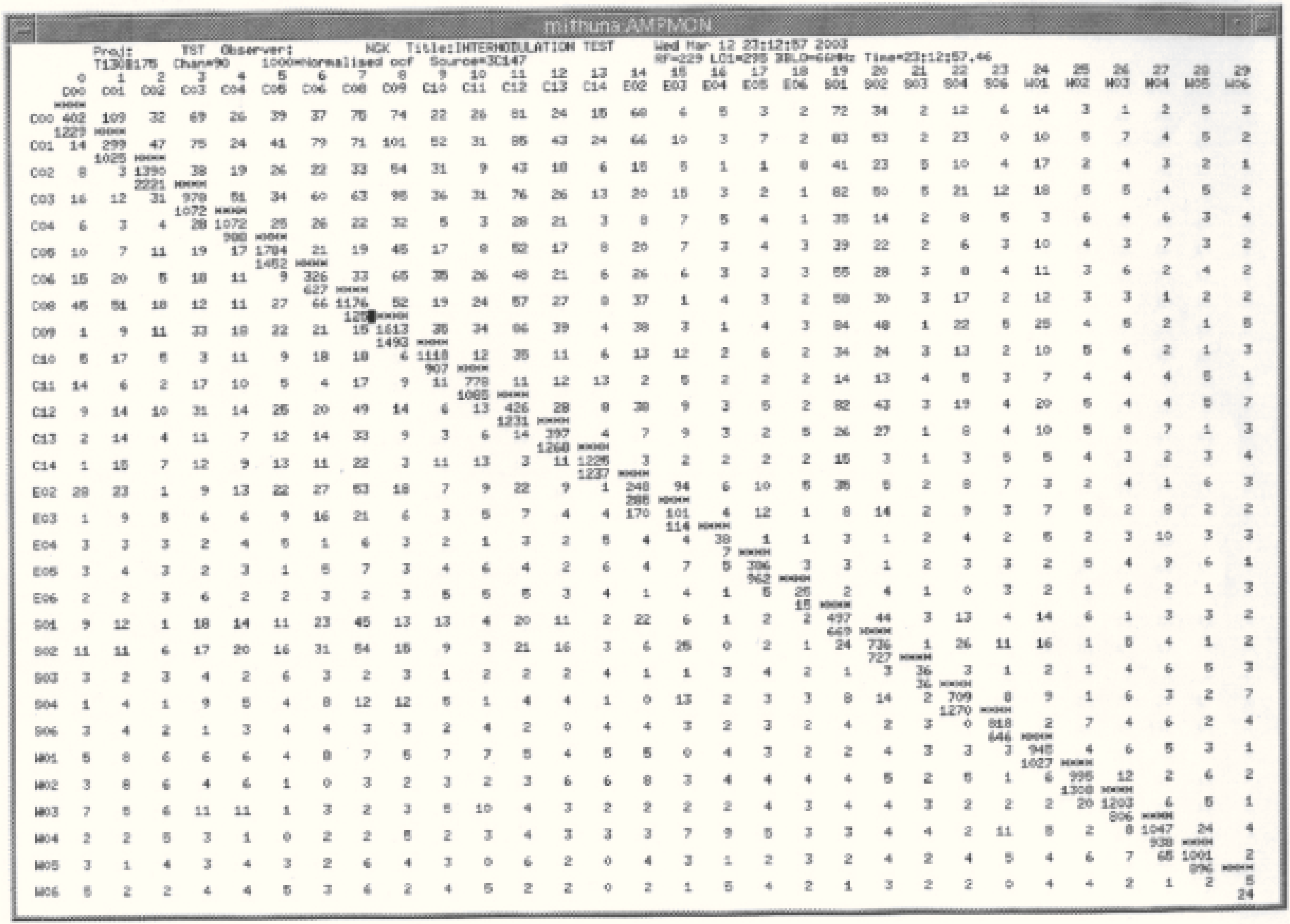
rf source 229 - 221 MHz LOI = 295 MHz



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         T130B175  Chan=90      1000=normalised ocf  Source=3C147                  RF=229 LO1=295 BBLO=66MHz  Time=23:12:57.46
        0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25   26   27   28   29
      C00  C01  C02  C03  C04  C05  C06  C08  C09  C10  C11  C12  C13  C14  E02  E03  E04  E05  E06  S01  S02  S03  S04  S06  W01  W02  W03  W04  W05  W06
    ****
C00  402  109   32   69   26   39   37   78   74   22   26   81   24   15   60    6    5    3    2   72   34    2   12    6   14    3    1    2    5    3
    1229 ****
C01   14  299   47   75   24   41   79   71  101   52   31   85   43   24   66   10    3    7    2   83   53    2   23    0   10    5    7    4    5    2
         1025 ****
C02    8    3 1390   38   19   26   22   33   54   31    9   43   18    6   15    5    1    1    8   41   23    5   10    4   17    2    4    3    2    1
              2221 ****
C03   16   12   31  979   81   34   60   63   98   36   31   76   26   13   20   15    3    2    1   82   80    5   21   12   18    5    5    4    5    2
                   1072 ****
C04    6    3    4   28 1072   25   26   22   32    5    3   28   21    3    8    7    5    4    1   35   14    2    8    5    3    6    4    6    3    4
                         988 ****
C05   10    7   11   19   17 1784   21   19   45   17    8   52   17    8   20    7    3    4    3   39   22    2    6    3   10    4    3    7    3    2
                             1452 ****
C06   15   20    5   18   11    9  326   33   65   35   26   48   21    6   26    6    3    3    3   55   28    3    8    4   11    3    6    2    4    2
                                   627 ****
C08   45   51   18   12   11   27   66 1176   52   19   24   57   27    8   37    1    4    3    2   58   30    3   17    2   12    3    3    1    2    2
                                       125█ ****
C09    1    9   11   33   18   22   21   15 1613   28   34   86   39    4   38    3    1    4    3   84   48    1   22    5   25    4    5    2    1    5
                                            1493 ****
C10    5   17    5    3   11    9   18   18    6 1118   12   35   11    6   13   12    2    6    2   34   24    3   13    2   10    5    6    2    1    3
                                                  907 ****
C11   14    6    2   17   10    5    4   17    9   11  778   11   12   13    2    5    2    2    2   14   13    4    5    3    7    4    4    4    5    1
                                                      1085 ****
C12    9   14   10   31   14   25   20   49   14    6   13  426   28    8   38    9    3    5    2   82   43    3   19    4   20    5    4    4    5    7
                                                           1231 ****
C13    2   14    4   11    7   12   14   33    9    3    6   14  397    4    7    9    3    2    5   26   27    1    8    4   10    5    8    7    1    3
                                                                1268 ****
C14    1   15    7   12    9   13   11   22    3   11   13    3   11 1225    3    2    2    2    2   15    3    1    3    5    5    4    3    2    3    4
                                                                     1237 ****
E02   28   23    1    9   13   22   27   53   18    7    9   22    9    1  248   94    6   10    5   35    5    2    8    7    3    2    4    1    6    3
                                                                           288 ****
E03    1    9    5    6    6    9   16   21    6    3    5    7    4    4  170  101    4   12    1    8   14    2    9    3    7    5    2    8    2    2
                                                                                114 ****
E04    3    3    3    2    4    5    1    6    3    2    1    3    2    5    4    4   38    1    1    3    1    2    4    2    5    2    3   10    3    3
                                                                                       7 ****
E05    3    4    3    2    3    1    5    7    3    4    6    4    2    6    4    7    5  396    3    3    1    2    3    3    2    5    4    9    6    1
                                                                                          962 ****
E06    2    2    3    6    2    2    3    2    3    5    5    5    3    4    1    4    1    5   25    2    4    1    0    3    2    1    6    2    1    3
                                                                                                15 ****
S01    9   12    1   18   14   11   23   45   13   13    4   20   11    2   22    6    1    2    2  497   44    3   13    4   14    6    1    3    3    2
                                                                                                    669 ****
S02   11   11    6   17   20   16   31   54   18    9    3   21   16    3    6   25    0    2    1   24  736    1   26   11   16    1    5    4    1    2
                                                                                                         727 ****
S03    3    2    3    4    2    6    3    2    3    1    2    2    2    4    1    1    3    4    2    1    3   36    3    1    2    1    4    6    5    3
                                                                                                               36 ****
S04    1    4    1    9    5    4    8   12   12    5    1    4    4    1    0   13    2    3    3    8   14    2  709    8    9    1    6    3    2    7
                                                                                                                  1270 ****
S06    3    4    2    1    3    4    4    3    3    2    4    2    0    4    4    3    2    3    2    4    2    3    0  818    2    7    4    6    2    4
                                                                                                                        646 ****
W01    5    8    6    6    6    4    8    7    5    7    7    5    4    5    5    0    4    3    2    2    4    3    3    3  948    4    6    5    3    1
                                                                                                                            1027 ****
W02    3    8    6    4    6    1    0    3    2    3    2    3    6    6    8    3    4    4    4    4    5    2    5    1    6  995   12    2    6    2
                                                                                                                                 1308 ****
W03    7    5    6   11   11    1    3    2    3    5   10    4    3    2    2    2    2    4    3    4    4    3    2    2    2   20 1203    6    5    1
                                                                                                                                       806 ****
W04    2    2    5    3    1    0    2    2    5    2    3    4    3    3    3    7    9    5    3    3    4    4    2   11    5    2    8 1047   24    4
                                                                                                                                            938 ****
W05    3    1    4    3    4    3    2    6    4    3    0    6    2    0    4    3    1    2    3    2    4    2    4    5    4    6    7   68 1001    2
                                                                                                                                                 996 ****
W06    5    2    2    4    4    5    3    6    2    4    5    2    2    0    2    1    5    4    2    1    3    2    2    0    4    4    2    1    2    5
                                                                                                                                                       24
```
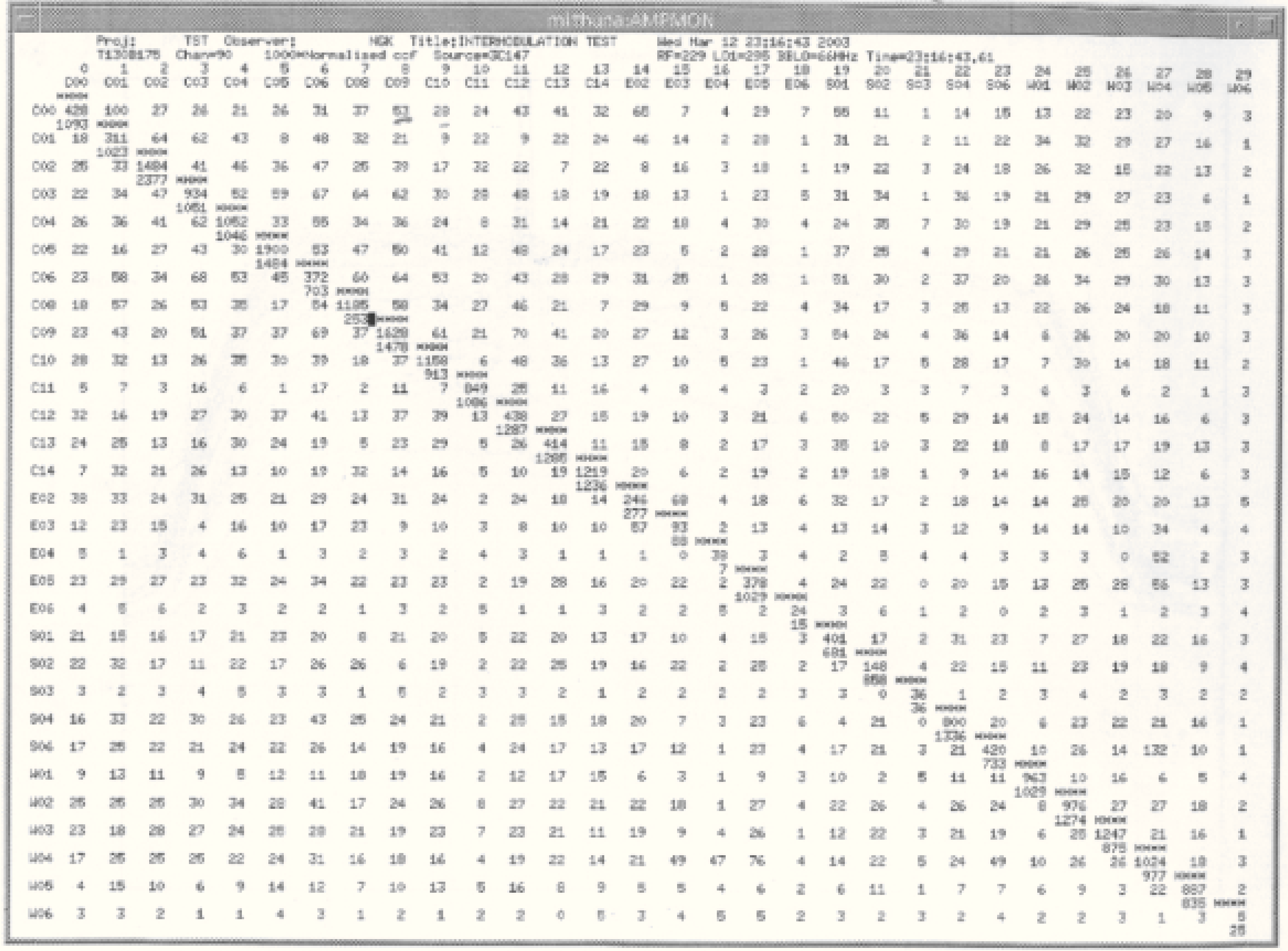

ch30 ~70%.   ch90 → ~$\overset{5dB}{3}$dB ↓   (229-221) MHz   on-source



```
    Proj:      TST  Observer:        NGK  Title:INTERMODULATION TEST      Wed Mar 12 23:16:43 2003
    T1308175  Chan=90    1000*Normalised ccf  Source=3C147                RF=229 LO1=295 BBLO=66MHz  Time=23:16:43,61
       0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20   21   22   23   24   25   26   27   28   29
     C00  C01  C02  C03  C04  C05  C06  C08  C09  C10  C11  C12  C13  C14  E02  E03  E04  E05  E06  S01  S02  S03  S04  S06  W01  W02  W03  W04  W05  W06
   *****
C00  428  100   27   26   21   26   31   37   53   29   24   43   41   32   68    7    4   29    7   58   11    1   14   15   13   22   23   20    9    3
    1093*****
C01   18  311   64   62   43    8   48   32   21    9   22    9   22   24   46   14    2   28    1   31   21    2   11   22   34   32   29   27   16    1
         1023*****
C02   28   33 1484   41   46   36   47   28   39   17   32   22    7   22    8   16    3   18    1   19   22    3   24   18   26   32   18   22   13    2
              2377*****
C03   22   34   47  934   52   59   67   64   62   30   28   48   18   19   18   13    1   23    5   31   34    1   36   19   21   29   27   23    6    1
                   1051*****
C04   26   36   41   62 1062   33   55   34   36   24    8   31   14   21   22   18    4   30    4   24   38    7   30   19   21   29   28   23   15    2
                        1046*****
C05   22   16   27   43   30 1900   53   47   50   41   12   48   24   17   23    5    2   28    1   37   28    4   29   21   21   26   28   26   14    3
                             1484*****
C06   23   58   34   68   53   45  372   60   64   53   20   43   28   29   31   28    1   28    1   51   30    2   37   20   28   34   29   30   13    3
                                   703*****
C08   18   57   26   53   38   17   54 1185   58   34   27   46   21    7   29    9    5   22    4   34   17    3   28   13   22   26   24   18   11    3
                                        253*****
C09   23   43   20   51   37   37   69   37 1628   41   21   70   41   20   27   12    3   26    3   54   24    4   36   14    6   26   20   20   10    3
                                            1478*****
C10   28   32   13   26   38   30   39   18   37 1158    6   48   36   13   27   10    5   23    1   46   17    5   28   17    7   30   14   18   11    2
                                                  913*****
C11    5    7    3   16    6    1   17    2   11    7  849   28   11   16    4    8    4    3    2   20    3    3    7    3    6    3    6    2    1    3
                                                     1086*****
C12   32   16   19   27   30   37   41   13   37   39   13  438   27   15   19   10    3   21    6   50   22    5   29   14   15   24   14   16    6    3
                                                          1287*****
C13   24   28   13   16   30   24   19    5   23   29    5   26  414   11   18    8    2   17    3   38   10    3   22   18    8   17   17   19   13    3
                                                               1288*****
C14    7   32   21   26   13   10   19   32   14   16    5   10   19 1219   20    6    2   19    2   19   18    1    9   14   16   14   15   12    6    3
                                                                    1236*****
E02   38   33   24   31   28   21   29   24   31   24    2   24   18   14  246   68    4   18    6   32   17    2   18   14   14   28   20   20   13    5
                                                                          277*****
E03   12   23   15    4   16   10   17   23    9   10    3    8   10   10   57   93    2   13    4   13   14    3   12    9   14   14   10   34    4    4
                                                                                88*****
E04    5    1    3    4    6    1    3    2    3    2    4    3    1    1    1    0   39    3    4    2    5    4    4    3    3    3    0   52    2    3
                                                                                     7*****
E05   23   29   27   23   32   24   34   22   23   23    2   19   28   16   20   22    2  378    4   24   22    0   20   15   13   28   28   56   13    3
                                                                                      1029*****
E06    4    5    6    2    3    2    2    1    3    2    5    1    1    3    2    2    5    2   24    3    6    1    2    0    2    3    1    2    3    4
                                                                                             15*****
S01   21   15   16   17   21   23   20    8   21   20    5   22   20   13   17   10    4   15    3  401   17    2   31   23    7   27   18   22   16    3
                                                                                                 681*****
S02   22   32   17   11   22   17   26   26    6   19    2   22   28   19   16   22    2   28    2   17  148    4   22   15   11   23   19   18    9    4
                                                                                                      858*****
S03    3    2    3    4    5    3    3    1    5    2    3    3    2    1    2    2    2    2    3    3    0   36    1    2    3    4    2    3    2    2
                                                                                                            36*****
S04   16   33   22   30   26   23   43   28   24   21    2   28   15   18   20    7    3   23    6    4   21    0  800   20    6   23   22   21   16    1
                                                                                                            1336*****
S06   17   28   22   21   24   22   26   14   19   16    4   24   17   13   17   12    1   23    4   17   21    3   21  420   10   26   14  132   10    1
                                                                                                                  733*****
W01    9   13   11    9    5   12   11   18   19   16    2   12   17   15    6    3    1    9    3   10    2    5   11   11  963   10   16    6    5    4
                                                                                                                      1029*****
W02   28   28   28   30   34   28   41   17   24   26    8   27   22   21   22   18    1   27    4   22   26    4   26   24    8  976   27   27   18    2
                                                                                                                           1274*****
W03   23   18   28   27   24   28   28   21   19   23    7   23   21   11   19    9    4   26    1   12   22    3   21   19    6   28 1247   21   16    1
                                                                                                                                 875*****
W04   17   28   28   28   22   24   31   16   18   16    4   19   22   14   21   49   47   76    4   14   22    5   24   49   10   26   26 1024   18    3
                                                                                                                                      977*****
W05    4   15   10    6    9   14   12    7   10   13    5   16    8    9    5    5    4    6    2    6   11    1    7    7    6    9    3   22  887    2
                                                                                                                                           835*****
W06    3    3    2    1    1    4    3    1    2    1    2    2    0    5    3    4    5    5    2    3    2    3    2    4    2    2    3    1    3    5
                                                                                                                                                 28
```