All maps were observed with an integration time of 0.5 s per pixel and a pixelsize of 15".

1) Calculations from point source measurements

8 point sources were mapped as calibration maps with a mapsize of 8' x 8' and 1 beam pattern on the source 3C84 with a mapsize of 12' x 12'.

a) Gainfactors referenced to channel 1, calculated with 9 observations of four different point sources.

<table>
<thead>
<tr>
<th>SCAN</th>
<th>SOURCE</th>
<th>CHAN 1</th>
<th>CHAN 2</th>
<th>CHAN 3</th>
<th>CHAN 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0968</td>
<td>NGC7027</td>
<td>1.000</td>
<td>1.068</td>
<td>0.983</td>
<td>0.903</td>
</tr>
<tr>
<td>0970</td>
<td>NGC7027</td>
<td>1.000</td>
<td>1.060</td>
<td>0.963</td>
<td>0.872</td>
</tr>
<tr>
<td>0971</td>
<td>NGC7027</td>
<td>1.000</td>
<td>1.062</td>
<td>0.955</td>
<td>0.881</td>
</tr>
<tr>
<td>0986</td>
<td>3C138</td>
<td>1.000</td>
<td>1.086</td>
<td>1.006</td>
<td>0.913</td>
</tr>
<tr>
<td>0991</td>
<td>3C138</td>
<td>1.000</td>
<td>1.049</td>
<td>0.985</td>
<td>0.886</td>
</tr>
<tr>
<td>0995</td>
<td>3C138</td>
<td>1.000</td>
<td>1.051</td>
<td>0.969</td>
<td>0.900</td>
</tr>
<tr>
<td>0999</td>
<td>3C84</td>
<td>1.000</td>
<td>1.087</td>
<td>0.990</td>
<td>0.909</td>
</tr>
<tr>
<td>1002</td>
<td>3C84</td>
<td>1.000</td>
<td>1.071</td>
<td>0.981</td>
<td>0.893</td>
</tr>
<tr>
<td>1006</td>
<td>3C286</td>
<td>1.000</td>
<td>1.095</td>
<td>0.981</td>
<td>0.891</td>
</tr>
</tbody>
</table>

mean value 1.000  1.070  0.979  0.894
error - 0.005  0.005  0.004

The deviations from the calculated mean value are lower than 3% in all channels, so that we can say that the gain factors are quite stable.

b) omegaB [sr] calculated with 7 observations of four point sources.

<table>
<thead>
<tr>
<th>SCAN</th>
<th>SOURCE</th>
<th>omegaB [1e-8 sr]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0968</td>
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<tr>
<td>0986</td>
<td>3C138</td>
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<tr>
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<td>3C138</td>
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<tr>
<td>0995</td>
<td>3C138</td>
<td>7.7408</td>
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<tr>
<td>0999</td>
<td>3C84</td>
<td>7.9222</td>
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<tr>
<td>1002</td>
<td>3C84</td>
<td>7.8501</td>
</tr>
<tr>
<td>1006</td>
<td>3C286</td>
<td>7.6861</td>
</tr>
</tbody>
</table>

mean value 7.717
error 0.021

All these observations have been made at elevation angles in the range from 38 to 55 degrees, so that we can neglect any effect of dependence on elevation.

c) Calculation of TB/S

\[ \frac{TB}{S} = \frac{\lambda^2}{\omega B \cdot \lambda^2 \cdot k} \]

\[ \lambda \text{ : wavelength} \]
\[ k \text{ : Boltzmann constant} \]

with

\[ \lambda = 2 \text{ cm} \]
\[ \omega B = 7.717 \times 10^{-8} \text{ sr} +/- 0.021 \times 10^{-8} \text{ sr} \]
\[ k = 1.3806 \times 10^{-16} \text{ erg/K} \]

we get: \[ \frac{TB}{S} = 1.877 +/- 0.007 \text{ (TB[K], S[Jy])} \]
d) Factor to calibrate the flux in mJy/beam calculated with 7 observations of 3 point sources.

The following sources were used for the calibration:

NGC7027 : 6.16 Jy  
3C286  : 3.44 Jy  
3C138  : 1.62 Jy

<table>
<thead>
<tr>
<th>SCAN</th>
<th>SOURCE</th>
<th>FITVALUE</th>
<th>CALIBRATION FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0968</td>
<td>NGC7027</td>
<td>197936</td>
<td>0.0311</td>
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<tr>
<td>0970</td>
<td>NGC7027</td>
<td>203192</td>
<td>0.0303</td>
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<td>0971</td>
<td>NGC7027</td>
<td>200090</td>
<td>0.0308</td>
</tr>
<tr>
<td>0986</td>
<td>3C138</td>
<td>52420</td>
<td>0.0309</td>
</tr>
<tr>
<td>0991</td>
<td>3C138</td>
<td>52837</td>
<td>0.0307</td>
</tr>
<tr>
<td>0995</td>
<td>3C138</td>
<td>54562</td>
<td>0.0297</td>
</tr>
<tr>
<td>1006</td>
<td>3C286</td>
<td>112684</td>
<td>0.0306</td>
</tr>
</tbody>
</table>

mean value 0.0306  
error 0.0005

With TB/S = 1.877 we get a calibration factor of 0.0574 +/- 0.0011 to calibrate the flux in mJy.

e) The beam pattern observed on the source 3C84

Figure 1 shows the beam pattern observed around the source 3C84 at an elevation angle of 38 degrees. The flux of the source is about 24.1 +/- 0.5 Jy. The first side lobes are at 2 to 3% of the peak flux and the other structures are lower than 1%.

2) Noise estimation.

A small area in the sky around the star Betelgeuse with an expected flux of 8 mJy at 14.7 GHz with a size of 10' x 10' was mapped seven times. The maps of the different feeds were taken as independent coverages to get a good noise estimation for each feed.

After combining the different maps of each feed we get:

CH 1 : rms = 4.6 mJy => rms = 12.1 mJy per coverage  
CH 2 : rms = 6.7 mJy => rms = 17.8 mJy per coverage  
CH 3 : rms = 3.4 mJy => rms = 8.9 mJy per coverage  
CH 4 : rms = 4.3 mJy => rms = 11.3 mJy per coverage

After combining all 28 maps we get a noise of 2.85 mJy on the final map which leads to a mean value for the noise of 15.1 mJy per coverage.

Theoretically we would expect for the rms noise:

\[ \text{rms} = \frac{T_{sys}}{\eta_B} \times \sqrt{t \times BW} \]

with Tsys : System temperature (about 100 K)  
t : integration time per point (0.5 s)  
BW : bandwidth (1 GHz)  
TB/S : 1.877  
\eta_B : main - beam - efficiency = 0.67 (67%)

we get rms = 3.55 mJy per coverage which is significantly lower than the observed values.

Especially feed number two has a noise nearly as twice as high as the others. Several spikes are on all maps of this feed.

Figure 2 shows the final map of Betelgeuse. The flux of the central source is about 11 +/- 2 mJy.
3) Maps of extended sources.

Observations of two supernova remnants were made with a mapsizze of 16' x 16'. The results are on figure 3 (Tycho's SNR) and figure 4 (3C58).

The fluxes of the sources are:

Tycho : 11.0 +/- 0.6 Jy (expected : 10.9 Jy)
3C58 : 26.2 +/- 0.9 Jy (expected : 25.2 Jy)

4) results:

a) Calculated parameters:

gainfactors:
  CH1 : 1.000
  CH2 : 1.070 +/- 0.005
  CH3 : 0.979 +/- 0.005
  CH4 : 0.894 +/- 0.004

omegaB : 7.717e-8 +/- 0.021e-8 sr

TB/S : 1.877 +/- 0.007

calibration factors:
  0.0304 +/- 0.0003 (mJy/beam)
  0.0574 +/- 0.0011 (mK)

b) Problems:

- significantly higher noise than the theoretical one in all feed
- feed 2 has about twice the noise of the others and many spikes on all maps
- sense of the "Drehstand" rotation is wrong

Distribution:

Wielebinski, Zins, W. Reich, P. Reich, Lochner, Koch, Fuerst, Beck, Altenhoff, Kothes
Figures:

figure 1: mean beam pattern for all feed observed with the source 3C84 with an integrated flux of 24.1 Jy.
the contours are:
   50 mJy + n* 50 mJy for outer structures
   600 mJy + n* 200 mJy for first sidelobes
   5000 mJy + n*5000 mJy for the main lobe
   (n : 0...9)
the zero contour is shown dashed.

figure 2: final map of Betelgeuse after combining all 7 coverages.
smoothed to 1.5' resolution
The contours are: 2 mJy + n*2 mJy, n : 0...6
the zero contour is shown dashed

figure 3: Tycho's supernova remnant.
The contours are: 30 mJy + n*30 mJy, n : 0...9
the zero contour is shown dashed

figure 4: the supernova remnant 3C58
the contours are: 20 mJy, 50 mJy and
   100 mJy + n*100 mJy, n : 0...14
the zero contour is shown dashed