AT/39.3/074

CSIRO - Australia Telescope National Facility

The Tidbinbilla 34m Beam Waveguide Antenna:

Feeding arrangements, and operations at 4.8 to 6.8 GHz

1. *Introduction*

The general feeding layout for operation in the S- and X-bands (2.29 and 8.45 GHz) is first described, the impact on design philosophy for 4.8 to 6.8 GHz is alluded to, and recommendations made to progress the design.

2. *Current Feeding Design*

Fig 1 shows the feeding layout derived from [1]. Table 1 gives corresponding parameters for the mirrors and horns including those required for horn design and pattern calculation. The following aspects of the feeding layout design should be noted:

- The horn for Ka-band is at the focus of M5, but the departure from this optimum focal length increases as the frequency of each system decreases.
- In particular, the S-band system is compromised,
- The overall antenna performance has been optimised at each band through a detailed parameter study, but for our purposes, the horn design (aperture size, and hence horn phase-error factor Δ and phase centre) and its location are required.
- The normalised horn aperture size (d/λ) increases with frequency (a function of location). It is not known what the relationship between the normalised horn diameter and frequency for a given location is, but as a first approximation, it would appear reasonable to assume that d/λ would be independent of frequency.
- The semi-flare angle of horns have been maintained constant at 6.254°, a JPL "standard".

3. *Proposal for Consideration of the 4.8 to 6.8 GHz system*

It is proposed to use either one, or two hours located at the S-band position using a metal plate (ie non-diochroic) for M6 (size to be specified).

It is recommended that the Australian interested entities (ATNF, Tidbinbilla) meet to discuss alternative feed/receiver configurations (eg one horn and 2 receivers, or two horns with separate receivers).

Once it is agreed what configuration is required, JPL (Watt Veruttipong) be requested to use the JPL optimisation software to define the horn aperture diameter(s), mirror diameter (M6), and horn phase centre positions. It is proposed that the ATNF design and manufacture the horn(s) if no such horns are available.

References:

(1) JPL Deep Space Network Design Description Report: "RF design and expected performances of a 34m multi-frequency beam-waveguide antenna", TDA/DSN No. 890-261, 15 July 1994.
(2) W. Veruttipong, J.C. Chen and D.A. Bathker, "Gaussian Beam and Physical Optics Iteration Technique for Wideband Beam-Waveguide Feed Design, "TDA Progress Report 42-105, May 15, 1991, Jan-March, pp. 128-135.

Bruce MacA. Thomas.

Bruce MacA Thomas
22 October, 1997

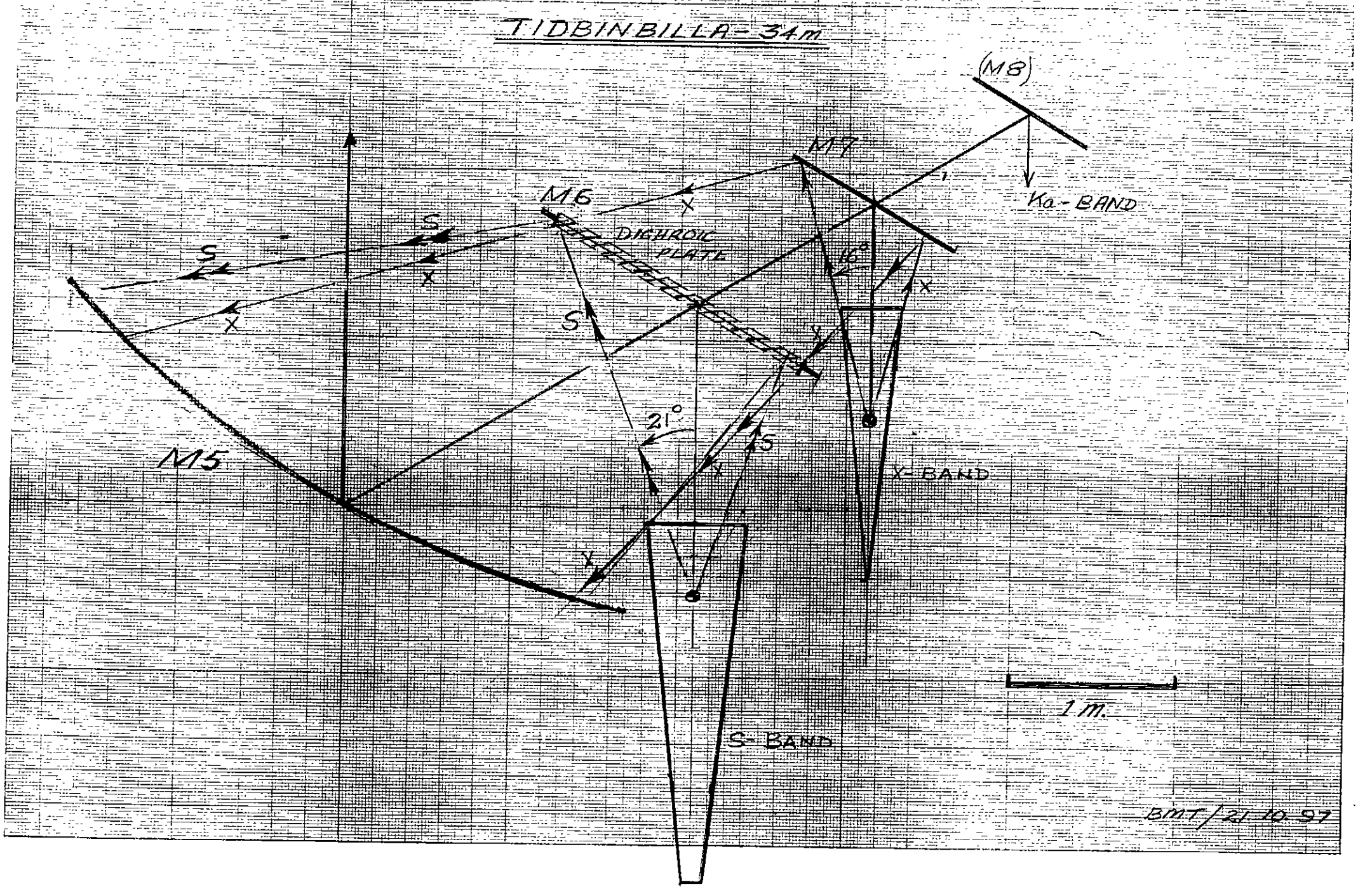
The Tidbinbilla 34m Antenna Beam Waveguide

System: Some typical parameters

Frequency (GHz)	Wavelength, λ (mm)	Distance from C.L. of M5 to phase centre of feed (mm)	Size of flat-plate mirror M6 or M7 (mm)	Horn inside dia, d(mm)	Horn aperture, d/λ	Horn phase error, Δ+	Edge taper, M5 (dB)	Spillover (dB)		
								M5	M6	M7/M8
2.295	130.7	4,107	1930 x 1575	597	4.57	0.125	-21	0.075	0.005	0.005
8.45	35.5	4,915	1118	356	10.0	0.274	-32	0.025	0.004	0.003
32.0	9.4	5,504*	?	173	18.4	?	-33	0.005	-	0.007

* Optimum distance

+ $\Delta = (d/2\lambda) \tan(\theta/2)$, where θ = semi-angle of horn ($\theta = 6.254°$)


TIDBINBILLA - 34m
(M8)
M7
M6
M5
Ka - BAND
DICHROIC PLATE
46°
21°
X - BAND
S - BAND
1 m.
BMT / 21. 10. 97