

Multi-horn feeds for cassegrain antennas.

With the steady improvements in tracking radar technologies over the past twenty years, the diameter requirements for the antennas has been reduced to match the improvements in transmitter power and receiver sensitivity. This has led to a need for shorter feeds for use in a cassegrain configurations.

Micro Metalsmiths has developed feeds for use at C-Band which are fabricated from its own cast waveguide components and optimised to tight phase characteristics. As a long standing manufacturer of monopulse comparators, the development of an antenna feed was the next logical step in the extension of the product range. The choice of horn design was crucial to achieving a compact feed design.

The first C-Band feed was developed for a 9-foot reflector and used a four-horn arrangement directly on the outputs of the comparator. This gave a small footprint to the feed which reduced blockage of the main reflector, however the beamwidths in the elevation and azimuth difference patterns were excessive resulting in high sidelobe levels.

The next generation feeds incorporated two auxiliary horns each in both the azimuth and elevation planes resulting in an eight-horn design. The sum pattern was un-affected by the new arrangement and gave similar performance to the earlier design. The delta patterns were significantly narrower giving reduced sidelobe levels, even though the footprint was increased.

Micro Metalsmith's compact comparator uses four waveguide tees connected via four extension waveguides to the central four horns. The overall waveguide section is tuned to achieve less than $\pm 1^\circ$ phase imbalance between ports. The C-Band version is capable of handling up to 1MW peak power at normal atmospheric pressure. It is designed for operation up to 30PSIA, and is recommended to be pressurised to maintain a dry atmosphere inside the waveguide. Sum, Elevation and Azimuth ports are provided as waveguide flanged interfaces. Isolation between any

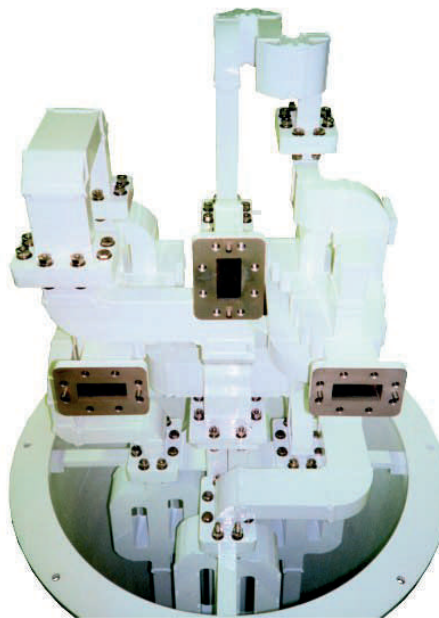
two ports is 35dB minimum. When fitted to an antenna Cross Polarisation ratios of 30dB minimum are achieved, and an Error channel Null stability of less than 0.1mil across the frequency range.

The auxiliary horns are connected to a power combiner network which includes the tees that are part of the central comparator. The two horizontal horns are combined with the azimuth signal from the comparator whilst the two vertical horns are combined with the elevation signal. All the interconnecting waveguide are phase matched during manufacture. A final test in an anechoic chamber allows the beam patterns from the main and auxiliary horns to be set coincident thus providing accurate combining to give the maximum possible null depth. When fitted to an antenna null depths of 35dB minimum are achieved with typical values greater than 50dB.

The first eight horn feeds used coaxial cables to connect the auxiliary horns to the power combiners. This resulted in a very compact feed, especially in the version fitted to the 8 feet reflectors.

Further development has replaced the cables by waveguides, which as well as giving a lower insertion loss, also provide better protection against the environment.

Although the earlier feeds were exclusively for C-Band operation, Micro Metalsmiths has developed versions for X-Band using its own range of precision investment castings. Compared to a multi-mode horn Micro Metalsmith's eight horn array is much shorter in overall length. This allows the C-band version to be fitted in antennas with reflector diameters down to 8 feet, without the comparator protruding too far behind the dish. When fitted into a 12 feet or 16 feet reflector extension waveguides are fitted to increase the overall feed length. These are used to improve the phase balance of the comparator, resulting in improved antenna performance.



Typical specification on next page ...



Typical Antenna Specification Using Micro Metalsmiths Monopulse Feed

Type

Cassegrain 3-channel monopulse

Diameter

5 meters/16 feet, effective

Frequency

5.4GHz to 5.9GHz

Polarization

Linear vertical

Beamwidth

$0.8^{\circ} \pm 1.1^{\circ}$ at the half power points

Gain

46dB minimum at 5.65GHz (measured at output of SUM Flange)
45dB minimum at 5.4GHz

Sum to Difference Gain

6.0dB maximum between the reference peak and the difference peak

Sidelobe (all below reference peak main lobe)

up to 10° off axis 18dB minimum
 10° to 30° off axis 26dB minimum
above 30° off axis 36dB minimum
(includes Sum and Difference patterns)

Cross Polarization Ratio

30dB minimum at boresight

VSWR

1.5:1 maximum for the Sum Port
1.7:1 maximum for the Difference Channels Ports

Isolation

35dB minimum, between any two ports

Depth of Null

Greater than 35dB

Pattern Symmetry

The difference patterns are symmetrical within ± 4 mils of the null & peak
Difference variation is no greater than 0.5dB

Waveguide Size

WR187. Sum, Azimuth and Elevation

