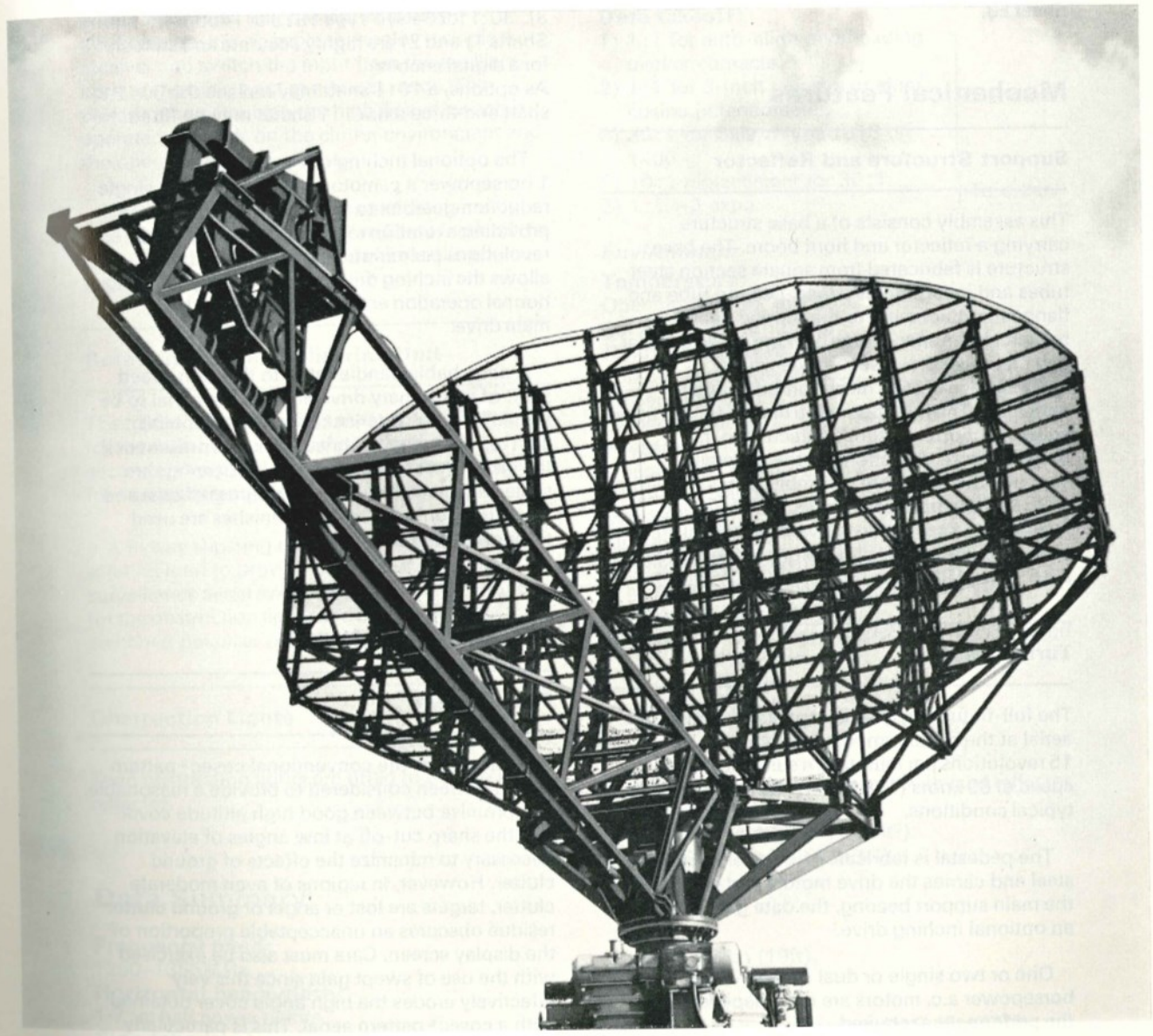
Marconi Radar Data Sheet A9

23cm L-Band Surveillance Aerial

Reflector size 32 feet by 19 feet
Type S1020–Double Curvature



Double-beam aerial for enhanced target to clutter ratio

Alternative versions for APP/TMA and TMA/En-route ATC applications

The Marconi Type S1020 is a double-curvature 23cm L-band aerial and turning gear covering the requirements for en route, terminal area and approach surveillance radars for civil and military ATC as part of Radar System Type S654. It incorporates a two-horn feed for reduction of ground clutter, and circular polarization for reduction of weather clutter. The S1020 is used with the Marconi 23cm L-band Transmitter/Receivers 2MW Type S2011 or 800kW Type S2021 which are fully described in Marconi Radar Data Sheet B2. Turning control is by Aerial Alternating Current Controller Type S6014, fully described in Marconi Radar Data Sheet E3.

Mechanical Features

Support Structure and Reflector

This assembly consists of a base structure carrying a reflector and horn boom. The base structure is fabricated from square section steel tubes and incorporates a load-bearing tube and flange for attachment to the turning gear. The reflector has a spaceframe backing of rectangular and triangular cross-section steel tube, and a surface of steel mesh carried by steel templates. The horn boom is a braced tripod, using square section steel tubes, attached to the base structure. A platform at the extremity supports the feed horn assembly, which is 7·28m (23ft 10in) in front of the reflector. Mounting facilities for a secondary surveillance aerial are provided. The overall dimensions of the reflector are 5·78m (19ft) high by 9·75m (32ft) wide.

Turning Gear

The full-fit turning gear is capable of driving the aerial at the maximum rotation rate of 15 revolutions per minute in a sustained wind speed of 80 knots (148 kilometres per hour) in typical conditions.

The pedestal is fabricated from welded mild steel and carries the drive motors and gearboxes, the main support bearing, the data gearbox and an optional inching drive.

One or two single or dual speed 20/40 horsepower a.c. motors are used depending on the performance required.

Each motor drives through a primary drive, using a single worm reduction, an intermediate drive using a single reduction gear, and a final drive, using a spur pinion meshing with a spur wheel on the aerial drive tube. Alternative ratios are used in the primary drive, to provide rotation rates of 5 and 10 revolutions per minute or 7·5 and 15 revolutions per minute, for either a 50 or 60 hertz power supply.

The main support assembly for the aerial drive tube consists of two pre-loaded taper roller bearings. Lubrication is provided for the main support bearings and intermediate drive by forced oil injection and for the primary and final drives by oil immersion. The sump is fitted with heaters and thermostats to maintain the oil at the correct operating temperature in cold climates.

The data gearbox is driven from the spur wheel on the aerial drive tube, through an anti-backlash pinion. The bearings are sealed for life.
Three output shafts are provided :

1) 1 :1 for auto-align and heading marker contacts
2) 1 :1 for 3-inch magslip or sine/cosine potentiometer
3) 30 :1 for Selsyn Type 1813 or 1406.

Shafts 1) and 2) are highly accurate and suitable for a digital encoder.
As options, a 10 : 1 shaft may replace the 30 : 1 shaft and three extra 1 : 1 shafts may be fitted.

The optional inching drive consists of a 1 horsepower a.c. motor driving through a single reduction gearbox to the main drive wheel, providing a rotation rate of approximately 0·3 revolutions per minute. A mechanical clutch allows the inching drive to be disengaged during normal operation and is interlocked with the main drive.

A detachable handle fitted to the high speed shaft of the primary drive enables the aerial to be turned by hand. Interlocks are fitted to inhibit start-up if adequate lubrication is not present or if the inching system is engaged. All bearings are sealed against oil leakage and ingress of dust and moisture. Corrosion resistant finishes are used throughout the equipment.

Electrical Features

Feed System

For many years the conventional cosec^2 pattern aerial has been considered to provide a reasonable compromise between good high altitude cover and the sharp cut-off at low angles of elevation necessary to minimize the effects of ground clutter. However, in regions of even moderate clutter, targets are lost or angel or ground clutter residue obscures an unacceptable proportion of the display screen. Care must also be exercised with the use of swept gain since this very effectively erodes the high angle cover obtained with a cosec^2 pattern aerial. This is particularly important as swept gain has been found to be the most effective device for removing clutter caused by angels. Reinforcement of the cosec^2 pattern at high angles of elevation, by modifying the reflector profile, has been tried, but it is uneconomic to take this to the point which adequately compensates for the effect of swept gain. The Company has fully investigated this method and found that the vertical aperture of the reflector is excessive if the desired cut-off at low angles is to be retained.

In the design of the S1020 aerial, the geometry of the reflector and feed is arranged to incorporate

a second feed horn below the main horn. If a receiver is connected to the second or auxiliary horn and the normal transmitter output applied to the main horn, the vertical polar pattern of the aerial is the combination of the individual one-way patterns of main and auxiliary horns. This composite pattern has an important characteristic; the change of gain in the region of zero to +3 degrees of elevation is significantly greater than the two-way pattern of the main horn. This means that a greatly improved target-to-angel and ground clutter ratio is obtained in a considerable proportion of the airspace within a radius of 30 miles from the radar. Since it is generally within this radius that the clutter is most troublesome, it is possible to employ a single receiver and switch the input from the auxiliary horn to the main horn at a preset range. The precise range at which the high-speed switch is operated depends on the clutter environment and the operational requirement.

Normally, circular polarizers are permanently incorporated in the main and auxiliary feeds of the aerial. As an option, switched circular/linear polarizers may be fitted.

Rotating Joint and Slip-ring Unit

The triple rotating joint has a waveguide path for the main horn, a coaxial path for the secondary horn and another coaxial connection for a secondary surveillance aerial.

A 6-way slip-ring unit is fitted below the rotating joint to provide paths for a secondary surveillance aerial switching pulse, connections for the obstruction lights and connections for the switched polarizer option.

Obstruction Lights

Twin obstruction lights are fitted to the top of the reflector.

Data Summary

Frequency band:
1250–1365MHz.
Horizontal beamwidth:
1·7° at half power points.
Side-lobe level:
−23dB with respect to main lobe.
Gain:
Main: 33·5dB.
Auxiliary: 31dB.
Polarization:
circular standard.
switched circular/linear to order.
VSWR:
1·5:1.
Tilt:
+2·0° to +4·0° (main beam peak) in 0·5° steps.

Turning Gear

Motors:
1) One or two 20/40 hp dual speed.
2) One or two 40 hp single speed.

Rotation rates:
Operational:
1) 5 and 10 rev/min.
2) 7·5 and 15 rev/min.

Inching: 0·3 rev/min.

Data takeoff:
1) 1:1 for auto-align and heading marker contacts.
2) 1:1 for 3-inch magslip or sine/cosine potentiometer.
3) 30:1 for Selsyn type 1813 or 1406.

} Standard.

1) 10:1 replacement for 30:1.
2) 1:1 −3 extra.

} To order.

Environment

Temperature:
Operational: −30° to +50°C.
Survival: −40° to +65°C.
Relative humidity:
100 per cent below 30°C.
53 per cent at 40°C.
32 per cent at 50°C.
Pressure:
Operational: 750mb.
Survival: 420mb.
Wind speed:
Operational:
dependent on speed of rotation and number of drive motors fitted. Typical figures for 380V operation at 30°C are—

Motors	*Aerial Speed rev/min.*	*Sustained Wind Speed (knots)*
1	10	73
	5	74
2	10	80
2	15	80

Survival: 227km/h (120knots) with iced reflector.
Ice coating:
Operational: 4·8kg/m² (1 lb/ft²).
Survival: 19·2kg/m² (4 lb/ft²).

Dimensions

Reflector:
Height: 5·78m (19ft).
Width: 9·75m (32ft).
Overall:
Height (from base of pedestal): 9·45m (31ft).
Width: 9·75m (32ft).
Depth (including feed assembly): 10·4m (34ft 3in).

Weight

including turning gear:
15800kg (34800lb).

The information given herein is subject to confirmation at the time of ordering.

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ISSUE 3

060673/1500+3500