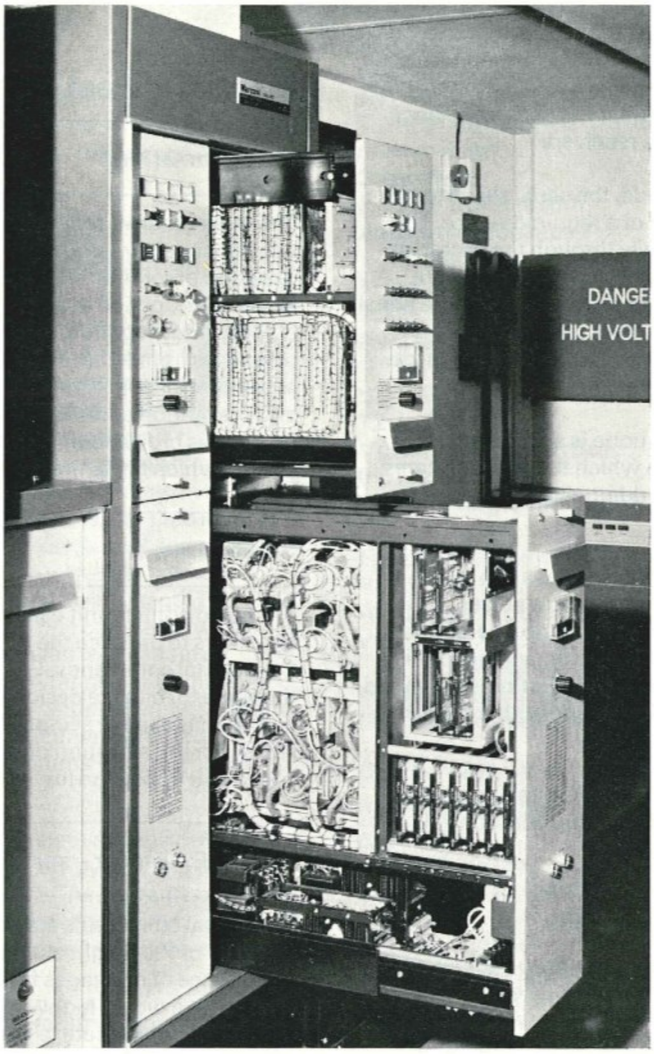
Marconi Radar Data Sheet E4

Height finder Servo Controller and Height Extractor Type S6013



Complete heightfinder aerial control, using solid state components

Digital command system

Fully automatic multiple height extraction

The Type S6013 equipment and ancillaries control the mode of movement in azimuth and elevation of a Type S1017 heightfinder aerial. An automatic height extractor provides elevation, centre-of-target and range correction data to an operations cabin, or to a data handling system.

Operational Modes

The heightfinder aerial may be controlled in four operational modes; normal, sector scan, volumetric scan and park.

In the normal mode, the aerial slews to a command bearing and performs a nod, the angle and velocity of which are appropriate to the target range as determined by the surveillance radar and the maximum height capability. This provides a number of pulse returns from a target proportional to target range. The sequence is performed once each time a command is received.

In the sector scan mode, the aerial slews to the counter-clockwise end of a required sector. The aerial then azicates slowly through the sector, at the same time nodding through a preset angle. When scanning of the sector is complete, the aerial repeats the sequence, unless commanded otherwise. In this way, the aerial can provide low rate surveillance facilities.

The volumetric scan mode is an extension of the sector scan mode in which the aerial azicates through 360°, while nodding through a preset angle.

In the park mode, the aerial slews to a preset azimuth bearing, then nods up to a preset elevation angle and stops where no operational or personnel hazard exists due to radiation. This action occurs automatically after a time-out period, whether the heightfinder is under either local or remote control.

All modes are controlled by digital messages from the operations cabin, or by local control.

Mechanical Features

The equipment consists of the main cabinet, an auxiliary rack and a resistor unit. The cabinet and rack are constructed of a steel framework, with an integral plinth, covered with polyvinylchloride-clad aluminium panels.

The cabinet is 1·680m (5ft 6in) high, by 584mm (1ft 11in) wide, by 654mm (2ft 1¾in) deep and weighs 182kg (400lb). The rack is 1·016m (3ft 4in) high, by 305mm (1ft) wide, by 648mm (2ft 1½in) deep and weighs 102kg (225lb). The resistor unit is 432 mm (1ft 5in) high, by 635mm (2ft 1in) wide, by 127mm (5in) deep and weighs 9·1kg (20lb).

The cabinet has four major compartments, the upper left housing the control and power unit, the lower left the azimuth servo and thyristor drive unit, the upper right the height extractor unit and the lower right the elevation servo and thyristor drive unit. The plinth houses input and output power controls.

The four major units are mounted on runners, so that they may be withdrawn for setting up and servicing, and they are retained in both the normal and servicing positions by spring latches. Access to the interior of the plinth is from the front by means of a hinge-down panel.

The ancillary rack houses an auto-transformer and the motor field control; the plinth houses input power controls.

The resistor unit houses two armature resistor assemblies, one for each drive, and it is normally wall mounted.

Electrical Features

Thyristor Drives

The thyristor drive for each motor employs two separate thyristor bridges, one for each direction of rotation. The direction and magnitude of the drive applied to a motor are governed by the polarity and magnitude of the control voltage. This originates from either a local control or from a servo control unit. Smooth regenerative braking and prevention of motor damage at sudden load increase is provided by a tachometer feedback system which limits the delivery of current.

Servo Control

The servo control unit uses solid state summing amplifiers to produce the thyristor control voltages from digital commands. For the azimuth drive, these are for either a designated position, continuous scan or sector scan with designated limits. For the elevation drive, these are amplitude, speed and upper and lower limit of nod.

Height Extractor – servo system channel

The digital commands are generated as part of the function of the height extractor unit. This receives a sequence of messages from the operations centre, via a digital highway, and produces a command appropriate to the mode of operation demanded, using wired logic of a standard integrated circuit type.

To obviate the need for mechanical alignment to refer the aerial to a chosen compass bearing, usually north, the data from the digital shaft encoder mounted on the aerial is corrected by means of a preset subtractor. The converted azimuth data is used in the servo system and for output to the display system in the volumetric scan mode.

Control and Power Unit

The control and power unit, under the control of interlocked relays and timers, switches and distributes three-phase and single-phase power to the sump heaters, the electronic units, the motor field supply and the thyristor drive in an ordered manner, dependent on the control settings.

Ancillary Rack

An auto-transformer is used to derive a 230V line three-phase supply for the forward and reverse thyristor bridges. The motor field control supplies direct current to the field windings of the azimuth and elevation drive motors.

Resistor Unit

Heavy duty armature resistors are fitted to provide additional current limiting to back-up the control circuits in the event of failure. Resistance mats are used to aid dissipation.

Height Extractor – height extraction channel

The angular position in elevation of the heightfinder aerial is given by the summed output of a precision potentiometer and a vertical reference unit. This analogue voltage is first converted to digital form by sampling at the transmitter pulse recurrence frequency. In order to compensate for the finite processing time involved in subsequent stages, a delay is imposed on this data, dependent on the target range, before it is passed to the elevation processing stage. The received video returns are first compared with a threshold, which is controlled to maintain a constant false alarm rate. A range gate 4 miles in length and centred on the range determined by the tracking operator from the surveillance radar is used to load into a store returns that exceed the threshold.

The range of the target relative to the height finder is measured accurately by dividing the store into ¼ mile range elements. The contents of the store are compared with the returns from subsequent radar periods to establish the presence of a target.

The centre of the target returns is found by extracting the angles for the start and finish of the pulse train, and this data, together with range correction, is transmitted in parallel digital form on a highway to the height calculator in the display system or operations cabin.

Controls and Indications

The front panel of the control and power unit carries all the controls necessary for running up the system, including a key-operated SERVICE/OFF/ON switch, which allows the time-controlled sequence to take place up to, but not including, application of power to the aerial motors. A REMOTE/LOCAL switch allows certain facilities to be controlled from the cabinet. Illuminated indicators are provided for essential function and interlock stages.

The front panel of the height extractor unit carries switches to allow manual address and data input digital messages to be entered into the system.

On both units a meter is provided for checking and setting-up of power supplies.

Data Summary

Power supply:
415V or 380V±5%, 50Hz 3-phase, 4 wire.
Power consumption:
8kVA maximum.
Size of controlled motors:
azimuth : 4·5 h.p.
elevation : 2·2 h.p.
Type of controlled motors:
direct current.
Slew time:
2·1 s for 180° azimuth.
Azimuth accuracy:
±0°5° overall.
Nod time
1·57 s mean, 2·8 s for maximum nod.
Nod limits:
−3° to +45°.
Sector scan angle limits:
12° to 150°.
Volumetric scan rate:
0·5 rev/min.
Parking angle limits:
Azimuth : any.
Elevation : 18° to 48°.
Range resolution : ¼ data milr.
Analogue inputs:
Video : 0·5V noise.
2·5V signal.
Trigger: +15V 2·5μs.
Elevation position : analogue voltage.

Digital highways

Input messages:
NORMAL
SECTOR SCAN
VOLUMETRIC SCAN
PARK
CLEAR HEIGHT
AZIMUTH BEARING
RANGE (nod amplitude)
SECTOR SCAN AMPLITUDE
Each message consists of a 2-bit address plus a 10-bit command.

Outputs:
Azimuth position, 13 bits.
Target elevation angle, 11 bits.
(LSD 2·6 minutes of arc.)
Range correction, 4 bits.
Level '0':
0V (+0·4V maximum), 12Ω impedance
Level '1':
Not less than +7·5V, 600Ω impedance

Environment

Temperature:
Operational : 0 to +50°C.
Survival : −40 to 65°C.

Relative humidity:
Operational: 95% at 25°C.
Survival: 95% at 40°C.
Pressure:
Operational: 750 mb.
Survival: 420 mb.

Dimensions

Main cabinet
Height: 1·680m (5ft 6in)
Width: 584mm (1ft 11in)
Depth: 654mm (2ft 1¾in)
Weight: 182kg (400lb)
Auxiliary rack
Height: 1·016m (3ft 4in)
Width: 305mm (1ft)
Depth: 648mm (2ft 1½in)
Weight: 102kg (225lb)
Resistor unit
Height: 432mm (1ft 5in)
Width: 635mm (2ft 1in)
Depth: 127mm (5in)
Weight: 9·1kg (20lb)

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ISSUE 2

150673/1000+3500