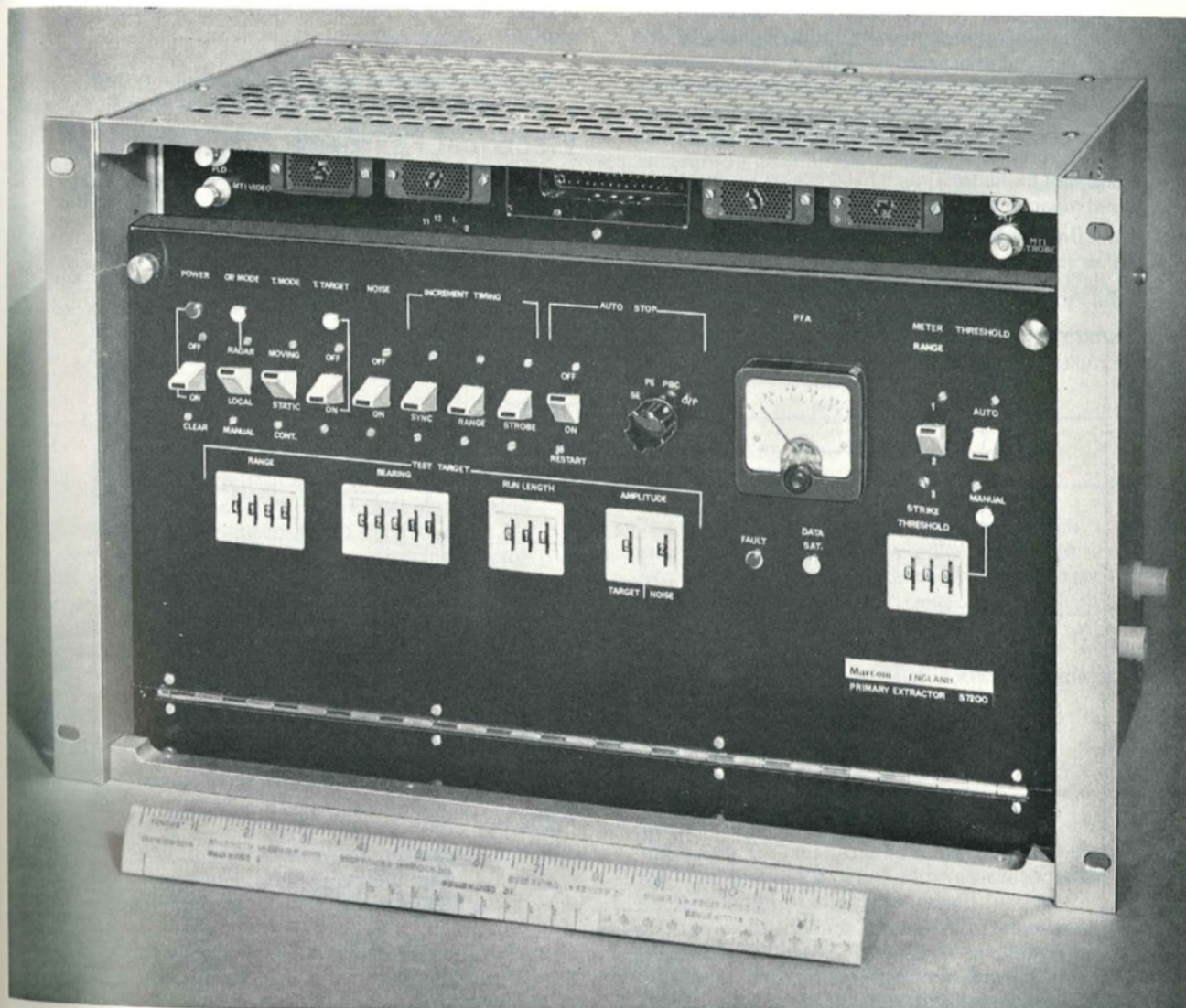


Marconi Radar Data Sheet C4

Primary Radar Plot Extractor Type S7200



Modular construction for system flexibility
Analogue or digital input interface
Test target facilities
Computer or serial data link output interface

Since the S7200 is engineered in modular form various system requirements can be met with a minimum of redundancy and the cost effectiveness is of a very high order.

The unit is constructed using double-sided, plated-through, printed circuit boards carrying dual-in-line integrated circuit packages and discrete components. The boards plug in to 136-way edge connectors, linked by a printed circuit back wiring board of similar type. Signal and power connections are made by BNC and multiway connectors.

Mechanical Features

The Digital Signal Processor Type S7100 and the Plot Extractor Type S7200 can be mounted in

Electrical Features

The unit contains all the circuitry required to perform the following functions:



Alternatively digital or analogue strike extraction, dependent on system requirements
Strike false alarm probability control
Plot forming
Plot bearing calculation
Output
Timing generation, with manual control to expedite fault finding
Test target generation for performance verification and also for fault finding
Monitoring at all stages

Digital Strike Extraction

The digital strike extractor is designed to interface with the Marconi Digital Signal Processor Type S7100 which generates both logarithmic and moving target indication video in multi-level quantized digital form and also includes clutter sensing circuits. The strike extractor is normally fed with logarithmic video, but in the presence of clutter the moving target indication (MTI) video is automatically selected within the signal processing equipment. A control signal to the strike extractor indicates which type of video has been selected.

The digitized video is compared with a slow-acting threshold derived from the strike false alarm probability control. This final video-above-threshold output is passed to a peak amplitude detector, which outputs the peak signal value only, at the range count at which it occurs. In parallel with this, a pulse length discriminator allows only those signals lying between minimum and maximum limits to be passed on for plot forming. A special video input is provided to enable test video data from the test target generator to be injected into the video path.

Analogue Strike Extraction

The analogue strike extractor is designed to accept both logarithmic and MTI videos from conventional signal processing equipment.

The logarithmic video is first passed to a clutter detection circuit, which uses a delay line and level comparators to produce a fast-acting threshold, proportional to the average signal level present over a period centred on the current video. When clutter exceeds preset level and density criteria, a signal is produced which selects either logarithmic video plus the fast acting threshold, or MTI video alone for comparison against a slow-acting threshold derived from the strike false alarm probability control. The selection of logarithmic/MTI video may be overridden by internal or external signals which allow any combinations of videos, below or above a predetermined range, to be chosen for most efficient extraction dependent on system requirements. These selections are made by wired patch links. The clutter and video selected signals are also used in the plot forming function to enable the appropriate criteria to be applied. The

final video-above-threshold output is digitized and passed to a peak amplitude detector and pulse length discriminator, as in the digital extraction, and then on for plot forming.

Further inputs are provided to initiate the input of test video data from the test target generator.

Strike False Alarm Probability Control

In order to achieve the best chance of correlation, the highest strike false alarm rate must be allowed whilst just maintaining non-saturation of the extractor and the required false plot rate. The strike data rate is therefore compared with a preset value during a period free from ground clutter and, at the same time, the slow-acting threshold is continuously adjusted to achieve not less than this value. If, during a period of several aerial revolutions, a much higher value is consistently registered, then the preset value is automatically raised to prevent saturation without sacrificing correlation. Four preset values may be selected by wired link to suit the system environment and a meter indication is given of the current value. A value may also be set manually.

Plot Forming

The function of plot forming is to correlate the strike received in successive pulse recurrence frequency (p.r.f.) periods through an interval corresponding to the radar aerial beam width, thereby building up complete target plots.

Noise pulses are largely eliminated at this stage by their failure to correlate in range. Clutter returns are filtered by checking plots against predetermined azimuth criteria.

The plot data is stored in range order for checking against preset acceptance criteria and strike data. Due to the complex nature of the data, the usual technique of providing a store location for each range quantum is not used. Instead, storage is provided for 256 partially formed plots each defined by a 32-bit word. These 256 plots, overlapping in azimuth, can be accommodated in a store considerably smaller than would be necessary if conventional techniques were employed.

Built-in test facilities automatically generate a signal in the event of a store fault.

Each time a strike is registered, the partially formed plots in the store are compared with predetermined criteria and optimized for a particular signal structure. The predetermined criteria are :

Leading edge – minimum strike pattern to initiate a plot.

Trailing edge – miss pattern to terminate a plot. These criteria are applied individually to logarithmic and MTI video plots to accommodate their different characteristics.

Run length — the maximum allowable strike pattern.

Range variant— minimum and maximum limits for range correlation.

The range of the incoming strike is compared to the current partial plot range. If it is less than the variant a new partial plot is initiated; if it is within the variant a hit is declared, the plot data is updated and leading edge and run length criteria are applied; if it is greater than the variant a miss is declared and the trailing edge criterion is applied. If the criteria of leading edge and trailing edge but not run length are met, then a valid plot is declared, otherwise it is declared void and the store cleared.

Plot Bearing Calculation

The angular position of the aerial is continuously obtained from a digital shaft encoder. If this data is combined with the time period defined by the p.r.f. of the radar, a measure of the aerial angular velocity can be found. This, combined with the absolute angular position and the width data for a valid plot, enables the bearing of the plot centre to be calculated. By performing the velocity calculation over a large number of traces, bearing errors due to aerial rotation speed fluctuation can be reduced to less than the angle turned between traces and p.r.f. stagger can also be accommodated.

Output

The output plot data appears as three 12-bit words presented sequentially on a single 12-bit output highway. The use of this output form, in conjunction with a simple output control circuit, facilitates the connection of the extractor to a computer via a suitable peripheral interface circuit or to the Marconi Link Buffer Unit Type S7210 for the transmission of plot data over a narrow band link.

Timing Generation

In normal operation, all timing waveforms are derived from a crystal-controlled oscillator in conjunction with a range counter. System-dependent values of timing and range are set up on a wired patchfield. At trace start time, test patterns are loaded into the store and the immediately previous patterns checked. By selection, timing may be generated from switches on the front panel, enabling single-step operation throughout the extraction process.

Test Target Generation

Three basic facilities are provided:

- 1) The generation of a simulated aircraft echo (the test target) can be mixed with the live video from an operational radar. This test target may be set to appear at a fixed range

and bearing or it may be set to move on a preset course.

- 2) In addition to the test target, aerial azimuth, synchronizing, video and pseudo-random noise data are generated in order to check the functioning of the false alarm probability controls. This facilitates setting-up fault-finding procedures in the absence of actual radar information. The simulated aerial rotation rate and radar p.r.f. can be preset to enable matching with the real radar parameters. The pseudo-random noise has well defined characteristics, so that the operation of the strike false alarm probability control can be checked.
- 3) Normal operation may be arrested at various stages in the process when the test target is detected. This facility allows the step-by-step checking of the extractor using the known characteristics of the test target. Manual timing is used under these conditions.

Monitoring Facilities

The logic state of fundamentally important waveforms may be selected for display on twelve indicator lamps. The use of this facility in conjunction with the test target and manual timing controls enables commissioning, on-line testing and fault diagnosis to be carried out with the minimum recourse to external test equipment.

Data Summary

Power input:

110V or 220V or 240V $\pm 10\%$

or

100 to 125V or 200 to 250V $\pm 10\%$

45 to 65Hz; 1-phase, 300VA maximum.

Digital strike extraction inputs

Digitized video:

8-bit natural binary coding.

all '1's, maximum video amplitude.

all '0's, minimum video amplitude.

Digitization clock:

coherent with digitized video maximum frequency 1 MHz.

Video-in-use:

'1', moving target indication video.

'0', logarithmic video.

Clutter:

'1', clutter present.

'0', no clutter.

Input levels:

'1', 1 to 3V positive differential.

'0', 1 to 3V negative differential.

Input impedance:

150 Ω using rugged balanced pair lines.

Radar sync:

P.R.F.

200 to 1000 p.p.s.

Level:

+70V peak maximum.

+3V peak minimum.

Impedance:

75 Ω terminated.

Analogue strike extraction inputs

Video signals, logarithmic and MTI:

Transmitter pulse length:

0.84 to 15 μ s

Signal level:

+6V peak maximum.

+1.5V peak minimum.

Impedance:

75 Ω terminated.

Radar sync:

P.R.F.:

200 to 1000 p.p.s.

Level:

+70V peak maximum.

+3V peak minimum.

Impedance:

75 Ω terminated.

Moving target indication strobe:

Level:

+70V peak maximum.

+3V peak minimum.

Impedance:

75 Ω terminated.

Aerial turning data input:

1) 13-bit natural binary coded.

2) Incremental with north mark to 13-bit accuracy.

Level:

Single phase differential.

'1', +1.8 to 30V or -1.8 to 30V.

'0', -0.9V to +0.9V.

Neither input must exceed 15V with respect to earth.

Impedance:

greater than 3k Ω between inputs and 1.5 k Ω between either input and earth.

Outputs

Plot range; plot bearing; north mark; test target; logarithmic/MTI video; plot in clutter:

12-bit highway 3-word transfer plus controls.

Aerial bearing data:

13 bits natural binary coded.

Level: standard logic.

Mode and status tellback:

clean contacts.

Preset criteria

Analogue input level for both logarithmic and moving target indication video:

1.5V to +6V peak input.

Range quantization period for analogue input:

1/12 nautical mile or greater.

Maximum extraction range:

dependent on radar in use.

Pulse length discrimination limits:

within the range 0.5 μ s to 30 μ s dependent on range quantization period.

Plot leading edge duplicated for logarithmic and moving target indication video:

within the range 1 to 15 traces.

Plot trailing edge duplicated for logarithmic and moving target indication video:

within the range 1 to 7 traces.

Plot range variant:

within the ranges 0 to +4 and 0 to -4 range periods.

Plot maximum run length:

within the range 1 to 230 traces.

Strike false alarm probability:

within the range 10^{-4} to 10^{-1}

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

Height:

312mm (12 1/4 in)

Width:

482mm (19 in)

Depth:

280mm (11 in)

Weight (digital version):

13.2kg (29 lb)

Weight (analogue version):

15.5kg (34 lb)

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

Marconi Radar Systems Limited

A GEC-Marconi Electronics Company

Crompton Works, Chelmsford, England CM1 3BN

Telephone: Chelmsford (0245) 671111. Telegrams: Marstor Chelmsford Telex.

Telex: 99108 and 99449

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