MODERN DISPLAYS AND SYSTEMS FOR RADAR AND AIR TRAFFIC CONTROL

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SUMMARY

This paper first considers the division of ground radar into (a) the small airfield requirement and (b) the large international airport with complex data system requirements. An attempt is made to put into perspective the role of conventional plan position indicators, marked radar displays, synthetic, tabular and large projection displays, together with the influence of high-speed data readout in providing bright displays. The significance of scan - conversion and of direct view storage displays is also considered in relation to data handling, and the small airfield. A modern transistorised radar display is described, and the important parameters of, and control of, scan conversion and direct view storage tubes is also discussed. Finally some opinions are given possible future developments, in particular the influence of improved display devices on data handling.

Introduction

● The primary requirement of a radar displays is that it shall perform as a Plan Position Indicator (P.P.I.), so as to indicate the true position of aircraft « echos » from the radar signals. This requirement is basic to a radar display for both small and large systems, and is certain to persist into the forseable future, even with the most complex automatic computer assisted systems. A desirable, but subsidiary requirement is the storage or « after glow » property of the display device, which enables the approximate direction and speed of the aircraft to be established.

However a fully flexible modern radar must be capable of performing many more functions. The increasing complexity of air traffic control demands that much more information needs to be available to the controller, either on the P.P.I. or ancilliary display devices. These include procedural information, secondary radar data, D/F fixes, meteorological data, video maps, identification marks and height.

Early radar P.P.I.'s generated the trace upon the c.r.t. by means of a sawtooth current waveform applied to a deflection coil. Rotation of the trace was achieved by rotating the coil on the tube neck, in synchronism with the aerial head. A.C. (transformer) coupling was usually employed, and centrally was maintained by area balancing the waveform. However, as the density of aircraft increased around large international air terminals, there arose a need to mark aircraft on the display for tracking and for indicating aircraft on adjacent displays. Previously this had been done when necessary by a simple grease pencil.

The most satisfactory way of doing this electrocnically is to use a D.C. coupled fixed coil deflection system The sawtooth waveforms, varying sinusoidally are applied in quadrature, to the X and Y deflection coils for the radar scan. A rest period is provided between each sawtooth, and the level of this rest period is controlled by D.C. potentiometers, conveniently attached to a joystick. A gating amplifier is used to switch in any suitable series of levels, from a number of display positions. As these levels are inserted in the system prior to the displays, the deflectional inaccuracies are eliminated and accurate registration ot the order of 0.1% is achievable.

For example, with a pulse repetition frequency (P.R.F.) of 250 p.p.s., and with a sequence of 10 intertrace marks, a flicker free mark rate of 25 c.p.s. is achieved. Simple identification shapes can be provided by superimposing small quadrature sine waves on X and Y deflection during the intertrace periods to produce circle, or small sawooth to produce squares. It will be seen that this system of marking by X, Y, orientated D.C. levels, a conversion from the polar co-ordinates of the radar scan, to cartesian co-ordinates is achieved. By suitable encoding, this information can be fed to a computer, and form the basis of an air traffic control data handling system.

In the more modern display systems, the joystick has been replaced by a tracker ball. This rolling ball can be rotated in any direction, and controls optical digital encoders, which feed directly to the computer.

The simple geometric shapes are no longer sufficient for identification purposes in high traffic density areas, and the real requirement is to write letters,