INTRODUCTION

The Microwave Landing System (MLS) was designed to replace ILS with an advanced precision approach system that would overcome the disadvantages of ILS and also provide greater flexibility to its users. However, there are few MLS installations in use at present and they are likely to co-exist with ILS for a long time.

MLS is a precision approach and landing system that provides position information and various ground to air data. The position information is provided in a wide coverage sector and is determined by an azimuth angle measurement, an elevation measurement and a range measurement.

ILS DISADVANTAGES

ILS has the following disadvantages:

- There are only 40 channels available worldwide.
- The azimuth and glideslope beams are fixed and narrow. As a result, aircraft have to be sequenced and adequately separated which causes landing delays.
- There are no special procedures available for slower aircraft, helicopters, and Short Take Off and Landing (STOL) aircraft.
- ILS cannot be sited in hilly areas and it requires large expanses of flat, cleared land to minimise interference with the localiser and glideslope beams.
- Vehicles, taxying aircraft, low-flying aircraft and buildings have to be kept well away from the transmission sites to minimise localiser and glideslope course deviations (bending of the beams).

THE MLS SYSTEM

The Microwave Landing System (MLS) has the following features:

- There are 200 channels available worldwide.
- The azimuth coverage is at least ± 40° of the runway on-course line (QDM) and glideslopes from .9° to 20° can be selected. The usable range is 20-30 nm from the MLS site; 20nm in the UK.
- There is no problem with back-course transmissions; a secondary system is provided to give overshoot and departure guidance ± 20° of runway direction up to 15° in elevation to a range of 10 nm and a height of 10,000 ft.
- It operates in the SHF band, 5031 - 5090 MHZ. This enables it to be sited in hilly areas without having to level the site. Course deviation errors (bending) of the localiser and glidepath caused by aircraft, vehicles and buildings are no longer a problem because the MLS scanning beam can be interrupted and therefore avoids the reflections.

- Because of its increased azimuth and elevation coverage aircraft can choose their own approaches. This will increase runway utilisation and be beneficial to helicopters and STOL aircraft.
- The MLS has a built-in DME.
- MLS is compatible with conventional localiser and glidepath instruments, EFIS, auto- pilot systems and area navigation equipment.
- MLS gives positive automatic landing indications plus definite and continuous on/off flag indications for the localiser and glideslope needles.
- The identification prefix for the MLS is an 'M' followed by two letters.
- The aim is for all MLS equipped aircraft to operate to CAT III criteria. Figures 10.1, 10.2 and 10.3 below show some of these features.

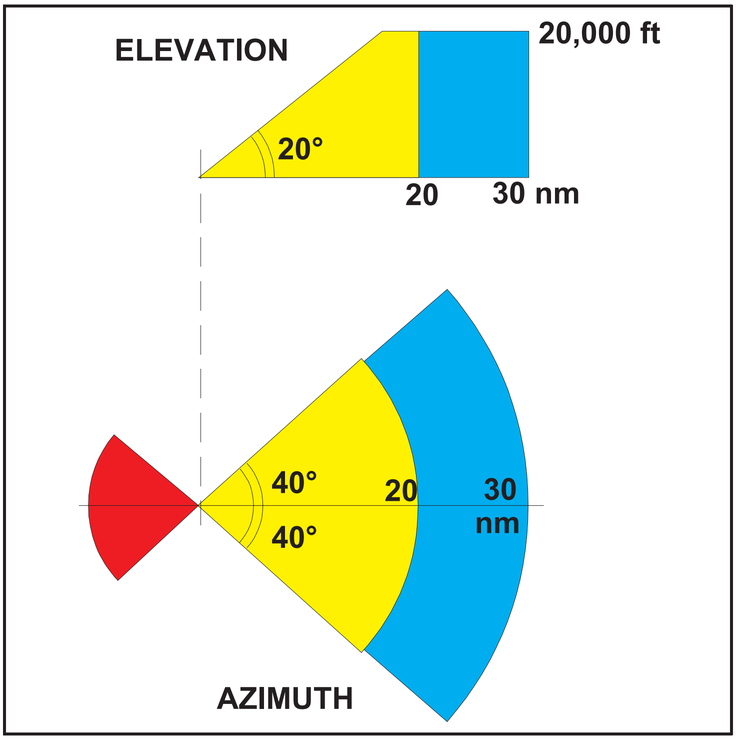

Figure 10.1: MLS coverage.

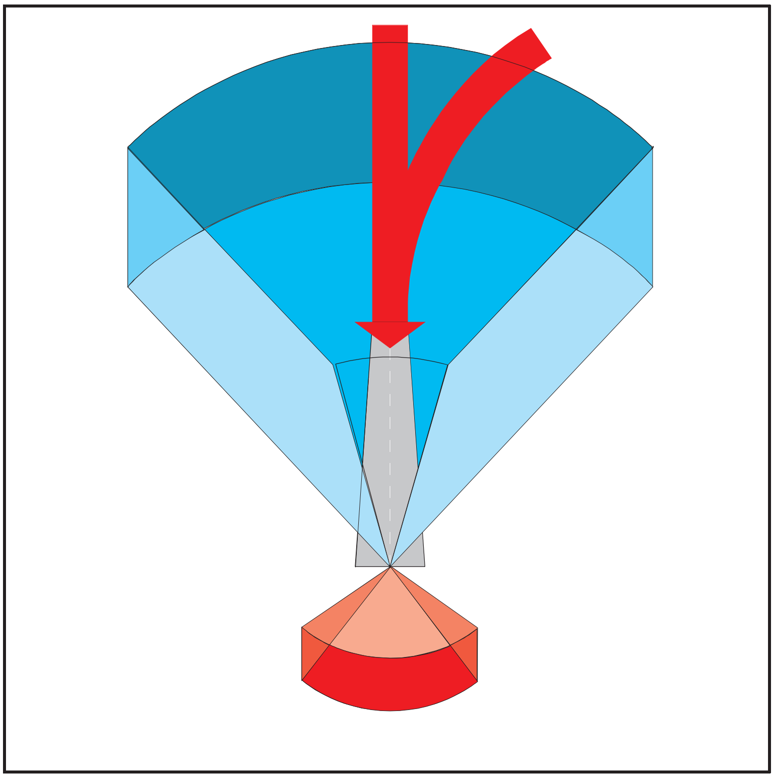

Figure 10.2: Approach coverage volume.

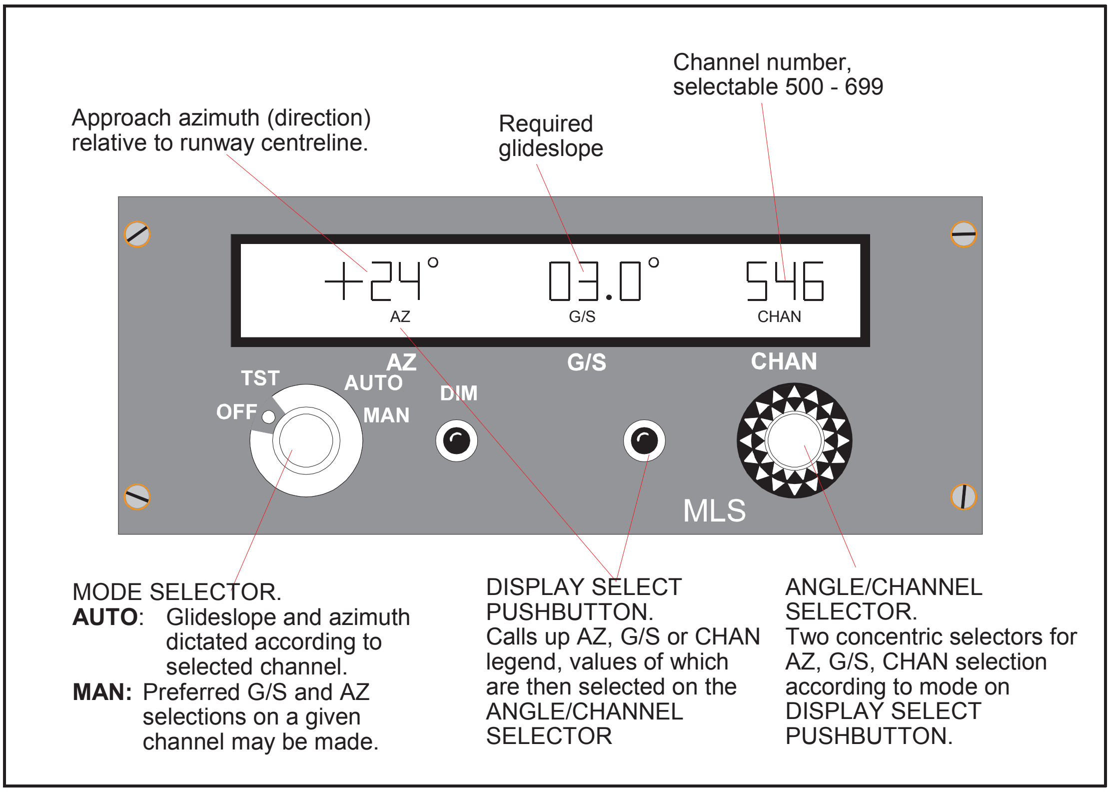

Figure 10.3: Typical MLS flight deck control panel.

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PRINCIPLE OF OPERATION

MLS employs the principle of Time Division Multiplexing (TDM) *(see Figure 10.5)* whereby only one frequency is used on a channel but the transmissions from the various angle and data ground equipments are synchronised to assure interference free operations on the common radio frequency.

- **Azimuth location.** Time referenced scanning beam (TRSB) is utilised in azimuth and elevation as follows: the aircraft computes its azimuth position in relation to the run-way centre-line by measuring the time interval in microseconds between the reception the 'to' and 'fro' scanning beams.

  The beam starts the 'to' sweep at one extremity of its total scan and travels at a uniform speed to the other extremity. It then starts its 'fro' scan back to its start position. The time interval between the reception of the 'to' and 'fro' pulses is proportional to the angular position of the aircraft in relation to the runway on-course line.

  The pilot can choose to fly the runway on-course line (QDM) or an approach path which he selects as a pre-determined number of degrees ± the runway direction. *(See Figure 10.4).*

- **Glideslope location.** Another beam scans up and down at a uniform speed within its elevation limits. The aircraft's position in relation to its selected glideslope angle is thus calculated in the same manner by measuring the time difference between the reception of the pulses from the up and down sweep. The transmissions from the two beams and the transmissions from the other components of the MLS system are transmitted at different intervals i.e. it uses ' time multiplexing'.

- Other components of the system are:

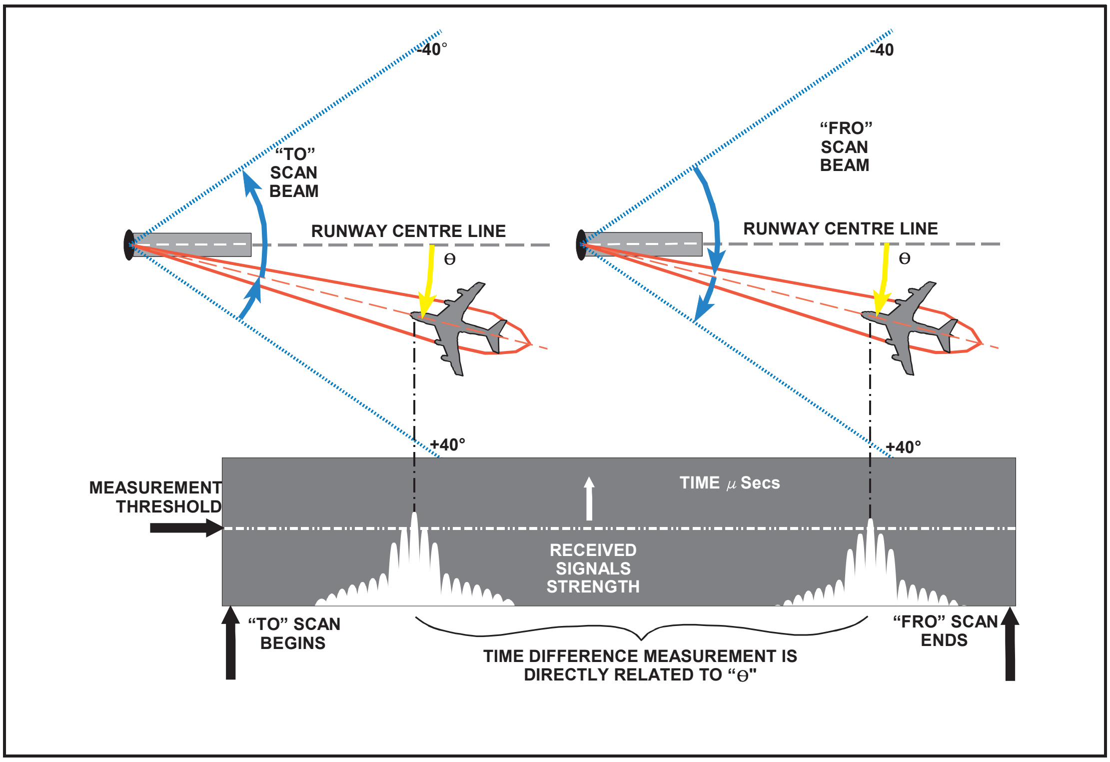
  - **Flare.** Although the standard has been developed to provide for flare elevation, this function is not intended for future implementation

  - **Back azimuth.** Gives overshoot and departure guidance ± 20° of runway direction up to 15° in elevation.

  - **DME** Range along the MLS course is provided not by markers but by a DME. For Cat II and III approaches a precision DME (DME/P) that is accurate to within 100 feet must be available.

  - Transmission of auxillary data. This consists of:

    > station identification
    > system condition
    > runway condition
    > weather information


-40°
"TO"
SCAN
BEAM
RUNWAY CENTRE LINE
Ө
-40
"FRO"
SCAN
BEAM
RUNWAY CENTRE LINE
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+40°
+40°
MEASUREMENT
THRESHOLD
TIME µ Secs
RECEIVED
SIGNALS
STRENGTH
"TO" SCAN
BEGINS
TIME DIFFERENCE MEASUREMENT IS
DIRECTLY RELATED TO "Ө"
"FRO" SCAN
ENDS

Figure 10.4

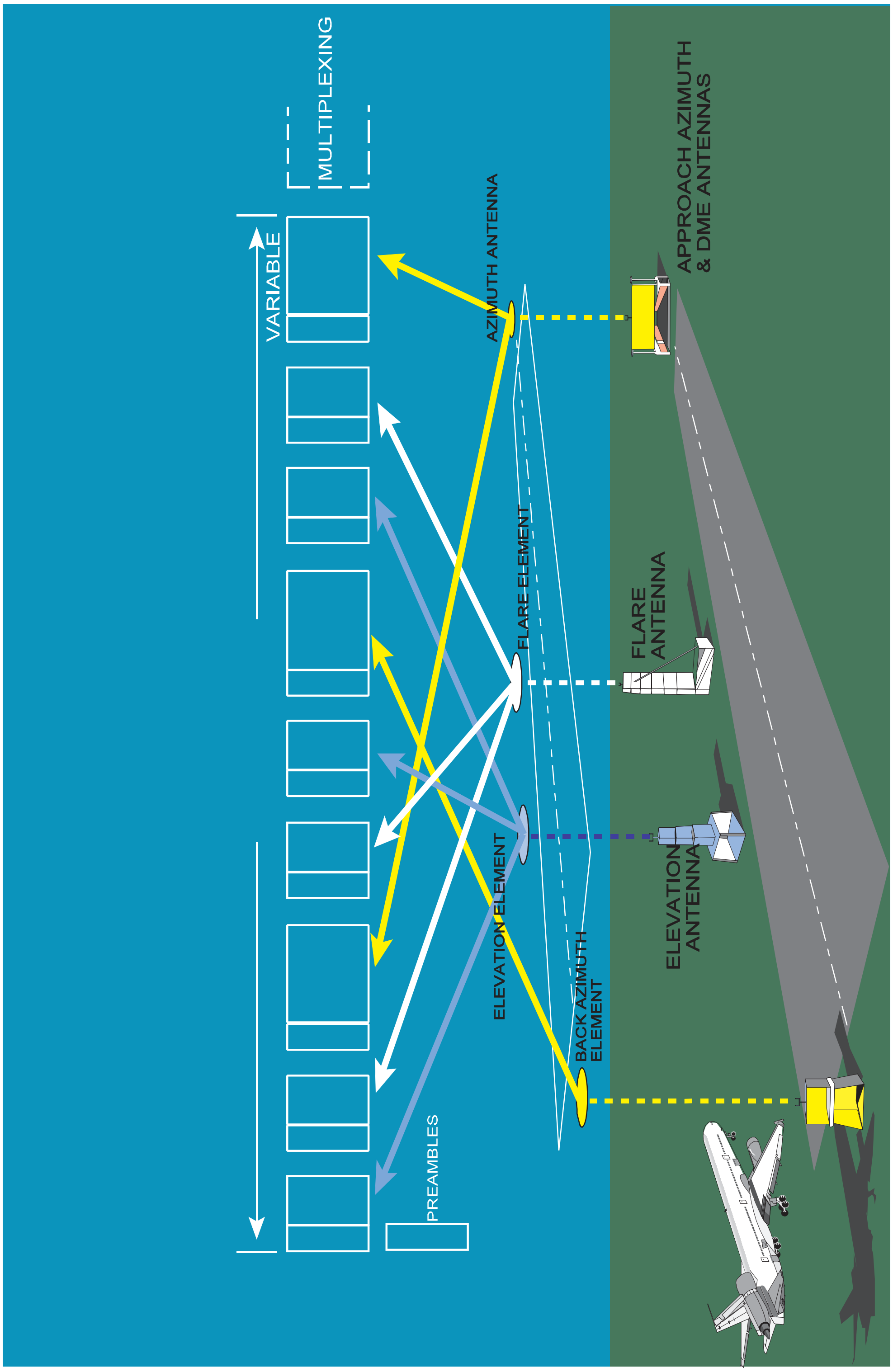

Figure 10.5: TRSB component site.

AIRBORNE EQUIPMENT

The airborne equipment is designed to continuously display the position of the aircraft in relation to the preselected course and glide path along with distance information during approach as well as during departure.

Display

The display consists of two cross bars similar to an ILS display except that the indications are given relative to the selective course. It is possible to program the computer to give segmented approaches and curved approaches for which a DME-P must be installed on the ground.

Control Unit

In order to receive ILS, MLS and GPS transmissions, aircraft are equipped with multi-mode receivers and a combined control unit for ease of use by the flight crew. An example of such a control unit is shown at *Figure 10.6.*

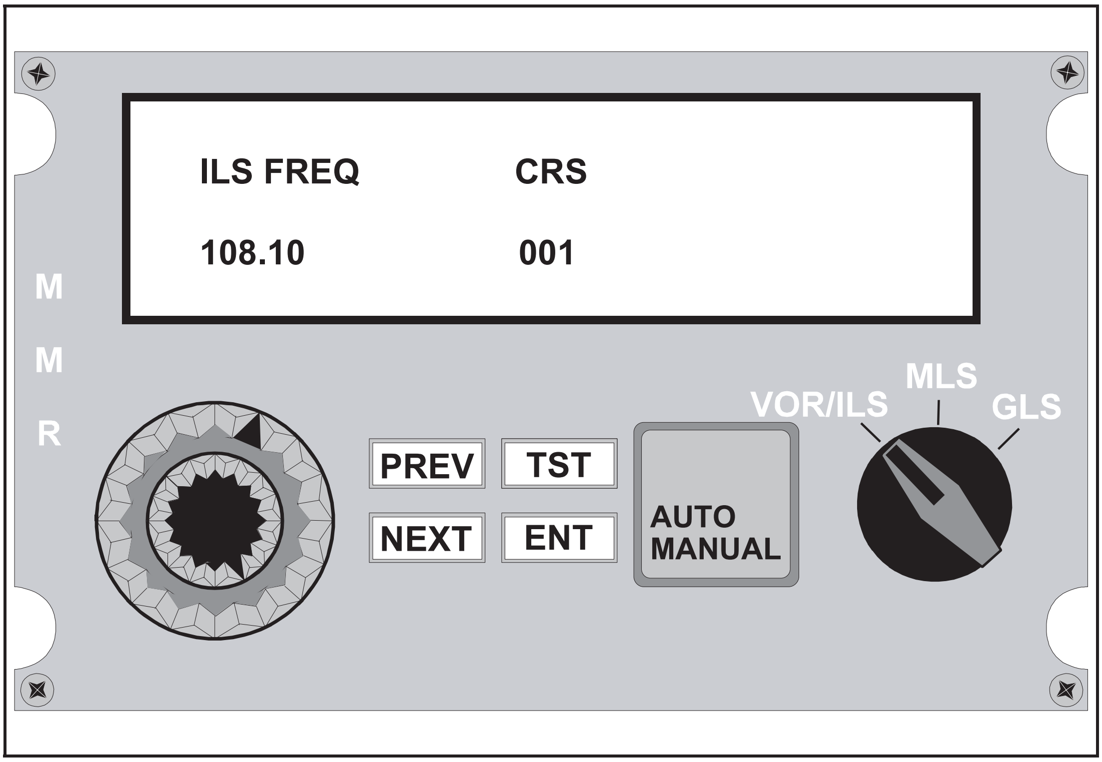

Figure 10.6: MMR control panel.