



DOCUMENT
GSM-G-ATP.035

DOCUMENT TITLE
RADIO NAVIGATION

CHAPTER 6 – GROUND DIRECTION FINDING (GDF)

Version 1.0
January 2013

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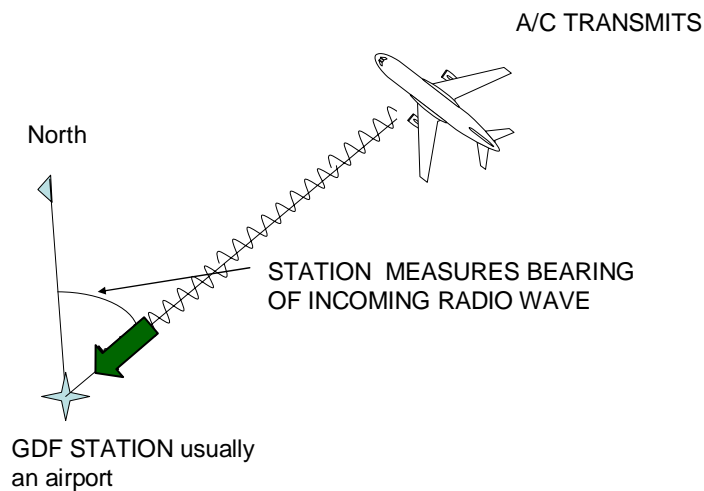
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CHAPTER 6: GROUND DIRECTION FINDING

GROUND DIRECTION FINDING

Ground stations with the facility of taking a bearing of an aircraft from that aircraft's transmissions are shown in the relevant section of the AIP. Users are advised that bearing information will only be given when conditions are satisfactory; furthermore a number of facilities are shown as "not available for en-route navigation".

World- wide such services may be provided in the MF and HF bands but in most countries it operates in the VHF and UHF bands only. As civil aircraft do not use UHF, effectively ground direction finding is limited to VHF. In Australia such a service does not exist.



VHF Direction-Finding (VDF) bearings are classified as follows:

- Class A accurate to within ± 2 degrees
- Class B accurate to within ± 5 degrees
- Class C accurate to within ± 10 degrees

The AIP may advise that normally no better than Class B bearings will be available.

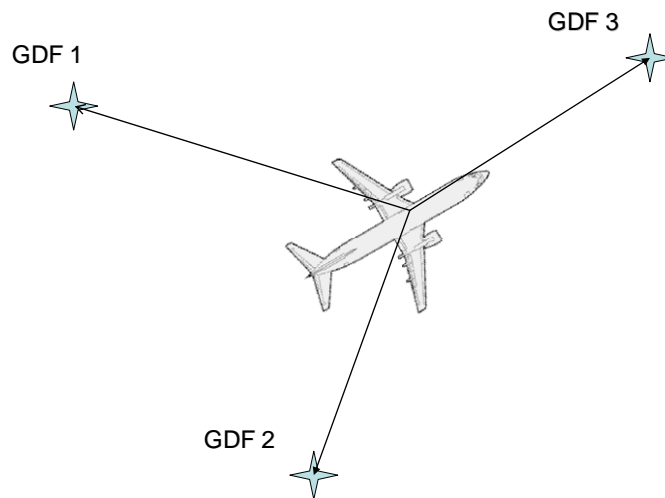
The frequencies to be used are in the AIP. An aircraft can call a VDF station and request true or magnetic bearings as follows:

- QTE- the aircraft's true bearing from the station
- QUJ- the aircraft's true track to the station
- QDR- the aircraft's magnetic bearing from the station
- QDM- the aircraft's magnetic track to the station
-

For a position line, a QTE (true) or a QDR (mag) can be requested. To fly towards the station, a QDM (mag) would normally be given. A series of QDM's will permit the aircraft to

home to the station and this is referred to as a QDL procedure. The controller may obtain bearings based on the pilot's transmissions and from these provide headings and heights to fly to maintain the aircraft in a published pattern. Such a procedure which is ATC interpreted is known as a QGH.

VDF is part of the aeronautical navigation service of the UK but the same principles are used to provide an emergency fixing service on 121.5 MHz, based on either the London or Scottish Area Control Centres. In the diagram each of the three Ground Direction Finding stations is picking up the aircraft's transmission. Automatic plotting of the measured bearings locates the position of the aircraft.



Automatic VDF is also used to assist in radar identification for ATC purposes. Generally bearings are not more accurate than Class B.

The range of VDF depends on:

- "Line of Sight" limitations ...height of aircraft, height of ground receiver and height of terrain.
- The power of the transmitter.
- The sensitivity of the receiver.

The range may at times be extended by duct propagation (super refraction) which is described in Section 2. Temperature and humidity conditions may however reduce range and this is referred to as sub-refraction.

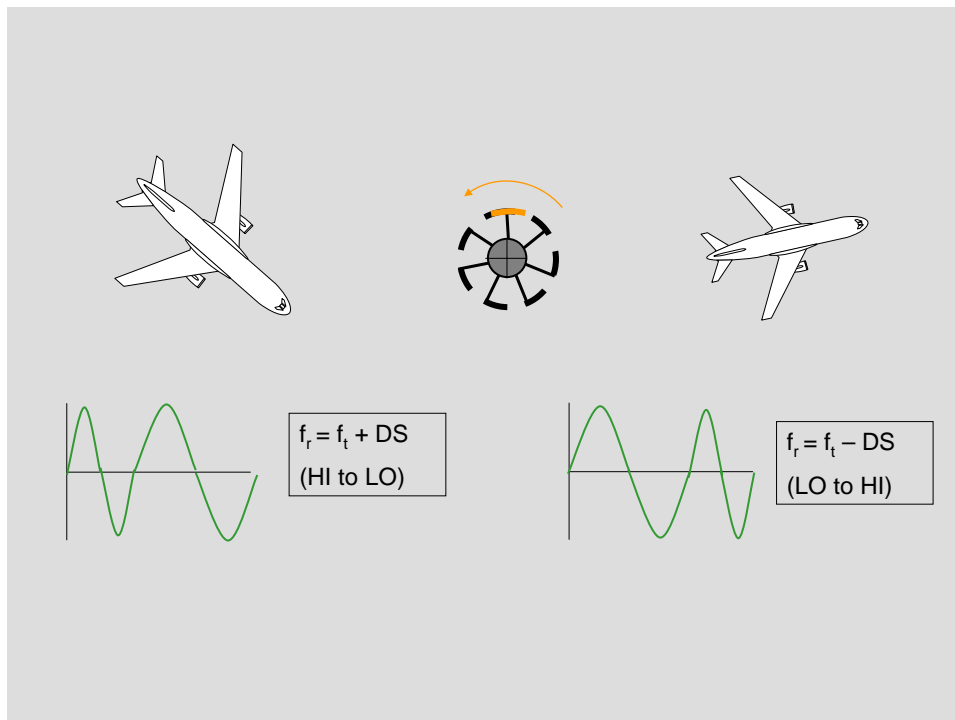
The accuracy of VDF depends on:

- Equipment errors.
- Site errors.
- Propagation errors.
- Multi-path effects.

Site error refers to the effect of reflections of the aircraft's transmissions by objects, man-made or natural, close to the receiving station. Propagation error, which is likely to be the major error, refers to reflections by either uneven terrain or obstacles en-route

Note that if two aircraft transmit on the same frequency at the same time an incorrect bearing may result.

Modern VDF equipment is computer-controlled using microprocessors in place of motors or moving parts. The digital display shows the bearing, the channel and a reading of signal strength which can be used to provide a measure of range. With ground D/F systems that utilize ADCOCK antennas, the vertically polarized radio signal transmitted from the aircraft induces voltages in the vertical sections of the receiving aerials, by a similar process to that used by ADF. More modern D/F systems measure the direction of the incoming radio wave from the phase of the Doppler shift.



WORKSHEET – GROUND DIRECTION FINDING

1. The range of VDF depends on a number of factors which include:
 - (i) Sensitivity of the ground receiver
 - (ii) Power of the airborne transmitter
 - (iii) Frequency in use.
 - (a) All are true
 - (b) Only (i) and (ii) are true
 - (c) Only (ii) and (iii) are true
 - (d) Only (i) and (iii) are true.
2. A DF bearing is given to an aircraft as "QDM 060 Class Bravo". The aircraft's magnetic bearing from the DF station is:
 - (a) 060 ± 5
 - (b) 060 ± 10
 - (c) 240 ± 5
 - (d) 240 ± 10
3. Worldwide DF bearings may be available on:
 - (a) VHF only
 - (b) HF and VHF only
 - (c) VHF and UHF only
 - (d) MF, HF and VHF
4. Causes of error to VDF bearings include:
 - (i) Propagation error
 - (ii) Site error
 - (iii) Coastal refraction
 - (a) All are true
 - (b) Only (i) and (ii) are true
 - (c) Only (ii) and (iii) are true
 - (d) Only (i) and (iii) are true.
5. A series of QDMs which will permit the aircraft to home to the station is referred to as a _____.
 - (a) QUJ
 - (b) QDL
 - (c) QTF
 - (d) QFF

6. Aircraft transmissions for the purposes of VDF are _____ polarised and will be most effectively received by a _____ aerial.
- | | | |
|-----|--------------|------------|
| (a) | vertically | vertical |
| (b) | horizontally | horizontal |
| (c) | horizontally | vertical |
| (d) | vertically | horizontal |