# 5 570 - 5 650 MHz

## 1. Band Introduction

The Department of Defense (DoD) and the National Aeronautics and Space Administration (NASA) use this band for test and launch range instrumentation radars to track rockets, missiles, satellites, launched vehicles, and other targets including testing of unmanned aircraft systems (UAS)[1] downlinks to ground control stations. This band supports daily DoD and Department of Homeland Security (DHS) UAS missions to provide command and control of unmanned aerial vehicle (UAV)[2] and control of cameras as the mission dictates.

DoD uses this band for a wide variety of radar applications including anti-air warfare radars, which are part of an advanced ground-based air defense missile system. Other uses in this band include shipborne radars for surface search, navigation, land-mapping and imaging, and weapons fire control.

National Oceanic and Atmospheric Administration (NOAA) and Coast Guard operate meteorological radars and meteorological aids (MetAids) in this band to provide area precipitation measurements used in hydrological, meteorological, and environmental forecasting. These radars also operate on airborne platforms for hurricane research and reconnaissance.

The Federal Aviation Administration (FAA) uses the 5 600 - 5 650 MHz band for Terminal Doppler Weather Radar (TDWR) meteorological systems for the quantitative measurements of gust fronts, wind shear, microbursts, and other weather hazards for improving the safety of operations at major airports.

NASA, in joint ventures with the French agency, Centre National d'Etudes Spatiales (CNES), also operates a satellite-based radar transmitter in this band for space-based observations and measurements including surface topography, soil moisture, and sea surface height.

Federal agencies operate unlicensed devices that comply with the FCC Part 15 Rules or Annex K of the NTIA Manual through adherence to NTIA Manual Part 7.8 ("PURCHASE AND USE OF NON-LICENSED DEVICES").

[1] UAS refers to the unmanned aircraft system including payload and communications.

[2] UAV refers only to the unmanned platform.

# 2. Allocations

## 2a. Allocation Table

The frequency allocation table shown below is extracted from the NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management, Chapter 4 – Allocations, Allotments and Plans.

***Table of Frequency Allocations***

5 570 - 5 650 MHz

***United States Table***

| | |
|---|---|
| 5 570 - 5 600<br>MARITIME RADIONAVIGATION US65<br>RADIOLOCATION G56<br><br>US50 G131 | 5 570 - 5 600<br>MARITIME RADIONAVIGATION US65<br>RADIOLOCATION<br><br>US50 |
| 5 600 – 5 650<br>MARITIME RADIONAVIGATION US65<br>METEOROLOGICAL AIDS<br>RADIOLOCATION G56<br><br>5.452 US50 G131 | 5 600 – 5 650<br>MARITIME RADIONAVIGATION US65<br>METEOROLOGICAL AIDS<br>RADIOLOCATION<br><br>5.452 US50 |

## 2b. Additional Allocation Table Information

**5.452** Between 5 600 MHz and 5 650 MHz, ground-based radars used for meteorological purposes are authorized to operate on a basis of equality with stations of the maritime radionavigation service.

**G56** Federal radiolocation in the bands 1 215 - 1 300, 2 900 - 3 100, 5 350 - 5 650 and 9 300 - 9 500 MHz is primarily for the military services; however, limited secondary use is permitted by other Federal agencies in support of experimentation and research programs. In addition, limited secondary use is permitted for survey operations in the band 2 900 - 3 100 MHz.

**G131** Federal stations in the radiolocation service operating in the band 5 470 - 5 650 MHz, with the exception of ground-based radars used for meteorological purposes operating in the band 5 600 - 5 650 MHz, shall not cause harmful interference to, nor claim protection from, Federal stations in the maritime radionavigation service.

**US50** In the band 5 470 - 5 650 MHz, the radiolocation service may be authorized for non-Federal use on the condition that harmful interference is not caused to the maritime radionavigation service or to the Federal radiolocation service.

**US65** The use of the band 5 460 - 5 650 MHz by the maritime radionavigation service is limited to shipborne radars.

# 3. Federal Agency Use

## 3a. Federal Agency Frequency Assignments Table

The following table identifies the frequency band, types of allocations, types of applications, and the number of frequency assignments by agency.

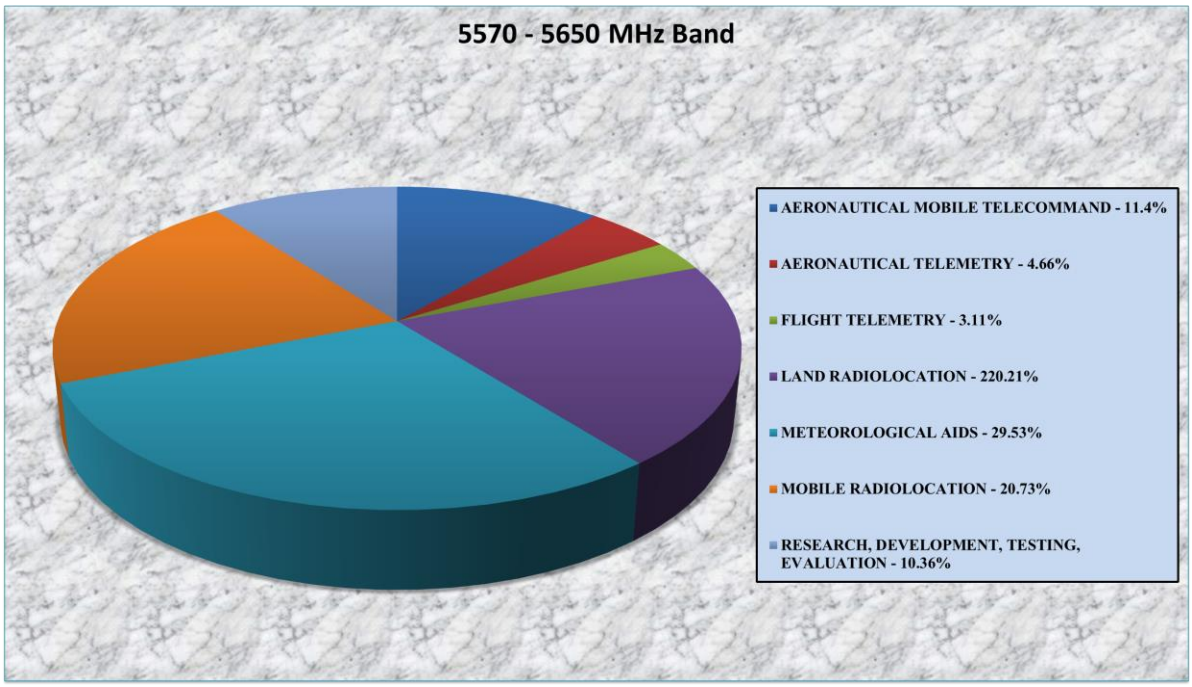
***Federal Agency Assignment Table***

| 5570 - 5650 MHz Band | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SHARED BAND | | | | | | | | |
| | MARITIME RADIONAVIGATION<br>METEOROLOGICAL AIDS<br>RADIOLOCATION | | | | | | | |
| | TYPE OF APPLICATION | | | | | | | |
| AGENCY | AERONAUTICAL MOBILE TELECOMMAND | AERONAUTICAL TELEMETRY | FLIGHT TELEMETRY | LAND RADIOLOCATION | METEOROLOGICAL AIDS | MOBILE RADIOLOCATION | RESEARCH DEVELOPMENT TESTING EVALUATION | TOTAL |
| AF | 18 | 7 | | 7 | 1 | 3 | 14 | 50 |
| AR | 3 | 2 | | 8 | 2 | 6 | | 21 |
| DOE | | | | | 1 | 5 | 2 | 8 |
| DOI | | | | 1 | | | | 1 |
| FAA | | | | | 51 | | | 51 |
| MC | | | | 2 | | | | 2 |
| N | 1 | | | 3 | 1 | 25 | 4 | 34 |
| NASA | | | 6 | 18 | 1 | 1 | | 26 |
| **TOTAL** | 22 | 9 | 6 | 39 | 57 | 40 | 20 | 193 |

The number of actual systems, or number of equipments, may exceed and sometimes far exceed, the number of frequency assignments in a band. Also, a frequency assignment may represent, a local, state, regional or nationwide authorization. Therefore, care must be taken in evaluating bands strictly on the basis of assignment counts or percentages of assignment.

### 3b. Percentage of Frequency Assignments Chart

The following chart displays the percentage of frequency assignments in the Government Master File (GMF) for the systems operating in the band 5 570 - 5 650 MHz.




## 4. Frequency Band Analysis by Application

### 4a. Aeronautical Mobile Telemetry and Telecommand

The DoD operates aeronautical telemetering mobile stations in this band for transmitting data directly related to the airborne testing of vehicles or major components. This band supports the testing of UAS downlinks to ground control stations. This testing ensures proper functioning of the command and control link to control the UAV. Also testing ensures that the transmit payload imagery and system data path are processing correctly and relayed to intelligence collection center. The DoD operates UAS telemetry and video uplink systems in this band supporting research, development, testing and evaluation and flight operations.

This band supports daily DoD and DHS UAS missions to provide command and control of aircraft and camera as the mission and aircraft dictate. UAS also support disaster relief efforts (i.e. firefighting operations in California). This expanded role results in a requirement to deploy UAS in proximity to U.S. cities and along the national borders.

## 4b. Instrumentation Radars

Test range instrumentation radars provide highly accurate position data on space launch vehicles and aeronautical vehicles undergoing developmental and operational testing. High transmitter powers and large aperture parabolic reflector antennas with narrow beamwidths typify these radars. The radars have auto-tracking antennas, which either skin-track or beacon-track the object of interest.[3] Periods of operation can last from minutes up to several hours, depending upon the test program. Operations are conducted at scheduled times throughout the week.

The technical characteristics for instrumentation radar systems operating in the 5 570 – 5 650 MHz frequency range derived from Recommendation ITU-R M.1638-1 are given in Table 1. The example system data provided in this recommendation is typical for radar systems deployed in the United States.

***Table 1. Instrumentation Radar Characteristics***

| Characteristics | Radar 2 | Radar 3 | Radar 4 | Radar 5 |
|---|---|---|---|---|
| | | | | |
| Tuning range (MHz) | 5 350 - 5 850 | 5 350 - 5 850 | 5 400 - 5 900 | 5 400 - 5 900 |
| Transmit power into antenna (Megawatts) | 2.8 | 1.2 | 1 | 0.165 |
| Pulse width (microsecond) | 0.25, 1.0, 5.0 | 0.25, 0.5, 1.0 | 0.25 - 1 (plain)<br>3.1 - 50 (chirp) | 100 |
| Pulse rise/fall time (microsecond) | 0.02 - 0.5 | 0.02 - 0.05 | 0.02 - 0.1 | 0.5 |
| Pulse repetition rate (pulses per second) | 160, 640 | 160, 640 | 20 - 1 280 | 320 |
| Chirp bandwidth (MHz) | N/A | N/A | 4.0 | 8.33 |
| Emission bandwidth (MHz)<br>–3 dB<br>–20 dB | 0.5 - 5 | 0.9 - 3.6<br>6.4 - 18 | 0.9 - 3.6<br>6.4 - 18 | 8.33<br>9.9 |
| Antenna main beam gain (dBi) | 54 | 47 | 45.9 | 42 |

## 4c. Tactical Radars

The DoD operates a transportable surface-to-air missile defense multi-function radar system in this band that is used to detect and track targets as part of a tactical air defense system. These systems are currently deployed at or near military bases.

The Navy operates shipboard sea and air surveillance radars in this band for ship protection and operate continuously while the ship is underway as well as when entering and leaving port areas. These surveillance radars usually employ moderately high transmitter powers and antennas which scan electronically in elevation and mechanically a full 360 degrees in azimuth. Operations can dicate that multiple ships operate these

[3] The characteristics for the radar beacons are not included in the table. These radar beacons are typically tunable over the frequency range of 5 400 - 5 900 MHz and have transmitter power levels in the range 50 to 200 Watts. They rebroadcast the received radar signal.

radars simultaneously in a given geographical area.

The Technical characteristics for tactical radar systems operating in the 5 570 - 5 650 MHz frequency range derived from Recommendation ITU-R M.1638-1 are given in Table 2. The example system data provided in this recommendation is typical for radar systems deployed in the United States.

***Table 2. Tactical Radar Characteristics***

| Characteristics | Radar 7 | Radar 9 |
|---|---|---|
| Function | Surface and air search | Search |
| Tuning range (MHz) | 5 450 - 5 825 | 5 250 - 5 725 |
| Transmit power into antenna (Kilowatts) | 285 | 0.1100 - 0.400 |
| Pulse width (microsecond) | 0.1/0.25/1.0 | 1.0 |
| Pulse rise/fall time (microsecond) | 0.03/0.05/0.1 | 0.05 |
| Pulse repetition rate (pulses per second) | 2 400/1 200/ 750 | 200 - 1 500 |
| Chirp bandwidth (MHz) | N/A | N/A |
| Emission bandwidth (MHz)<br>–3 dB<br>–20 dB | <br>5.0/4.0/1.2<br>16.5/12.5/7.0 | <br>4.0<br>10.0 |
| Antenna main beam gain (dBi) | 30.0 | 30 - 40 |

## 4d. Meteorological

Meteorological radars provide quantitative area precipitation measurements and in most cases belong to networks that coordinate such measurements over national or regional areas. Those that use Doppler radar technology also observe precipitation velocity, which indicates the presence and motion of severe weather elements such as tornadoes, hurricanes and violent thunderstorms as well as wind shear and turbulence. NOAA and Coast Guard take quantitative measurements from both kinds of radar, in real time, as a critical and unique data source for hydrological, meteorological and environmental forecasting. The data increases the accuracy and timeliness of forecasts and warnings through numerical data assimilation, modeling and forecasting of weather. This mitigates damaging events. Many applications can be critical to safety and protection of the public (i.e. lightning risk assessment to protect both life and property) and the safety and security of military operations.

The TDWR operates in the 5 600 - 5 650 MHz band, and provides quantitative measurements of gust fronts, wind shear, microbursts, and other weather hazards that improve the safety of operations at major airports. Forty-Five airports deploy TDWR as shown in Figure 1. TDWRs improve the management of air traffic through forecasts of gust fronts, induced wind shifts, detection of precipitation, and detection of other hazardous weather phenomena including turbulence and tornados.


***Figure 1. TDWR Locations in the United States***

The FAA uses TDWR for detection of severe weather and often locates these systems near airports. These radars operate throughout the day.

The Coast Guard uses airborne meteorological radars for both hurricane research and reconnaissance. The aircraft penetrate the eyewall repeatedly at altitudes up to 20 000 feet (6 096 m) and as low as 1 500 feet (457 m). Other aircraft penetrate hurricanes at higher, less turbulent altitudes (30 000-45 000 feet, or 9 144-13 716 m). Both types of aircraft collect research-mission data critical for computer models that predict hurricane intensity and landfall.

Ground-based meteorological radar systems operate within the frequency range 5 570 – 5 650 MHz. The technical characteristics for these radar systems derived from ITU-R Recommendation M.1849-1 are given in Table 3. The example system data provided in this recommendation is typical for ground-based meteorological radar systems deployed in the United States.

***Table 3. Meteorological Radar Characteristics***

| Characteristics | Radar 3 | Radar 4 | Radar 5 | Radar 6 | Radar 7 | Radar 8 |
|---|---|---|---|---|---|---|
| | | | | | | |
| Tuning range (MHz) | 5 600 - 5 650 | 5 300 - 5 700 | 5 600 - 5 650 | 5 600 - 5 650 | 5 600 - 5 650 | 5 250 - 5 725 |
| Transmit power into antenna (Kilowatts) | 250 Peak | 250 Peak | 250 Peak | 250 Peak 0.150 Average | 250 Peak 0.150 Average. | 2.25 Peak |
| Pulse width (microsecond) | 1.1 | 0.8 - 2 | 3 | 0.8 - 5 | 0.8 - 5 | 0.1 |
| Pulse rise/fall time (microsecond) | 0.11 | 0.08 | 0.3 | 0.2 - 2 | 0.2 - 2 | 0.005 |
| Pulse repetition rate (pulses per second) | 2 000 | 250 - 1 180 | 259 | 250 - 1 200 | 50 - 1 200 | 100 000 |
| Antenna main beam gain (dBi) | 50 | 40 | 40 | 40 - 50 | 40 - 50 | 35 - 45 |

Many meteorological weather radars operate in the 5 350 - 5 600 MHz band and are owned and operated by state and local governments, private weather forecasting businesses, utility companies, cable television companies, broadcast stations, and college and universities.

In addition to Meteorological weather radars, equipment employed in the MetAids service (*e.g.*, weather radars, radiosondes, dropsondes and rocketsondes) perform some of these observing functions and provide critical data used in daily weather forecasting services, flood warning, and meteorological research studies. Most Federal agencies, state and local governments, academic research programs, and commercial weather-forecasting firms use the data collected by NOAA. Some entities utilize the data for specialized forecasts for broadcast and to industry sectors such as agriculture.

## 4e. Special Purpose Radars

DoD utilizes special-purpose radar systems in the 5 570 - 5 650 MHz band to include airborne synthetic aperture radars for land-mapping and imaging, environmental and land-use studies, and other related research activities. DoD operates these radars systems continuously at various altitudes and with varying look-down angles for periods of time up to hours in duration depending upon the specific measurement campaign being performed.

## 4f. Low Power Devices

Responding to industry requests for spectrum in which to operate unlicensed devices, e.g., primarily wireless local area networks and WiFi devices, in June 2006, the Federal Communications Commission (FCC) adopted rules in Part 2[4] and Part 15 subpart E[5] of

[4] http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=3012cbea9f5a67984ec438c5cd3e9fde&tpl=/ecfrbrowse/Title47/47cfr2_main_02.tpl

the Commission's Rules (CFR 47) allowing commercial users to employ opportunistic sharing techniques to share 355 MHz of radio spectrum. Using Dynamic Frequency Selection (DFS) detect-and-avoid algorithms, commercial devices are now able to operate in the 5 250 - 5 350 MHz and 5 470 - 5 725 MHz bands. Commercial devices may use the 5 150 - 5 250 MHz and 5 725 - 5 825 MHz bands without DFS. Federal agencies operate unlicensed devices that comply with the FCC Part 15 Rules or Annex K of the NTIA Manual through adherence to NTIA Manual Part 7.8 ("PURCHASE AND USE OF NON-LICENSED DEVICES").

## 5. Planned Use

The DoD and DHS will continue operating UAS systems in this band for the foreseeable future.

The DoD will continue to operate ground-band air defense and shipborne surface search, navigation and weapons fire control radar systems in this band for the foreseeable future.

NOAA and Coast Guard will continue to operate weather radar systems in this band for the foreseeable future.

The FAA will continue to operate the TDWR at the 45 sites around major airports. There are currently no plans to deploy TDWR at additional locations.

DoD and NASA use of aeronautical mobile telemetry and telecommand in the 5 350 - 5 460 MHz band will continue for the foreseeable future.

Federal agencies will continue to operate MetAids systems in this band for the foreseeable future.

[5] http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=3012cbea9f5a67984ec438c5cd3e9fde&rgn=div6&view=text&node=47:1.0.1.1.14.5&idno=47