



## **Differential Global Positioning System (DGPS)**

### **DGPS Service**

AMSA's Differential Global Positioning System provides a network of radio beacons that improve the accuracy and integrity of the Global Positioning System (GPS) around selected areas of Australia's coast. These areas include the entire Great Barrier Reef and Torres Strait region, Bass Strait, the south-eastern ports and selected port regions such as Perth, Brisbane, Darwin, Sydney (includes Newcastle and Port Kembla) and Karratha (see coverage map on page 2). The service is primarily intended for commercial shipping.

### **What is DGPS?**

DGPS provides differential corrections to a GPS receiver in order to improve navigation accuracy and monitors the integrity of GPS satellite transmissions.

Integrity monitoring of the reference stations is a vital feature of DGPS. The stations test for GPS signals that are out of specification and immediately notify users to disregard the signal. With DGPS, this warning occurs within a few seconds of the satellite becoming 'unhealthy', compared to the GPS system, where up to 12 hours can elapse before notification is received.

The improved accuracy offered by DGPS takes on greater significance in the 21st century. This is because the use of highly accurate positional information is central to the functioning of navigational aids like Electronic Chart Display and Information Systems (ECDIS) and Automatic (ship) Identification System (AIS).

Each DGPS radio beacon comprises of two independent GPS receivers, (including special software to calculate the corrections), an MSK modulator, a transmitter operating in the LF/MF band (285 - 325 kHz), a DGPS station controller and an integrity monitor. Critical components of the system are redundant and the DGPS radio beacons are remotely controlled and monitored 24 hours a day. The status of any 'unhealthy' DGPS radio beacon is reported to mariners via coastal navigational (AUSCOAST) warnings.

AMSA's DGPS station network was completed in December 2002. The 16 stations are located at (*frequencies of transmission in brackets*):

- Albany (315 kHz)
- Brisbane (294 kHz)
- Cape Flattery (304 kHz)
- Corny Point (316 kHz)
- Crib Point (314 kHz)
- Darwin (294 kHz)
- Exmouth (297 kHz)
- Gladstone (313 kHz)
- Horn Island (320 kHz)
- Ingham (306 kHz)
- Karratha (304 kHz)
- Mackay (315 kHz)
- Mallacoota (318 kHz)
- Perth (306 kHz)
- Sydney (308 kHz)
- Weipa (316 kHz)

The range of coverage is approximately 150 nautical miles out to sea from each of these beacons.

## Standards And Accuracy

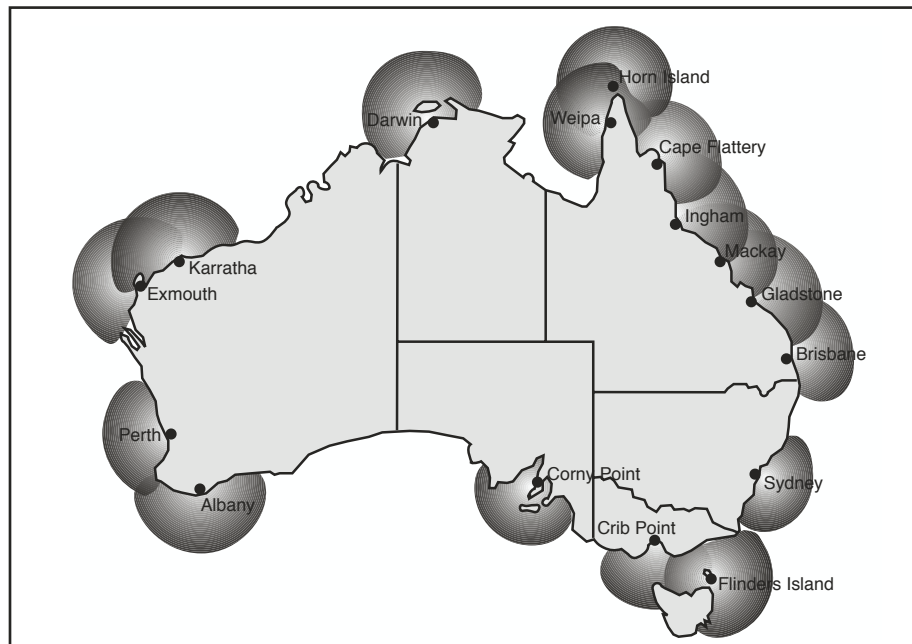
DGPS services can be delivered by terrestrial radio broadcasting stations or via satellites, providing a wide area service.

AMSA's DGPS service which operates in the MF radiobeacon band (285-325 kHz) has been designed to comply with the relevant prevailing standards of RTCM (Radio Technical Commission for Maritime Services), IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities) and ITU (International Telecommunications Union), to ensure that shipboard equipment on international ships is capable of receiving and using the signals.

This form of DGPS uses pseudo-range (distance measurement) corrections and range-rate corrections from a single reference station, which has sufficient channels (typically 12) to track all satellites in view. Pseudo-ranges are simultaneously measured to all satellites in view, and using the known position of the receiver's antenna and the positional data from each satellite, the errors in the pseudo-ranges are calculated. These errors are converted to corrections and are broadcast to user receivers.

The user's GPS receiver applies the corrections to the pseudo-ranges measured to each satellite used in its position calculation. The GPS receiver always applies the latest corrections received.

Using this method, and depending on the user-to-reference station separation and the age of the



corrections being applied, horizontal accuracy of the system can be improved from 13 to 22 metres (95% of the time) to better than 10 metres (95% of the time). Monitoring of AMSA's operational stations indicates that accuracies of 2-4 metres can be expected from a typical maritime DGPS receiver.

The further the user is from the reference station, the less accurate the navigational solution is likely to be.

## Equipment Required

To improve GPS navigational accuracy, users need a GPS receiver, which is 'differential-ready', and a DGPS beacon receiver. Another solution is to use a DGPS receiver that houses the GPS and beacon receivers inside the one unit. Installation requires mounting the DGPS beacon receiver antenna, and connecting the DGPS beacon receiver to the DGPS (or RTCM) port on your Differential-Ready GPS receiver. This equipment can be purchased from GPS or maritime equipment distributors.

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Visit [www.amsa.gov.au/Shipping\\_Safety/Navigation\\_Safety/](http://www.amsa.gov.au/Shipping_Safety/Navigation_Safety/) for up-to-date information, including details on the accuracy of AMSA's DGPS reference station's antenna position surveys.