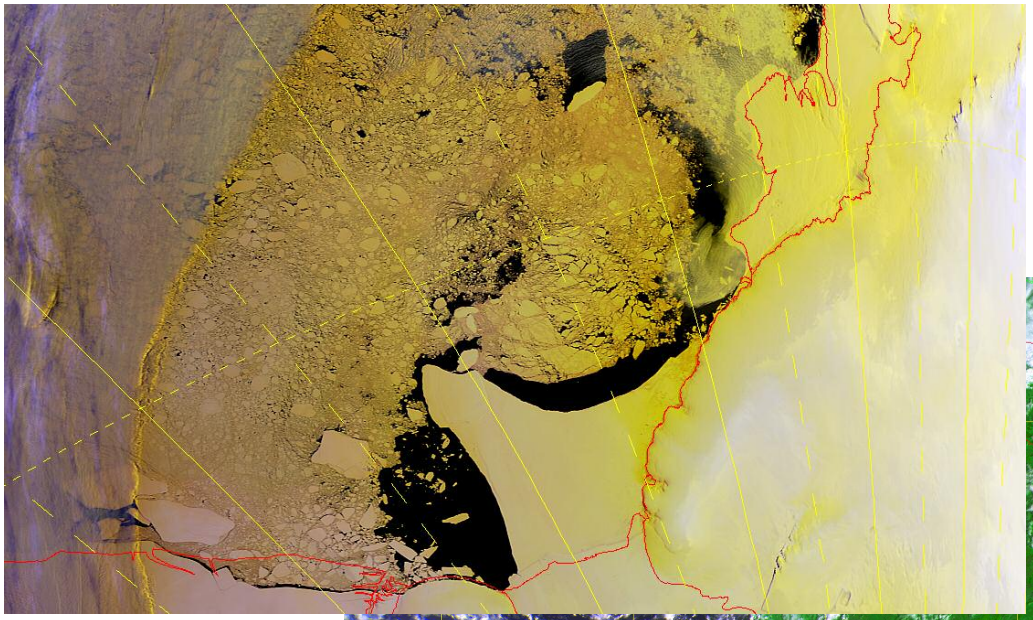
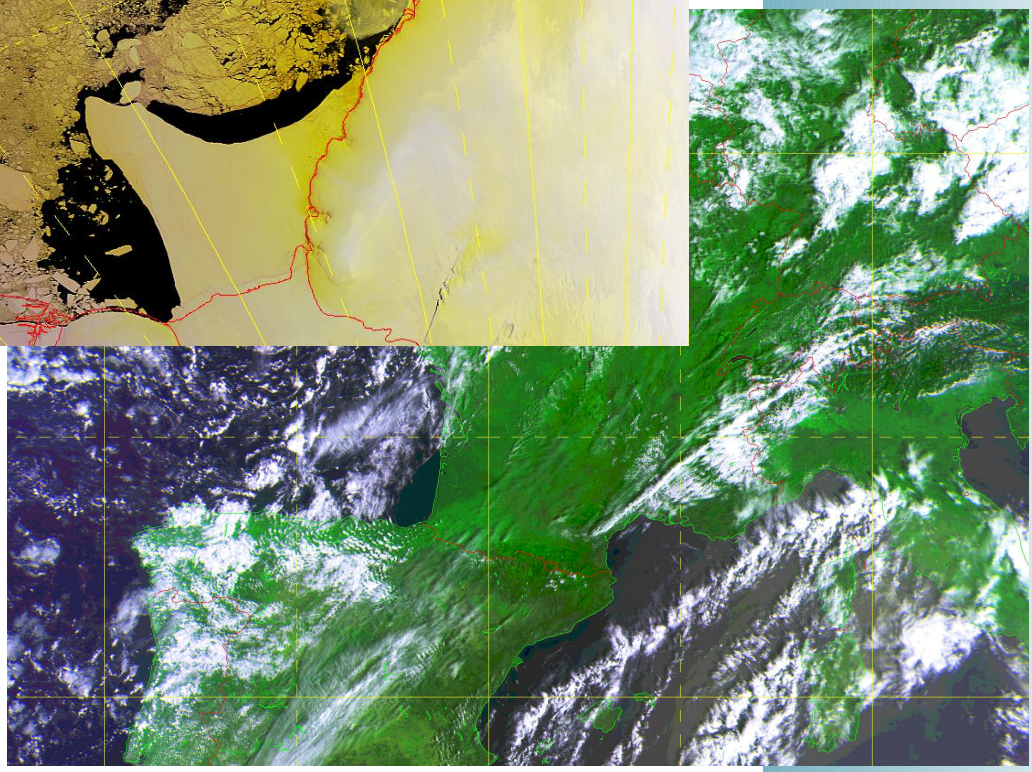
L-Band Polar Orbiter systems

Acquisition, processing and display systems for HRPT, CHRPT, SeaWiFS and AHRPT data from NOAA, Feng Yun, SeaStar and Metop satellites



▲ *NOAA HRPT image (bands 1, 2 and 4) showing Halley Base and surrounding area in Antarctica*



► *Feng Yun CHRPT image (bands 1, 2 and 7) of Europe transformed to fit a Mercator projection*

The Dartcom L-Band Polar Orbiter systems receive, archive, process and display digital HRPT, CHRPT, SeaWiFS* and AHRPT data from NOAA, Feng Yun, SeaStar and Metop polar-orbiting satellites.

The satellite data is transmitted in real-time and provides a spatial resolution of 1.1km in up to ten spectral bands, from visible to infra-red. Atmospheric and environmental data such as AMSU, SEM, TOVS and DCS (Argos) is also available from NOAA and Metop satellites.

A wide range of antenna options is available to suit land-based and marine applications, from a 1.8m parabolic dish and rotator to a 1.3m active-stabilised antenna enclosed in a radome.

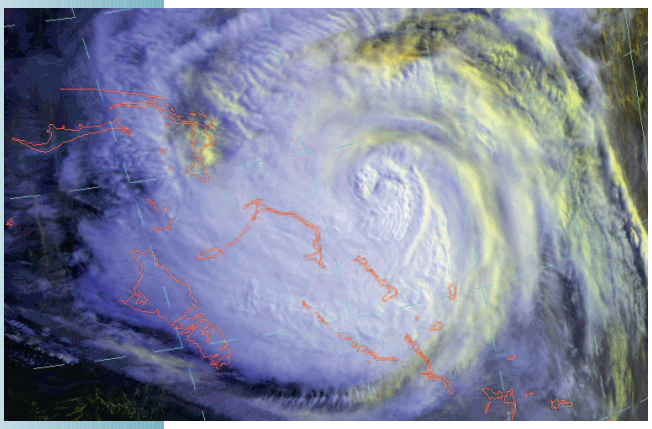
Between passes LRIT reception from MSG direct broadcast, GOES and MTSAT is also possible with an optional rack module and software. An additional antenna can also be supplied if continuous LRIT reception is required.

All systems can be upgraded in the future to receive LRD data from NPOESS (when available).

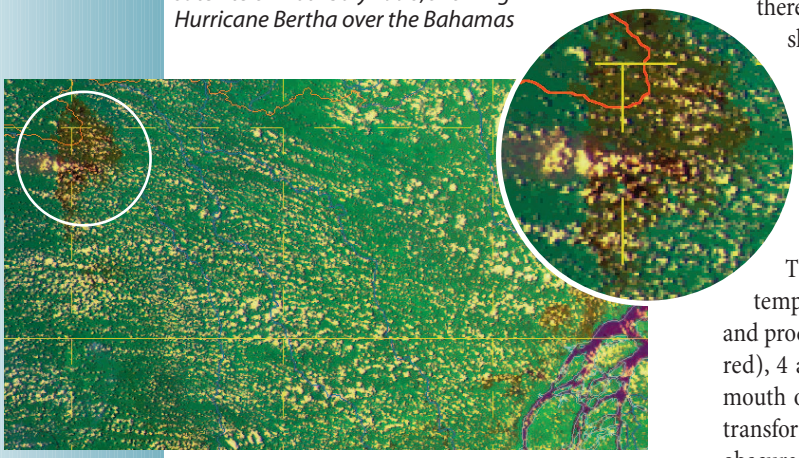
* SeaWiFS data from SeaStar is encrypted and requires a decryption licence from ORBIMAGE Inc.

DARTCOM

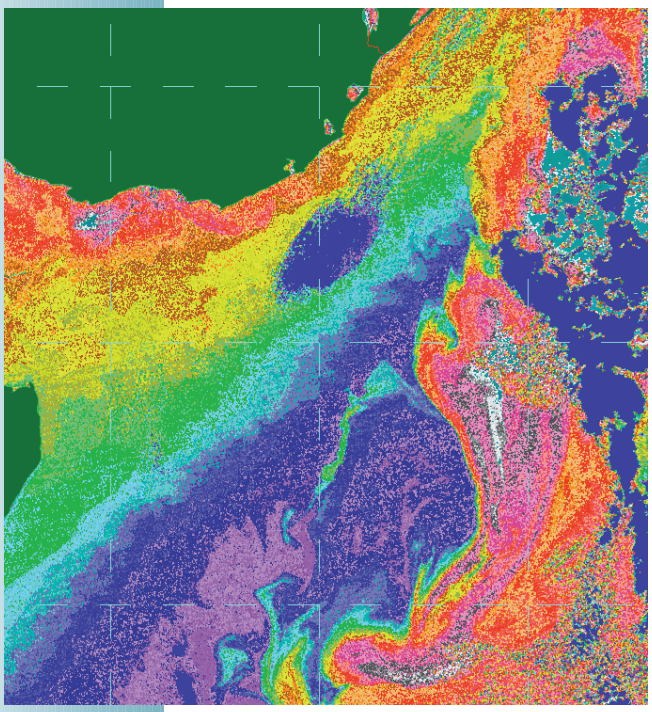
L-Band Polar Orbiter systems applications



▲ *HRPT image received from the NOAA 12 satellite on 10th July 1996, showing Hurricane Bertha over the Bahamas*



▲ *Scrubland in Brazil, between the Marapi and Paru de Oeste rivers, is clear on this HRPT image*



▲ *A McClain SST product (Mercator-reprojected with land masking) showing sea surface temperatures and currents*

► *Areas of algal bloom off the coast of South-West England on an enhanced CHRPT image*

Weather system observation

The multi-spectral HRPT image opposite (bands 1, 2 and 4) shows Hurricane Bertha near Eleuthera in the Bahamas. As well as tracking hurricanes and storms, HRPT and CHRPT data can be used to study weather systems and determine cloud types, temperatures and sizes.

The TOVS data received by the system can be used, for example, to look at geostrophic wind fields at different altitudes, produce T-Φ and T-log(P) tephigrams and plot ozone mappings, using third-party software (such as PC-TOVS or University of Wisconsin ITPP).

Environmental monitoring

Green vegetation has a reflectance of up to 60% in the near infra-red band. The data from the band 2 (near infra-red) sensor can therefore be applied to the green plane of a multi-plane image to show green vegetation.

The magnified area of the image opposite shows a large area of scrubland in Brazil. This is indicated by the brown colour, caused by the low vegetation activity compared with the surrounding areas.

Sea surface temperatures

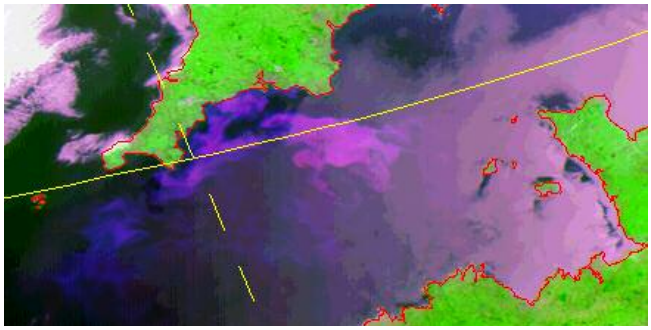
The image below left is a McClain SST (sea surface temperature) product generated by the Dartcom iDAP display and processing software. It was produced from bands 2 (near infra-red), 4 and 5 (both thermal infra-red) of an HRPT image of the mouth of the River Plate, between Uruguay and Argentina. It was transformed to fit a Mercator projection, and a mask was applied to obscure the land, which is not relevant in an SST product.

The image clearly shows currents, boundaries between areas of different sea surface temperature and mixing of warm and cold water. The temperature of each pixel in the image can be obtained to an accuracy of 0.1˚C.

SST products can be used to determine likely areas of fish feeding. Also, knowing the exact location and direction of travel of warm and cold currents can be vital in route planning to help reduce fuel consumption and voyage times.

Ocean colour

Feng Yun CHRPT images contain five more bands than HRPT images. Three of these are ocean colour, which enable features such as the algal bloom in the image below to be detected. The image is a colour composite of bands 1, 2 and 8 of a Feng Yun 1C CHRPT image, and has been enhanced using the Dartcom iDAP software. The areas of algal bloom (purple and magenta) are clearly visible.



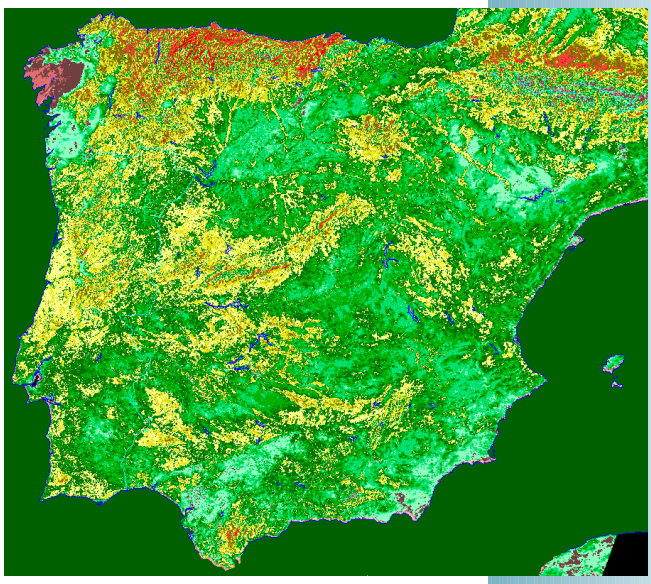
Vegetation indexing

The image opposite was produced using the Dartcom iDAP software, and shows Spain and Portugal. It is a Normalised Difference Vegetation Index (NDVI) product, and was generated using the following formula:

(band 2 – band 1) ÷ (band 2 + band 1) × 255

This shows the vegetation activity over the land area. The higher the NDVI value, the more active the vegetation.

The image has been transformed to fit a Mercator projection and areas of sea have been removed from the image with a user-defined mask. All of this processing can be accomplished using the the Dartcom iDAP software, which includes a comprehensive formula language for product generation and Digital Elevation Model (DEM) masking facilities for land and sea masking.

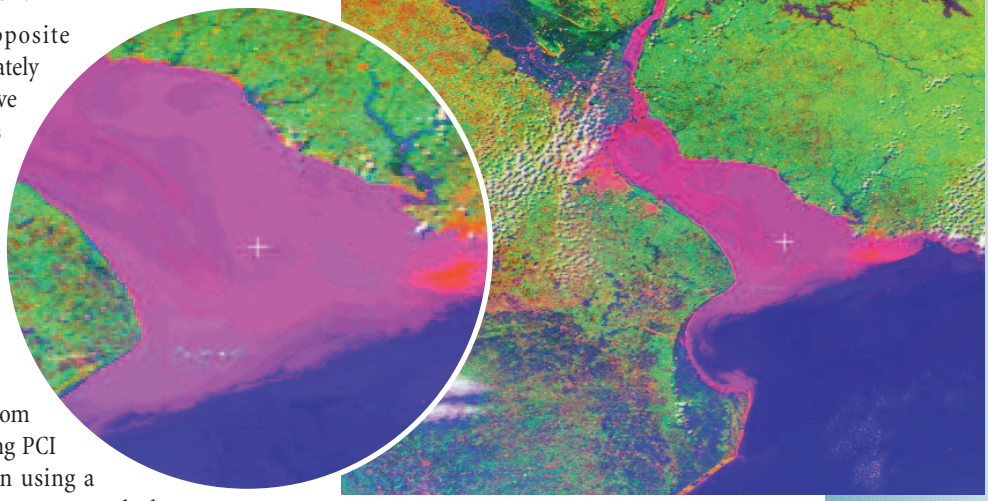


▲ *A normalised difference vegetation index (NDVI) product generated using the Dartcom iDAP software, showing vegetation activity*

Third-party image processing

In addition to a wide range of image processing facilities, the Dartcom iDAP viewing and processing software also provides file format outputs to enable further processing in a number of widely-used third-party image processing applications, such as PCI Geomatica, ERDAS Imagine and ENVI*. NOAA level 1B and SHARP level 1B outputs are also available to allow importing of data into other processing packages, such as Space 2.

The multi-spectral image opposite (magnification inset) shows approximately the same area as the SST product above (the mouth of the River Plate). It was exported to PCI Geomatica format from iDAP, then processed to show suspended sediment at the mouth of the river. The image shows a clear boundary between the sea (blue) and the sediment (magenta).



▲ *An HRPT image processed using PCI Geomatica software to show suspended sediment at the mouth of the River Plate*

Cloud classification

The image below right was produced from an HRPT image of Western France using PCI Geomatica. It is a cloud classification using a cluster analysis. The water and land areas were masked out and an unsupervised classification was carried out to identify up to eight cloud classes.

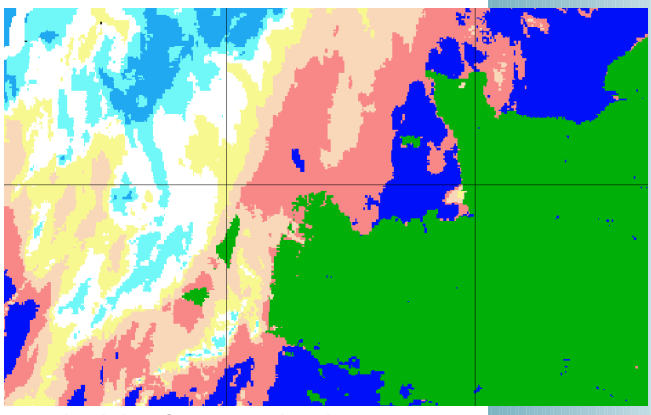
The results were then examined and labels assigned to each class, based upon interpretation and reference to a cloud chart giving the temperature ranges and brightness values in bands 1 and 2.

Where appropriate, two classes were merged so that the final classification contains only six classes, plus land and water.

**PCI Geomatica, ERDAS Imagine or ENVI optional at extra cost.*

Cloud classification legend

- *Water*
- *Land*
- *Fog (low cloud)*
- *Thin Stratos cloud*
- *Low Stratocumulus*
- *Medium Stratocumulus*
- *Nimbus*
- *Nimbus*



▲ *A cloud classification produced using PCI Geomatica software, enabling cloud classes to be identified quickly and easily*

L-Band Polar Orbiter systems technical details

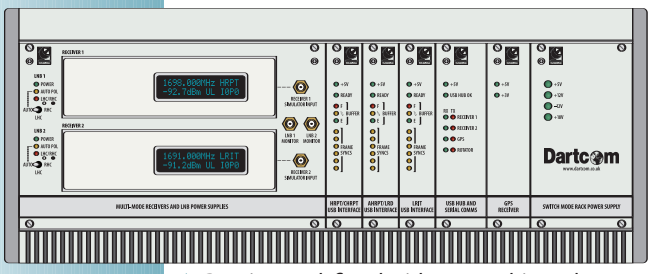




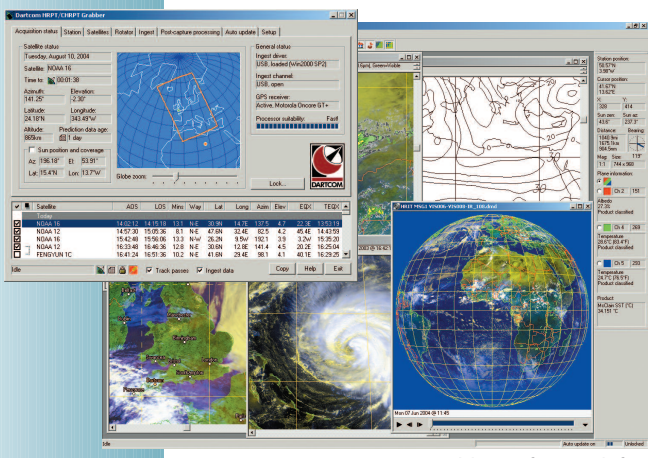




▲ *Clockwise from top left: 1.8m antenna and rotator, 1.5m antenna and rotator inside radome, 1.2m antenna and rotator, 1.3m active-stabilised marine antenna*



▲ *Receiver rack fitted with two multi-mode digital receivers and LRIT USB interface module*



▲ *Dartcom HRPT/CHRPT Grabber software (left), Dartcom iDAP and MacroPro software (right)*

Antenna

A wide range of antennas is available to suit land-based and marine applications. The 1.8m, 1.5m and 1.2m parabolic dish and rotator are designed for fixed, land-based ground stations.

The 1.3m active-stabilised marine antenna uses a state-of-the-art active stabilisation system and is enclosed in a radome.

These options all provide reliable, high-quality data and are capable of HRPT, CHRPT, SeaWiFS, AHRPT, LRD and LRIT reception.

Receiver rack

The receiving equipment is housed in a 84HP Eurocard rack (desk or rack mount) containing plug-in modules:

- Multi-mode receivers and LNB power supplies module containing up to two digital multi-mode receivers (one as standard).
- HRPT/CHRPT/SeaWiFS USB interface module.
- AHRPT/LRD USB interface module.
- Optional LRIT USB interface module.
- USB hub and serial communications module containing 7-port USB hub, four USB serial adaptors and RS232/422/485 rotator interface.
- GPS receiver module.
- Switch mode rack power supply module.

Satellite data is transferred to the host computer via a 12Mbit/s USB connection. GPS data is transferred via RS232 and rotator control data via RS232/422/485, or optionally via USB if serial ports are not available on the host computer.

Host computer

The exact specifications of the host computer can be tailored according to your requirements. Suggested specifications are:

- Desktop or notebook PC with dual-core processor.
- PCI Express graphics with 128MB RAM.
- 19" TFT display (15" for notebooks).
- 1GB RAM.
- 80GB+250GB hard disk drives (single 160GB for notebooks).
- DVD±RW drive.
- 10/100Mbit Ethernet for data output and remote archiving.
- Windows XP Professional.

Software

- **Dartcom HRPT/CHRPT Grabber** software, providing automatic image capture, archiving, decommutation and exporting.
- **Dartcom iDAP** software, providing a comprehensive range of display, manipulation, processing and printing facilities.
- **Dartcom MacroPro** software which automates the powerful processing facilities provided by iDAP.

Dartcom, Powdermills, Postbridge, Yelverton, Devon, PL20 6SP, UK

Telephone (01822) 880253 • International +44 1822 880253
Fax (01822) 880232 • International +44 1822 880232
Internet *http://www.dartcom.co.uk*
E-mail *sales@dartcom.co.uk*

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Correct from 6th September 2007. E&OE.

L-Band Polar Orbiter systems land-based antennas

1.8m parabolic dish and rotator

The Dartcom 1.8m antenna is a prime focus aluminium parabolic dish with an F/D ratio of 0.42 and a gain of 27.5dBi. This enables a G/T of better than 6.0dBK at 5˚ to be achieved. An integrated feed, LNA and downconverter is mounted at the focal point of the antenna in a hermetically sealed unit.

The 1.8m antenna system allows continuous tracking of satellites with no cone of silence (loss of data) and a bit error rate of better than $1:10^6$ from 1˚ elevation. Azimuth and elevation control of the rotator is achieved via an RS232–RS422 link to the host computer.

The reflector is finished in light grey paint to PML specification RS20. The antenna is fixed to the rotator using interface steelwork galvanised to BS729 specification. The rotator is precision engineered using aluminium castings and machined steel for strength. The antenna and rotator are mounted on a durable galvanised steel pedestal.

1.5m and 1.2m parabolic dish and rotator

The Dartcom 1.5m antenna is a prime focus aluminium parabolic dish with an F/D ratio of 0.36 and a gain of 26.0dBi. This enables a G/T of better than 4.5dBK at 5˚ to be achieved. The 1.5m antenna system allows continuous tracking of satellites with no cone of silence (loss of data) and a bit error rate of better than $1:10^6$ from 2˚ elevation.

The Dartcom 1.2m antenna is a prime focus aluminium parabolic dish with an F/D ratio of 0.38 and a gain of 24.6dBi. This enables a G/T of better than 3.0dBK at 5˚ to be achieved. The 1.2m antenna system allows continuous tracking of satellites with no cone of silence (loss of data) and a bit error rate of better than $1:10^6$ from 3.5˚ elevation.

With both options an integrated feed, LNA and downconverter is mounted at the focal point of the antenna in a hermetically sealed unit. Azimuth and elevation control of the rotator is achieved via an RS232–RS422 link to the host computer.

The reflector is finished in light grey paint to PML specification RS20. The antenna is fixed to the rotator using a counter-weighted aluminium frame assembly. The rotator is a compact unit with a separate housing for the power supply and control electronics.

The antenna assembly is mounted on a steel pedestal (galvanised with the 1.2m antenna option). The 1.5m antenna is mounted inside a two-part (plus base) glass-fibre radome with bottom or side inspection hatches.





▲ *Dartcom 1.8m parabolic dish antenna and rotator*

◀ *Dartcom 1.5m parabolic dish antenna and rotator inside glass-fibre radome*



► *Dartcom 1.2m parabolic dish antenna and rotator*

Feed:	
Beamwidth	3dB at 80˚, 10dB at 150˚
Gain	+4.5dBi
Polarisation	Right-hand circular
Filter/LNA:	
Insertion loss	0.4dB (maximum)
Filter bandwidth	200MHz (maximum)
Noise figure	0.8dB (maximum)
Gain	+35dB (minimum)
LNA bandwidth	100MHz (minimum)
Bandpass filter:	
Insertion loss	1.5dB (maximum)
Bandwidth	1690MHz to 1710MHz
Downconverter:	
RF-IF gain	40dB (nominal)
Input range	1690MHz to 1710MHz
IF output	125MHz to 145MHz

	1.8m antenna	**1.5m antenna and radome**	**1.2m antenna**
Bit error rate	$1:10^6$ (from 1˚ elevation)	$1:10^6$ (from 2˚ elevation)	$1:10^6$ (from 3.5˚ elevation)
Azimuth range	0˚ to 359.9˚ (minimum)	0˚ to 359.9˚ (minimum)	0˚ to 359.9˚ (minimum)
Elevation range	0˚ to 180.0˚ (minimum)	0˚ to 180.0˚ (minimum)	0˚ to 180.0˚ (minimum)
Azimuth rate	12.0˚/second (±10%)	10.0˚/second (±10%)	10.0˚/second (±10%)
Elevation rate	1.0˚/second (±10%)	10.0˚/second (±10%)	10.0˚/second (±10%)
Mechanical tolerance	< ±0.1˚ azimuth and elevation	< ±0.5˚ azimuth and elevation	< ±0.5˚ azimuth and elevation
Tracking accuracy	< ±0.5˚	< ±0.5˚	< ±0.5˚
Survival temperature	–35˚C to +63˚C	–20˚C to +60˚C	–20˚C to +60˚C
Survival wind speed	210km/h (100km/h operational)	200km/h	145km/h (85km/h operational)

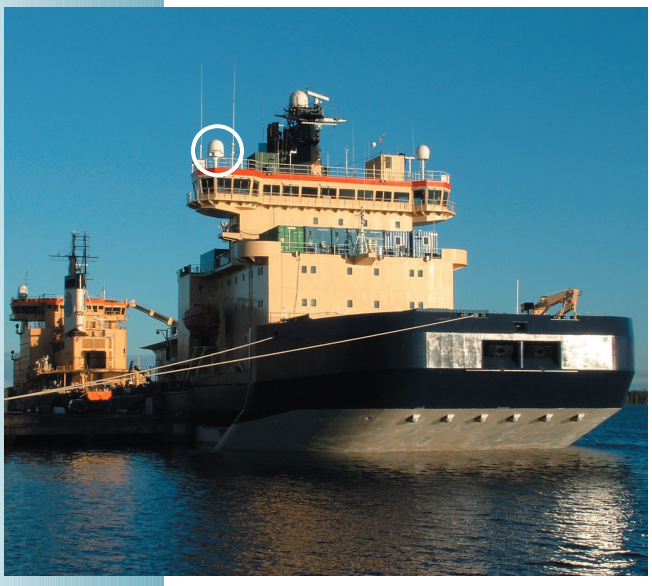
L-Band Polar Orbiter systems marine antenna





▲ *Equipment rack installed on* ***Oden***

▲▼ *Dartcom 1.3m active-stabilised marine antenna installed on the Swedish Polar Institute icebreaker* ***Oden***



1.3m active-stabilised marine antenna

The Dartcom 1.3m active-stabilised marine antenna is capable of tracking NOAA, Feng Yun, SeaStar, Metop and NPOESS polar-orbiting satellites on-board moving vessels.

The antenna uses a state-of-the-art X-Y pedestal to compensate for the pitch, roll and yaw of the vessel. It provides continuous axis movement, eliminating cable wrap problems without the need for slip-rings or rotary joints. Together with the pedestal's very high speed and accuracy, this also ensures that there is no "cone of silence", even during overhead passes.

The antenna control unit is located below decks in a 19" rack with the receiving equipment and rack-mount computer. It provides fully-automatic control of the X-Y pedestal using an advanced stabilisation algorithm. Full diagnostics and maintenance tools are available via a graphical user interface on a TFT colour display.

When not ingesting polar-orbiter data, options are available which allow the reception of LRIT data from geostationary satellites (such as MSG direct broadcast, GOES and MTSAT) or Ku-band satellite TV transmissions (in conjunction with a suitable receiver).

Features

- 1.3m parabolic dish antenna.
- 1.7GHz L-band RHC feed, pre-LNA filter and LNA unit.
- High-speed, high-accuracy, high-reliability XY pedestal compensating for pitch, roll and yaw, with continuous axis movement to eliminate cable wrap problems.
- Weather-tight glass fibre radome and base, with access hatch.
- Fully-automatic antenna control unit with full diagnostics and maintenance tools provided via a TFT colour display and GUI.
- Below-decks equipment mounted in a 19" rack.
- Bit error rate of better than 1:10^6 from 3.5˚ elevation for HRPT, AHRPT and LRD, 5˚ for SeaWiFS and 7.5˚ for CHRPT.
- System G/T of 3.4dB/K at 5˚ elevation.
- Designed to meet MIL-STD specifications.
- ISO9001/CE certified.

Antenna:		**Radome:**	
Diameter	1.3m	**Height**	1.68m (approximately)
Polarisation	L-band right-hand circular	**Diameter**	1.52m (approximately)
Gain	24.7dBiC	**Environment:**	
Pedestal:		**Operational wind speed**	185km/h (100 knots)
Stabilisation	Active, with gyro sensors for pitch, roll and yaw rates	**Survival wind speed**	240km/h (130 knots)
		Operating temperature	–30˚C to +70˚C
Azimuth range	No limit (continuous)	**Design specifications:**	
Elevation range	–10˚ to 190˚	**EMI/RFI**	MIL-STD-461
Pitch rate	±15˚ in 6 seconds	**Vibration**	MIL-STD-167-1
Roll rate	±30˚ in 8 seconds	**Shock**	MIL-STD-901
Yaw rate	±80˚ in 50 seconds	**Power requirements:**	
Turn rate	10˚/second	**Voltage**	115/230V AC @ 50/60Hz
Total weight	150kg (approximately)	**Power consumption**	1000VA (typically)

L-Band Polar Orbiter systems receiver rack

The receiver rack can be supplied with up to two state-of-the-art digital multi-mode receivers to provide support for HRPT, CHRPT, SeaWiFS, AHRPT and LRIT. With an additional antenna and software simultaneous reception is also possible from two types of service (HRPT/CHRPT/SeaWiFS and LRIT, for example).

The rack can be upgraded in the future to support LRD data from NPOESS satellites (when available).

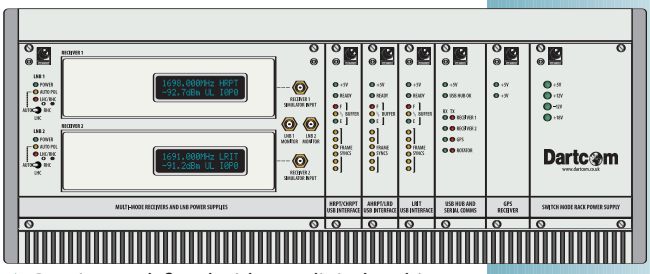
Features

- 19 inch 4U high Eurocard rack.
- Plug-in modules for easy maintenance and upgrades.
- Desk or rack mount.
- 12Mbit/s USB connection for satellite data and rack control.
- RS232 for GPS data and RS232/422/48 for rotator control, or optionally via USB if serial ports are not available.

Modules

The receiver rack contains the following plug-in modules:

- Multi-mode receivers and LNB power supplies module containing up to two digital multi-mode receivers (one as standard).
- HRPT/CHRPT/SeaWiFS USB interface module.
- AHRPT/LRD USB interface module.
- Optional LRIT USB interface module.
- USB hub and serial communications module containing a 7-port USB hub, four USB serial adaptors and an RS232/422/485 rotator interface.
- GPS receiver module.
- Switch mode rack power supply module.



▲ *Receiver rack fitted with two digital multi-mode receivers and LRIT USB interface module*

Demodulation	QPSK, BPSK, PSK, up to 3.5MSPS
Decoding	Viterbi
IF conversion	Direct 70MHz, up to 50MSPS, 10-bit resolution
Operating temperature	0˚C to +50˚C
Storage temperature	0˚C to +70˚C
Humidity	30% to 70% non-condensing
EMC	BS EN 6100-6-4:2001
Electrical safety	LVD 73/23/EEC as amended by 93/68/EEC
Dimensions (W×H×D)	450×180×455mm (including connector projections)
Weight	14.5kg (approximate)
Power requirements	110–240V AC @ 50–400Hz
Power consumption	60VA
Wild heat	100W

▲ *Specifications of receiver rack fitted with two digital multi-mode receivers and LRIT USB interface module*