



VideoWave 1.4GHz

Operation and Installation Instructions



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The VideoWave system is a professional quality system designed for sending composite NTSC or PAL video signals. All products comply with the R&TTE Directive 1999/5/EC. Models are available with various power outputs for license-free operation in most European countries. Due to the license-free operation of these products, there is no guarantee that interference will not occur in a particular installation. RDT does not assume any responsibility for the use of the products described. No product patents are implied and RDT reserves the right to change the said products without notice at any time.

System Description

The VideoWave Wireless Video Transmission is a professional system designed for sending composite NTSC or PAL video signals using 1.4 GHz wireless technology.

Figure 1 - Transmitter connections

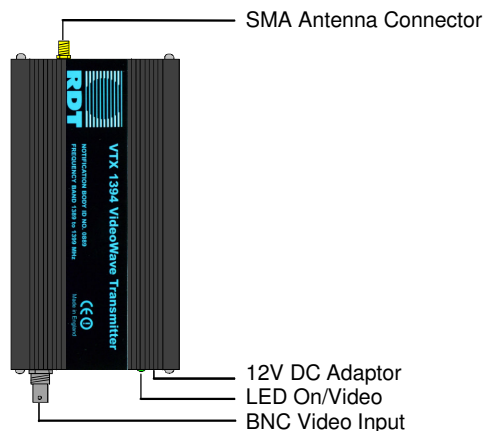
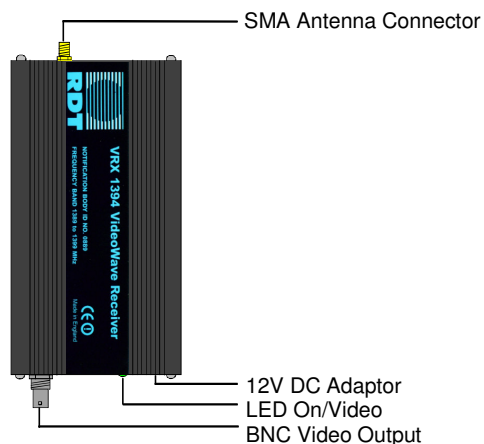


Figure 2 – Receiver connections



Survey and Installation Guide

Before carrying out installation, it is important to bench test and familiarize yourself with the equipment. This manual will help with antenna choice, transmission performance, achievable distance etc.

Note: The longer the radio path the more critical details of installation become.

Bench Test

The Videowave system is supplied as standard with an ANT2350, Patch antenna. These will be sufficient for testing and for use over short to medium distances (see table on Page 9).

Before testing the VideoWave equipment, connect the camera to be used, directly to the monitor with a 75 ohm cable and check for correct operation.

Note: Do not power the transmitter without an antenna connected. Always disconnect power to the transmitter before connecting the antenna. Failure to do so may damage the unit.

Fit the antenna to the VTX unit (transmitter) and connect the power using the 12V unit supplied (or the mains supply in an SE version). The LED will show RED indicating 'power on'. Now connect the camera to the video input. When the camera is powered the 'on' LED will change to GREEN, indicating the presence of a video signal.

Note: The unit will not transmit until it detects a valid video input.

Fit the antenna to the VRX unit (receiver) and connect the power. The LED will light RED to show 'power on'. Connect the video output to the monitor. When the camera is turned on, the LED will change to GREEN, indicating a video signal is being received. The picture should appear on the monitor and be clear with no distortion.

System Performance

The VideoWave functions in exactly the same way as standard broadcast TV transmissions, but on a much lower signal strength. TV aerials are normally installed as high as possible to give the clearest signal path and achieve good reception. In most cases if the external TV aerial is disconnected and replaced with a small indoor aerial, the reception becomes poor. In the same way, VideoWave will always perform best by adopting the same principle. Terrain, antenna height and signal strength will always be the deciding factors in achieving good communications.

In an ideal installation 'LINE-OF-SIGHT' between the transmitter and receiver will give optimum results (see Technical Notes). Obstacles blocking the line of sight will reduce transmission distances and affect picture quality. The video signal may pass through walls of brick or wood but metal objects will almost certainly block the signal; the denser the obstacles the greater their effect.

Note: Metal objects near or directly behind the antennas may also have an adverse effect. If possible carry out a survey to establish good communications before final installation

Site Survey

It is advisable to carry out a survey to establish a good radio path prior to installation. This will help with the positioning of the equipment and choice of antenna. Your distributor should be able to assist with information and may be able to provide a Survey Kit and antennas.

Before commencing a survey, measure or estimate from a map, the straight-line distance between the two sites. From the tables on page 9, check which type of antenna would be needed to cover the required distance. Visit the sites to see if there is a suitable location for equipment and the antennas, normally on the roof of the building. It should also be possible to see if there is a reasonable line-of-sight between the two locations or if there are any significant obstructions (see Technical Notes). A pair of field glasses may be useful if the sites are some distance apart.

Make a temporary installation of a camera and transmitter. *Note: battery-operated equipment is available for this purpose.* Position the antenna and leave the equipment running. At the receive site, set up the receiver and monitor. Position the antenna and adjust its position to get the best picture quality. If the picture quality is not good, try moving the antenna to other locations. Performance will be affected by obstructions or metal objects nearby. Even the antenna mounting pole can cause a problem if the antenna is not correctly mounted clear of the pole. For longer distances, it may be necessary to use a high gain antenna on the receiver site.

Note: High gain antennas are directional and must be aimed at the transmission site and then adjusted by rotating until maximum signal strength is achieved. The POLARISATION of both antennas must match. For example, if the transmitting antenna is vertical then the receiving antenna must also be vertical.

If the signal strength is too low it may be increased by raising the height of the transmit antenna, receive antenna or both. Care must be taken, however, because there will be a loss of signal in the cable and connectors. For the actual installation, a good quality low-loss cable should be used between the antenna and the VideoWave units (i.e. LMR400). Alternatively, the VideoWave unit can be housed in a weatherproof enclosure and mounted on the pole near the antenna.

If the picture quality is poor, even with reasonable signal strength, this may be due to interference. Remember that this is a license free band and other users could be transmitting in the area. If interference is suspected, try turning off the transmitter and checking the LED on the receiver. This should be RED and not GREEN or flickering RED/GREEN. Also look at the monitor, which should just show a clean screen with no patterning. If there is interference, try moving the antennas.

Figure 3

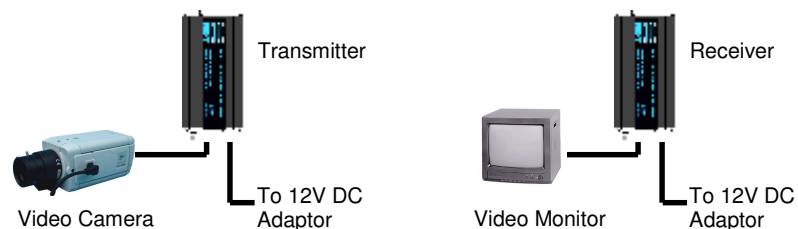


Figure 3 shows the most common connection diagram for setting up a simple wireless video link using the VideoWave system.

Installation

For this section, it is assumed that the equipment has been bench tested, is working correctly and that a site survey has been completed. If not, carry out these tests before beginning the installation.

Transmitter

Start by installing the transmitter in the required location. The transmitter can either be located inside or outside, if it is housed in a suitable weatherproof enclosure. (See page 11)

Connect the antenna. For short-range operation the standard Patch or 1/2 Wave whip antenna can be used, fitted directly to the transmitter. For greater distances a Dipole or 12dB patch should be selected. These will require external mounting on a suitable pole (see page 7).

Note: 1/2 Wave Whip antennas are not weatherproof and therefore not really recommended for external use.

Generally, the higher the antenna, the better the radio performance. It should be noted however that there will be a significant loss of signal in the antenna cable if it is too long. The recommended cable is LMR400, which has a loss of approximately 0.2dB per metre. There will also be a small loss of approximately 0.2dB for each connector.

Using these figures as a guide, the recommended maximum length of antenna cable is about 5 metres, which equates to a loss of about 1dB. This will reduce the effective radiated power, but will have little effect on the actual distance achieved. Raising the antenna height has a much greater effect than changing the radiated power.

If it is necessary to mount the antenna even higher, to clear a building for example, then a higher gain antenna can be used to compensate for the loss in the cable. If possible, it may be better to house the transmitter in a weatherproof enclosure and mount the unit close to the antenna.

Install the camera in the required position and connect to the transmitter using a 75 ohm coax cable. Connect the power to both units.

Before leaving the transmitter site, if possible, check that the unit is working correctly using the receiver unit connected to a monitor. It may be necessary to adjust the camera view or lens iris to obtain the clearest picture.

Receiver

Installation of the receiver unit is basically a repeat of the transmitter installation.

The antenna selection will depend on the distance from the transmitter site and the results of the site survey.

When the antenna is in position, before finally tightening the fixings and securing the cable, connect the receiver unit and connect a monitor to the receiver. Check the picture on the monitor. Again adjust the antenna position if required to obtain the best possible picture. Because of reflections and multi-path, small movements of the antenna can have a significant effect.

If a high gain antenna is being used, aim the antenna in the direction of the transmitter. Make sure that the polarization of the two antennas match. Using the picture on the monitor, rotate the antenna in the horizontal plane until the best picture is achieved.

Once the best results have been obtained fix all the equipment in position.

Note: As with the transmitter installation, cable lengths should be kept to a minimum to reduce losses. Again, consider mounting the receiver unit close to the antenna in an external

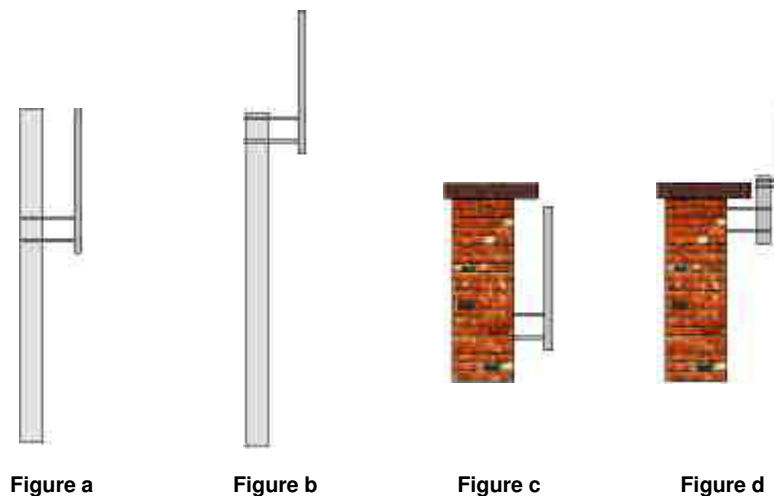
General

It is important that antennas are mounted correctly and securely. Remember that on a high pole, although the antennas are relatively small, there will still be a considerable wind loading. If in any doubt, contact a qualified aerial rigger.

It is essential that the polarization of the transmit and receive antenna is matched.

Make sure that all connections are weatherproof. This can best be achieved by covering all connectors with a layer of self-amalgamating tape. Also make sure that cable entries to buildings are well sealed with mastic.

Antenna Mounting



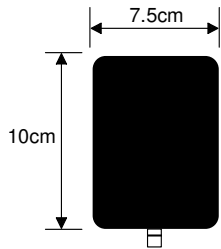
The above diagrams show some typical examples of antenna mounting.

- Not recommended. The mounting pole will have an effect on the antennas performance and could cause reflections.
- This is the preferred arrangement where the antenna is clear of the mounting pole.
- Not recommended. Although in this position the antenna may work, especially if the radio path is away from the wall, the proximity of the wall can cause adverse effects. Many walls, for example, have steel reinforcing or even metal cladding.
- This is the preferred arrangement with the antenna clear of the building. A small pole mounted on 'A' brackets may be required to clear the roof overhang, as shown.

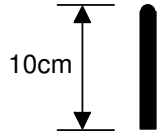
Antenna Types and Performance

Any of the following antennas may be used in combination to give the best possible link quality. Always make sure that the polarity is matched i.e. both vertically polarized.

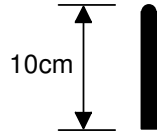
High gain antenna, such as the 12dB Patch, should only be used on the receiver. A small amount of gain is acceptable on the transmitter to compensate for cable losses providing the ERP (maximum output power at the antenna) does not exceed the limit.



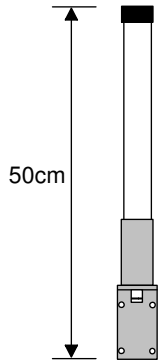
ANT2350 3dB patch
(standard issue)



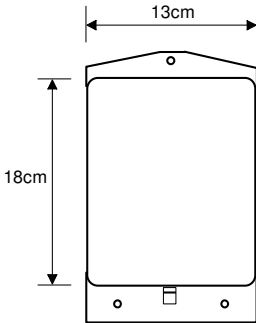
ANT0002 1/2 wave whip
(TNC connector)



ANT0003 1/2 wave whip
(SMA connector)



ANT0005-CAB Dipole
with 3m cable



ANT2351-CAB 12dB patch

Transmission Distances in Metres (Line-of-Sight)

Antenna	Description	Distance
ANT2350	3dB patch (standard issue)	1000 -1500m
ANT0002	1/2 wave whip (TNC connector)	800m
ANT0003	1/2 wave whip (SMA connector)	800m
ANT0005-CAB	Dipole with 3m cable	1000 – 1500m
ANT2351-CAB	12dB patch	2000 – 4000m

Wireless Telemetry

Telemetry for controlling PTZ cameras etc. cannot be transmitted directly over the VideoWave but requires the addition of a Radio Modem to transmit the data. The RM96XX series of modems is designed for use in the license free bands and is approved for all European countries.

The modem is compatible with most commercially available video telemetry units (see table below).

Installation

The RM96XX modem can be supplied separately or mounted alongside the VideoWave unit in an IP67 enclosure. (SED versions) Because the modem relies on a good radio path, the installation procedure and test methods should be basically the same as for VideoWave. It is always best to carry out a survey to ensure good signal strength.

The 96XX modem will normally operate over a much greater distance than the VideoWave system, therefore if a suitable site is found for the VideoWave, there should be no problem with the modem link. Care must be taken in selecting the correct antenna and the antenna installation. Follow the same principals as for VideoWave.

The data antenna should be mounted a minimum of 3 metres apart from the video antenna to avoid interference.

See the RM 96XX User Manual, supplied with the unit, for details on modem operation and set-up. Application notes are available giving details of the modem settings for most of the common telemetry systems.

Telemetry Protocols Supported:

Telemetry Manufacture/Protocol	RS485/ RS232	Baud Rate	Data Bits	Stop Bits	Parity
American Dynamics (sensomatic)	RS485	4800	8	1	None
Baxall Baxnet	RS485	9600	8	1	None
BBV RS485	RS485	9600	8	1	None
BBV 20mA	RS232	1200	8	1	Even
Conway	RS485	9600	8	1	None
Dennard dome	RS485	9600	8	1	None
Dedicated Micros DS2 remote keyboard	RS232	19200	8	1	None
Honeywell Orbiter	RS485	9600	8	1	None
Honeywell KD6	RS485	9600	8	1	Even
Honeywell HRHD remote keyboard	RS485	9600	8	1	None
Mark Mercer	RS485	9600	8	1	None
Bewator/Molynx	RS485	9600	8	1	Even
Panasonic	RS485	4800, 9600	8	1	None
Pelco D	RS485	2400	8	1	None
Pelco P	RS485	4800	8	1	None
Pelco P (9600)	RS485	9600	8	1	None
Vicon	RS485	4800, 9600	8	1	None
Videoswitch Vi series DVR	RS485	9600	8	1	None
Vista DVR remote keyboard (Baxnet)	RS485	9600	8	1	None
Vista Powerdome	RS485	9600	8	1	None

IP67 Weatherproof Enclosures

Standard Enclosure for VideoWave Transmitter or Receiver Model VTX1394SE or VRX1394SE



The enclosure is supplied with a Top antenna connector, Bulkhead Plate and internal cables. The top connector is a TNC connector suitable for direct connection of a ANT0002 or ANT2350 antenna. The bulkhead also has cable glands to seal the video and power input leads.

Dual Enclosure for VideoWave Transmitter or Receiver and Radio Modem Model VTX1394SED or VRX1394SED



The enclosure is supplied with Top antenna connectors, Bulkhead Plate and internal cables.

On the top there is a BNC for the data antenna (modem) and a TNC for the video. The Bulkhead has two 'N' Type connectors for mounting remote antennas via an extension cable.

The bulkhead also has cable glands to seal the video, data and power input leads.

Videowave Survey Kit



Features

1.4GHz, 2.4GHz and 5.8GHz versions available
Licence exempt operation
Compact & portable
Low power 12V operation
4" LCD display
Video input/power indication
Received signal strength indication

Contents

1 x Flight case
1 x Videowave transmitter
1 x Videowave receiver
2 x ½ wave whip antenna
1 x Monitor
1 x Tripod/clamp
1 x 12V battery 2.1Ah
1 x 12V battery 4Ah
1 x Battery charger
1 x 12V power supply & mains lead
2 x 12V power leads
1 x Antenna ext. cable & mounting clip
1 x Video lead (BNC to phono)
1 x BNC elbow adapter



Brief Description

The Videowave Survey Kits are ideal for conducting site tests/surveys prior to installation of fixed radio links. An adjustable mounting bracket on the transmitter enables simple fixture to a wall or other surface, or freestanding use mounted to the 4Ah battery. The receiver and 4" monitor may be operated in the case, or out of the case using the adjustable mounting bracket and versatile tripod/clamp. The tripod/clamp may alternatively be used to support a video camera (not supplied). Low power 12V operation ensures versatile power options with the high capacity batteries and mains PSU supplied, and LED's for indication of power, video input, and received signal strength enable simple set up for maximum performance.

Note: Camera is Not included.

Technical Notes

Propagation/Distance

For any radio link, the distance that can be achieved between sites depends on a number of factors, the main ones being; the output power, the antenna height (above ground), the type of terrain and 'line-of-sight'. Line-of-sight means how clear the path is between the two antennas, whether there are any obstructions and how dense these obstructions are. The major effect on distance however, is the height of the antennas above ground. The basic relationship between signal strength, antenna height and distance is given in the following formula:-

$$\text{Signal strength} : \frac{(\text{TX antenna height})^2 \times (\text{RX antenna height})^2}{(\text{Distance})^4}$$

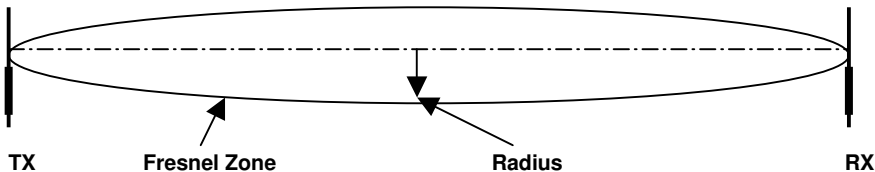
From this formula it can be seen that if the distance doubles, the signal strength decreases to one sixteenth. In other words, to increase the distance from 1 Km to 2 Km, requires an increase in signal strength of sixteen times. It can be seen therefore that increasing output power has a limited effect on distance.

Increasing the antenna height however, has more effect. If the antenna height (above ground) is doubled, the effective signal strength increases four times. This is true for either the transmit or receive antenna so by increasing the height of both a significantly greater distance can be achieved.

Clear line-of-sight

When we refer to a clear line-of-sight for radio signals, this is different to a visual line-of-sight. You may be able to see the transmitting antenna from the receiver site, but this does not necessarily mean a good radio path.

A radio signal transmitted between two antennas will spread out forming an elliptical shape that is widest at the mid distance between the two antennas. The area within this ellipse is known as the Fresnel Zone and any obstructions within this zone will cause an obstruction and interference to the signal path.



Note that this Fresnel Zone is three-dimensional and has both height and width. The maximum radius of the beam, at the centre, increases with the distance between the two antennas. As a guide, at 1.4GHz the radius for a particular signal path is:

1Km signal path	5 - 6Mtr radius
2Km signal path	8 - 9Mtr radius
5Km signal path	12 - 14Mtr radius

This means for example, that if the link is 2Km long, the antennas must be at least 8 to 9 metres above the ground and above any building or obstruction. There must also be the same 8 to 9 metres clearance to either side.

It should also be remembered that radio signals at 1.4GHz will not normally pass through buildings and they will be severely attenuated by vegetation, such as trees.

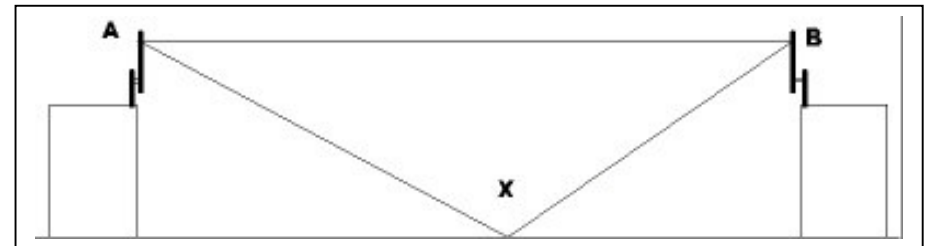
Even with a clear line-of-sight (as defined above) the ground, or nearby buildings, can cause reflections. These reflected signals will also arrive at the receiver and can interfere with the direct signal causing a reduction in signal strength or lost data.

Reflections

The best possible performance and therefore distance, will be achieved if there is perfect unobstructed line-of-sight between the two sites 'A' and 'B'. Even in this situation however there is almost certain to be some degree of reflections from the ground or nearby structures.

These reflections will have an effect on the signal strength and the final picture quality obtained. It is useful therefore to understand the basic principals of a radio link and the effect of reflections. The most common reflection is from the ground although other structures, buildings etc. will have a similar effect. The reflections from these other structures are less predictable because they depend on the shape of the structure, construction material etc.

Consider a radio path between site 'A' and 'B' with each antenna 10 metres from the ground. Assuming good line of sight, there will obviously be a path directly between the two antennas, drawn as a straight line on the diagram. There may also be one or more paths that are reflected from the ground and reach site 'B' indirectly via a point on the ground, 'X'. Obviously the distance A-X-B is longer than the direct route A-B. The receiver at site B will receive a direct signal and a reflected signal via point X.



The effect of this reflected signal depends on its strength and the difference in length between A-B and A-X-B. If the difference is a multiple of the wavelength (approximately 21.4cm for 1394MHz) the reflection is 180° out of phase and will reduce the received signal strength. In fact if both signals were the same strength they would cancel and no signal would be received.

Because at these frequencies the wavelength is quite short, even a small adjustment in antenna height can affect the path length of the reflected signal and so change the received signal strength. By raising the antenna gradually it will cycle through a regular pattern of in phase and out of phase signals giving a corresponding pattern of reduced and increased signal strength.

The reflected signal will show up as ghosting on the monitor. Occasionally this may be seen in adverse weather conditions when a signal may be reflected from rain, snow, dense cloud or fog.

Interference

Because the 1.4GHz frequency band is an unlicensed public access bands, there is no control on other users. It is therefore possible that another user could be operating on the same frequency in your area. If this is suspected, turn off the transmitter and check that the LED on the receiver is RED and does not flicker GREEN. Also check the monitor, which should be clear of any moving patterns, ghosting etc.

If there are other users it may be possible to avoid interference by repositioning the antenna. A directional antenna such as a Yagi may also reduce the effect.

Fault Finding

Problem	Solution
No LED's illuminated Applies to Tx and Rx units)	Check 12V power supply. The RED LED should light to indicate 'power on'.
Venetian blind effect	Incorrect voltage from power supply. Should be 12V
Low or no signal strength on VRX	Check that the VTX is transmitting: RED LED: power on - not transmitting GREEN LED - transmitting
Snowy or grainy picture	Weak signal. Check number of GREEN LED's on VRX unit. See pages 5 and 13 regarding antenna height and location.
Picture rolling or tearing	Reflections. See page 14 Check output voltage from camera. it should be nominally 1V p-p

Specifications

General

Video Input	1 Vp-p into 75W BNC
Video Output	1 Vp-p into 75W BNC
Pre-emphasis	CCIR PAL 405-1
Operating voltage	10-15 V DC
Protection	Reverse Polarity
Current consumption:	
VTX2400	450mA
VRX2400	250mA
Antenna connector	50 Ω TNC
Power connector	2.1mm jack
Indicators:	
Power	RED
Received Signal	GREEN

Radio

Frequency	1394MHz
Frequency stability	+/- 40KHz
RF Power Output	500mW
Local oscillator	PLL Synthesized
Modulation type	FM
Modulation bandwidth	4.5MHz
Good signal threshold	-80dBm

Mechanical

Dimensions	125x62x30mm
Weight	240g
Enclosure Material	Extruded aluminium

Environmental

Operating temperature	-10 to +55°C
Storage temperature	-25 to +85°C

Radio Modem

Frequency Range	406-470MHz*	Adj. Channel Rejection	-70dB
Channel Spacing	25KHz	RSSI Threshold Level	-105dBm 16k
No. of Channels	32		-110dBm at 8k
Transmitter		Max Bit Rate	16kbps
RF Power Output	50-500mW (4 steps)	Modulation	GMSK
Adj. Channel Power	-37dBm	Interface Baud Rate	150-19.2 Kbaud
Freq. Tolerance	+/- 1KHz	Parity	Odd, Even, None
FM Deviation	+/- 3.5KHz	Power Consumption at 240V	
Receiver		Transmitter at	7.2W
		500mW	
RF Sensitivity	-110dBm for 10BER	Receiver	4.2W
Intermodulation	-70dB		

SE Version

Height	230mm
Width	88mm
Depth	80mm
Weight	800g
Enclosure	IP67 weatherproof

SED Version

Height	280mm
Width	180mm
Depth	120mm
Weight	2800g
Enclosure	IP67 weatherproof

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