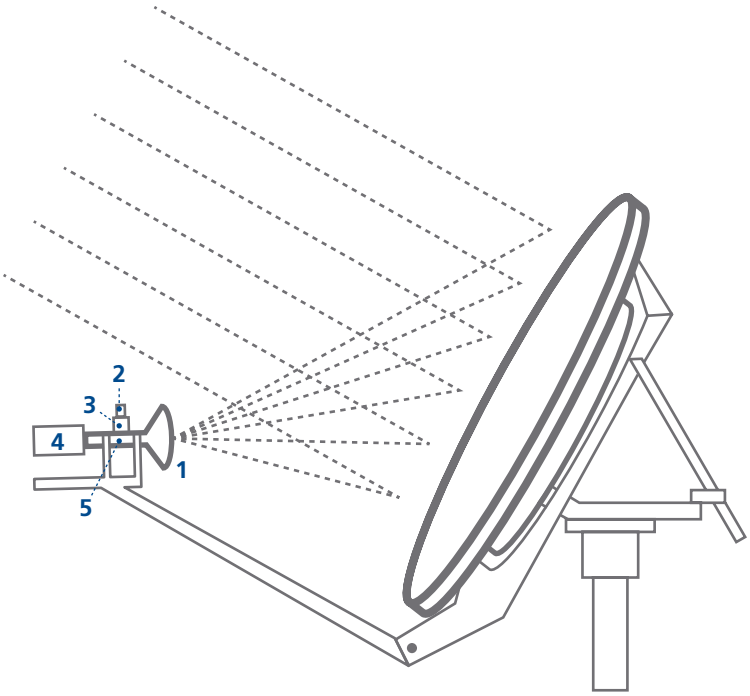
Outdoor VSAT Station Operation and Safety Guide

Satellite Dish Operation



1 Feed Horn **Focal Point**
2 LNB
3 TX Reject
4 BUC Amplifier
5 OMT

Fig 1 shows a typical Ground Earth Station (GES) receiving and transmitting a signal to an orbiting satellite which is located 30,000 km above the equator.

The Satellite downlink signal covers a very large area of the continental North America allowing the Comtech satellite network to transmit and receive satellite coverage all across Canada.

Typical Comtech Install

Comtech satellite station installation, use the Andrews 1.2m RX/TX Class III Antenna System (Type 121), typically in the Ku Band (TX: 13.75 – 14.50 GHz & RX 10.70 – 12.75GHz). This antenna has an elevation (angle to the satellite) of 20° to 25°. The antenna is actually offset by 22°.

The result is that if the angle to the satellite is 22° the antenna will appear to be pointing parallel to the ground when in fact the radio signal is pointing in the direction of the satellite, 22° above the horizon.

This is done for several reasons, the first is so that during warm summer days the sunlight does not heat the feed horn as the sunlight focal point is different and the second is so that rain and snow fall off the dish easier thus maintaining a constant signal.

The typical RF cable used by Comtech is RG6Q (Double Shielded Cable) which has a Transmit and Receive side. Both carry a DC component. The transmit cable provides DC power to the Block Up Converter (BUC) and the receive cable, DC power to the Low Noise Block (LNB).

As per Fig 1 the satellite dishes has a parabolic shape which focuses the radio signal. The dish size (1.2m) is important, the larger the dish the more directional the signal. This results in the need for the dish to be both coarse then finely adjusted to receive the best signal to and from the satellite and thus reduce reception of stray signals or interference. If the signal is not directional the power needed to reach the satellite would be very large and extremely expensive.

The dish has to be installed with a clear Line of Site (LOS) between the satellite dish and the satellite position in the sky. If the path is obstructed then signal loss will occur and the dish may not be able to receive a strong enough signal and will not operate properly.

The signal from the antenna is very directional and only sends and receives the signal to and from the satellite. This is very different from the antenna of a cellular phone that transmits in 360 degrees and radiates everywhere.

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For the purpose of this guide the signal process will be broken down into two areas, Transmitting and Receiving.

Receiving

Due to the distance the Satellite signal has to travel from either Satellite to GES or GES to Satellite there will always be a reduction on the amount of signal that was transmitted to what is received at the antenna.

As a result of this very weak satellite signal it must be amplified or increased in strength. To combat this loss of signal a method of improving the signal has to be devised. The Antennas used by Comtech are large parabolic dishes (1.2m) which provide a gain both to improve the receive signal level from the satellite (Downlink) and to also boost the transmit signal from the dish up to the satellite (uplink).

This amplification is done by two main steps:

- The first is by the use of a parabolic antenna which takes the signals from the satellite and concentrates these signal to the focal point of the antenna (much in the same way a magnifying glass would concentrate the sunlight).
- The second step is to take the concentrated signal and passes it physically through the OMT and the reject filter to the LNB where the signal is converted to more manageable frequency (IF) prior to been passed down the cable to the Satellite Modem

Transmit

To get the signal to the satellite the signal path is essentially reversed.

- An IF Signal along with DC power is sent from the Satellite Modem though the RF cable to the BUC.
- The IF signal is then Up Converted and amplified to a higher frequency approx 13+ Ghz.
- Comtech typically uses a 1 Watt or 2 Watt amplifier for most of its customer installations.
- This Low Power (1 or 2 watt) radio signal is sent from the BUC to the OMT and onto the feed horn.
- The feed horn is the focal point of our satellite dish and a further amplification process takes place and the signal is transmitted to the satellite.
- The larger dish and subsequent gain greatly reduces the amount of transmit power required.

Notes

1 It is important to note that the bigger the dish the more the 1 or 2 watts of power is spread out across the area of the dish, therefore, the bigger the dish the less energy is radiated per square inch, but what is radiated is highly directional.

2 Conversely a smaller dish, resulting in less gain, would mean that more power would be needed to launch the signal onto the dish and up to the satellite.

A trade off commonly noted:

SMALLER DISH = LOW GAIN = WIDE BEAMWIDTH
LARGER DISH = HIGH GAIN = NARROW (Tighter) BEAMWIDTH

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RF Signal Radiation – Safety Code 6 (SC6): Safety Concerns

The risk to the customer due to radio signals being transmitted or received from a satellite dish is very small. The satellite dish acts like a large parabolic mirror in that it takes the radio signals from the satellite and focus's (concentrates) these signals to a single receive point called the feed horn. This feed horn both receives and transmits these radio signals to and from the satellite. The feed horn or focal point is the only location at which a concentrated radio signal is present, the signal being sent from the main antenna to the satellite is actually very weak but is very directional and would be the less than the radiated signal from a 25 watt 2 way radio system commonly in use today.

The actual frequencies being transmitted are in the 12 and 14 GHz range and are themselves not a safety issue.

A good satellite station installation will ensure the following:

- When ground mounted (free standing base) a recommended Safety Zone (Fig 2) of approx 5.5M in front of the antenna is to be established.
- When Pole Mounted the zone can be decreased. A recommended distance of not less than 3M (Fig 2).
- A clear line of site free from all obstructions to the satellite from the antenna, including adjacent buildings, vehicles, trees or hills.
- The focal point or feed horn is not easily assessable
- The antenna is located such that no vehicles can easily drive into antenna mount
- The antenna is located such that it is free from any high traffic area's that could lead to personnel accidentally hitting antenna and detuning antenna
- Ensuing all cable are secured properly to prevent tripping hazards.

Safety concerns to communicate to the customer:

- Do not work on any equipment with the power turned, including the indoor satellite modem
- Do not put any part of your body at the focal point or feed horn of the satellite dish while it is in operation.
- Always ensure that the dish has a clear line of site to the satellite.
- Comtech utilizes a larger dish size and a small amplifier size which significantly reduces any safety risks even at the focal point of the antenna.
- Although the dish may appear to be pointing at a building the actual radio path is 22 degrees higher than the optical appear of the dish pointing.
- If clearing snow from dish, always turn off satellite modem indoors.

Electrical Safety

The outdoor equipment has 2 power sources both of which are low power and of little danger to personnel. The LNB requires a – 24 VDC power source from the indoor satellite modem, the second power source also from the satellite modem is 24 VDC required to power the BUC. Both of these electrical levels are very low and are considered safe and of little danger. Also all points of electrical contact have been properly terminated and exposure to these voltages would only occur if damage to wiring had occurred.

For additional reading on SC6 the following publications can be reviewed online

Health Canada (Website Address: www.hc-sc.gc.ca/rpb)

- Limits of Human Exposure to Radio Frequency Electromagnetic Field in the Frequency Range from 3KHz to 300GHz

Industry Canada (Website Address: http://strategis.ic.gc.ca/epic/site/smt-gst.nsf/en/)

- Guidelines for the Protection of the General Public in Compliance with Safety Code 6
- Radio Frequency Exposure Compliance (All Frequency Bands)
- Guidelines for the Measurement of Radio Frequency Field at Frequencies from 3KHz to 300GHz

COMTECH SATELLITE SYSTEMS Ltd.

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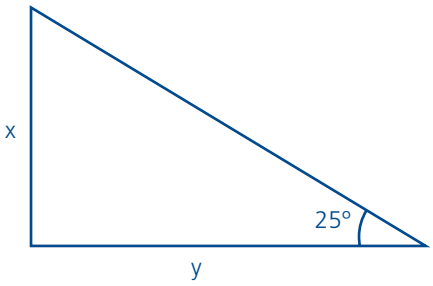
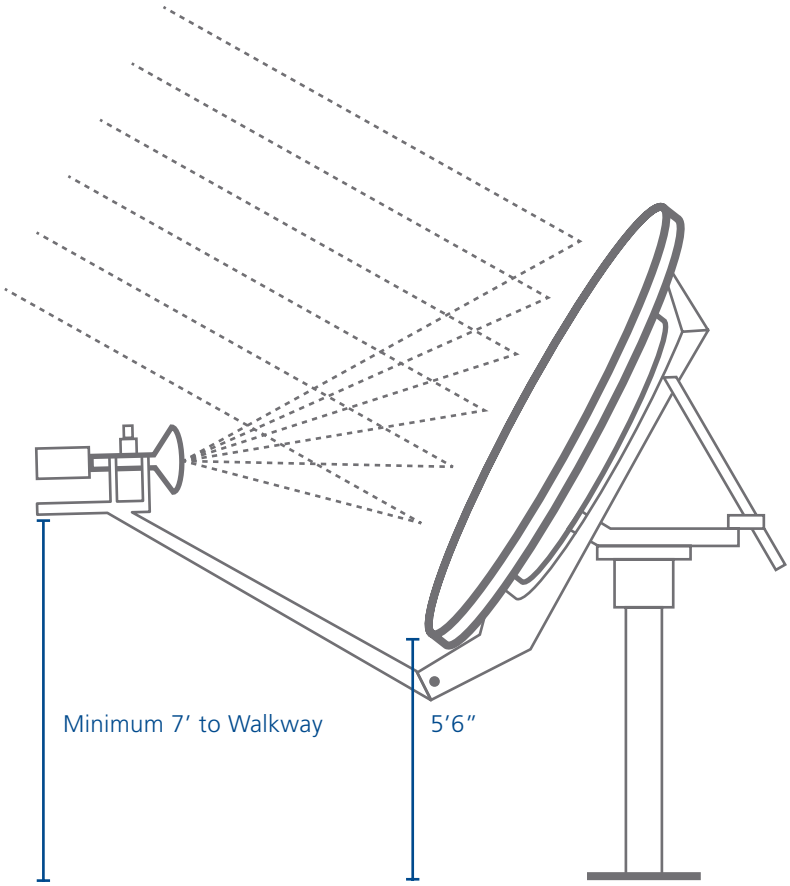
Typical VSAT Installation

Signal to/from Satellite 25°
Elevation to Satellite





Example of Clear Line of Site

Bottom of dish is 5.5′ above ground.
Distance to nearest object is 10′

Formula **x = y(tan25)**

x = y(.46631)

x = 4.6631

The signal of the satellite dish would then be 5.5′ + 4.6″ = 10.1′ above ground. Therefore a vehicle parking 10′ from the dish would not block any signal unless the height of the truck and its load is more than 10.1′. This assumes flat ground from the dish to the vehicle.

At 50′ from the satellite dish

x = 50(.46631)

x = 23.3

The signal at 50′ from the dish would be 23.3′ above the ground.

At 100′ from the satellite dish

x = 100(.46631)

x = 46.6

At 100′ the signal would be 46.6′ above ground.