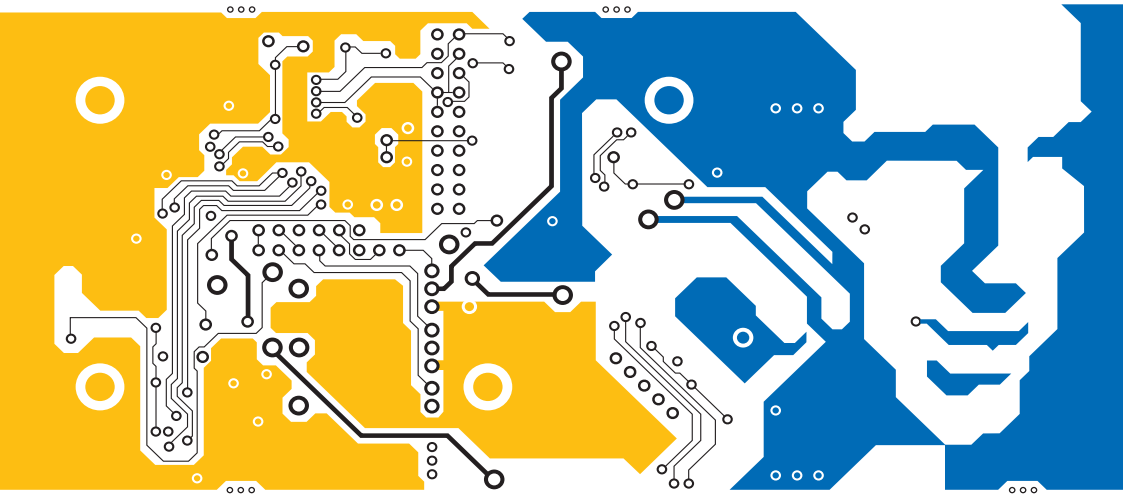
CODAN

Satellite Communication Equipment

SATELLITE COMMUNICATIONS



INSTALLATION HANDBOOK

Codan part number 15-44016-EN Issue 1, November 2002

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Introduction

This installation handbook describes the general procedures to be followed in the installation of outdoor satellite communication equipment.

This handbook assumes you have limited knowledge of the satellite communication medium or how to use or install a satellite station.

This guide contains the following sections:

Chapter 1 Installing the transceiver—provides general guidelines you should follow when installing your transceiver

Chapter 2 Troubleshooting the installation—describes the diagnostic sequence that you should follow when fault finding your transceiver

Appendix A Definitions—explains the terms and abbreviations used in this handbook

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1 Installing the transceiver

This section contains the following topics:

Unpacking the equipment

Ensure that the packing boxes containing the equipment are upright, as indicated by the printing on the boxes. Open each box and examine the contents for signs of damage. If damage is detected, contact Codan immediately to obtain an RMA before returning the equipment. Failure to do so may result in any warranty being void.

If all units are in a satisfactory condition, follow the safety and installation procedures in this section.

Safety issues

Equipment covers

The covers for the equipment must be correctly fitted.

CAUTION If it is necessary to remove the covers at any stage, they must be refitted correctly before using the equipment.

Electrical safety

All circuits within the BUC are TNV circuits provided that the protective earth terminal on the BUC is connected to earth. All circuits within the LNB are SELV circuits provided that the LNB is connected to earth.

Radiation safety

WARNING A radiation hazard exists if the BUC is operated unterminated. Do *not* operate the BUC without a load or termination attached to the RF output.

The symbol shown in Table 1 is used to identify the potential for non-ionising radiation to be emitted.

Table 1: Warning label for non-ionising radiation

Symbol	Meaning
	Non-ionising radiation may be emitted

Suitable fencing or a barrier should be provided around the satellite station to prevent people standing too close to the antenna. The safe distance for the particular equipment will be specified in the documentation for the equipment.

Earth symbol

A protective earth connection point is provided on the BUC. The symbol shown in Table 2 is used to identify the connection.

Table 2: Earth symbol

Symbol	Meaning
	Protective earth

Site considerations

Heat

Keep heatsink fins clean and free from obstructions such as spider webs.

WARNING

Where fans are fitted, ensure intake vents and outlets on equipment are unobstructed. Keep the vents clean at all times.

Moisture

Codan transceivers are protected against harsh environments, particularly moisture and salt ingress. Each module is fully sealed and protected against full immersion, however it is recommended that you provide as much protection from the environment as possible.

CAUTION

Be aware that in areas of high humidity, condensation may occur on the connections. All connections should be sealed (see page 14, *Sealing connections*).

All components of the installation should be provided with the following protection from moisture ingress:

- Wherever practical, mount modules under the cover of the dish. Avoid any areas where water runoff may be channelled into concentrated streams across the connectors, e.g. some dishes have a central hole in the reflector, and when heavy rain falls, water flows through this.
- All waveguide joints must be correctly gasketed (see page 18, *Sealing waveguide connections*).
- All connections must be fully taped from the plug/socket junction to the cable itself (see page 14, *Sealing connections*).

Hazardous areas

Codan transceivers are fully sealed, but they are not rated for hazardous area operation, e.g. on an oil rig. Equipment such as motors and stabilised platforms may form part of a satellite station and may create sparks that can present a safety hazard in dangerous areas. Therefore it is recommended that you select a mounting site that does not have special requirements.

For more information, contact your Codan representative.

Mounting equipment on an offset antenna

When installing equipment on an offset antenna, the main consideration is its structural limits. You should avoid mounting too much heavy equipment directly onto the boom.

WARNING Excessive weight on the antenna may cause distortion of the reflector (especially if it is made of fibreglass), possibly affecting the electrical performance of the antenna.

To decide upon the most effective equipment configuration, you should acquire all the weights of the equipment and the manufacturer's recommendations on weight limits for the boom and the antenna feed.

A load greater than 20 kg mounted directly at the antenna feed can cause a measurable gain reduction and slight pattern distortion. A load of up to approximately 35 kg can be tolerated on most dishes, provided the majority of the load is located near the lower end of the boom. For example, a typical fibreglass 1.8 m or 2.4 m antenna can be loaded with up to 14 kg at the antenna feed (including the feed itself) and a further 23 kg added on the boom, preferably low down.

With some antenna designs, the feed systems are actually supported by the composite reflector material itself instead of the steel structure of the reflector mount. The composite materials have an inherent creep property, which means that under prolonged stress the reflector may deform progressively after installation.

CAUTION While it may be possible to attach even greater loads than mentioned above, it is not recommended as the long-term effect may be a gradual, constant gain reduction.

Installing the equipment

A satellite station typically consists of the following equipment:

- a BUC
- an LNB
- a TRF
- a modem
- an interface unit (if required)

NOTE Once you have installed the equipment, ensure that you seal all the connections thoroughly (see page 14, *Sealing connections*).

Block up converter

Mount the BUC on the antenna feed support boom with the transmit output as close as possible to the feed.

Install the BUC in a position that meets the recommendations listed on page 7, *Site considerations*.

NOTE It is preferable to mount the BUC so that you have a clear view of the LED indicators. Also, ensure that interconnecting cables can be run neatly.

A boom-mounting kit is available for mounting the BUC onto circular or rectangular structures. Fitting instructions are provided in the documentation for the equipment.

BUCs with a waveguide output can be connected to the antenna feed transmit flange with a length of flexible waveguide and waveguide bends as required. Alternatively, if suitable brackets are available, the BUC can be mounted directly on to the feed. Ensure all waveguide joints are correctly gasketed (see page 18, *Sealing waveguide connections*).

If the BUC has an N-type connector output, use a length of low-loss coaxial cable to connect it to the antenna feed transmit connector.

The BUC is powered via the Tx IF cable from the modem or L-Band IF interface unit.

Ensure that you use the connector covers supplied with the BUC to weatherproof any unused connectors.

Low noise block converter and transmit reject filter

To maintain a good station G/T performance, the LNB should be mounted directly on the feed receive port.

If a TRF is required, you can bolt the LNB and TRF together before connecting them directly to the feed receive port.

Ensure all waveguide joints are correctly gasketed (see page 18, *Sealing waveguide connections*).

DC power through the **Rx IF O/P** connector of the LNB enables the LNB to be connected by a single coaxial cable.

Interface unit

The interface unit is required when the modem used does not produce the required DC power and 10 MHz reference signals. It is installed in a 19" rack.

When installing the interface unit:

- ensure you mount the unit in a position that receives adequate ventilation
- ensure the vents are unobstructed

Cables

Where required, you *must* use standard shielded Codan cables for the power and control cabling to ensure safety and EMI/EMC standards are met.

In installations where the cables are not supplied by Codan, all power and control cables *must* be assembled in accordance with drawings supplied by Codan.

For details of the installation requirements see below *Cable installation*.

Cable installation

General guidelines

Use the most direct route possible for the cable runs. Secure the cable runs with cable ties or other suitable clamps.

You may install the indoor/outdoor interconnecting cables underground (e.g. in 75 mm PVC pipe), or supported by an overhead catenary wire. If the transmit and receive IF coaxial cables are identical, mark the cables at each end before you install them. Also, ensure that there is enough slack left to make antenna adjustments without straining the cables.

Securing cables

Once connections have been made, it is important to secure cables so they do not hang loosely or flap in the wind.

CAUTION Loose hanging cables tend to elongate over time, causing the conductors to stretch and the performance of the cables to degrade.

CAUTION The cables should be secured in such a way that water falling on the cables does not run directly onto the connections.

To ensure water drains off the cables and not onto the connections, create a loop in each cable that hangs lower than the cable connectors.

Sealing connections

Poor sealing of connections is the most common cause of transceiver faults.

WARNING

Ensure you follow all the sealing precautions in this section during installation. If the modules or cable connections are not sealed correctly, the equipment may be damaged or the performance of the transceiver may deteriorate over time.

Without correct sealing the following can occur:

- In most cases, water causes an attenuated signal with intermittent LNB faults or intermittent powering down of the BUC. This progresses until complete failure of the connection occurs.
- Water within a connection may be drawn into the cable by capillary action.
- Water (and sometimes dust) within a connection or cable attenuates the signal.
- In extreme cases, water causes a short circuit and corrosion within the connection or cable.

If water has entered a connection, remove the cable and thoroughly dry out the bulkhead connector before attaching a new cable and sealing the connection. Ensure there is no corrosion on the connector. If corrosion is present, replace the connector.

For effective sealing you must use self-amalgamating tape made of PIB or EPR. Manufacturers include 3M (Type 23 Scotch Self-Amalgamating, Black) and Rotunda (2517 Self-Amalgamating, Black).

WARNING

Do not use the following for sealing:

- electrical PVC tape
- mastic tapes
- duct tapes
- plain rubber tape
- cellotape
- plumbing sealants
- silicone gel
- other construction sealants
- paint
- glue

All cable connection points require sealing, particularly the N-type connections. The slightest amount of water in a microwave coaxial connection will almost completely attenuate the signal.

There are three main areas where N-type connectors leak:

- around the connector junction, where the plug is screwed onto the socket
- the plug itself, between the turning and fixed parts of the plug
- the cable jacket connection to the back of the plug

CAUTION

To seal the connections, follow the instructions on page 16, *How to seal connectors*.

The tape must cover the connector junction so that no water can creep into the thread between the plug and socket. To prevent water entering the plug, cover between the turning and fixed parts of the plug with self-amalgamating tape.

It is not sufficient to rely on heatshrink tubing over the connector body to seal the cable jacket connection to the back of the plug. Even the best heatshrink glues do not adhere reliably to the cable outer sheath or to the shiny metal connector body. It is essential to tape this area with self-amalgamating tape to prevent water getting into the back of the N-type plug.

The N-type connections should be carefully taped from the plug/socket junction right to the cable itself.

All other connectors must also be taped. Although many control and power connections are made with MS connectors, it is still recommended that these junctions are fully taped in the same way as the N-type connections outlined above. Tape from the fixed equipment socket (or plug body), right over the cable connector, to the cable sheath.

How to seal connectors

You will require approximately 25 cm of self-amalgamating tape.

CAUTION When using self-amalgamating tape, do not stretch it too much, especially over the protruding parts of MS connectors. If the tape is over-stretched, it tends to break away after a few weeks or months.

To seal connectors:

- ❑ Ensure that the two connectors are tightly joined.

  CAUTION Do not use tools to tighten the connection. Tightening by hand is sufficient.

- ❑ Unpeel the backing from the tape, taking care not to get dirt on the tape or tangle it, then begin to stretch it around the circular base of the bulkhead connector attached to the unit (see Figure 1). Wrap the tape around the entire connection making sure it overlaps and no gaps exist.

NOTE

Avoid applying the tape around the outside (rectangular) part of the bulkhead connector as sealing in this area is not effective.

Figure 1: Unsealed connector

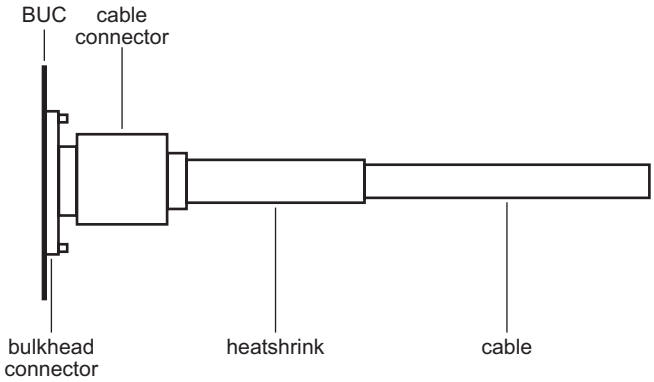
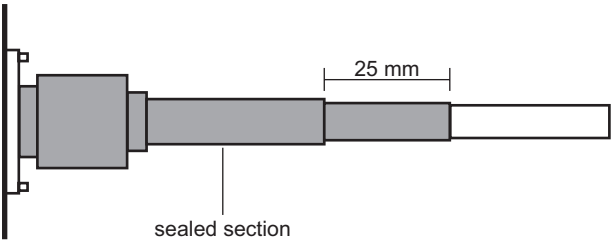


Figure 2: Sealed connector



- ❑ Wrap the tape until it reaches approximately 25 mm beyond the heatshrink on the cable (see Figure 1 and Figure 2).
- ❑ If the tape finishes, apply another piece from where the first tape ended.

- ❑ Once you have completed the initial seal, wrap back over the connection until you return to the starting point. This creates the recommended double layer of self-amalgamating tape.
- ❑ Check that the tape is tightly wrapped with no gaps. If any gaps exist, cut off the tape and re-apply the tape as described above.
- ❑ If the tape is applied correctly, the layers polymerise to each other after a few days preventing the tape from peeling off. To remove the tape, it must be cut off.

Sealing waveguide connections

It is pointless to use tape around waveguide joints because no pressure will exist between the tape and the straight edges of the waveguide. O-ring gaskets must be used to seal the waveguide joints.

CAUTION Ensure the appropriate o-ring is used, otherwise sealing is compromised or correct mating of the waveguide flange is not possible.

The gasket is always supplied as a standard part of the waveguide connection kit and must be used. For details on the types of gaskets used for C-Band and Ku-Band transceivers see page 18, *C-Band transceivers* or *Ku-Band transceivers*.

C-Band transceivers

Generally the waveguide used is either:

- WR137 (transmit)
- WR229 (receive)

The flanges are either:

- CPRF type (flat—no provision for a gasket)
- CPRG type (grooved—with provision for a gasket)

The grooves in the CPRG type are always the same depth.

If a flat flange is mated with a grooved flange, a half-thickness gasket should be used. These are commonly called WR137 or WR229 half gasket. For example, LNBs (grooved) are always supplied with a half gasket for mating the LNB directly to the antenna feed (flat). If a waveguide switch is used, a full gasket is supplied to join the LNB to the switch because both parts are grooved.

Ku-Band transceivers

The waveguide used is always WR75.

The flanges are either:

- UBR120—WR75 cover flange (flat)
- PBR120—WR75 flange with a groove for a gasket
- CBR120—WR75 flange with a choke groove and a groove for a gasket

There are two commonly used depths for the gasket grooves:

- 1.25 mm/0.050" (shallow)
- 2 mm/0.080" (deep)

Codan supplies different types of o-ring gaskets for different parts.

LNBs usually have a deep groove so a thick gasket is supplied for the LNB. It should be joined directly to a WR75 cover flange, such as that used by the TRF or the OMT.

Other waveguide sections have shallow grooves, so they should be joined to WR75 cover flanges using thin gaskets.

CAUTION If two o-ring flanges need to be mated, select two gaskets that ensure the joint is sealed adequately (e.g. do not use two circular cross-section o-rings as they tend to slide off each other).

Flange kits for C-Band transceivers

Table 3: Flange kits available for C-Band receive path

Part number	Contains...	Used for...
15-40093	WR229 half gasket (with M6 × 25 screws, nuts and washers)	Attaches the LNB or TRF to the antenna feed
15-40094	WR229 full gasket (with M6 × 25 screws, nuts and washers)	Attaches two grooved flanges together
15-40106	WR229 full gasket (with M6 × 16 screws and washers)	Attaches the TRF or LNB to a waveguide switch
15-40108	WR229 half gasket (with M6 × 8 screws and washers)	Attaches the blanking plate to a waveguide switch

Table 4: Flange kits available for C-Band transmit path

Part number	**Contains...**	**Used for...**
15-40095	WR137 half gasket (with M5 × 25 screws, nuts and washers)	Attaches the BUC or the flexible waveguide to the antenna feed
15-40096	WR137 full gasket (with M5 × 25 screws, nuts and washers)	Either: • attaches the BUC to a section of grooved waveguide • joins two pieces of grooved waveguide together
15-40123	WR137 full gasket (with M5 × 12 screws and washers)	Attaches waveguide sections to a waveguide
15-40197	WR137 half gasket (with M5 × 16 screws and washers)	Optionally available where thicker flanges are used
15-40198	WR137 full gasket (with M5 × 16 screws and washers)	Optionally available where thicker flanges are used

Flange kits for Ku-Band transceivers

NOTE

Rigid and flexible waveguide sections generally have one cover flange (flat) and a cover gasket flange (shallow groove) at the other end.

LNBs and Sector Microwave relays have deep groove (0.080") cover gasket flanges.

Table 5: Flange kits available for Ku-Band receive and transmit paths

Part number	Contains...	Used for...
15-40172	Thick gasket kit (with M4 × 10, M4 × 12 and M4 × 16 screws, nuts and washers)	Either: • joins a cover flange to a Sector Microwave relay • replaces lost LNB kits (includes a variety of different length screws)
15-40173	Thin gasket kit (with M4 × 10, M4 × 12 and M4 × 16 screws, nuts and washers)	Joins any shallow grooved cover gasket flange with a flat cover flange
15-40174	Universal gasket kit (includes thin and thick, round and flat gaskets, and M4 × 10, M4 × 12 and M4 × 16 screws, nuts and washers)	Seals almost any flange-to-flange joint

Grounding

WARNING Precautions *must* be taken to ensure the installation is adequately protected against voltage potential differences that may occur between the outdoor and indoor equipment.

These potential differences may occur:

- if there is a fault in the AC mains reticulation system
- when high power electrical machinery located nearby is switched on or off
- if a lightning strike occurs in the area

It is highly recommended that the antenna metal structures and the cases of the outdoor equipment be connected together and grounded. The protective earth screws on the transceiver modules are provided specifically to provide this protection. This practice will also reduce the likelihood of the mains supply or RF interfering with the serial interface signals.

Lightning precautions

NOTE For critical installations in lightning prone areas, it is strongly advised that you seek expert advice on lightning protection.

At installations where there is a potential for lightning discharges, precautions must be taken to prevent dangerous voltage potentials between the outdoor equipment and the indoor equipment. As a minimum precaution, it is recommended that the metal structures of the outdoor equipment are well grounded with earth stakes, or in the case of rooftop sites, grounded to the lightning grid and earth system of the building.

One of the main causes for equipment failure is large voltage potentials created between separate earth points when a strike in the area (perhaps even several hundred metres away) causes huge ground currents. For this reason, some lightning engineers recommend the use of large copper earth straps (or braid) to connect the indoor and outdoor equipment earth systems, thus minimising the potential differences that can be created between the two.

NOTE It is recommended that external earth straps are used to bond equipment together (including antenna hardware) to minimise the possibility of mains or RF interference with the communications signals.

Welding precautions

WARNING Large welding currents may damage the communication equipment.

When arc welding on or near the antenna structure, you should minimise the welding currents flowing through the communication cables.

To minimise the welding currents:

- ❑ Disconnect all cables from the indoor equipment, including power, control and IF cables.
- ❑ Disconnect all cables between each piece of equipment.

Aligning the antenna

If an antenna tracking system is available, use this to align the antenna on the peak of the signal received. Take care that you do not select side lobe peaks.

If an antenna tracking system is not available, use a spectrum analyser to monitor the received IF output signal and manually adjust the antenna to receive the maximum signal level. Alternatively, use a received signal strength meter within the demodulator and manually adjust the antenna to receive the maximum signal level.

Adjusting the polarisation

NOTE

You are only required to adjust the polarisation when the antenna uses linear polarisation. When the antenna uses circular polarisation, adjustment is *not* required.

CAUTION

When required, it is important that the polarisation of the antenna is set correctly. If you transmit without correctly adjusting the polarisation, it may cause signal interference to other satellite users.

The polarisation is adjusted by rotating the OMT, which is installed between the feed subassembly and the LNB subassembly. Depending upon the design of the feed system, it may be necessary to rotate the whole LNB, BUC, OMT and feed assembly.

NOTE

It is necessary to know the polarisation offset angle for the assigned transponder at the installation site. The polarisation offset angle is usually provided by the satellite operator.

Using a spectrum analyser to view a broad spectrum of carriers being transmitted from the satellite allows you to see other carriers being transmitted at the assigned and opposing polarities. If no receive carriers are visible, the polarisation will have to be adjusted with the assistance of the satellite operator.

NOTE

To provide voice communication between your station and the satellite operator, an orderwire circuit or other communication channel is required.

The polarisation setting is initially adjusted in receive-only mode by nulling out reception of the opposite polarity rather than peaking the reception of carriers of the required polarity. Nulling out reception of the opposite polarity is the preferred method as the opposing null is sharper than the required peak and therefore, a null is a more accurate measure of the polarisation.

Once the carriers have been nulled out as best as possible, the final alignment is made with the assistance of the satellite operator. The operator will measure your transmit signal as you adjust the polarisation setting and advise you when the correct setting is achieved.

Setting the transmit attenuator

To set the transmit attenuator, the transceiver must be connected to a terminal. To establish communications between a PC and the transceiver, and to set the transmit attenuator see the documentation for the L-Band IF transceiver. The transmit attenuator should be set to a value of 0, 4, 8 or 12 dB using the **STA** command.

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2 Troubleshooting the installation

You should troubleshoot your installation in the following order:

- check for ingress of water
- check unsecured cables
- check individual units

NOTE Ingress of water is indicated by a fall in the transmit/receive level.

To troubleshoot your installation:

❑ Check the following cables for ingress of water.

Cable	From	To
Tx IF	indoor equipment	BUC
Tx RF	BUC	antenna
Rx IF	LNB	indoor equipment

❑ If water, dampness or discolouration is present, remove the cable and dry the bulkhead connector using a clean, soft cloth, or allow to dry naturally. If there is corrosion present on the connector, return the BUC to Codan for repair.

NOTE To seal connections correctly see page 14, *Sealing connections*.

❑ Check if there are any unsecured cables.

Over time, unsecured cables will stretch and cause attenuation of the signal.

NOTE To secure connections correctly see page 13, *Securing cables*.

- ❑ If there are no problems with the connections or cables, check the individual units of your transceiver.

  To fault find the units in your transceiver see the documentation for the transceiver.

Appendix A—Definitions

This section contains the following topics:

Standards and icons

The following standards and icons are used in this handbook:

This typeface	Means...
BOLD/Bold	A button, switch, connector or LED
Italic	A cross-reference or text requiring emphasis

This icon	Means...
❑	A step within a task
NOTE	Note: the text provided next to this icon may be of interest to you
CAUTION	Caution: your actions may lead to loss of data, privacy or signal quality
WARNING	Warning: your actions may cause harm to yourself or the equipment

Acronyms and abbreviations

Acronym	Means...
BUC	block up converter
EMC	electromagnetic compatibility
EMI	electromagnetic immunity
EPR	ethylene propylene rubber
G/T	gain/temperature
IF	intermediate frequency
LNB	low noise block converter
MS	military style
O/P	output
OMT	ortho-mode transducer
PIB	polyisobutylene
PVC	polyvinyl chloride
RF	radio frequency
RMA	return material authorisation
Rx	receive
SELV	safety extra low voltage
TNV	telecom network voltage
TRF	transmit reject filter
Tx	transmit

Glossary

This term	Means...
C-Band	Frequency band nominally covering the range 3 to 7 GHz.
Ku-Band	Frequency band nominally covering the range 10 to 15 GHz.
Transceiver	Equipment comprising a BUC, LNB, power supply and appropriate connecting cables.

Units

Measurement	Unit	Abbreviation
Attenuation	decibel	dB
Distance	metre	m
Frequency	hertz	Hz
Mass	gram	g

Unit multipliers

Unit	Name	Multiplier
m	milli	10^{-3}
c	centi	10^{-2}
k	kilo	10^{3}
M	mega	10^{6}
G	giga	10^{9}

About this issue

This is the first issue of the Satellite Communication Equipment Installation Handbook. Although the information presented is generic in its content, this handbook is intended for use with the L-Band IF transceiver range of equipment.

Associated documents

The other publications associated with the Low Power L-Band IF Transceiver 6700/6900 series are:

- Low Power L-Band IF Transceiver 6700/6900 series User Guide (Codan part number 15-44017-EN)
- L-Band IF Interface Unit 6550 User Guide (Codan part number 15-44020-EN)

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