DMR 38 INSTALLATION AND COMMISSIONING PROCEDURES FOR OPTUS

NOKIA
TELECOMMUNICATIONS

CONTENTS

1. PURPOSE

The purpose of this document is to define the Installation and Commissioning procedures for Nokia DMR38 microwave links in the Optus BSS network.

2. SCOPE

This procedure applies to all DMR38 microwave links installed in the Optus BSS network.

3. RESPONSIBILITIES

Authorisation	Manager Customer Services Australasia
Amendments	Optus Project Manager, Implementation Services Manager
Implementation	Optus National Site Manager, Commissioning Engineers, Sub Contractors

4. PROCEDURE

4.1. Roles and Responsibilities

4.1.1. Nokia

1. Installation of Indoor and Outdoor Units to Optus design including all installation materials.
2. Supply, install and terminate coaxial cable between IU and OU.
3. Run power cables to IU.
4. Connect all 2Mb/s tributaries to DSX panel as per Optus design.
5. Connect Network Management Interface to TMC bus.
6. Align antennas for maximum receive level as per path analysis and perform test measurements to determine correct operation of terminals. Results to be entered in the Site Specific Documentation Package.
7. Perform commissioning tests to confirm correct operation of the link in the presence of Optus Operations Staff, including 24 hour BER test.

8. Provide all site documentation including factory test reports, commissioning test results and site details.

9. Co-ordinate with State Cellular Operations Teams to witness and accept link in conjunction with BTS commissioning / handover.

4.1.2. Optus

1. Nominate paths and check LOS. Link path analysis, availability and design.

2. Produce link design package including: frequency, polarisation, transmit power level, antenna heights, antenna sizes, link capacity, rack layouts and DSX allocation.

3. Witness commissioning tests and accept link from Nokia.

4. Connection of the link into the Operational Network.

4.2. Installation

4.2.1. Installation of the Indoor Unit

Installation of the Indoor Unit is described in document number DMR40-1802-SEC1, DMR4x2 - 38W Digital Radio Relay Equipment, Installation, chapter 2, pages 17-50. Refer to Appendix A.

4.2.2. Installation of the Outdoor Unit

Installation of the Outdoor Unit is described in document number DMR40-1802-SEC1, DMR4x2 - 38W Digital Radio Relay Equipment, Installation, chapter 3, pages 51-73. Refer to Appendix A. Installation of this unit must also comply with the drawings in Appendix B.
The Radio Section of the Outdoor Unit should not be left outdoors for longer than 24 hours when disconnected, if condensation inside the unit can occur.

4.2.3. Strapping Instructions

Strappings are to be the default (normal) strappings as described in document number E00172602RE_B1, Baseband Unit Strapping Instructions, E00172546RE_B0, Programmable Interface Strapping Instructions, E00172088RE_A0, Baseband Branching 8x2M Euro Strapping Instructions, T38100001RE_00, Outdoor Radio Interface Strapping Instructions, and T38045001RE_01, Power Supply Strapping Instructions. Refer to Appendix C.

4.2.4. Installation of Coaxial Cables

The installation of N type connectors to RG213 / RG214 coaxial cable is described in document number E10007468RE_00, Work Instructions N Connector 5421281. Refer to Appendix D.

4.3. Commissioning

Commissioning procedures and tests are described in document number DMR40-1803-SEC1, DMR4x2 - 38W Digital Radio Relay Equipment, Operation, chapters 1 - 6, pages 3 - 55. Refer to Appendix E.

4.4. Acceptance Testing

All tests as described in the commissioning procedures and the test report must be completed and recorded, and witnessed by a representative from Optus. Refer to Appendix F.

4.5. Documentation

Two copies of the following documentation must be supplied to Optus within two weeks after commissioning and acceptance testing:

Factory test results
Site specific information
Signed commissioning test results

5. TEST EQUIPMENT AND ACCESSORIES

Multimeter or 100µA moving coil instrument:
Power meter 37.0 - 39.5 GHz, +20dBm:
Frequency counter 500MHz, < 1 ppm:
Adjustable attenuator 37.0 - 39.5 GHz, 0....50dB:

6. DEFINITIONS

BER	Bit Error Rate
DMR	Digital Microwave Radio
DSX	
IU	Indoor Unit
LOS	Line Of Sight
OU	Outdoor Unit
TMC	

7. REFERENCES

DMR4x2 - 38W Digital Radio Relay Equipment, Operating Handbook, Version 2A

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APPENDICES

Appendix A Installation Instructions

DMR 4x2–38W

DIGITAL RADIO RELAY EQUIPMENT

Installation

Contents

GENERAL

The Radio Relay Equipment DMR 4x2–38W consists of the following structural elements:

- Indoor Unit (IU)
- Outdoor Unit (OU)
- Antenna

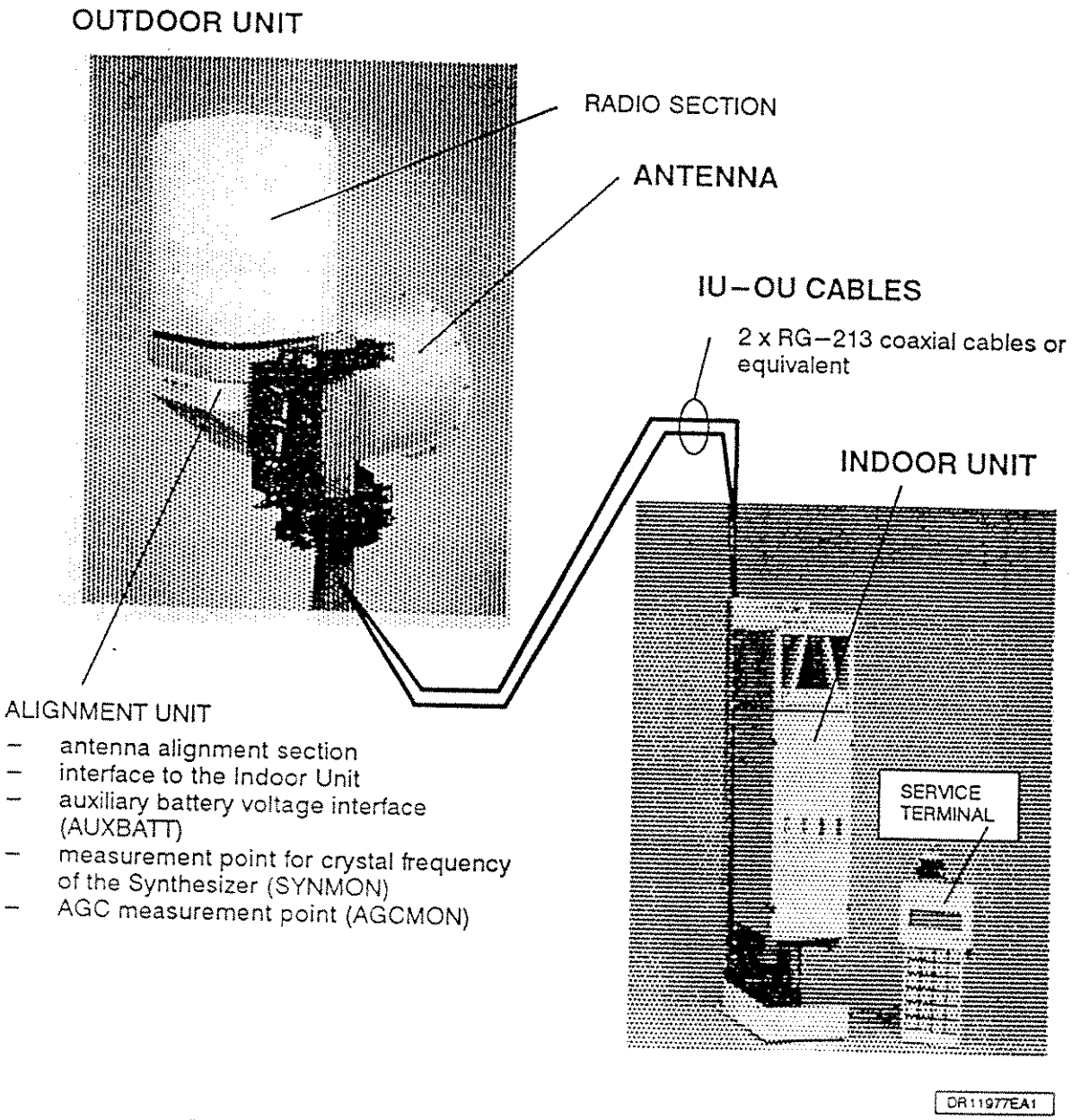


Figure 1 *DMR 4x2–38W, main parts*

.1.2 Outdoor Unit (OU)

Installation accessories for the Outdoor Unit

The installation accessories for the Outdoor Unit are selected in accordance with the installation method:

- Mounting Kit OU Roof TX 38085.01
  (for installations on flat and slanting roofs or equivalent)
- Mounting Kit OU Wall TX 38085.02
  (for installations onto a wall–mounting support)
- Mounting Kit OU for D60–D140mm TX 38085.03
  (for installations onto a tube with 60...140 mm diameter; the kit does not contain the installation tube or the mounting accessories with which the tube is mounted onto the tower)

Recommended installation tools

The following tools are recommended to be used in the installation of the Outdoor Unit:

Water level	for vertical installation of the installation tube
Allen key, 5 mm [1]	for mounting the antenna to the connector case of the Alignment Unit, for locking the handle of the Radio Section, for fastening the cable clamp (M6 Allen screws)
Spanner, 13 mm [1] (2 pcs)	for screwing in the nuts of the eye bolts used for antenna alignment
Spanner, 17 mm [1] (2 pcs)	for mounting the connector case of the Alignment Unit to the support (alignment lock–in), for mounting the Alignment Unit to the installation accessories
Compass	to facilitate the antenna alignment (when there is no direct visual contact with the station at the other hop end)
Analog multimeter,	for measuring the AGC voltage used for antenna alignment

[1] = included in the installation accessories T38140.01, *Installation Tools, Basic Set*.

.2 Main structural parts

The main parts of the Indoor Unit of the DMR 4x2–38W are illustrated in *Figure 2*. The TM4–EMC cartridge is housed with Outdoor Radio Interface (ORI) and 4x2 Mbit/s Baseband Unit (BBU). The interunit signals pass via the cartridge Motherboard (MB).

The grounding assembly of the IU–OU cables located above the cartridge includes the EMC inlets and mounting parts for the IU–OU cables (i.e. two coaxial cables between the Indoor and Outdoor Unit). Other interface cables are routed through the grounding assembly of the data cables installed below the cartridge.

In the cartridge there is an empty unit location for one extra unit. For example for:

- Service telephone
- 2–8 Mbit/s second–order multiplex equipment

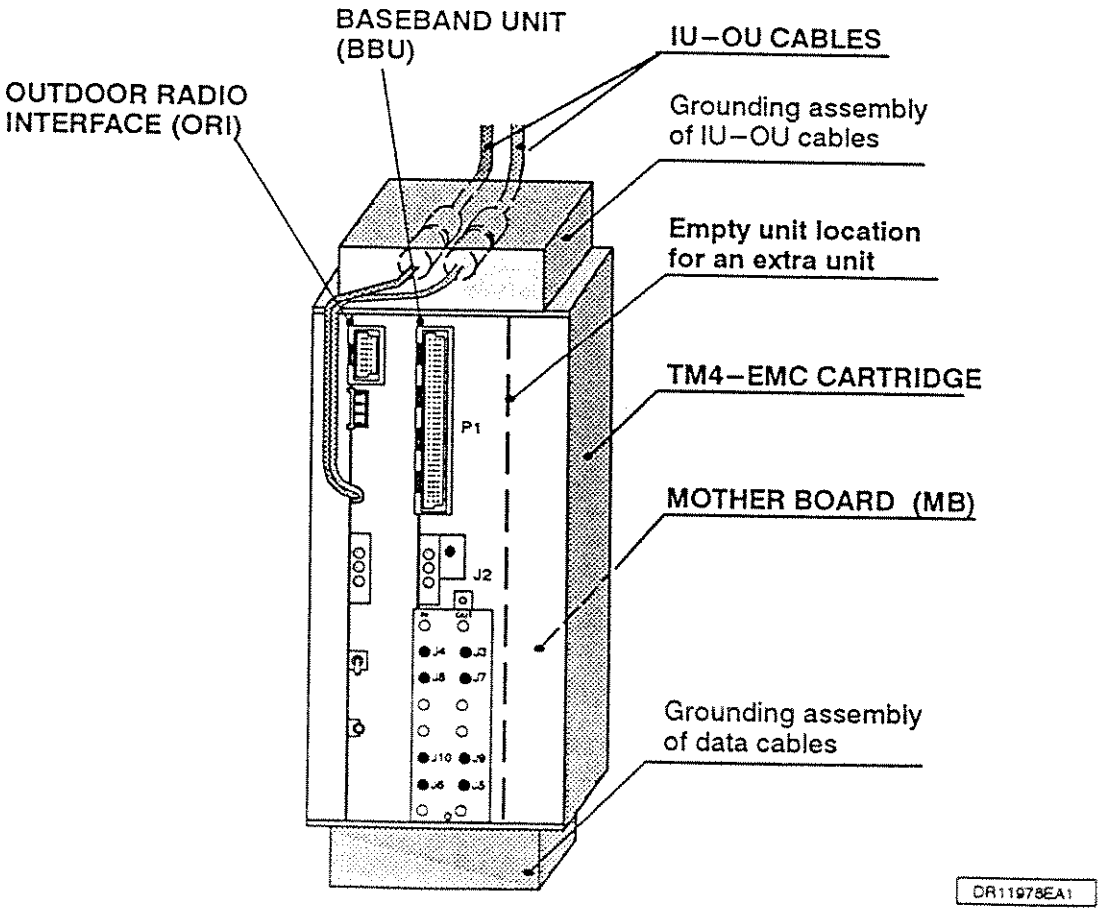


Figure 2 *DMR 4x2–38W Indoor Unit, main parts*

1.3 Interfaces

1.3.1 Indoor Unit (IU)

The locations of the front connectors of the DMR 4x2–38W are indicated in *Figure 4*. The placement of the 3 x 7 Euroconnectors on the 2 x 32 or 3x32 Euroconnectors is also shown (shaded areas). *Figure 4* also provides the numbers of the figures where the interfaces are presented in more detail.

The service, auxiliary data channel and service telephone interfaces, and programmable interface are connected to connector P1 on the Baseband Unit (BBU). The P1 connector is a 3x32 Euroconnector. (See *Figure* 6).

The main channel interfaces are also located on the BBU. The interfaces are either located on 75 ohm SMB connectors (*Figure 7*) or on a 2 x 32 Euroconnector (*Figure 8*).

The Service Terminal charging connector P1 (3x7 Euro, *Figure 5b*) for recharging the batteries of the Service Terminal TC 21700 is located at the upper front edge of the Outdoor Radio Interface (ORI).

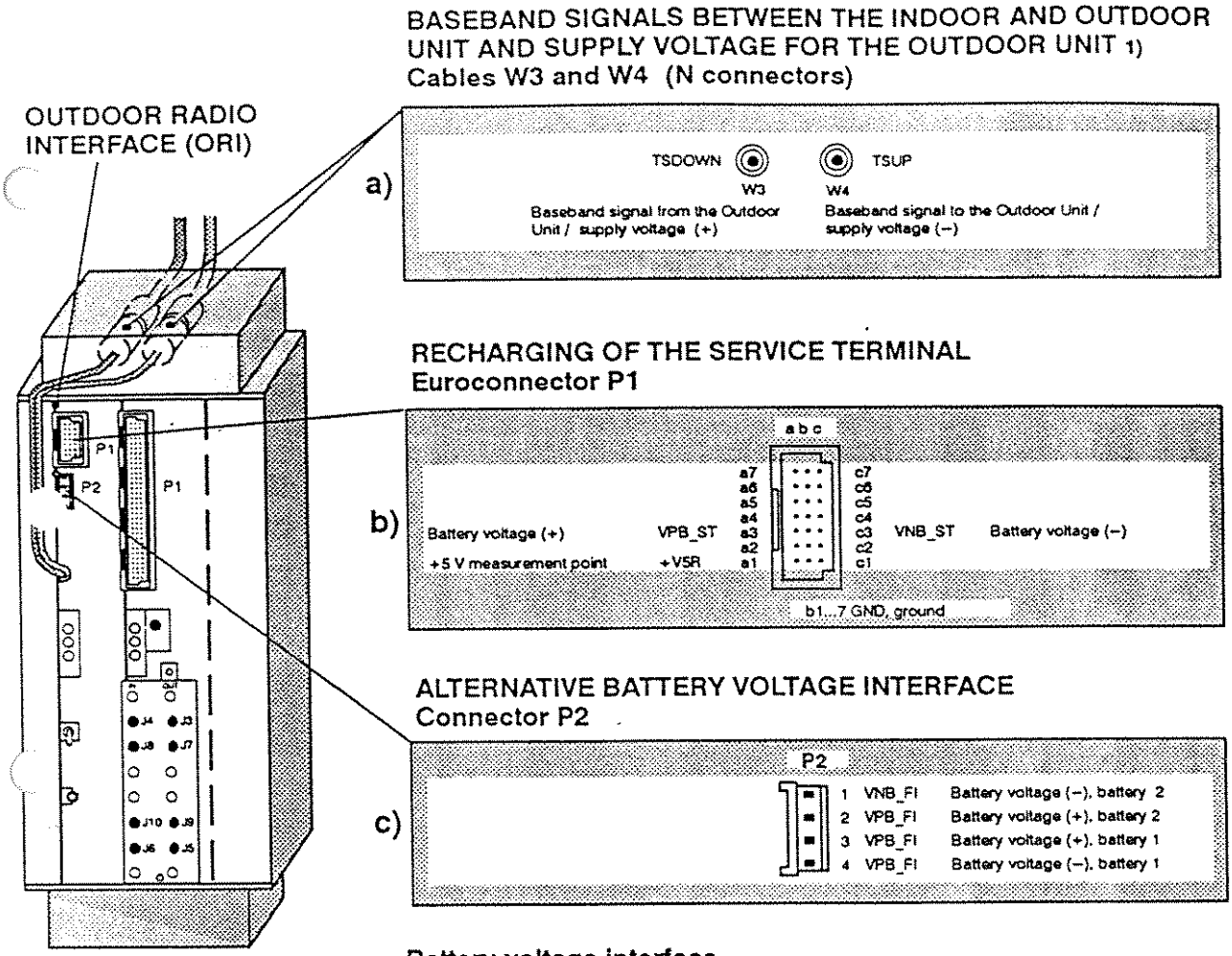
Alternative battery voltage interface P2 located at the upper front edge of the Outdoor Radio Interface (ORI) can be used for the battery voltage supply of the Indoor Unit instead of using rack bus connector. The pin allocation of the connector is shown in *Figure 5c*.

The measurement point MP (see *Figure 4*) is used only temporarily for the duration of the servicing and testing.

The protection bus is connected to the rear of the radio equipment cartridge with the connectorized Protection bus cable (see *Figure 16* on page 24 and *Figure 17* on page 25).

The power supply and rack alarm interface (located at the upper rear edge of the cartridge) is connected with a flat cable to the cartridge bus connector when using a Power Supply Adapter Cartridge (PSA). (See the *Operating Handbook for the TM4–EMC Construction Practice.*)

The baseband signals from the Outdoor Unit / to the Outdoor Unit (OU) are connected with coaxial cables from the front edge of the Outdoor Radio Interface (ORI). The N connector located at cable ends are connected to the grounding assembly of IU–OU cables located above the cartridge, see *Figure 5a*. The actual coaxial IU–OU cables leading to the Outdoor Unit are then connected to the connector interface. The supply voltage to the Outdoor Unit is conveyed over the IU–OU cables, unless the 24 V supply voltage is used, when an external DC supply voltage to the AUXBATT connector of the Outdoor Unit must be used (see subsection 1.3.2).



Battery voltage interface
- battery voltage, battery 1
- battery voltage, battery 2

NOTE: Disconnect the battery connector from the equipment while connecting the battery cables.

1) An external supply voltage fed to the AUXBATT connector of the Outdoor Unit must be used when the battery votlage is 24 V.

DR11915EB1

Figure 5 Interfaces on the Outdoor Radio Interface (ORI)

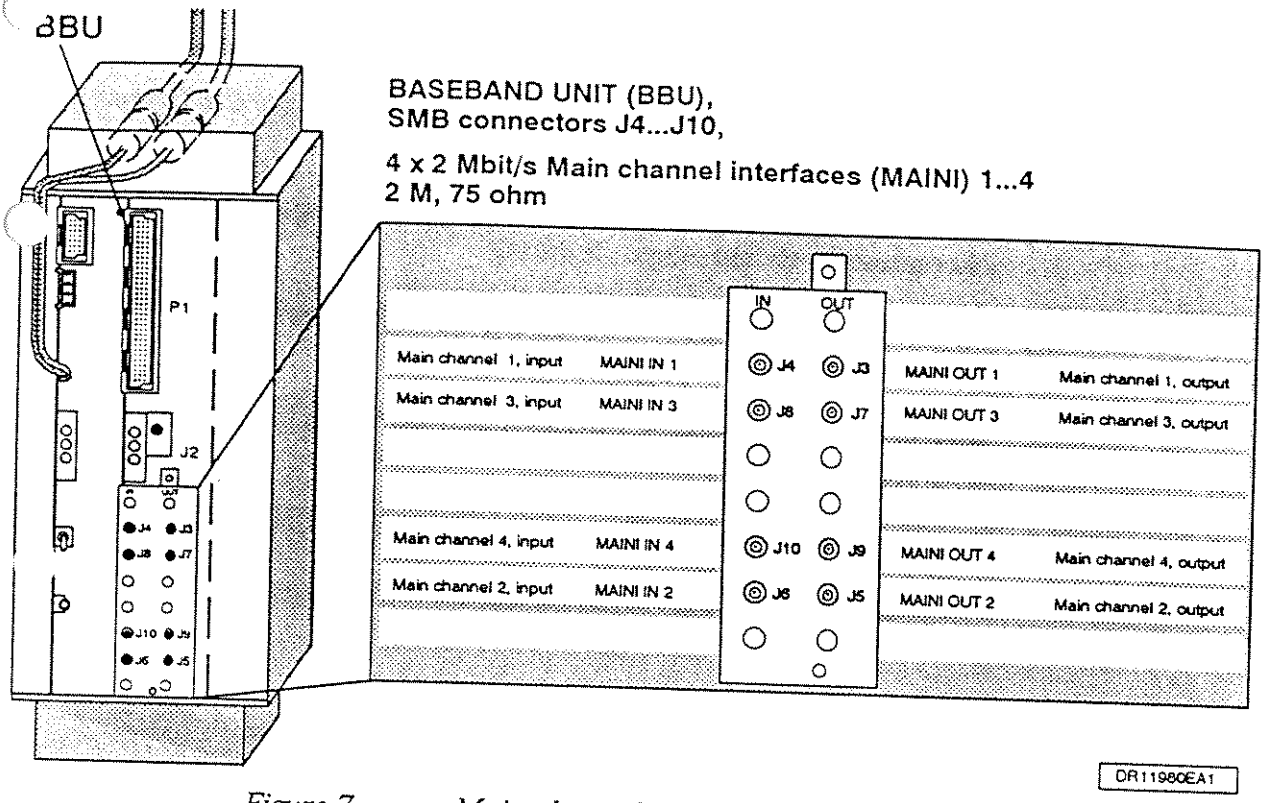


Figure 7 *Main channel interfaces with SMB connectors (75 ohm unbalanced)*

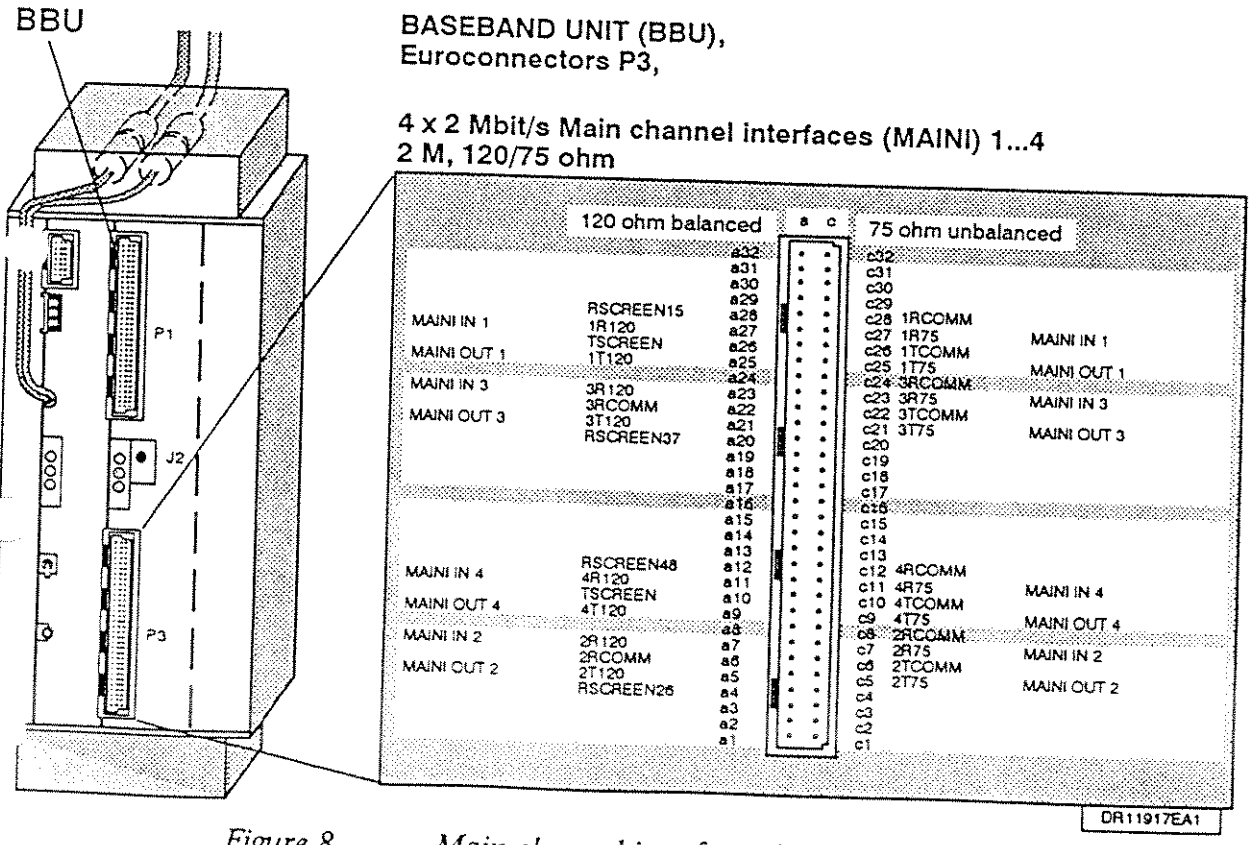


Figure 8 *Main channel interfaces 2 x 32 Euro (120/75 ohm)*

1.4 Installation restrictions

1.4.1 Indoor Unit (IU)

The following installation restrictions must be taken into account when installing the Indoor Unit of the DMR 4x2–38W:

- The ambient temperature for a separately installed equipment must not exceed + 55 °C.
- At least 0.5 U of empty space should be left above and below the Indoor Unit. If other equipments are installed in the same rack with the radio relay equipment, air deflectors should be used.

1.4.2 Outdoor Unit (OU)

The following installation restrictions must be taken into account when installing the Outdoor Unit of the DMR 4x2–38W:

- The Radio Section of the Outdoor Unit should not be left outdoors for longer than 24 hours when disconnected, if it is likely that moisture will condensate on the unit.
- The installation location for the Outdoor Unit should be so selected that the maximum temperatures given in the technical specifications should not be exceeded and the corresponding minimum temperatures should not be below the specifications.
- There should be no obstructions between the radio stations at hop ends.
- The integrated antenna of the Outdoor Unit can be aligned in vertical direction ± 25° (coarse and fine adjustment) and in horizontal direction ± 180° (fine adjustment ± 15°).
- The Outdoor Unit should be so installed that there is space enough behind the connector case of the Alignment unit for the installation. The cover of the connector case opens downwards approx. 260 mm.
- There should be at least 100 mm empty space above the Radio Section so that the Radio Section can be installed into the Alignment unit. Empty space of 410 mm is required if only the case of the Radio Section is to be detached at the installation site (e.g. for adjusting the power level , check–ups etc.)

INSTALLATION OF INDOOR UNIT

2.1 Installation methods, dimensions

The following figures give the installation dimensions for the Indoor Units of the DMR 4x2–38W radio relay equipments at terminal and repeater stations containing single and redundant radio relay equipments. The dimensions are given for installations into TM4 racks (*Figure 11*) and 19" racks (*Figure 12*).

Measurement units:

- Height 1 U = 44.45 mm
- Width 1 T = 5.08 mm

The various parts of the equipment require space as follows:

- DMR 4x2–38W Indoor Unit 8 U 20 T
- Baseband Branching 4 x 2 Mbit/s 7.5 U 20 T

As regards the installation space for the Indoor Unit, it should be noted that although the height of a TM4–EMC cartridge with the grounding assembly is 8 U, it requires installation space of 7 U only, as the grounding assembly is placed in the air deflectors.

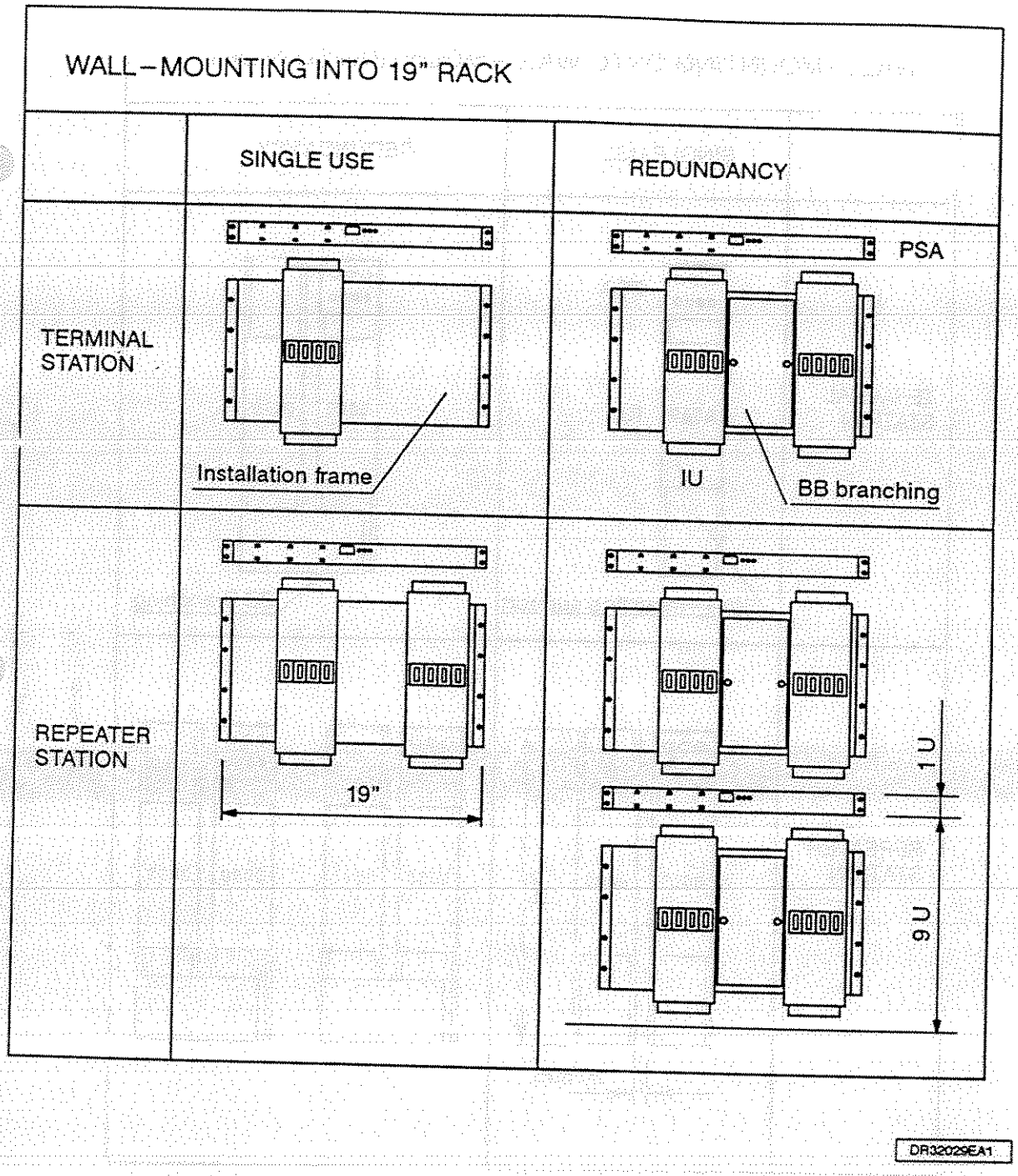


Figure 12 Installation dimensions for wall–mounting into 19" rack

2 Work order

The installation of the TM4–EMC rack is described in the *Operating Handbook for the TM4–EMC Construction Practice.*

In the following are listed the different work phases for installing the Indoor Unit of a DMR 4x2–38W in single use or the two Indoor Units of a redundant DMR 4x2–38W into a preassembled rack complying with the TM4–EMC Construction Practice. The numbers in the parentheses following the work phases, refer to the subsections in this chapter where the work phases are described in detail.

1) Preparing the IU–OU cables (2.3)
2) Preparing the rack (2.4)
3) Installing the cartridge into the rack (2.5)
4) Connecting the alternative battery voltage interface (2.6)
5) Auxiliary data channel interfaces, service telephone interface and programmable interface, and their protection cabling (2.7)
6) Service interface (2.8)
7) Installing the Baseband Branching (2.9)
8) Cabling of main channel interfaces (2.10)
9) Baseband cable options in redundant operation (2.11)
10) Connecting the main channel interfaces and finishing the installation (2.12)
11) Installing the units into the cartridge (2.13)

2.3 Preparing the IU–OU cables

The two coaxial cables between the Indoor and Outdoor Unit i.e the IU–OU cables, are installed according to given instructions. The cables are equipped with N connectors, included in the Connector set T38080.01. The set contains four N connectors. The *Work instructions E1000746RE* for the N connector are enclosed in this description.

NOTE! When the IU–OU cables are used to convey the supply voltage from the Indoor Unit to the Outdoor Unit, it should be checked that the cables are connected to correct connectors of the Indoor and Outdoor Unit (see *Figure 20* on page 28 and *Figure 46* on page 69). The jumper settings (e.g. BATT/AUXBATT) on the component board of the Outdoor Unit Power supply T38045.01 should also be checked (see the enclosed strapping instructions for the Power supply).

With the lowest battery voltage (24 V) or when for other reasons required, the power supply to the Outdoor Unit is to be provided by using an external DC voltage supply connected to the AUXBATT connector of the Outdoor Unit (See subsection 3.7.3 of this chapter).

2.5 Installing the cartridge into the rack

Preparing the cartridge

The installation of the TM4–EMC cartridge is described in the *Operating Handbook for the TM4–EMC Construction Practice*, except for the installation of the grounding assembly of the cables described in this chapter.

The grounding of the cables to the grounding assembly located below the cartridge is illustrated in *Figure 15*.

The installation and grounding of the IU–OU cables to the grounding assembly of the IU–OU cables are illustrated in *Figure 20* (on page 28).

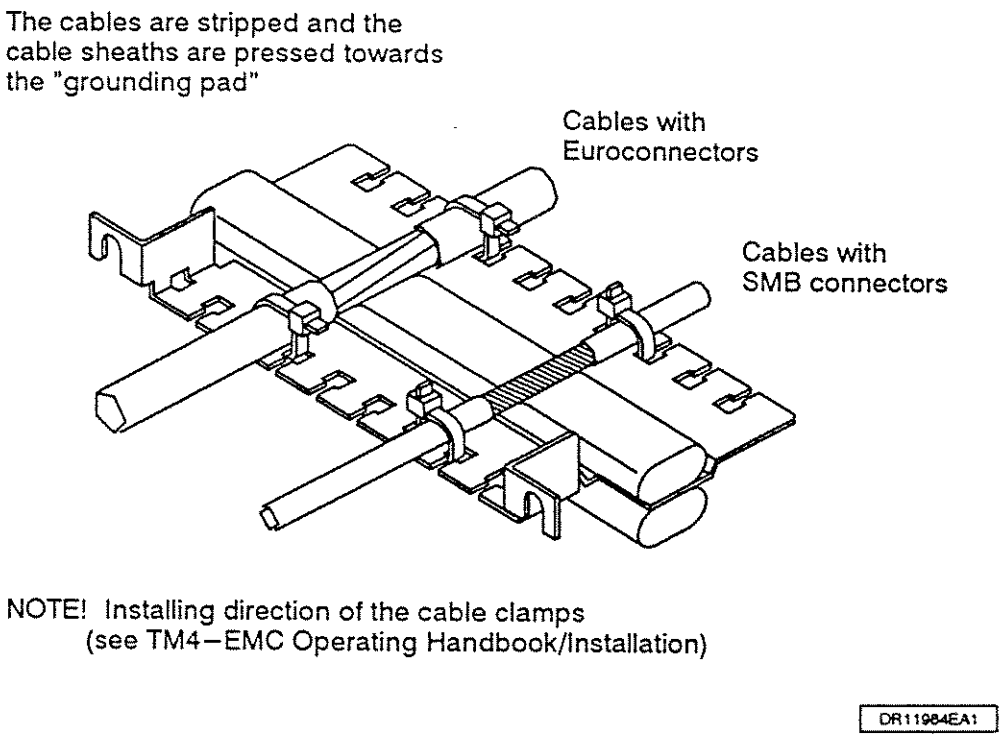


Figure 15 *Grounding the cables to the grounding assembly of data cables located below the cartridge*

The ID stickers of the units to be installed into the cartridge are attached inside the cartridge cover.

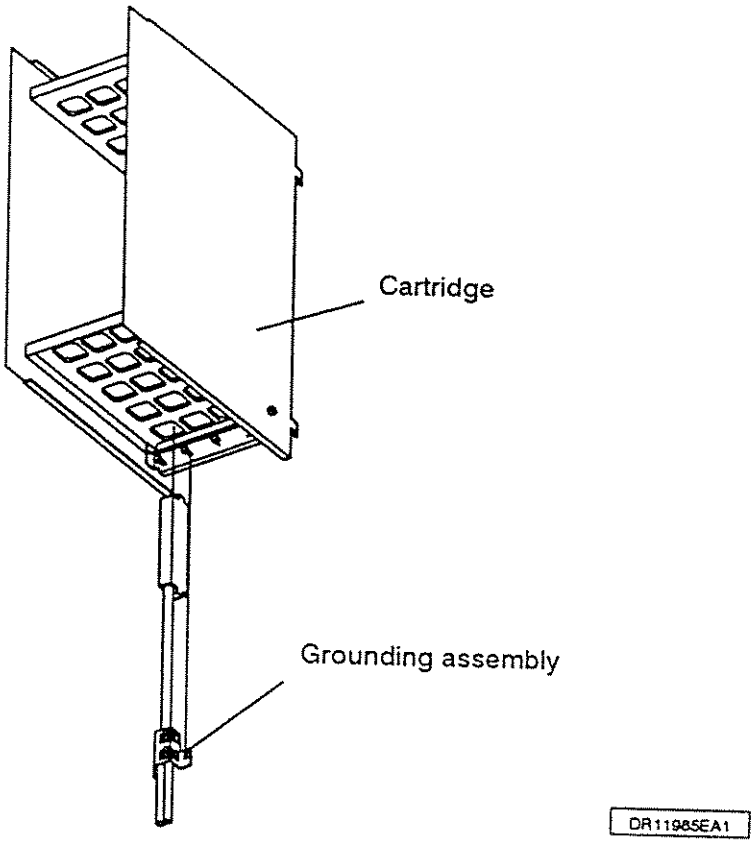


Figure 17 *Routing the protection bus cable through the inlets on the bottom of the TM4–EMC cartridge*

Cartridge A

The cartridge A is installed into the location specified in the installation plan and is locked in place with two locking screws.

Cartridge B

Before installing the cartridge B, a mark is made for the alignment of the upper edge of the cartridge at the location indicated in *Figure 18*. A space of 9 U is left between the cartridge A and B for the Baseband branching (18 empty installation holes between the bottom edge of the cartridge A and upper edge of the cartridge B on the rack body, see *Figure 18*). The cartridge is locked in place in the same way as the cartridge A. The installation of the Baseband branching is described in subsection 2.8.

Single use

The cartridge of an equipment in single use is installed as the cartridge A of a redundant equipment.

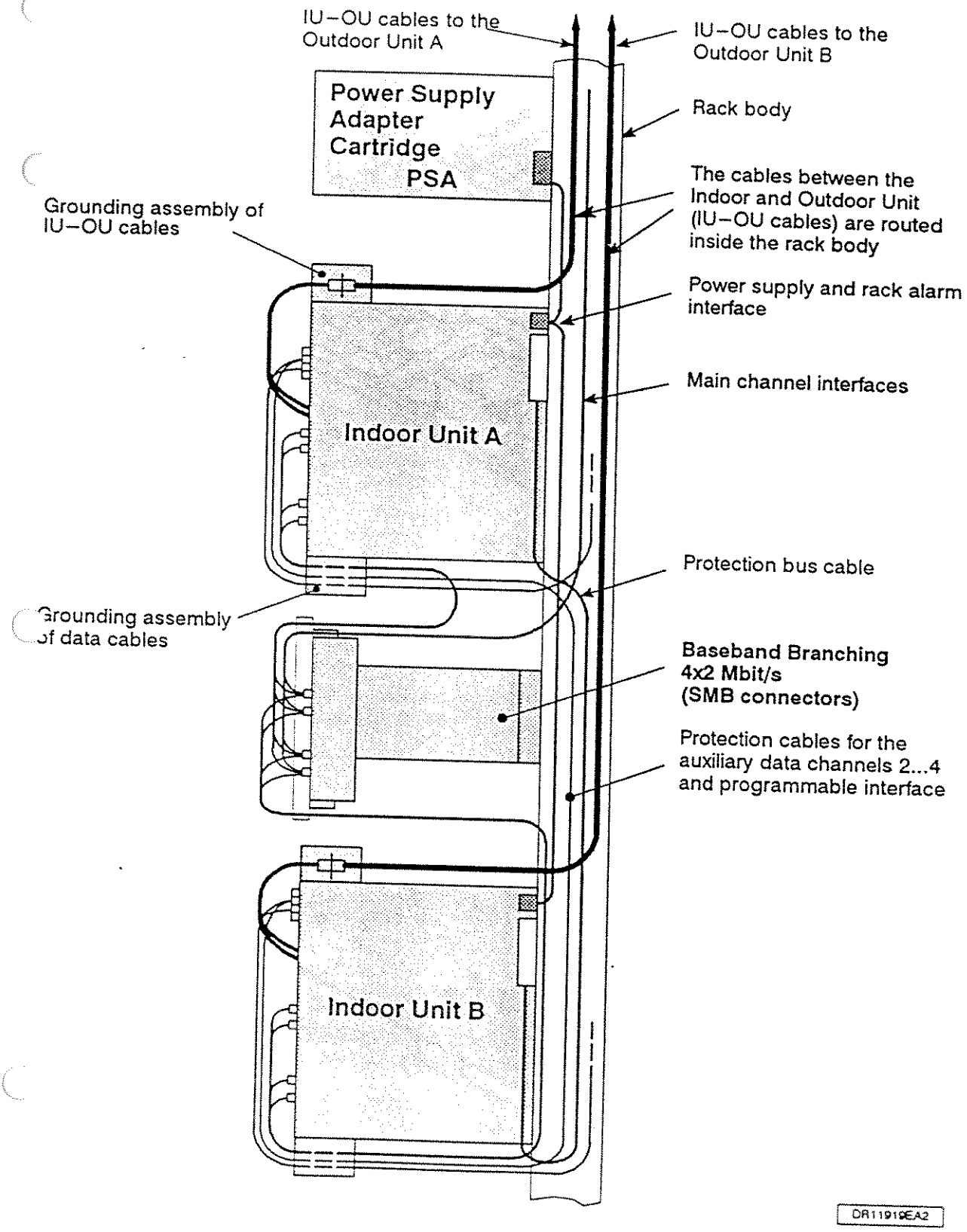


Figure 19 *Profile of a CSB protected equipment (main channel interfaces with SMB connectors)*

.6 Connecting the alternative battery voltage interface

If the Power Supply Adapter Cartridge (PSA) is not used for the power supply of the equipment, the battery voltage can be connected to the alternative battery voltage interface P2 located at the front edge of the Outdoor Radio Interface (ORI) of the Indoor Unit (see *Figure 5* on page 11).

A 4–pole connector required for establishing the connection to the Outdoor Radio Interface is delivered with the unit.

The 2–wire Power supply line (delivered with the TM4–EMC cartridge) is used between the connector and supply cable brought from the battery.

The unconnected conductor ends of the Power supply line are connected to the 4–pole connector equipped with screw connections (red/+, blue/–).

The Π–type filters functioning as EMC protectors of the Power supply line are grounded by routing the Power supply line from the unit connector to the grounding assembly of data cables located below the cartridge.

The Power supply line is connected to the supply cable from the battery with a 2–pole terminal block connector located at the conductor end (1/red/+, 2/blue/–).

BASEBAND UNIT (BBU), Euroconnector P1

SERVICE TELEPHONE INTERFACE, AUXILIARY DATA CHANNEL INTERFACES AND PROGRAMMABLE INTERFACE

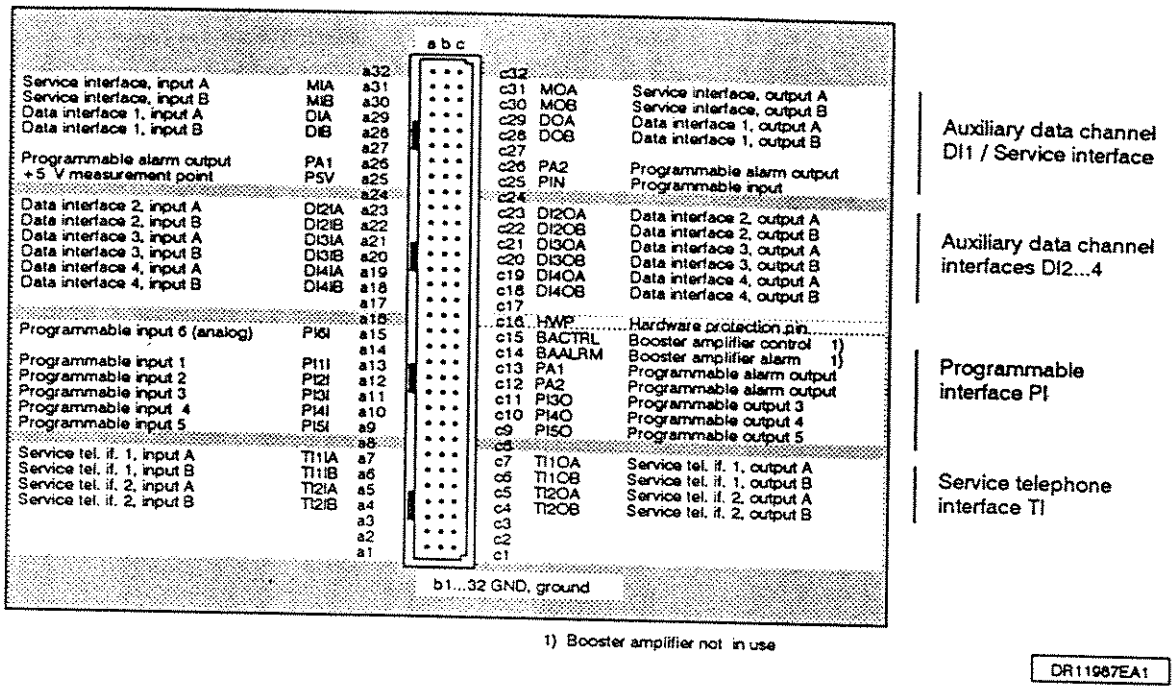


Figure 21 *Pin allocation of the service telephone interface, auxiliary data channel interfaces and programmable interface on the Baseband Unit connector P1*

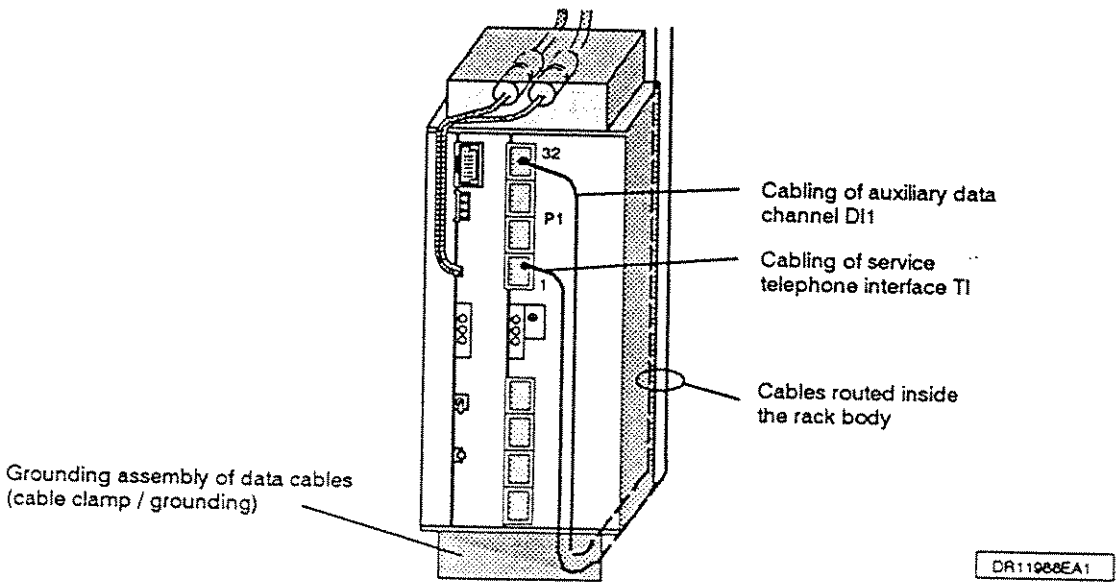


Figure 22 *Example cabling of auxiliary data channel DI1 and service telephone interface TI (in single use)*

7.8 Service interface

The operation of the DMR 4x2–38W is controlled with the Service Terminal TC 21700 via the service interface included in the Euroconnector P1 on the Baseband Unit (see *Figure 24*). Via the interface, equipment state and alarm data can be read, controls and settings can be given, loops can be set etc. The traffic at the interface is serial–formatted. See the *Service Terminal Operating Handbook* and section 6 *Operation with Service Terminal* of this Operating Handbook.

Radio relay equipments may also be managed with the TMS Transmission Management System (See the *Operating Handbook for the TMS Transmission Management System*).

The service interfaces can be connected into a bus at the equipment station and the service buses of the different stations can be further be connected into a service network by means of the data channel on each equipment (see *Figure 25*). All equipments connected to the bus or network can then be remotely controlled using the Service Terminal or TMS Transmission Management System (refer to the corresponding handbooks).

Service connector (Baseband Unit Euroconnector P1)		
MI	Service Interface	(MIA, MOB, MOA, MOB)
	Service interface for the Service Terminal or Transmission Management Computer (TMC). Via this interface, settings and controls are given to the equipment, and status, fault data and statistics are read. Bidirectional. Differential levels as per CCITT V.11 (EIA RS–422). The interface is active only when the equipment is transmitting a signal. At other times, the output is at a high– impedance state, so the interface can be connected to a bus together with other corresponding interfaces, whereupon several equipments can be controlled from one point.	
DI	Data Interface	(DIA, DIB, DOA, DOB)
	Data interface for transferring asynchronous serial–formatted data as a separate channel along with the frame structure. Bidirectional. Differential levels as per CCITT V.11 (EIA RS–422). Unlike the interface MI, the data interface is always active; it is not intended to be a bus. The interface DI can be connected to the interface MI by using the data hybrid of the equipment.	

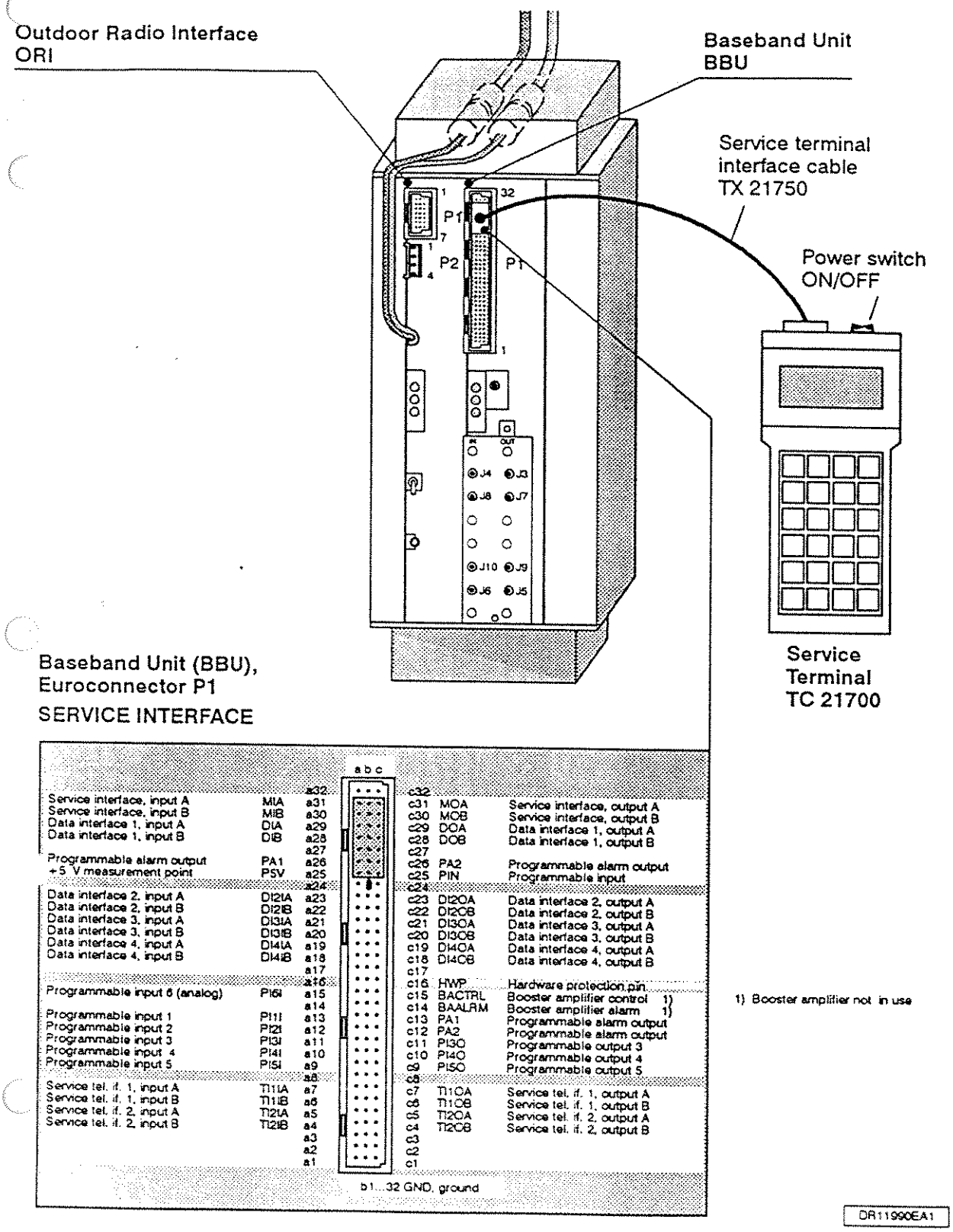


Figure 24 *Location of signal outputs of the service interface at the Euroconnector P1 on the Baseband Unit*

2.9 Installing the Baseband Branching

Redundancy for the DMR 4x2–38W Radio Relay Equipment can be provided either in cold standby operation (CSB) or twin–frequency use. In each case two radio relay equipments (Equipment A and Equipment B), Baseband Branching adapting the main channel interfaces of the equipment pair and cables to be connected between the Indoor Units of the equipments and the Baseband Branching are needed.

The overall dimensions of the Baseband Branching with Euroconnectors and that with SMB connectors are the same.

The installation of the Baseband Branching is illustrated in *Figure 26*. The cover of the branching is first opened by unscrewing the two knurled–head screws. The branching is suspended by its mounting brackets to the seventh rack body hole as counted from the lower edge of the cartridge A. The Baseband Branching is then locked in place by tightening the locking bars with a screwdriver.

2.9.1 Baseband Branching, 8 x 2 Mbit/s, Euroconnectors

The 8 x 2 Mbit/s Baseband Branching TP 26020.11 is used for the redundancy of the DMR 4x2–38W Radio Relay Equipment equipped with Euroconnectors. This branching equipment covers the lower branching capacities 2 x 2 Mbit/s and 4 x 2 Mbit/s.

The cabling principle for the Baseband Branching equipped with Euroconnectors is illustrated in *Figure 27*. Preassembled cables (BBr cables TX 26282.92) to be connected between the radio relay equipments and Baseband Branching are routed from the Baseband Unit Euroconnector P3 of each radio relay equipment through the grounding assembly (also grounding the cable sheaths) of data cables located below the TM4–EMC cartridge on each equipment to the cable space of the rack. From the cable space the cables are routed to the connectors of the Baseband Branching. The cables are grounded through the grounding assembly of the Baseband Branching.

Connection to the 2 x 32 –pole Euroconnector P3 on the Baseband Unit is implemented e.g. with 2 x 7 –pole Euroconnectors of the four interface cables included in the above cable set. Each Euroconnector contains interfaces for two main channels illustrated in *Figure 28*.

It should be noted in the cabling that the pin allocation of the main channel interfaces on the Baseband Unit Euroconnector P3 of the equipment A differs from the corresponding pin allocation on the connector P2 of the Baseband Branching.

The cabling of 2 Mbit/s main channel signals from and to the Euroconnector P1 on the Baseband Branching is described in subsection 2.10.2.

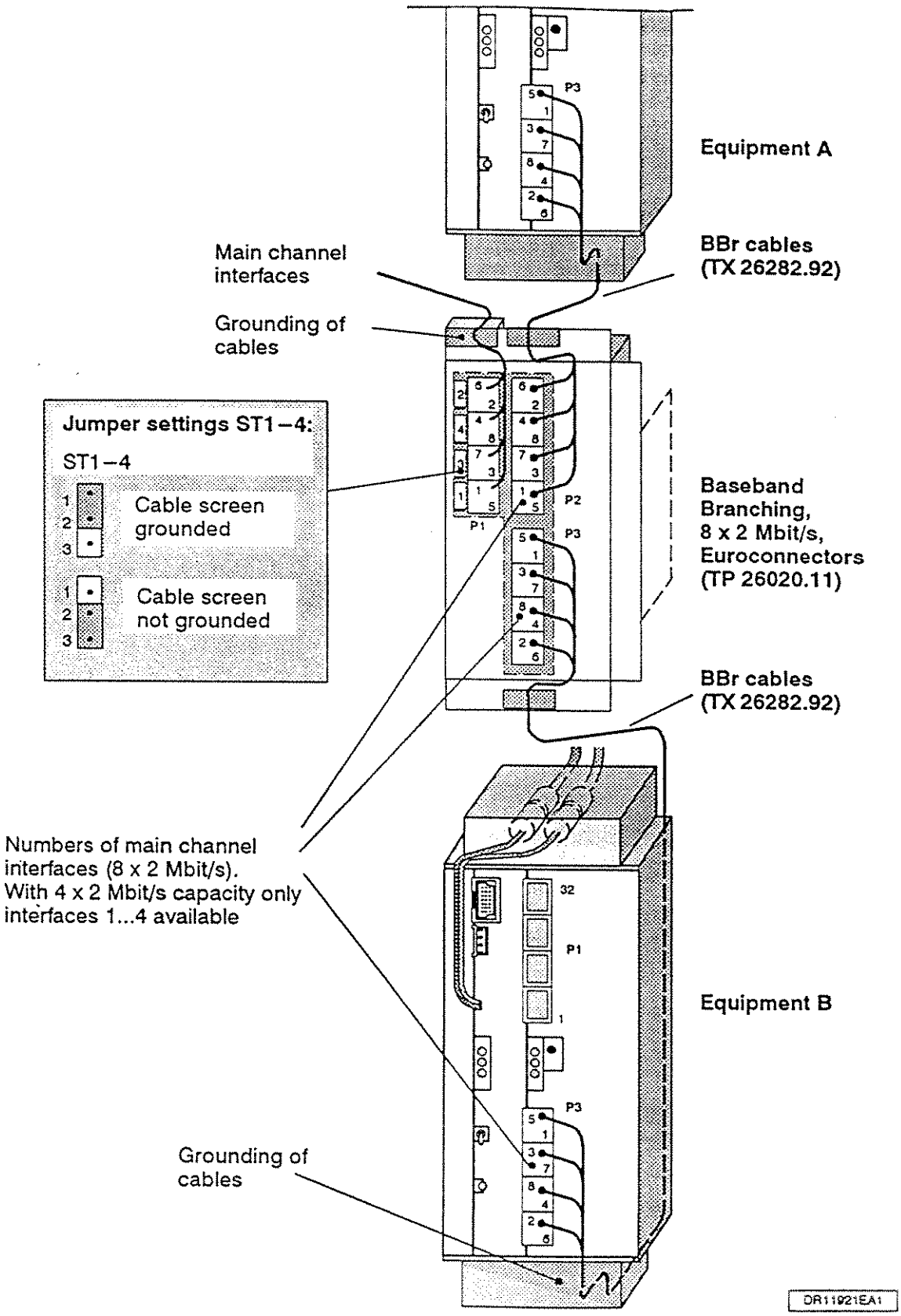


Figure 27 *Cabling of 4 x 2 Mbit/s (8 x 2 Mbit/s) Baseband Branching equipped with Euroconnectors*

2.9.2 Baseband branching, 4 x 2 Mbit/s, SMB connectors

The cabling principle for the 4x2 Mbit/s Baseband Branching TP26022.12 equipped with SMB connectors is illustrated in *Figure 29*. The numbers for the main channel interfaces and signal directions are indicated in the below figure. Each cable is routed from the Baseband Branching via the appropriate cable clamps and grounding assembly, and further via the grounding assembly of data cables located below each equipment cartridge to the appropriate main channel interface on the Baseband Unit of the equipment A and B and on the Baseband Branching (see *Figure 30*). As cabling is routed similarly for each main channel, cabling for one 2 Mbit/s channel (MAINI 1) only is illustrated in *Figure 30*.

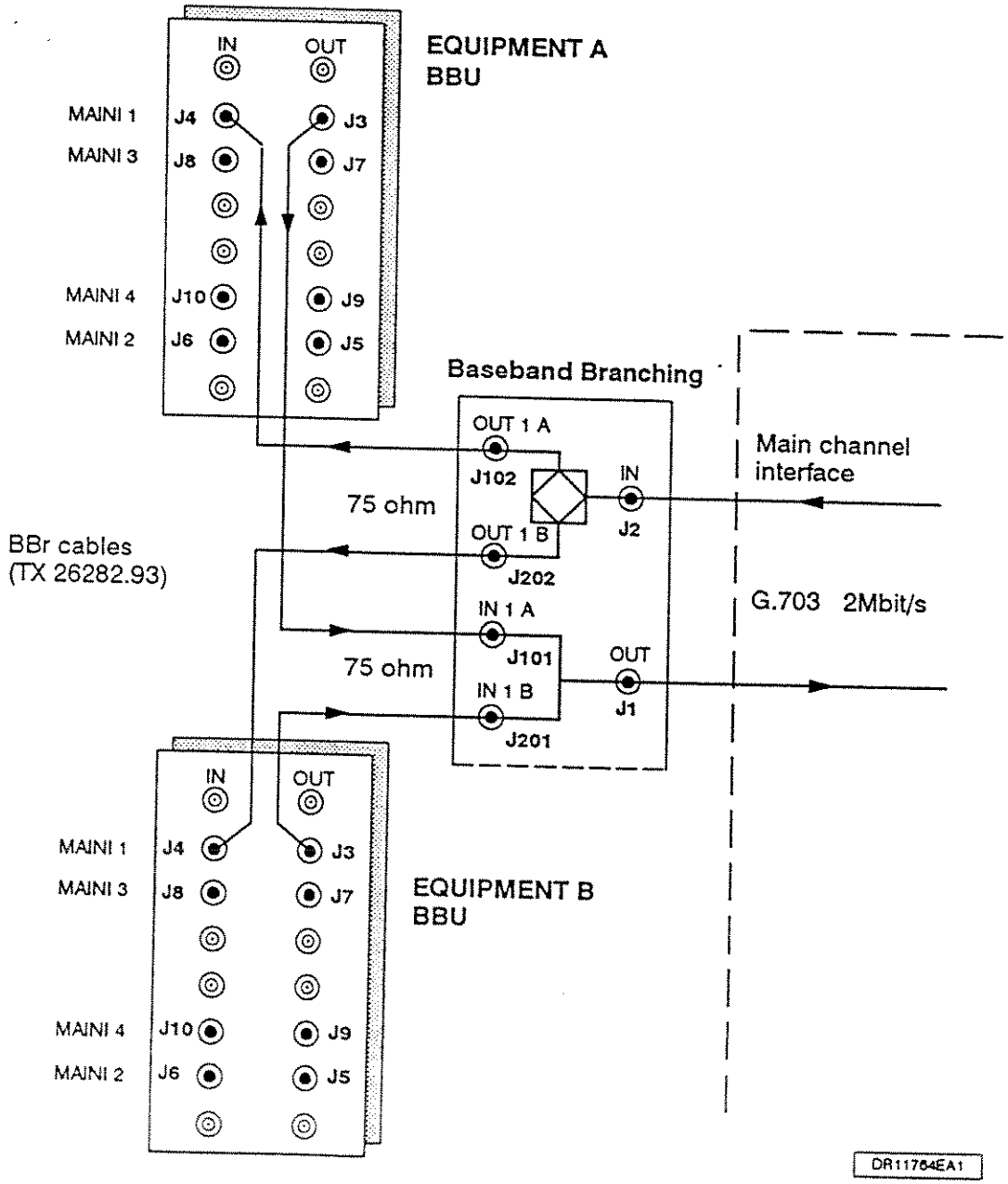


Figure 29 *Cabling of 4 x 2 Mbit/s Baseband Branching equipped with SMB connectors*

2.10 Cabling of main channel interfaces

In single use, the cables of the 2 Mbit/s main channel signals from and to the radio relay equipment are directly connected to the Euroconnector P3 on the Baseband Unit TC 26000.** (see *Figure 32*) and in redundant use to the Euroconnector P1 on the Baseband Branching TP 26020.11 (see *Figure 34*).

In should be noted by the cabling that the cabling direction and pin allocation on the Baseband Unit Euroconnector P3 and on the Baseband Branching Euroconnector P1 differ from each other (see *Figure 32* and *35*). The main channel signal cabling implemented on the Baseband Unit of a radio relay equipment in single use can, however, be implemented as such when the equipment is provided with redundant equipment, if approx. 300 mm extra cable length is left for the main channel cables to an appropriate location as regards the (later) cabling.

3 x 7 –pole Euroconnectors, delivered with the Connector Set TX 26285.12, are used for the main channel cabling. Two main channel interfaces are connected to each Euroconnector when the capacity is 8 x 2 Mbit/s. However, when the capacity is 4 x 2 Mbit/s (basic application) only one main channel interface per connector is available.

2.10.1 Baseband Unit, Euroconnectors

The pin location of the Baseband Unit Euroconnector P3 for four main channel interfaces is illustrated in *Figure 32*. 3 x 7 –pole Euroconnectors used for the cabling are placed on the Baseband Unit Euroconnector P3 so that the connector guides fit to the grooves of the connector frame.

The cabling order depends on the interface type that is whether the interface is balanced or unbalanced. *Figure 33* illustrates how the main channel interfaces connected to 3 x 7 –pole Euroconnectors are cabled when the interface is balanced and when the interface is unbalanced.

Table 2 presents an example cabling of a balanced and unbalanced interface, when Nokia KLVMAAM 2 x (2 x 0.4 + 0.4) cable is used.

It should be noted by the cabling that the cabling of the Baseband Unit Euroconnector P3 (including the main channel interfaces) with 3 x 7 –pole Euroconnectors is to be implemented so that the cables are first routed to the grounding assembly of data cables below the cartridge, where the cable sheaths are grounded and the cables are then routed to the cabling space of the rack.

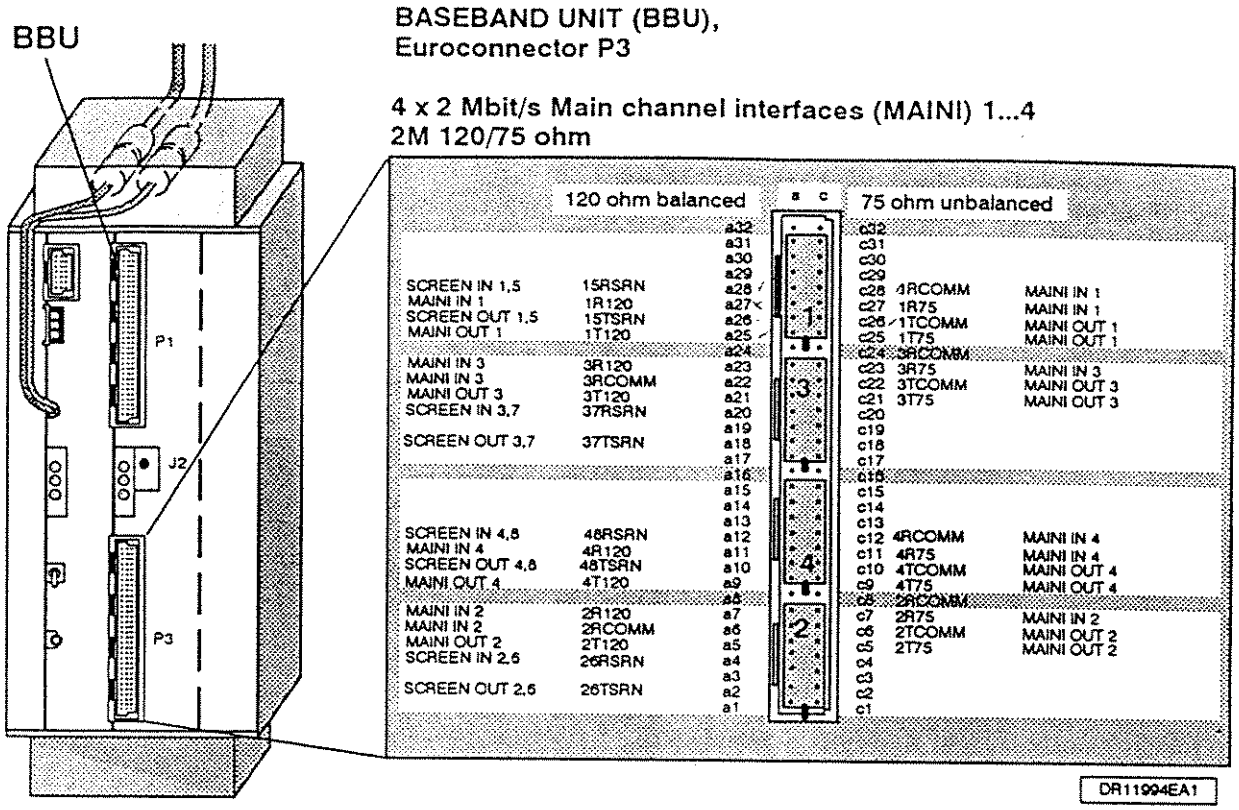


Figure 32 *Baseband Unit 4x 2 Mbit/s main channel interfaces, Euroconnectors*

MAIN CHANNEL INTERFACE		BBU connector P3, pin	KLVMAAM 2 x (2 x 0.4 + 0.4) pair	120 ohm	75 ohm
MAINI IN 1	1R120	a27	1	blue (a3)	–
	1R75	c27		– –	blue (c3)
	1RCOMM	c28		white (c4)	white (c4)
	15RSRN	a28		bare (a4)	bare (a4)
MAINI OUT 1	1T120	a25	2	blue (a1)	–
	1T75	c25		– –	blue (c1)
	1TCOMM	c26		white (c2)	white (c2)
	15TSRN	a26		bare (a2)	bare (a2)

3 x 7 –pole Euroconnector pin numbering in brackets

NOTE! The jumper settings ST1...ST8 and ST15, ST26, ST37, ST48 (see strapping instructions) should be taken into account when cabling the Baseband Unit main channel interfaces equipped with Euroconnectors

Table 2 *Example cabling of the Baseband Unit main channel interface MAINI 1 with Nokia cable KLVMAAM 2 x(2 x 0.4 + 0.4)*

2.10.2 Baseband Branching, Euroconnectors

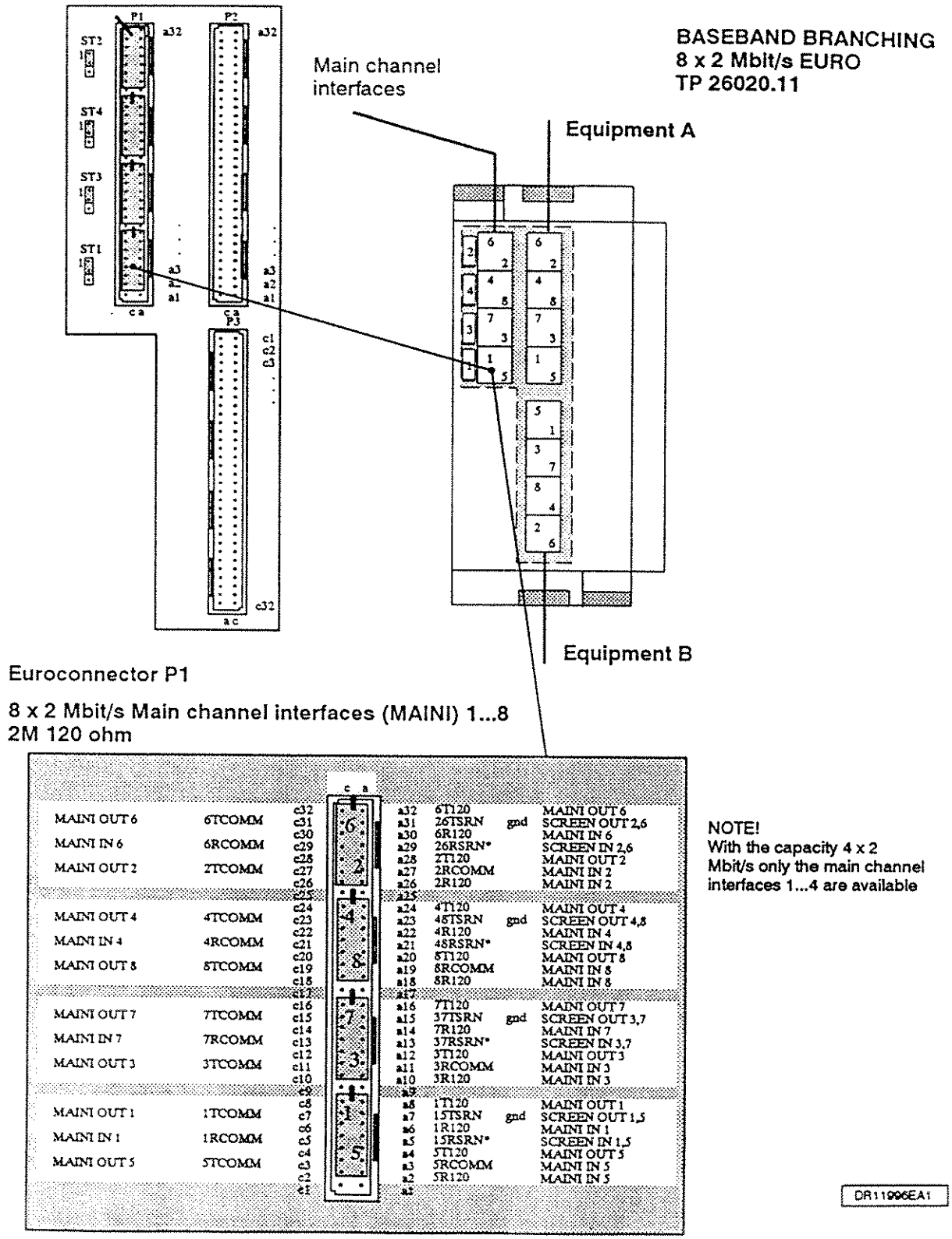


Figure 34 *Main channel interfaces of the 8 x 2 Mbit/s Baseband Branching*

Example cabling of Baseband Branching main channel interface MAINI 1 with Nokia cable KLWMAAM 2 x (2 x 0.4 + 0.4) is given in *Table 3*.

MAIN CHANNEL INTERFACE		Baseband Branching connector P1 pin	KLVMAAM 2x(2x0.4 + 0.4)	
			pair	120 ohm
MAINI IN 1	1R120 1RCOMM 15RSRN	a6 c5 a5	1	blue (c5) white (a4) bare (c4)
MAINI OUT 2	1T120 1TCOMM 15TSRN	a8 c7 a7	2	blue (c7) white (a6) bare (c6)

3 x 7 –pole Euroconnector pin numbering in brackets

NOTE! The jumper settings ST1...ST8 and ST15, ST26, ST37, ST48 (see strapping instructions) should be checked when cabling the Baseband Branching main channel interfaces equipped with Euroconnectors

Table 3 *Example cabling of the Baseband Branching main channel interface MAINI 1 with Nokia cable KLVMAAM 2 x (2 x 0.4 + 0.4)*

NOTE!
When cabling the Baseband Branching main channel interfaces, the jumper settings ST1...4 at the left front edge of the Baseband Branching should be checked:

The sheaths (**RSRN) of the 2 Mbit/s main channel cables brought (receive direction) to the Baseband Branching can be grounded with the Baseband Branching jumper settings. The jumper settings are provided for each main channel interface pair to be connected to a 3 x 7 –pole Euroconnector (see the enclosed strapping instructions for the Baseband Branching). The sheaths of the transmit direction cables are permanently grounded (**TRSN) via the Baseband Branching Euroconnector.

Connector sets

Main channel and auxiliary data channel connectors required for the cabling are included in the connector sets.

The Connector Set TX 26285.12 includes connectors required for the cabling of an equipment equipped with Euroconnectors.

The Connector Set TX 26285.13 includes connectors required for the cabin of an equipment equipped with SMB connectors.

3 INSTALLATION OF THE OUTDOOR UNIT (OU)

3.1 Work order

The installation of the Outdoor Unit (OU) can be implemented in many different ways. The installation method is determined e.g. by the installation site, mounting accessories available etc.

The installation of the various parts of the Outdoor Unit may be divided into 6 installation phases (A, B, C, D, E, F). The installation order may be varied to some extent, for example according to the four installation order options presented in *Table 4* (columns I, II, III and IV in the table).

It is recommended to prepare the cabling in advance so that the cables can be attached to the Radio Section immediately after the Radio Section has been installed.

NOTE!
The Radio Section of the Outdoor Unit should not be left outdoors for more than 24 hours when disconnected if it is likely that moisture will be condensated inside the unit.

INSTALLATION PHASE:	WORK ORDER OPTIONS I	II	III	IV
A Attaching the mounting kit	1	1	1	1
B Attaching the support and clamps onto the tube	4	2	2	2
C Attaching the Antenna to the connector case of the Alignment Unit	3	4	3	3
D Attaching the connector case of the Alignment Unit to the support	2	3	4	5
E Attaching the Radio Section to the connector case of the Alignment Unit	5	5	5	4
F Connecting the cables to the Radio Section	6	6	6	6

Table 4 *Work order options for installation phases of the the Outdoor Unit*

The above work order options are illustrated in the enclosed *Installation instructions E10007510RE*.

The installation base in the roof–mounting should be strong enough (e.g. concrete beam). To avoid damages which may be caused by the installation, the structure of installation base material and construction of the building must be known. Mechanical strain due to the installation and moisture damages should be taken into special account.

Installation work phases for the mounting kit for roof installations are as follows (example, see enclosed *Installation instructions T38085001RX):*

1. Check the material of the installation base and choose appropriate fastening bolts (hex head screws) for the support (2), the diameter of which is 10 mm (the bolts are not included in the mounting kit; the bolt type to be used depends on the roof construction).

2. Mark the hole locations onto the installation base and drill the holes for the fastening bolts. Ensure that the installation will not cause any water or moisture damages on the roof construction. Bitumen or silicon paste can be used as sealing compound.

3. Attach the support (2) to the base with the bolts. The base can be attached with five bolts at the maximum.

4. Attach the T–tube (1) to the support with the clamps (3). The clamps are attached with the fastening parts (14, 15, 18) presented in the *Installation instructions*.

5. Install the T–tube in vertical direction using the water level. Tighten the bolts. The tightening torque is approx. 28 Nm.

6. Before attaching the stay tubes (7) supporting the T– tube, the support and connector case of the Alignment Unit of the Outdoor Unit are attached (see subsections 3.3 and 3.5 of this chapter) or the installation of the stay tubes (7) is carefully planned so that the installation will not cause any difficulties in later Outdoor Unit installations and antenna alignment.

7. The stay tube (7) is connected to the T–tube (1) with two clamps (11) and a mounting bracket (9) using the fastening parts (13, 16, 17, 19) illustrated in the *Installation instructions*.

8. The stay tube (7) is attached to the roof with a slide rail (12). The slide rail is attached to the installation base with mounting brackets (9, 10). The braclets are attached with the fastening parts (13, 17, 19) illustrated in the *Installation instructions*.

9. The stay tube (7) and the slide rail (12) are interconnected with U–bolts (8), mounting plate (6) and required fastening parts (17, 19).

3.2.2 Wall–mounting

The mounting of the Outdoor Unit on a wall presented in the following is implemented with the *Mounting Kit OU Wall* T38085.02. A parts list and *Installation instructions T38085002RX* (also enclosed in this description) are delivered with the above mounting kit.

The parts numbers, given in brackets in the following example wall installation of the Outdoor Unit, refer to the parts numbering in the *Installation instructions T38085002RX*.

Wall–mounting in general

The tube for wall–mounting, O–tube (*Figure 38*) is intended for vertical installations on walls. The tube can also be used for low–profile roof installations (*Figure 40*) or even for installations on a tower (*Figure 41*).

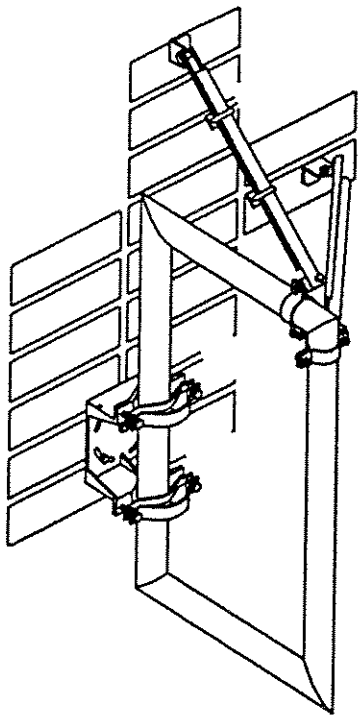


Figure 38 O–tube used for wall installations

The position of the O–tube can be changed according to the location (see examples in *Figure 39*). The rigidity of the installation can be increased with vertical and horizontal tubes functioning as stays.

10. The stay tubes (5) are connected to the slide rails (12) with U–bolts (8) and mounting plates (6) using the fastening parts (17, 19) illustrated in the *Installation instructions.*

11. Check the verticality of the O–tube and check the joints. After installing the Outdoor Unit, check the verticality and rigidity of the installation and perform necessary adjustments.

The mounting kit for wall installations T38085.02 also includes the hex head screws, washers and hex nuts, with which the Alignment Unit of the Outdoor Unit is mounted onto the O–tube. This part of the installation work is described in more detail in subsection 3.3 *Installing the support of the Alignment Unit onto to the tube* of this chapter.

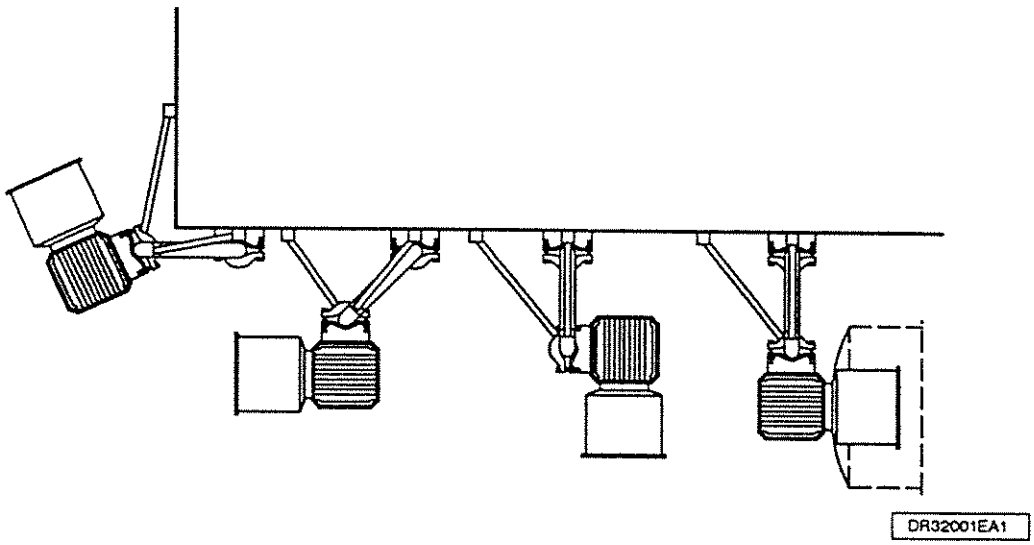


Figure 39 *Installation options for O–tube in wall installations (seen from above)*

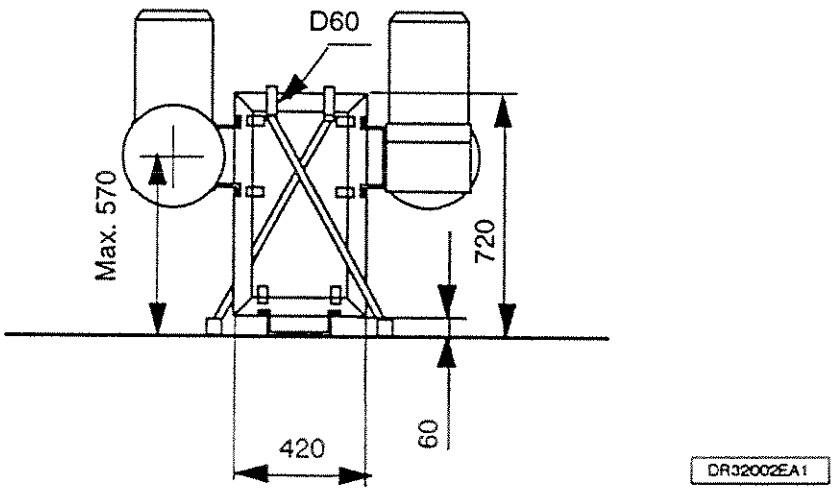


Figure 40 *O–tube in low–profile installation*

3.2.5 Wind load

The tower and the tube mounted onto the tower should sustain a wind load due to wind velocity of 55 m/s.

When the wind velocity is 40 m/s, the 30 cm antenna is allowed to turn 0.5° and 60 cm antenna 0.25° at the maximum, when the received signal is degraded by 1 dB at the maximum.

The forces and moments affecting the installation tube (D60 mm) (see *Figure 42*) are as presented in *Table 5* (wind velocity 55 m/s and 40 m/s, wind directions: front and side, antennas 30 cm and 60 cm).

Roof and wall installation accessories when provided with stays are strong enough for a 60 cm antenna. **NOTE!** It must be checked that the roof and wall constructions will sustain the intended load.

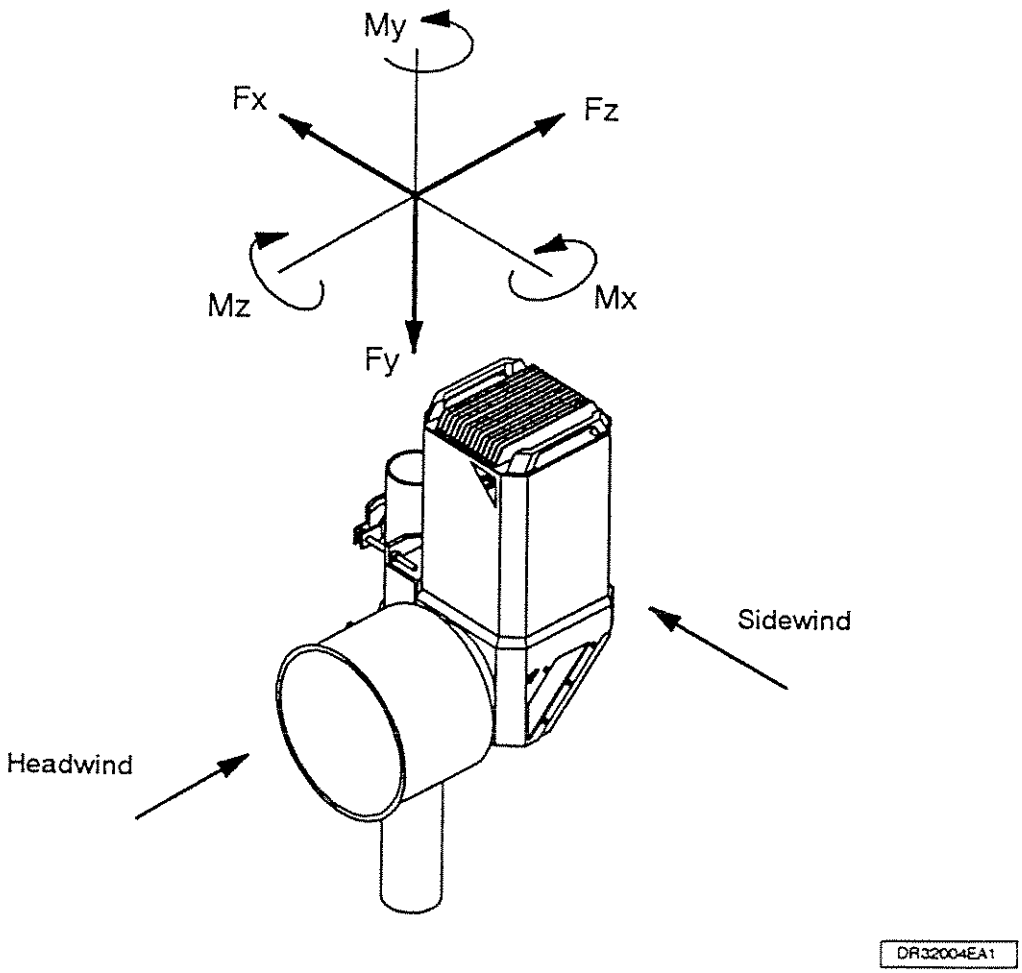


Figure 42 *Powers and torques affecting the installation tube*

3.3 Installing the support of the Alignment Unit onto the tube

(Installation phase B: Attaching the support and clamps onto the tube)

The mounting of the OU Alignment Unit support onto the tube presented in the following is implemented with the Alignment Unit T38070.. Required mounting accessories, parts list and *Installation instructions T38070001RX* (also enclosed in this description) are delivered with the Alignment Unit.**

The parts numbers, given in brackets in the following example installation of the Alignment Unit support, refer to the parts numbering in the *Installation instructions T38070001RX.*

Installing the Alignment Unit in general

The Alignment Unit T38070.01 of the Outdoor Unit is delivered as an installation set, in which the connector case of the Alignment Unit is assembled into a subassembly and other parts are separate. This allows for that the different units of the Outdoor Unit can be installed in desired work order.

NOTE! The installation side must be chosen, i.e. which connector case side will locate closer to the tube, before attaching the Alignment Unit support.

Installation example (see *Installation instructions T3807001RX*):

1. Attach the support (4) to a vertical tube using two clamps (5). The Clamps are attached with the mounting accessories included in the application–specific mounting kit (bolts for roof and wall installations / threaded rods, washers and nuts for the D60...140 mm tube installations). The bolts / nuts are tightened with a 17 mm spanner.

2. Attach two clamps (5) below the support (4) using application–specific mounting accessories (see item 1 above).

3. A 27 mm eye bolt (9) is screwed to the threaded hole located in the middle of the clamp (5) attached below the support (4). A 19 mm eye bolt (8) is screwed to the threaded hole located below the support (4).

4. Adjust the eye bolts to level with each other so that the Threaded rod (10) used for vertical alignment easily slides through the holes in the eye bolts.

5. Screw two (adjusting) hex nuts (16) into the middle of the threaded rod (10) next to each other.

3.4.1 Polarization

Usually, only vertical polarization is used in the frequency range 38 GHz to reduce the reflections caused by buildings and rain attenuation (electric field E and narrow side of the waveguide in vertical direction, see *Figure 43, "V"*).

However, it is also possible to use the antenna in horizontal polarization (the narrow side of the waveguide in horizontal direction, see *Figure 43, "H"*). With the horizontal polarization the rain attenuation in light rain is approx. 1 dB/km higher than with the vertical polarization (see Nokia's *Route Design for Radio Links above 17 GHz*).

Depending on the antenna type the polarization change over is implemented either by turning the whole antenna by 90° or by turning the feeder. It is recommended to rotate the feeder only when the antenna is detached from the Alignment Unit.

The antenna is mounted to the Radio Section with flexible and rotating waveguide, which is to be rotated by 90°, so that the waveguide of the antenna and the flexible waveguide will be in a parallel direction. The adjustment of the waveguide to the antenna flange fails, if the waveguides cross each other.

If there are holes for water–discharge in the antenna, the holes should be located downwards.

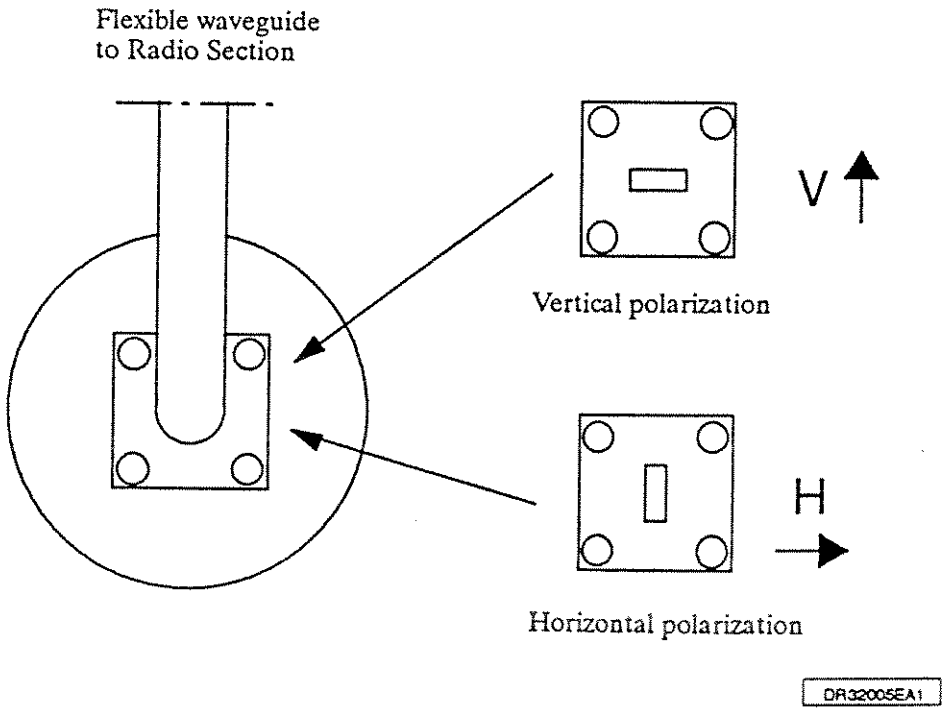


Figure 43 Antenna flange in vertical and horizontal polarization

8. Slip the threaded rod (10) equipped with the (adjusting) hex nuts (16) between the eye bolts (8, 9).

9. Screw an adjusting hex nut (16) to each end of the threaded rod.

10. Adjust the threaded rod (10) in its place with the adjusting hex nuts (16) so that the adjusting range is above the eye bolt located in the arched opening of the support (4) (see the cross–sectional figure " Vertical adjustment" in the *Installation instructions*). The adjusting hex nuts of the threaded rod, located on the side of the support, can then be tightened. The adjusting hex nuts at the other end of the threaded rod (adjusting range) are tightened, when the antenna is aligned. The adjusting hex nuts are opened with a 13 mm spanner.

3.7 Cabling

(Installation phase F: Connecting the cables to the Radio Section)

The cabling is recommended to be done before installing the Radio Section. Some instructions for preparing the cabling and for determining the lenght of the cables, are given in the following. Cables can be connected to the Radio Section only after performing the other installation phases.

3.7.1 Grounding the Outdoor Unit (OU)

The Radio Section of the Outdoor Unit must always be connected to an external grounding point (grounding electrode of the tower or other similar grounding electrode).

The grounding cable is routed via the cable clamp rubber to the Alignment Unit connector case and the cable end is equipped with M6 cable shoe (included in the Connector Set).

The length of the grounding cable from the opening of the cable shoe to the lower edge of the connector case (inside) should be approx. 230 mm.

The cable shoe of the grounding cable is attached with a M6 screw to the threaded hole on the bottom of the Radio Section after the Radio Section has been installed.

The grounding of the Radio Section is illustrated in *Figure 45* below.

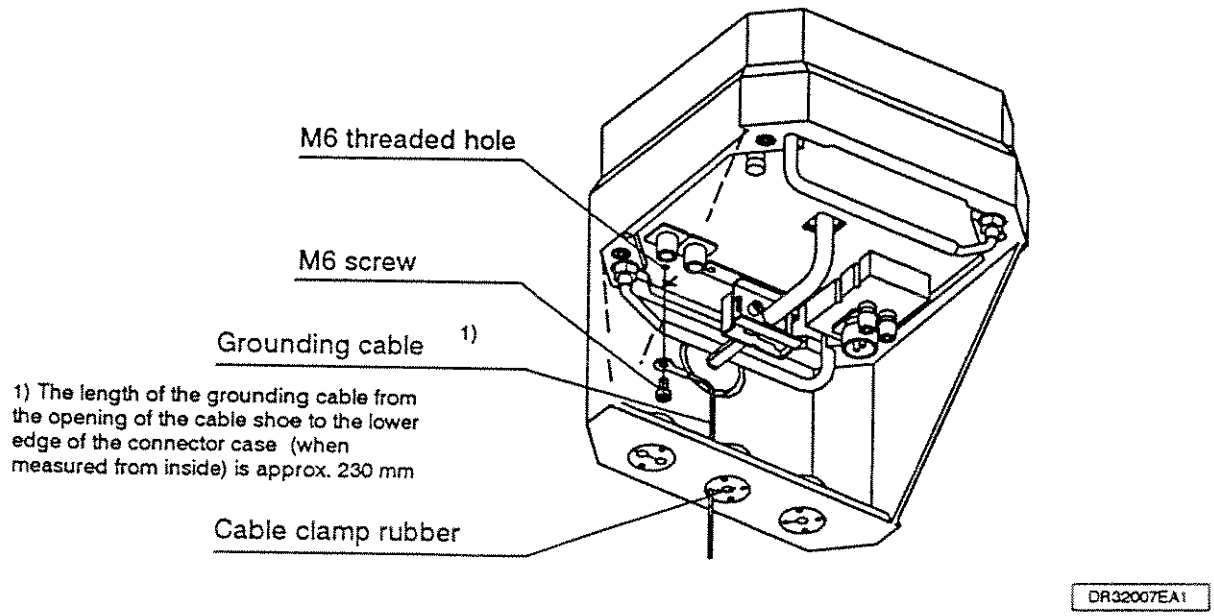
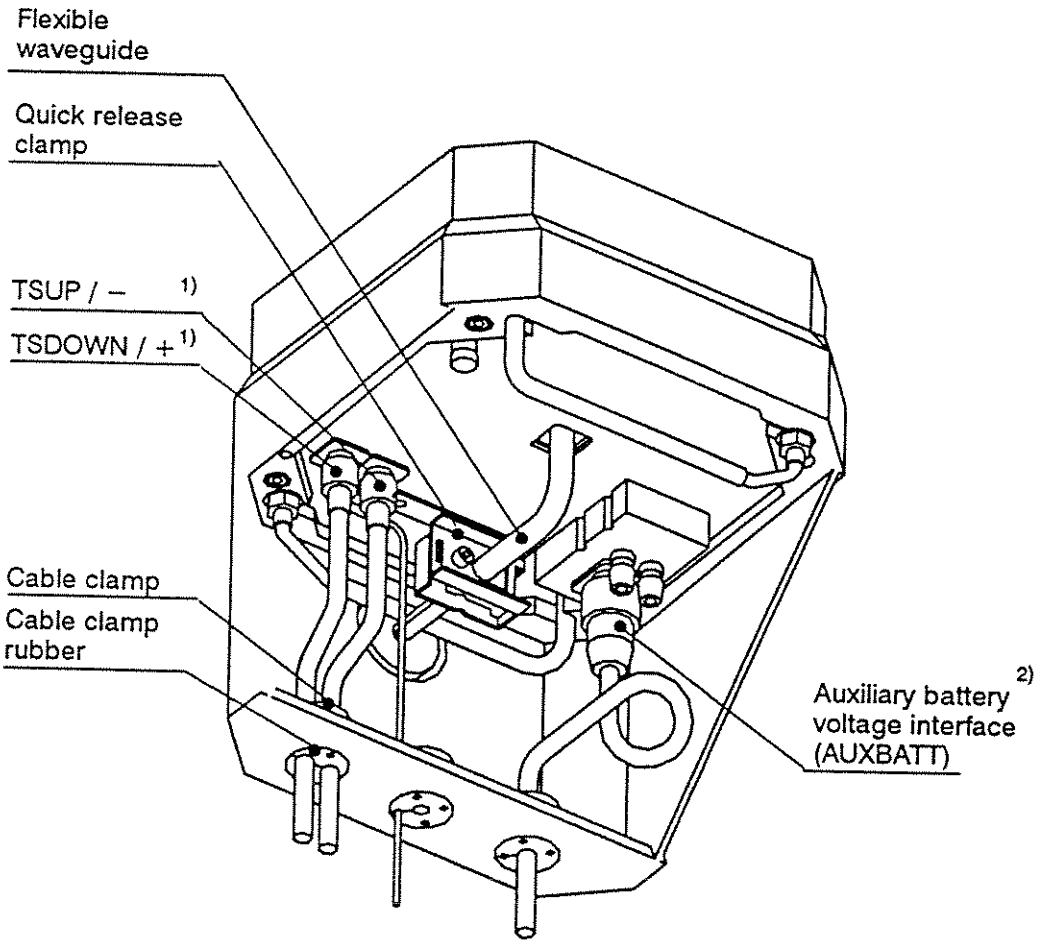


Figure 45 Grounding the Outdoor Unit

At lower ends of the cables the N connectors are connected to the N connectors (which have been connected to the grounding assembly of the IU–OU cables) of the cables brought from the Outdoor Radio Interface (ORI).

Ensure also at the Indoor Unit that the cables are connected to correct connectors TSDOWN / + and TSUP / –. The installation of the IU–OU cables to the Indoor Unit is illustrated in *Figure 20* on page 28. The cables W3 and W4 of the Outdoor Radio Interface (ORI) are marked with appropriate stickers. The marking of the IU–OU cables with stickers and coloured tapes are also recommended at the cable ends by the Indoor Unit.



1) The length of the IU–OU cables from the N connector end to the lower edge of the connector case (measured inside the connector case) is approx. 170 mm

2) The length of the IU–OU cables from the connector end to the lower edge of the connector case (measured inside the connector case) is approx. 300 mm

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Figure 46 *Installation of the IU–OU cables and auxiliary battery voltage interface (AUXBATT) to the Outdoor Unit, quick release clamp of the antenna*

The distribution box provides for the distribution of OU supply voltage for three radio relay equipments. Preassembled (connector + cable) supply cables (T38126.**) of different lengths (five different lengths 1...20 m) are available, the installation of which is described in the enclosed *Installation instructions T38125001RX*.

When an external supply voltage fed to the AUXBATT connector is used, the jumper settings on the Outdoor Unit Power supply T38045.01 should be set to correspond to the supply method (see the enclosed strapping instructions for the Power supply).

3.7.4 Antenna connector

A quick release clamp is used for the joint between the OU Radio Section and the Antenna (see *Figure 46*). **The mounting of the quick release clamp in vertical polarization is illustrated in the *Installation instructions E10007509RX* enclosed in this description.**

1. When the Radio Section is not connected to the Antenna, the flange and tube of the flexible waveguide is attached to the transport support with a quick release clamp for protection.

2. Unscrew the hex head screw with the 5 mm Allen key to the point that you can pull out the quick release clamp and flange from the transport support.

3. **Vertical polarization (V)**, see *Installation instructions E10007509RX*: Hold the waveguide and quick release clamp so that the flange stays in the connector guide pins. Slide the quick release clamp to the antenna flange from the left–hand side and direct the flange of the antenna and quick release clamp. Check the direction also from the flange edges. The wide side of the antenna waveguide and flexible waveguide must be parallel to each other (see *Figure 43* on page 63).

   Horizontal polarization (H): Hold the waveguide and quick release clamp so that the flange stays in the connector guide pins. Slide the quick release clamp to the antenna flange from below and direct the flanges with the connector guides. Check the direction also from the flange edges. The wide side of the antenna waveguide and flexible waveguide must be parallel to each other (see *Figure 43* on page 63).

4. Tighten the hex head screw of the quick release clamp.

The flexible waveguide is routed inside the Alignment Unit connector case through the opening for the antenna. The opening is sealed with a ring inlet installed onto the flexible waveguide (the ring inlet is included in the Alignment Unit connector case designed for the separate antenna).

The connection to the flexible waveguide of the Radio Section is implemented with the quick release clamp used for integrated antennas.

The separate antenna is aligned with its own alignment section.

The coarse alignment of a separate antenna can be performed according to the principles described in subsection 3.8 of chapter 3.

Figure 47 illustrates an example of a separate antenna.

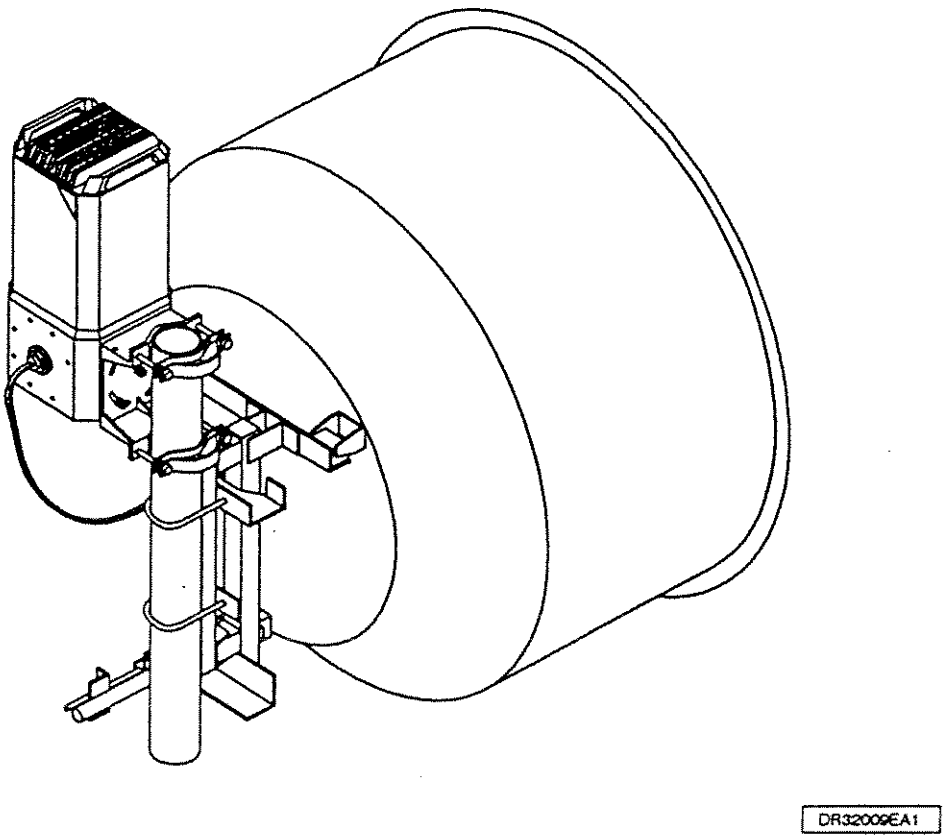
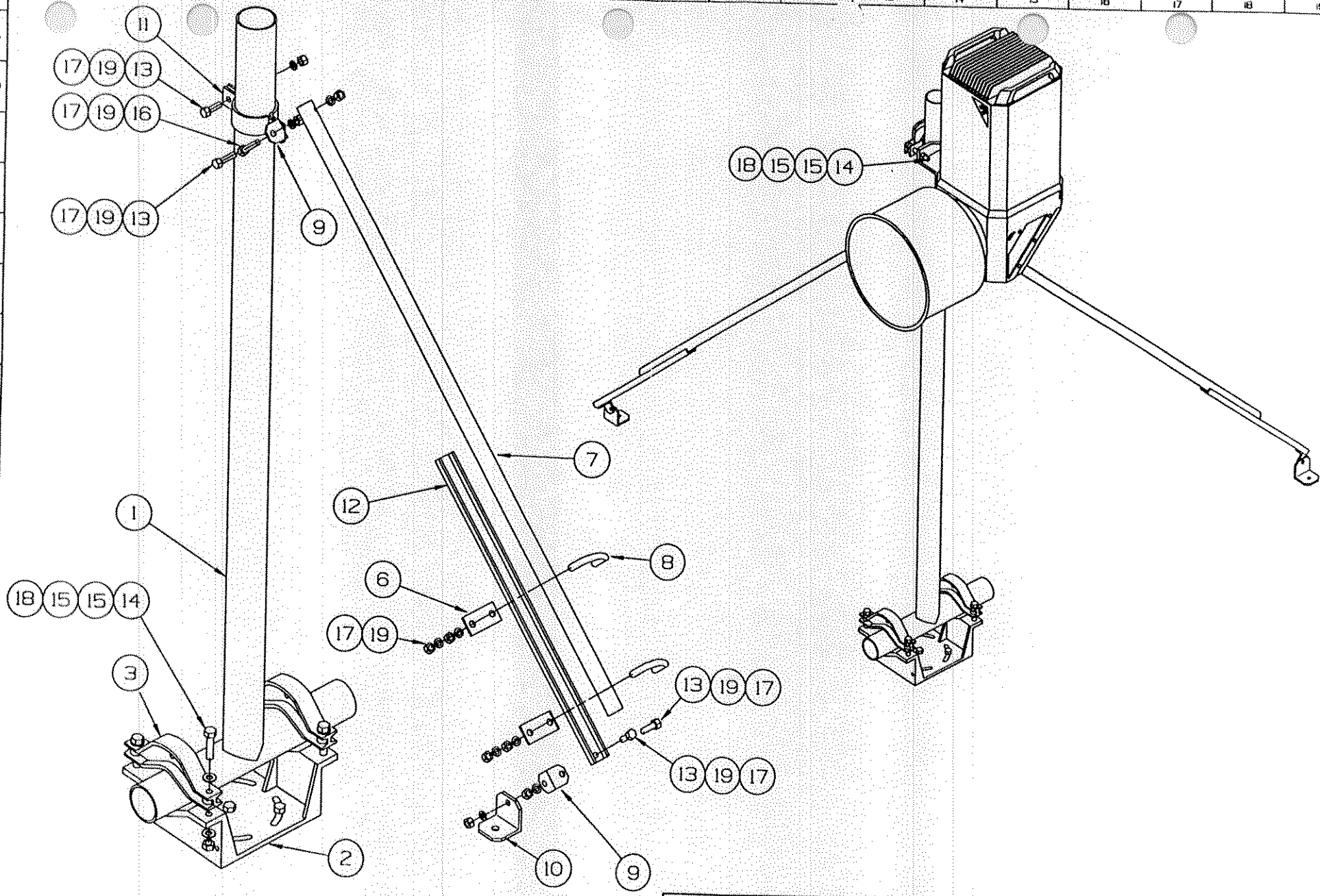


Figure 47 Example of a separate antenna

Appendix B Installation Drawings



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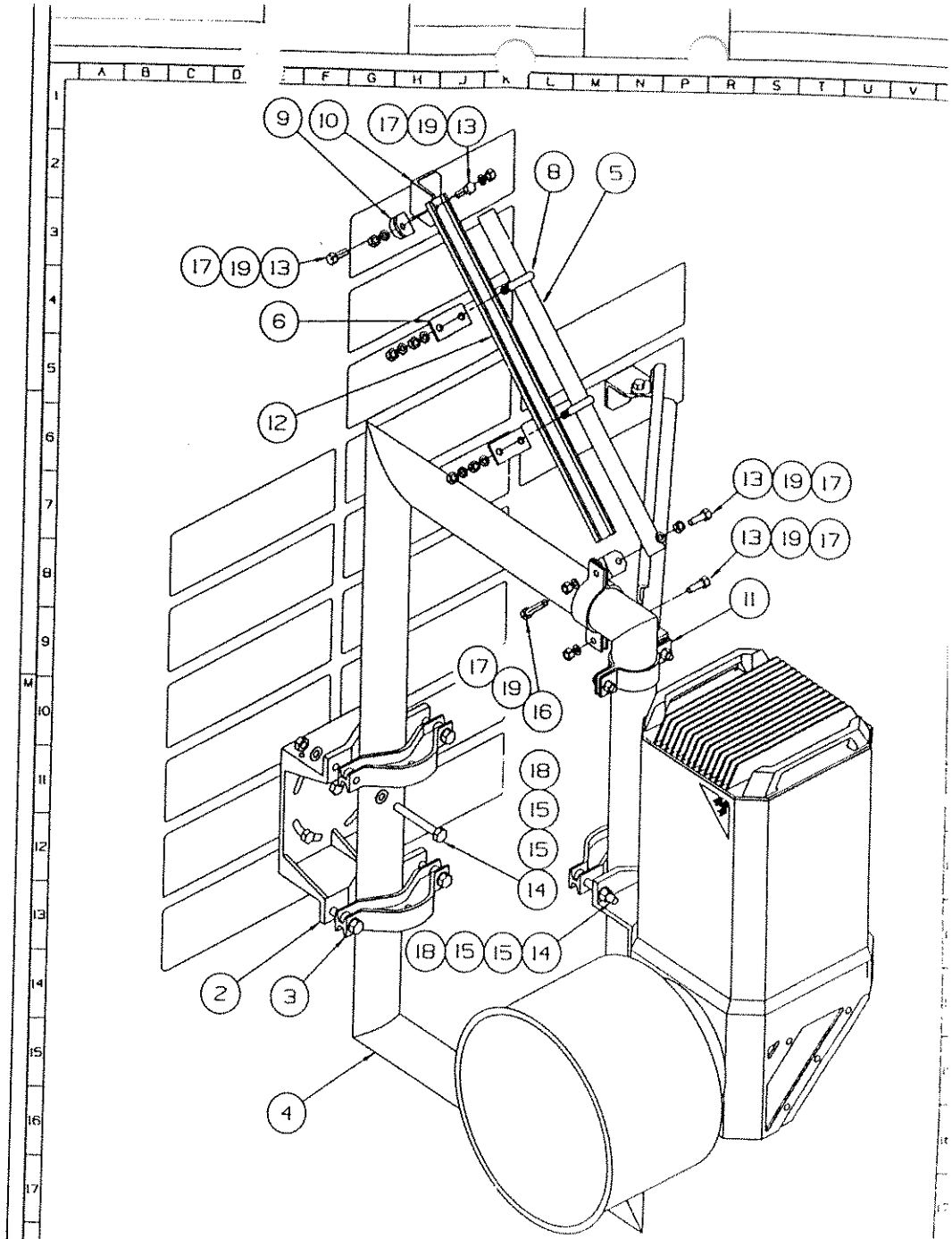
APPRD	JRo	28.01.93	
ARCHVD			
REV.			

T38085.01
Installation Instruction
Asennusohje

SCALE Z

NOKIA TELECOMMUNICATIONS

T3808500IRX-00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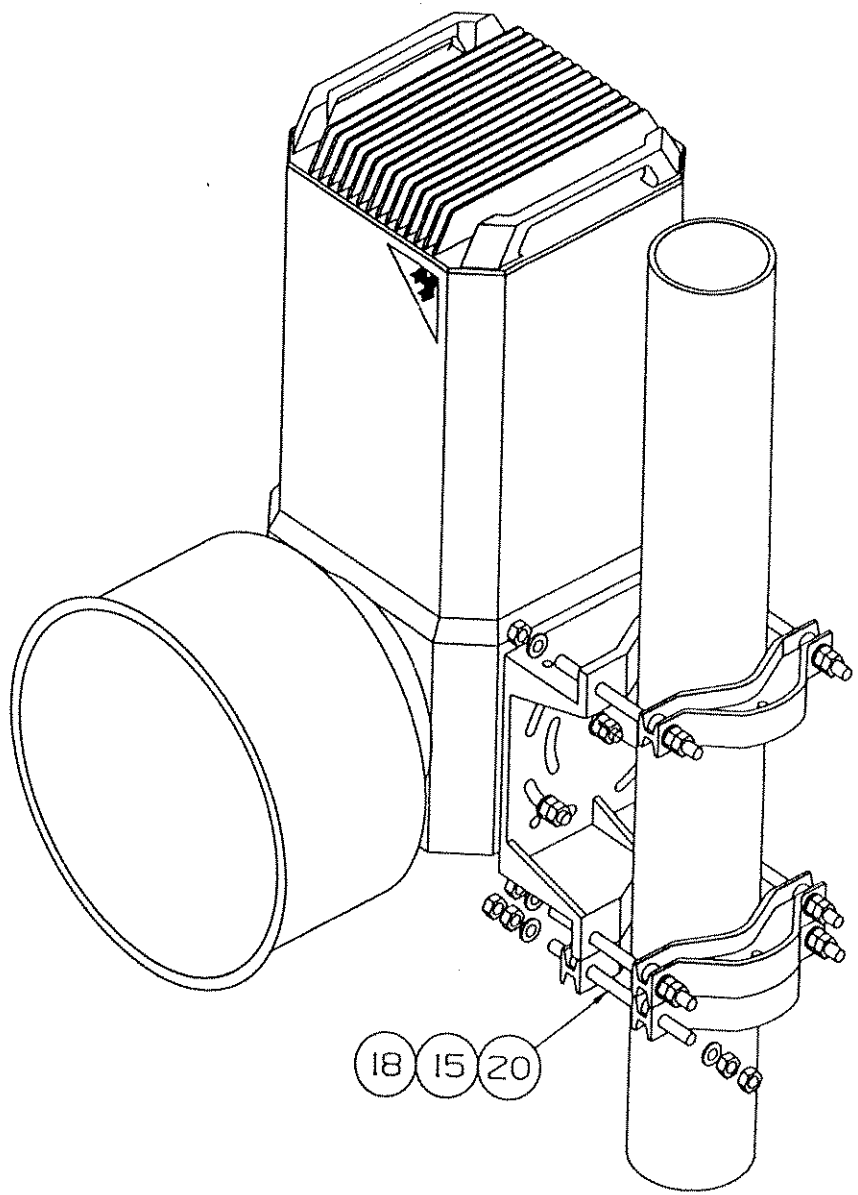

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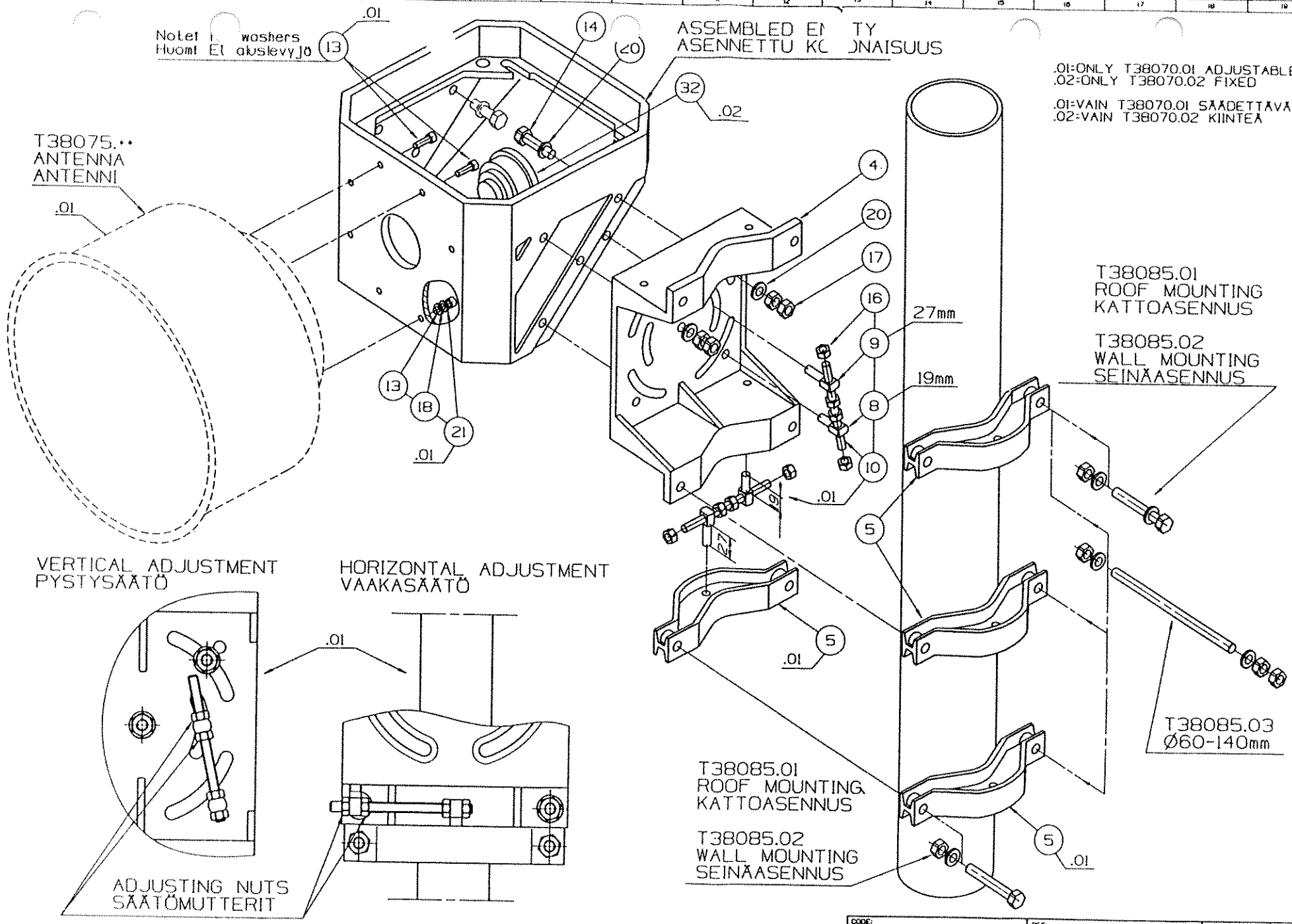
T38085.03
Installation Instruction
Asennusohje

SCALE Z

NOKIA TELECOMMUNICATIONS

T38085003RX-01


Note! washers
Huom! Et aluslevyjä
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ASENNETTU KO JNAISUUS
.01=ONLY T38070.01 ADJUSTABLE
.02=ONLY T38070.02 FIXED
.01=VAIN T38070.01 SÄÄDETTÄVÄ
.02=VAIN T38070.02 KIINTEÄ
T38075.••
ANTENNA
ANTENNI
VERTICAL ADJUSTMENT
PYSTYSÄÄTÖ
HORIZONTAL ADJUSTMENT
VAAKASÄÄTÖ
ADJUSTING NUTS
SÄÄTÖMUTTERIT
27mm
19mm
T38085.01
ROOF MOUNTING
KATTOASENNUS
T38085.02
WALL MOUNTING
SEINÄASENNUS
T38085.03
Ø60-140mm
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ROOF MOUNTING
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T38085.02
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SEINÄASENNUS
Note! Holes of the eyebolts should be aligned.
Huom! Silmäruuvien reiät säädettävä samankeskeisiksi.
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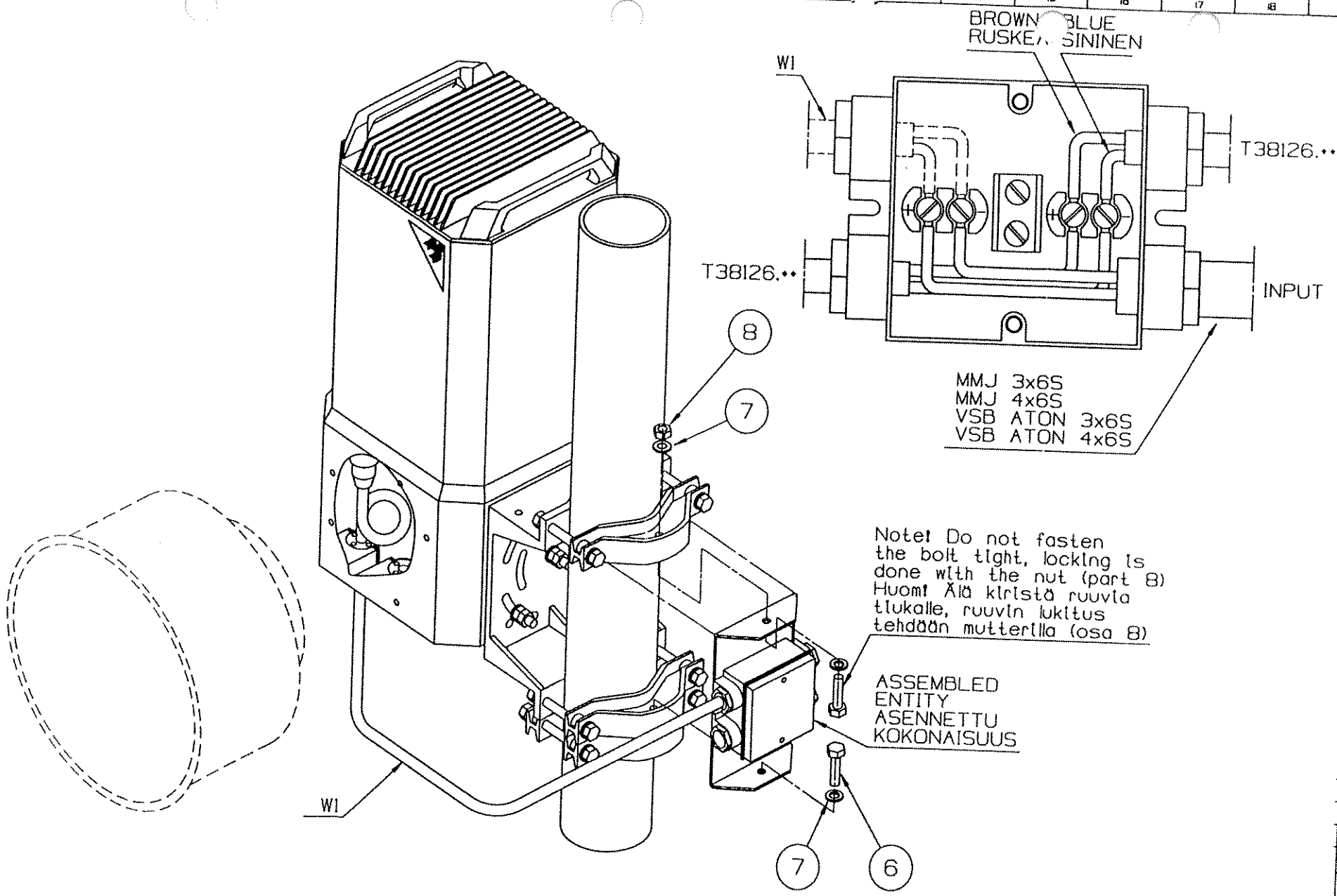

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CHKD	YSa	27.01.93	Installation Instruction
APPRD	JRa	27.01.93	Asennusohje
ARCHVD			
REV.			

SCALE Z

NOKIA TELECOMMUNICATIONS

T3812500IRX-00

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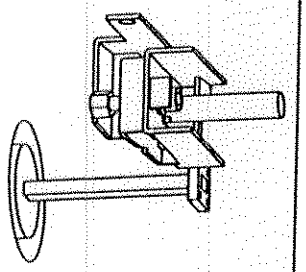
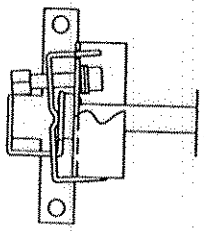


The flange of the flexible waveguide attached to the transport support

Talpulsan aaltoputken laippa kiinnitettynä kuljetustukeen



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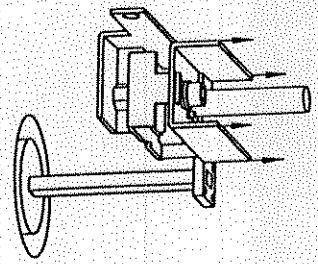
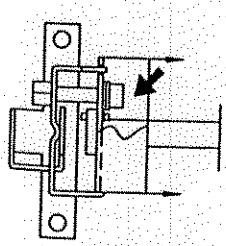
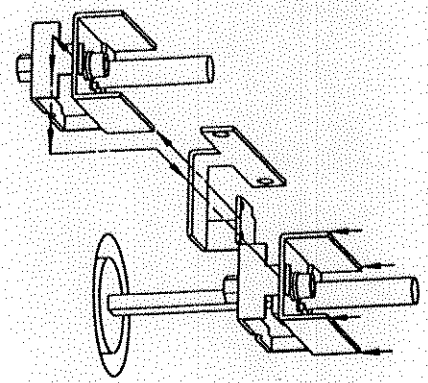


Detachment of the quick release clamp from the transport support

Pikallittimen irrottaminen kuljetustuesta

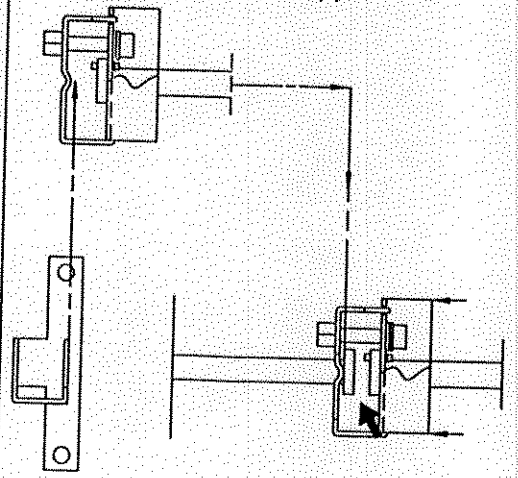


3

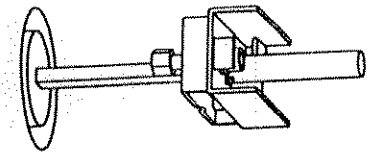


Moving the flexible waveguide from the transport support to the antenna flange

Talpulsan aaltoputken siirtäminen kuljetus-tuesta antennilaippaan

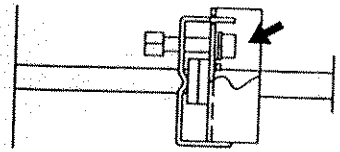


4



End position. The quick release clamp attached to the antenna flange

Käyttöasento. Pikalliitin lukittuna antennilaippaan



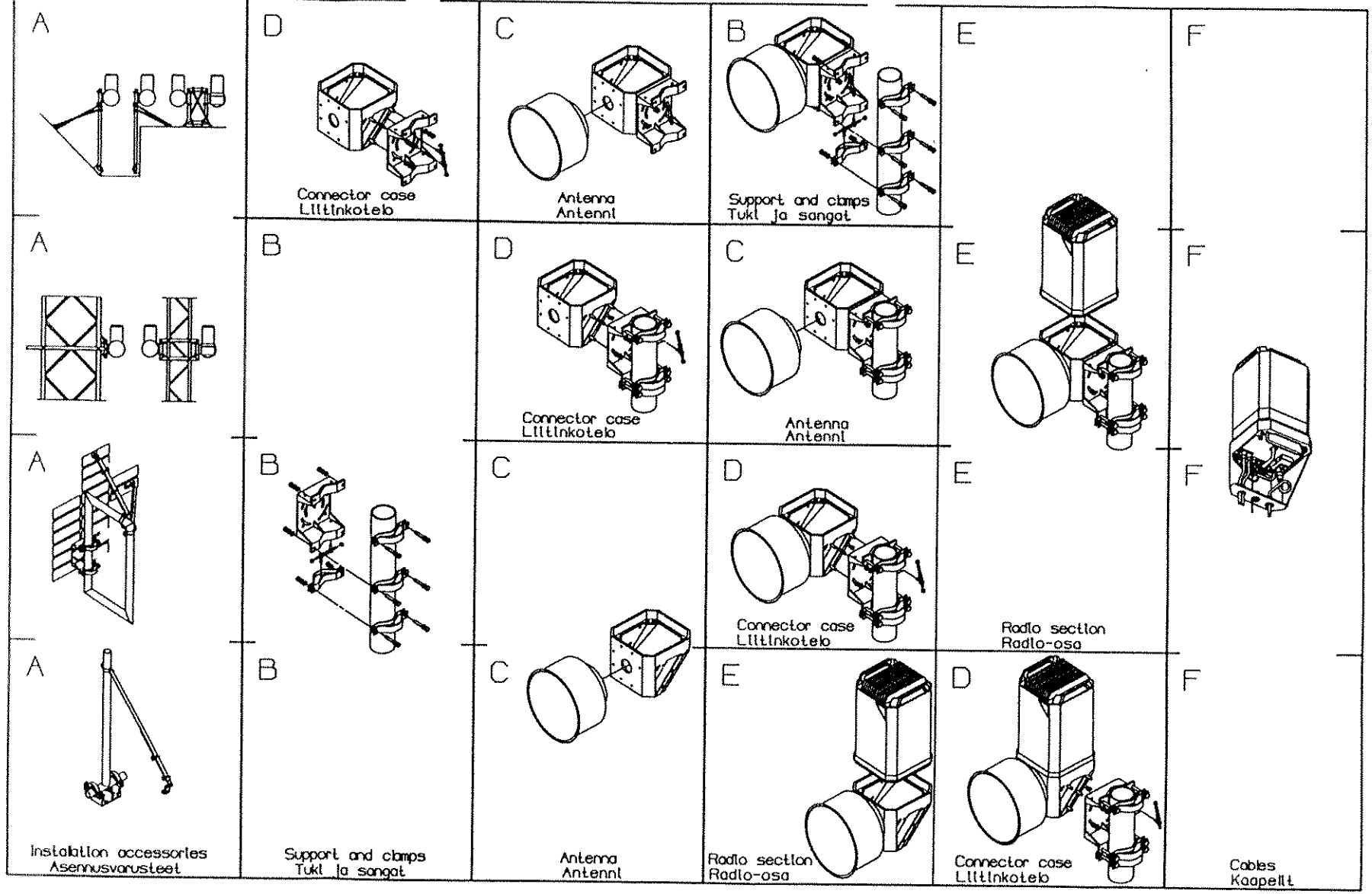
CC:

CODE:			REF:
PREPD	JV	26.04.93	Installation Instructions Quick release clamp for the antenna Asennusohje Antennin pikalliitin
CHKD	YSa	28.04.93	
APPRD	JRa	28.04.93	
ARCHVD			
REV.	JV	20.08.93	

SCALE Z

NOKIA TELECOMMUNICATIONS

EI0007509RX-01



The installation order of the various parts of the Outdoor Unit may also be changed e.g. as follows:

Ulkoyksikön osat voidaan kiinnittää eri järjestyksessä, esim:

IV: A D C B E F
III: A B D C E F
II: A B C D E F
I: A B C E D F

CC:

CODE:			REF:	
PREPD	JV	27.04.93	Installation Instructions DMR 18/23/38W Outdoor Unit	SCALE Z
CHKD	YSa	28.04.93		NOKIA TELECOMMUNICATIONS
APPRO	JRa	28.04.93	Asennusohje DMR 18/23/38W Ulkoyksikkö	
ARCHVD				E100075I0RX-01
REV.	JV	20.08.93		

Appendix C Strapping Instructions

LOCATIONS OF STRAPPINGS AND TESTING POINTS

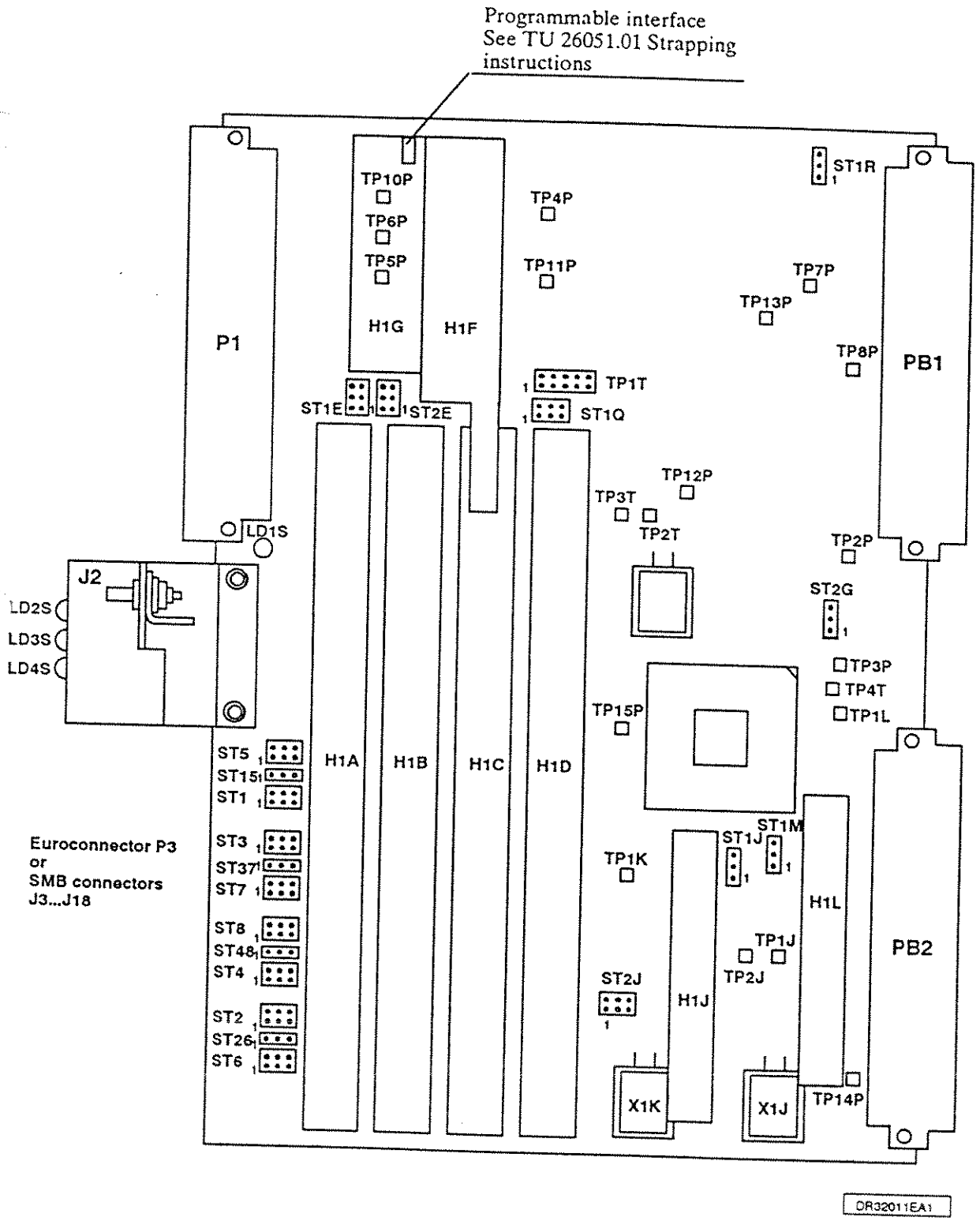
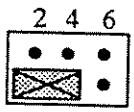
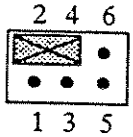
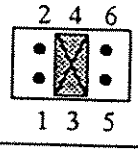
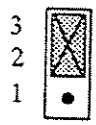
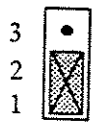


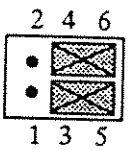
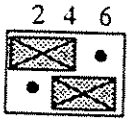
Figure 1 *TC 26000 ** Baseband Unit, strapping connectors and testing points*

ST15 ST26 ST37 ST48	Grounding the incoming signal cable screen, main channels 1 and 5 Grounding the incoming signal cable screen, main channels 2 and 6 Grounding the incoming signal cable screen, main channels 3 and 7 Grounding the incoming signal cable screen, main channels 4 and 8 Euroconnector P3	
	Effect/function	**Use**
 1 2 3	Screen grounded	Normal (N)
 1 2 3	Screen not grounded	

ST1–ST8	Main channel interface, unbalanced (75 ohm), SMB connectors J3...J18	
	Effect/function	**Use**
 2 4 6 1 3 5	Unbalanced transmit (output)	Normal (N)
 2 4 6 1 3 5	Unbalanced receive (input)	Normal (N)

ST2J	Selection of phase control for Tx oscillator hybrid H1J	
	Effect/function	**Use**
	Phase control via connector PB2 from RBUS–ASIC	Always connected (N)

ST1M	Watchdog control	
	Effect/function	**Use**
	Watchdog enabled	Normal (N)
	Watchdog disabled	Testing only (T)

ST1Q	Processor operating mode	
	Effect/function	**Use**
	Processor in 'Normal expanded multiplexed mode'	Normal (N)
	Processor in 'Special test mode'	During BBU initialization at the factory (T)

LOCATIONS OF STRAPPINGS

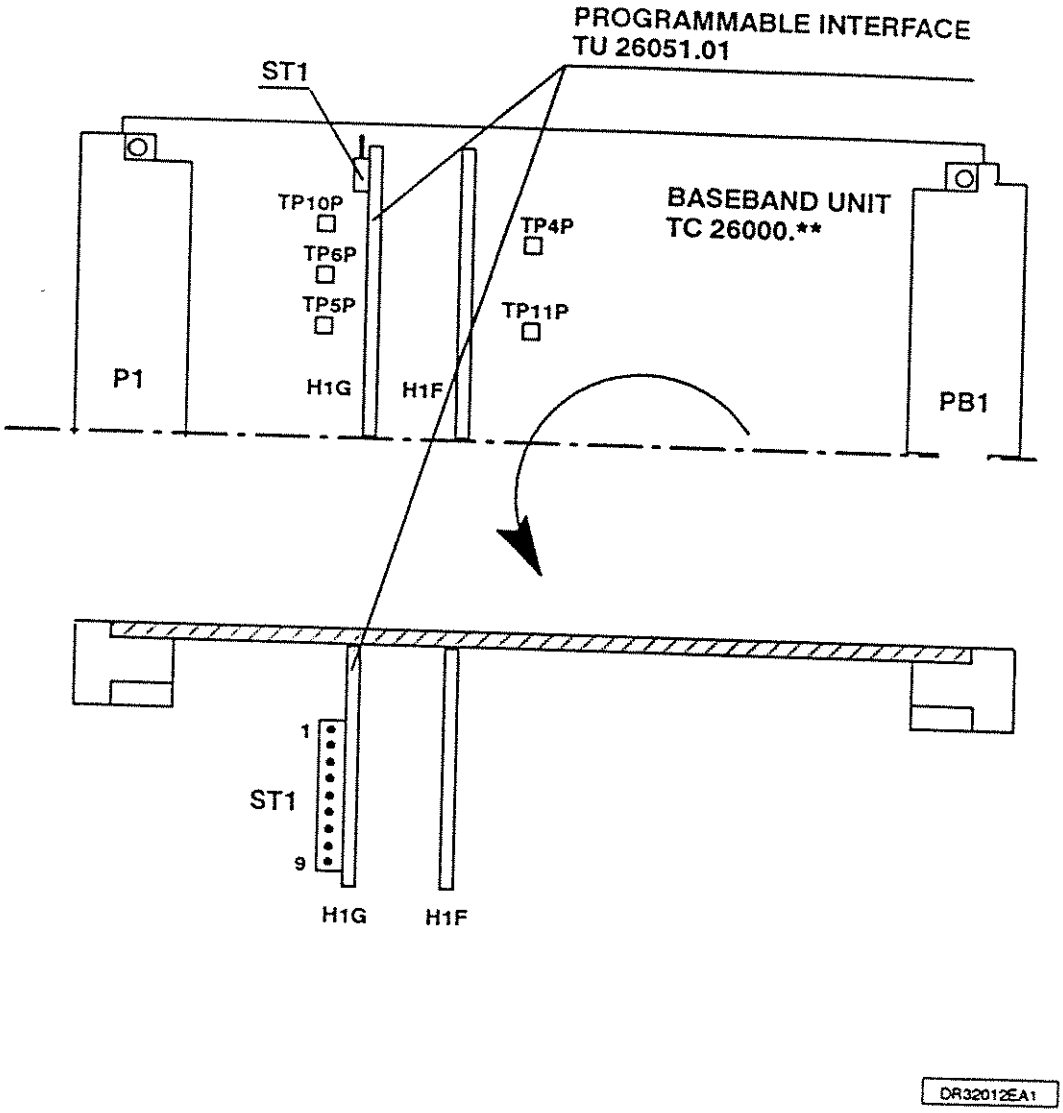


Figure 1 *Programmable interface TU 26051.01, location on the Baseband Unit TC 26000.** and pin numbering of the strapping connector ST1*

ST1	Function of programmable interface PI3O output	
	Effect	Use
4 5 6 	Output in pull−up mode	When controlling an external equipment e.g. relay control (N)
4 5 6 	Output in pull−down mode	In DMR equipments when connecting PI4O to PI4I of another equipment (channel use) In DMF 16 x 2 when connecting PI4O to PI*I of another equipment or when controlling an external equipment

* =1, 2, 3, 4, 5

ST1	Function of programmable interface PI5O output	
	Effect	Use
7 8 9 	Output in pull−up mode	When controlling an external equipment e.g. relay control (N)
7 8 9 	Output in pull−down mode	In DMR equipments when connecting PI5O to PI5I of another equipment (channel use) In DMF 16 x 2 when connecting PI5O to PI*I of another equipment or when controlling an external equipment

* =1, 2, 3, 4, 5

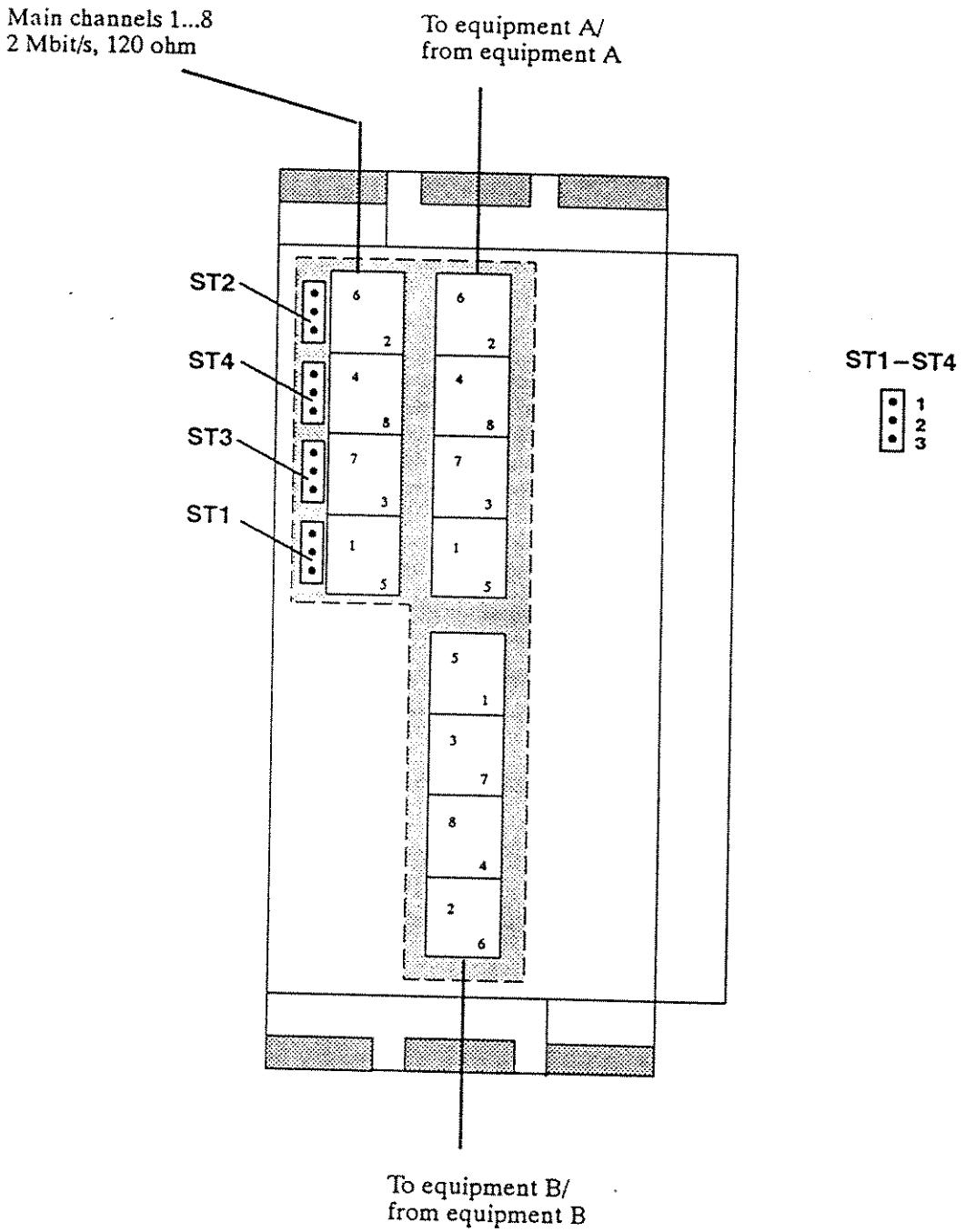


Figure 1 *TP 26020.01, Baseband Branching 8x2M Euro, strapping connectors*

LOCATIONS OF STRAPPINGS AND TESTING POINTS

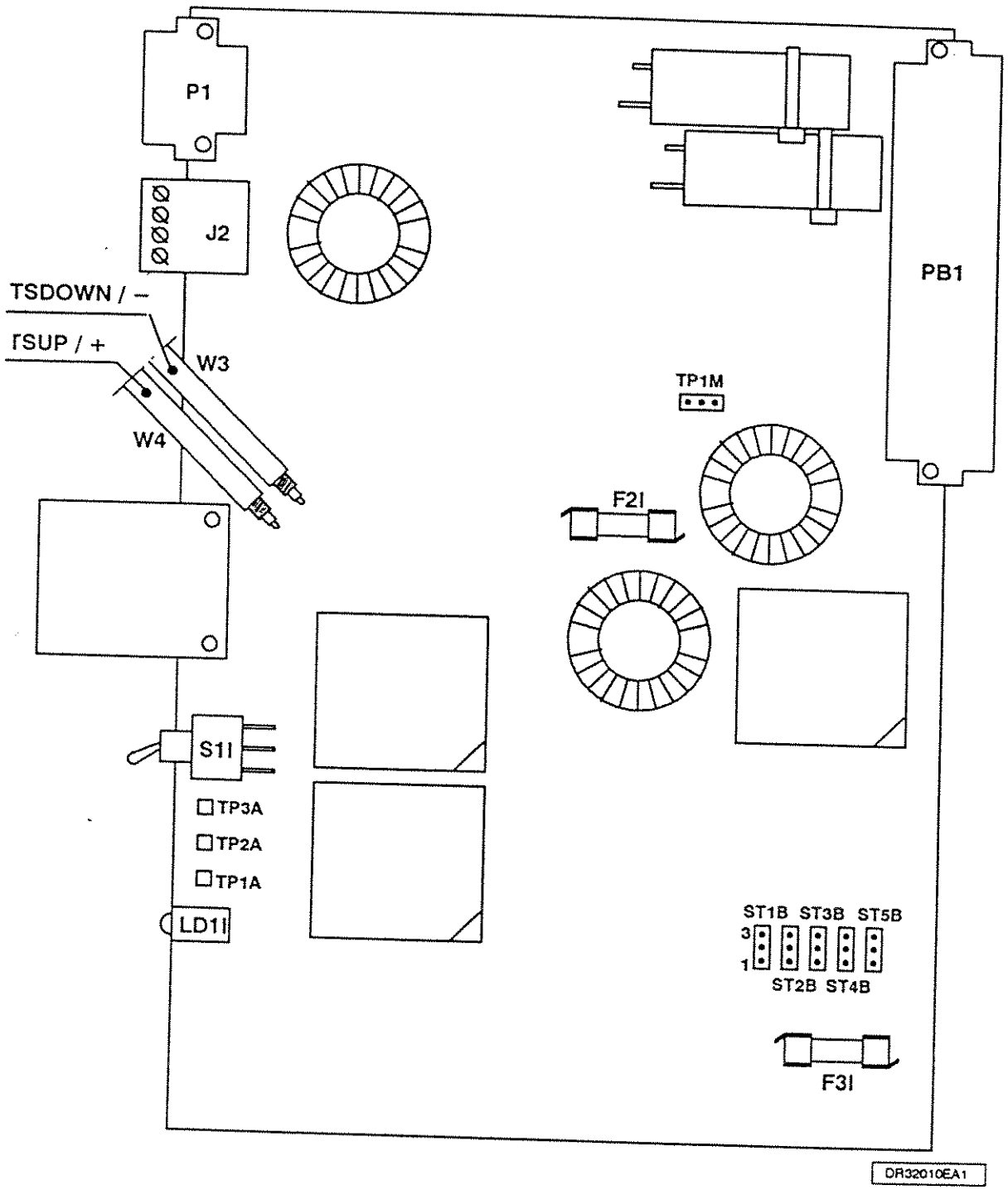
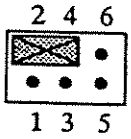
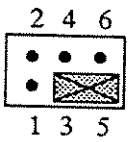


Figure 1 *T38100.01 Outdoor Radio Interface unit, strapping connectors and testing points*

NOTE! **The main channel jumper settings ST1–ST8 (unbalanced/ balanced, 75/120ohm) on the Baseband Unit TC 26000.** should be set according to the following table.**

ST1–ST8	Main channel interface jumper setting, unbalanced/ balanced (75/120 ohm), Euroconnector P3	
	Effect/function	**Use**
	Unbalanced receive (input)	Unbalanced interface, 75 ohm. In redundant use, when the equipment is connected to the Baseband Branching equipment TP 26020.*1.
	Balanced transmit (output)	Balanced interface, 120 ohm. In redundant use, when the equipment is connected to the Baseband Branching equipment TP 26020.*1.

LOCATIONS OF STRAPPINGS AND TESTING POINTS

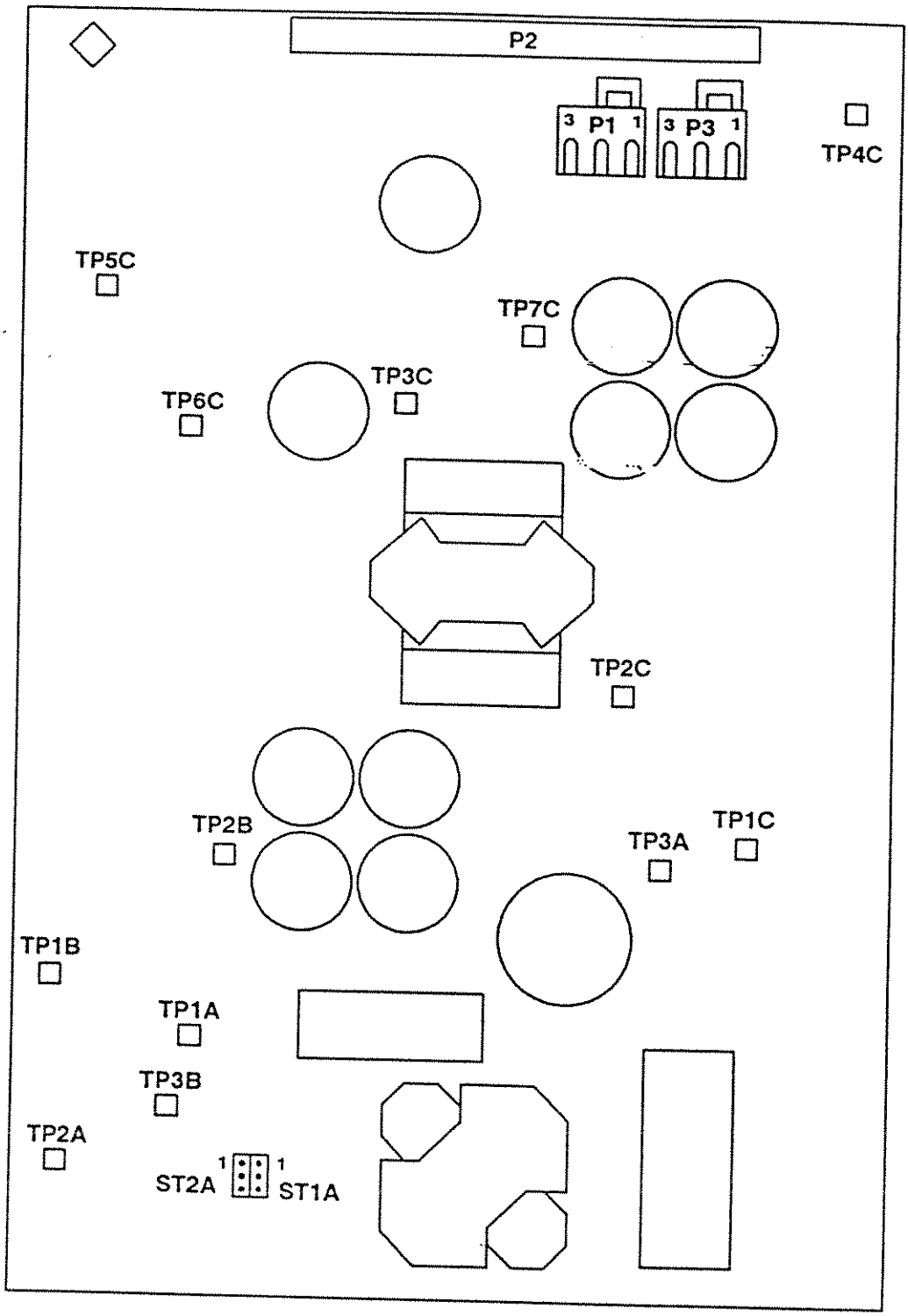


Figure 1 *T38045.01 Power supply, strapping connectors and testing points*

TESTING POINTS

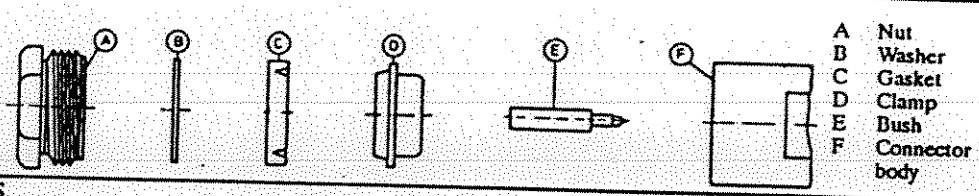
The testing points for the Power supply T38045.01 are described in more detail in the testing instructions included in the Repair Handbook.

Appendix D Installation of Coaxial Cable

Instructions for the installation of the coaxial cables RG−213/U (7130569) and RG−214/U (7130489) into the N connector (5421281)

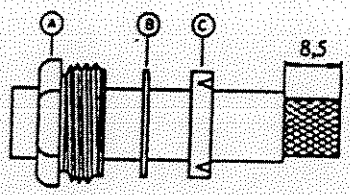
Centre contact: non−captive, solderable

CONNECTOR PARTS



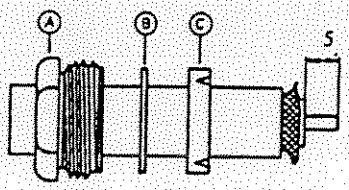
A Nut
B Washer
C Gasket
D Clamp
E Bush
F Connector body

WORK PHASES

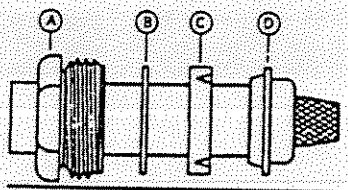


1. Slide nut (A), washer (B) and gasket (C) on the cable. Remove 8,5 mm / .335" <9 mm / .355"> of jacket without damaging the braid.

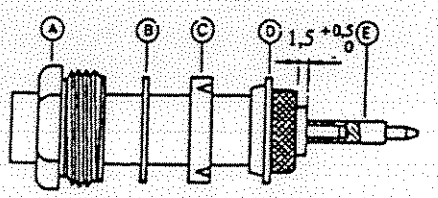
   Cables with double braid: Remove 9 mm / .355" of jacket.



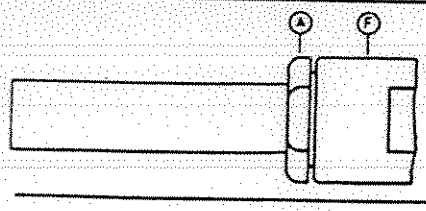
2. Push the braid back and widen it slightly, but do not comb it out. Cut off dielectric 5 mm / .2" from end even and perpendicular towards the cable axis. Do not damage the centre conductor.



3. Taper the braid towards the centre conductor. Position clamp (D) so that its shoulder fits against the cable jacket.



4. Fold back the braid over clamp (D) and cut it off in front of the clamp rim. Check dimension 1,5 mm / .06". Tin centre conductor of the cable. Heat bush (E) with a soldering iron of about 250 W. Tin bore hole located on the bush (E). Insert the centre conductor into the bush (E) and remove soldering iron quickly in order to prevent the deformation of the dielectric. Remove any excess tin from the surface of the bush (E).



5. Insert the connecotr body (F) onto the cable. Screw in and tighten nut (A) with wrenches of 16 mm:n / .63", type 74 Z 0−0−3, until the rubber gasket (C) is split. Do not distort the cable and connector body.

NOTE! The dimensions given above apply to N connectors manufactured by HUBER + SUHNER only. The dimensions given between the <> characters apply to N connectors manufactured by Rosenberger.

Appendix E Commissioning Instructions

DMR 4x2–38W

DIGITAL RADIO RELAY EQUIPMENT

Operation

Contents

1 GENERAL

The DMR 4x2–38W Radio Relay Equipment is delivered in the configuration ordered by the customer. Almost all of the commissioning settings and measurements are performed with the Service Terminal TC21700. If desired, some additional measurements may be conducted by means of external measuring instruments. When commissioning the DMR 4x2–38W, the following settings must be checked and modified if required:

- Radio frequencies
- Operating mode and station type
- Activation of the main channel interfaces
- Possible cross–connection of channels
- Equipment address on the TMS bus
- Setting of the transmitter attenuator
- Selection of the power supply method for the Outdoor Unit

A list of issues which by experience need to be considered at the commissioning stage is listed in the following. In general, the commissioning of the equipment should be conducted with care and precision.

1. The installation and alignment of the antenna should be done with extra care: even a slight deviation may affect the transmission quality.

2. **The Radio Section of the Outdoor Unit should not be left outdoors for longer than 24 hours when disconnected, if it is likely that moisture will be condensated inside the unit.**

3. The RF–cables and waveguides should be connected with extra care to avoid loose connections along the RF–path.

4. The commissioning settings presented in this description should be carried out with care to ensure correct operation of the radio hop. It is especially important to document the settings for later use. In the event of a fault the documents will provide instant and reliable information on the settings performed in the equipment.

5. Connections to other equipments should be implemented with care and the given instructions should be followed to avoid a range of problems. In unclear cases, time should be devoted to finding the correct information from the operating handbooks. It is likely that ignoring such unclarities will lead to difficulties later on.

2 PREPARATIONS FOR COMMISSIONING

NOTE! **The following measures are performed with the Nokia Service Terminal TC 21700. If not familiar with the operation of the Service Terminal, the user is recommended to study subsection 2.3 of this description and the *Service Terminal Operating Handbook*.**

2.1 Before switching power to the radio relay equipment

Before the commissioning measures the equipment should be installed in accordance with the section *4 Installation* of this Operating Handbook and the coarse alignment of antenna should be done.

Before switching power to the radio relay equipment, it should be checked that the equipment has been set to the correct radio channel. This should be done to avoid transmission on wrong channel and thus not to interfere with other radio connections.

If the user is not sure of proper channel allocation, the following measures dependant on the Outdoor Unit voltage supply should be carried out:

A) Outdoor Unit supply voltage over IU–OU cables

Before the power is switched to the radio relay equipment, at least one of the two coaxial cables leading from the Indoor Unit (IU) to the Outdoor Unit (OU) (IU–OU cables) must be disconnected. This prevents the Outdoor Unit from starting, as the voltage supply to the Outdoor Unit is carried in the centre conductors of the coaxial cables.

When the cable(s) is disconnected, the ON/OFF switch in the Outdoor Radio Interface (ORI) unit of the Indoor Unit is switched to its upper position (ON). Now only the Indoor Unit is started.

B) Supply voltage to the Outdoor Unit from an external voltage supply via the AUXBATT connector

If an external voltage supply via the AUXBATT connector is used as the supply voltage for the Outdoor Unit, the supply voltage can be connected to the Outdoor Unit immediately after the installation provided that the IU–OU cables between the Indoor and Outdoor Unit have been disconnected. For example, the disconnection of IU–OU cables from the Indoor Unit prevents the start–up of the microwave oscillator of the Indoor Unit when the power is switched on in the Indoor Unit.

After switching the power on, the Baseband Unit performs a self–test, during which the service LEDs of the Baseband Unit blink. The red and yellow LED remain lit, since the transmission power is switched off. In addition, the LEDs may remain lit, as there is no traffic on the line. The green LED on the Baseband Unit is lit, when the unit is accessed by the Service Terminal.

It is recommended to check the transmit frequency with the Service Terminal (menu command TOP 6,7,8,1,0 RET) immediately after the power has been switched on and reset the frequency to desired level when necessary (see chapter *3 Using the Service Terminal* and *5 Commissioning settings* of this description).

It is also advisable to check the alarms that may be displayed on the Service Terminal Fault display (with the Service Terminal menu command TOP 1 RET) and take the appropriate measures when necessary.

After it has been checked that the transmit frequencies are correct and the coarse alignment of the antenna has been done in accordance with the section *4 Installation* of this Operating Handbook, the setting Emergency Tx and Rx power OFF can be removed with the Service Terminal menu command TOP 6,7,8,2,1 RET, when the start–up of the equipment depends on other settings. The following text is then displayed on the Service Terminal: *done*.

The transmission power is switched on only after the microwave oscillator has heated up. The heating of the oscillator is controlled by a thermostat and before reaching the appropriate operational temperature, an alarm is generated, which is displayed on the Service Terminal (TOP 1 RET) as follows:

OU: Wait, MW osc:
– temperature alarm

In a room temperature the heat–up takes approx. 2 minutes and in the temperature of –40°C less than 20 minutes after the power has been switched to the Outdoor Unit.

The transmitter tries the start–up and phase–locking for several times.

If the start–up is not successful, the equipment recognizes the situation as a fault event and generates an alarm:

Tx/Rx power:
– equipment fault

After the alarm the start–up can still be tried with the Service Terminal menu command TOP 5,7,4,9 RET, Forced start.

2.3 Connecting the Service Terminal to the radio relay equipment

The Service Terminal TC 21700 is connected to the DMR 4x2–38W Radio Relay Equipment with the Service Terminal interface cable TX 21750 as shown in *Figure 2*.

- Connect the D–type connector of the cable to the Service Terminal
- Connect the Euroconnector of the cable to the service terminal interface on the Baseband Unit (BBU) with the connector P1 (see *Figure 2*)

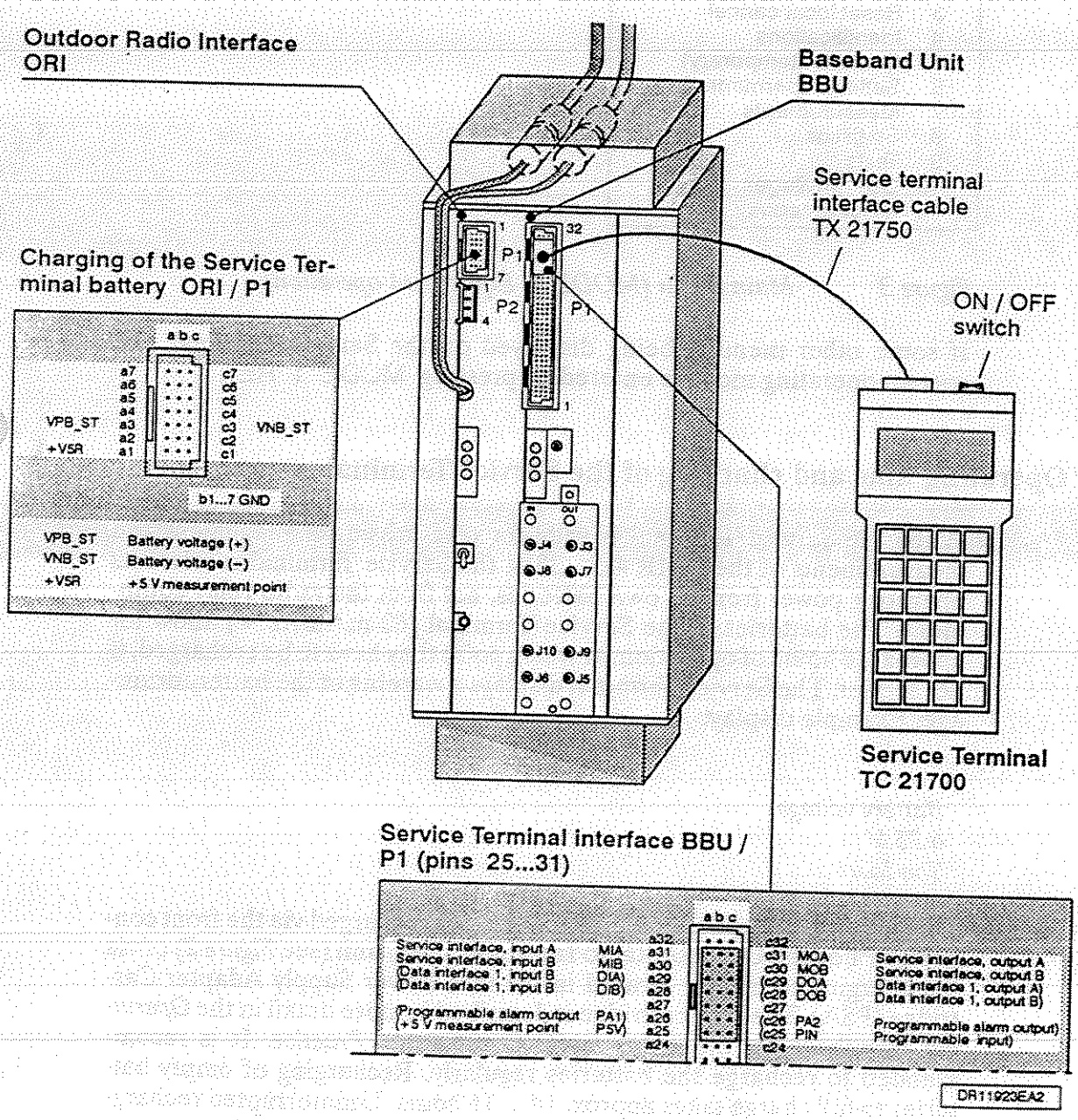


Figure 2 *Connecting the Service Terminal to DMR 4x2–38W*

3 USING THE SERVICE TERMINAL

3.1 Structure

The Service Terminal (TC21700) is a hand–held device equipped with a 4 x 20 character display and a 24–key keyboard. The keys are used to enter numerical data and move through the Service Terminal menus or through the menu structure of the equipment connected to the Service Terminal. The menus and e.g. the statistics are displayed on the Service Terminal. The Service Terminal has a non–locking power switch (ON/OFF) and a connector for the Service terminal interface cable (see *Figure 2*).

3.2 Major keys

INV	The upper key functions (blue printing) are executed by first pressing the INV key and thatafter by pressing the selected key. For example, the pressing of INV and AUTO key just after a command leads to a continuous command execution. This is useful when monitoring certain voltages, e.g. the AGC voltage in antenna alignment. INV function can be cancelled by pressing INV again. INV state is indicated on the display by the ^ character.
RET	Command terminator key. Pressed to end the selected command.
MODE	For setting the Service Terminal operating mode. The most important operating mode is MODE 1 RET. In this operating mode the functions of the accessed equipment are controlled. The other operating modes are for controlling the Service Terminal's own functions (see the *Service Terminal Operating Handbook*).
TOP	Leads to the top menu level (of the current operating mode).
UP	Leads one menu level upwards in the menu structure.

2) Items 1...3 on the main menu are carried out directly, while items 4...11 lead to submenu level. In the example shown in *Figure 4* the selection 5 RET on the main menu level leads to the submenu level of the function Controls (temporary), which in accordance with *Figure 4* leads to next submenu level according to user's selections (in *Figure 4* illustrated with continuous thick line) until the desired function has been performed.

For a complete presentation of the menu structure and associated functions, see the section *6 Operation with Service Terminal* of this Operating Handbook. Each description of a function includes the Service Terminal menu string through which the function can be accessed from the main menu level. In the example given in *Figure 4* it is illustrated how the Rx baseband switch can be force–controlled on by entering the menu string TOP 5,7,3,5 RET on the Service Terminal main menu level (dotted line in *Figure 4*).

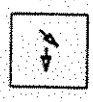
The previous menu level can be accessed by pressing the UP key (dashed line in *Figure 4*).

The main menu can be accessed from each menu level by pressing the TOP key (indicated with dotted–dashed line in *Figure 4*). It is recommended to press the TOP key before entering a menu string described in the alternative 2) above to ensure that the menu command is performed from the main menu level.

The individual Service Terminal commands are presented in this description as strings of key strokes beginning from the main menu level. When operating in the submenus of the same key stroke group, it is not necessary to go through the main menu. It is also possible to jump to the next or previous menu in the menu structure as indicated in *Figure 4*.

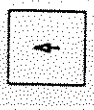
3.4 Scrolling the display

The display on the Service Terminal shows only four lines at a time. The ends of long lines (< 20 characters) will also fall outside the display (to the right). The text extending outside the boundaries of the display can be scrolled with the arrow keys. The window will move on top of the menu in the direction indicated by the arrow:

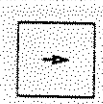


displays lower lines

displays upper lines



displays the text to the left of the display window



displays the text to the right of the display window

leads to the first line of a menu

leads to the last line of a menu

3.5 Entering ASCII characters

Any character may be entered on the Service Terminal in the form of an ASCII code by giving the two–digit hexadecimal code (00...FF) of the character on the keyboard and pressing the ASCII key. The codes of the characters are listed in the ASCII table in *Figure 5.b*. Information containing other characters than numbers are entered in ASCII form. This information includes the station and equipment identifications. The numbers contained in the identifications may be entered as such without using the ASCII key.

Pressing the ASCII key converts the preceding two characters to an ASCII character. Any earlier characters are interpreted without ASCII conversion. *Figure 5.a* shows how to use the ASCII key. The ASCII conversion table is shown in *Figure 5.b*.

Character strings entered with the ASCII key are ended by pressing the RET key. For example, the character string XY is entered as follows:

58 ASCII 59 ASCII RET

3.6 Setting the baud rate and address

The connection and communication between the radio relay equipment and Service Terminal can be established provided that the baud rate of the Service Terminal correspond to the baud rate of the equipment.

If the user does not know the baud rate of the equipment and Service Terminal, a direct connection to the selected equipment can easily be established by pressing the Service Terminal key OBJ leading to the mode Select object. The option 7 Direct connection is selected from the displayed menu by pressing the character string: OBJ 7 RET. The Service Terminal then sets its baud rate to correspond to the baud rate of the equipment.

When the radio relay equipment is connected to the TMS bus with other equipments, an individual address is provided for the radio relay equipment.

In direct connection the user does not need to know the individual address of the target equipment, because the general address 4095 common to all equipments can be used in the Service Terminal. **The common address 4095 must not be used when the radio relay equipment is connected to the TMS bus.**

When the equipment is connected to the TMS bus, a connection to the equipment should be established through its individual address (OBJ 2 RET). If the user does not know the address, it can be checked with the Service Terminal menu command TOP 6,1,2,0 RET.

The setting of baud rate and address are described later in this description and in more detail in the section *6 Operation with Service Terminal* of this Operating Handbook and in the *Service Terminal Operating Handbook*.

Channel configuration:

- 6,7,4,3,4 Equip MAINI
- 6,7,4,3,5 Remove MAINI equipping
- 6,7,4,3,6 Initial settings

IU battery:

- 6,7,9,1,1 Nominal voltage

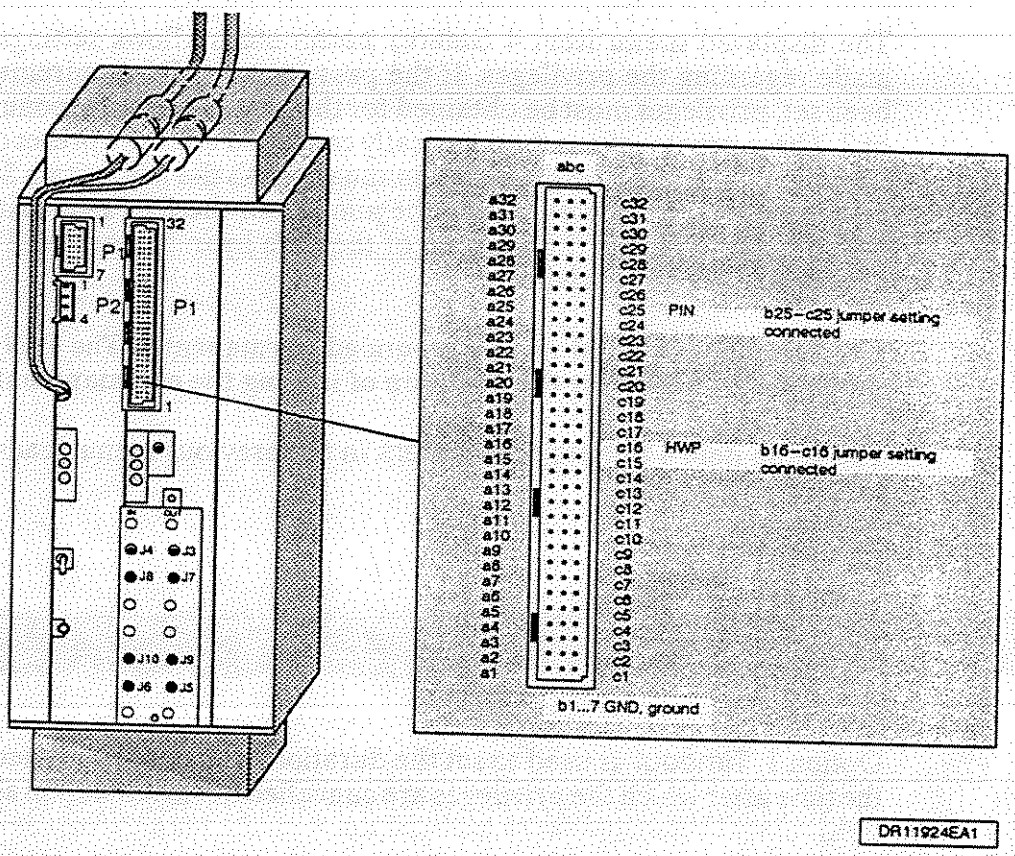


Figure 6 PIN signal and HWP jumper setting

Password / PIN

Some functions in the DMR 4x2–38W have been protected in such a way that they can be accessed only through certain privileges. The protected functions include the settings and controls of the radio relay equipment. A function requiring privileges will prompt either for a password or a jumper setting for the PIN signal (i.e. connection of the pin PIN to the ground pin, see *Figures 2* and *6*) depending on the settings presented below before the function can be accessed. A proper U–jumper is needed for the jumper setting of the HWP and PIN signal. In addition, certain connectors must be disconnected before the jumper setting can be done.

This menu applies to all protected functions in the DMR 4x2–38W. Option 0 (TOP 10,4,2,0 RET) shows the current protection state. Option 1 (TOP 10,4,2,1 RET) cancels the protection of equipment functions, option 2 (TOP 10,4,2,2 RET) causes the password to be required in connection with the protected functions, and option 3 (TOP 10,4,2,3 RET) causes the local PIN to be required for the protected functions.

Verifications

Inadvertent use of some functions, mainly a few resetting functions, has been prevented by setting a verification for the function in addition to the above protections: the equipment software requires the operator to issue the command for the function (the last command in the menu chain) once more before the command will be executed.

Alarms for settings

In a redundant equipment pair, the settings listed below must be the same in both equipments. If they are not, the equipment acting as the master will generate a setting alarm. The settings are made separately for each equipment with the Service Terminal. The settings concerned are listed in the following as menu strings beginning at the main menu level:

Equipment settings

- 6,7,1 Operating mode
- 6,7,2 Station type
- 6,7,3 Capacity
- 6,7,7 Change over

Main channels:

- 6,7,4,1 Line code
- 6,7,4,2 Scrambling

Channel configuration:

- 6,7,4,3,1 MAINI (Main channel interfaces)
- 6,7,4,3,2 RBUS (Protection bus) (Function not yet implemented)
- 6,7,4,3,3 Remove channel
- 6,7,4,3,7 Equip MAINI
- 6,7,4,3,5 Remove MAINI equipping
- 6,7,4,3,6 Initial settings

RF power:

- 6,7,8,2,2 Emergency Tx and Rx power OFF

IU battery:

- 6,7,9,1,1 Nominal voltage

If the frequency setting does not correspond to the frequency set for the radio hop, the frequency setting must be reproduced. The frequency setting is performed with the Service Terminal menu command TOP 6,7,8,1,1 RET. The command displays the following setting display, the second line of which indicates the frequency band in use:

```
Tx frequency?
37618000...37898000
```

The prompt is responded by entering the Tx frequency of the radio relay equipment (the frequency grid of the synthesizer within the frequency range is divided into 1.75 MHz steps beginning from the lowest frequency). For example, by entering 37863000 RET, the frequency is set to 37863000 kHz.

If the given frequency is not in the frequency grid, the following message is displayed on the Service Terminal: *Not in grid.*

The receive direction frequency (Rx) is automatically set based on the transmit frequency.

If the frequency received by measuring does not correspond to the set frequency, the frequency must be adjusted. (The adjusting is described in chapter 7 *Maintenance*, in subsection 7.3 *Adjusting the radio frequency*. Frequency stability is described in detail in chapter 6 *Commissioning measurements*, in subsection 6.3.

4.4 Antenna alignment

The coarse antenna alignment is performed in accordance with the instructions given in the section 4 *Installation* of this Operating Handbook. This chapter deals with the fine alignment of the antenna.

After checking the frequency, the antenna is aligned by using the AGC voltage proportional to the input level. The antenna alignment requires that the equipment at the other end of the radio hop is transmitting a signal. From the AGC connector (AGCMON) (see *Figure 7*) on the Outdoor Unit it is possible to measure a current (0...100 µA) proportional to the AGC voltage. This current can be measured with a current meter or directly as a voltage (0...8 V/80 kohm), for example 3.075 V.

The antenna alignment can also be performed by measuring the input level with the Service Terminal. The input level measurement is done with the Service Terminal menu command TOP 7,2 INV AUTO.

4.5 Setting the transmit power

The DMR 4x3–38W includes an attenuator, with which the transmit power can be attenuated within 0...30 dB.

The transmit power is recommended to be set before the Outdoor Unit (OU) is installed on a tower, onto a wall or other difficult installation location.

The following accessories are required for setting the transmit power: 38 GHz power meter (unless the coarse scale of the attenuator is relied on), flat–head screwdriver and Allen key required for opening the case of the Radio Section.

The following order is applied when setting the transmit power:

1. Switch off the power from the equipment and open the case of the OU Radio Section. Connect the IU–OU cables between the Indoor and Outdoor Unit and connect the 38 GHz power meter instead the antenna.

2. Unscrew the knurled–head screws holding the upper part of the Synthesizer and turn the Synthesizer downwards. The adjusting screw of the attenuator of the Microwave Unit is now exposed (*Figure 8*).

3. Switch on power to the equipment and wait until the Microwave Unit starts up.

4. Adjust the transmit power to the desired level with the attenuator. An indicating point has been painted on the adjusting screw and a rough dB–scale is provided around the adjusting screw opening. (The reference crystal frequency of the Synthesizer can also be adjusted at this stage (see chapter 7 *Maintenance*, subsection 7.3 *Adjusting the frequency*).

5. Switch off the equipment and mount the Synthesizer and Radio Section back to their locations. Switch on the equipment.

4.6 Default settings

The default settings are made with the Service Terminal.

The setting mode of the default settings is accessed with the Service Terminal menu command TOP 6,6 RET. To avoid extra work in returning the equipment–specific settings for an equipment that has earlier been in use, the setting of default settings for such an equipment with the Service Terminal is provided with the following verification menu:

```
1 Set
```

By entering the Service Terminal menu command 1 RET (or TOP 6,6,1 RET from the main menu level), the following default settings are recorded in the non–volatile memory of the DMR 4x2–38W:

Rack alarms	Normal
PA1 function	Activated by A alarm
PA2 function	Activated by B alarm
Rack alarm delay	1 second
Control timeout	10 minutes
Auxiliary data channel 3 (DI3)	channel use and parity counted from a hop

Consequences:

Of link chain alarm	S
Of far–end alarm	B + S
Of error ratio alarm E–3	A and AIS

Change over:

Cold–standby operation: (CSB)	All faults except for Loops, Forced AIS, Error ratio and Rx frame alignment cause the change over
Twin–frequency use:	All faults except for Loops and Forced AIS cause the change over
Alarms	All alarms enabled except for the external analog alarm at the programmable interface PI

For other settings the non–volatile memory remain unaltered.

After the above setting is performed with the Service Terminal, the following text is displayed on the Service Terminal: *done*.

4.9 Commissioning the main channel interfaces

The main channel interfaces can be commissioned and connected to the channels of the radio frame with the Service Terminal.

As default setting, the 2 Mbit/s main channel interfaces are activated according to the capacity. The main channel interfaces are connected to the corresponding radio frame channels (main channel 1 to radio frame channel 1 etc.).

The Service Terminal menu command TOP 6,7,4,3 RET displays the following menu:

```
Channel configuration:
0   Display
1   MAINI
2   RBUS 1)
3   Remove channel
4   Equip MAINI
5   Remove MAINI equipping
6   Initial settings
```

1) Not yet implemented

4.9.1 Checking the settings for main channel interfaces

The settings for the main channel interfaces are displayed with the selection 0 from the above menu (or with the menu command TOP 6,7,4,3,0 RET). When the main channel interfaces has been set according to the default settings, the settings for the main channel interfaces are displayed on the Service Terminal.

Example (4x2 Mbit/s):

MAINI 1: Eq 1
MAINI 2: Eq 2
MAINI 3: Eq 3
MAINI 4: Eq 4

Main channel interface no. — Eq = Equipped — Radio frame channel no.

The above display shows that all main channel interfaces of the equipment are equipped and connected to the corresponding radio frame channels i.e. no dynamic branching has been performed.

4.9.3 Connecting a main channel interface to the radio frame channel

When an equipped main channel interface is to be connected to a radio frame channel, the main channel interface is first selected with the Service Terminal menu command TOP 6,7,4,3,1 RET. The Service Terminal now prompts for the number of the main channel interface to be connected:

MAINI? (1...16):

Note! With 4 x 2 Mbit/s capacity only main channel interfaces MAINI 1...4 are in use

The prompt is responded with the number of the main channel interface to be connected. For example, the main channel interface 3 is connected by entering 3 RET. The Service Terminal now prompts for the number of the radio frame channel to which the selected main channel interface is to be connected:

Radio frame channel? (1...16):

Note! With 4 x 2 Mbit/s capacity only channels 1...4 are in use

The prompt is responded with the number of the radio frame channel to be selected. For example, the main channel interface 3 is connected to the radio frame channel 3 by entering 3 RET. The following response to the command is displayed on the Service Terminal: *done*. The setting can be checked with the Service Terminal menu command TOP 6,7,4,3,0 RET (Display).

4.10 Cross–connection of channels

With the built–in cross–connection capability of the radio relay equipment the connection of each main channel interface to different radio frame channel can be performed with the Service Terminal.

In practice, the setting is similar to the procedure described in subsection 4.9.3. The difference lies within that the number of the main channel interfaces and radio frame channels may change. For example, main channel interface 1 can be connected to the radio frame channel 2, main channel interface 2 to radio frame channel 4 etc.

With the 4 x 2 Mbit/s capacity only main channel interfaces (MAINI) 1...4 are available. This means that any of the main channel interfaces 1...4 can be connected to any of the radio frame channels 1...4.

If the selected radio frame channel is already reserved for another use, the channel must be removed according to instructions given in subsection 4.9.2.

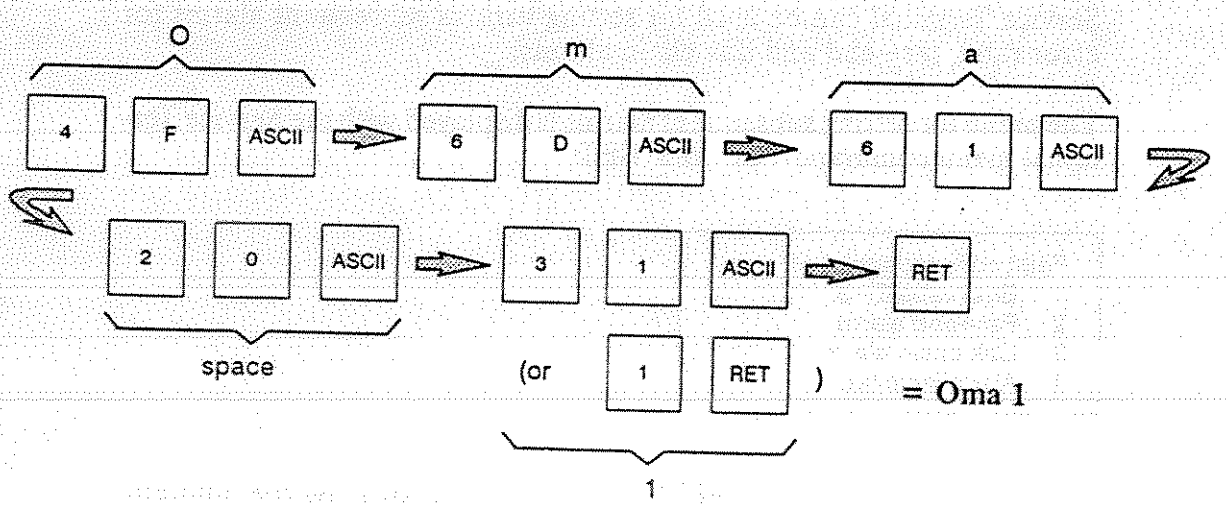
```
Modify IDs:
2   Equipment name
4   Station ID
51  Baseband Unit
52  Expansion unit
53  Outdoor Radio Interface
54  Cartridge
```

These identifications can be set by the user for the individual identification of the equipment and its location:

- Equipment name (selection 2) is the 'name' given to the radio relay equipment.
- Station ID (selection 4) indicates at which station the equipment in question is located.
- Unit IDs (selections 51..54) indicate the manufacture IDs and versions of the units used in the Indoor Unit of the equipment. The unit ID for each unit is set at the factory, but may be modified e.g. when changing the version of the unit.

When the program prompts for the ID, the user should enter the identification in ASCII format, character by character (see ASCII conversion table in *Figure 5* on page 16). The maximum length of the identification is 15 characters. Any numbers in the identification can be entered without ASCII conversion. Example:

```
ID string?
(1...15 characters)
```



```
Error ratio E-3:
0   Display
1   A alarm
2   B alarm
3   Alarms inhibited
4   A, S and AIS
```

The selection 0 (TOP 6,3,1,0 RET) displays the subsequent alarm set earlier for the error ratio alarm. With selections 1...4 the subsequent alarm for an error ratio alarm is set. After entering the selected command, the following text is displayed on the Service Terminal: *done*.

The selection 2 Far–end alarm (TOP 6,3,2 RET) from the menu on fault consequences displays the submenu for setting the subsequent alarms for a far–end alarm:

```
Far-end alarm:
0   Display
1   A+S alarm
2   B+S alarm
3   S alarm
```

The selection 0 (TOP 6,3,2,0 RET) displays the subsequent alarm set earlier for the far–end alarm. With selections 1...3 the subsequent alarm for an far–end alarm is set. After entering the selected command the following text is displayed on the Service Terminal: *done*.

The selection 3 Link chain alarm (TOP 6,3,3 RET) from the menu on fault consequences displays the submenu for setting the subsequent alarms for a link chain alarm:

```
Link chain alarm:
0   Display
1   A+S alarm
2   B+S alarm
3   S alarm
```

The selection 0 (TOP 6,3,3,0 RET) displays the subsequent alarm set earlier for the link chain alarm. With selections 1...3 the subsequent alarm for a link chain alarm is set. After entering the selected command, the following text is displayed on the Service Terminal: *done*.

The selection 4 Alarm inhibit (TOP 6,3,4 RET) from the menu on fault consequences displays the submenu for inhibiting a subsequent alarm for a fault. This function proves handy, for example, at the commissioning stage of the equipment. The selection 4 displays the following menu:

4.14 Setting the change over criteria

The change over criteria in redundant operation of the radio relay equipment is set with the Service Terminal menu command TOP 6,7,7 RET. The command displays the following menu:

```
Change over:
0  Display
1  Initial settings
2  Protection bus fault
3  MAINI IN
4  MAINI OUT
5  Loops
6  RBUS
7  Forced AIS
9  Bit error ratio
10 Tx oscillator
11 CPU faults
12 Rx frame alignment
13 Radio control
14 Tx/Rx power
```

The selections on the menu either inhibit or allow the effect of a certain fault or fault group on the change over.

Selection 0 Display (TOP 6,7,7,0 RET) displays the fault groups listed in the selections 2...14, the effect of which on the change over has earlier been inhibited.

Selection 1 Initial settings (TOP 6,7,7,1 RET) allows the effect of selections 2...14 on the change over with the following exceptions:

In twin–frequency use:
Allows the effect of all faults except for Loops and Forced AIS on the change over .

In cold standby operation:
Allows the effect of all faults except for Loops, Forced AIS, Bit error ratio and Rx frame alignment on the change over .

Selections 2...14 display the following menu for inhibiting or allowing the effect of the selected item on the change over (c/o):

```
1 Inhibit c/o
2 Allow c/o
```

When the connection has not been established:

Current object
AD 103
No response
9600 bit/s

4) The transmission management operations on the far–end equipment are begun by accessing the main menu level by entering TOP.

4.16 Selecting the scrambling polynomial

Scrambling is described in more detail in the section *3 Application Planning* of this Operating Handbook.

The same scrambling polynomial must be selected at both ends of the hop. The Service Terminal menu command TOP 6,7,4,2 RET displays the following menu:

```
Scrambling:
0  Display
1  Set polynomial
2  Disable scrambling
```

Selection 0 (TOP 6,7,4,2,0 RET) displays the previously set polynomial.

Selection 1 Set polynomial (TOP 6,7,4,2,1 RET) displays the following prompt:

```
Give polynomial
(1...7):
```

The prompt is responded with the number of the selected polynomial (1..7). For example, the polynomial 1 is set by entering 1 RET.

NOTE! **When the polynomial of a hop in use is to be changed and the resetting is performed over the connection from the near–end equipment, the polynomial of the far–end equipment must be changed before changing the polynomial of the near–end equipment. (If the polynomial of the far–end equipment is not changed first, the connection to the far–end will be lost.)**

Scrambling can be disabled with the selection 2 Disable scrambling. **Scrambling may be disabled only for the duration of the testing.**

- Alarm outputs PA1 and PA2 are activated according to the A, B and S main alarms of the equipment. Alarm combinations can be set with the Service Terminal.

Settings for the programmable interface inputs and outputs are made on the menu Programmable interface displayed by the Service Terminal menu command TOP 6,7,6 RET.

5.2 Programmable interface inputs

Digital inputs

An external signal connected to the input 1...5 (PI1I...PI5I) generates an alarm in the equipment. The generated alarm can be read with the Service Terminal or TMC from the Fault display (with the Service Terminal menu command TOP 1 RET).

The input state can also be read as ON/OFF state with the Service Terminal menu command TOP 6,7,6,0 RET (Display inputs).

P1 CONNECTOR	INPUT	Normal use	Alternative use
PI1I	Input 1	B alarm	–
PI2I	Input 2	B alarm	–
PI3I	Input 3	B alarm	Link chain alarm
PI4I	Input 4	B alarm	Channel use
PI5I	Input 5	B alarm	Channel use

In the table:

B alarm The interface involved causes a B alarm. The continuous signal state should be > 200 ms for alarm generation.

Channel use The interface involved can be set into channel use with a jumper setting (see subsection 5.4 of this chapter).

An alarm (ON state) is produced by grounding the interface involved.

A no–alarm state (OFF state) corresponds to an unconnected input or the connection of + 5 V voltage to a programmable input (inputs PI1I...PI5I are connected to + 5 V voltage via resistors).

The strapping instructions for programmable inputs and outputs on the Baseband Unit are enclosed in the section 4 *Installation* of this Operating Handbook.

The outputs 3,4,5 (PI3O, PI4O, PI5O) can be set either into pull–up or pull–down mode. The output mode can be selected with a jumper setting. Channel use requires the open collector output to be set in pull–down mode, when the activation of the output grounds the programmable input (see *Figure 11*). The outputs PA1 and PA2 are always in pull–up mode (see *Figure 10*).

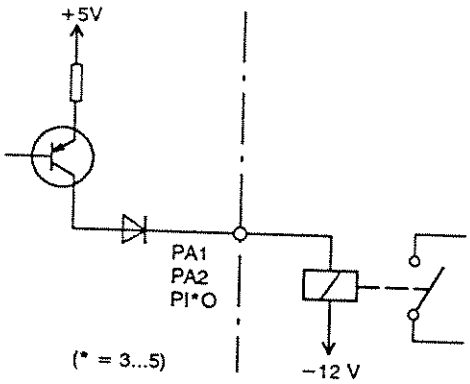


Figure 10 *Example: Programmable output as alarm output (jumper setting in pull–up mode)*

The strapping instructions for programmable inputs and outputs on the Baseband Unit are enclosed in the section 4 *Installation* of this Operating Handbook.

PA1 and PA2 alarm outputs

The outputs PA1 and PA2 can be set to be activated by the the main alarms of the equipment i.e. by A, B, D, A+B and S alarms. The settings are made with the Service Terminal menu command TOP 6,1,5 RET (PA1 function) and TOP 6,1,6 RET (PA2 function).

The PA1 output is also activated, when the operating voltages of the equipment are lost. In this case the PA1 output is activated by the + 5 V auxiliary voltage supply of the rack.

Programmable digital outputs PI3O, PI4O, PI5O

The outputs 3, 4 and 5 (PI3O, PI4O, PI5O) can be set to a fixed state (ON/OFF state) with the menu command TOP 6,7,6,2 RET, when the Service Terminal prompts for the number of the output to be set first:

```
Output 3...5?
```

The sampling rate of a programmable interface PI*I is 100 ms on the average. The sampling rate is determined based on the execution rate of the program's main process. The timing of the process may vary some tens of milliseconds.

In channel use the outputs PI*O are set in pull–down mode with jumper settings. In addition, the channel use always requires some cabling between the equipments at the repeater station.

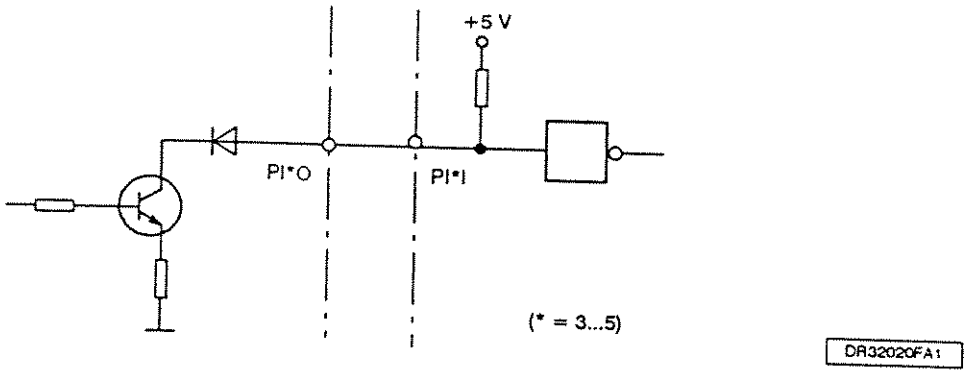


Figure 11 *Channel use: At the repeater station the programmable interface set into pull–down mode is connected to the output of the programmable interface of another equipment*

In the example in *Figure 12* the inputs 4 and outputs 4 of the equipments in the link chain are set into channel use. The signal fed to the input PI4I of the Terminal station A (equipment 1) is conveyed to the output PI4O of the Terminal station B (equipment 4).

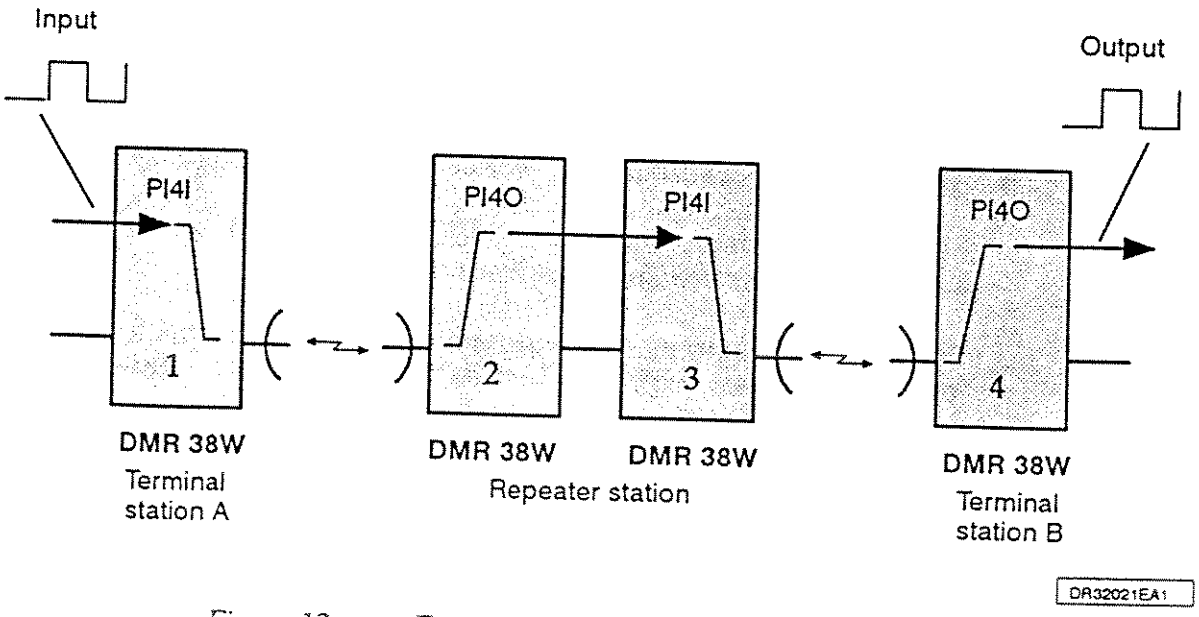


Figure 12 *Example: The inputs 4 and outputs 4 of the equipments in the link chain are set into channel use to form a slow–rate data channel*

5.5 Link chain alarm

When the inputs 3 (PI3O) and outputs 3 (PI3I) of the programmable interfaces of the equipments in the link chain are set into channel use with the Service Terminal menu command TOP 6,7,6,3,1,3 RET, Link chain alarm, the generated channel is used to convey the link chain alarm. The transmission of a link chain alarm over a repeater station requires jumper settings and intermediate cabling similar to those required for the actual channel use presented in subsection 5.4.

The link chain alarm is activated in the radio relay equipment when:

- a far–end alarm is received
- input 3 (PI3I) is active

When there is an alarm in the equipment (not link chain alarm), the alarm data is conveyed to the far end by adding the state of the input 3 (PI3I) to the equipment alarm. In addition, the data on the active alarm is conveyed to the output 3 (PI3O) by adding the equipment alarm to the link chain alarm channel received from the far end.

Alarm data can thus be conveyed in the link chain to a manned station, in which the link chain alarm has been set to activate an A+S or B+S alarm. These alarms in turn switch on the service LED and rack alarm lamp for visual indication of the fault in the link chain.

The link chain alarm can be set to activate any of the following alarms: A+S, B+S or S alarm.

Example (*Figure 13*): the outputs 3 and inputs 3 of the equipments in the link chain are interconnected and the link chain alarm is conveyed on the generated channel. If there is a fault generating an alarm in the equipment 3, the fault will also be indicated as link chain alarms in the equipments 1,2 and 4. Without the link chain alarm or TMS the terminal station A (equipment 1) or B (equipment 4) would receive no error message of such a fault.

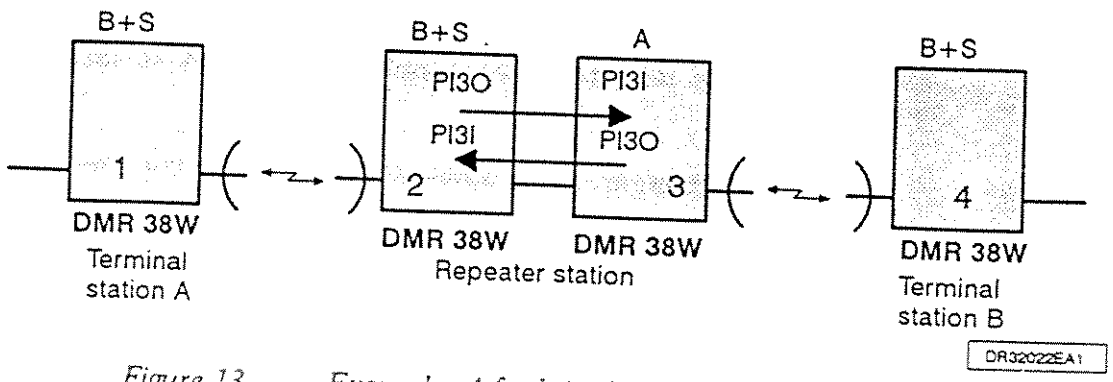


Figure 13 *Example: A fault in the equipment 3 has generated an A alarm generating a B+S alarm chosen for the link chain alarm*

6.2.1 Measuring the fading margin with the Service Terminal

The fading margin of a radio hop can be measured by using the Service Terminal TC 21700. The fading margin is measured as follows:

The Service Terminal is connected according to *Figure 2* (see page 9) to the upper pin of the Euroconnector P1 on the Baseband Unit of the Indoor Unit (upper pin strip of the connector, pins a1, b1 and c1 remain unconnected). The equipment is accessed by the Service Terminal.

Enter the menu command TOP 7,2 RET at the main menu level of the Service Terminal. The Service Terminal now shows the input level (dBm) of the receiver at the antenna connector. The fading margin is received by subtracting the receiver threshold from the input level value of the receiver.

The guaranteed threshold value for the radio relay equipment is given in the section 2 *Technical specifications* of this Operating Handbook. In addition, the documents delivered with the equipment include the measured equipment–specific threshold value.

It is advisable to compare the measured fading margin with the value calculated for the hop to ensure correct antenna alignment and hop clarity.

The accuracy of the input level is typically better than ± 5 dBm.

6.2.2 Measuring the fading margin with an adjustable attenuator

The antenna line of the transmitting radio relay equipment can be equipped with an adjustable attenuator placed between the flexible waveguide and antenna. The attenuator can be used in the following two ways (see *Figure 14*):

- The antenna line of the receiver is attenuated (1), when the operation of the equipment at each hop end can be checked in the receive direction.
- The far–end transmitter is attenuated (2), when also the interference over the hop can be detected.

Figure 14 illustrates the measurement procedure for the transmission direction from the station A to the station B. If the the Service Terminal displaying the error ratio is at the receiving station (B), the error ratio is obtained directly from the processor.

If the Service Terminal displaying the error ratio is at the transmitting station (A), the error ratio data measured at the station B passes over the

6.3 Checking the frequency stability

The radio relay equipment has a specified frequency stability which is guaranteed after six months of operation. The operator may monitor the change in the frequency, e.g. once a year. The measurement results should then be recorded for future reference.

The frequency stability is checked by measuring the 3rd harmonic frequency (3 x crystal frequency) of the reference frequency of the Synthesizer. The SYNMON measurement point (BNC connector, socket–type) is located on the bottom surface of the Outdoor Unit Radio Section (see *Figure 16* on page 55). The measurement point is accessed by opening the connector case of the Alignment unit.

The reference frequency of the Synthesizer is approx. 120 MHz and is frequency range specific according to the following table:

Tx frequency range/ frequency band	Crystal frequency MHz	3 x crystal frequency MHz
A	121.6362	364.9086
B	122.5337	367.6011
C	123.4311	370.2933
D	124.3285	372.9855
A'	118.4952	355.4856
B'	119.3926	358.1778
C'	120.2901	360.8703
D'	121.1875	363.5625

Table 1 Reference frequencies of the Synthesizer

6.4 Using external measuring equipments

6.4.1 Indoor Unit (IU)

The DMR 4x2–38W is equipped with a 75 ohm unbalanced measurement interface (MP) for servicing and testing. External measuring equipments may be connected to the measurement interface.

The measurement point connector is located at the front edge of the Baseband Unit (BBU). The connector is an SMB type connector and is located beside the unit indicators (service LEDs) (see *Figure 15*).

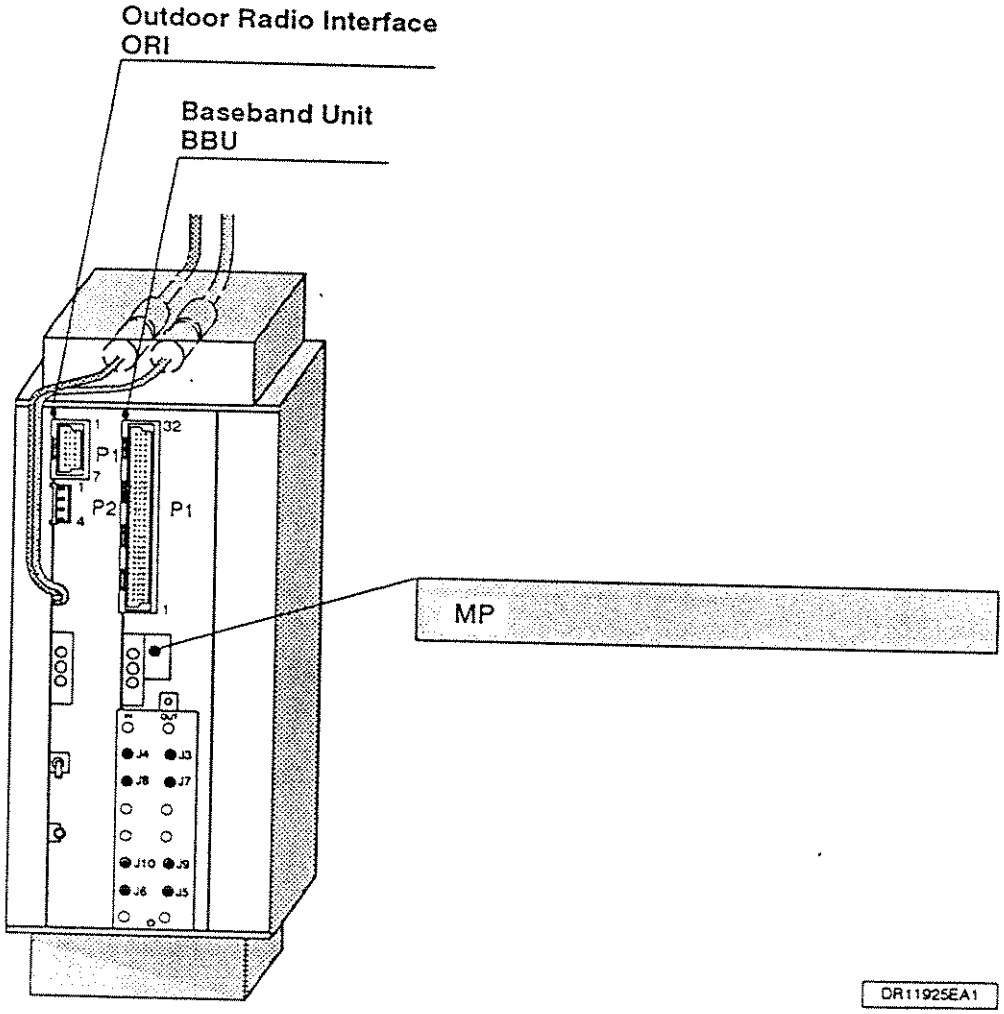


Figure 15 *Indoor Unit, location of the measurement point connector (MP)*

6.4.2 Outdoor Unit (OU)

The measurement points of the Outdoor Unit are illustrated in *Figure 16*.

The AGC voltage can be measured from the AGC measurement point AGCMON and the 3rd harmonic (approx. 360 MHz) of the reference frequency (approx. 120 MHz) of the Synthesizer from the measurement point SYNMON on the Outdoor Unit.

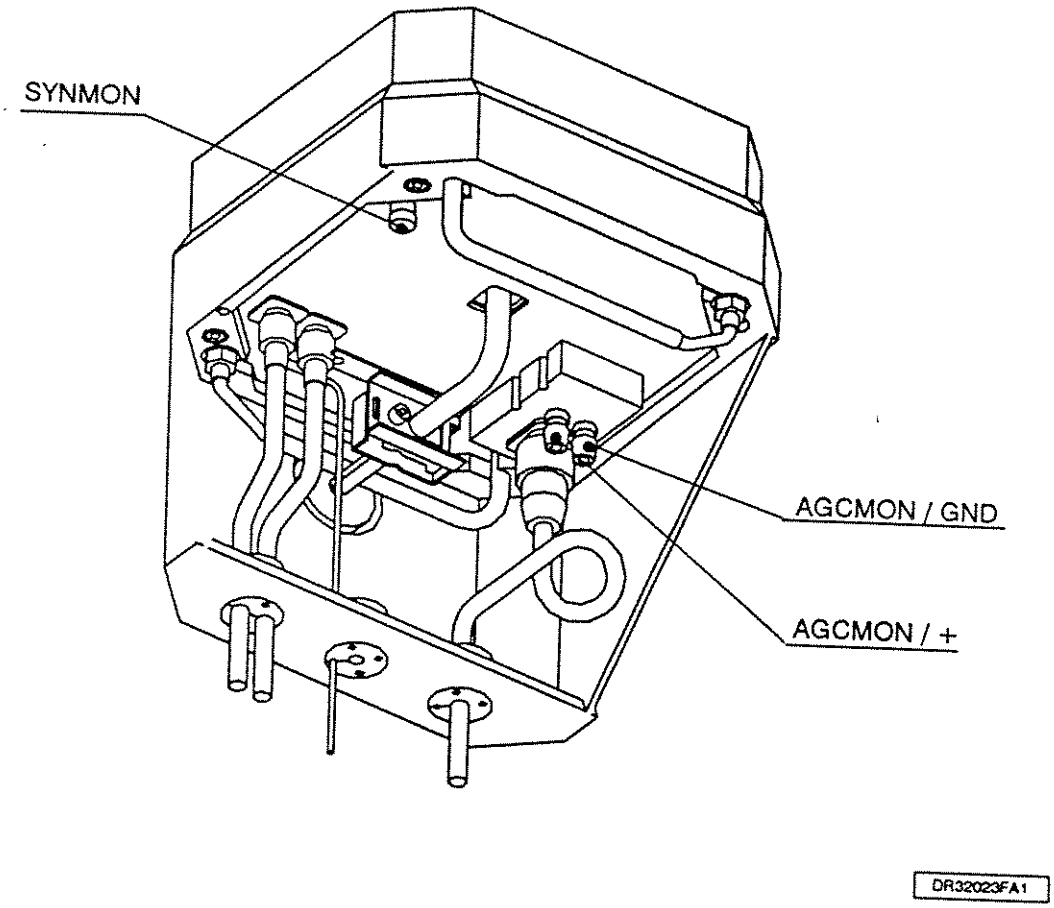


Figure 16 *Outdoor Unit, locations of the measurement points*

- Conduct and record the measurements at regular intervals and compare the results with the previous ones.
- Use the statistics to monitor the radio hop. The significance of the statistics is described in more detail in the section 3, *Application Planning* of this Operating Handbook.

Spare equipment

The servicing of the DMR 4x2–38W radio relay equipment is based on replacing the faulty unit (Radio Section of the Outdoor Unit, Outdoor Radio Interface, Baseband Unit or cartridge motherboard of the Indoor Unit).

For large networks, it is advisable to have several spare units available. The spare units should be stored in a ready–to–install state except for the final settings. When replacing the unit, a Service Terminal should be available, because the settings of the spare unit must be changed to correspond to the radio hop.

It is to be noted that the Outdoor Unit of the DMR 4x2–38W is frequency band specific. Therefore, there should be two spare Outdoor Units for each frequency band used in the network (NOTE! The Outdoor Units at both hop ends have different properties) and at least one spare Baseband Unit and Outdoor Radio Interface unit for the Indoor Unit.

7.2 Measurements

The maintenance of the radio relay equipment includes measurements which do not interfere with the communication. Measurements interfering with the communication can also be conducted when the radio relay equipment is in operation, provided that the measurements are performed at a time when there is no traffic or the traffic can be rerouted. The Transmission Management System (TMS) enables the Service Terminal measurements to be performed centrally for the entire network without having to move physically from station to station. Any measurements performed with external measuring instruments are, however, locally conducted.

The measurements should be recorded to permit comparison with earlier results and to detect significant changes in the results. The measurement records should be stored at the location where the measurements are conducted, that is for centralized measurements in the central monitoring room, and for external measurements at the equipment station.

7.3 Adjusting the frequency

The frequency stability of the DMR 4x2–38W is ± 5 ppm in the temperature range –40°C ... +45°C. The allowed frequency drift is < 1 ppm per year as measured at a temperature of + 20°C. These values are guaranteed after six months of operation.

The checking of the frequency stability is described in chapter 6 of this description. If the values obtained from this check are outside the allowed range, the frequency must be adjusted according to the following instructions (see *Figure 17*):

1. The case of the Radio Section is detached exposing the Synthesizer.

2. The power to the equipment is switched on (if it has been off) and the temperature of the crystal oven is let to stabilize for 5 ... 10 minutes.

3. The frequency is measured in accordance with chapter 6 and adjusted with a tuning key included in the *Installation Tools, Basic Set T38140.01* through the opening in the cover of the Synthesizer (see *Figure 17*).

Adjusting the frequency requires precision. If the adjusting is performed when connection is established to the equipment to be adjusted, the adjusting must be performed slowly and with extra care.

The frequency is measured (see chapter 6, *Checking the frequency stability*) from the SYNMON connector located on the Outdoor Unit (*Figure 16* on page 55).

7.4 Generation of alarms

In the DMR4x2–38W radio relay equipment the fault location is based on the alarm data composed by the equipment itself (over 150 different alarm messages).

Figure 19 illustrates the alarm system of the DMR 4x2–38W: faults in the equipment generate alarms. The software processes the alarms and generates a main alarm (A or B depending on the equipment settings), which is indicated by the corresponding service LED being lit on the Indoor Unit of the radio relay equipment. The alarms can be read with the Service Terminal or TMS Transmission Management System.

The main alarms are:

1) A alarm (red LED): activated in the event of a traffic interrupt

2) B alarm (yellow LED): activated when the communication is retained, but the operation of the equipment has deteriorated beyond the set limits. In redundant operation, the loss of redundancy causes a B alarm. An equipment may be completely inoperative, but an A alarm is not generated, as the communication is transmitted via the protective equipment.

When an alarm is activated in the equipment due to the error ratio in the receive direction or a loss of frame alignment, a far–end alarm will be sent over the radio hop (R alarm). When the station at the other end of the hop detects the far–end alarm, it indicates it with a LED. The operation of the R alarm is described in *Figure 20*.

In the situation described above, the AIS (Alarm Indication Signal) is switched to the line in the receive direction (*Figure 20*). In redundant operation, the break in the traffic causes the equipment change over.

Figure 21 illustrates the generation of alarms in a schematic form. Settings may be made with menu commands to inhibit an alarm or change over as a consequence of a fault. The change over and AIS may also be force–controlled.

The link chain alarm (A+S, B+S or S alarm) is an alarm conveying method separate from the TMS. It is made operative by setting the programmable interface PI3 into link chain alarm use. The information transferred as a link chain alarm may be set to activate the desired alarm (at the monitored station) for immediate detection of a fault state in the link chain. The principle of the link chain alarm is described in subsection 5.5 of this description.

When an alarm condition is detected at a manned station, the Service Terminal or TMS Transmission Management System may be used to locate the original alarm and to find out its cause.

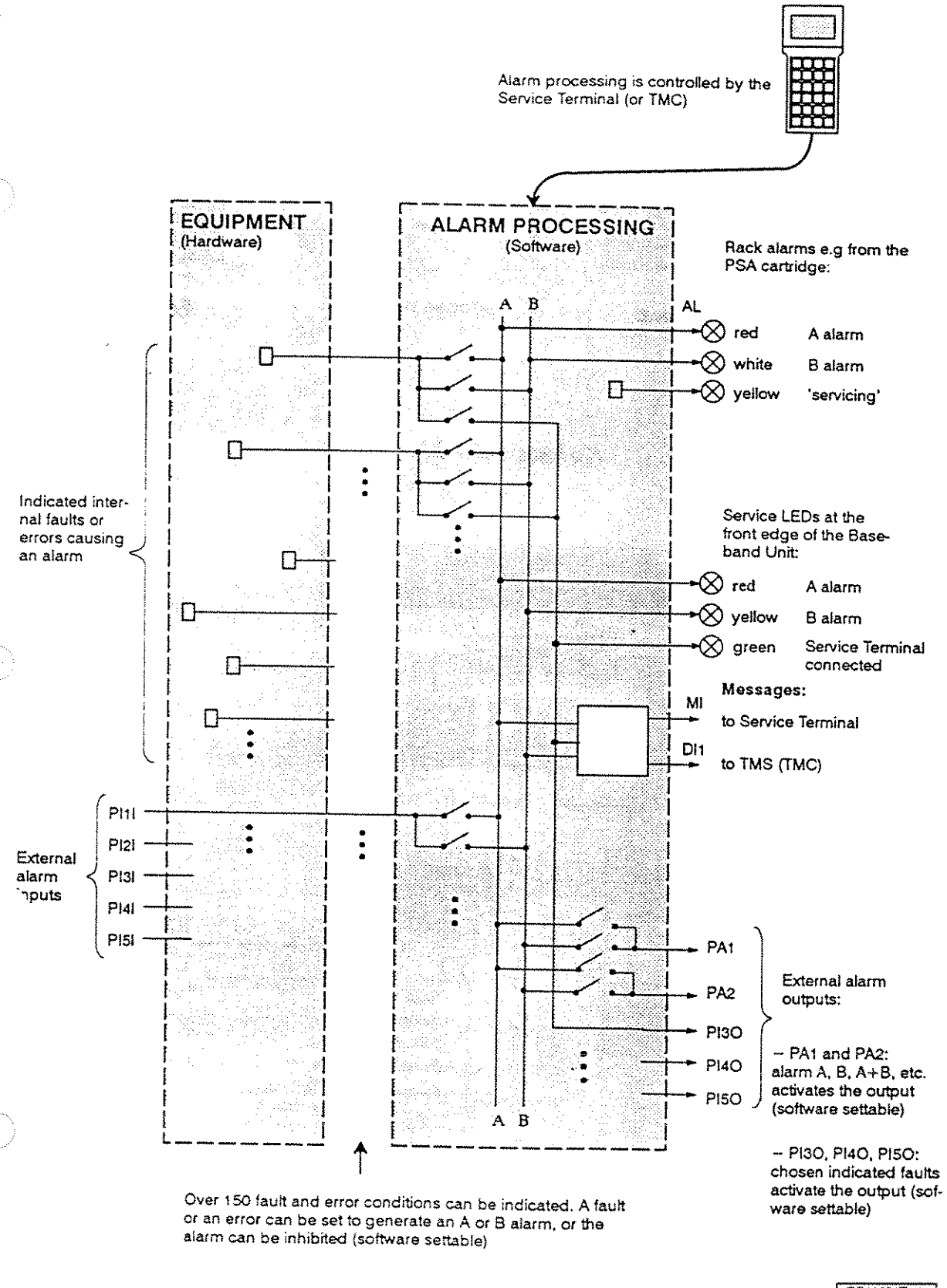


Figure 19 DMR 4x2–38W, alarm system

7.5 Using the alarms in fault location

An *Alarm list* is enclosed in the section 6 *Operation with Service Terminal* of this Operating Handbook. It contains all alarms generated in the equipment and the change overs and main alarms caused by them. All alarms may be read via the TMS Transmission Management System.

In the event of a fault anywhere in the link chain, it is crucially important that an alarm is activated immediately at the manned station or in the TMS. Normally the TMS continuously reads the alarms of the equipments in the link chain.

If such polling method is not available, the equipments may be chained for link chain alarm use with the programmable interface PI3, in which case the link chain alarm is set to switch on a service indicator (LED) and cause a rack alarm at the manned station.

When an alarm has been detected in the radio relay equipment chain, each radio relay equipment is examined individually with the Service Terminal. The fault display of each equipment is examined to deduce whether the fault is located in this particular equipment or somewhere else in the chain. This procedure is repeated along the link chain until the equipment is found which contains a fault on its fault display originating in the equipment itself.

If the transmission path is broken at a point of the chain and it is not possible to contact the next radio relay equipment, the fault is probably located in the equipment closest to the breakage point. If the TMS bus is ring–protected, the breakage point can be accessed via the protective route of the ring. If this is not the case, the following procedure is followed:

- Examine the radio relay equipment closest to the breakage point to which a connection can be established. If the fault display of the equipment contains faults which may be originating in the equipment, it can be considered that the network fault locates in this particular equipment.

- If the fault display indicates that the radio relay equipment closest to the breakage point is intact, the equipment on the other side of the breakage point is probably faulty.

The DMR 4x2–38W is equipped with a number of loopback possibilities (see section 1, *Functional Description* of this Operating Handbook). Depending on the situation, the loop may cause a traffic interrupt. Therefore, the fault location in the network should primarily be based on examining the detailed alarm information. Loops can be used mainly when the traffic has already been interrupted.

- Before replacing the faulty unit(s) of the radio relay equipment with the spare unit(s), the Service Terminal is connected to the faulty equipment, which must be force–controlled to act as a slave. This is done to ensure that a possible fault occurring in the operating equipment will not cause change over to the equipment whose units or Radio Section is being replaced. The Forced slave control is issued with the Service Terminal menu command TOP 5,7,5 RET.

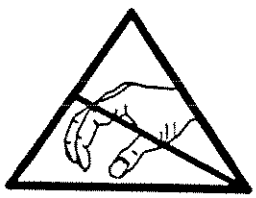
7.8 Preparing the spare equipment

Before installing a spare equipment to the Indoor or Outdoor Unit, the settings of the faulty equipment must be duplicated into the spare equipment. All settings can be done manually from the Indoor Unit with the Service Terminal. The essential settings include:

- operating mode
- station type
- capacity
- main channels
- radio frequencies
- equipment address on the TMS bus
- opening of the data hybrid switch
- setting of the transmitter attenuator
- selection of the power supply method for the Outdoor Unit

Other settings can be made after the spare equipment has been installed. The settings should be checked from the setting list delivered with the original equipment or with the section 6 *Operation with Service Terminal* of this Operating Handbook.

NOTE!
Anti–static protectors such as wrist grounding, should be used when assembling or disassembling the equipment.



NOTE!

Wrist grounding or corresponding anti–static protectors should always be used when handling a plug–in unit once it has been removed from its anti–static packaging

Before replacing the faulty unit with a spare unit, it should be ensured that the jumper settings of the spare unit correspond to the jumper settings of the unit to be replaced. The purpose and use of each jumper setting can be checked from the strapping instructions enclosed in the section 4 *Installation* of this Operating Handbook.

7.9.2 Replacing the Baseband Unit (BBU)

1. Open the cover of the Indoor Unit of the faulty equipment.
2. Switch off the power from the faulty equipment with the ON/OFF switch of the Outdoor Radio Interface (ORI).
3. Disconnect all cables connected to the connectors located at the front edge of the Baseband Unit:
   - Cables of main channel interfaces
   - Cables connected to the connector P1
4. Pull the faulty unit out of the cartridge. **(Anti–static protection should be provided!)**
5. Ensure that the connections of the jumper settings correspond to the connections in the faulty unit. The strapping instructions for the Baseband Unit enclosed in the section 4 *Installation* of this Operating Handbook can be used as reference if necessary.
6. Insert the spare unit into the cartridge location of the faulty unit. **(Anti–static protection should be provided!)**
7. Connect the detached cables to the connectors of the unit.
8. Switch on the power to the equipment with the ON/OFF switch of the Outdoor Radio Interface (ORI).
9. Check the settings and operation of the equipment with the Service Terminal (see subsection 7.8 *Preparing the spare equipment*).
10. Close the cover of the Indoor Unit.

7.9.3 Replacing the TM4–EMC cartridge

The replacement of the TM4–EMC cartridge is performed in the reverse order to the instructions given in the section 4 *Installation* of this Operating Handbook. The replacement of the cartridge does not include any operational settings or jumper settings.

2. Place the Radio Section onto the Alignment Unit connector case.

3. Press the rubber gasket of the Radio Section case against the edge of the connector case.

4. Screw the Radio Section in its place with the nuts of the handles.

5. Detach the flexible waveguide from the transport support and attach it to the flange of the antenna with a quick release clamp. The mounting of the quick release clamp is described in the *Installation Instructions E10007509RE* enclosed in the section 4 *Installation* of this Operating Handbook.

6. Connect the grounding cable, IU–OU cables and AUXBATT supply cable (if necessary) of the Radio Section.

7. Lift up the Alignment Unit connector case cover and tighten the knurled–head screw. Lock the cover (e.g. with a padlock).

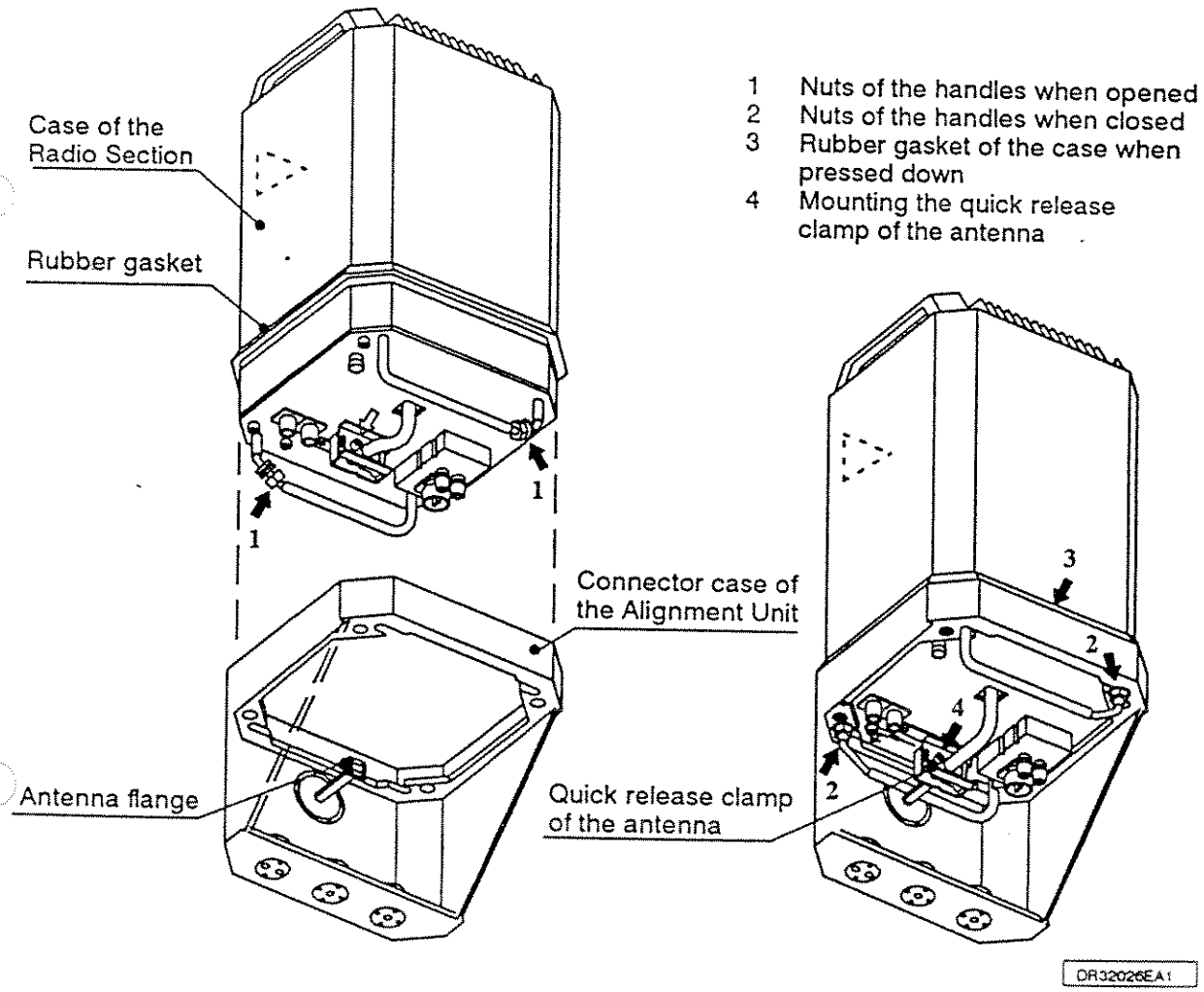


Figure 22 Installing the Radio Section

7.10.4 Replacing units of the Radio Section

The Radio Section of the Outdoor Unit contains the following units: IF Unit, Microwave Unit, Modem, Synthesizer, Power supply and Cable Interface.

The above units can be replaced separately and their replacement is described in detail in the Repair Handbook. The replacement of the Outdoor unit is recommended to be performed at repair facilities. However, some of the units can also be replaced on the site.

The following measurements and calibrations should be performed when replacing a unit of the Radio Section:

The units have been designed so that they can be replaced with corresponding units without degrading the properties of the equipment. When possible, the measurements necessary for equipment verification presented in the Repair Handbook should be performed after replacing Radio Section units.

If the Microwave Unit, IF unit or Modem is replaced with a spare unit, the following calibrations and measurements should be made (from the MI of the Outdoor Unit):

- calibration of the VCO control characteristic (with the Service Terminal)
- Rx–AGC calibration of the Modem (requires calibrated hop between two terminals)
- input level/AGC calibration (requires calibrated hop between two terminals)

When replacing the Microwave Unit, it also recommended to check the position of the adjustable attenuator i.e transmit power setting.

If the Synthesizer is replaced, the frequency of the spare Synthesizer should be checked and adjusted if necessary (see subsections 6.3 and 7.3).

If the Power supply is replaced, it should be checked that the Power supply jumper settings for supply voltage value and supply method correspond to the current equipment set–up. The jumper settings can be checked from the Power supply strapping instructions enclosed in the section 4 *Installation* of this Operating Handbook.

If the Modem is replaced, in addition to the calibrations, the Service Terminal settings related to the functions of the Modem should be made from the Outdoor Unit.

DMR 4x2–38W, BASIC INFORMATION FORM

Customer _____

Equipment station _____

Date _____ Prepared by _____

1 LIST OF SETTINGS

(NOTE: The Service Terminal TC 21700 command string used when performing check–ups and measurements are given in the the format (TOP x,x,x RET))

Equipment identifications:

- ☐ Equipment type (TOP 4,1 RET) _____
- ☐ Station ID (TOP 4,1 RET) 1) _____
- ☐ Equipment name (TOP 4,2 RET) 1) _____

1) = Identification defined by the user

Radio capacity _____ Mbit/s

Main channel capacity _____ Mbit/s

Tx frequency (TOP 6,7,8,1,0 RET) _____ MHz

Rx frequency (TOP 6,7,8,1,0 RET) _____ MHz

Nominal power _____ dBm

Setting of the RF power attenuator _____ dB

Operating mode (TOP 6,7,1,0 RET) _____

Station type (TOP 6,7,2,0 RET) Terminal station ☐

Repeater station ☐

Indoor Unit (IU) measurements

Measurements performed with the Service Terminal TC 21700 (appropriate menu string is given in parenthesis after each item measured with the Service Terminal, e.g (TOP x,x,x RET); more detailed information on measurements is available in the section 6, *Operation with Service Terminal* of the Operating Handbook):

The threshold values for the measured voltages are given in parenthesis.

- ☐ Battery voltage, IU (TOP 7,4,4 RET) _____ V

- ☐ Supply voltages:
  - ☐ +5 V (TOP 7,4,1 RET) (+4.7...+5.5 V) _____ V
  - ☐ −5.2 V (TOP 7,4,2 RET) (− 5.7...−4.7 V) _____ V
  - ☐ +12 V (TOP 7,4,3 RET) (+11.0...+13 V) _____ V

Measurements from the measurement point (MP):

- ☐ Rx AIS clock (TOP 5,4,6 RET) _____ MHz
- ☐ Rx clock (TOP 5,4,7 RET) _____ MHz
- ☐ Tx clock (TOP 5,4,8 RET) _____ MHz

Outdoor Unit (OU) measurements

- ☐ Auxiliary battery voltage at AUX BATT connector _____ V

The following measurements are performed at the Indoor Unit with the Service Terminal TC 21700 (appropriate menu string is given after each item measured with the Service Terminal, e.g. (TOP x,x,x RET):

The threshold values for the measured voltages are given in parenthesis.

- ☐ txsqem (norm. 0.6...7 V) _____ V
  (TOP 7.7.11 RET)
- ☐ txagcm (1...4 V) _____ V
  (TOP 7.7.12 RET)
- ☐ txibiasm (norm. 2...6 V) _____ V
  (TOP 7.7.13 RET)
- ☐ rxafcm (approx. 3...5 V) _____ V
  (TOP 7.7.14 RET)
- ☐ rxiqphm (2...8 V) _____ V
  (TOP 7.7.15 RET)
- ☐ rxbiasm (norm. 2...6 V) _____ V
  (TOP 7.7.16 RET)
- ☐ rxiqbalm (1...7 V) _____ V
  (TOP 7.7.17 RET)

- ☐ Temperatures, OU (TOP 7.8 RET)
  - ☐ Microwave Unit (+40...+80 °C or +50...+70 °C 2)) _____ °C
  - ☐ Modem (+50...+96,5 °C) _____ °C

Measurements from the Outdoor Unit measurement points:

- ☐ AGC (AGCMON) _____ V
- ☐ Reference frequency of the Synthesizer (SYNMON) _____ MHz

(See section 5 *Operation* of the Operating Handbook, subsection 6.3)

2) = depends on the type of the microwave oscillator

Appendix F Commissioning Test Report

1. SITE SPECIFIC DOCUMENTATION & INFORMATION

1.1. Site Documentation

1.1.1. Site Specific Documentation

This site is installed and commissioned according to DMR 4x2 - 38W Installation and Operation Handbook.

1.1.2. Differences from the Standard Packages

All site documents differing from the Standard Packages are to be listed in the following table the documents are placed at the end of this section in the order of the list.

DOCUMENT NUMBER	DOCUMENT NAME	ISSUE

1.2. DMR Operation Mode Information

☐ Single use

☐ Protected

☐ Cold Standby ☐ Twin Frequency

1.3. Site and Terminal Information

Site Name: XXXXXXXXXXXXXXXX

Site Address: YYYYYYYYYYYYYYYYY

YYYYYYYYYYYYYYYYY

Site Telephone: _____

Contact Person: _____

Tel. No: _____ Fax No: _____

Hop: AAAAAAA-BBBBBBB

Station 1: Station AAAAAAA

Station 2: Station BBBBBBBB

Distance between Station 1 and 2: _____

Nominal Power of Transmitter: _____

Baseband Interface Impedance: _____

	Station 1	**Station 2**
Subband Tx frequency	AAAAAAA	BBBBBBB
Rx frequency		

Road Conditions: ( ) Accessible w/normal vehicle

( ) 4WD vehicle recommended

Key Box: ( ) Yes Code: _____

( ) No Keys from: _____

Access to site info: _____

_____

2. ANTENNA AND CABLE INFORMATION

2.1. General information about Antenna and Cables

ITEM		TERMINAL A	TERMINAL B
Antenna Type			
Antenna Beamwidth	dgr		
Antenna Diameter	mm		
Antenna Gain	dBi		
Antenna Polarization	H/V		
Antenna Bearing (point of direction)	dgr		
Antenna Height (from ground level)	m		
Mechanical Tilting Angle	dgr		
Electrical Tilting Angle	dgr		
Cable Type (between Radio and Antenna)			
Cable Length (between Radio and Antenna)	m		
Cable Type (between OU and IU)			
Cable Length (between OU and IU)	m		
Antenna Serial Number			

NOTE: Terminal B is use for Redundant only

2.2. Installation Checklist

ITEM	TERMINAL A	TERMINAL B
IU-OU Cables correctly marked (yes/no)		
All external connectors and cables checked for correct sealing (yes/no)		

_ = Antenna rigger to complete the information

CARRIED OUT BY:

NAME : _____ **SIGNED:**_____ **DATE:**_____/_____/_____

3. POWER SUPPLY INFORMATION

3.1. General information about Power Supply

Supply Voltage for Equipment		+ VDC
Battery used	(yes / no)	
Supply Voltage for Test Equipment (AC)		VAC

NOTE: 1. Existing power supply (rectifier) at site will be use for DMR 4x2 - 38W equipment.

2. Supply voltage to outdoor unit will be supplied by indoor unit via IU - OU cable.

CARRIED OUT BY:

NAME : _____ **SIGNED:** _____ **DATE:** ____/____/____

4. TRANSMISSION CABLING

4.1. Transmission Cabling and Wiring

☐ Is in accordance with the operation mode nominated in Section 1.2

4.2. Checklist

☐ **Case 1:** BTS Installed at time of DMR commissioning

	PASS	FAIL
In & Out of 2 mbps cables connected in DMR		
Labels on DMR are OK		
Cables connected to BTS		
Labels on BTS are OK		
Test loops removed		
Notes on Transmission Cabling		

☐ **Case 2:** BTS not present at time of DMR commissioning

	PASS	FAIL
In & Out of 2mbps cables connected to DMR		
Labels on cables at DMR end are OK		
Labels on cables at BTS end are OK		
Notes on Transmission Cabling		

CARRIED OUT BY:

NAME : _____ **SIGNED:** _____ **DATE:** ____/____/____

5. DMR Indoor and Outdoor Unit Installation

5.1. Indoor and Outdoor Unit Installation

☐ Is in accordance with the operation mode nominated in Section 1.2

5.2. Method of Installation (Indoor Unit)

☐ TM4 rack ☐ Wall mounting into 19" rack ☐ Wall mounting onto wall-mounting support

5.3. Method of Installation (Outdoor Unit)

☐ Roof mounting ☐ Wall mounting ☐ Tower installation

5.4. DMR Checklist

	TERMINAL A		TERMINAL B	
ITEM	**Pass**	**Fail**	**Pass**	**Fail**
General Appearance of Outdoor Unit				
General Appearance of Indoor Unit				
OU / IU cables labelled correctly				
Cables Ok - between units				
External cables Ok				
Ground Cable fitted to Indoor Unit				
Notes about DMR IU & OU check				

5.5. Outdoor Unit Commissioning Results

		TermA	Term B
Auxilairy Battery voltage at OU	V		
AGC (When Link is establish)	V		
Reference Frequency of Synthesizer	mHz		
Transmitter Attenuator setting	dB		

CARRIED OUT BY:

NAME : _____ **SIGNED:** _____ **DATE:** ____/____/____

6. JUMPER SETTINGS

6.1. Baseband Unit

6.1.1. Main Channel Jumper settings, 120 ohm balance Euroconnector; P3

TERMINAL A

ST NO:	SETTING	
ST1	3-5, 4-6	☐ Checked
ST2	3-5, 4-6	☐ Checked
ST3	3-5, 4-6	☐ Checked
ST4	3-5, 4-6	☐ Checked
ST5	3-5, 4-6	☐ Checked
ST6	3-5, 4-6	☐ Checked
ST7	3-5, 4-6	☐ Checked
ST8	3-5, 4-6	☐ Checked

TERMINAL B

ST NO:	SETTING	
ST1	3-5, 4-6	☐ Checked
ST2	3-5, 4-6	☐ Checked
ST3	3-5, 4-6	☐ Checked
ST4	3-5, 4-6	☐ Checked
ST5	3-5, 4-6	☐ Checked
ST6	3-5, 4-6	☐ Checked
ST7	3-5, 4-6	☐ Checked
ST8	3-5, 4-6	☐ Checked

Note: Refer to PCB markings for jumper settings

6.1.2. Main Channel Jumper settings, 75 ohm unbalanced SMB connector; J3...J8

TERMINAL A

ST NO:	SETTING	
ST1	1-3, 2-4	☐ Checked
ST2	1-3, 2-4	☐ Checked
ST3	1-3, 2-4	☐ Checked
ST4	1-3, 2-4	☐ Checked
ST5	1-3, 2-4	☐ Checked
ST6	1-3, 2-4	☐ Checked
ST7	1-3, 2-4	☐ Checked
ST8	1-3, 2-4	☐ Checked

TERMINAL B

ST NO:	SETTING	
ST1	1-3, 2-4	☐ Checked
ST2	1-3, 2-4	☐ Checked
ST3	1-3, 2-4	☐ Checked
ST4	1-3, 2-4	☐ Checked
ST5	1-3, 2-4	☐ Checked
ST6	1-3, 2-4	☐ Checked
ST7	1-3, 2-4	☐ Checked
ST8	1-3, 2-4	☐ Checked

6.1.3. Main Channel jumper settings for ST1 to ST8 (75/120 ohm, unbalance/balance) on the Baseband Unit TC 26000.** should be set according to the following table.

TERMINAL A

ST NO:	SETTING	
ST1	2-4, 3-5	☐ Checked
ST2	2-4, 3-5	☐ Checked
ST3	2-4, 3-5	☐ Checked
ST4	2-4, 3-5	☐ Checked
ST5	2-4, 3-5	☐ Checked
ST6	2-4, 3-5	☐ Checked
ST7	2-4, 3-5	☐ Checked
ST8	2-4, 3-5	☐ Checked

TERMINAL B

ST NO:	SETTING	
ST1	2-4, 3-5	☐ Checked
ST2	2-4, 3-5	☐ Checked
ST3	2-4, 3-5	☐ Checked
ST4	2-4, 3-5	☐ Checked
ST5	2-4, 3-5	☐ Checked
ST6	2-4, 3-5	☐ Checked
ST7	2-4, 3-5	☐ Checked
ST8	2-4, 3-5	☐ Checked

6.1.4. Grounding the incoming signal

TERMINAL A

ST NO:	SETTING	
ST15	1-2	☐ Checked
ST26	1-2	☐ Checked
ST37	1-2	☐ Checked
ST48	1-2	☐ Checked

TERMINAL B

ST NO:	SETTING	
ST15	1-2	☐ Checked
ST26	1-2	☐ Checked
ST37	1-2	☐ Checked
ST48	1-2	☐ Checked

6.1.5. Connection of Service Telephone Channels 2

TERMINAL A

ST NO:	SETTING	
ST1E	3-5, 4-6	☐ Checked
ST2E	3-5, 4-6	☐ Checked

TERMINAL B

ST NO:	SETTING	
ST1E	3-5, 4-6	☐ Checked
ST2E	3-5, 4-6	☐ Checked

6.1.6. Connection of TX Oscillator

TERMINAL A

ST NO:	SETTING
ST1J	1-2

☐ Checked

TERMINAL B

ST NO:	SETTING
ST1J	1-2

☐ Checked

6.1.7. Selection of Phase Control for TX Oscillator Hybrid

TERMINAL A

ST NO:	SETTING
ST2J	3-4

☐ Checked

TERMINAL B

ST NO:	SETTING
ST2J	3-4

☐ Checked

6.1.8. Watch Dog Control

TERMINAL A

ST NO:	SETTING
ST1M	2-3

☐ Checked

TERMINAL B

ST NO:	SETTING
ST1M	2-3

☐ Checked

6.1.9. Processor Operating Mode

TERMINAL A

ST NO:	SETTING
ST1Q	3-5, 4-6

☐ Checked

TERMINAL B

ST NO:	SETTING
ST1Q	3-5,4-6

☐ Checked

6.1.10. Processor Pulse Accumulator Input

TERMINAL A

ST NO:	SETTING
ST2Q	

☐ Checked

TERMINAL B

ST NO:	SETTING
ST2Q	

☐ Checked

6.1.11. Hardware Protection Pin

TERMINAL A

ST NO:	SETTING
ST1R	2-3

☐ Checked

TERMINAL B

ST NO:	SETTING
ST1R	2-3

☐ Checked

6.2. Programmable Interface

6.2.1. Function of Programmable Interface P130 / P150 Output

TERMINAL A

ST NO:	SETTING
ST1	1-2, 4-5, 7-8

☐ Checked

TERMINAL B

ST NO:	SETTING
ST1	1-2,4-5,7-8

☐ Checked

6.3. Baseband Branching Settings

6.3.1. Grounding Incoming Signal

TERMINAL A

ST NO:	SETTING	
ST1	1-2	☐ Checked
ST2	1-2	☐ Checked
ST3	1-2	☐ Checked
ST4	1-2	☐ Checked

6.4. Outdoor Radio Interface Settings

6.4.1. Scrambler and Dual - Data - Codec Circut Connected

TERMINAL A

ST NO:	SETTING	
ST1	2-3	☐ Checked
ST2	2-3	☐ Checked
ST3	2-3	☐ Checked
ST4	2-3	☐ Checked
ST5	2-3	☐ Checked

TERMINAL B

ST NO:	SETTING	
ST1	2-3	☐ Checked
ST2	2-3	☐ Checked
ST3	2-3	☐ Checked
ST4	2-3	☐ Checked
ST5	2-3	☐ Checked

CARRIED OUT BY:

NAME : _____ SIGNED : _____ DATE: _____/_____/_____

(LSE/Nokia Representative)

7. EXTERNAL CABLE INSTALLATION

7.1. Cabling / Wiring Schedule

☐ Is in accordance with the operation mode nominated in Section 1.2

7.2. External Cabling Checklist

	Pass	Fail
IU - OU cable connected to Outdoor / Indoor Unit		
Labels on IU / OU cables at DMR IU - OK		
Grounding of Outdoor Unit		
Grounding of Indoor Unit		
Power cables connected at DMR / Indoor Unit		
Cables arranged and secured to cable tray		
Cables connected to MDF		
Management alarms connected to MDF		
Labels at MDF - OK		
Notes on Grounding & External Cabling Checks		

CHECKED BY:

NAME :_____ **SIGNED:**_____ **DATE:**____/____/____

8. FACTORY TEST REPORTS

8.1. DMR Factory Test Report

☐ Is provided following this page

Checked by:

NAME : _____SIGNED : _____ DATE: ____/____/____

9. INVENTORY LISTS

9.1. Inventory List Check

☐ Manual Inventory List completed in following section.

9.2. Inventory List

9.2.1 Indoor and Outdoor Units

		SERIAL NUMBER	
ITEM	HW / FW REVISION	TERMINAL A	TERMINAL B
OUTDOOR UNIT			
Microwave Unit			
Modem			
Program			
Synthesizer			
IF - Unit			
Power Supply			
Cable Interface			
Frame			
Housing			
INDOOR UNIT			
BB - Unit			
Program			
Outdoor Radio Interface			
Cardridge TM4			

9.2.2. Baseband Branching Unit

ITEM	HW / FW REVISION	TERMINAL A

CHECKED BY:

NAME : _____ **SIGNED :** _____ **DATE:** ____/____/____

10. VISUAL CHECKS

10.1. Outdoor Unit / Antenna Installation

Installation completed and check list filled.

Pass	Fail
☐	☐

10.2. Indoor Unit Installation

Installation completed and check list filled.

Pass	Fail
☐	☐

10.3. IU - OU Cables

Installation completed and check list filled.

Pass	Fail
☐	☐

10.4. Transmission

Installation completed and check list filled.

Pass	Fail
☐	☐

10.5. External Alarm

Installation completed and check list filled.

Pass	Fail
☐	☐

CARRIED OUT BY:

NAME :_____**SIGNED :**_____ **DATE:**____/____/____

(Nokia Representative)

ACCEPTED BY:

NAME :_____**SIGNED :**_____ **DATE:**____/____/____

(OPTUS Representative)

11. INSTALLATION STATUS REPORT

☐ To be placed after this page

12. TRANSMISSION COMMISSIONING TEST REPORT

12.1. Checklist

Visual check for units	OK
Baseband Unit	
Outdoor Radio Interface Unit	
2 mbps cable between DMR-IU and BTS	
IU / OU cable	
Baseband branching Unit	
Baseband branching and Indoor Unit 2 mbps cable	

12.2. Parameter Settings

OPTUS Site Specific Settings available during commissioning:

YES	NO
☐	☐

OPTUS Site Specific Settings included in the following section:

YES	NO
☐	☐

			Terminal A		Terminal B	
Command TOP(.....)	**Parameter**	**Standard Settings**	**Check**	**Site Specific**	**Check**	**Site Specific**
4,1	Equipment Type					
4,1	Station ID					
4,2	Equipment Name					
6,1,1,0	ST Baud rate	9600				
6,1,2,0	TMS address	4095				
6,1,3	Rack alarms	normal				
6,1,4	Rack alarms delay	1 sec				
6,1,5	PA1 Function	A				
6,1,6	PA2 Function	B				
6,1,7	Programmable Timeout	10 mins				
6,1,8	Data Hybrid Config.	disconnect				
6,3,1	BER measurement	A+S & AIS				
6,3,2	Far End Alarm	B+S				
6,3,3	Radio Link Chain Alarm	S				
6,4,0	Alarm Inhibit 1-155	ON				
6,5,1	Calibration					
6,7,1,0	Operating Mode					
6,7,2,0	Station Type					
6,7,3	Capacity					

			Terminal A		Terminal B	
Command TOP(.....)	**Parameter**	**Standard Settings**	**Check**	**Site Specific**	**Check**	**Site Specific**
6,7,4,1	Line code	HDB3				
6,7,4,2,1	Polynom No.	1				
6,7,4,2,2	Disable scram.	NO				
6,7,4,3,0	Main Chnl 1 Interface no.	1				
6,7,4,3,0	Main Chnl 2 Interface no.	2				
6,7,4,3,0	Main Chnl 3 Interface no.	3				
6,7,4,3,0	Main Chnl 4 Interface no.	4				
6,7,5,1	Aux Data Chnl 1	1				
6,7,5,3	Aux data Chnl 3	1				
6,7,6	Programmable Inter. P1					
6,7,6,2,3	Output 3	OFF				
6,7,6,2,4	Output 4	OFF				
6,7,6,2,5	Output 5	OFF				
6,7,6,3,3	Link Chain Alarm	OFF				
6,7,6,3,4	Channel usage	OFF				
6,7,6,3,5	Channel usage	OFF				
6,7,7	Change over Switch 1-14	YES				
6,7,8,1,0	Transmit Frequency					
	Receive Frequency					
6,7,8,2	RF Power	Normal				
6,7,9,1,1	Nominal Voltage	24.....60V				
6,7,9,1,2,1	Set Lower Limit	40.....95%				
6,7,9,1,2,2	Set Upper Limit	105...150%				
6,7,9,2,1	Set Lower Alarm Limit	18.....60V				

CARRIED OUT BY:

NAME :_____ **SIGNED :**_____ **DATE** ____/____/____

(Nokia Representative)

ACCEPTED BY:

NAME :_____ **SIGNED :**_____ **DATE** ____/____/____

(OPTUS Representative)

13. EXTERNAL ALARMS

CARRIED OUT BY:

NAME :_____**SIGNED :**_____ **DATE** ____/____/____
(Nokia Representative)

ACCEPTED BY:
NAME :_____**SIGNED :**_____ **DATE** ____/____/____
(OPTUS Representative)

14. DMR COMMISSIONING TEST

14.1. Commissioning Measurements

14.1.1. Fade Margin

Threshold Level of the Receiver _____ dBm

RX input Level measured with the Service Terminal (TOP 7,2,0 RET) _____ dBm

Computed Fading Margin _____ dBm

14.1.2. Indoor Unit Measurements

Command TOP(.....)	Parameter	Standard Settings	Terminal A		Terminal B	
			Check	Site Specific	Check	Site Specific
5,4,6	Receive AIS Clock					
5,4,7	Receive Clock					
5,4,8	Transmit Clock					
7,4,4	Battery Voltage, IU	V				
7,4,1	Supply Voltage + 5V	+4.7....+5.5				
7,4,2	Supply Voltage - 5.2V	--5.7....--4.7				
7,4,3	Supply Voltage +12V	+11...+13				

14.1.3. Outdoor Unit Measurements

Auxiliary Battery voltage at AUX BATT connector _____ V

Command TOP(.....)	Parameter	Standard Settings	Terminal A		Terminal B	
			Check	Site Specific	Check	Site Specific
7,6,1	Supply Voltage +5V	+4.8...+5.3				
7,6,2	Supply Voltage --5.2V	--5.5....--4.9				
7,6,3	Supply Voltage +10V	+9.....+11				
7,6,4	Supply Voltage +35V	+33....+37				
7,6,5	Aux Battery Voltage					
7,7,1	Mwosctmp	+2....+4V or +2.5..+3.5**(2)**				
7,7,2	Mwosctunem	+2....+27V				
7,7,3	Synpwr	> 1V				
7,7,4	Txclkm	+2....+8V				
7,7,5	Rxclkm	+2....+8V				
7,7,6	Receive AGC					
7,7,7	Modemtemp	0.....+4.5V				

14.2. Test Results

☐ The Test Result Printouts from the BERT DMR Commissioning Tests are provided following this page

AND

☐ A $3^{1/2}$" Diskette (following this page) is included in the *Operations* copy of the Optus site folder. The Engineering copy of the site folder does not include a diskette.

THE DISKETTE CONTAIN A COPY OF :

☐ The BERTest DMR Commissioning Test Results (file ***.prt**) for each Terminal.

CHECKED BY:

NAME :_____ **SIGNED :**_____ **DATE** ____/____/____

(Nokia Representative)