Normarc®

NORMARC 7000

INSTRUMENT LANDING SYSTEM

Installation & Commissioning Handbook Vol. 1

NAVIA AVIATION

21465-3.0

RECORD OF CHANGES

NM 7000 series

Part no.:

21465

Change No.:	Section:	Entered by:	Rev.:
	Section 1		3.0.
	Section 2		3.0.
	Section 3		3.0.
	Section 4		3.0.
	Section 5		3.0.
	Section 6		3.0.

Change No.:	Description:

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For further information, please look up Installation & Commissioning Handbook Volume 2, containing drawings and parts lists.

SECTION 1

ANTENNA INSTALLATION PROCEDURE

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1 Civil Work Checks

Check that the civil work is carried out according to NM specifications.

- Correct positions for antenna foundation bolts.
- Correct dimensions and quality of bolts in concrete.
- Check note 4 and 5 on LLZ foundation drawing.
- Earth sticks/plates at shelter and antenna foundation.
- Shelter interior installations.
- Mains power installations in shelter and antenna assembly.
- Pulling rope in cable ducts.
- Remote control cables and terminals for RCU interface.

1.1 Unpacking

Equipment cases are carefully transported to the appropriate sites before unpacking.
Check each item toward packing list so as to detect any discrepancy before assemblies.
Parts to be installed in shelters shall be immediately brought inside.
Do not spread out loose isopore pieces

2 Localizer Antenna System Assembly

2.1 *Positioning of antenna frame work*

By means of a theodolite determine the exact position of the extended runway centre line and mark the 90 degrees angle points on each concrete slab. See Figure 2-1.

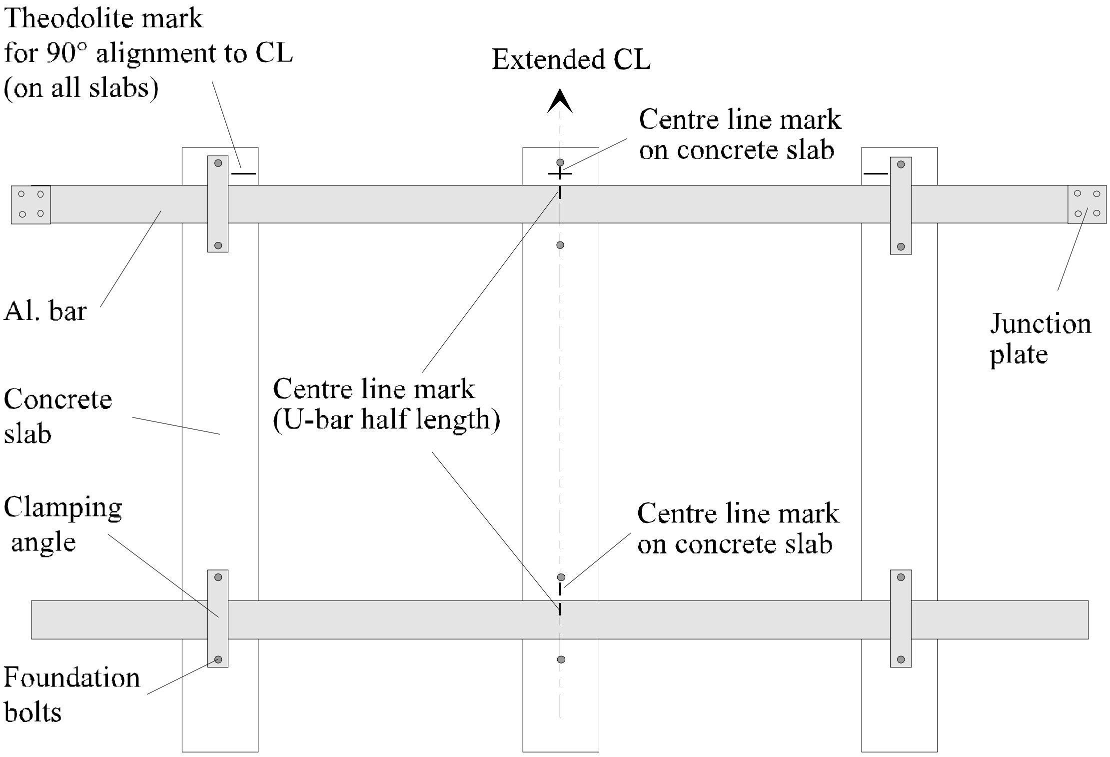

Figure 2-1 Alignment of antenna frame work.

2.2 *Framework assembly*

See Vol. 2 Section 2 Chapter 6.

See also Figure 2-1

On middle aluminium bar mark exact centre. Position the bar accurately so the marks line up with the extended centre line. Affix the two clamping angles.The remaining aluminium bars of the front part can now be assembled across the concrete fundaments. Use junction plates between each bar. On each fundament (left and right) adjust to the same distance between the theodolite mark and the aluminium bar.

The al. Bars are numbered at each end on top side. The center bar is marked 1-1 and the next bar on each side is marked 1-2. The third bar on each side is marked 2-3 and so on.

2	2 1	1 1	1 2	2 3

Figure 2-2

Check antenna spacing after assembly. Repeat for the rear bars and maintain correct spacing distance between the front and rear bars.Tighten all clamping angles.

2.3 Cable duct assembly

See Vol. 2 Section 2 Chapter 6.

The cable duct sections are numbered and should be assembled according to the drawing. Sections are joined together by means of blind rivets. When the assembly is complete drill holes through to the concrete and fix the duct by means of plastic plugs and screws.The lids should not be put on until cables are installed.

2.4 Antenna assembly

See Vol. 2 Section 2 Chapter 6.

Lay out all masts and stay on the frame work.

Place the bottom ends on al.bar and let all top ends point towards the runway. Notice that the rear masts have a slot near the bottom end.

Before erecting, all monitor and antenna cables must be installed. Check that the cable markings are close to the connector. Roll off about one meter from the outer end and form it to a straight line. Push the cable through the slot in the mast all the way to the top at the same time as you roll off more of the cable. Gently turn the roll left/right to avoid the obstacles inside the mast. Leave the rest of the roll in the cable duct.

After all cables are installed the masts can be erected. Secure masts with stays immediately after erection. Depending on antenna mast height there will be one or two long stays between front and rear rows.

Tighten all bolts at the mast bottom. Level the masts sideways and tighten the short stays. Leave the long stays loose, to make it easier to install antennas.

Install the networks. Check the drawing for antenna system in question. Don’t forget the thick alu.-washer behind the backplate (pos 9 dwg 16361 A3)

Install the antennas. The flange at the front can be tightened with all four bolts. Cables should not be connected at this stage, just secure the rear flange with one bolt.

2.5 Anntenna cables

During this operation the connectors must be protected.

Carefully roll out the cables forward, through the antenna system and towards the runway. All cables to the left of the centre should be brought to the left of respectively mast and of course opposite for the other side (see figure 2-3)

Cut appr. 0,5 m pieces of the flexible conduit, one for each antenna. Push them over the cables and into the mast, leaving just a few cm outside. Also slide the plastic bushing all the way to the mast. Pull the cables back and feed them through the hole in the cable duct. Lay the cables in a loop inside the duct, and connect them to respectively network. Be observant by pulling so the cables don’t hook on to any obstacles on the ground.

Now the cables can be connected to the antennas. Lift up the rear end 4-5 cm and put something between the flanges to keep them apart. **Be careful don't shake the mast**. Connect the cables, take away the support and tighten the flange.

Level the antenna masts backward/forward and tighten the long supports.


cables to the left
for the left side of
the antenna system
flexibel conduit
plastic bushing
HBK 1133-1
HBK 1132-1
cables to the left
for the left side of
the antenna system

Figure 2-3

2.6 Near Field monitor antenna installation

The mast shall be assembled and installed at the extended runway centre line according to dwg.no. 14256A3 Vol. 2 Section 2 Chapter 8.

The NF antenna shall be installed horizontally and point towards the centre of the LLZ antenna array.

2.7 Cable installation NF

The NF Monitor cable is first carefully rolled out and positioned such that there is no risk for damage during installation in the cable duct.

The cable is fixed to the pulling rope at the NF position end together with and extra rope for maintenance purpose.

Connectors and cable labels must be protected against dust and water wear during pulling operation.

The cable is pulled through the pipe into the shelter and installed and connected to the NF Monitor Input of the Cabinet.

The coaxial cable shall be protected with flexible conduit tube and strapped along the mast. The entrance of the cable tube shall be filled with expansion foam in order to prevent water leakage into the cable tube.

3 Glidepath antenna system assembly/towers 10m and 15m

3.1 General

See Volume 2 Section 3 Chapter 6.

The site selected for the assembly of the GP mast framework should be of sufficient size to accommodate either the 10 meter or the 15 meter mast.

It is also recommended to select a relatively well levelled site to avoid twists or bends in the mast construction which may create difficulties in joining the parts.

To facilitate the work, four trestles are needed, made of timber from the transport crates or other. See Vol. 2 Section 3 Chapter 6.

Align the trestles, one pair for the first section, parallel to each other, approximately 4 meters apart. See marked-up drawing 16641A3/16642A3.

Before the work starts, the colours of the sections should be observed as follows:

10 meter mast:	Top section:	Orange
	Bottom section:	White
Ref. drawing 16641A3.		

15 meter mast:	Top section:	Orange
	Middle section:	White
	Bottom section:	Orange
Ref. drawing 16642A3.		

Tightening and securing of bolts:

Recommended torque's are: M12 - 75NM; M24 - 700NM (ungreased bolts). Preferred tightening method is "Turn of nut" method:

1. Snug tight using 0,6 x recommended torque. (0,36 x for greased bolts)

Turn nut -	1/3 turn if C1< 2x bolt dia.
	1/2 turn if C1 is between 2 and 4x bolt dia.
	2/3 turn if C1 is between 4x and 8x bolt dia.

C1 (clearance length) = Distance between bolthead and nut. See fig. 3-1

.

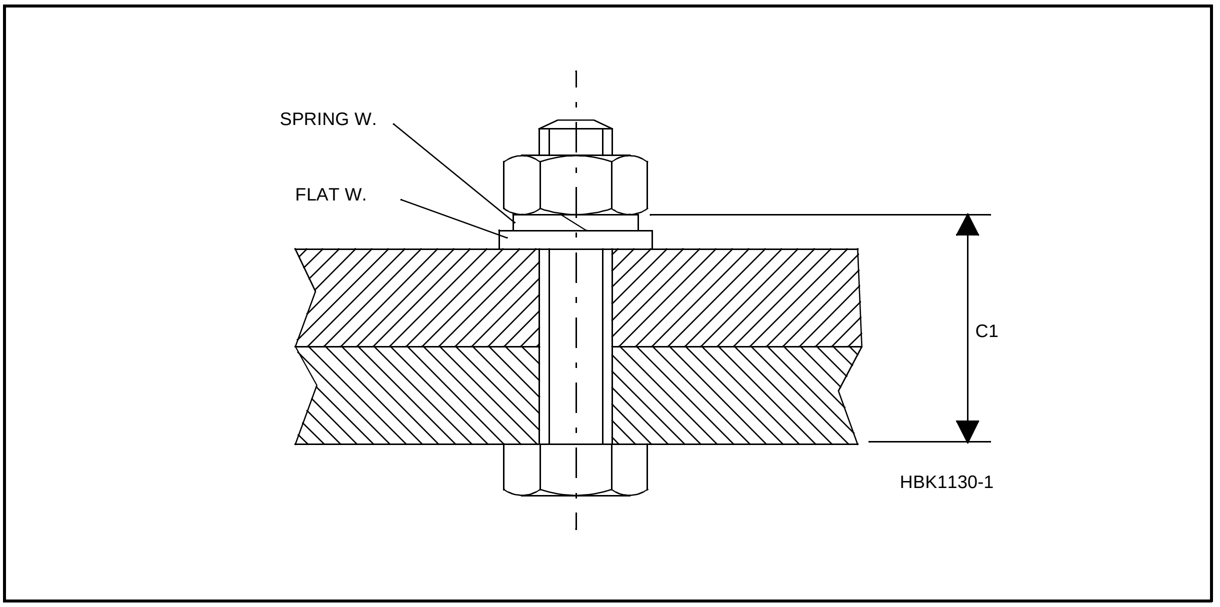

Figure 3-1

Securing: Bolts should be secured by either deformation of threads by use of a chisel or by the use of lock-nuts (double nuts). Ref. Fig. 3-2 .

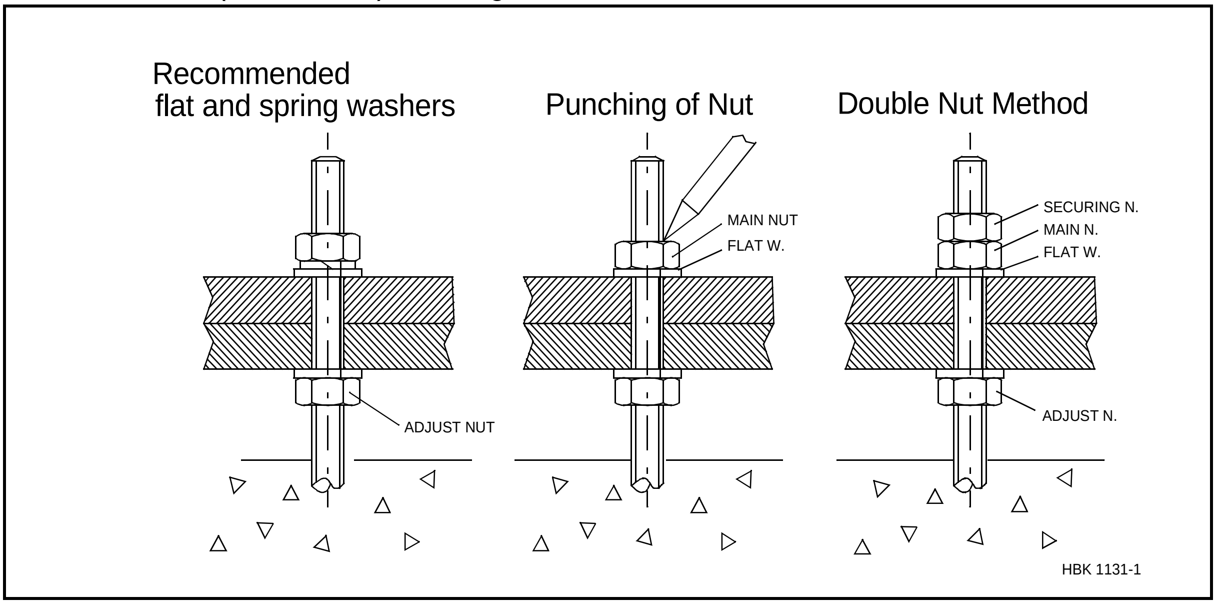

Figure 3-2

3.2 Bottom Section

3.2.1 Vertical Beams

Place two vertical main legs, pos. 1 dwg.16612A3 on the trestles.

3.2.2 Bottom Flange

Assemble vertical main legs and bottom flanges, pos. 8 DWG. 16612A3 and also junction plates pos. 9.

3.2.3 Diagonal struts

Position and bolt diagonal struts, starting with the shorter, pos. 2, and continuing with the longer pos. 3 in accordance with pos. 2, 3, and 4, DWG. 16612A3.

3.2.4 Third vertical leg

Repeat the procedure as for 3.2.2 and 3.2.3. Bolt third leg to end of diagonal struts of the other two legs.

3.2.5 Ladder

Hoist/lift the ladder pos. 20 into the centre of the section, assemble 8 PC's of brackets pos: 11 and connect them to the ladder acc. dwg. 16612A3. Lift up the ladder, and connect pos. 11 as shim between the bracing. Don't tighten up the bolts before all brackets are connected and adjusted.

3.2.6 Locking of nuts

Torque - load nuts as follows: According to general instructions Chapter 3.1 M-12: 75 Nm.

3.3 Middle section

3.3.1 Vertical legs

Repeat procedure as for 3.2.1 and onwards, (except 3.2.2 bottom flanges)

NOTE

The second (middle) section will, on a 10 m mast, be the top section.

3.4 Top section

3.4.1 General

Follow steps described under MIDDLE SECTION, except for "section joints" which in this case is pos. 10.

3.4.2 Horizontal struts

Position and bolt horizontal struts pos 5 at the top of the upper mast section. Ref. dwg. 16612A3.

3.5 Obstruction light

3.5.1 Obstruction light bracket

The obstruction light bracket (pos. 7) is fixed to two of the horizontal struts at the top, pos. 5. Dwg. 16612A3.

3.5.2 Obstruction light

The obstruction light is mounted on the bracket (pos. 7) and the power cable is fixed with cable ties to the rear side of the ladder or inside the cable trunking if space is available.

3.6 Antenna suport

3.6.1 Adjustment rails

As support for the antennas, the mast is equipped with rails for vertical adjustment, see Dwg. No.: 16643A3

3.6.2 Mounting of supports

The vertical adjustment rails are mounted in the mast structure in accordance with drawing dwg. 16643A3. The rails should be offset according to calculation made for the site in question. They should be positioned horizontally such that the centre of the rail lines up with the antenna offset given by the site data, and vertically so the centre lines up with the antenna height. See example Dwg. No.: 16641A3/16642A3.

If the offset is too wide to be adjusted with the vertical rail, position the rail as far as possible to the side and do the rest of the adjustment by sliding the antenna in the bracket pos. 2 dwg. 16792A3.

3.6.3 Antenna assembly

The antenna assembly, which comprises the radom and the antenna, is mounted to the vertical adjustment rail. See dwg. 16792A3.

If NM antennas are supplied, see dwg. 10039A3.

From site data determine the exact distance between the antennas and to the ground. Adjust the vertical antenna positions according to these data. Tolerance: +/-5 mm.

From site data determine the antenna offsets, i.e. the relative horizontal displacements between the antennas. Adjust the offsets. Tolerance: +/-5 mm.

From site data determine the antenna forward shift i.e. relative vertical displacement. Adjust the forward shift. Tolerance ± 2mm.

3.7 Cable trunks

3.7.1 Cable trunk brackets

All cable trunk brackets are prepared with 3 evenly spaced holes of 3.2 mm for cable trunk fixes.

Brackets are mounted to the ladders in accordance with dwg. 16612A3.

Cable trunks are mounted to the brackets with rivets.

3.7.2 Antenna cables

Antenna cables and monitor cables are carefully laid out in the cable trays such that equal length of all cables is sufficient to be guided into the shelter. However, the excess cables shall be neatly bundled and temporarily fixed to the antenna mast, and protected from damage during later mast erection.

Connect the cable end connectors to the antenna receptacle temporarily in order to avoid dust and water problems.

3.8 Antenna mast erection

3.8.1 Erection of the mast

A mobile crane will be needed in erecting the mast into the vertical position and placed onto the concrete foundation. Ref. dwg. 16641A3/16642A3.

The vertical position of the mast must be checked after erection. Adjustment of the mast is made by means of the lower nuts ref. dwg. 7084A3 on the retaining bolts. The tolerance is +/-0,02 degrees. (Top of mast should be within +/- 5 mm referred to vertical centreline.)

3.8.2 Locking of nuts

Torque-load nuts as follows:

M24: 700 Nm and secure them according to Chapter 3.1.

3.9 Cable installation into shelter

3.9.1 Cable tube

A cable tube is installed from the upper part of the shelter to the antenna mast, such that the tube ending in the mast is positioned a few centimetres lower than the other end in the shelter. (Prevents water from entering into the shelter).

3.9.2 Cable installation

Carefully unwind the antenna cable coils and feed the cables through the cable tube. Install the cables inside the shelter ending at the Antenna distribution unit and Monitoring combining unit. The excess cables are pulled back through the cable tube and fixed in the antenna mast.

The power cable is installed through the cable tube to the Mains Distribution box.

4 Near field monitor

4.1 Cable installation

The NF Monitor cable is first carefully rolled out and positioned such that there is no risk for damage during installation in the cable duct.

The cable is fixed to the pulling rope at the NF position end together with and extra rope for maintenance purpose.

Connectors and cable labels must be protected against dust, water and wear during the pulling operation.

The cable is pulled through the duct into the shelter and installed and connected to the NF Monitor Input of the cabinet.

4.2 NF Monitor antenna assembly

The mast and antenna is assembled complete in horizontally position according to dwg.no. 7058 A3.

The antenna element is positioned as accurate as possible according to site date for NF monitor antenna height.

Install a gasket in the top cover.

On the NF monitor cable remove the connector and thread the cable from the bottom of the mast through the gasket.

The mast is erected by three persons. Make sure that the cable at the bottom end is not bent excessively during mast erection.

The vertical position of the mast must be checked after the erection. Adjustments of the mast is made by means of the lower nuts of the base section.

The cable is installed from the top along the mast leaving adequate excess for antenna height adjustments.(Estimated adjustments: +/-60 cm.)

5 Marker beacon installation antenna assembly

5.1 Antenna assembly

See Volume 2 Section 4.

The LPDA is first mounted to the antenna mast, horizontally on the ground.

Position the assembly such that the base is close to the foundation bolts.

5.2 Antenna Cables installation

For Dual Antenna system the Distribution Network is preferably installed inside shelter.

Antenna- and monitor cables are then carefully rolled out and positioned such that there is no risk for damage during installation.

Install the cables through the hole below the end of the LPDA and out through the bottom of the mast.

Fit the cable connectors into the appropriate A and M marked N-connectors in the LPDA.

Carefully thread/pull the cables further into the shelter so there is no loop between the antenna mast base and the fundament.

5.3 Antenna Mast erection

A crane is needed to erect the antenna mast assembly.

Install the antenna in direction with the elements parallel to the runway.

During erection make sure that there will be no twist or strain to the cables near the antenna base as the mast is lowered onto the base. If necessary carefully pull the cables from the shelter end to account for the excess cable length inside the base.

SECTION 2

SHELTER INSTALLATION

Table of contents

1 General

Equipments are installed according to interior drawings. All electrical equipment including antenna systems and monitor antennas must be connected to a common earth point. See Volume 2 Chapters «Grounding» for resp. Equipment.

Cables are routed the shortest distance in the cable trunks. Use terminal shoes at the cable ends before connecting them to cabinet terminals.

Coax cables must be carefully formed along the trunking to avoid damage.

Line transient absorbers must be installed at the entrance of the remote control lines, both in the shelter and the tower.

2 Mechanical installation LLZ/GP

The «NM7000» cabinet is constructed for mounting on a wall. For easy operation, the key-board/display section should be in eye/shoulder height (140-160cm). The RF connectors may be mounted either on the cabinet top or the cabinet bottom. The free space required around the cabinet is approximately one by one meter, see figure 2-1

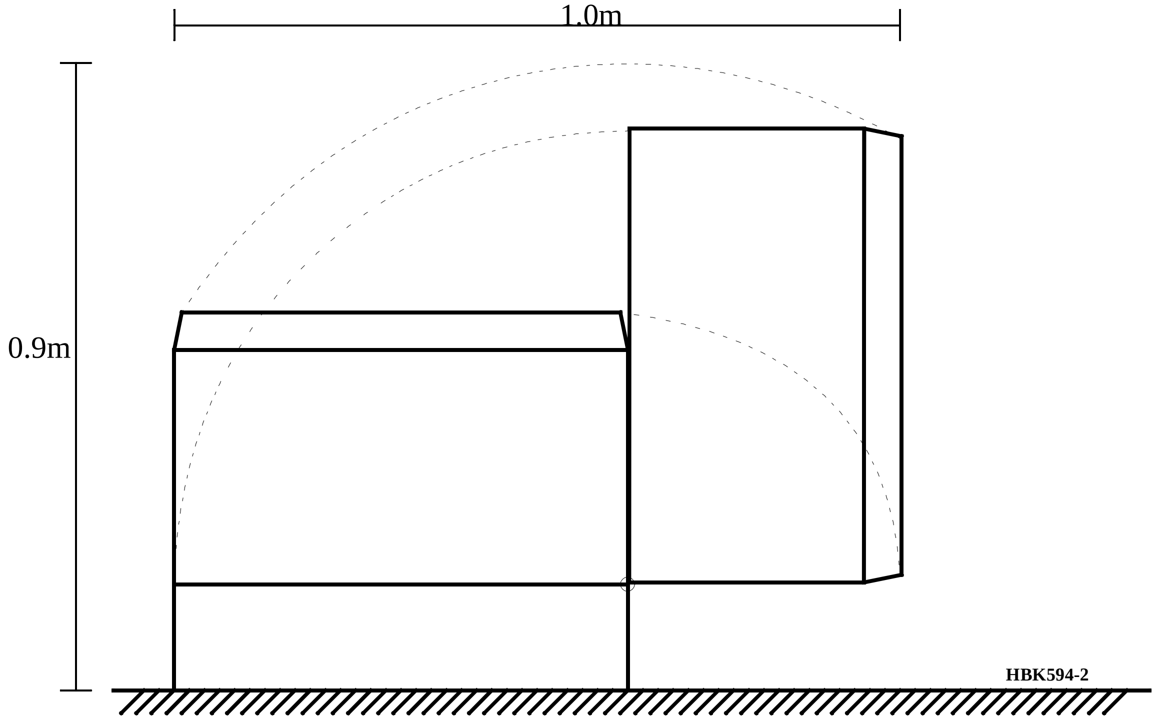

Figure 2-1 «NM7000» required mounting space (top view).

2.1 Mounting Kit MK1343A

NAVIA AVIATION supplies a wall mounting kit, MK1343A. This kit is dimensioned for standard 60 cm space between studs. For easy mounting, place the cabinet on the rest screws (B) before entering the mounting screws (A). This is shown in the enlarged view in figure 2-2.

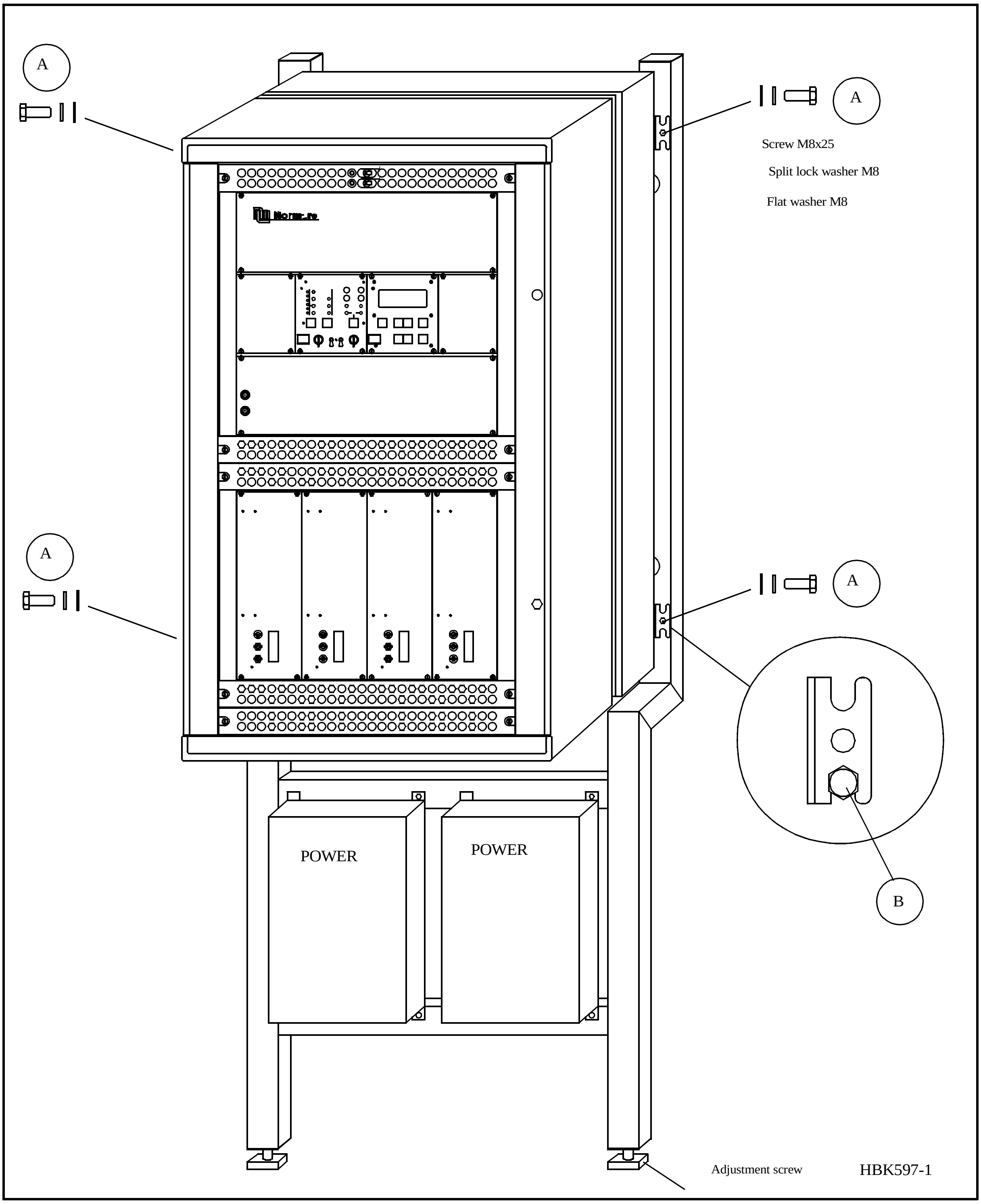

Figure 2-2 «NM7000» mounted on wall with MK1343A.

2.2 Moving RF Connectors

If desired the RF connectors may be moved from the cabinet top to the bottom or vice versa, as illustrated in figure 2-3. The back section (F) of the main cabinet consists of a connector plate and a blind plate that are interchangeable. These plates are identical, except for the connectors.

To interchange the plates, follow these instructions:

- Release the nuts (A), washers (B) and flanges (C) on the plates.
- Release the ground connections (D) on the connector plate and (H) on the blind plate.
- Interchange the plates.
- Remount the nuts, washers and flanges in the order shown.
- Remount the ground connections (D) and (H). Make shore they are located on the hinge (G) side of the cabinet.

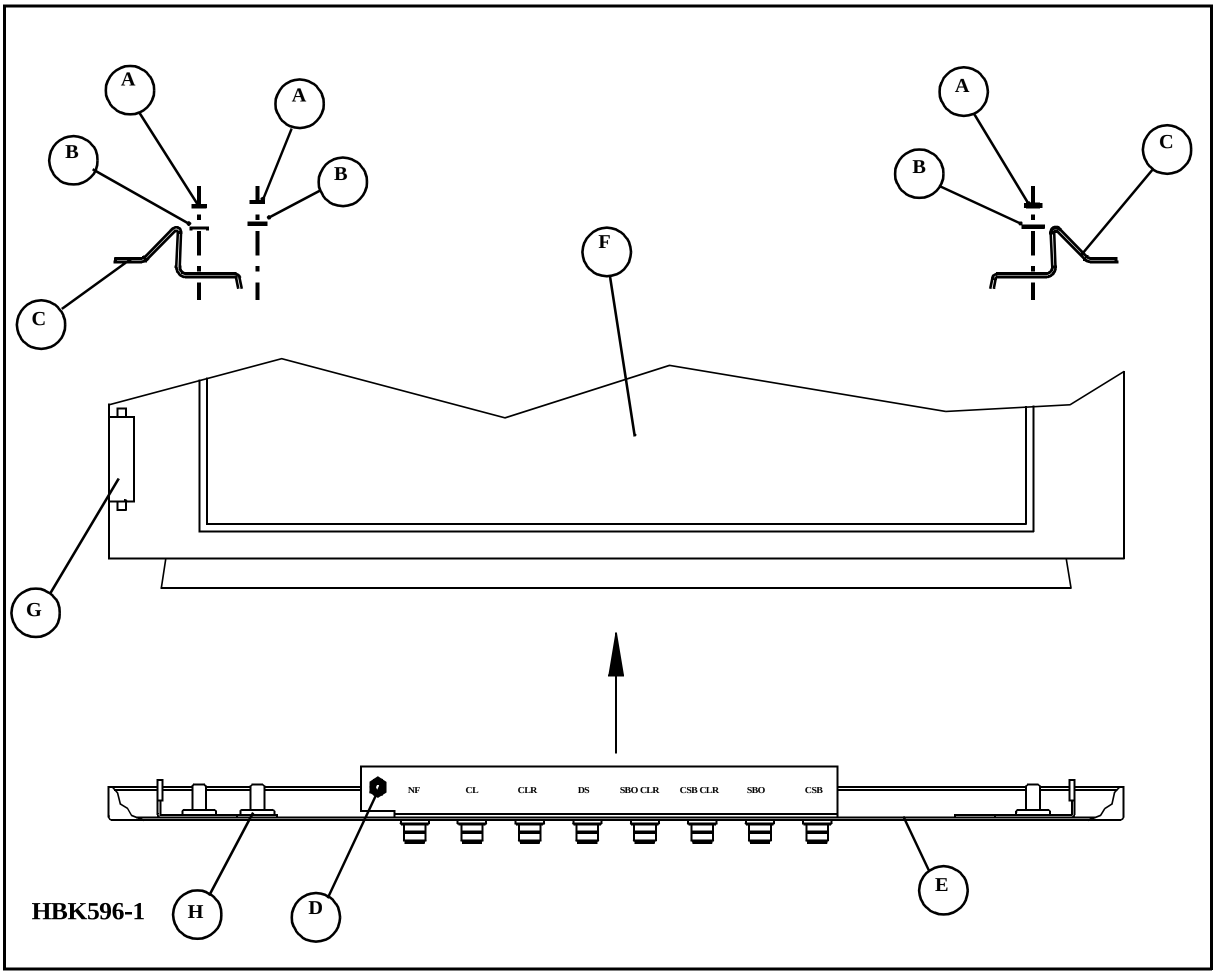

Figure 2-3 Moving the RF connectors to the cabinet top.

3 Electrical Installation LLZ/GP

This paragraph describes the external electrical connections of the «NMnr» main cabinet.

3.1 Connection Overview

The ILS main cabinet consists of three connector sites, illustrated in Figure 3-1.

- The ILS RF signals to and from the antenna system are connected at the top of the main cabinet. These connectors may be moved to the top, see *Mechanical Installation*.
- The power supply (supplies) and the backup battery are connected to the power connector rail inside the cabinet back section.
- All other external connections are sited on the CI1210A connection interface board inside the cabinet back section

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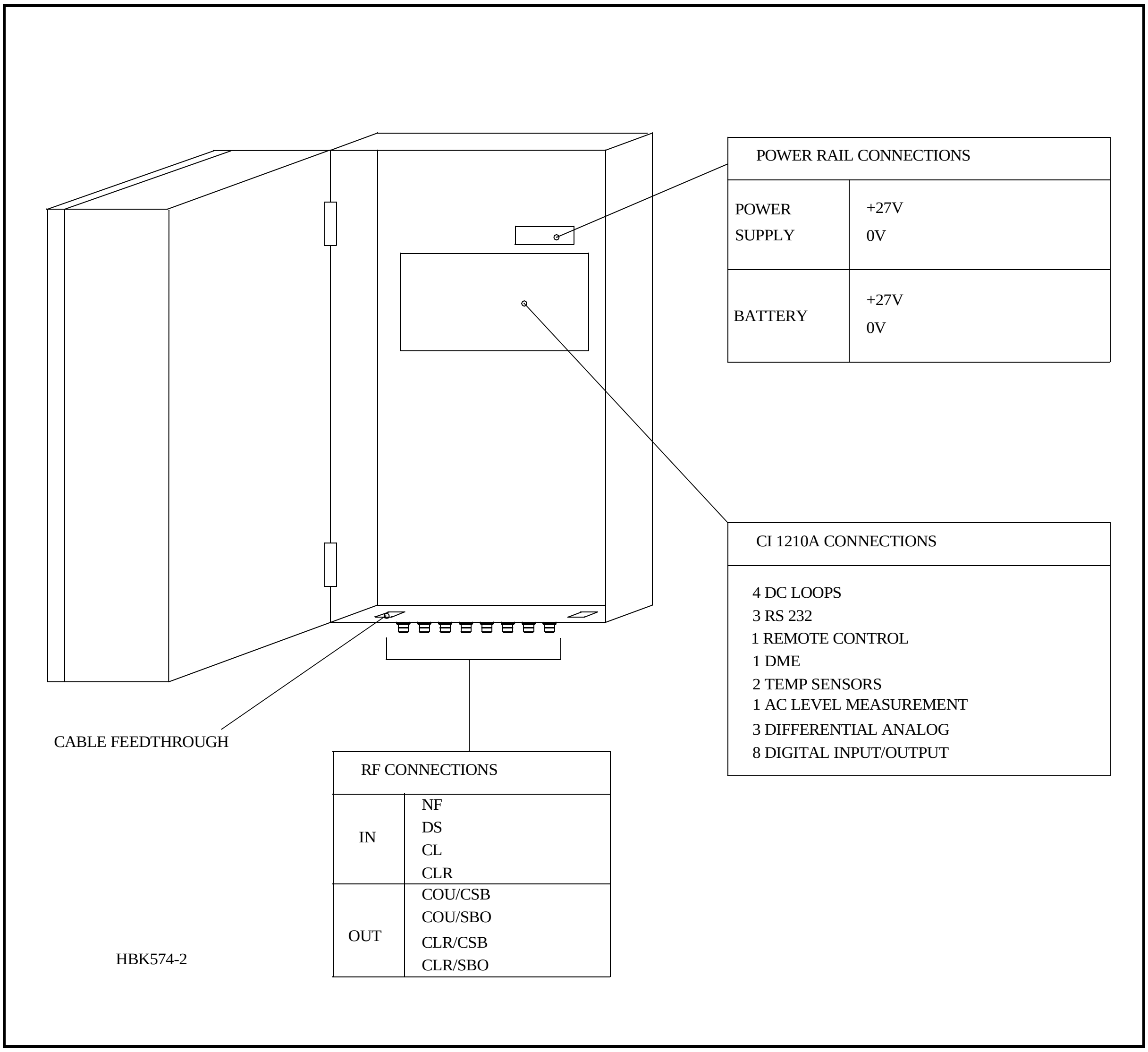

Figure 3-1 ILS main cabinet connection overview.

3.2 Power and Battery

The power supply and the backup battery are connected to the power connector rail inside the cabinet back section as shown in Figure 3-2 and 3-3. If two power supplies are used, these are parallel coupled inside one of the power supplies (see Dwg.no.: 17370A3). The cables used should have $6mm^2$ intersection.

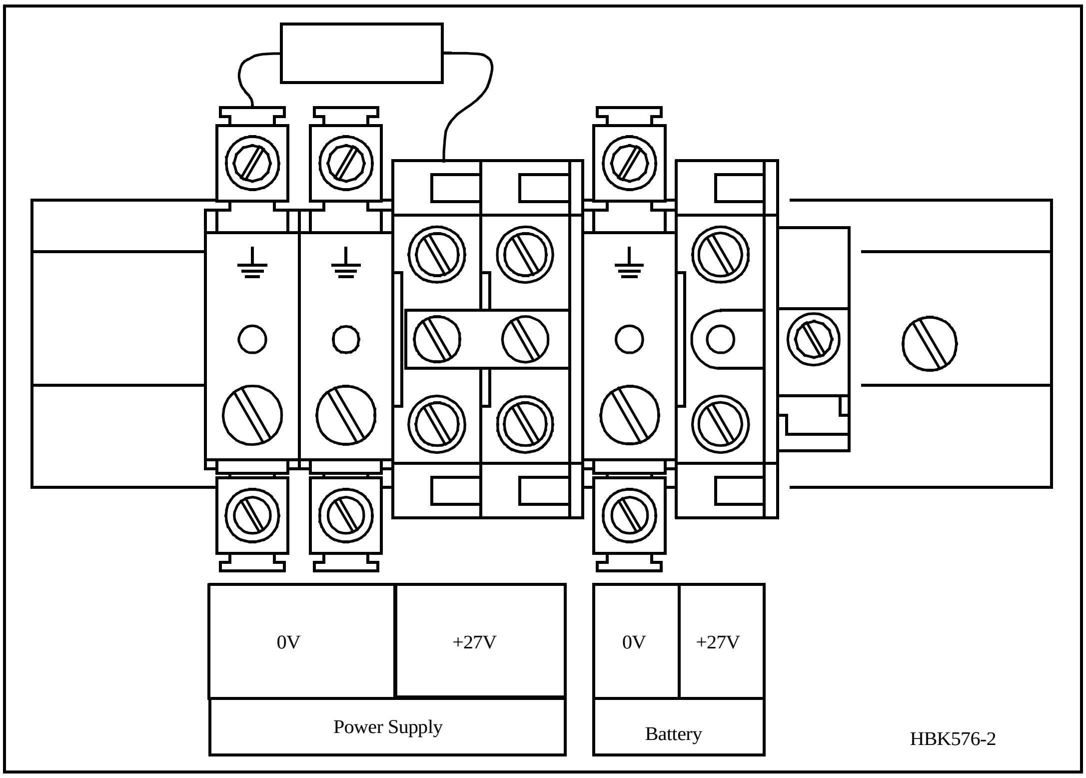

Figure 3-2 Power and backup battery connections.

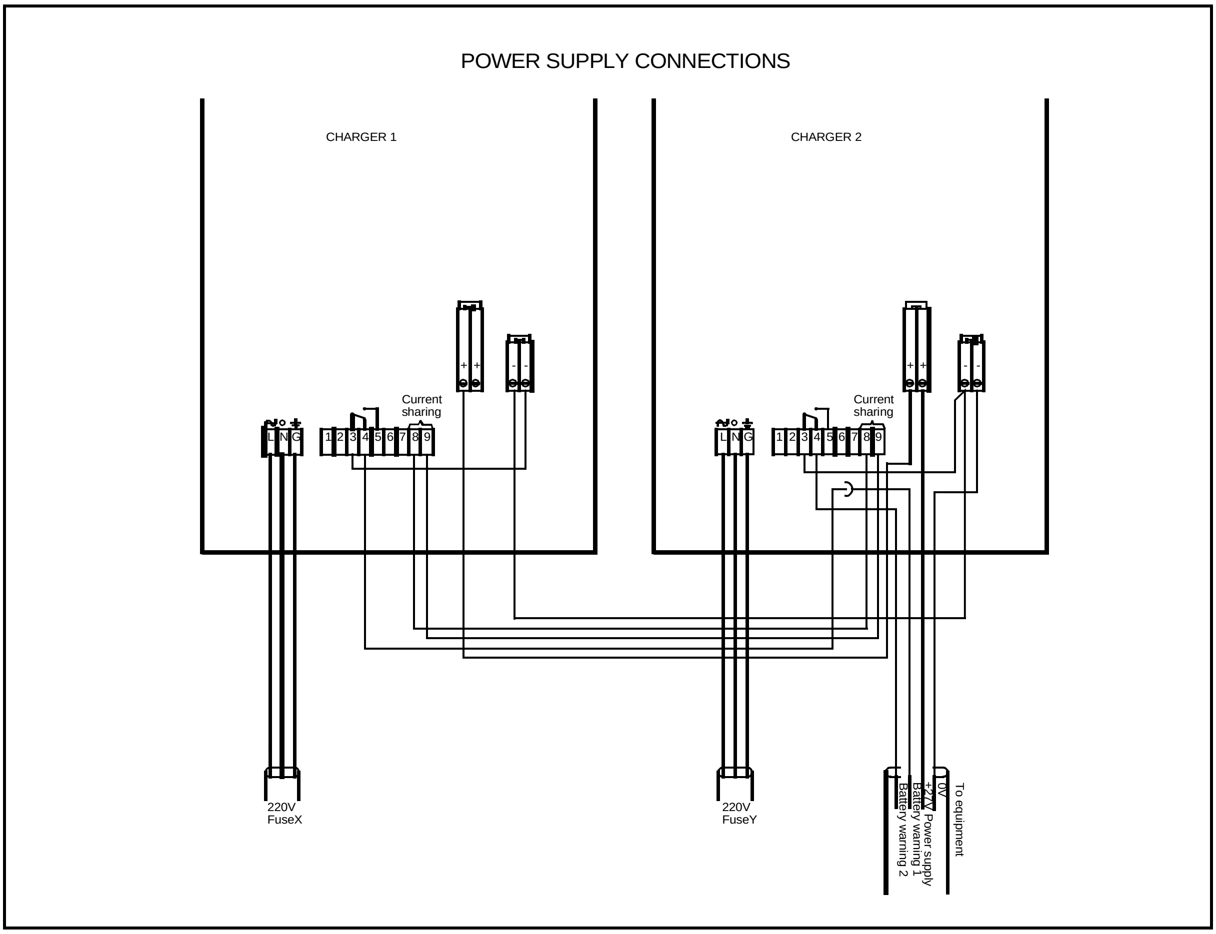

Figure 3-3 Power Supply connections.

3.3 RF Inputs

The RF inputs are:
- Course Line - CL.
- Near Field Antenna - NF.
- Displacement Sensitivity - DS.
- Clearance - CLR (two frequency applications only).

These are connected as shown in Figure 3-4 (front view)
.

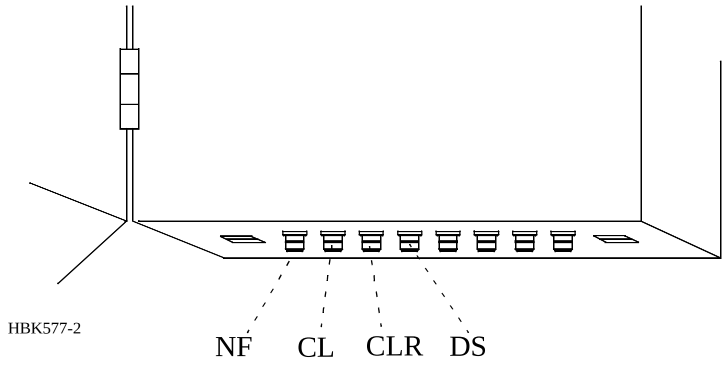

Figure 3-4 RF input connections.

3.4 RF Outputs

The RF outputs are sited at the cabinet top as illustrated in Figure 3-5. The connections are:

All applications:
- COU SBO - COUrse Tx SideBand Only.
- COU CSB - COUrse Tx Carrier and SideBand.

Two frequency applications:
- CLR SBO - CLeaRance Tx SideBand Only.
- CLR CSB - CLeaRance Tx Carrier and SideBand
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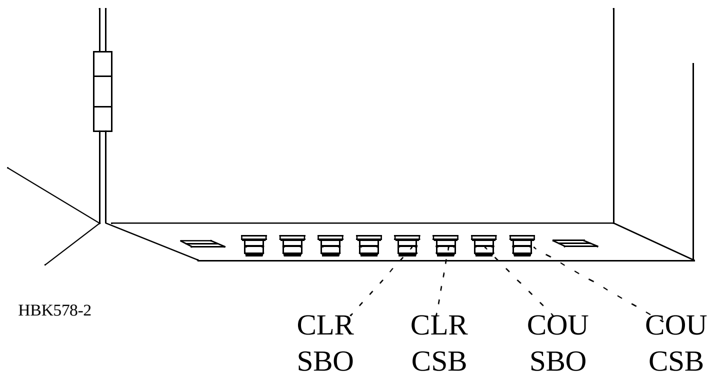

Figure 3-5 RF output connections.

3.5 DC Loop (Localizer only)

The DC loops are connected to the CI1210A connection interface board in the cabinet back section. Placement and pin out are illustrated in Figure 3-6.

- *DL_REF** are the reference voltages from the main cabinet.
- *DL_DETECT** are the return voltages from the antennas.
- *GND* is main cabinet ground.

Suitable female connectors are Weidemüller *BLZ-5.08/6* or equivalent.

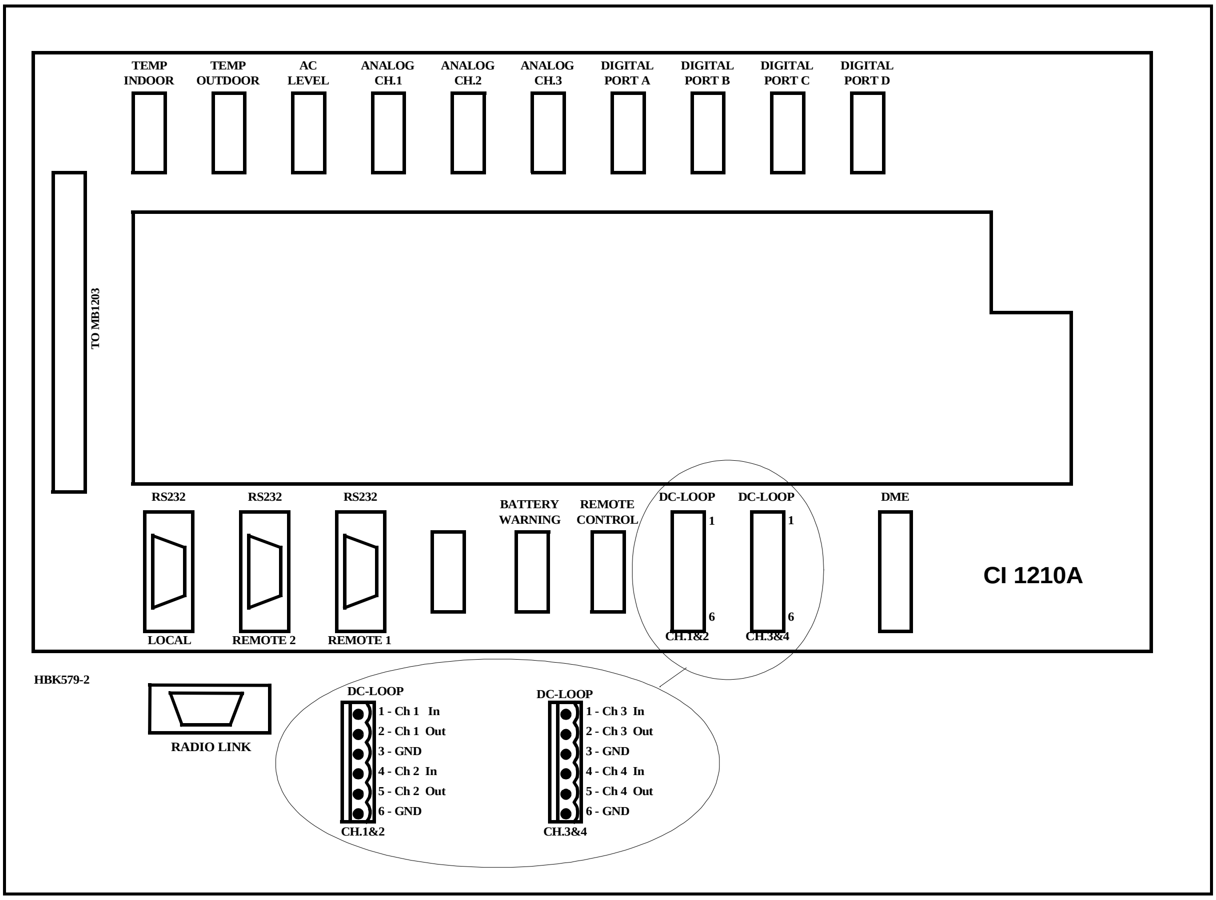

Figure 3-6 DC loop connections.

3.6 Remote Control (CABINET)

The remote control is connected to the CI1210A connection interface board as illustrated in Figure 3-7. The connection of the remote control, remote slave panel and interlock switch is done at the remote control site and covered in Section 2 6.1-6.4.

- *FSK_[P,N]* is the modem line pair.
- *GND* is main cabinet ground.

For normal FSK modem operation the straps S9-11 on CI1210A should be mounted.

A suitable female connector is Weidemüller *BLZ-5.08/4* or equivalent.

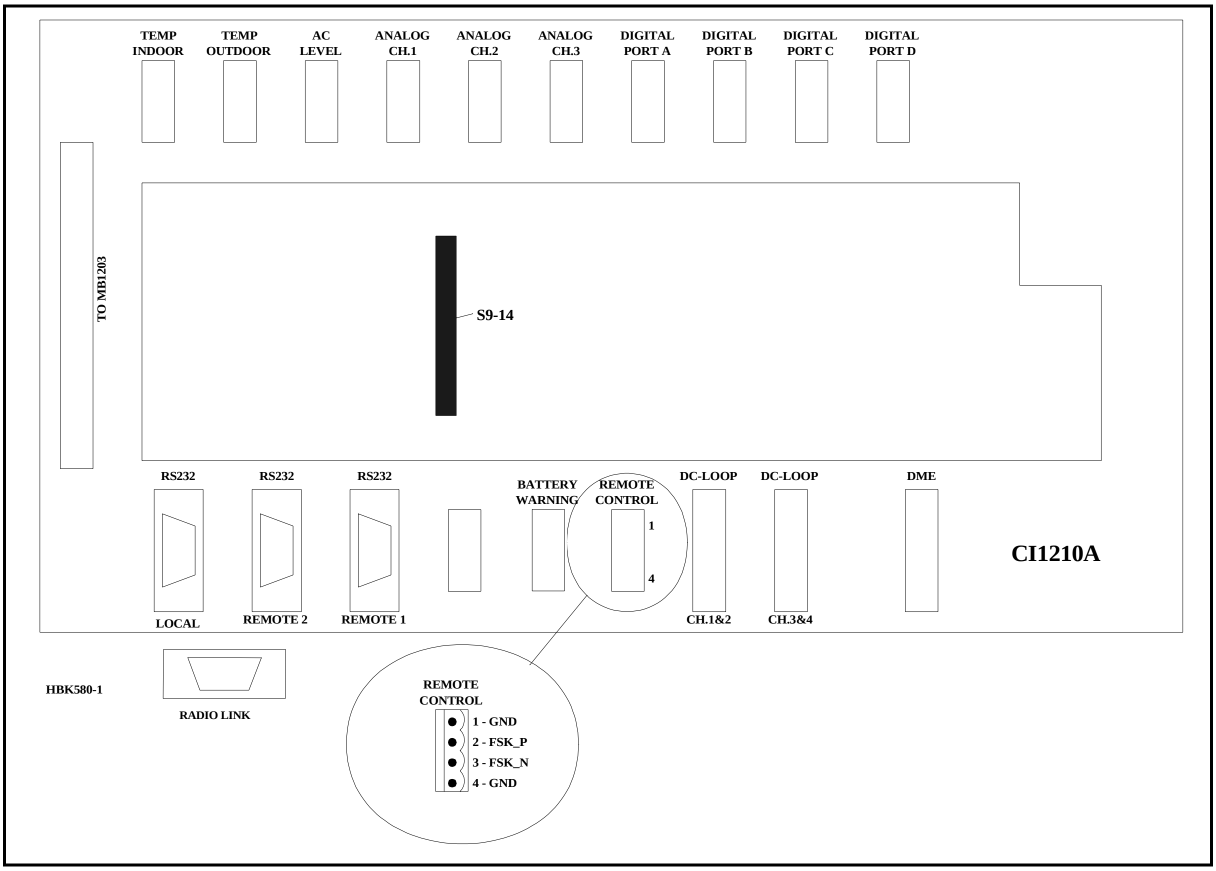

Figure 3-7 Remote control connection.

3.7 PC and Modem

PC terminals and modems are connected to the standard pin out RS232, 9 pins DSUB connectors on the CI1210A connection interface board as illustrated in Figure 3-8. Recommended connections are:

- LOCAL - the PC located at the ILS main cabinet site.
- REMOTE 2 - distant PC terminals connected through a modem.
- REMOTE 1 - the PC located at the airport technical maintainance site

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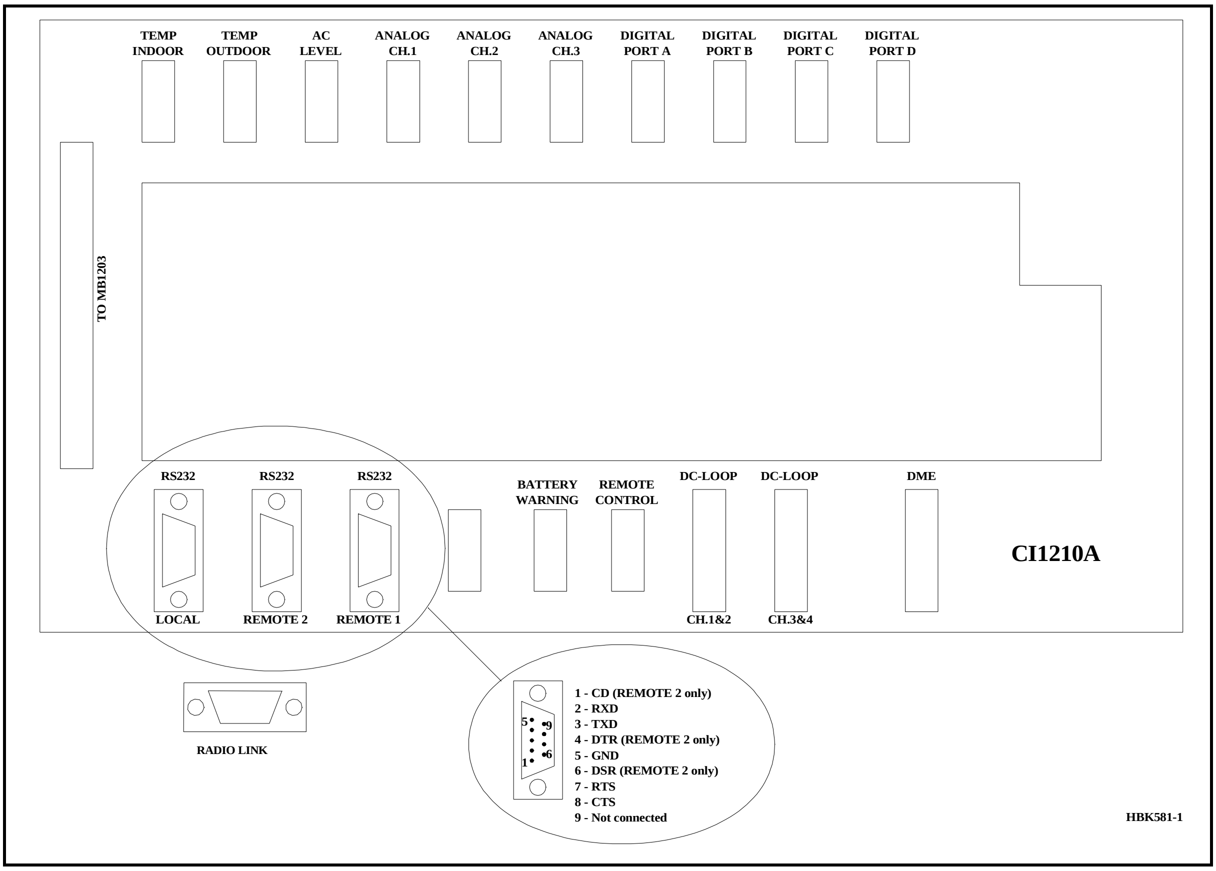

Figure 3-8 PC and modem connections.

3.8 DME (localizer only)

Distance Measurement Equipment DME is connected to the CI1210A connection interface board as illustrated in Figure 3-9.

- *ACT_DME[P,N]* is the positive and negative terminal of the DME active signal from the DME, respectively.
- *IN_DME[P,N]* is the positive and negative terminal of the morse code envelope signal from the DME, respectively.
- *OUT_DME[P,N]* is the positive and negative terminal of the morse code envelope signal to the DME, respectively.

A suitable female connector is Weidemüller *BLZ-5.08/6* or equivalent.

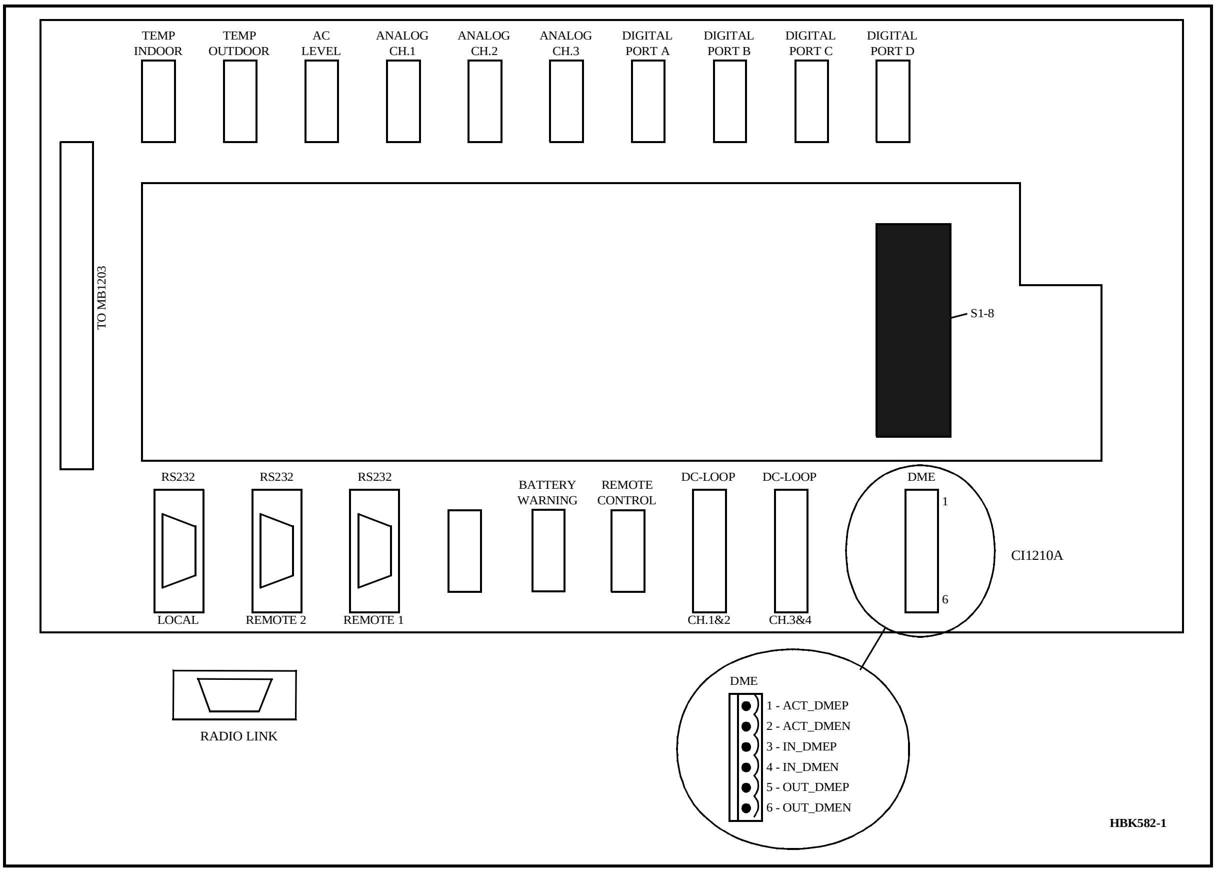

Figure 3-9 DME connections.

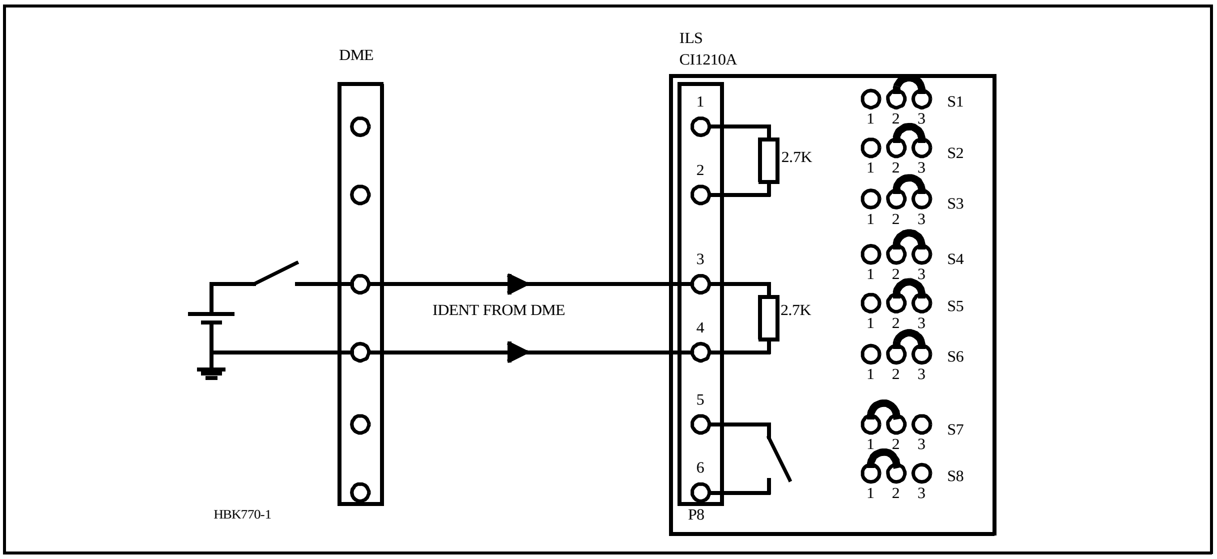

Figure 3-10 DME master connections.

If the DME shall be used as ident master, connect as shown in Figure 3-10. In the RMM program, *CLR modulation and DME interface* dialogue (see Operators Manual), set DME as master and DME active signal to OPEN. The LLZ will now transmit the DME dictated morse code. If the LLZ does not receive any ident signal for approximately 20 seconds, the LLZ will start to transmit its own programmed morse code. When the DME signal returns, the LLZ will start to transmit the DME code instantaneously

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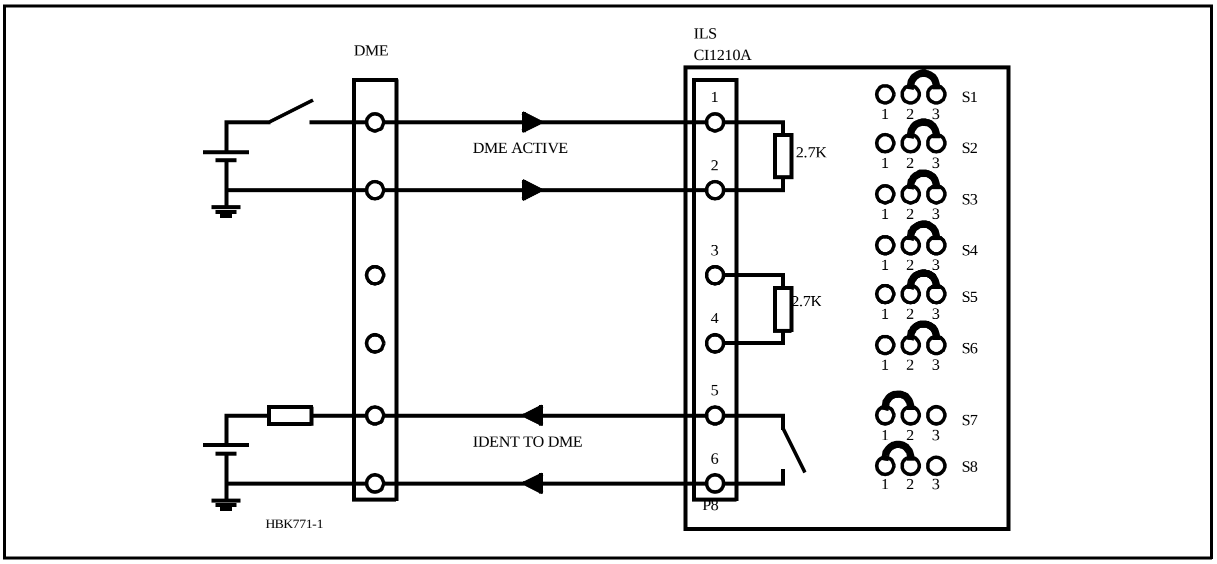

Figure 3-11 LLZ master connections.

If the LLZ shall be used as ident master, connect as shown in Figure 3-11. In the RMM program, *CLR modulation and DME interface* dialogue (see Operators Manual), set LLZ as master and the DME active signal according to the DME's manual. When the DME is active, the LLZ will send every forth ident word to the DME. When the DME is inactive the LLZ will be keying four out of four words. If the LLZ shall be keying three out of four words whether the DME is active or not, disconnect the DME ACTIVE wires and program the DME active signal to OPEN.

3.9 Analog Inputs

The analog inputs are connected to the CI1210A connection interface board as illustrated in Figure 3-12. The inputs are:

- ANALOG CH.1-3 - three differential DC analog inputs, P is the positive and N is the negative terminal.
  Maximum voltage: ±15V.
  Input impedance: 10kohms.
- TINDOOR, TOUTDOOR - temperature measurement inputs with interface to an LM35 temperature sensor.
  Maximum voltage: ±15V.
  Input impedance: 10kohms.
- AC LEVEL - AC level measurement input. Intended for use with a battery eliminator (i.e. 220/9VAC) to monitor the mains voltage.
  Maximum voltage: 24Vpp.
  Input impedance: 10kohms.

Suitable female connectors are Weidemüller *BLZ-5.08/4* or equivalent

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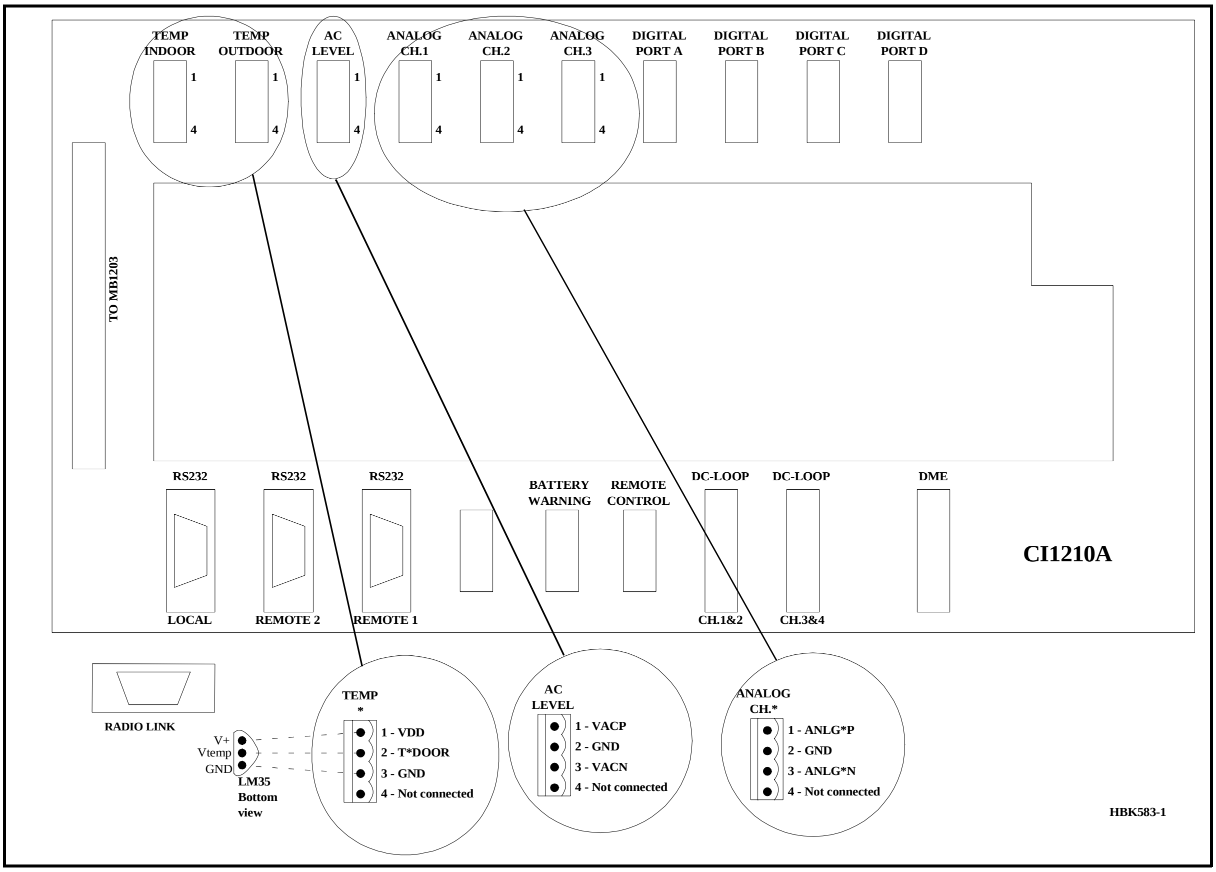

Figure 3-12 Analog input connections.

3.10 Digital Inputs and Outputs

Eight bidirectional digital channels (numbered 0-7) are sited on the CI1210A connection interface board as illustrated in Figure 3-13.

Logic levels: TTL.
Input impedance: 560ohms.

Suitable female connectors are Weidemüller *BLZ-5.08/4* or equivalent.

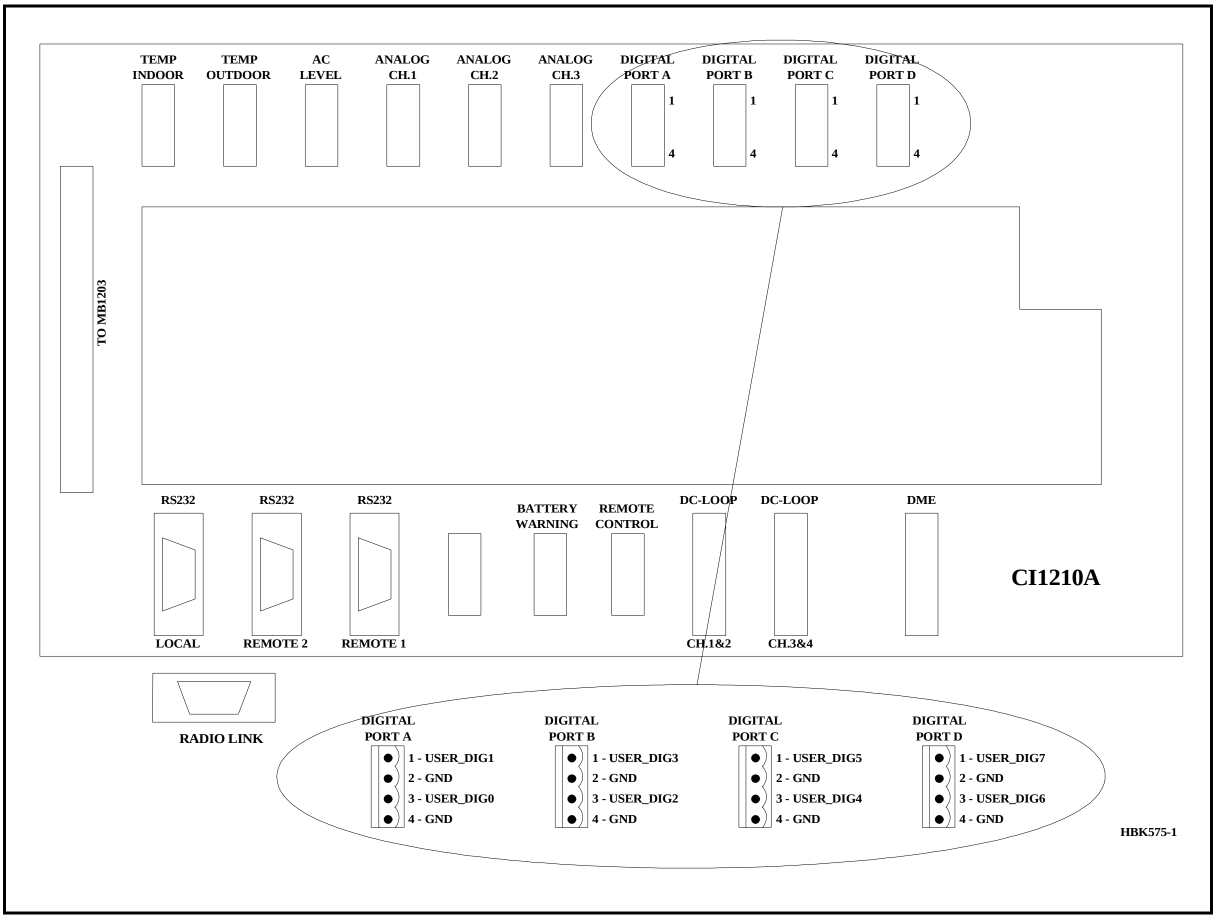

Figure 3-13 Digital input/output connections.

3.11 Battery Warning

Two inputs for main power supply failure (backup battery active) are sited on the CI 1210A connection interface board as illustrated in Figure 3-14. See also Figure 3-3.

Logic levels: Normally high (5V) (0V =battery warning).

Input impedance: 10kohms.

Suitable female connectors are Weidemüller *BLZ-5.08/4* or equivalent

.

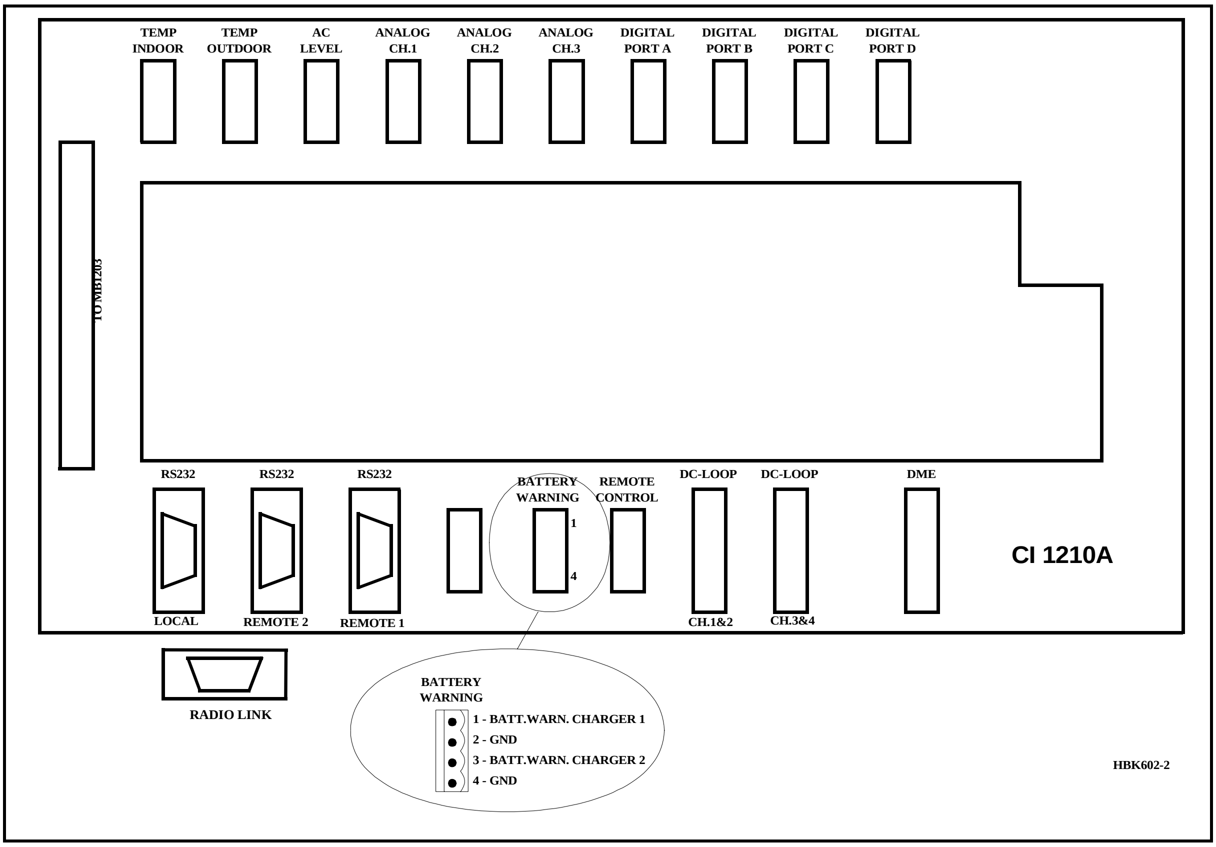

Figure 3-14 Battery warning connections.

4 Mechanical Installation Marker Beacon

This chapter gives a brief instruction on the mechanical installation of the Marker Beacon cabinet and antenna.

4.1 Marker beacon Cabinet

The NM7050 cabinet is constructed for mounting on a wall. For easy operation, the keyboard and display section should be in eye/shoulder height (140-160cm).

The ventilation holes at the bottom of the cabinet should be kept uncovered to ensure proper cooling.

The cabinet is 45 cm wide, 34 cm deep and 27 cm height and weighs about 5 kg.

When mounting the cabinet on a wall, do the following:

- First drill the holes according to Figure 4-1.
- Mount the upper screws. Leave 6 mm distance from the screw head to the wall.
- Hang the cabinet on these screws, using the key holes on the mounting rails
- Mount the lower screws
- Tighten all screws
-

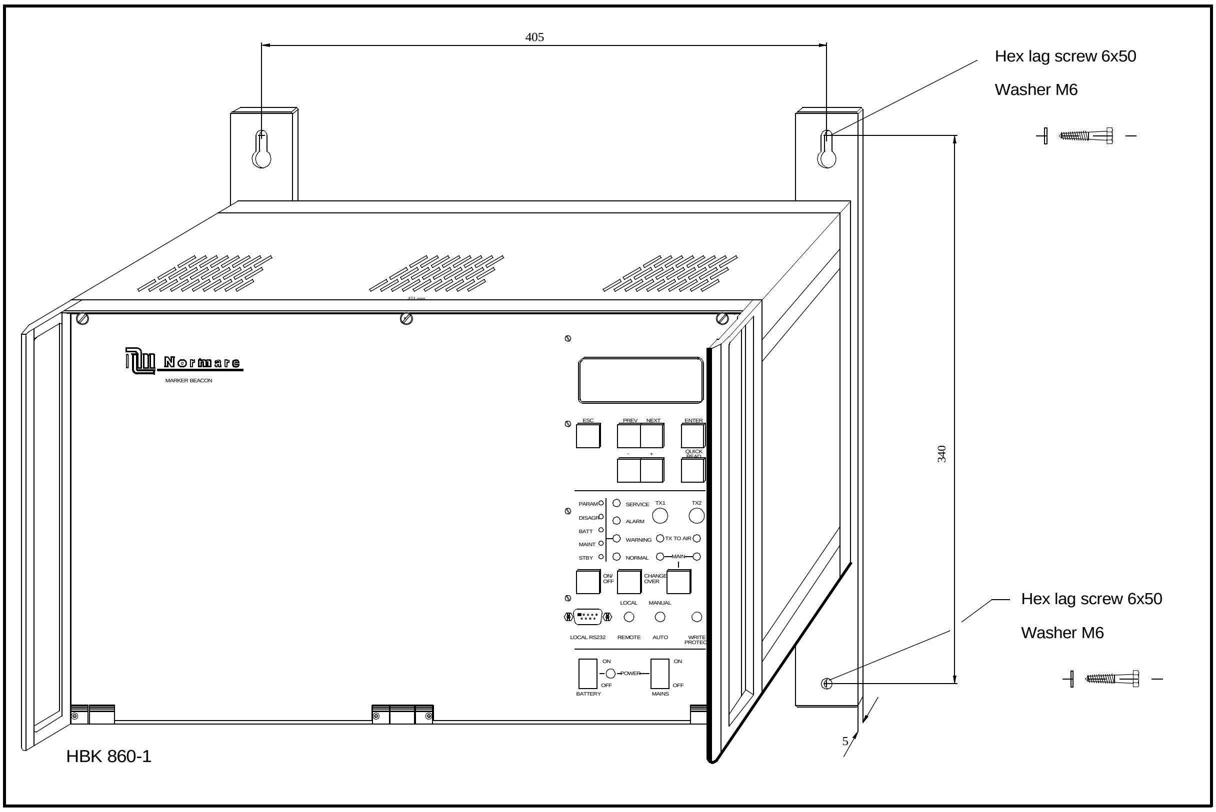

Figure 4-1 Mounting the cabinet on a wall.

5 Electrical installation marker beacon

5.1 Marker beacon cabinet

5.1.1 Connection Overview

All electrical connections except the local PC connection, the mains connection and the RF IN and OUT connections are on the CI1376 connection interface board inside the cabinet.

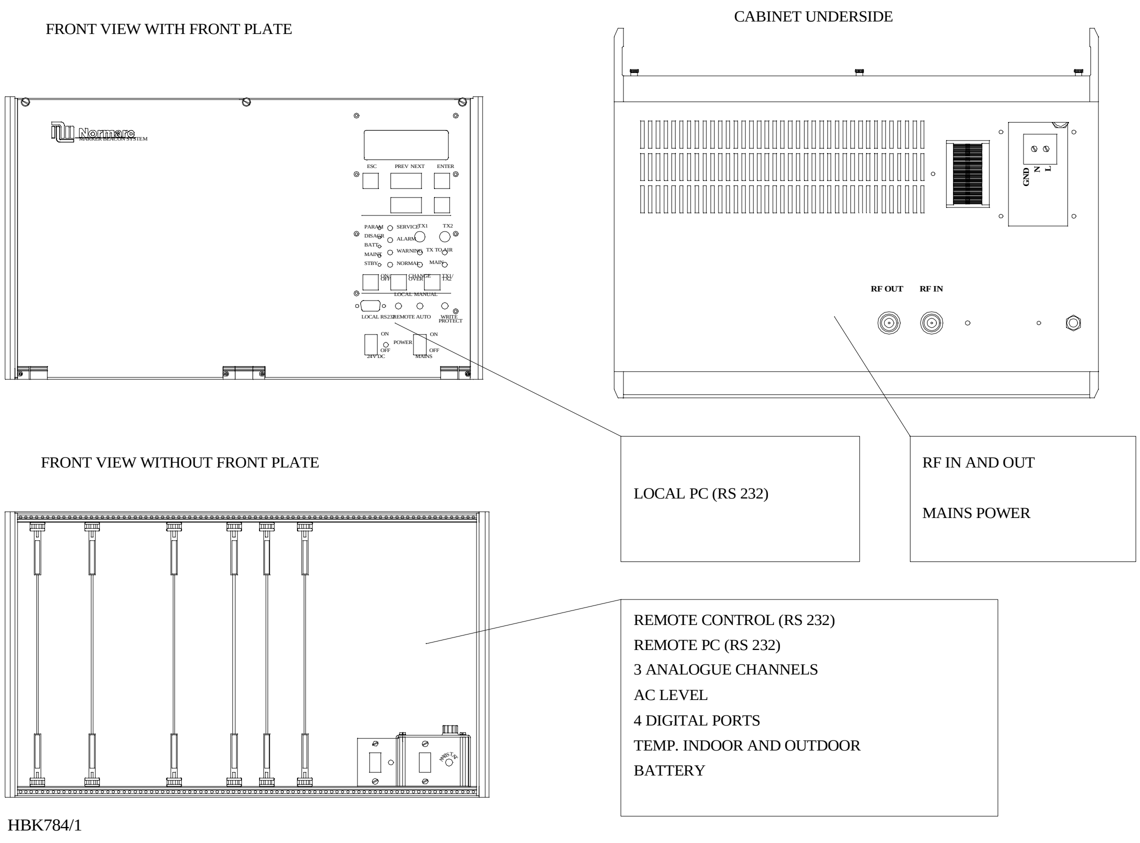

Figure 5-1 Marker Beacon main cabinet connection overview

5.2 RF In and Out

- The output signal RF OUT is connected to the antenna with N-connectors and 50 Ω coaxial cable.
- The input signal RF IN is connected to the antenna probe with N-connectors and 50 Ω coaxial cable

.

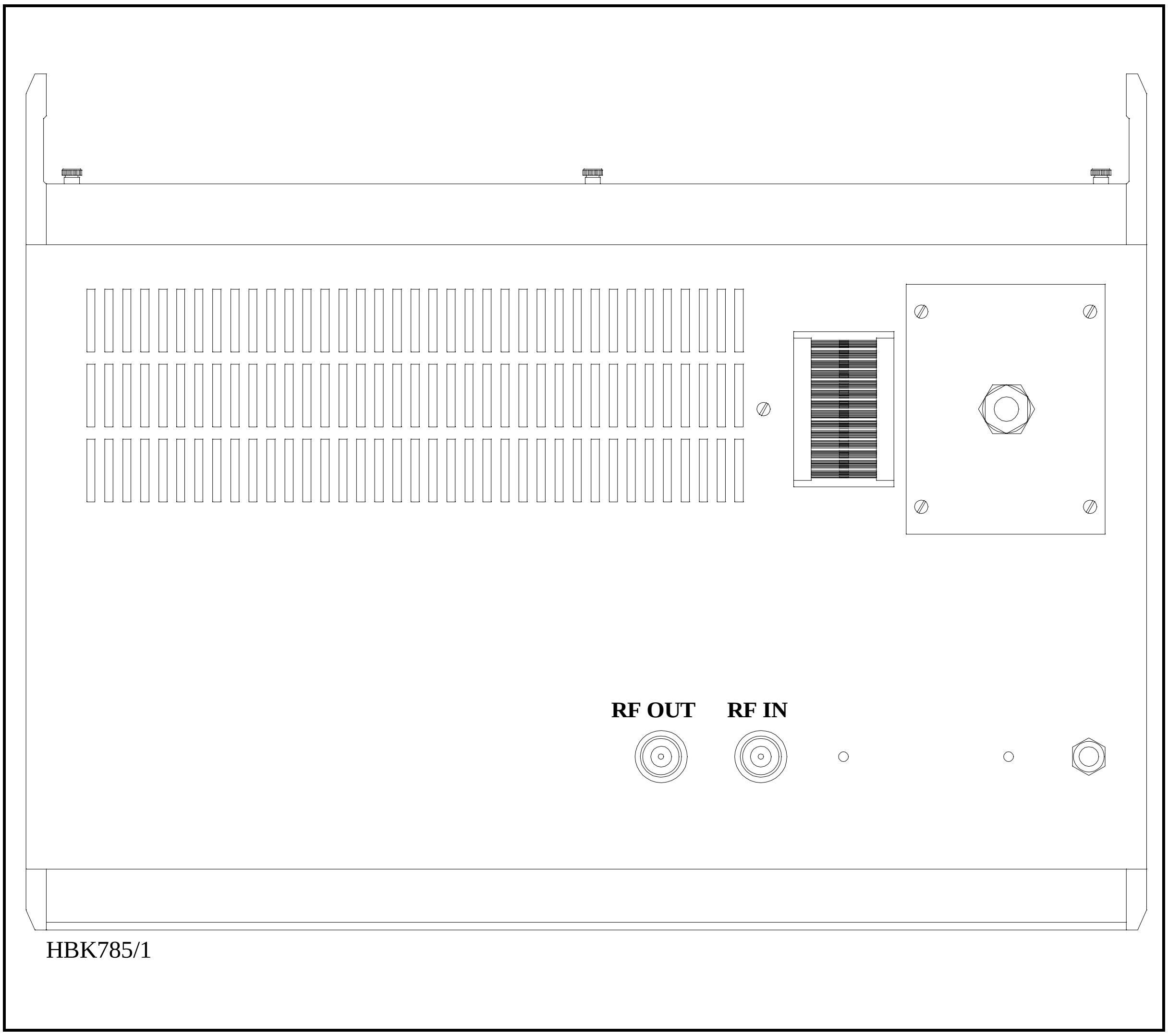

Figure 5-2 RF cable connection

5.3 Battery

The external backup battery is connected between **Batt Gnd** (-) and **Batt +24V** (+) on the connector marked **Battery** on **CI 1376**.

A 16Ah battery gives approximately six hours backup time with 5-8 hours charging time dependent on model. For longer backup time an external charger is required to be able to charge the battery within a reasonable time. An external battery protection circuit (like Normarcs **BP 543**) has to be connected between the **Ext. Charger** (+) and **BATT GND** (-) input. In addition **Mains** directly on **NM 7050** has to be disconnected. Figure 5-4 shows the connections schematically.

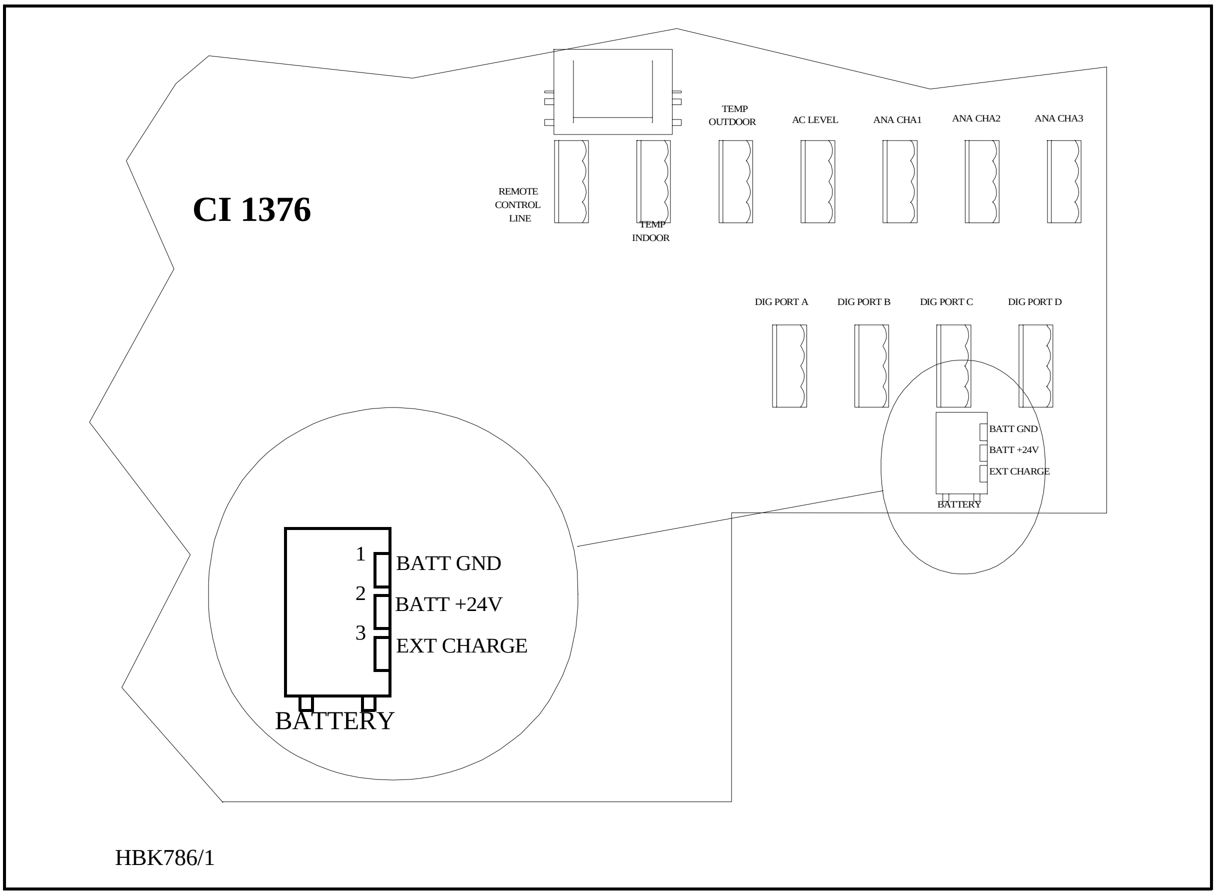

Figure 5-3 Battery connection

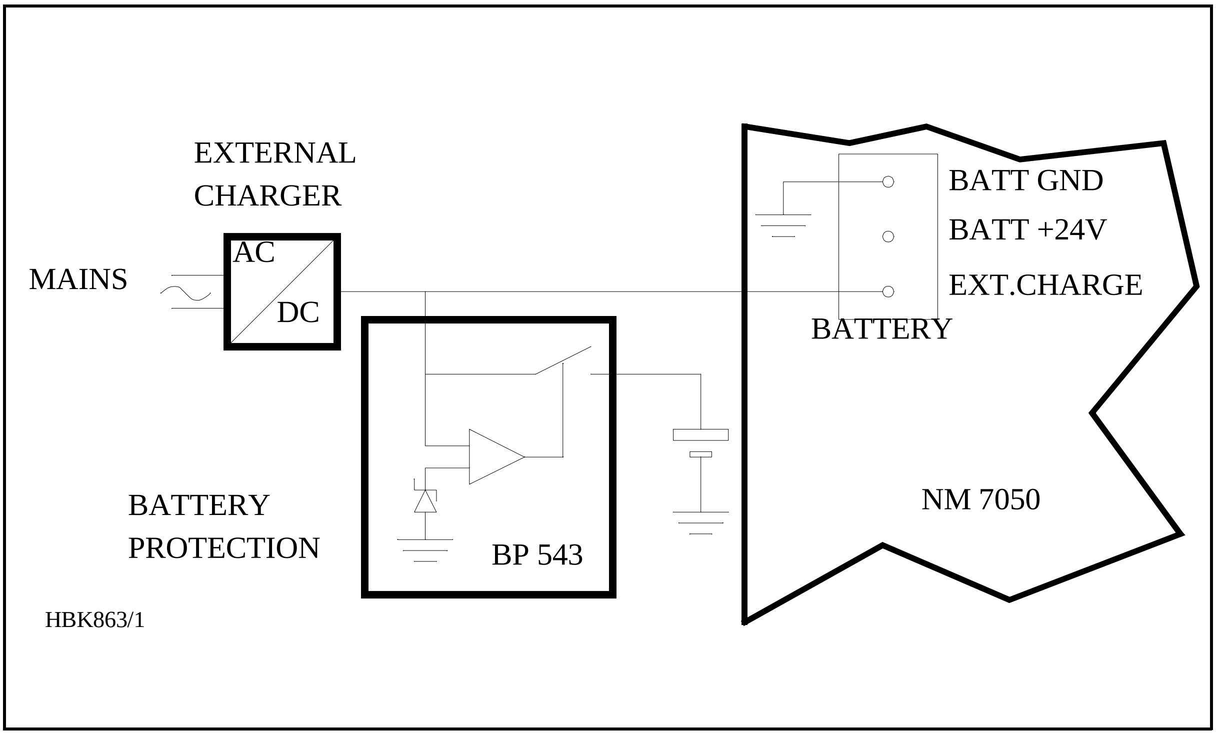

Figure 5-4 External charger connection

5.4 Mains

The mains power cable connections are underneath the cabinet. They are covered by a aluminium plate fastened with four screws. The cable itself is threaded through the cable gland and the three wires are connected to the terminals N, L and GND shown below in Figure 5-5.

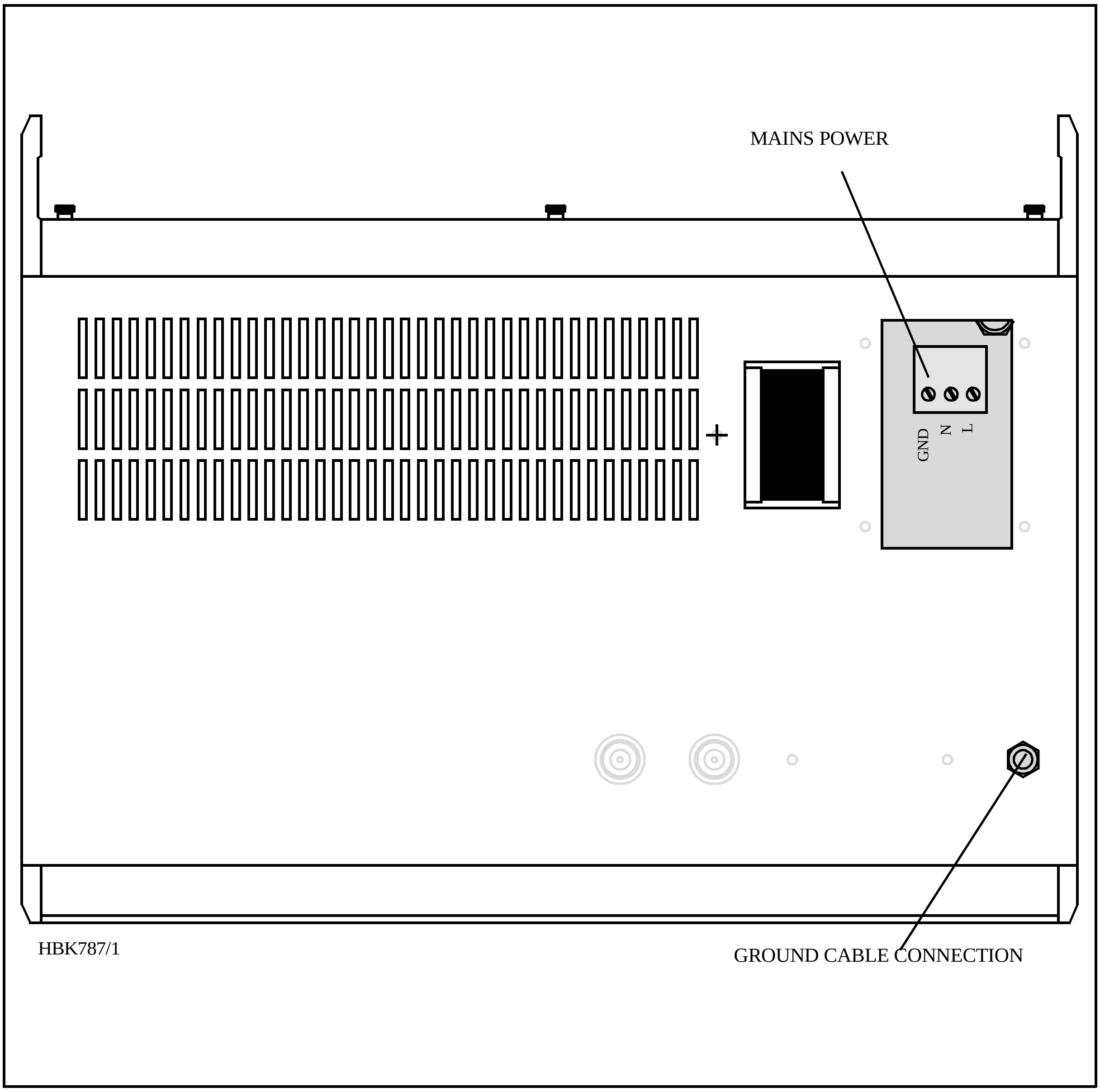

Figure 5-5 Power connection

5.5 Remote Control cabinet

The remote line and remote controis connected to the CI 1376 connection interface board as illustrated in Figure 5-6.

- FSK_[A,B] is the modem line pair.
- GND is main cabinet ground

A suitable female connector for the remote line is Weidemüller *BLZ-5.08/4* or equivalent. Alternatively the remote control connection is done with a RS 232 interface, standard pin out 9 pins DSUB.

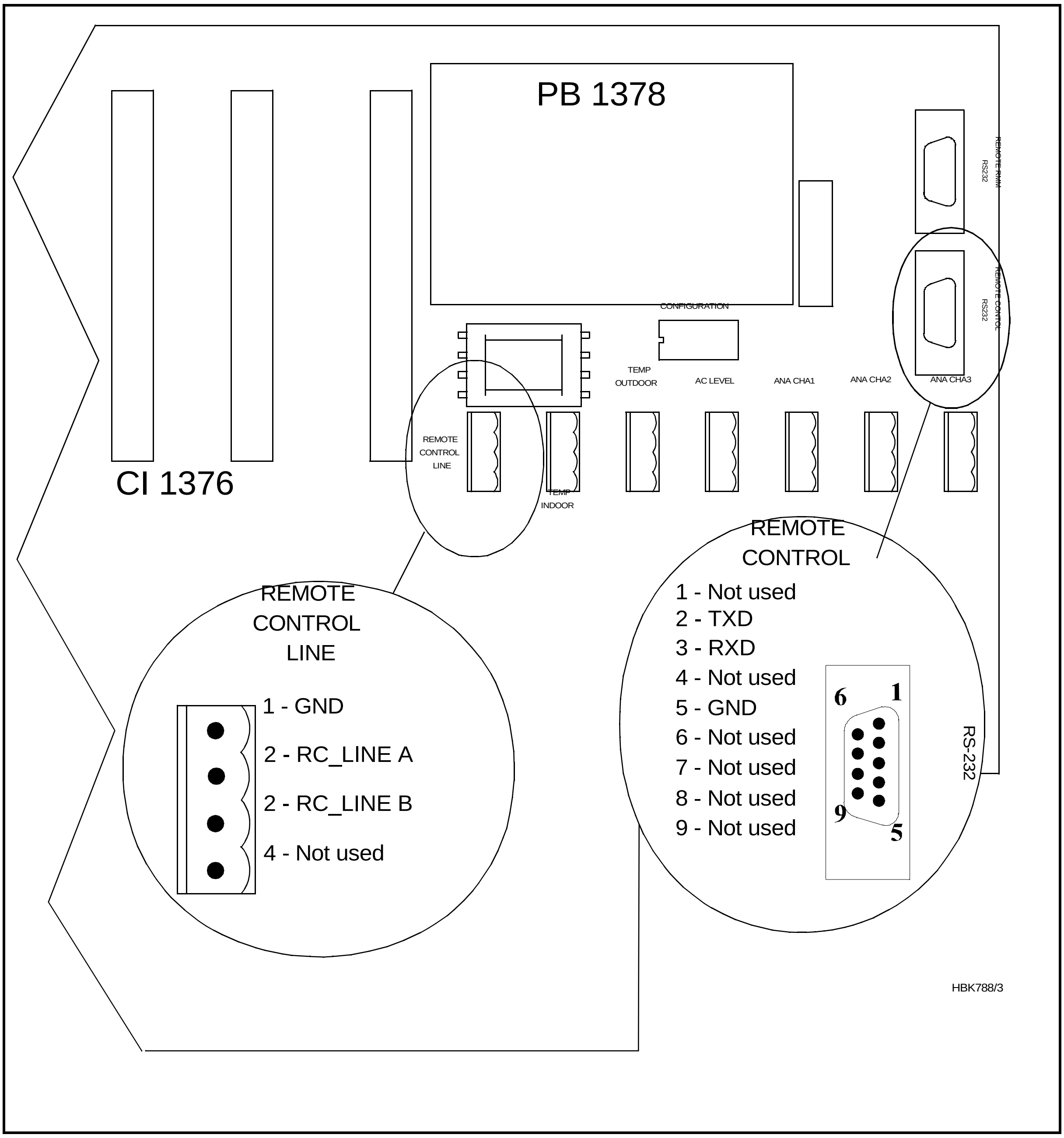

Figure 5-6 Remote control connection

5.6 PC and Modem

Modem connections for remote PC are the standard pin out RS232, 9 pins DSUB connector on the CI1376 connection interface board marked remote-rmm as illustrated in Figure 5-7.

For local PC connection use the RS232 on front panel Figure 5-7

.

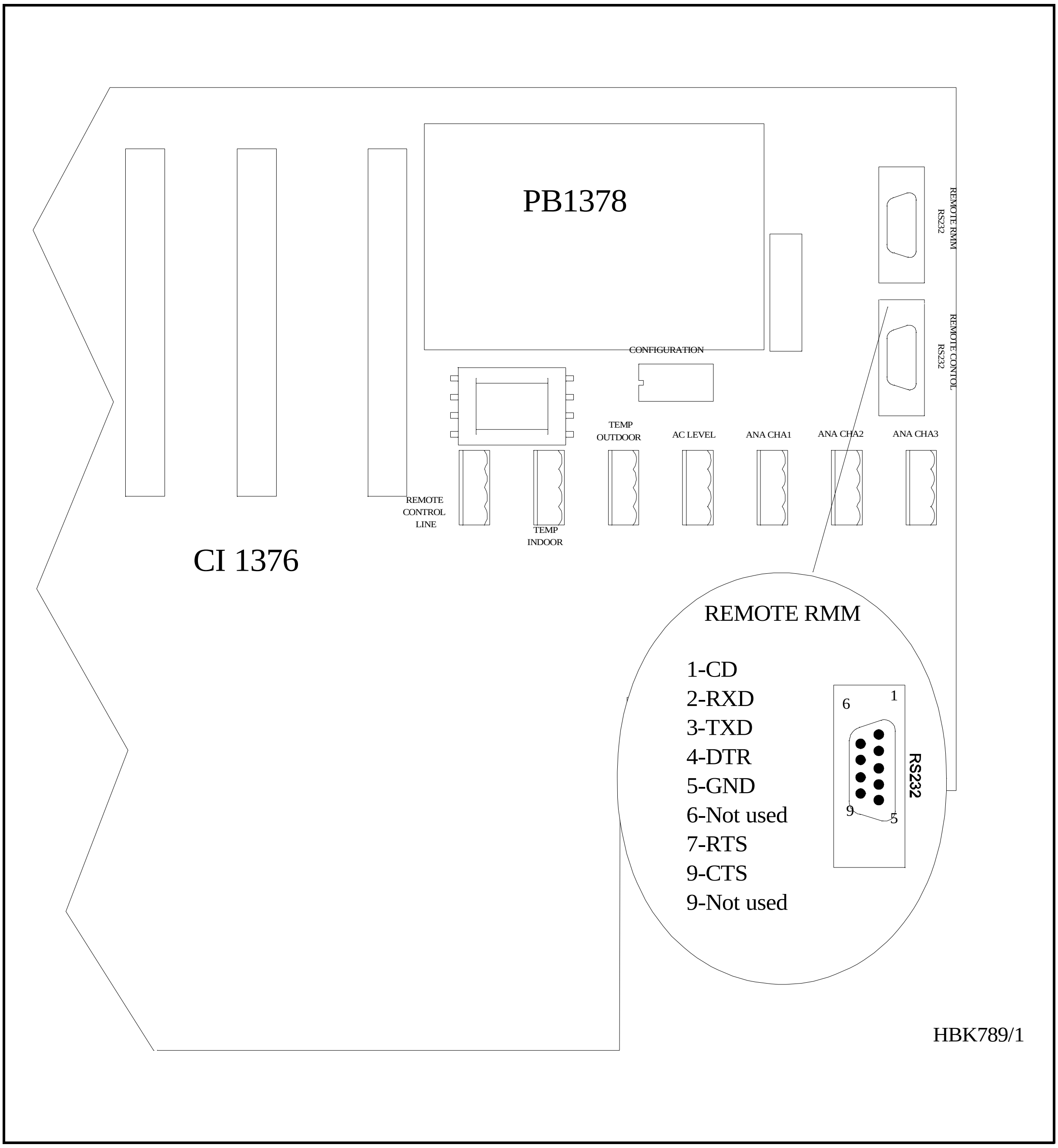

Figure 5-7 Modem and modem battery backup connection

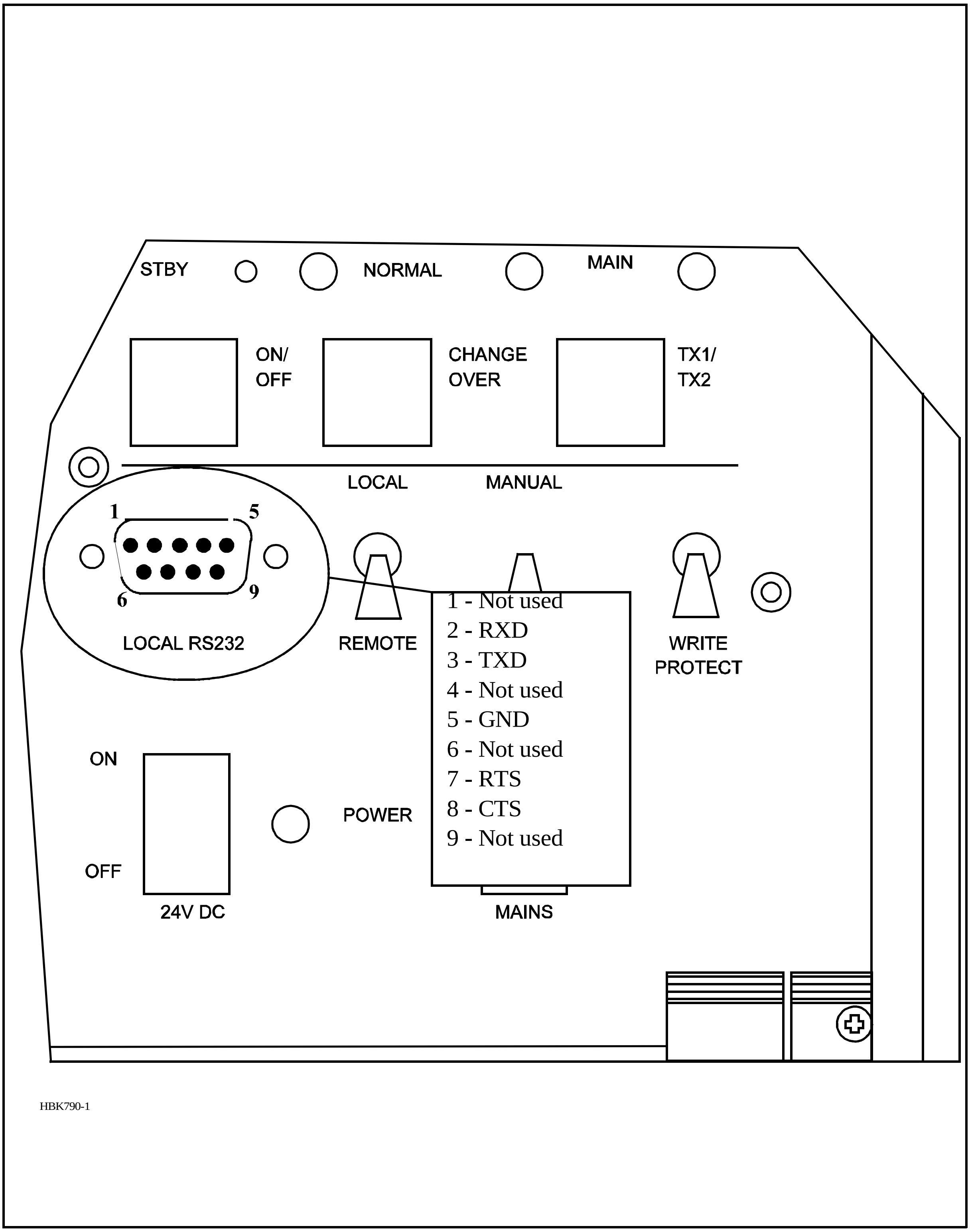

Figure 5-8 Local PC RS232 connection

5.7 Analogue Inputs

The analogue inputs are connected to the CI1376 connection interface board as illustrated in Figure 5-9.

The inputs are:

- Analogue Channel 1-3 - three differential DC analogue inputs, P (pin-1) is the positive and N (pin-3) is the negative terminal, and pin 2 is GND.
  Maximum voltage: ±15V
  Input impedance: 10kΩ
- Temp Indoor and Outdoor - temperature measurement inputs with interface to an LM35 temperature sensor.
  Maximum voltage: ±15V
  Input impedance: 10kΩ
- AC Level - AC level measurement input. Intended for use with a battery eliminator to monitor the mains voltage.
  Maximum voltage: 24Vpp
  Input impedance: 10 kΩ

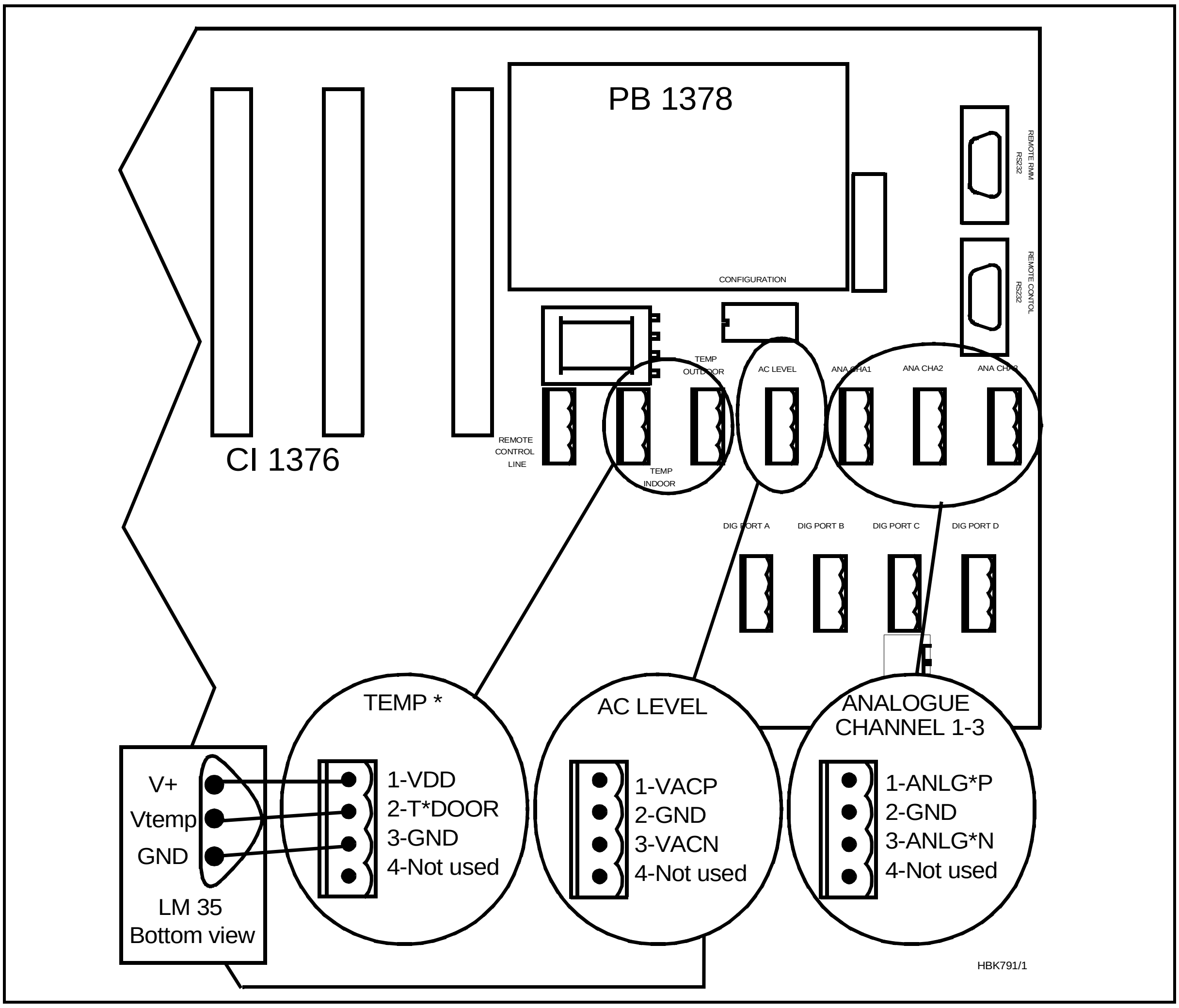

Figure 5-9 Analogue input connections

5.8 Digital Inputs and Outputs

Eight bi-directional digital channels (numbered 0-7) are sited on the CI1376 connection interface board as illustrated in Figure 5-10.

Logical levels: TTL

Input impedance: 560Ω.

A suitable female connector is Weidemüller *BLZ-5.08/4* or equivalent

.

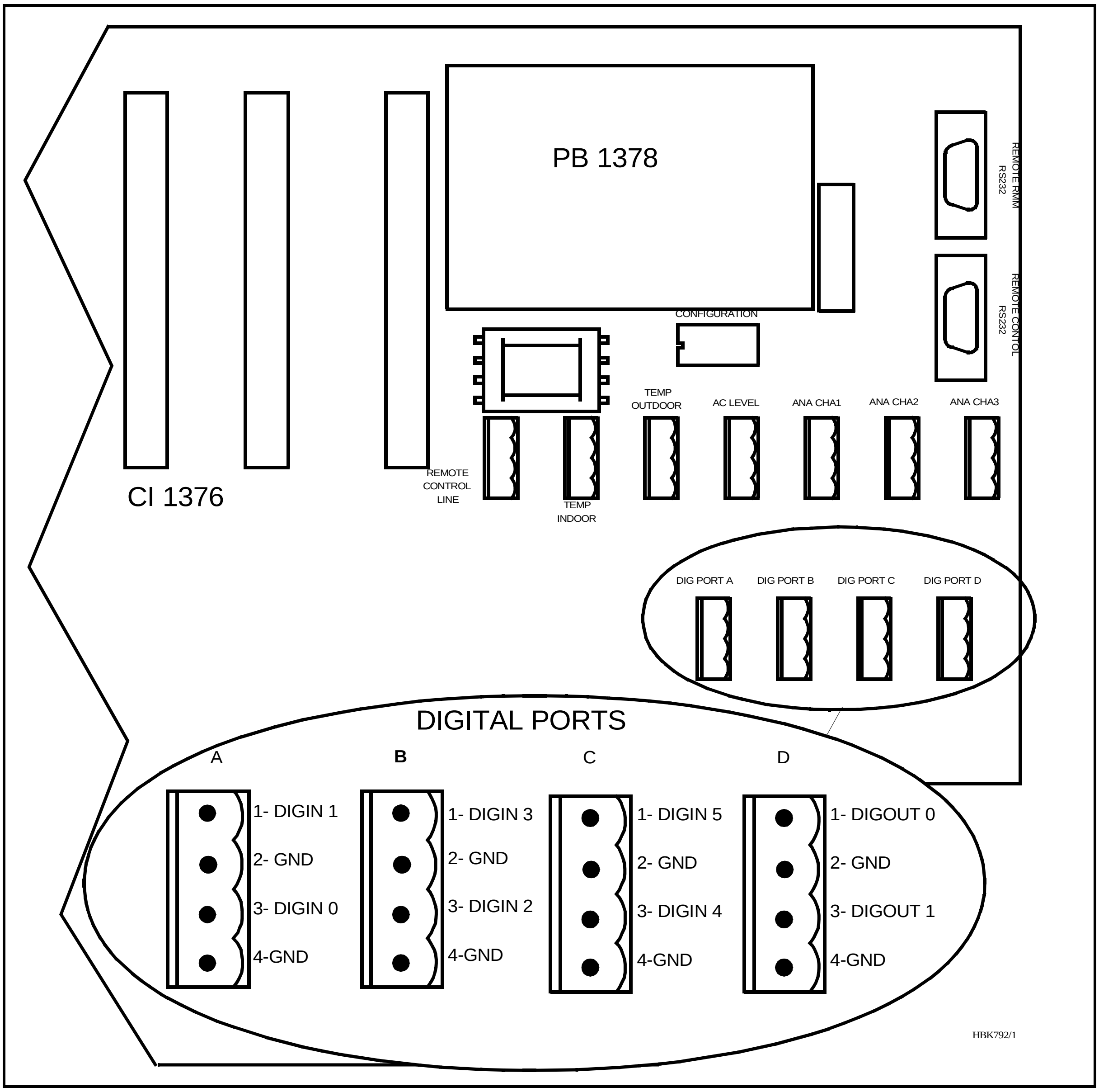

Figure 5-10 Digital input/output connections

6 Remote Control Connections (TWR)

6.1 Remote Master Connection

The remote control is connected to the corresponding ILS by connecting the REMOTE CONTROL connector on CI1210 (ILS) or CI1376 (Marker Beacon) to P9 on MB1346 as shown in figure 6-1.

Suitable female connectors are Weidemüller *BLZ-5.08/4* or equivalent. 600 ohms cable should be used.

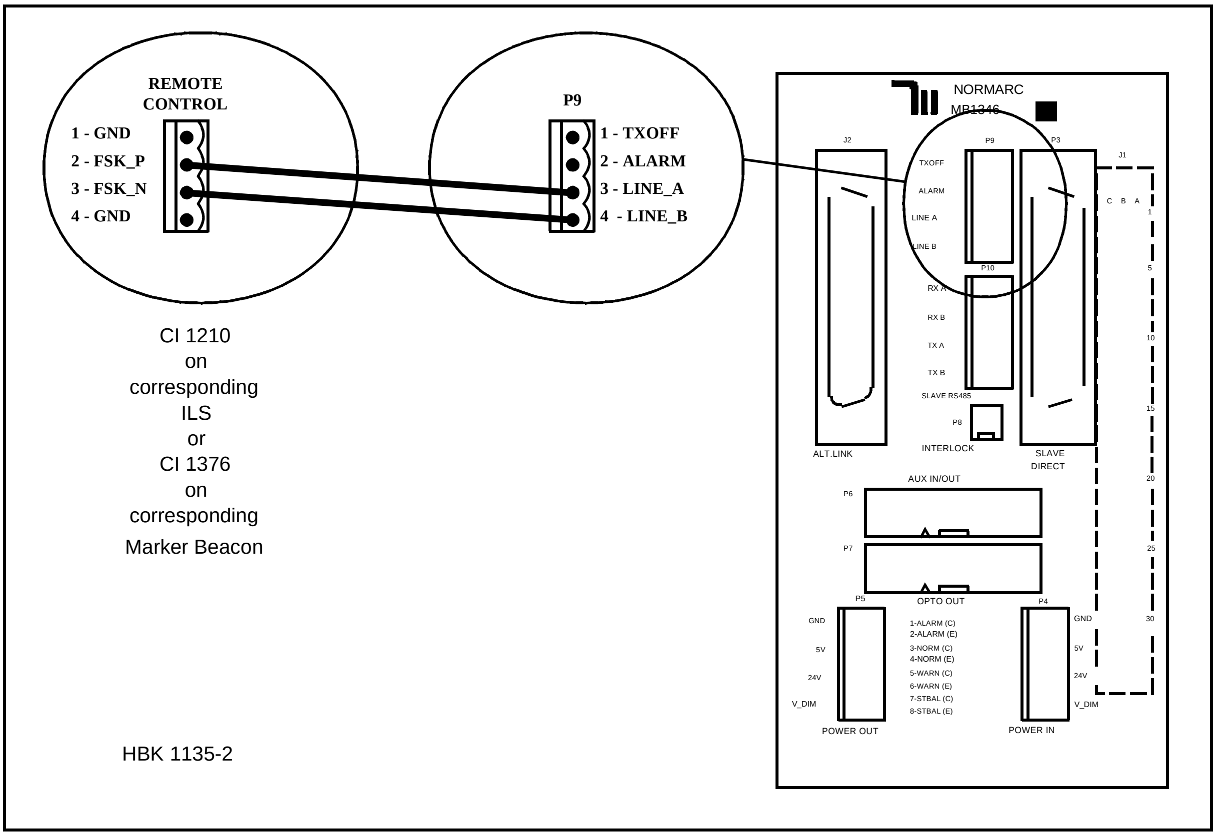

Figure 6-1 Remote control to ILS connection

6.2 Power Supply Connection

The power supply to the remote control is connected according to Figure 6-2. The battery charger is connected to P2 on the MB1347 - power supply motherboard. Output connector P3 on MB1347 is connected to input connector P4 on MB1346 - remote control motherboard. Several MB1346's are serial linked by connecting P5 on one board to P4 on the next.

Suitable female connectors are Weidemüller *BLZ-5.08/4* or equivalent.

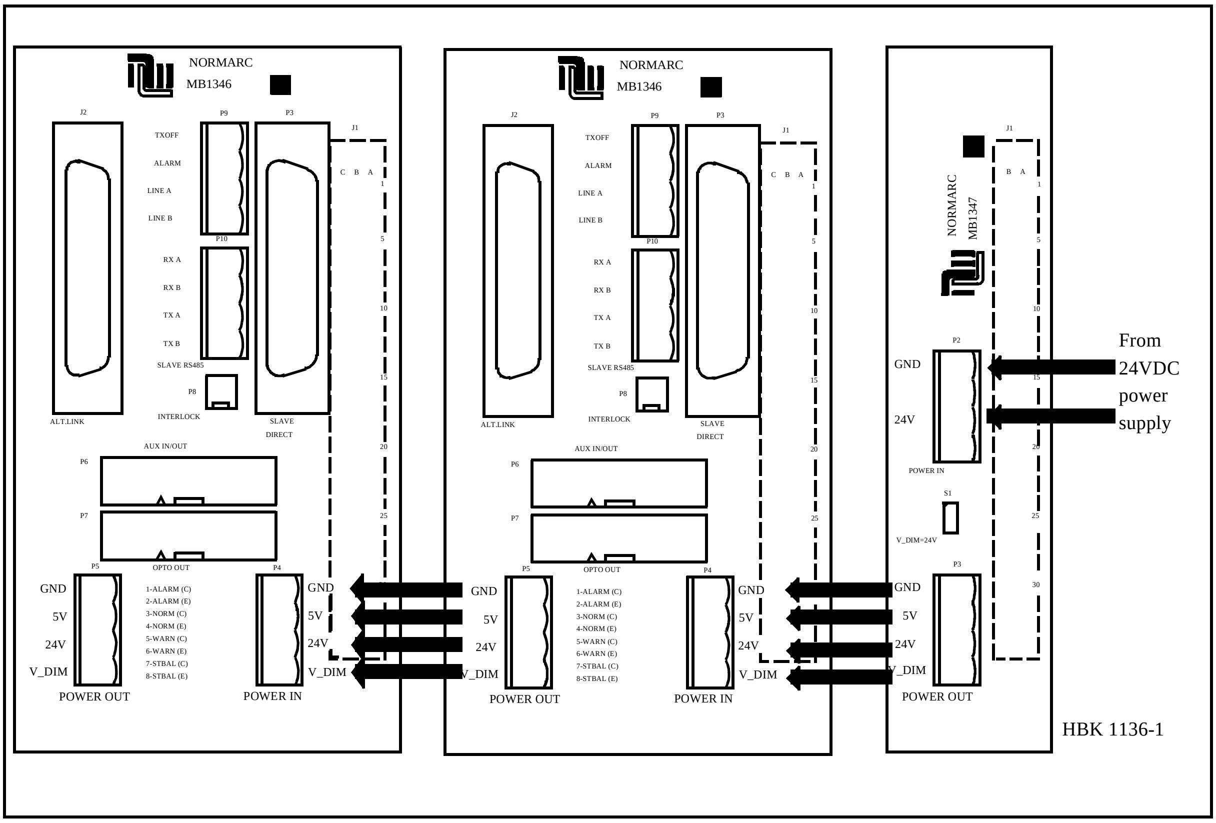

Figure 6-2 Remote control power supply connections

6.3 Remote slave connection

The remote slave panel SF1344 is connected to the corresponding remote control's mother-board by connecting P3 on MB1346 to P1 on SF1344. P10 on MB1346 is not used. See Figure 6-3.

Suitable connectors are standard 25 pins female DSUB (Harting 0967 025 0442 and 0967 225 4704 or equivalent), connected by a 10 wire 1:1 cable

.

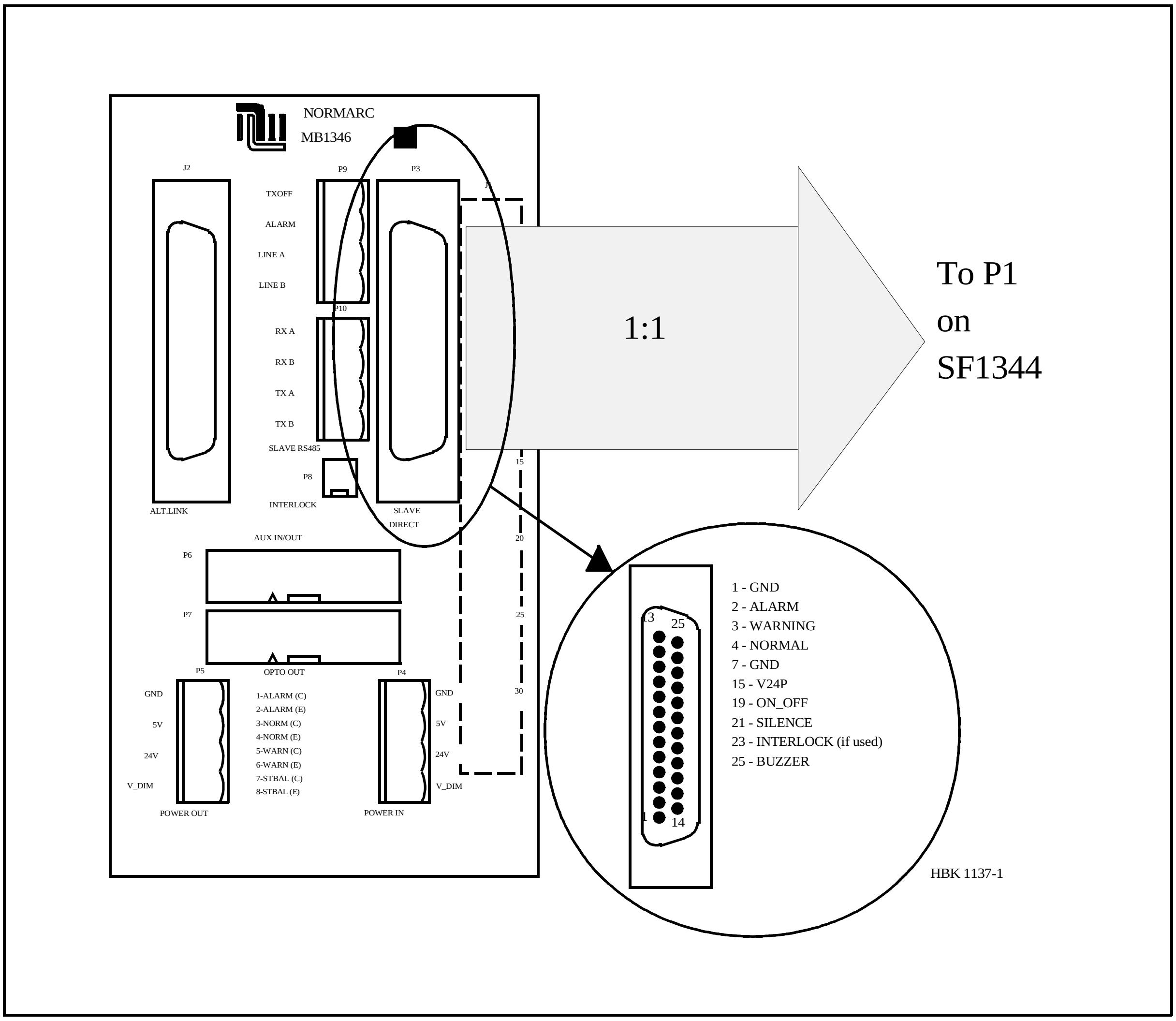

Figure 6-3 Remote slave connection

6.4 Interlock switch connection

The interlock switch is either connected to P8 on MB1346 (remote control motherboard) or to P2 on SF1344 (remote slave panel), see Figure 6-4.

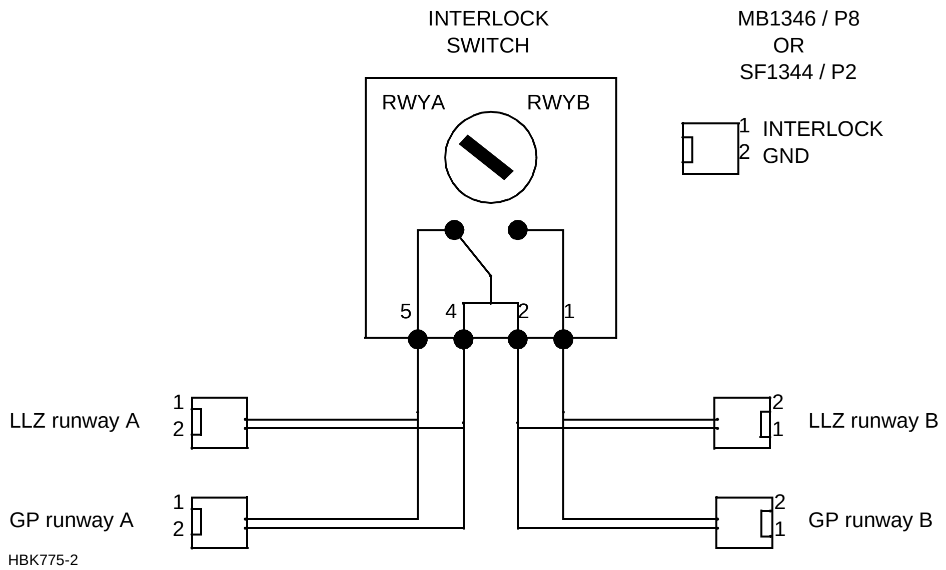

Figure 6-4 Interlock switch connection

SECTION 3

ANTENNA SYSTEMS ADJUSTMENTS PROCEDURE

Table of contents

1 NM 3522 6 elements antenna system adjustments - LLZ

1.1 Mechanical alignment of antenna array

1.1.1 Right angle points with reference to runway center line

The alignment of the antenna array perpendicular to the runway centreline should be carried out to an accuracy of 0.03°.

This corresponds to within 4 mm accuracy at positions antenna 1 and antenna 6. A theodolite should be utilised.

1.1.2 Spacing distance between LPDA's

Check that the spacing between each LPDA is according to dimensions given in dwg.no. 7106A3.

Tolerance: ±5 mm.

1.1.3 Vertical alignment of LPDA support masts

On each rear support mast for LPDA check with waterlevel that mast is vertically aligned in both planes.

1.1.4 Azimuth alignment of LPDA's

Determine a fixed point as far as possible along the extended centreline not less than approximately 3000 m from the antenna array.

On each LPDA utilise the top horizontal line composed of the two half sections of the radome to point toward the fixed point.

If necessary adjust the LPDA horizontally by adjusting the mast supports on the front mast, so that the extended radome top line ends at the fixed point.

1.2 Electrical measurements

1.2.1 CSB and SBO cables

The CSB and SBO cable between the cabinet and MCU must be of equal electrical length. Utilise a vector voltmeter or network analyser in a test set-up as in Figure 1-1.

Measure open cable return phase for each cable.

Refer to CSB cable as zero phase and measure the return phase for the SBO cable. The cable pair must be matched within ±3.0° return phase, equal to ±1.5° true phase

.

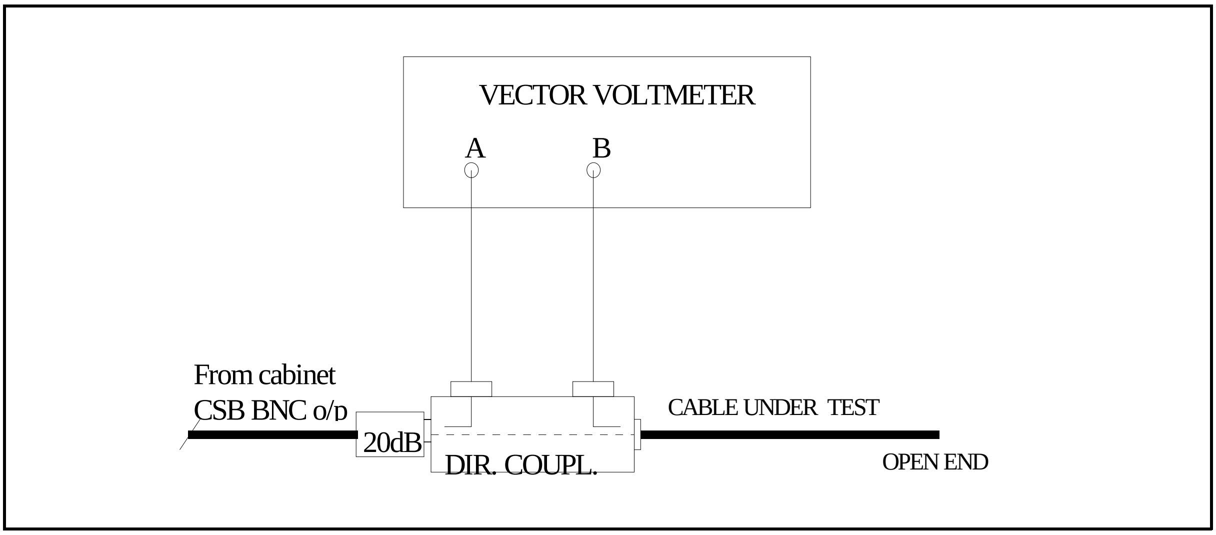

Figure 1-1 Cable phasing measurements set-up.

1.2.2 CSB/SBO phasing

NOTE

Ascertain that the Tx/modulator used is optimally calibrated.

Connect the NM3710 Field Test Set to the monitor BNC test connector in the ADU. (Use 20..30 dB attenuator at the I/P of the Field Test Set.)

Adjust SBO phaser in the Cabinet (associated with Tx to air) to obtain 0.0% DDM reading.

Repeat the phasing procedure for the other transmitter.

1.2.3 Antenna cable lengths (Electrical phase equality)

Each antenna cable should be electrically checked before the end connector is terminated in the LPDA.

Utilise a vector voltmeter or network analyser. Establish antenna cable (A1) (leftmost seen from rear) return phase as 0° reference phase.

Measure return phase for each of the remaining antenna cables (A2...A6).

Tolerance: ±1.0° true electrical cable length.

See measurement set-up diagram Figure 1-1.

1.2.4 Antenna pair phasing

NOTE

Before the antenna pair phasing procedure is commenced ascertain that the Tx/modulator used is optimally calibrated.

Connect the antenna cables A1 and A6 to the ADU outputs labelled A1 and A6 respectively.

Connect all other ADU outputs to dummy load. Use the NM3710 with portable test antenna.

On the the runway establish a point officially marked as the centre line for DDM measurements. Ascertain that the measurement point is not affected by reflected signals degrading the direct received signals from the antenna pairs. This can be tested by moving the test antenna a few meters back and fourth while observing the DDM reading. If the value is not changing significantly then the measurement position is OK.

Take a note of the DDM reading first from antenna pair A1/A6.

Connect pair A2/A5 to ADU outputs A2/A5 and disconnect pair A1/A6, dummyload A1/A6 ADU.

Take a note of the DDM reading.

Carry out this procedure until all antenna pairs DDM readings have been noted.

If any antenna pair measures DDM different from zero, one of the antenna pair feed cable lengths should be trimmed in order to bring the DDM reading to zero.

If the DDM reading is positive (150 Hz dominance) the antenna cable at the right hand side (A4...A6) should be trimmed.

The sensitivity of DDM versus electrical phase error of 2° (5° CS) is given in the table below:

The sensitivity of DDM versus electrical phase error can be estimated using the following procedure:

1. Note the DDM value reported by the operator at the Field Test Set for the antenna pair under test.

2. a) If the DDM value is positive (150 Hz dominance), insert a male-female (MF) N-adaptor (-9°) in the antenna left side seen forward toward the Field test set.

   b) If the DDM value is negative (90 Hz dominance), insert a male-female (MF) N-adaptor (-9°) in the antenna right side seen forward toward the Field test set.

3. Note the new DDM value. (This value should have oposite polarity compared to the value without the adaptor.)

4. Calculate the corresponding phase error (electrical degrees) from the formula

$$\varphi(°) = \frac{9°|DDM_1|}{|DDM_1 + DDM_3|}$$

: DDM_1 (%) measured in item 1.

: DDM_3 (%) measured in item 3.

(Example values from NM3523B)

Example 1:

Item 1: A1/A12:   +4.3% DDM

Item 3: A1+MF/A12: -2.0% DDM (MF in A1)

$$\varphi = \frac{9° \cdot 4.3}{4.3 + 2.0} = 4.8°$$

Example 2:

Item 1: A6/A7:   -0.6% DDM

Item 3: A6 /A7+MF: +1.86% DDM (MF in A7)

$$\varphi = \frac{9° \cdot 0.6}{0.6 + 1.86} = 1.7°$$

Cable trimming length: 6.2 mm/°.

1.2.5 Phase and amplitude transfer measurement

Connect each antenna cable and monitor cable to LPDA load and source respectively. Utilise a vector voltmeter or network analyser in a test set-up

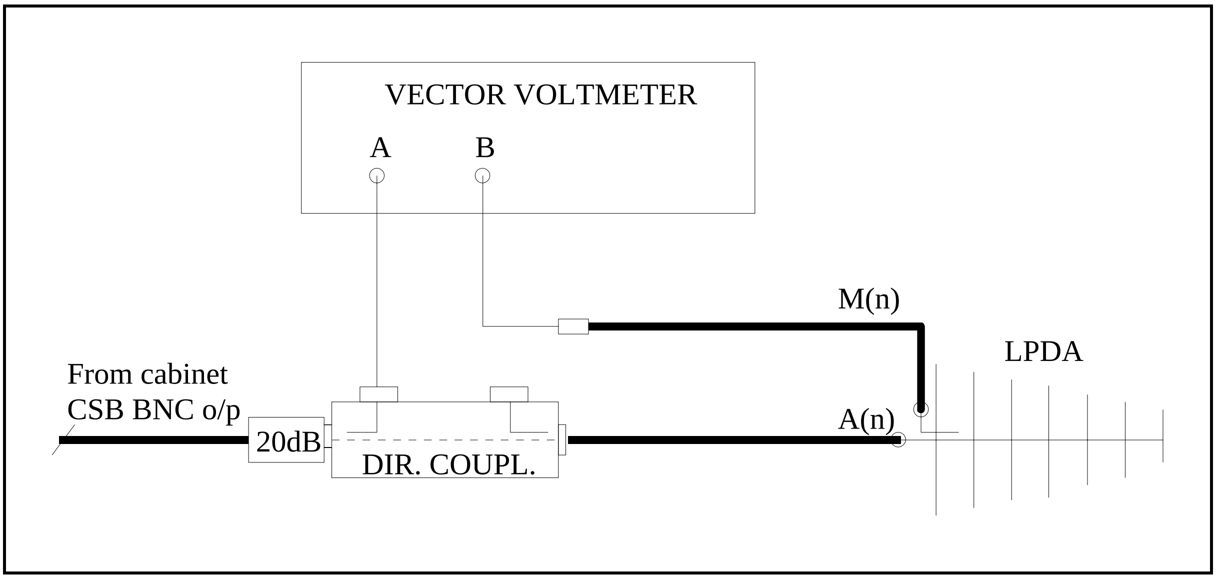

Figure 1-2 Phase and amplitude transfer measurement set-up.

Measure relative transfer phase and amplitude for each Antenna/Monitor return cable in reference to A1/M1.

Then determine if one or more of the monitor cables must be trimmed in order to comply with phase tolerance for the set of cables.

Tolerance: ±2°.

Amplitude tolerance: ±1.0 dB. If the amplitude tolerance is exceeded something might be wrong in the LPDA monitor circuit or connector/cable.

Record the final result in Ground Commissioning Record.

1.2.6 Antenna return loss

Utilise a vector voltmeter or network analyser in a test set-up

Figure 1-3. Measure return loss for each LPDA.

Measure and record in Ground Commissioning Record the return loss value for each LPDA including antenna cable.

Tolerance: 20 dB minimum

.

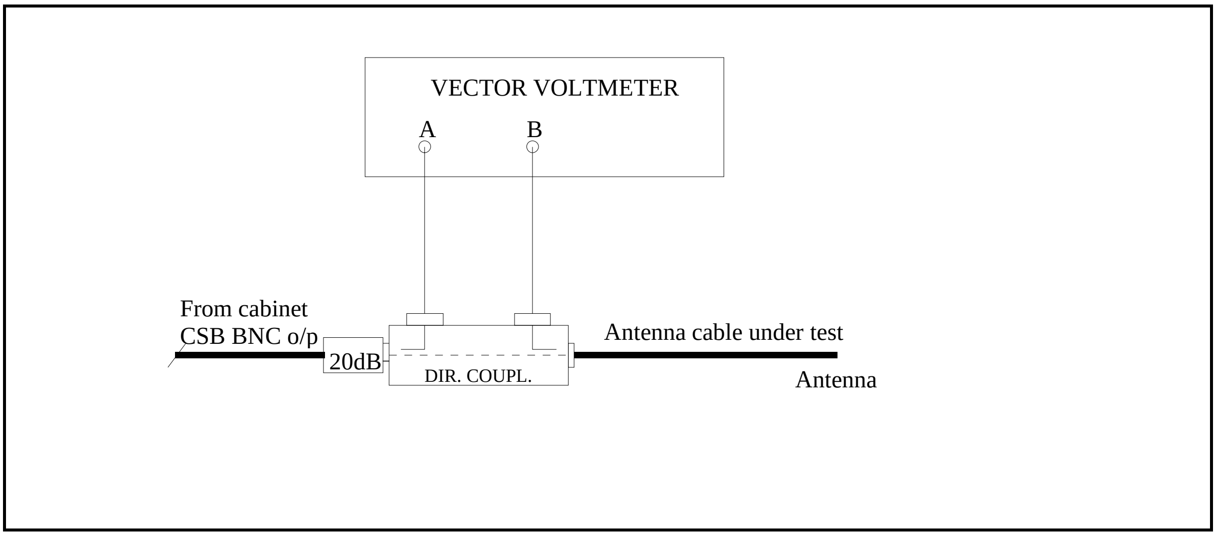

Figure 1-3 Antenna return loss measurement set-up.

1.3 Course sector width adjustment

The required course sector width (CS) can be pre-adjusted by two methods:

1. DDM measurement of ADU antenna feed outputs.

2. DDM field check.

Preferably both methods should be carried out and compared.

1.3.1 DDM check of ADU O/P (output port)

At each antenna feed output of the ADU the measured DDM is a result of the SBO/CSB ratio according to the formula

$$DDM = \frac{2 \cdot SBO}{CSB} COS\gamma$$

	%DDM	µA	%SDM
A2	-34.8	-337	40.0
A3	-32.7	-316	40.0

where

CSB is a fixed value.

SBO is adjustable by the SBO attenuator in the cabinet.

γ is 0° when the 90°-stub is inserted into the SBO.

For each course sector width (CS) of the array a set of corresponding DDM values exists unique for each antenna O/P.

For CS = 5°:

For other CS values use the formula:

$$DDM_{A(n)} = \frac{DDM_{(5°)} \cdot 5°}{CS}$$

Example

A3 DDM for CS = 5.4°:

$$DDM_{A3} = \frac{-32.7 \cdot 5}{5.4} = 29.5\%$$

PROCEDURE

Insert the 90°-stub into the SBO path.

Connect a directional coupler with 50* load to antenna O/P A3.

Connect the NM3710 (use 20 dB attenuator at NM3710 I/P) to the directional coupler's forward port.

Adjust the SBO attenuator (for the Tx to air) until the DDM value equals the previously calculated value for the CS.

Move the directional coupler to A4 and compare readings with calculated value. If measured DDM is lower than the calculated values for A4 then increase the SBO power, or vice versa, until a fairly good matching set of values are obtained.

Adjust the SBO attenuator for the other Tx to the same setting.

Remove the 90°-stub

1.3.2 DDM field check

Set the localizer to normal radiation. From the centreline of the opposite threshold determine points perpendicular to the CL 105 meter to both sides of the runway. Use the NM3710 with portable antenna and measure DDM at these points. The readings should be close to -15.5% at the 90-side and 15.5% at the 150-side. However, some unsymmetry may be expected due to reflections and tolerances in the antenna system.

Check the CL DDM at two or three positions in order to estimate an average value.

Expected value: 0.0%±0.2% DDM.

1.4 Monitor combining unit (MCU) adjustments

1.4.1 Course Line

Connect the Field Test Set to the CL output connector of the MCU.

Adjust the CL line stretcher to obtain 0.0% DDM.

1.4.2 Course Sector

Connect the Field Test Set to the CS output of the MCU.

Adjust the CS line stretcher to obtain a reading of 15.5% DDM.

1.5 Near field monitor adjustments

The exact position of the near field monitor antenna cannot be determined until after the flight check is completed, due to possible mechanical re-alignment of the antenna array.

1.5.1 Mechanical alignment

Align the near field (NF) monitor antenna mechanically in the extended runway centreline position.

1.5.2 Final electrical position adjustment

Connect the Field Test Set to the NF monitor cable. The reading should be 0.0% DDM if the antenna is aligned correctly and no reflections appear.

Otherwise, a small mechanical re-positioning of the antenna may be necessary in order to obtain 0.0% DDM.

1.6 DC-Loop adjustment and testing

1.6.1 DC-LOOP adjustment

The DC loop (cable fault monitor) alignment is carried out accordingly to the procedure described in Monitor Alignment and Calibration chapter.

1.6.2 Antenna fault condition testing

For this test observe that the LLZ cabinet System Status indicates ALARM.

The transmitter must be on during this test.The monitors should be in MANUAL mode in order to prevent transmitter from being shut off during the test.

Disconnect one antenna at a time and check that the LLZ cabinet System Status indicates ALARM after each antenna disconnection.

Carry out this test for all antennas.

2 NM 3523B 12 Elements antenna system adjustments - LLZ (Single frequency)

2.1 Mechanical alignments of antenna array

2.1.1 Right angle points with reference to runway centre line

The alignment of the antenna array perpendicular to the runway centreline should be carried out to an accuracy of 0.02°.

This corresponds to within 5 mm accuracy at positions antenna 1 and antenna 12. A theodolite should be utilised.

2.1.2 Spacing distance between LPDA's

Check that the spacing between each LPDA is according to dimensions given in dwg.no. 8151A3.

Tolerance: ±5 mm.

2.1.3 Vertical alignment of LPDA support masts

On each rear support mast for LPDA check with waterlevel that mast is vertically aligned in both planes.

2.1.4 Azimuth alignment of LPDA's

Determine a fixed point as far as possible along the extended centreline not less than approximately 3000 m from the antenna array.

On each LPDA utilise the top horizontal line composed of the two half sections of the radome to point toward the fixed point.

If necessary adjust the LPDA horizontally by adjusting the mast supports on the front mast, so that the extended radome top line ends at the fixed point.

2.2 Electrical measurements

2.2.1 CSB and SBO cables

The CSB and SBO cable between the cabinet and MCU must be of equal electrical length. Utilise a vector voltmeter or network analyser in a test set-up as in Figure 2-1.

Measure open cable return phase for each cable.

Refer to CSB cable as zero phase and measure the return phase for the SBO cable. The cable pair must be matched within ±3.0° return phase, equal to ±1.5° true phase

.

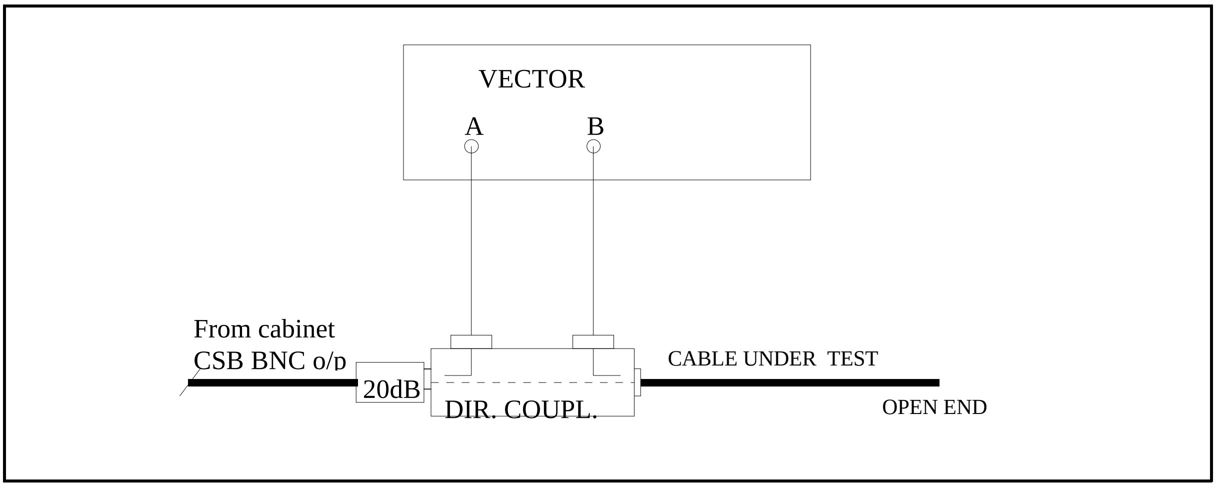

Figure 2-1 Cable phasing measurement set-up.

2.2.2 CSB/SBO phasing

NOTE

Ascertain that the Tx/modulator used is optimally calibrated.

Connect the NM3710 Field Test Set to the monitor BNC test connector in the ADU. (Use 20..30 dB attenuator at the I/P of the Field Test Set.)

Adjust SBO phaser in the Cabinet (associated with Tx to air) to obtain 0.0% DDM reading.

Repeat the phasing procedure for the other transmitter.

2.2.3 Antenna cable lengths (Electrical phase equality)

Each antenna cable should be electrically checked before the end connector is terminated in the LPDA.

Utilise a vector voltmeter or network analyser. Establish antenna cable (A1) (leftmost seen from rear) return phase as 0° reference phase.

Measure return phase for each of the remaining antenna cables (A2...A12).

Tolerance: ±1.0° true electrical cable length.

See measurement set-up diagram 2-1.

2.2.4 Antenna pair phasing

NOTE:

Before the antenna pair phasing procedure is commenced ascertain that theTx/modulator used is optimally calibrated.

Connect the antenna cables A1 and A12 to the ADU outputs labelled A1 and A12 respectively.

Connect all other ADU outputs to dummy load. Use the NM3710 with portable test antenna.

On the the runway establish a point officially marked as the centre line for DDM measurements. Ascertain that the measurement point is not affected by reflected signals upsetting the direct received signals from the antenna pairs. This can be tested by moving the test antenna a few meters back and fourth while observing the DDM reading. If the value is not changing then the measurement position is OK.

Take a note of the DDM reading first from antenna pair A1/A12.

Connect pair A2/A11 to ADU outputs A2/A11 and disconnect pair A1/A12, dummyload A1/A12 ADU.

Take a note of the DDM reading.

Carry out this procedure until all antenna pairs DDM readings have been noted.

If any antenna pair measures DDM different from zero, one of the antenna pair feed cable lengths should be trimmed in order to bring the DDM reading to zero.

If the DDM reading is positive (150 Hz dominance) the antenna cable at the right hand side (A7...A12) should be trimmed.

The sensitivity of DDM versus electrical phase error can be estimated using the following procedure:

1. Note the DDM value reported by the operator at the Field Test Set for the antenna pair under test.

2. a) If the DDM value is positive (150 Hz dominance), insert a male-female (MF) N-adaptor (-9°) in the antenna left side seen forward toward the Field test set.

   b) If the DDM value is negative (90 Hz dominance), insert a male-female (MF) N-adaptor (-9°) in the antenna right side seen forward toward the Field test set.

3. Note the new DDM value. (This value should have oposite polarity compared to the value without the adaptor.)

4. Calculate the corresponding phase error (electrical degrees) from the formula

$$\varphi(°) = \frac{9°|DDM_1|}{|DDM_1 + DDM_3|}$$

DDM_1: DDM(%) measured in item 1.

DDM_3: DDM(%) measured in item 3.

(Example values from NM3523B)

Example 1:

Item 1: A1/A12: +4.3% DDM

Item 3: A1+MF/A12: -2.0% DDM (MF in A1)

$$\varphi = \frac{9° \cdot 4.3}{4.3 + 2.0} = 4.8°$$

Example 2:

Item 1: A6/A7: -0.6% DDM

Item 3: A6 /A7+MF: +1.86% DDM (MF in A7)

$$\varphi = \frac{9° \cdot 0.6}{0.6 + 1.86} = 1.7°$$

Cable trimming length: 6.2 mm/°.

2.2.5 Phase and amplitude transfer measurement

Connect each antenna cable and monitor cable to LPDA load and source respectively. Utilise a vector voltmeter or network analyser in a test set-up Figure 2-2

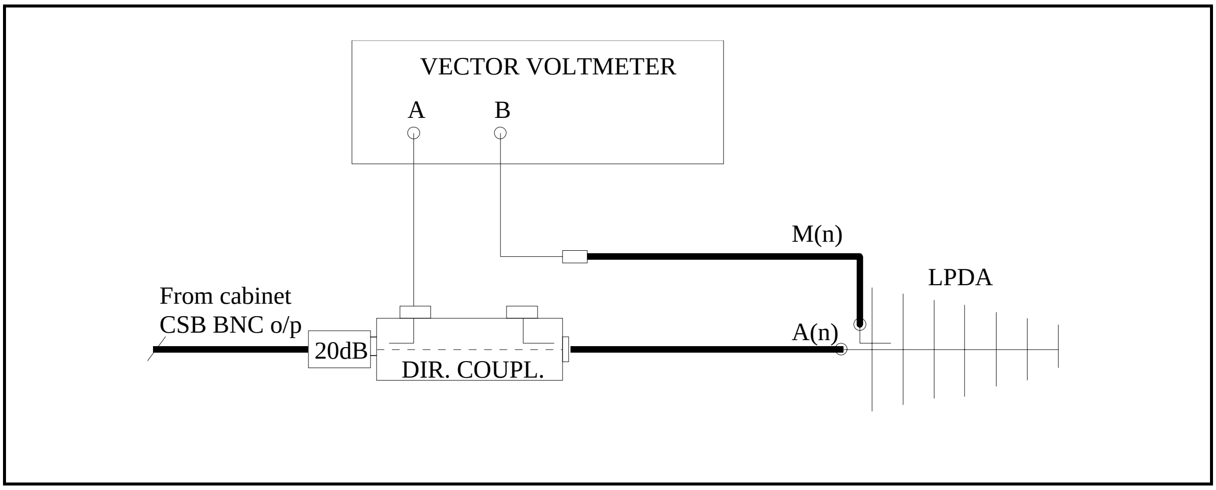

Figure 2-2 Phase and amplitude transfer measurement set-up.

Measure relative transfer phase and amplitude for each Antenna/Monitor return cable in reference to A1/M1.

Then determine if one of the **monitor** cables must be trimmed in order to comply with phase tolerance for the set of cables.

Tolerance: ±2°.

Amplitude tolerance: ±1.0 dB. If the amplitude tolerance is exceeded something might be wrong in the LPDA monitor circuit or connector/cable.

Record the final result in Ground Commissioning Record.

2.2.6 Antenna return loss

Utilise a vector voltmeter or network analyser in a test set-up Figure 2-3. Measure return loss for each LPDA.

Measure and record in Ground Commissioning Record the return loss value for each LPDA including antenna cable.

Tolerance: 20 dB minimum.

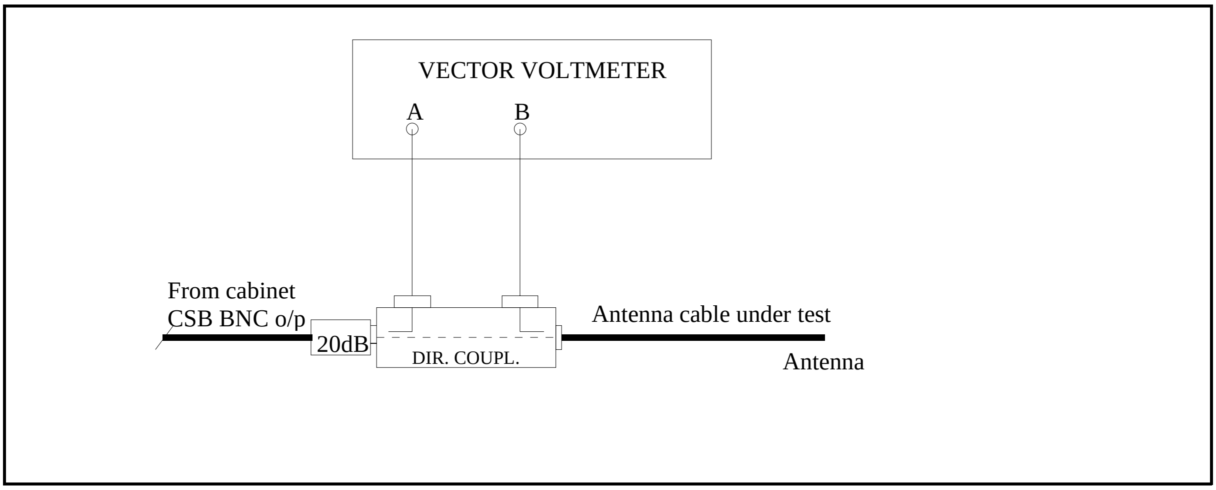

Figure 2-3 Antenna return loss measurement set-up.

2.3 Course sector adjustment

The required course sector width (CS) can be pre-adjusted by two methods:

1. DDM measurement of ADU antenna feed outputs.

2. DDM field check.

Preferably both methods should be carried out and compared.

2.3.1 DDM check of ADU O/P

At each antenna feed output of the ADU the measured DDM is a result of the SBO/CSB ratio according to the formula

$$DMM = \frac{2 \cdot SBO}{CSB} COS\gamma$$

where

CSB is a fixed value.

SBO is adjustable by the SBO attenuator in the cabinet.

γ is 0° when the 90°-stub is inserted into the SBO.

For each course sector width (CS) of the array a set of corresponding DDM values exists unique for each antenna O/P.

For CS = **4°**:

	% DDM	µA	%SDM
A2	-34.8	-337	40.0
A3	-32.7	-316	40.0
A5	-28.1	-272	40.0
A6	-30.4	-294	40.0

For other CS values use the formula:

$$DDM_{A(n)} = \frac{DDM_{(4°)} \cdot 4°}{CS}$$

<u>EXAMPLE</u>

A5 DDM for CS = 5°:

$$DM_{A3} = \frac{-28.1 \cdot 4}{5} = -22.5\%$$

<u>PROCEDURE</u>

Insert the 90°-stub into the SBO path.

Connect a directional coupler with 50Ω load to antenna O/P A3.

Connect the NM3710 (use 20 dB attenuator at NM3710 I/P) to the directional coupler's forward port.

Adjust the SBO attenuator (for the Tx to air) until the DDM value equals the previously calculated value for the CS.

Move the directional coupler to A4, A5, A6 and compare readings with calculated values. If measured DDM is lower than the calculated values for A4, A5, A6 then increase the SBO power, or vice versa, until a fairly good matching set of values are obtained.

Adjust the SBO attenuator for the other Tx to the same setting.

Remove the 90°-stub.

2.3.2 DDM field check

Set the localizer to normal radiation. From the centreline of the opposite threshold determine points perpendicular to the CL 105 meter to both sides of the runway. Use the NM3710 with portable antenna and measure DDM at these points. The readings should be close to -15.5% at the 90-side and 15.5% at the 150-side. However, some unsymmetry may be expected due to reflections and tolerances in the antenna system.

Check the CL DDM at two or three positions in order to estimate an average value.

Expected value: 0.0%±0.2% DDM.

2.4 Monitor combining unit (MCU) adjustments

2.4.1 Course Line

Connect the Field Test Set to the CL output connector of the MCU.

Adjust the CL line stretcher to obtain 0.0% DDM.

2.4.2 Course Sector

Connect the Field Test Set to the CS output of the MCU.

Adjust the CS line stretcher to obtain a reading of 15.5% DDM.

2.5 Near field monitor adjustments

The exact position of the near field monitor antenna cannot be determined until after the flight check is completed, due to possible mechanical re-alignment of the antenna array.

2.5.1 Mechanical alignment

Align the near field (NF) monitor antenna mechanically in the extended runway centreline position.

2.5.2 Final electrical position adjustment

Connect the Field Test Set to the NF monitor cable. The reading should be 0.0% DDM if the antenna is aligned correctly and no reflections appear.

Otherwise, a small mechanical re-positioning of the antenna may be necessary in order to obtain 0.0% DDM.

2.6 DC-Loop adjustment and testing

2.6.1 DC-LOOP adjustment

The DC loop (cable fault monitor) alignment is carried out accordingly to the procedure described in Monitor Alignment and Calibration chapter.

2.6.2 Antenna fault condition testing

For this test observe that the LLZ cabinet System Status indicates ALARM.

The transmitter must be on during this test.

The monitors should be in MANUAL mode in order to prevent transmitter from being shut off during the test.

Disconnect one antenna at a time and check that the LLZ cabinet System Status indicates ALARM after each antenna disconnection.

Carry out this test for all antennas.

3 NM 3524 12 Elements antenna system adjustments - LLZ (Dual frequency)

3.1 Mechanical alignment of antenna array

3.1.1 Right angle points with reference to runway centre line

The alignment of the antenna array perpendicular to the runway centreline should be carried out to an accuracy of 0.02°.

This corresponds to within 4 mm accuracy at positions antenna 1 and antenna 12. A theodolite should be utilised.

3.1.2 Spacing distance between LPDA's

Check that the spacing between each LPDA is 2.04 m.

Tolerance: ±5 mm.

3.1.3 Vertical alignment of LPDA support masts

On each rear support mast for LPDA check with waterlevel that mast is vertically aligned in both planes.

3.1.4 Azimuth alignment of LPDA's

Determine a fixed point as far as possible along the extended centreline not less than approximately 3000 m from the antenna array.

On each LPDA utilise the top horizontal line composed of the two half sections of the radome to point toward the fixed point.

If necessary adjust the LPDA horizontally by adjusting the mast supports on the front mast, so that the extended radome top line ends at the fixed point.

3.2 Electrical measurements

3.2.1 CSB and SBO cables

Course Tx cables.

The CSB and SBO cable between the cabinet and MCU must be of equal electrical length. Utilise a vector voltmeter or network analyser in a test set-up as in Figure 3-1.

Measure open cable return phase for each cable.

Refer to CSB cable as zero phase and measure the return phase for the SBO cable. The cable pair must be matched within ±3.0° return phase, equal to ±1.5° true phase.

Clearance Tx cables.

Repeat the procedure 3.2.1 for CLR Tx CSB and SBO cables

.

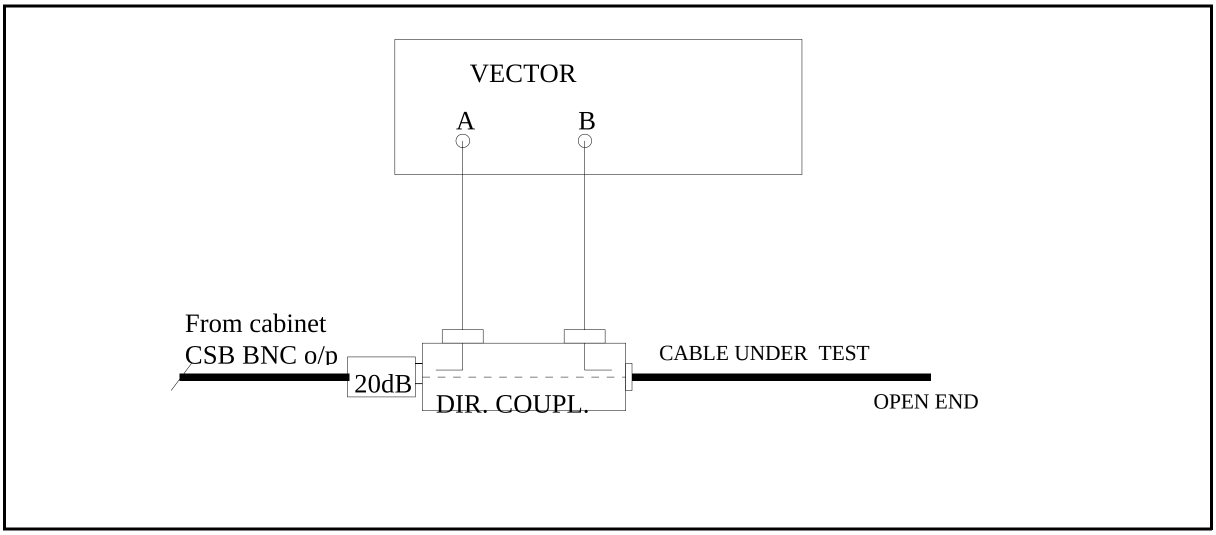

Figure 3-1 Cable phasing measurement set-up.

3.2.2 CSB/SBO phasing

NOTE

Switch off the clearance transmitter.

Ascertain that the Tx/modulator used is optimally calibrated.

Connect the NM3710 Field Test Set to the monitor BNC test connector in the ADU. (Use 20..30 dB attenuator at the I/P of the Field Test Set.)

Adjust Course SBO phaser in the Cabinet (associated with Tx to air) to obtain 0.0% DDM reading.

Repeat the phasing procedure for the other transmitter.

Switch off the course transmitter.

With the clearance transmitter on repeat the phasing procedure now adjusting the clearance SBO phaser associated with Tx to air.

3.2.3 Antenna cable lengths (Electrical phase equality)

Each antenna cable should be electrically checked before the end connector is terminated in the LPDA.

Utilise a vector voltmeter or network analyser. Establish antenna cable (A1) (leftmost seen from rear) return phase as 0° reference phase.

Measure return phase for each of the remaining antenna cables (A2...A12).

Tolerance: ±1.0° true electrical cable length.

See measurement set-up diagram Figure 3-1.

3.2.4 Antenna pair phasing

NOTE

Before the antenna pair phasing procedure is commenced ascertain that the TX/modulator used is optimally calibrated.

Switch off the clearance transmitter.

Connect the antenna cables A1 and A12 to the ADU outputs labelled A1 and A12 respectively.

Connect all other ADU outputs to dummy load. Use the NM3710 with portable test antenna.

On the the runway establish a point officially marked as the centre line for DDM measurements. Ascertain that the measurement point is not affected by reflected signals upsetting the direct received signals from the antenna pairs. This can be tested by moving the test antenna a few meters back and fourth while observing the DDM reading. If the value is not changing then the measurement position is OK.

Take a note of the DDM reading first from antenna pair A1/A12.

Connect pair A2/A11 to ADU outputs A2/A11 and disconnect pair A1/A12, dummyload A1/A12 ADU.

Take a note of the DDM reading.

Carry out this procedure until all antenna pairs DDM readings have been noted.

If any antenna pair measures DDM different from zero, one of the antenna pair feed cable lengths should be trimmed in order to bring the DDM reading to zero.

If the DDM reading is positive (150 Hz dominance) the antenna cable at the right hand side (A7...A12) should be trimmed.

The sensitivity of DDM versus electrical phase error of 2° (4° CS) is given in the table below:

Cable trimming length: 6.2 mm/°.

The sensitivity of DDM versus electrical phase error can be estimated using the following procedure:

Note the DDM value reported by the operator at the Field Test Set for the antenna pair under test.

a) If the DDM value is positive (150 Hz dominance), insert a male-female (MF) N-adaptor (-9°) in the antenna left side seen forward toward the Field test set.

b) If the DDM value is negative (90 Hz dominance), insert a male-female (MF) N-adaptor (-9°) in the antenna right side seen forward toward the Field test set.

Note the new DDM value. (This value should have oposite polarity compared to the value without the adaptor.)

Calculate the corresponding phase error (electrical degrees) from the formula

$$\varphi(°) = \frac{9°|DDM_1|}{|DDM_1 + DDM_3|}$$

: DDM (%) measured in item 1.

: DDM (%) measured in item 3.

(Example values from NM3523B)

Example 1:

Item 1: A1/A12: +4.3% DDM

Item 3: A1+MF/A12: -2.0% DDM (MF in A1)

$$\varphi = \frac{9° \cdot 4.3}{4.3 + 2.0} = 4.8°$$

Example 2:

Item 1: A6/A7: -0.6% DDM

Item 3: A6 /A7+MF: +1.86% DDM (MF in A7)

$$\varphi = \frac{9° \cdot 0.6}{0.6 + 1.86} = 1.7°$$

3.2.5 Phase and amplitude transfer measurement

Connect each antenna cable and monitor cable to LPDA load and source respectively. Utilise a vector voltmeter or network analyser in a test set-up Figure 3-2.

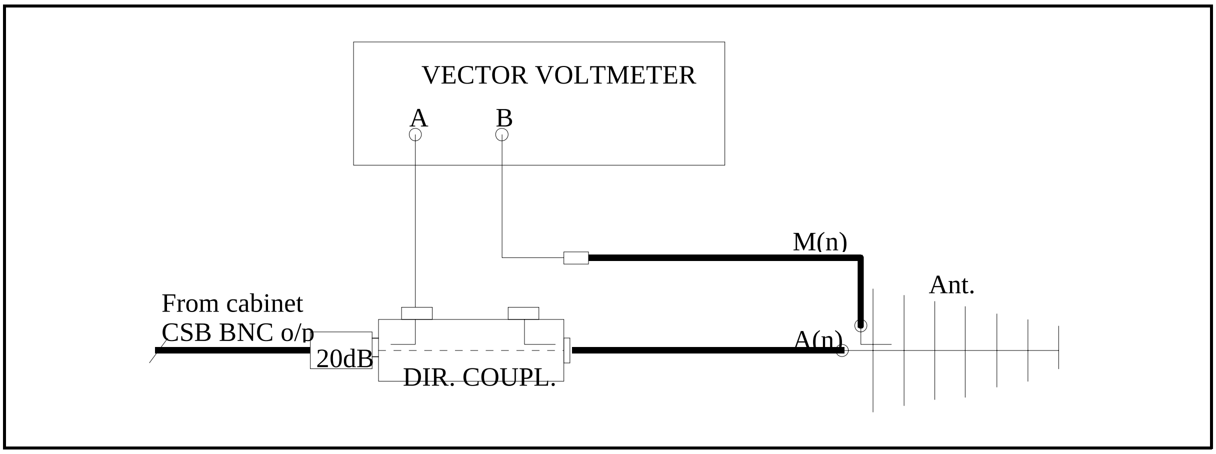

Figure 3-2 Phase and amplitude transfer measurement set-up.

Measure relative transfer phase and amplitude for each Antenna/Monitor return cable in reference to A1/M1.

Then determine if one of the monitor cables must be trimmed in order to comply with phase tolerance for the set of cables.

Tolerance: ±2°.

Amplitude tolerance: ±1.0 dB. If the amplitude tolerance is exceeded something might be wrong in the LPDA monitor circuit or connector/cable.

Record the final result in Ground Commissioning Record.

3.2.6 Antenna return loss

Utilise a vector voltmeter or network analyser in a test set-up

Figure 3-3. Measure return loss for each LPDA.

Measure and record in Ground Commissioning Record the return loss value for each LPDA including antenna cable.

Tolerance: 20 dB minimum

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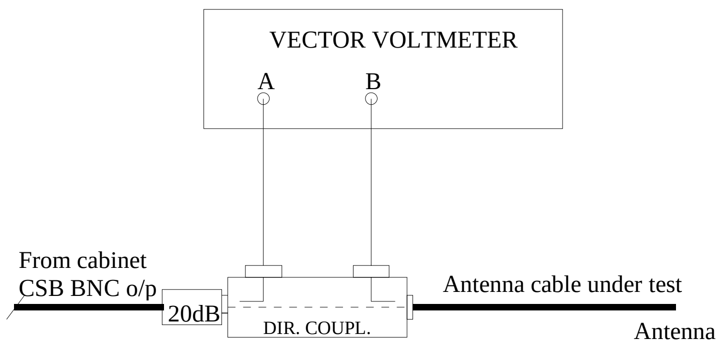

Figure 3-3 Antenna return loss measurement set-up.

3.3 Course sector width adjustment

The required course sector width (CS) can be pre-adjusted by two methods:

1. DDM measurement of ADU antenna feed outputs.

2. DDM field check.

Preferably both methods should be carried out and compared.

3.3.1 DDM check of ADU O/P

At each antenna feed output of the ADU the measured DDM is a result of the SBO/CSB ratio according to the formula

where

CSB is a fixed value.

SBO is adjustable by the SBO attenuator in the cabinet.

γ is 0° when the 90°-stub is inserted into the SBO.

For each course sector width (CS) of the array a set of corresponding DDM values exists unique for each antenna O/P.

For CS = 4°:

	% DDM	µA	%SDM
A3	-40.0	-387	53.8
A4	-38.3	-371	40.0
A5	-22.9	-222	40.0

For other CS values use the formula:

$$DDM_{A(n)} = \frac{DDM_{(4°)} \cdot 4°}{CS}$$

Example

A3 DDM for CS = 5°:

$$DDM_{A3} = \frac{-53.8 \cdot 4}{5} = 43.0\%$$

<u>PROCEDURE</u>

Turn off the clearance transmitter. Insert the 90°-stub into the course SBO path.

Connect a directional coupler with 50Ω load to antenna O/P A3.

Connect the NM3710 (use 20 dB attenuator at NM3710 I/P) to the directional coupler's forward port.

Adjust the SBO attenuator (for the Tx to air) until the DDM value equals the previously calculated value for the CS.

Move the directional coupler to A4, A5 and compare readings with calculated values. If measured DDM is lower than the calculated values for A4, A5 then increase the SBO power, or vice versa, until a fairly good matching set of values are obtained.

Adjust the SBO attenuator for the other Tx to the same setting.

Remove the 90°-stub.

3.3.2 Clearance SBO power

Switch off the course transmitter.

Insert the 90°-stub in the CLR SBO path. Connect the Field Test Set to the BNC test connector (antenna 7 sample) in the ADU. (Use 20...30 dB attenuator at the Field Test Set I/P).

Switch on the clearance transmitter. Adjust the CLR SBO attenuator in the cabinet (associated with Tx to air) until a reading of 36% DDM is obtained.

Carry out the same procedure for the other transmitter.

3.3.3 DDM field check

Set the localizer to normal radiation (clearance transmitter on). From the centreline of the opposite threshold determine points perpendicular to the CL 105 meter to both sides of the runway. Use the NM3710 with portable antenna and measure DDM at these points. The readings should be close to -15.5% at the 90-side and 15.5% at the 150-side. However, some unsymmetry may be expected due to reflections and tolerances in the antenna system.

Check the CL DDM at two or three positions in order to estimate an average value. Expected value: 0.0%±0.2% DDM.

3.4 Monitor combining unit (MCU) adjustments

3.4.1 Course Line

Connect the Field Test Set to the CL output connector of the MCU.

Adjust the CL line stretcher to obtain 0.0% DDM.

3.4.2 Course Sector

Connect the Field Test Set to the CS output of the MCU.

Adjust the CS line stretcher to obtain a reading of 15.5% DDM.

3.4.3 Clearance

Connect the Field Test Set to the CLR output connector of the MCU. Adjust the CLR line stretcher to obtain a reading of 27% DDM.

3.5 Near field monitor adjustments

The exact position of the near field monitor antenna cannot be determined until after the flight check is completed, due to possible mechanical re-alignment of the antenna array.

3.5.1 Mechanical alignment

Align the near field (NF) monitor antenna mechanically in the extended runway centreline position.

3.5.2 Final electrical position adjustment

Connect the Field Test Set to the NF monitor cable. The reading should be 0.0% DDM if the antenna is aligned correctly and no reflections appear.

Otherwise, a small mechanical re-positioning of the antenna may be necessary in order to obtain 0.0% DDM.

3.6 DC-Loop adjustment and testing

3.6.1 DC-LOOP adjustment

The DC loop (cable fault monitor) alignment is carried out accordingly to the procedure described in Monitor Alignment and Calibration chapter.

3.6.2 Antenna fault condition testing

For this test observe that the LLZ cabinet System Status indicates ALARM.

The transmitter must be on during this test.

The monitors should be in MANUAL mode in order to prevent transmitter from being shut off during the test.

Disconnect one antenna at a time and check that the LLZ cabinet System Status indicates ALARM after each antenna disconnection.

Carry out this test for all antennas.

4 NM 3525 24 Elements antenna system adjustments - LLZ

4.1 Mechanical alignments of antenna array

4.1.1 Right angle points with reference to runway centre line

The alignment of the antenna array perpendicular to the runway centreline should be carried out to an accuracy of 0.01°.

This corresponds to within 5 mm accuracy at positions antenna 1 and antenna 24. A theodolite should be utilised.

4.1.2 Spacing distance between LPDA's

Check that the spacing between each LPDA is 2.04 m.

Tolerance: ±5 mm.

4.1.3 Vertical alignment of LPDA support masts

On each rear support mast for LPDA check with waterlevel that mast is vertically aligned in both planes.

4.1.4 Azimuth alignment of LPDA's

Determine a fixed point as far as possible along the extended centreline not less than approximately 3000 m from the antenna array.

On each LPDA utilise the top horizontal line composed of the two half sections of the radome to point toward the fixed point.

If necessary adjust the LPDA horizontally by adjusting the mast supports on the front mast, so that the extended radome top line ends at the fixed point.

4.2 Electrical measurements

4.2.1 CSB and SBO cables

Course Tx cables.

The CSB and SBO cable between the cabinet and MCU must be of equal electrical length. Utilise a vector voltmeter or network analyser in a test set-up as in Figure 4-1.

Measure open cable return phase for each cable.

Refer to CSB cable as zero phase and measure the return phase for the SBO cable. The cable pair must be matched within ±3.0° return phase, equal to ±1.5° true phase.

Clearance Tx cables.

Repeat the procedure 1.2.1 for CLR Tx CSB and SBO cables

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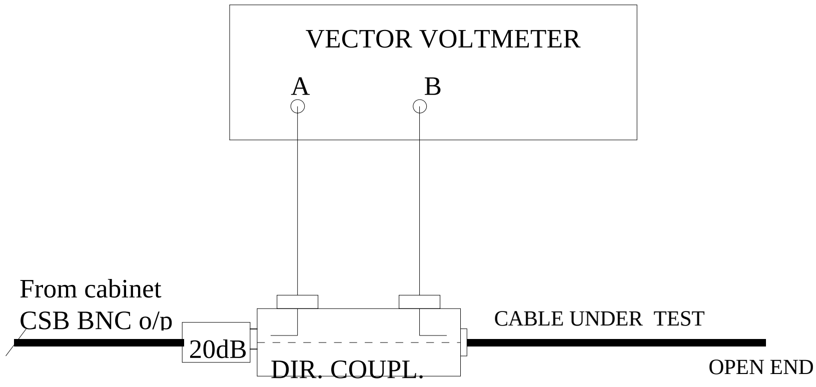

Figure 4-1 Cable phasing measurement set-up.

4.2.2 CSB/SBO phasing

NOTE

Switch off the clearance transmitter.

Ascertain that the Tx/modulator used is optimally calibrated.

Connect the NM3710 Field Test Set to the monitor BNC test connector in the ADU. (Use 20..30 dB attenuator at the I/P of the Field Test Set.)

Adjust SBO phaser in the Cabinet (associated with Tx to air) to obtain 0.0% DDM reading.

Repeat the phasing procedure for the other transmitter.

Switch off the course transmitter.

With the clearance transmitter on repeat the phasing procedure now adjusting the clearance SBO phaser associated with Tx to air.

4.2.3 Antenna cable lengths (Electrical phase equality)

Each antenna cable should be electrically checked before the end connector is terminated in the LPDA.

Utilise a vector voltmeter or network analyser. Establish antenna cable (A1) (leftmost seen from rear) return phase as 0° reference phase.

Measure return phase for each of the remaining antenna cables (A2...A24).

Tolerance: ±1.0° true electrical cable length.

See measurement set-up diagram Figure 4-1

4.2.4 Antenna pair phasing

NOTE

Before the antenna pair phasing procedure is commenced ascertain that the Tx/modulator used is optimally calibrated.

Switch off the clearance transmitter.

Connect the antenna cables A1 and A24 to the ADU outputs labelled A1 and A24 respectively.

Connect all other ADU outputs to dummy load. Use the NM3710 with portable test antenna.

On the the runway establish a point officially marked as the centre line for DDM measurements. Ascertain that the measurement point is not affected by reflected signals upsetting the direct received signals from the antenna pairs. This can be tested by moving the test antenna a few meters back and fourth while observing the DDM reading. If the value is not changing then the measurement position is OK.

Take a note of the DDM reading first from antenna pair A1/A24.

Connect pair A2/A23 to ADU outputs A2/A23 and disconnect pair A1/A24, dummyload A1/A24 ADU.

Take a note of the DDM reading.

Carry out this procedure until all antenna pairs DDM readings have been noted.

If any antenna pair measures DDM different from zero, one of the antenna pair feed cable lengths should be trimmed in order to bring the DDM reading to zero.

If the DDM reading is positive (150 Hz dominance) the antenna cable at the right hand side (A13...A24) should be trimmed.

The sensitivity of DDM versus electrical phase error of 6° (4° CS) is given in the table below:

Pair	µA DDM (6°)	% DDM (6°)
A1/A24	20.1	2.08
A2/A23	18.5	1.91
A3/A22	16.8	1.74
A4/A21	14.9	1.54
A5/A20	13.2	1.36
A6/A19	11.4	1.18
A7/A18	9.7	1.00
A8/A17	7.9	0.82
A9/A16	6.2	0.64
A10/A15	4.4	0.45
A11/A14	2.6	0.27
A12/A13	0.9	0.09

Cable trimming length: 6.2 mm/°.

4.2.5 Phase and amplitude transfer measurement

Connect each antenna cable and monitor cable to LPDA load and source respectively. Utilise a vector voltmeter or network analyser in a test set-up Figure 4-2

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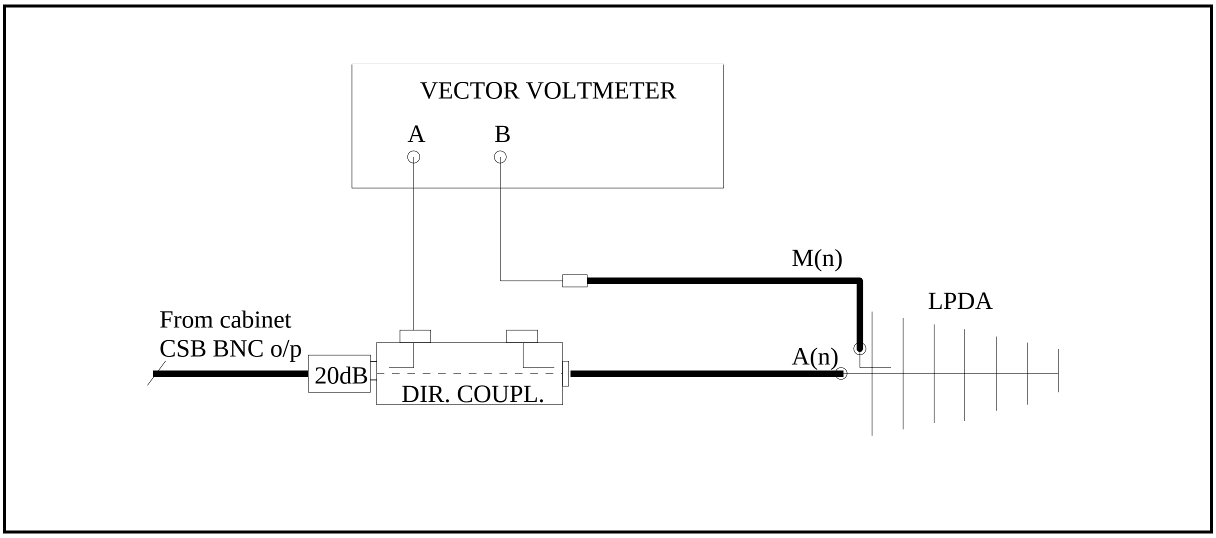

Figure 4-2 Phase and amplitude transfer measurement set-up.

Measure relative transfer phase and amplitude for each Antenna/Monitor return cable in reference to A1/M1.

Then determine if one of the monitor cables must be trimmed in order to comply with phase tolerance for the set of cables.

Tolerance: ±2°.

Amplitude tolerance: ±1.0 dB. If the amplitude tolerance is exceeded something might be wrong in the LPDA monitor circuit or connector/cable.

Record the final result in Ground Commissioning Record.

4.2.6 Antenna return loss

Utilise a vector voltmeter or network analyser in a test set-up Figure 4.3. Measure return loss for each LPDA.

Measure and record in Ground Commissioning Record the return loss value for each LPDA including antenna cable.

Tolerance: 20 dB minimum

.

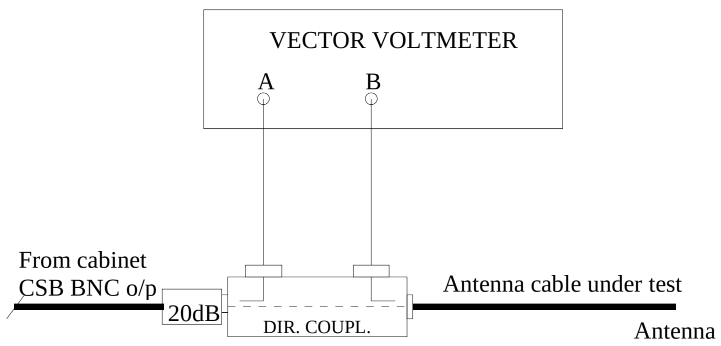

Figure 4-3 Antenna return loss measurement set-up.

4.3 Course sector width adjustments

The required course sector width (CS) can be pre-adjusted by two methods:

1. DDM measurement of ADU antenna feed outputs.

2. DDM field check.

Preferably both methods should be carried out and compared.

4.3.1 DDM check of ADU O/P

At each antenna feed output of the ADU the measured DDM is a result of the SBO/CSB ratio according to the formula

$$DDM = \frac{2 \cdot SBO}{CSB} COS\gamma$$

where

CSB is a fixed value.

SBO is adjustable by the SBO attenuator in the cabinet.

γ is 0° when the 90°-stub is inserted into the SBO.

For each course sector width (CS) of the array a set of corresponding DDM values exists unique for each antenna O/P.

For CS = 4°:

A3	-33.0%	DDM
A4	-29.3%	DDM
A5	-26.0%	DDM

For other CS values use the formula:

$$DDM_{A(n)} = \frac{DDM_{(4°)} \cdot 4°}{CS}$$

Example

A3 DDM for CS = 3.5°:

$$DDM_{A3} = \frac{-33.0 \cdot 4}{3.5} = -37\%$$

<u>PROCEDURE</u>

Turn off the clearance transmitter. Insert the 90°-stub into the course SBO path.

Connect a directional coupler with 50Ω load to antenna O/P A3.

Connect the NM3710 (use 20 dB attenuator at NM3710 I/P) to the directional coupler's forward port.

Adjust the SBO attenuator (for the Tx to air) until the DDM value equals the previously calculated value for the CS.

Move the directional coupler to A4, A5 and compare readings with calculated values. If measured DDM is lower than the calculated values for A4, A5 then increase the SBO power, or vice versa, until a fairly good matching set of values are obtained.

Adjust the SBO attenuator for the other Tx to the same setting.

Remove the 90°-stub.

4.3.2 Clearance SBO power

Switch off the course transmitter.

Insert the 90°-stub in the CLR SBO path. Connect the Field Test Set to the BNC test connector TEST 1 (antenna 13 sample) in the ADU. (Use 20...30 dB attenuator at the Field Test Set I/P).

Switch on the clearance transmitter. Adjust the CLR SBO attenuator in the cabinet (associated with Tx to air) until a reading of 36% DDM is obtained.

Carry out the same procedure for the other transmitter.

4.3.3 DDM field check

Set the localizer to normal radiation (clearance transmitter on). From the centreline of the opposite threshold determine points perpendicular to the CL 105 meter to both sides of the runway. Use the NM3710 with portable antenna and measure DDM at these points. The readings should be close to -15.5% at the 90-side and 15.5% at the 150-side. However, some unsymmetry may be expected due to reflections and tolerances in the antenna system.

Check the CL DDM at two or three positions in order to estimate an average value.

Expected value: 0.0% ±0.2% DDM.

4.4 Monitor combining unit (MCU) adjustments

4.4.1 Course Line

Connect the Field Test Set to the CL output connector of the MCU.

Adjust the CL line stretcher to obtain 0.0% DDM.

4.4.2 Course Sector

Connect the Field Test Set to the CS output of the MCU.

Adjust the CS line stretcher to obtain a reading of 15.5% DDM.

4.4.3 Clearance

Connect the Field Test Set to the CLR output connector of the MCU. Adjust the CLR line stretcher to obtain a reading of 27% DDM.

4.5 Near field monitor adjustments

The exact position of the near field monitor antenna cannot be determined until after the flight check is completed, due to possible mechanical re-alignment of the antenna array.

4.5.1 Mechanical alignment

Align the near field (NF) monitor antenna mechanically in the extended runway centreline position.

4.5.2 Final electrical position adjustment

Connect the Field Test Set to the NF monitor cable. The reading should be 0.0% DDM if the antenna is aligned correctly and no reflections appear.

Otherwise, a small mechanical re-positioning of the antenna may be necessary in order to obtain 0.0% DDM.

4.6 DC-Loop adjustment and testing

4.6.1 DC-LOOP adjustment

The DC loop (cable fault monitor) alignment is carried out accordingly to the procedure described in Monitor Alignment and Calibration chapter.

4.6.2 Antenna fault condition testing

For this test observe that the LLZ cabinet System Status indicates ALARM.

The transmitter must be on during this test.

The monitors should be in MANUAL mode in order to prevent transmitter from being shut off during the test.

Disconnect one antenna at a time and check that the LLZ cabinet System Status indicates ALARM after each antenna disconnection.

Carry out this test for all antennas.

5 NM 3526 16 Elements antenna system adjustments - LLZ

5.1 Mechanical alignments of antenna array

5.1.1 Right angle points with reference to runway centre line

The alignment of the antenna array perpendicular to the runway centreline should be carried out to an accuracy of 0.01°.

This corresponds to within 4 mm accuracy at positions antenna 1 and antenna 16. A theodolite should be utilised.

5.1.2 Spacing distance between LPDA’s

Check that the spacing between each LPDA is according to dimensions given in dwg.no. 16362A3.

Tolerance: ±5 mm.

5.1.3 Vertical alignment of LPDA support masts

On each rear support mast for LPDA check with waterlevel that mast is vertically aligned in both planes.

5.1.4 Azimuth alignment of LPDA’s

Determine a fixed point as far as possible along the extended centreline not less than approximately 3000 m from the antenna array.

On each LPDA utilise the top horizontal line composed of the two half sections of the radome to point toward the fixed point.

If necessary adjust the LPDA horizontally by adjusting the mast supports on the front mast, so that the extended radome top line ends at the fixed point.

5.2 Electrical measurements

5.2.1 CSB and SBO cables

Course Tx cables.

The CSB and SBO cable between the cabinet and MCU must be of equal electrical length. Utilise a vector voltmeter or network analyser in a test set-up as in Figure 5-1.

Measure open cable return phase for each cable.

Refer to CSB cable as zero phase and measure the return phase for the SBO cable. The cable pair must be matched within ±3.0° return phase, equal to ±1.5° true phase.

Clearance Tx cables.

Repeat the procedure 1.2.1 for CLR Tx CSB and SBO cables

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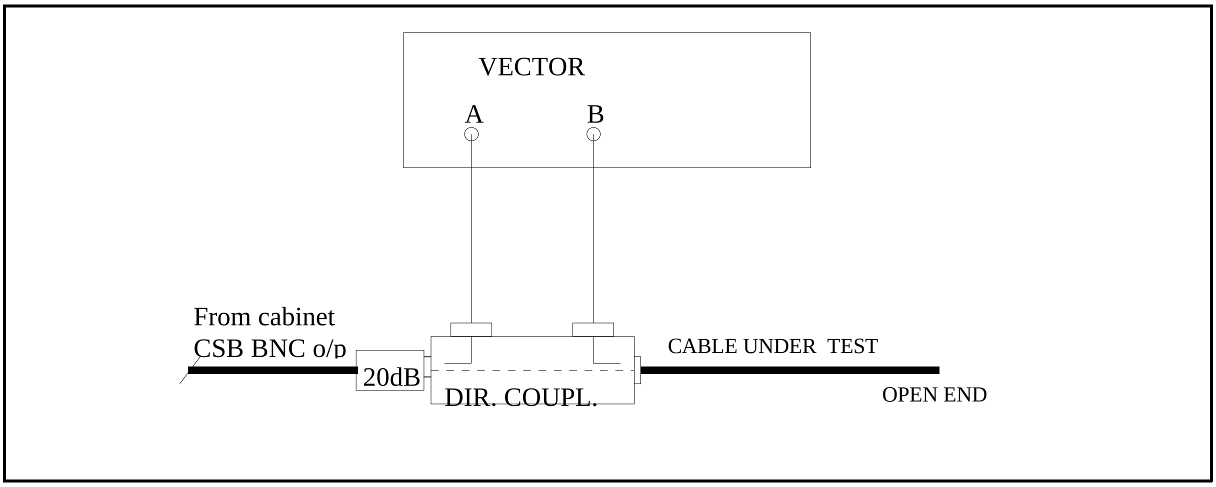

Figure 5-1 Cable phasing measurement set-up.

5.2.2 CSB/SBO phasing

NOTE

Switch off the clearance transmitter.

Ascertain that the Tx/modulator used is optimally calibrated.

Connect the NM3710 Field Test Set to the monitor BNC test connector in the ADU. (Use 20..30 dB attenuator at the I/P of the Field Test Set.)

Adjust SBO phaser in the Cabinet (associated with Tx to air) to obtain 0.0% DDM reading.

Repeat the phasing procedure for the other transmitter.

Switch off the course transmitter.

With the **clearance transmitter on** repeat the phasing procedure now adjusting the clearance SBO phaser associated with Tx to air.

5.2.3 Antenna cable lengths (Electrical phase equality)

Each antenna cable should be electrically checked before the end connector is terminated in the LPDA.

Utilise a vector voltmeter or network analyser. Establish antenna cable (A1) (leftmost seen from rear) return phase as 0° reference phase.

Measure return phase for each of the remaining antenna cables (A2...A16).

Tolerance: ±1.0° true electrical cable length.

See measurement set-up diagram Figure 5-1

5.2.4 Antenna pair phasing

NOTE

Before the antenna pair phasing procedure is commenced ascertain that the Tx/modulator used is optimally calibrated.

Switch off the clearance transmitter.

Connect the antenna cables A1 and A16 to the ADU outputs labelled A1 and A16 respectively.

Connect all other ADU outputs to dummy load. Use the NM3710 with portable test antenna.

On the the runway establish a point officially marked as the centre line for DDM measurements. Ascertain that the measurement point is not affected by reflected signals upsetting the direct received signals from the antenna pairs. This can be tested by moving the test antenna a few meters back and fourth while observing the DDM reading. If the value is not changing then the measurement position is OK.

Take a note of the DDM reading first from antenna pair A1/A16.

Connect pair A2/A15 to ADU outputs A2/A15 and disconnect pair A1/A16, dummyload A1/A16 ADU.

Take a note of the DDM reading.

Carry out this procedure until all antenna pairs DDM readings have been noted.

If any antenna pair measures DDM different from zero, one of the antenna pair feed cable lengths should be trimmed in order to bring the DDM reading to zero.

If the DDM reading is positive (150 Hz dominance) the antenna cable at the right hand side (A8...A16) should be trimmed.

The sensitivity of DDM versus electrical phase error of **2°** (4° CS) is given in the table below:

Pair	DDM µA	DDM %
A1/A16	12.6	1.30
A2/A15	7.5	0.78
A3/A14	5.7	0.59
A4/A13	4.2	0.43
A5/A12	2.8	0.29
A6/A11	2.0	0.21
A7/A10	1.1	0.11
A8/A9	0.4	0.04

The sensitivity of DDM versus electrical phase error can be estimated using the following procedure:

1. Note the DDM value reported by the operator at the Field Test Set for the antenna pair under test.

2. a) If the DDM value is positive (150 Hz dominance), insert a male-female (MF) N-adaptor (-9°) in the antenna left side seen forward toward the Field test set.

   b) If the DDM value is negative (90 Hz dominance), insert a male-female (MF) N-adaptor (-9°) in the antenna right side seen forward toward the Field test set.

3. Note the new DDM value. (This value should have oposite polarity compared to the value without the adaptor.)

4. Calculate the corresponding phase error (electrical degrees) from the formula

$$\varphi(°) = \frac{9°|DDM_1|}{|DDM_1 + DDM_3|}$$

DDM_1 : DDM (%) measured in item 1.

DDM_3 : DDM (%) measured in item 3.

(Example values from NM3523B)

Example 1:

Item 1: A1/A12: +4.3% DDM

Item 3: A1+MF/A12: -2.0% DDM (MF in A1)

$$\varphi = \frac{9° \cdot 4.3}{4.3 + 2.0} = 4.8°$$

Example 2:

Item 1: A6/A7: -0.6% DDM

Item 3: A6 /A7+MF: +1.86% DDM (MF in A7)

$$\varphi = \frac{9° \cdot 0.6}{0.6 + 1.86} = 1.7°$$

Cable trimming length: 6.2 mm/°.

5.2.5 Phase and amplitude transfer measurement

Connect each antenna cable and monitor cable to LPDA load and source respectively. Utilise a vector voltmeter or network analyser in a test set-up Figure 5-2

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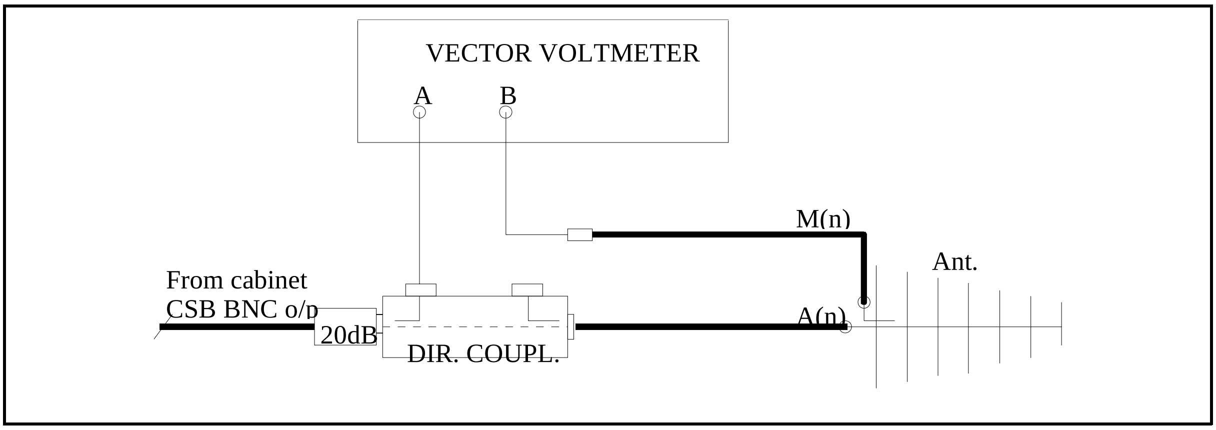

Figure 5-2 Phase and amplitude transfer measurement set-up.

Measure relative transfer phase and amplitude for each Antenna/Monitor return cable in reference to A1/M1.

Then determine if one of the **monitor** cables must be trimmed in order to comply with phase tolerance for the set of cables.

Tolerance: ±2°.

Amplitude tolerance: ±1.0 dB. If the amplitude tolerance is exceeded something might be wrong in the LPDA monitor circuit or connector/cable.

Record the final result in Ground Commissioning Record.

5.2.6 Antenna return loss

Utilise a vector voltmeter or network analyser in a test set-up Figure 5-3. Measure return loss for each LPDA.

Measure and record in Ground Commissioning Record the return loss value for each LPDA including antenna cable.

Tolerance: 20 dB minimum

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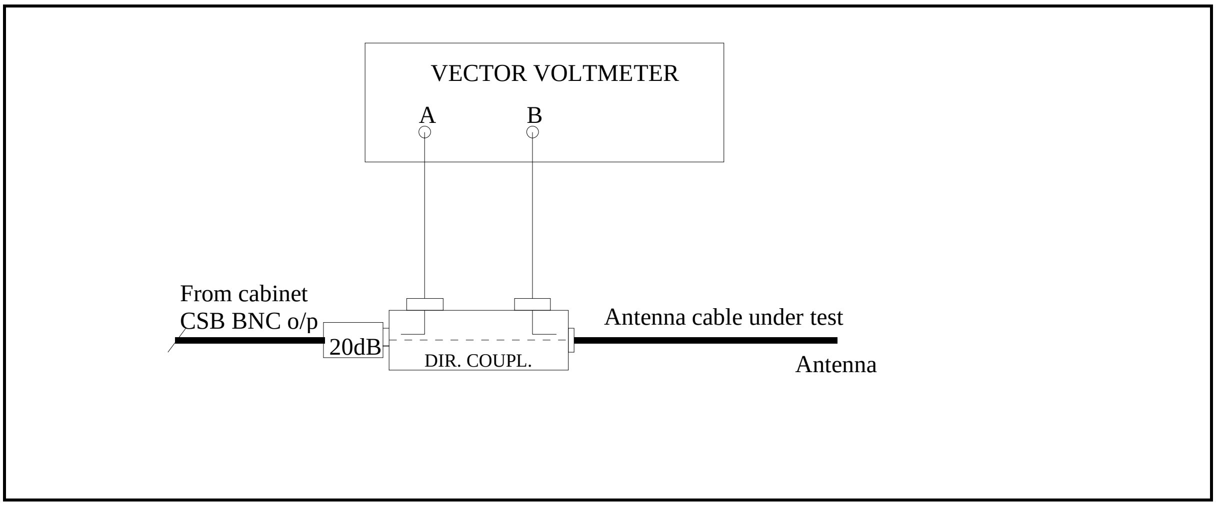

Figure 5-3 Antenna return loss measurement set-up.

5.3 Course sector width adjustment

The required course sector width (CS) can be pre-adjusted by two methods:

1. DDM measurement of ADU antenna feed outputs.
2. DDM field check.

Preferably both methods should be carried out and compared.

5.3.1 DDM check of ADU O/P

At each antenna feed output of the ADU the measured DDM is a result of the SBO/CSB ratio according to the formula

$$DDM = \frac{2 \cdot SBO}{CSB} COS\gamma$$

where

CSB is a fixed value.

SBO is adjustable by the SBO attenuator in the cabinet.

γ is 0° when the 90°-stub is inserted into the SBO and clearance transmitter is switched off.

For each course sector width (CS) of the array a set of corresponding DDM values exists unique for each antenna O/P.

For CS = **4°**:

	% DDM	µA	% SDM
A3	-33.7	-326	40.0
A4	-24.9	-241	40.0
A5	-17.9	-173	40.0

For other CS values use the formula:

$$DDM_{A(n)} = \frac{DDM_{(4°)} \cdot 4°}{CS}$$

Example

A3 DDM for CS = 3.5°:

$$DM_{(A3)} = \frac{-33.7 \cdot 4}{3.5} = 38.5\%$$

<u>PROCEDURE</u>

Turn off the clearance transmitter. Insert the 90°-stub into the course SBO path.

Connect a directional coupler with 50Ω load to antenna O/P A3.

Connect the NM3710 (use 20 dB attenuator at NM3710 I/P) to the directional coupler's forward port.

Adjust the SBO attenuator (for the Tx to air) until the DDM value equals the previously calculated value for the CS.

Move the directional coupler to A4, A5 and compare readings with calculated values. If measured DDM is lower than the calculated values for A4, A5 then increase the SBO power, or vice versa, until a fairly good matching set of values are obtained.

Adjust the SBO attenuator for the other Tx to the same setting.

Remove the 90°-stub.

5.3.2 Clearance SBO power

Switch off the course transmitter.

Insert the 90°-stub in the CLR SBO path. Connect the Field Test Set to the BNC test connector (antenna 4 sample) in the ADU. (Use 20...30 dB attenuator at the Field Test Set I/P).

Switch on the clearance transmitter. Adjust the CLR SBO attenuator in the cabinet (associated with Tx to air) until a reading of 43.6% SDM is obtained.

Carry out the same procedure for the other transmitter.

5.3.3 DDM field check

Set the localizer to normal radiation (clearance transmitter on). From the centreline of the opposite threshold determine points perpendicular to the CL 105 meter to both sides of the runway. Use the NM3710 with portable antenna and measure DDM at these points. The readings should be close to -15.5% at the 90-side and 15.5% at the 150-side. However, some unsymmetry may be expected due to reflections and tolerances in the antenna system.

Check the CL DDM at two or three positions in order to estimate an average value.

Expected value: 0.0%±0.2% DDM.

5.4 Monitor combining unit (MCU) adjustments

5.4.1 Course Line

Connect the Field Test Set to the CL output connector of the MCU.

Adjust the CL line stretcher to obtain 0.0% DDM.

5.4.2 Course Sector

Connect the Field Test Set to the CS output of the MCU.

Adjust the CS line stretcher to obtain a reading of 15.5% DDM.

5.4.3 Clearance

Connect the Field Test Set to the CLR output connector of the MCU and use the acual DDM as standard signal to the monitors.

5.5 Near field monitor adjustments

The exact position of the near field monitor antenna cannot be determined until after the flight check is completed, due to possible mechanical re-alignment of the antenna array.

5.5.1 Mechanical alignment

Align the near field (NF) monitor antenna mechanically in the extended runway centreline position.

5.5.2 Final electrical position adjustment

Connect the Field Test Set to the NF monitor cable. The reading should be 0.0% DDM if the antenna is aligned correctly and no reflections appear.

Otherwise, a small mechanical re-positioning of the antenna may be necessary in order to obtain 0.0% DDM.

5.6 DC-Loop adjustment and testing

5.6.1 DC-LOOP adjustment

The DC loop (cable fault monitor) alignment is carried out accordingly to the procedure described in Monitor Alignment and Calibration chapter.

5.6.2 Antenna fault condition testing

For this test observe that the LLZ cabinet System Status indicates ALARM.

The transmitter must be on during this test.

The monitors should be in MANUAL mode in order to prevent transmitter from being shut off during the test.

Disconnect one antenna at a time and check that the LLZ cabinet System Status indicates ALARM after each antenna disconnection.

Carry out this test for all antennas.

6 NM 3543 Null reference antenna system adjustments - Glide path

6.1 Mechanical alignment of mast and antennas

6.1.1 Preparation of mechanical- and electrical data

A ground level plot made with theodolite should be available. From this plot Forward slope (FSL) and Sideway slope (SSL) can be calculated. FSL is defined negative for falling forward slope seen from the GP mast. SSL is defined positive for rising side slope seen from the GP mast toward the runway.

In order to calculate the data needed to position the GP mast, the antenna elements and near field antenna, the following parameters must be known:

- Forward slope (FSL)
- Sideway slope (SSL)
- Sideway distance from runway centreline to GP mast
- Operating glide path angle
- GP rf channel frequency

The mechanical data outputs are:

- Antenna forward shift, same as FSL
- Antenna elements heights
- Antenna elements offsets
- Near field monitor antenna distance and height
- Threshold data

6.1.2 Forward shift (FWD)

The antennas should be vertically offset to compensate for forward slope (FSL). See Section 1, Chapter 3.6.3.

6.1.3 Antenna heights

Antenna heights shall be referenced to the intercept point of the terrain slope and the GP mast. In addition rf wave penetration a few centimetres into the soil (reflection plane) shall be included to equal the specified antenna heights. See Section 1, Chapter 3.6.3.

6.1.4 Antenna offsets.

The antenna offsets derived from (51.0) shall be accurately adjusted such that the upper element is closer to the runway than the lower element. See Section 1, Chapter 3.6.3.

6.2 Electrical measurements

6.2.1 Antenna cable lengths (Electrical phase equality)

Each antenna cable must be electrically measured before the end connector is terminated in the Antenna.

Utilise a vector voltmeter or network analyser. Establish the lower antenna cable (A1) return phase as 0° reference phase.

Measure return phase for the upper antenna cable (A2). Then take into account the phase centres of the Antenna given in the factory data sheet. Determine if one of the cables should be trimmed in order to comply with phase equality tolerance for the set of antennas.

Tolerance: ±1.0° true electrical cable length including Antenna phase centre deviation. (if available)

See measurement set-up diagram Figure 6-1

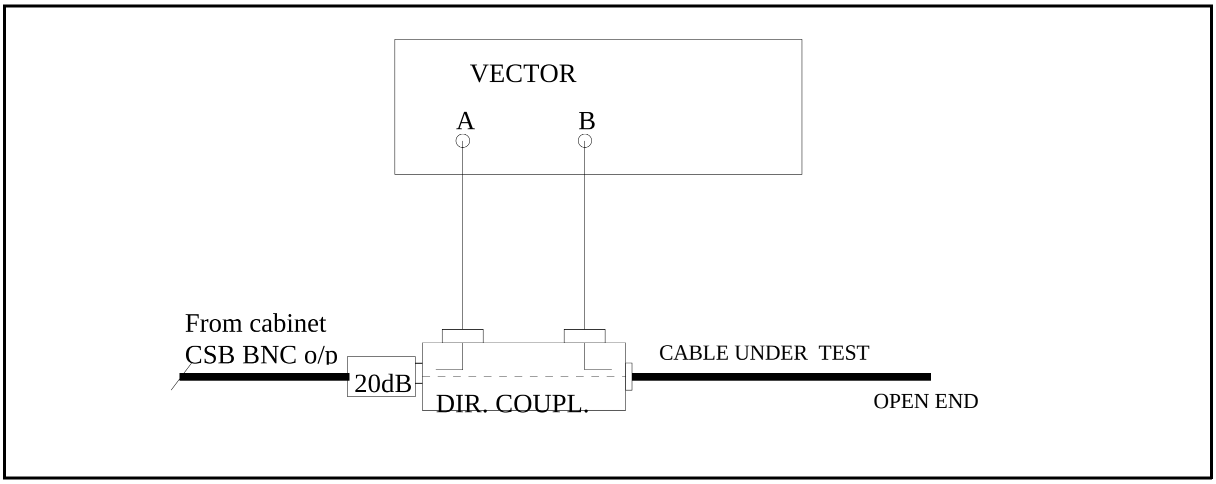

Figure 6-1 Cable phasing measurement set-up.

6.2.2 Monitor return cable length

Measure return phase as described in (52.0) for both monitor cables. Check that initial values are within ±1.5° true phase (±3.0° return phase).

6.2.3 Phase and amplitude transfer measurement

Connect each antenna cable and monitor cable to Antenna load and source respectively. Utilise a vector voltmeter or network analyser in a test set-up

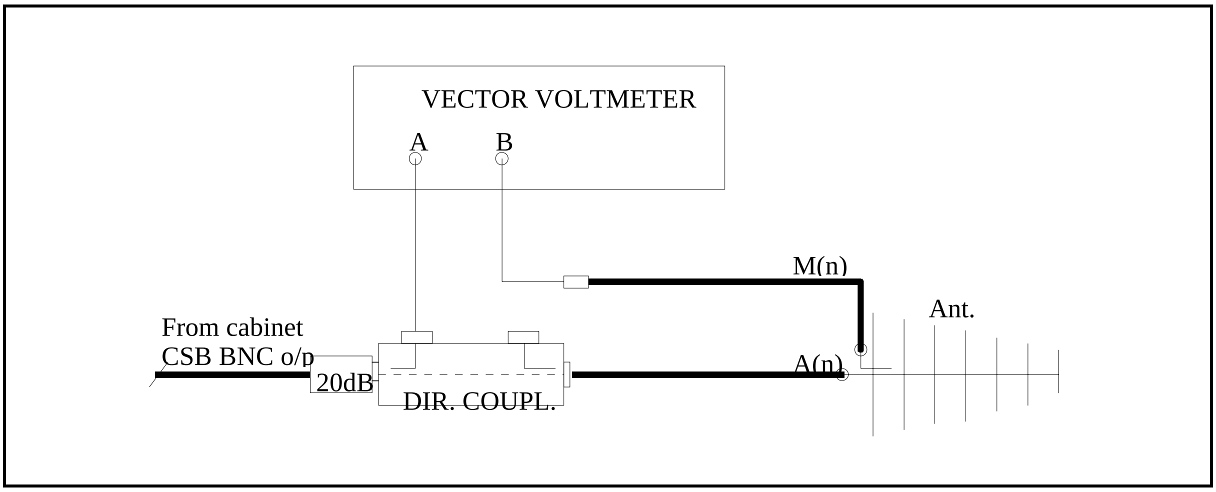

Figure 6-2 Phase and amplitude transfer measurement set-up.

Measure and record phase/amplitude for upper antenna transfer signals. Then determine if one of the monitor cables must be trimmed in order to comply with phase tolerance for the set of cables.

Tolerance: ±1°.

Amplitude tolerance: ±1.0 dB. If the amplitude tolerance is exceeded something might be wrong in the Antenna monitor circuit or connector/cable.

Record final result in Ground Commissioning Records.

6.2.4 Antenna return loss

Utilise a vector voltmeter or network analyser in a test set-up

Figure 6-3. Measure return loss for each Antenna.

Measure and record in Ground Commissioning Record the return loss value for each Antenna including antenna cable.

Tolerance: 20 dB minimum

.

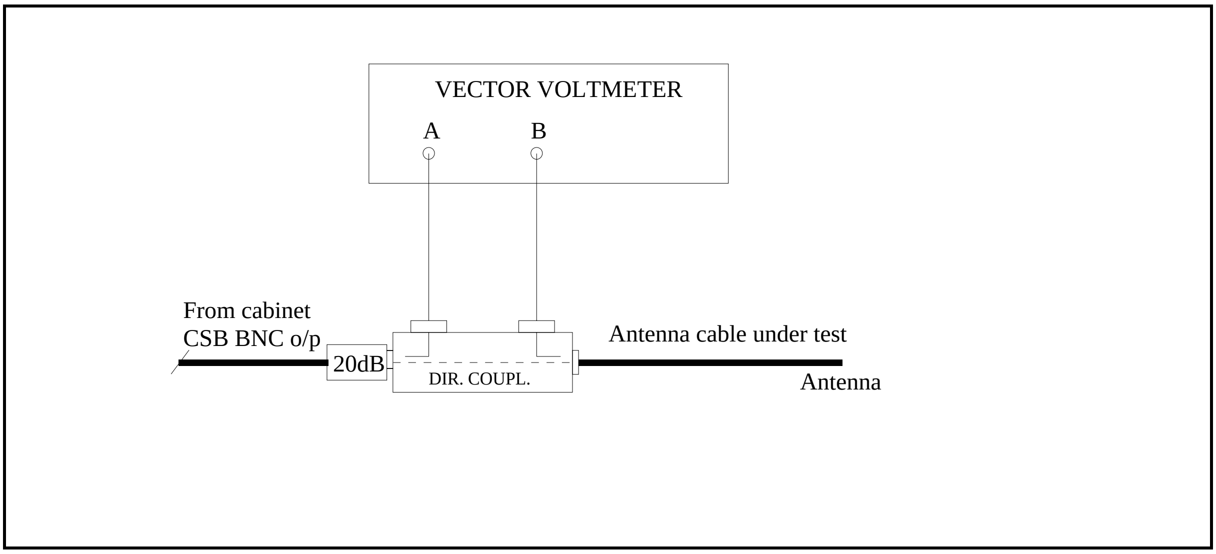

Figure 6-3 Antenna return loss measurement set-up.

6.3 CSB/SBO Phasing and sector width adjustment

See Figure 6-4

6.3.1 CSB/SBO phasing

A 180° hybrid can be utilised to adjust (preset) the phase between CSB and SBO.

Connect the O/P CSB cable from the Cabinet to port 1. Connect the O/P SBO cable from the Cabinet to port 3.

Insert the 90°-stub into the SBO path.

The hybrid port 4 is terminated in 50Ω, min. 5 watts dummy load. Port 2 is connected to a directional coupler which is terminated in 50Ω, min. 5 watts dummy load. The directional coupler forward port is connected to NM3710 Field Test Set. Use 20 dB attenuator at the BNC I/P of NM3710.

The NM3710 DDM should be 0.0%. If necessary adjust the SBO phaser of associated transmitter in the Cabinet to 0.0% DDM. Carry out the same procedure for the other transmitter.

6.3.2 Sector Width adjustment

Figure 6-4 test set-up is used. Remove the 90°-stub.

The NM3710 DDM should be 23.4%. If necessary adjust the SBO attenuator of associated transmitter in the Cabinet to obtain 23.4% DDM. Carry out the same procedure for the other transmitter.

NOTE

To compensate for a sloping terrain in front of the GP the DDM accordingly should be:

$$DDM = \frac{11.7(\theta_0 - FSL)}{\theta_0}$$

where

θ_0 is the glide path angle

FSL is forward slope, negative sign for falling terrain referred from the GP

.

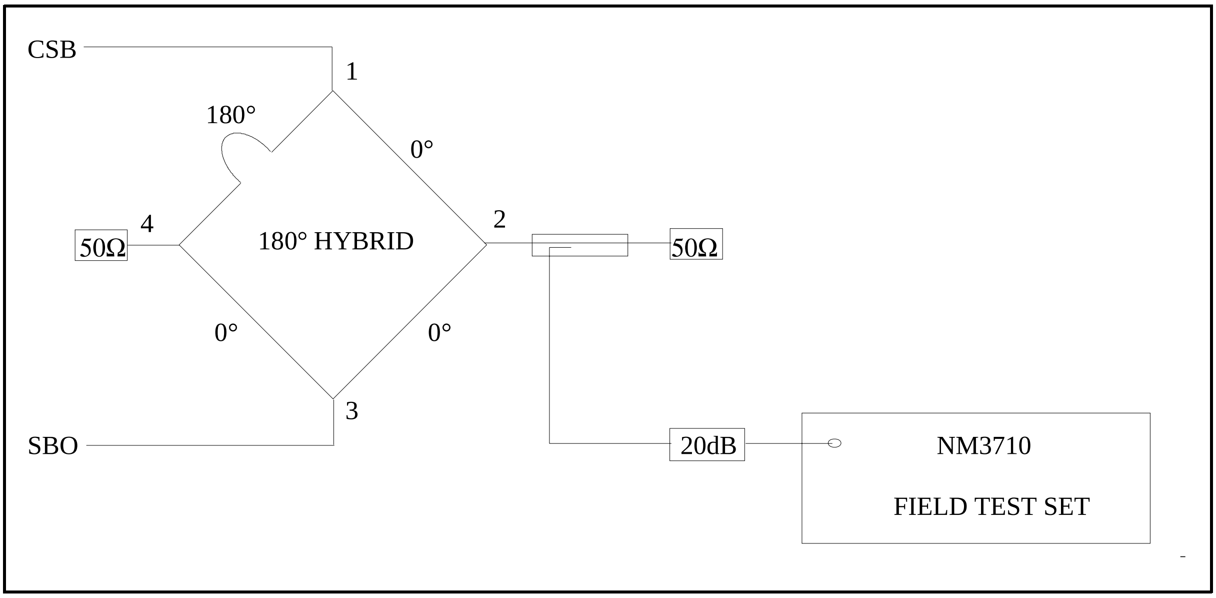

Figure 6-4 Measurement set-up for CSB/SBO phasing and Sector Width adjustment.

6.4 Monitoring combining unit (MCU) adjustments

6.4.1 Procedure

Insert the 90°/stub in the SBO output of the NM3531 Cabinet.

Connect the Field Test Set to the CL output of the MCU. Check that the reading is 0% ±0.5% DDM.

Remove the 90°-stub from the SBO path.

Connect the Field Test Set to the DS output of the MCU. Adjust the MCU attenuator at A2 to obtain 17.5% DDM.

6.5 Location of near field antenna position

According to site data (slope, etc.,) the theoretical position of the NF antenna should be calculated.

6.5.1 Near Field Monitor Position Search

Install the NF antenna at the position according to calculations (distance and height). Adjust the height to obtain 0 DDM reading on the Field Test Set connected to the NF monitor cable. (Ladder and personnel must be vacated from the NF area.)

7 NM 3544 Sideband reference antenna system adjustment - Glide path

7.1 Mechanical alignment of mast and antennas

7.1.1 Preparation of mechanical- and electrical data

A ground level plot made with theodolite should be available. From this plot Forward slope (FSL) and Sideway slope (SSL) can be calculated. FSL is defined **negative** for **falling** forward slope seen from the GP mast. SSL is defined **positive** for **rising** side slope seen from the GP mast toward the runway.

In order to calculate the data needed to position the GP mast, the antenna elements and near field antenna, the following parameters must be known:

- Forward slope (FSL)
- Sideway slope (SSL)
- Sideway distance from runway centreline to GP mast
- Operating glide path angle
- GP rf channel frequency

The mechanical data outputs are:

- Mast tilt, same as FSL
- Antenna elements heights
- Antenna elements offsets
- Near field monitor antenna distance and height
- Threshold data

7.1.2 Forward shift (FWD)

The antennas should be vertically offset to compensate for forward slope (FSL). See Section 1, Chapter 3.6.3.

7.1.3 Antenna heights

Antenna heights shall be referenced to the intercept point of the terrain slope and the GP mast. In addition rf wave penetration a few centimetres into the soil (reflection plane) shall be included to equal the specified antenna heights. See Section 1, Chapter 3.6.3.

7.1.4 Antenna offsets

The antenna offsets derived from (61.0) shall be accurately adjusted such that the Upper element is closer to the runway than the lower element. See Section 1, Chapter 3.6.3.

7.2 Initial electrical measurements

7.2.1 Antenna cable lengths (Electrical phase equality)

Each antenna cable must be electrically measured before the end connector is terminated in the Antenna.

Utilise a vector voltmeter or network analyser. Establish the lower antenna cable (A1) return phase as 0° reference phase.

Measure return phase for the upper antenna cable (A2). Then take into account the phase centres of the Antenna given in the factory data sheet. Determine if one of the cables should be trimmed in order to comply with phase equality tolerance for the set of antennas.

Tolerance: ±1.0° true electrical cable length including Antenna phase centre deviation. (if available)

See measurement set-up diagram Figure 7-1 below
:

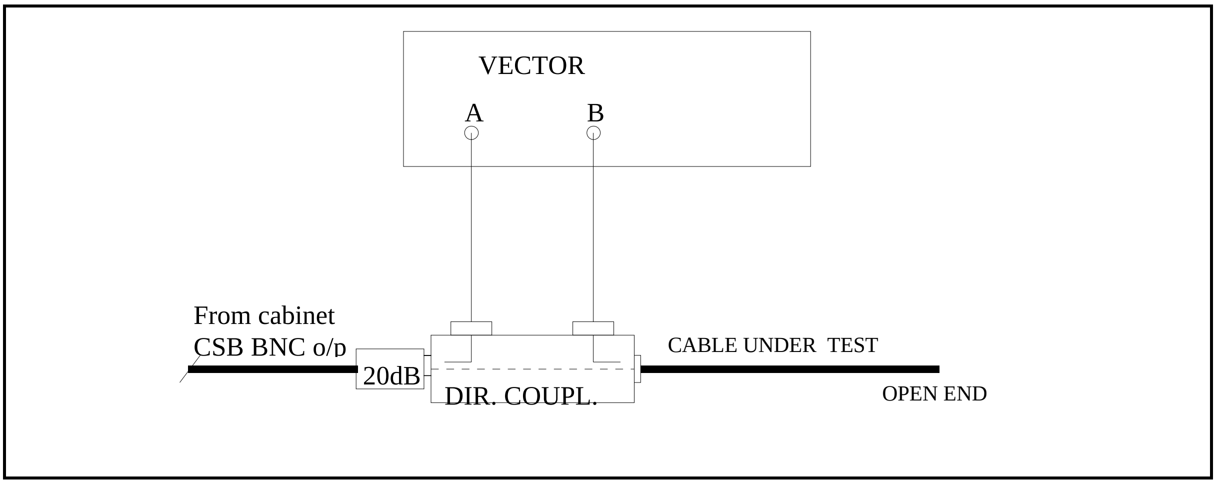

Figure 7-1 Cable phasing measurement set-up.

7.2.2 Monitor return cable length

Measure return phase as described in (62.0) for both monitor cables. Check that initial values are within ±1.5° true phase (±3.0° return phase).

7.2.3 Phase and amplitude transfer measurement

Connect each antenna cable and monitor cable to Antenna load and source respectively. Utilise a vector voltmeter or network analyser in a test set-up Figure 7-2, and measure relative transfer phase and amplitude for the upper antenna cable (A2) in reference to the lower antenna (A1).

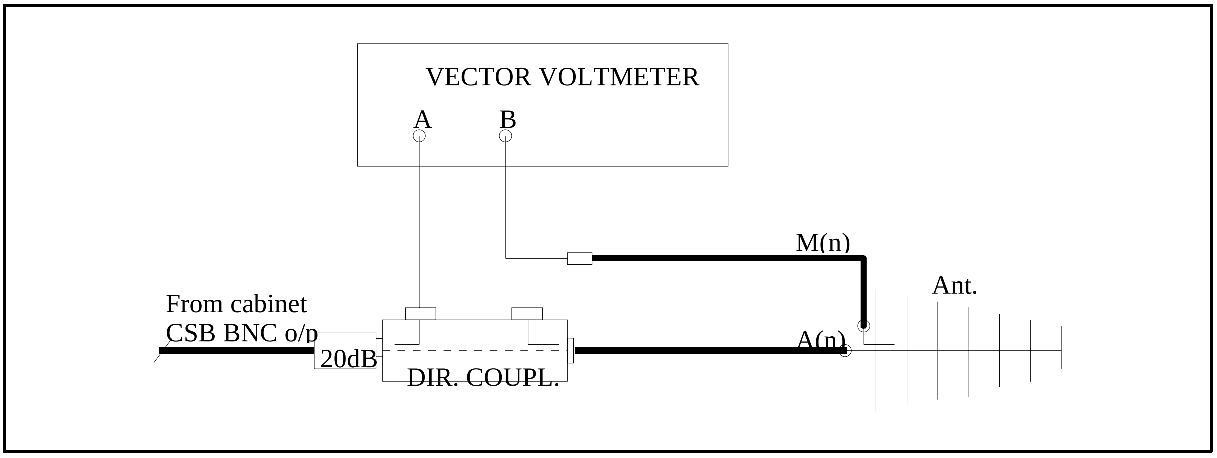

Figure 7-2 Phase and amplitude transfer measurement set-up.

Measure and record phase/amplitude for upper antenna transfer signals. Then determine if one of the monitor cables must be trimmed in order to comply with phase tolerance for the set of cables.

Tolerance: ±1°.

Amplitude tolerance: ±1.0 dB. If the amplitude tolerance is exceeded something might be wrong in the Antenna monitor circuit or connector/cable.

Record final result in Ground Commissioning Record.

7.2.4 Antenna return loss

Utilise a vector voltmeter or network analyser in a test set-up Figure 7-3. Measure return loss for each Antenna.

Measure and record in Ground Commissioning Record the return loss value for each Antenna including antenna cable.

Tolerance: 20 dB minimum

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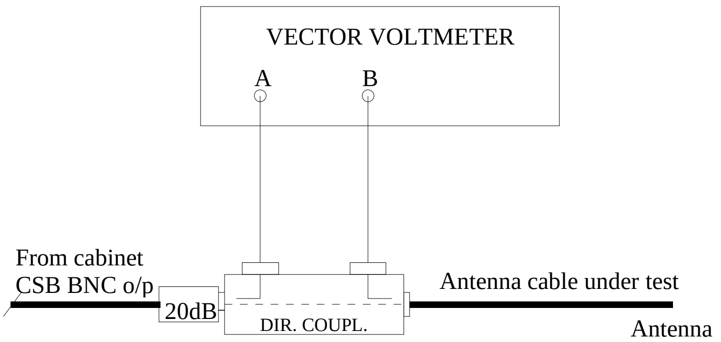

Figure 7-3 Antenna return loss measurement set-up.

7.3 CSB/SBO Phasing

7.3.1 CSB and SBO cables

The CSB and SBO cable between NM3531 cabinet and MCU must be of equal electrical length. Utilise a vector voltmeter or network analyser in a test set-up as in Figure 7-1.

Measure open cable return phase for each cable.

Refer to CSB cable as zero phase and measure the return phase for the SBO cable. The cable pair must be matched within ±3.0° return phase, equal to ±1.5° true phase.

7.3.2 CSB/SBO phasing

Insert the 90°-stub in the SBO cable path to the ADU. Connect the NM3710 Field Test Set to the monitor return cable (M1) from the lower antenna.

Adjust SBO phaser in the Cabinet (associated with Tx to air) to obtain 0 DDM reading.

Repeat the phasing procedure for the second transmitter.

Remove the 90°-stub from the SBO path.

7.4 Sector width adjustment

7.4.1 SBO power adjustment

Connect the Field Test Set to the monitor return cable (M1) from the lower antenna.

Adjust the SBO step attenuator in the cabinet (associated with Tx to air) to obtain the prescribed DDM value.

For a perfect flat terrain the DDM in A1 (M1) should be -11.7%.

NOTE

To compensate for a sloping terrain in front of the GP the DDM accordingly should be:

$$DDM = \frac{-11.7(\theta_0 - FSL)}{\theta_0}$$

where θ is the glide path angle

FSL is forward slope, **negative for falling** terrain referred from the GP.

Repeat the SBO attenuator adjustment for the second transmitter.

7.5 Monitor combining unit (MCU) adjustments

7.5.1 Procedure for horizontal terrain (FSL = 0°)

Connect the Field Test Set to the CL output of the MCU. Adjust the MCU phaser at A1 (lower antenna) to read 0% DDM.

Remove the 90°-stub from the SBO path. Adjust the MCU attenuator at A1 to read 0% DDM at the CL output.

Connect the Field Test Set to the DS output of the MCU. Read the DDM value. This should be 8.75% DDM unless a SBO power compensation for sloping foreground and K3, K4 cable length compensation has been taken into account (See **1.5.2**).

7.5.2 Procedure for sloping terrain (1° > FSL > -1°)

If the terrain in front of the GP is not horizontal, cable lengths K3 and K4 should be changed in accordance with the table below:

FSL (°)	K3 (mm)	K4 (mm)	DS DDM (%)
1.0	-27	-18	10.3
0.9	-23	-15	10.1
0.8	-19	-13	9.9
0.7	-16	-11	9.7
0.6	-13	-9	9.5
0.5	-11	-7	9.4
0.4	-8	-5	9.3
0.3	-6	-4	9.2
0.2	-4	-3	9.0
0.1	-2	-2	8.9
0.0	0	0	8.75
-0.1	2	1	8.6
-0.2	3	2	8.5
-0.3	5	3	8.4
-0.4	6	4	8.3
-0.5	8	5	8.2
-0.6	9	6	8.1
-0.7	10	7	8.0
-0.8	11	7	7.9
-0.9	12	8	7.8
-1.0	13	9	7.8

FSL (+) : Upsloping terrain.

(-) mm means shorter cable.

After cable length modification carry out procedure **1.5.1**. Note that DS DDM after adjustment should correspond to the value given in the table above (column 4). However, the final DS DDM value depends on the SBO power setting of the Tx SBO attenuator.

7.6 Location of near field antenna position

According to site data (slope, etc.,) the theoretical position of the NF antenna should be calculated.

Install the NF antenna at the position according to calculations (distance and height). Adjust the height to obtain 0% DDM reading on the Field Test Set connected to the NF monitor cable. (Ladder and personnel must be vacated from the NF area.)

Theoretically, DDM should be close to -0.9% DDM (90) as a minimum value due to path loss differences between antennas seen from the NF antenna.

7.6.1 Near Field Monitor Position Search

A de-phasing test procedure of upper antenna (A2) can be carried out in order to search for the optimum monitor position.

An "elbow" type N-adapter (-21°) is inserted in the lower antenna feed (A1). This is equivalent to advance (+) phase of the upper antenna.

Retard (-) phase is introduced by inserting the "elbow" adapter in A2 only.

The DDM readings and correlation of the monitor antenna signal to the CL integral from MCU (far field) should theoretically be:

Dephasing	Near Field (NF)	Far field (CL)
21° retard	-13µA/-1.5% DDM	-11µA/-1.3% DDM
21° advance	-11µA/-1.3% DDM	-13µA/-1.5% DDM

NOTE

The values at the NF position are normalised, i.e. 0 DDM with no A2 dephasing.

In order to look for the optimal distance between the GP mast and the NF antenna carry out the following test:

Measure DDM at positions +1 m and -1 m of original position. Then compare the results with the theoretical values for these offsets from the nominal 180° position, as denoted below:

Dephasing	NF 1 m forward	NF 1 m backward
21° retard	-19µA/-2.2% DDM	-9µA/-1.1% DDM
21° advance	-7µA/-0.8% DDM	-16µA/-1.9% DDM

NOTE

When moving the NF antenna position backward and forward take into account the offset DDM for no de-phasing, i.e. normalise the values before comparing to theoretical values.

Based on the comparing results then determine the best correlated position for the NF monitor antenna.

7.7 *Antenna distribution unit (ADU) phase and amplitude check*

This check is optional.

7.7.1 Preparation

Utilise a vector voltmeter in a test set-up Figure 7-4
.

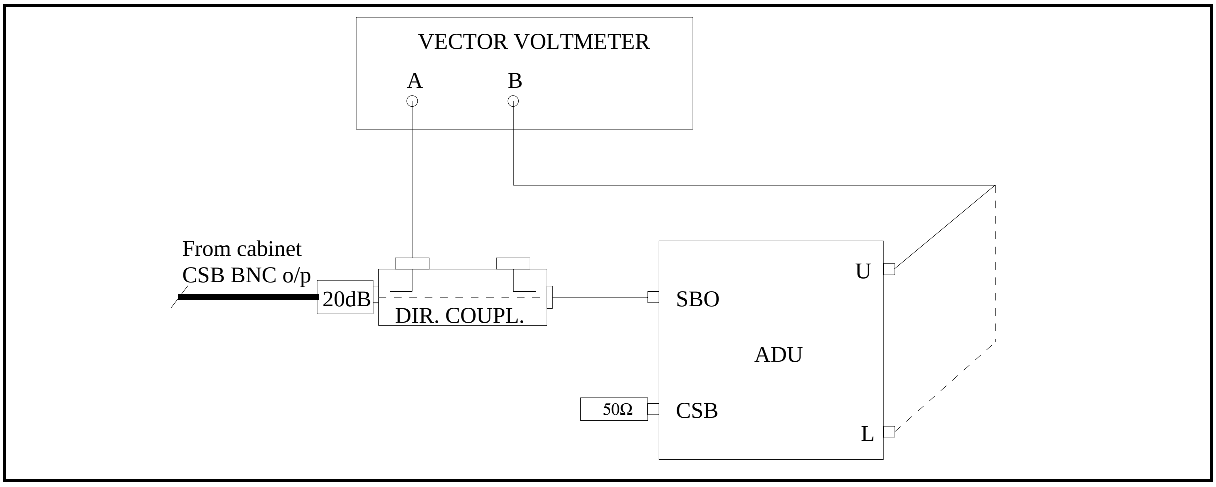

Figure 7-4 Test set-up for ADU Phase and Amplitude check.

Connect CSB and SBO outputs from Cabinet to dummy loads. Terminate the disconnected cables from ADU to dummy loads.

Switch off the modulation to the transmitter used for the test.

Insert a 20 dB attenuator at the input port of the directional coupler.

Connect a test cable from the Cabinet’s CSB BNC connector to the 20 dB attenuator.

Connect the vector voltmeter A-probe to the directional coupler’s forward O/P.

7.7.2 Procedure

1. Connect the cable TEST SIG (throughput from the directional coupler) to the ADU **SBO** I/P.

   Connect the B-probe to **L** O/P. Note the B-probe RF level (dB). (0.1 dB resolution)

   Move the B-probe to **U** O/P. If necessary adjust phaser PH1 (AMPLITUDE ADJ) to obtain 0.0 dB difference referenced to **L** O/P.

NOTE

If PH1 has been adjusted recheck the reference level from L O/P and measure again the U O/P level. Repeat until 0.0 dB difference is achieved.

2. Connect the cable TEST SIG to the **SBO** input. Connect the B-probe to **L** O/P. Adjust the

vector voltmeter to 0° reference phase.

Move the B-probe to **U** O/P. If necessary adjust SBO U/L phaser (PH2) to obtain 180° reading at the **U** O/P.

NOTE

If PH2 has been adjusted recheck the reference phase from L O/P and measure again the U phase. Repeat until 180° phase difference is achieved.

End of check.

8 NM 3545 M-Array antenna system adjustments - Glide path

8.1 Mechanical alignment of mast and antennas

8.1.1 Preparation of mechanical- and electrical data

A ground level plot made with theodolite should be available. From this plot Forward slope (FSL) and Sideway slope (SSL) can be calculated. FSL is defined **negative** for **falling** forward slope seen from the GP mast. SSL is defined **positive** for **rising** side slope seen from the GP mast toward the runway.

In order to calculate the data needed to position the GP mast, the antenna elements and near field antenna, the following parameters must be known:

- Forward slope (FSL)
- Sideway slope (SSL)
- Sideway distance from runway centreline to GP mast
- Operating glide path angle
- GP rf channel frequency

The mechanical data outputs are:

- Mast tilt, same as FSL
- Antenna elements heights
- Antenna elements offsets
- Near field monitor antenna distance and height
- Threshold data

8.1.2 Forward shift (FWD)

The antennas should be vertically offset to compensate for forward slope (FSL). See Section 1, Chapter 3.6.3.

8.1.3 Antenna heights

Antenna heights shall be referenced to the intercept point of the terrain slope and the GP mast. In addition rf wave penetration a few centimetres into the soil (reflection plane) shall be included to equal the specified antenna heights. See Section 1, Chapter 3.6.3.

8.1.4 Antenna offsets

The antenna offsets derived from (71.0) shall be accurately adjusted such that the upper element is closer to the runway than the lower element. See Section 1, Chapter 3.6.3.

8.2 Initial electrical measurements

8.2.1 Antenna cable lengths (Electrical phase equality)

Each antenna cable must be electrically measured before the end connector is terminated in the Antenna.

Utilise a vector voltmeter or network analyser. Establish the lower antenna cable (A1) return phase as 0° reference phase.

Measure return phase for the middle antenna cable (A2) and upper antenna cable (A3). Then take into account the phase centres of the Antennas given in the factory data sheet. Determine if one of the cables should be trimmed in order to comply with phase equality tolerance for the set of antennas.

Tolerance: ±1.0° true electrical cable length including Antenna phase centre deviation. (if available)

See measurement set-up diagram Figure 8-1 below:

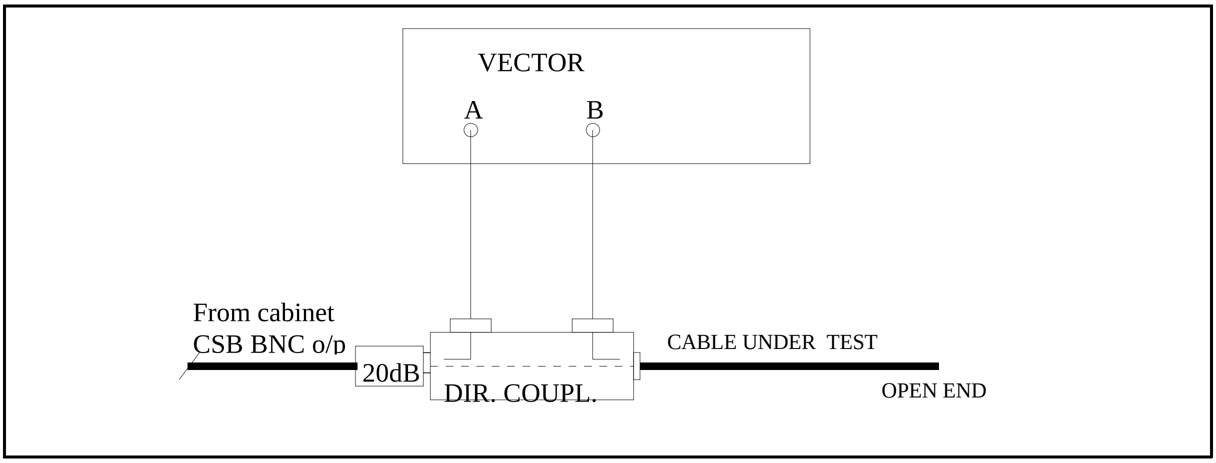

Figure 8-1 Cable phasing measurement set-up.

8.2.2 Monitor return cable length

Measure return phase as described in (72.0) for all three monitor cables. Check that initial values are within ±1.5° true phase (±3.0° return phase).

8.2.3 Phase and amplitude transfer measurement

Connect each antenna cable and monitor cable to Antenna load and source respectively. Utilise a vector voltmeter or network analyser in a test set-up Figure 8-2, and measure relative transfer phase and amplitude for the middle and upper antenna cable (A2 & A3) in reference to the lower antenna (A1)

.

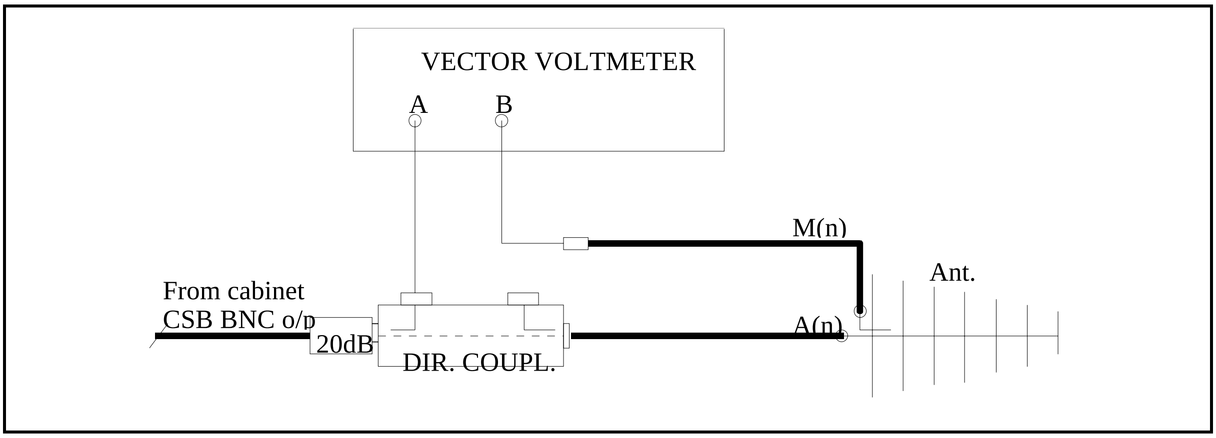

Figure 8-2 Phase and amplitude transfer measurement set-up.

Measure and record phase/amplitude for upper antenna transfer signals. Then determine if one of the monitor cables must be trimmed in order to comply with phase tolerance for the set of cables.

Tolerance: ±1°.

Amplitude tolerance: ±1.0 dB. If the amplitude tolerance is exceeded something might be wrong in the Antenna monitor circuit or connector/cable.

Record final result in Ground Commissioning Records.

8.2.4 Antenna return loss

Utilise a vector voltmeter or network analyser in a test set-up Figure 8-3. Measure return loss for each Antenna.

Measure and record in Ground Commissioning Record the return loss value for each Antenna including antenna cable.

Tolerance: 20 dB minimum

.

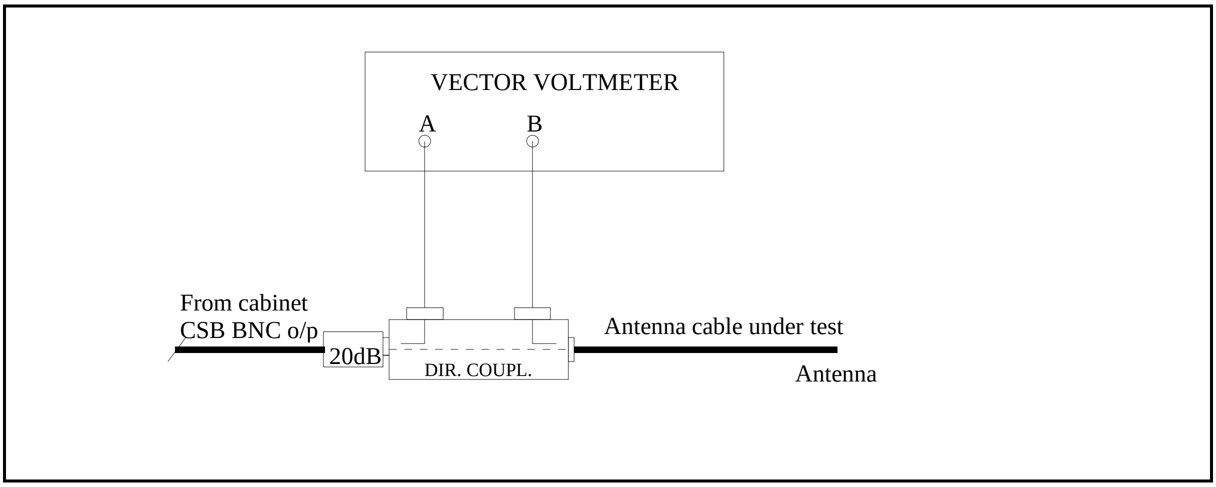

Figure 8-3 Antenna return loss measurement set-up.

8.3 CSB/SBO Phasing

8.3.1 CSB and SBO cables

The CSB and SBO cable between NM3531 cabinet and MCU must be of equal electrical length. Utilise a vector voltmeter or network analyser in a test set-up as in Figure 8-1.

Measure open cable return phase for each cable.

Refer to CSB cable as zero phase and measure the return phase for the SBO cable. The cable pair must be matched within ±3.0° return phase, equal to ±1.5° true phase.

8.3.2 CSB/SBO phasing

Insert the 90°-stub in the SBO cable path to the ADU. Connect the NM3710 Field Test Set to the monitor return cable (M1) from the lower antenna.

Adjust SBO phaser in the Cabinet (associated with Tx to air) to obtain 0 DDM reading.

Repeat the phasing procedure for the second transmitter.

Remove the 90°-stub from the SBO path.

8.4 Sector width adjustment

8.4.1 SBO power adjustment

Connect the Field Test Set to the monitor return cable (M1) from the lower antenna.

Adjust the SBO step attenuator in the cabinet (associated with Tx to air) to obtain the prescribed DDM value.

For a perfect flat terrain the DDM in A1 (M1) should be -11.7%.

NOTE. To compensate for a sloping terrain in front of the GP the DDM accordingly should be:

$$DDM = \frac{-11.7(\theta_0 - FSL)}{\theta_0}$$

where θ is the glide path angle

FSL is forward slope, **negative for falling** terrain referred from the GP.

Repeat the SBO attenuator adjustment for the second transmitter.

8.5 Monitor combining unit (MCU) MOA 338D adjustments

Monitor Combining Unit MOA338D is equipped with plug-in attenuators dependent upon forward slope, according to the following table (AT6 is common for all FSL):

FSL rel.to θ_0	Equiv.FSL in degrees for θ_0= 3°	AT3 Type	AT4 Type	AT5 Type	AT7 Type
$-0.2\theta_0 \pm 0.05\theta_0$	-0.6° ± 0.15°	AT1305B	AT1305G	AT1305 M	AT1305S
$-0.1\theta_0 \pm 0.05\theta_0$	-0.3° ± 0.15°	AT1305C	AT1305H	AT1305N	AT1305T
$0.0\theta_0 \pm 0.05\theta_0$	0.0° ± 0.15°	AT1305D	AT1305J	AT1305P	AT1305U
$+0.1\theta_0 \pm 0.05\theta_0$	+0.3° ± 0.15°	AT1305E	AT1305K	AT1305Q	AT1305V
$+0.2\theta_0 \pm 0.05\theta_0$	+0.6° ± 0.15°	AT1305F	AT1305L	AT1305B	AT1305 W

Make sure that correct attenuators are installed for the actual site.

8.5.1 Adjustments procedure

The Clearance transmitter shall be switched off during steps a) through e) below.

1. Connect the Field Test Set to the CL output of the MCU. Insert the 90° stub in the SBO output of the Transmitter Cabinet. In the Antenna Distribution Unit (ADU), disconnect SBO to Lower antenna by using the SBO-L link. Terminate open ends. Adjust Upper antenna phaser PH1 in MCU to give 0% DDM.

2. Reconnect SBO to Lower antenna. Remove the 90° stub. Adjust CL attenuator AT1 in MCU to give 0 % DDM.

3. Connect the Field Test Set to the DS output of the MCU. Insert the 90° stub in the SBO output of the Transmitter Cabinet. Adjust Middle antenna phaser PH2 in MCU to give 0% DDM.

4. Remove the 90° stub. Adjust DS attenuator AT2 in MCU to give 8.75% DDM (75µA), 150 Hz dominance.

5. Connect the Field Test Set to the CLR output of the MCU. Adjust phaser PH3 in MCU to maximum DDM (150 Hz dominance).

6. Turn on CLR transmitter. Check that sufficient 150Hz dominance remains.

8.6 Location of near field antenna position

According to site data (slope, etc.,) the theoretical position of the NF antenna should be calculated.

Install the NF antenna at the position according to calculations (distance and height). Adjust the height to 0 DDM reading on the Field Test Set connected to the NF monitor cable. (Ladder and personnel must be removed from the NF area.)

8.6.1 Near Field Monitor Position Search

A de-phasing test procedure of upper antenna (A3) can be carried out in order to search for the optimum monitor position.

A N-type adapter (-27°) (made from a male-male and female-female adapter put together) is inserted in the lower antenna feed (A1) and middle antenna feed (A2). This is equivalent to advance (+) phase of the upper antenna.

Retard (-) phase is introduced by inserting the adapter in upper antenna feed A3 only.

The DDM readings and correlation of the monitor antenna signal to the CL integral from MCU (far field) should theoretically be:

Dephasing	Near Field (NF)	Far field (CL)
27° retard	-12µA/-1.4% DDM	-11µA/-1.3% DDM
27° advance	-9µA/-1.1% DDM	-11µA/-1.3% DDM

NOTE

The values at the NF position are normalised, i.e. 0 DDM with no A3 dephasing.

In order to look for the optimal distance between the GP mast and the NF antenna carry out the following test:

Measure DDM at positions +1 m and -1 m of original position. Then compare the results with the theoretical values for these offsets from the nominal 360° position, as denoted below:

Dephasing	NF 1 m forward	NF 1 m backward
27° retard	-16µA/-1.9% DDM	-9µA/-1.1% DDM
27° advance	-5µA/-0.6% DDM	-12µA/-1.4% DDM

NOTE

When moving the NF antenna position backward and forward take into account the offset DDM for no de-phasing, i.e. normalise the values before comparing to theoretical values.

Based on the comparing results then determine the best correlated position for the NF monitor antenna.

8.7 Antenna distribution unit (ADU) DIA 346A phase and amplitude check

This check is optional. If it is carried out, it should preferably be executed prior to step 8.3.

8.7.1 Preparation

Use a vector voltmeter in a test set-up figure 8-4

.

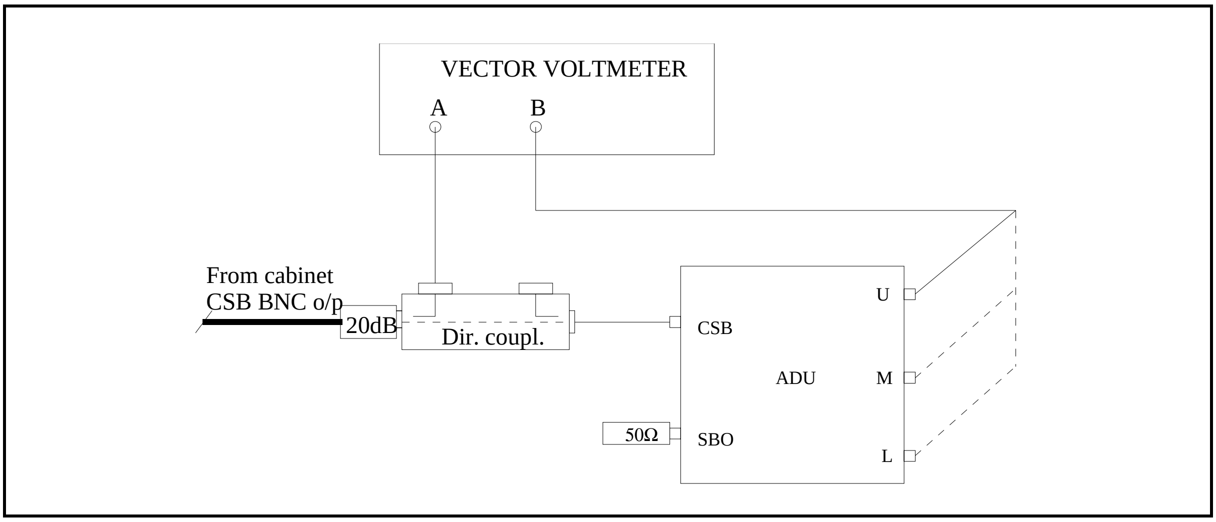

Figure 8-4 Test set-up for ADU Phase and Amplitude check.

Connect CSB and SBO outputs from Cabinet to dummy loads. Terminate the disconnected cables from ADU to dummy loads.

The clearance transmitter shall be switched off.

Switch off the modulation to the transmitter used for the test.

Insert a 20 dB attenuator at the input port of the directional coupler.

Connect a test cable from the Cabinet's CSB BNC connector to the 20 dB attenuator.

Connect the vector voltmeter A-probe to the directional coupler's forward output.

8.7.2 Procedure

1. Connect the cable TEST SIG (throughput from the directional coupler) to the ADU **CSB** input.

   Connect the B-probe to **L** output. Note the B-probe RF level (dB). (0.1 dB resolution)

   Move the B-probe to **M** output. If necessary adjust phaser D1 to obtain -6.0 dB difference referenced to **L** output.

NOTE

If D1 has been adjusted recheck the reference level from L output and measure again the M output level. Repeat until -6.0 dB difference is achieved.

2. Connect the cable TEST SIG to the SBO input. Connect the B-probe to **U** output. Note the level.

   Move the B-probe to the **L** output. If necessary adjust phaser D3 to obtain 0.0 dB difference referenced to **U** output.

NOTE

If D3 has been adjusted recheck the reference level from U output and measure again the L output level. Repeat until 0.0 dB difference is achieved.

3. Connect the B-probe to **M** output. Note the level.

   Move the B-probe to **L** output.

   If necessary adjust phaser D2 to obtain -6.0 dB difference referenced to **M** output.

NOTE

If D2 has been adjusted recheck the reference level from L output and measure again the M Oout-put level. Repeat until -6.0 dB difference is achieved.

4. Connect the cable TEST SIG to the **SBO** input. Connect the B-probe to **M** output. Adjust the vector voltmeter to 0° reference phase.

   Move the TEST SIG cable to the **CSB** input. Check that the phase is 180° ±2°.

5. Connect the B-probe to **L** output. If necessary adjust LOWER ANT phaser (PH1) for 0° phase.

6. Connect the cable TEST SIG to the **SBO** input. If necessary adjust SBO U/L phaser (PH2) to obtain 180° reading at the **L** output.

7. Connect the B-probe to **U** output. If necessary adjust UPPER ANT phaser (PH3) to obtain 180°. (same phase as in f).

9 NM 3561 Single antenna system adjustments - MKR

9.1 Mechanical alignment

9.1.1 Antenna mast

Utilise a waterlevel and align the mast vertically by adjustments of the base nuts.

9.2 Electrical measurements

9.2.1 Antenna return loss

Utilise a vector voltmeter or network analyser in a test set-up.

Measure return loss for the LPDA.

Measure the return loss value for the LPDA including antenna cable.

Tolerance: 22 dB minimum

.

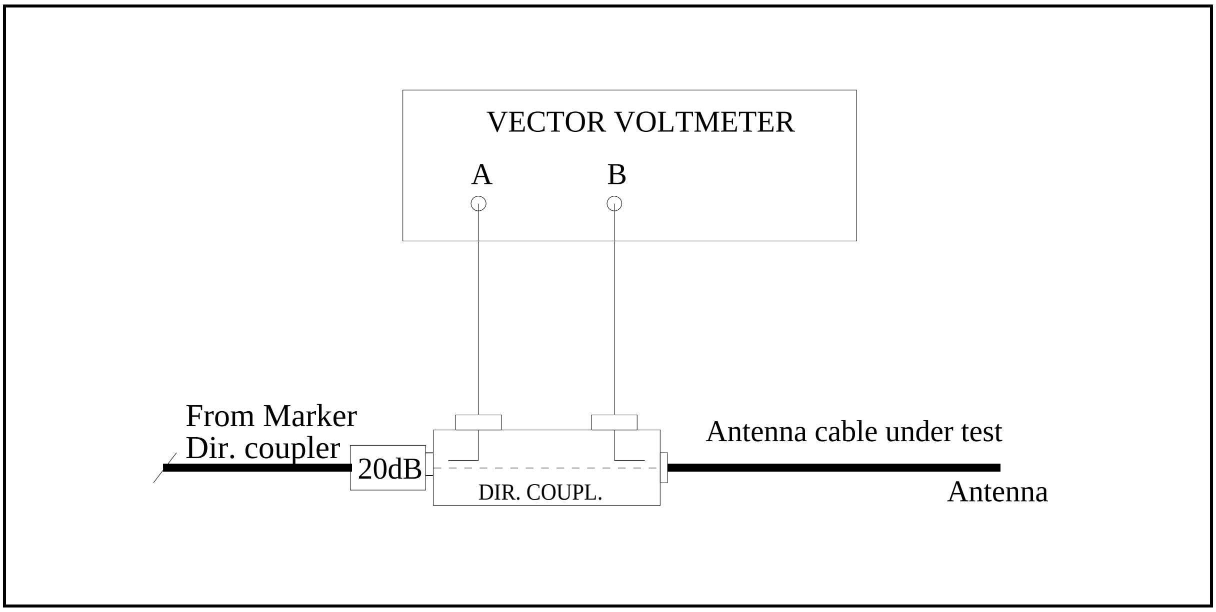

Figure 9-1 Antenna return loss measurement set-up.

10 NM 3562 Dual antenna system adjustments - MKR

10.1 Mechanical alignment

10.1.1 Antenna mast

Utilise a waterlevel and align the mast vertically by adjustments of the base nuts.

10.2 Electrical measurements

WARNING

If the attenuator module in the Marker unit is configured for 0 dB then the RF output power is in the range of 2...5 watts. Take care of not to overload the vector voltmeter.

Connect a directional coupler terminated in 50* 10W to the N output connector of the Marker. Then use the forward coupled port as the signal source for the measurements.

Always use a 20 dB attenuator at the I/P of the directional coupler in Fig. 1,2 and 3.

10.2.1 Antenna cable lengths (Electrical phase equality)

Each antenna cable must be electrically measured before the end connector is terminated in the LPDA.

Utilise a vector voltmeter or network analyser. Establish antenna cable (A1) return phase as 0° reference phase.

Measure return phase for the other antenna cable (A2). Then take into account the phase centres of the LPDA's given in the factory data sheet.

Tolerance: ±1.5° true electrical cable length.

See measurement set-up diagram Figure 10-1 below:

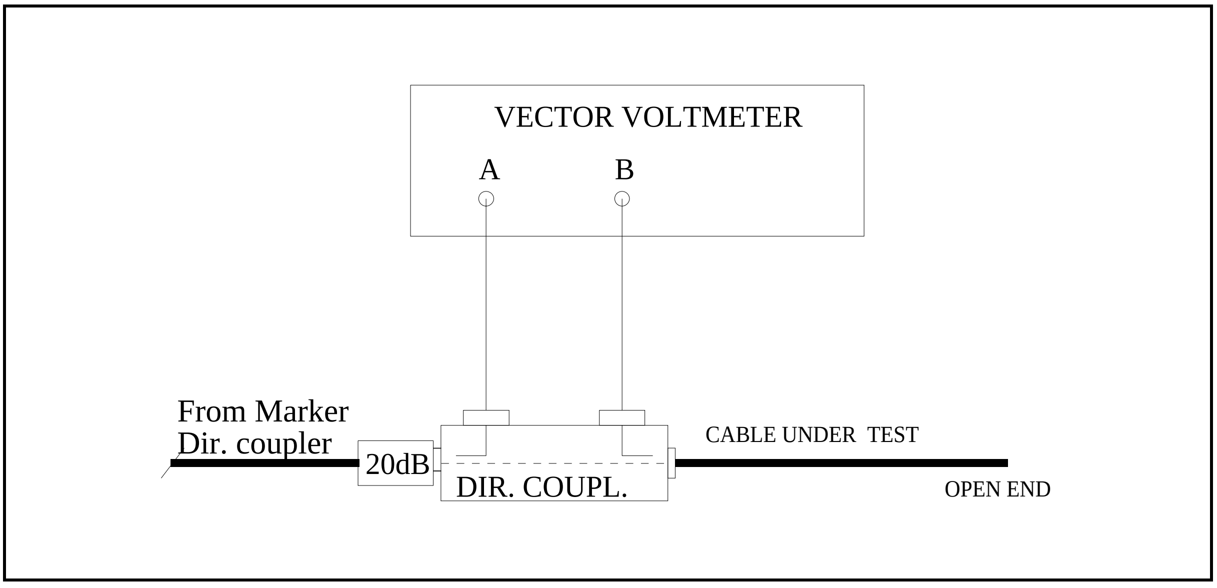

Figure 10-1 Cable phasing measurement set-up.

10.2.2 Monitor return cable length

Measure return phase as described in (8.2.1) for both monitor cables. Check that initial values are within ±1.5° true phase (±3.0° return phase).

10.2.3 Phase and amplitude transfer measurement

Connect each antenna cable and monitor cable to LPDA load and source respectively. Utilise a vector voltmeter or network analyser in a test set-up

Figure 10-2, and measure relative transfer phase and amplitude for the antenna cable (A2) in reference to antenna (A1)

.

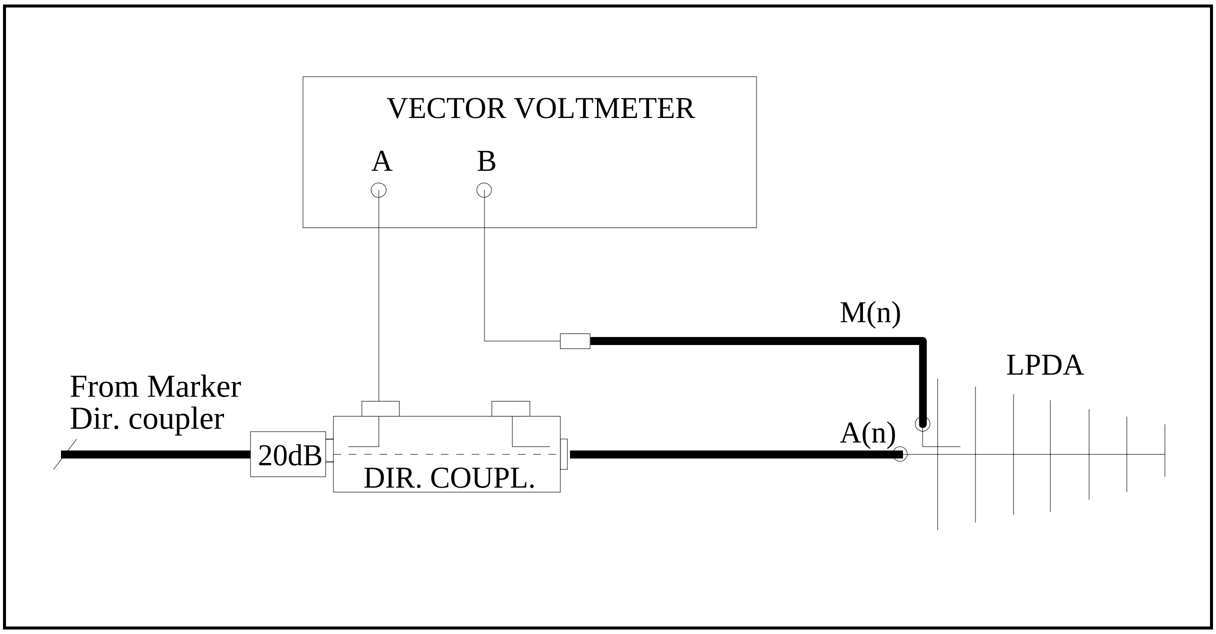

Figure 10-2 Phase and amplitude transfer measurement set-up.

Measure and record phase/amplitude for each antenna. Then determine if one of the monitor cables must be trimmed in order to comply with phase tolerance for the set of cables.

Tolerance: ±3°.

Amplitude tolerance: ±1.0 dB. If the amplitude tolerance is exceeded something might be wrong in the LPDA monitor circuit or connector/cable.

SECTION 4

TEST AND ADJUSTEMENTS

Table of Contents

1 Tests and adjustments LLZ/GP

1.1 Configuration Settings

Follow this procedure to set the configurations in the ILS according to the desired system configuration.

1.1.1 ILS Configuration

Set the correct configuration for this ILS according to this table. The Station Control strap platform is located on TCA 1218.

1	Strap **IN**	NOT interlock
	Strap **OUT**	Interlock
2	Strap **IN**	NOT hot standby
	Strap **OUT**	Hot standby
3	Strap **IN**	2 frequency ILS
	Strap **OUT**	1 frequency ILS
4	Strap **IN**	1 of 2 voting
	Strap **OUT**	2 of 2 voting (default)
5	Strap **IN**	Lost contact with remote control will NOT turn off transmitters.
	Strap **OUT**	Lost contact with remote control will turn off transmitters. (default)
6	Strap **IN**	WRITE DISABLE switch in horizontal position generate service condition. (default)
	Strap **OUT**	WRITE DISABLE switch in horizontal position does not generate service condition.
7	Strap **IN**	Grant/deny switch on remote control must be grant position in order to obtain access level 2 or 3 from the RMM system on the remote ports.
	Strap **OUT**	Grant/deny switch on remote control is overridden.
8	Strap **IN**	Tells the RMS that this is a GP ILS.
	Strap **OUT**	Tells the RMS that this is a LLZ ILS.
9	Strap **IN**	Spare, Not used.
	Strap **OUT**	Spare, Not used.
10	Strap **IN**	Spare, Not used.
	Strap **OUT**	Spare, Not used.

Table 1-1 ILS configuration settings.

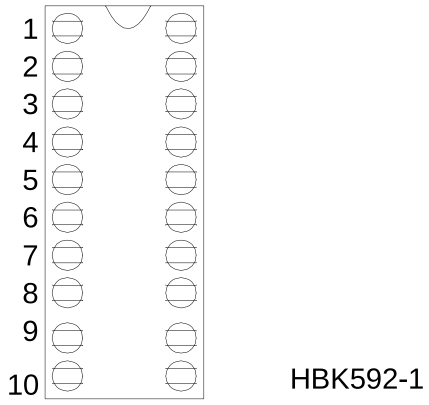

Figure 1-1 Station Control strap platform.

1.1.2 Remote Ports Access Level Configuration

The allowed access levels on REMOTE ports 1 and 2 on the RMS can be configured by setting jumpers on the TCA1218A.

Set jumpers in S1 - S4 to configure which access levels that are allowed on remote ports 1 and 2.

Jumper in means that access level is allowed.

Jumper out means that access level is denied.

The table below shows which jumpers are connected to different ports and access levels.

PORT	ACC. LEVEL 2	ACC. LEVEL 3
Remote 1	Strap S1	Strap S2
Remote 2	Strap S3	Strap S4

Table 1-2 Access level strap settings.

1.1.3 Warning Configuration

Use the RMM Program to configure which warnings shall cause system warning i.e. illuminate the RC main warning lamp.

1.2 Transmitter Alignments and Calibration

TEST EQUIPMENT REQUIRED:
- Oscilloscope, general purpose
- NM 3710 Field Test Set (with 20 dB attenuator)
- BNC Test Cable
- Frequency Counter RF

Carry out the alignment steps in the order outlined below:

1.2.1	RF Phase Feedback Adjustment
1.2.2	RF Power
1.2.3	LF Phase Adjustment
1.2.4	RF Power Balance Adjustment
1.2.5	RF Phase at Combiner I/P
1.2.6	SDM Calibration
1.2.7	DDM Calibration
1.2.7.1	TEST DDM Setting
1.2.8	Ident Tone Modulation Depth
1.2.9	RF Frequency Adjustment

NOTE

If some of the functions/parameters depart considerably from normal, then repeat the steps in sequence once more, except steps 1.2.7.1. - 1.2.9

NOTE

This adjustment procedure assumes that the LPAs and GPAs RF level, DDM and SDM parameters are correctly adjusted. Site adjustments should be limited to small touch up adjustments on RF phase, RF phase feedback and RF power balance.

1.2.1 RF Phase Feedback Adjustment

Connect the oscilloscope to the BNC test connector labelled PHASE CORR. located on the transmitter modules.

NOTE

Set the scope's input mode to DC.

The waveform observed should take a continuous form without limiting segments or deep notches or other dis-continuities.

(Each modulator developes it’s own waveform shape due to spreads in insertion phases).

The dynamic maximum point should be adjusted to approximately -4 volt.

The average operating point of the PHASE CORR. signal can be shifted by means of adjusting potentiometer PH.OFFS. at the back of the LPA/GPA.

1.2.2 RF Power

The CSB and corresponding SBO output power can be adjusted by means of the RMM Program or the Local Display/Keyboard.

Normal operating power level is:

LLZ Course	15 W CSB
LLZ Clearance	15 W CSB
GP Course	5 W CSB
GP Clearance	0.5 W CSB

The output power can be read by means of the RMM Program or the Local Display/Keyboard.

1.2.3 LF Phase Adjustment

1.2.3A LF Phase Adjustment (One-frequency system)

Connect oscilloscope channel A to the BNC test connector labelled CSB located on LPA/ GPA Course 1 (2).

Set oscilloscope input mode to DC.

Adjust **150 Hz COU phase adj.** R3 (LF1223A) observing oscillocope channel A until the waveform equals left hand graph in Figure 1-2.

A significant indication of correct LF phase is that the pair of the intermediate peaks are equal in amplitude.

Figure 1-3 shows the corresponding SBO waveforms for normal and 10º LF phase error respectively.

1.2.3B LF Phase Adjustment (Two-frequency system)

Connect oscilloscope channel A to the BNC test connector labelled CSB located on LPA/ GPA Course 1 (2).

Connect oscilloscope channel B to the BNC test connector labelled CSB located on LPA/ GPA Clearance 1 (2).

Set oscilloscope input mode to DC. Select CHOP mode.

Adjust channel A and B gain so that both waveforms show the same amplitude.

By means of the RMM turn off 90 Hz modulation for Course Tx and Clearance Tx.

Adjust **150 Hz CLR phase adj.** R180 to track 150 Hz Course waveform in the same phase (waveform overlap).

By means of the RMM turn on 90 Hz modulation for both Course Tx and Clearance Tx.

Adjust **90 Hz COU phase adj.** R1 (LF1223A) observing oscillocope channel A until the wave-form equals left hand graph in Figure 1-2.

Adjust **90 Hz CLR phase adj.** R179 (LF1223A) observing oscillocope channel B until the waveform equals left hand graph in Figure 1-2.

A significant indication of correct LF phase is that the pair of the intermediate peaks are equal in amplitude

.

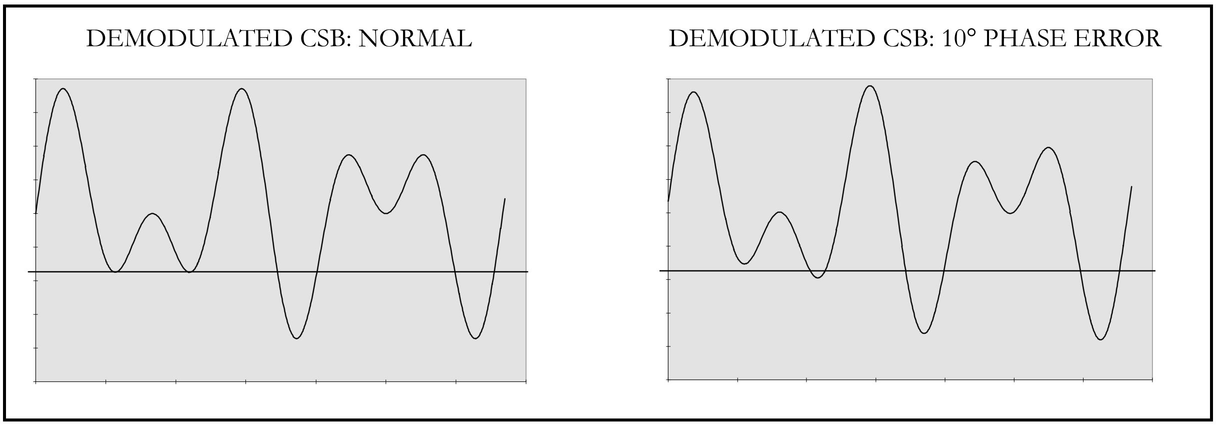

Figure 1-2 LF phase CSB illustration.

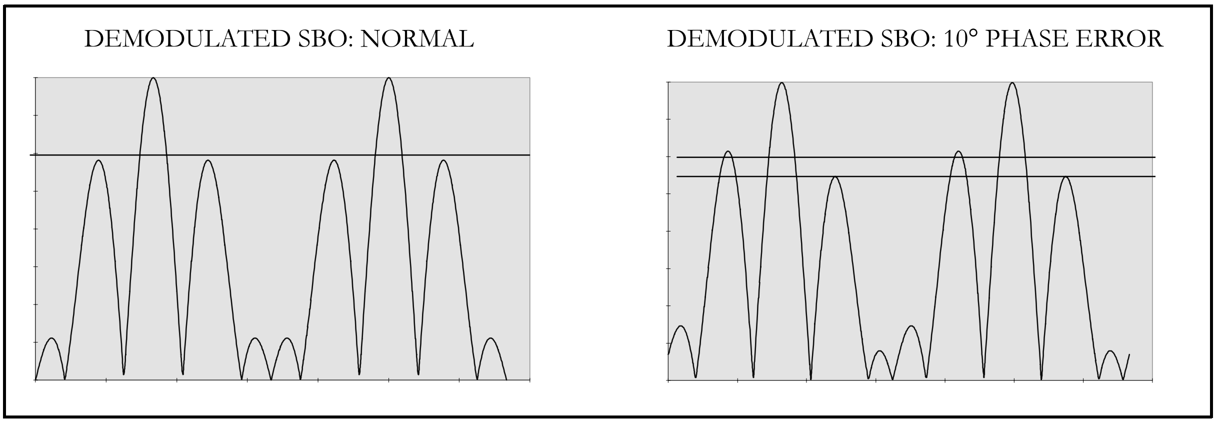

Figure 1-3 LF phase SBO illustration.

1.2.4 RF Power Balance Adjustment

Connect the oscilloscope to the BNC test connector labelled SBO located on the transmitter modules.

NOTE

Set the scope's input mode to <u>DC</u>

.

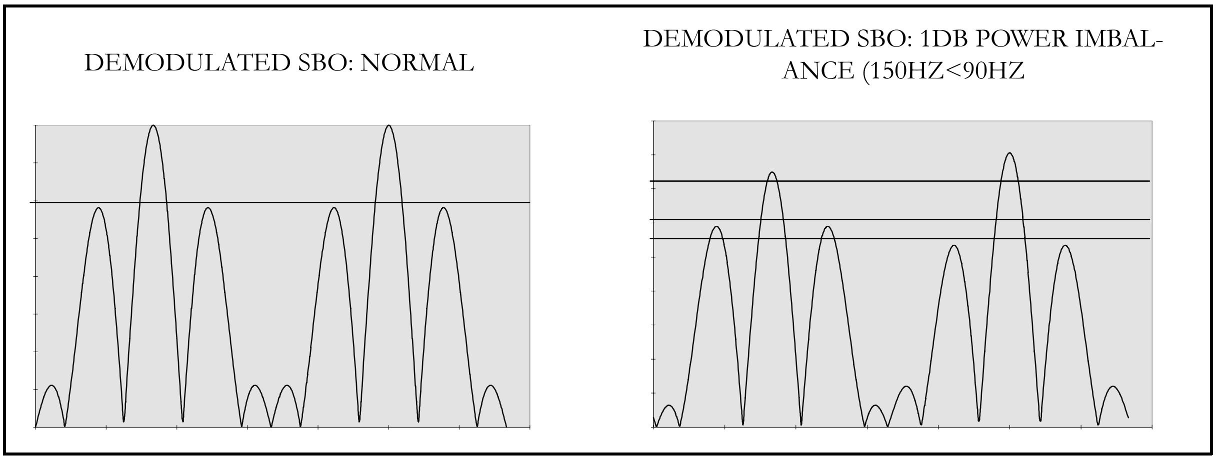

Figure 1-4 Power balance SBO illustration.

Perfect power balance between the 90 Hz modulated carrier and the 150 Hz modulated carrier is indicated when the two largest sets of peak waveforms fall on lines paralell to the baseline.

A more accurate way of observing a power balance error is to double the sweep rate in non-trigger mode such that the second 60 Hz half of the cycle is folded back on the first half and tracks the envelope waveform. (Kissing pattern method)

RF Power Balance can be adjusted by potentiometer RF-BAL on the back of the LPA/GPA Adjust until both halvs fall on the same envelope waveform or the two largest sets of peak waveforms fall on lines paralell to the baseline.

1.2.5 RF Phase at Combiner I/P

Connect the oscilloscope to the BNC test connector labelled SBO located on the transmitter modules.

NOTE

Set the scope's input mode to DC.

Set the oscilloscope in normal trigger mode such that the waveform below can be observed .

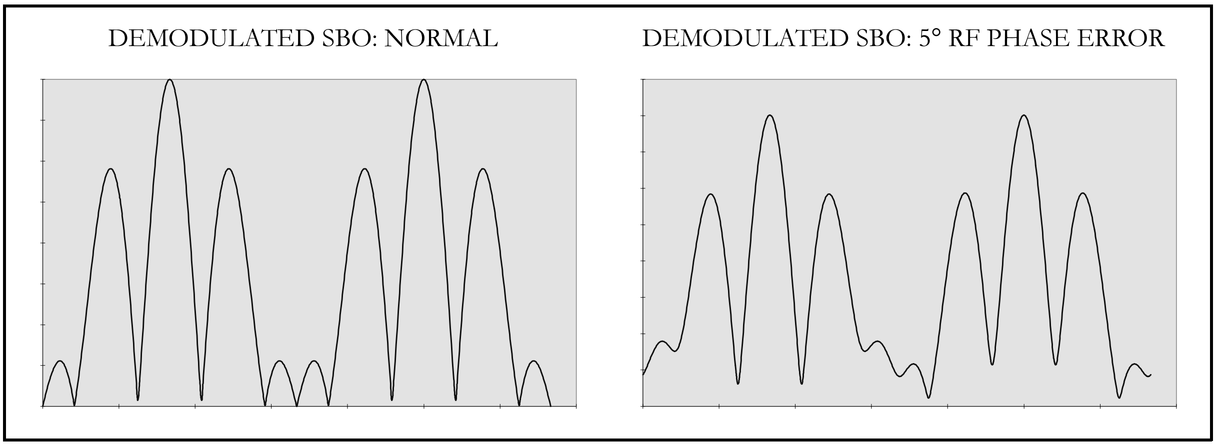

Figure 1-5 RF phase SBO illustration.

The RF phase (90° start phase) can be adjusted by trimmer RF PHASE on the back of the LPA/GPA.

Adjust until the minima points between the smallest peak waveform reach the baseline or a minimum.

1.2.6 SDM Calibration

Connect the NM 3710 Field Test Set to the CSB BNC test connector in the Cabinet's Change-over section.

(Insert a 20 dB attenuator at the input of the Field Test Set in order to avoid overloading).

SDM should be calibrated to 40.0% +/-0.1% SDM by adjusting SDM from the RMM Program or the Local Display/Keyboard.

1.2.7 DDM Calibration

NOTE

Check that all TEST DDM settings are in NORMAL.

Connect the NM 3710 Field Test Set to the CSB BNC test connector in the Cabinet's Change-over section.

(Insert a 20 dB attenuator at the input of the Field Test Set in order to avoid overloading).

DDM should be calibrated to 0.0% +/-0.05% DDM by adjusting DDM from the RMM Program or the Local Display/Keyboard.

1.2.7.1 TEST DDM Setting

TEST DDM with 90Hz or 150Hz dominance can be switched on and off from the RMM Program or the Local Display/Keyboard. The DDM values inserted by TEST DDM are preset values which is set as described below.

a) <u>90 Hz dominance preset</u>

Utilise the Field Test Set as in the previous test.
Set the TEST DDM in position 90 Hz dominance from the RMM Program or the Local Display/Keyboard. Adjust the (90 Hz) test DDM setting until a wanted DDM value indicating (-) sign is obtained. (Typical value: -0.8%...-1.0% DDM).

b) <u>150 Hz dominance preset</u>

Utilise the Field Test Set as in the previous test.
Set the TEST DDM in position 150 Hz dominance from the RMM Program or the Local Display/Keyboard. Adjust the (150 Hz) test DDM setting until a wanted DDM value indicating (+) sign is obtained. (Typical value: 0.8%...1.0% DDM).

Set the TEST DDM back to normal.

1.2.8 Ident Tone Modulation Depth

Connect the Field Test Set to the CSB BNC test connector in the Cabinet's Change-over section.

(Insert a 20 dB attenuator at the input of the Field Test Set in order to avoid overloading).

Set the Ident Control to CONTINUOUS from the RMM Program or the Local Display/Keyboard.

On the Field Test Set, press IDENT.

1020 Hz modulation depth can be adjusted from the RMM Program or the Local Display/Keyboard.

Adjust modulation depth to 10.0% +/-0.3%.

An alternative method of checking 1020 Hz modulation depth to 10% is described below:

Connect the oscilloscope to the BNC test Connector labelled CSB.

Switch off the 90 Hz modulation and the 1020 Hz modulation.

Note the peak-to-peak deflection of the remaining 150 Hz waveform.

Then switch off the 150 Hz modulation and switch the 1020 Hz modulation to CONTINUOUS.

For mod. Depth 10%.The observed 1020 Hz peak-to-peak waveform amplitude should be 50% of the 150 Hz amplitude.

1.2.9 RF Frequency Adjustment

Fine-adjustment of the operating frequency can be carried out by adjusting C1 in the OS1221A/B RF Oscillator module.

The top cover must be removed.

Set the OS1221A/B on an extention board.

In order to monitor the frequency, connect the Frequency Counter to the BNC test connector labelled CSB. (Make sure the transmitter under test is routed to Antenna).

If necessary for reliable counting switch off modulation tones.

Adjust until frequency is less than 1 kHz from operating frequency. Trimmer C1 adjusts course and clearance frequencies simultaneously.

1.3 Antenna System Adjustments

After the transmitters has been alligned correctly the antenna system must be alligned. This includes mechanical adjustments of the Antenna System, electrical adjustments (phasing) and adjustments of the ADU and MCU.

For details, refer to the adjustment procedure for each antenna system.

1.4 Monitor Alignment and Calibration.

TEST EQUIPMENT REQUIRED:

- Oscilloscope, general purpose
- NM 3710 Field Test Set (with 20 dB attenuator)
- BNC Test Cable
- Digital Voltmeter, 4 digits, DC

1.4.1 General:

Description is given only for the DS channels. R338++ means that the other channels has numbers R1338, R2338 and R3338 for CL, CLR and NF channels.

Before any monitor adjustments are attempted, the following procedures shall be completed:
Transmitter calibrations
Network alignments

It is imperative for the result that the signals from the Monitor Combining Network (MCU) are correct. Check these signals with the NM3710, Field Test Set,It will be these signals which we use for aligning the monitors.

1.4.2 RF Input Level Adjustment.

Put the MF12xx on an extender card.

Turn on the transmitters.

Set the potmeter SR338++ in middle position. See Figure 1-6

.

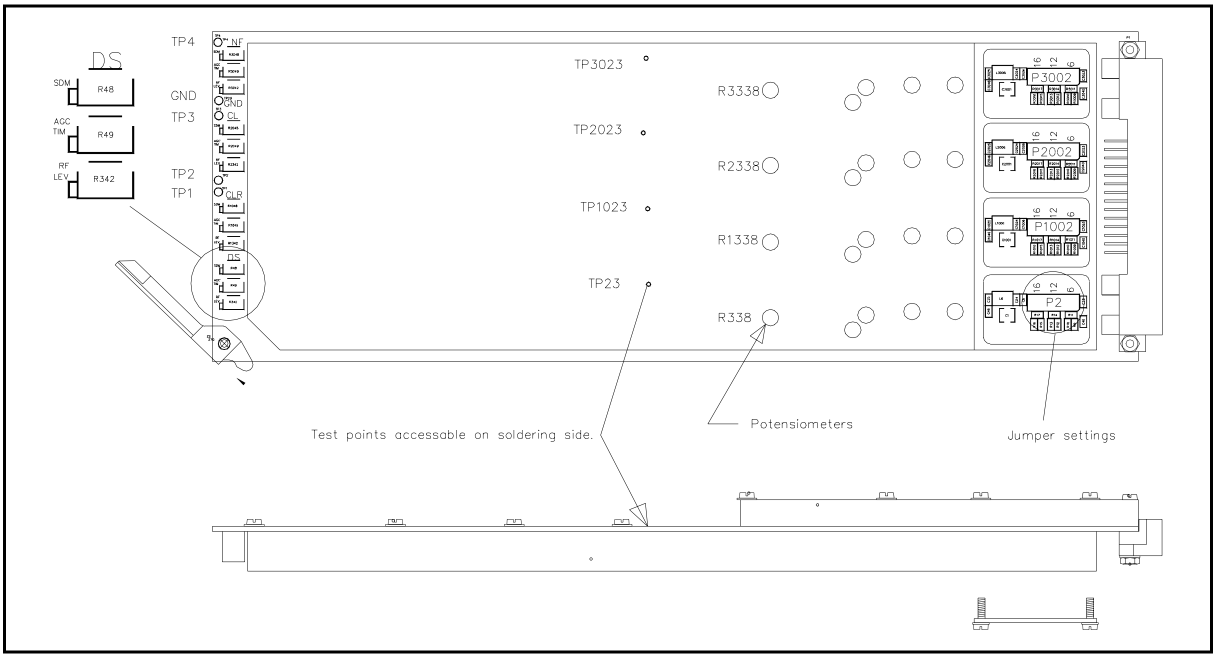

Figure 1-6 Adjustment points on MF12xx.

Adjust the jumper settings in P2++ and potmeters R338++ until the voltage is 240mV at TP23++

.

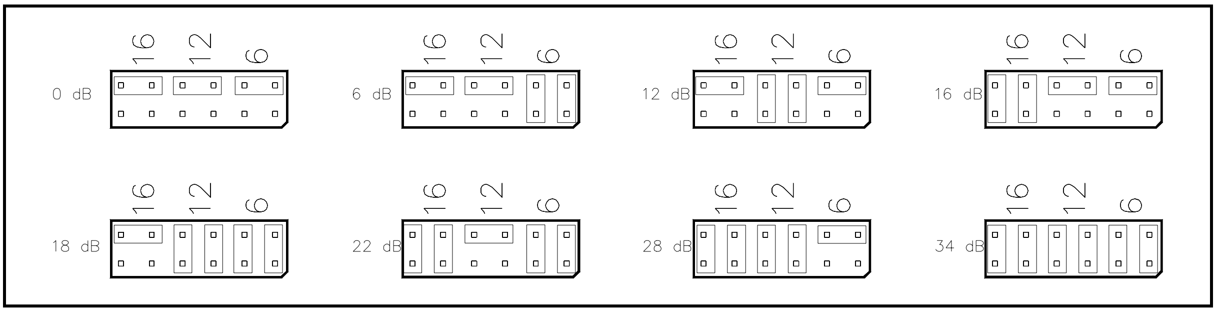

Figure 1-7 Alternative jumper settings of P2++.

Turn off the equipment and remove the extender card. Set the MF12xx in its correct position.

Turn on the transmitters.

Adjust the RF level potensiometer on the front of MF12xx until the monitor gives a RF level reading of 3.0V.

Repeat above for all monitor channels.

1.4.3 AGC Time Adjustment

Turn on the transmitters.

Make a note of the AGC voltages on TP 1,2,3 and 4 on MF12xx.

Turn off the transmitters.

Adjust the AGC TIM potmeter on the front of MF12xx until the AGC voltage (TP1,2,3 or 4) is the same as with a nominal RF input.

Do this for all four monitor channels on all of the MF12xx modules in the system.

This ensures fast response from the monitors.

1.4.4 SDM Adjustment

Adjust the SDM potmeter on the front of MF12xx until the monitors reads 40.0/80.0%SDM +/- 0.1%SDM.

1.4.5 DDM Adjustment

Measure and note down the DDM values from the MCU and NF antenna with help of the Field Test Set.

Set the Nominal values for each channel to the measured values with help of the RMM Program.

1.5 Monitor Alarm Setting Procedure

Type in the wanted alarm limits from the RMM Program or the Local Display/Keyboard.

The monitors will have preset alarm limits when the ILS is delivered for factory.These alarm limits are as listed in the table below:

Table 1-3 Localizer alarm limits

.

<table>
<tr><th></th><th></th><th></th><th>CL</th><th>DS</th><th>NF</th><th>CLR</th></tr>
<tr><td rowspan="9">LLZ</td><td rowspan="3">CAT I</td><td>DDM</td><td>15uA</td><td>25uA</td><td>15uA</td><td>40uA</td></tr>
<tr><td>SDM</td><td>+/- 4%</td><td>---</td><td>---</td><td>+/- 4%</td></tr>
<tr><td>RF level</td><td>+/- 3dB*)</td><td>---</td><td>---</td><td>+/- 1dB</td></tr>
<tr><td rowspan="3">CAT II</td><td>DDM</td><td>11uA</td><td>25uA</td><td>11uA</td><td>40uA</td></tr>
<tr><td>SDM</td><td>+/- 4%</td><td>---</td><td>---</td><td>+/- 4%</td></tr>
<tr><td>RF level</td><td>+/- 3dB*)</td><td>---</td><td>---</td><td>+/- 1dB</td></tr>
<tr><td rowspan="3">CAT III</td><td>DDM</td><td>9uA</td><td>25uA</td><td>9uA</td><td>40uA</td></tr>
<tr><td>SDM</td><td>+/- 4%</td><td>---</td><td>---</td><td>+/- 4%</td></tr>
<tr><td>RF level</td><td>+/- 3dB*)</td><td>---</td><td>---</td><td>+/- 1dB</td></tr>
</table>

*) Only for single frequency ILS. For two frequency ILS the limit is +/- 1dB.

Table 1-4 Glidepath alarm limits

.

			CL	DS	NF	CLR
GP	CAT I	DDM	see annex. 10	37uA 18.5uA	35uA	45uA
		SDM	+/- 5%	---	---	+/- 5%
		RF level	+/- 3dB*)	---	---	+/- 1dB
	CAT II	DDM	see annex. 10	37uA 18.5uA	35uA	45uA
		SDM	+/- 5%	---	---	+/- 5%
		RF level	+/- 3dB*)	---	---	+/- 1dB
	CAT III	DDM	see annex. 10	37uA	35uA	45uA
		SDM	+/- 5%	---	---	+/- 5%
		RF level	+/- 3dB*)	---	---	+/- 1dB

*) Only for single frequency ILS. For two frequency ILS the limit is +/- 1dB.

CLR transmitter is only present in two frequency ILS.

1.6 Maintenance Limit Adjustments

Use the RMM Program to set maintenance warning limits in the system. All new systems will have factory preset maintenance warning limits. Maintenance warning limits can not be set from the Local Display/Keyboard.

1.7 Adjustment points

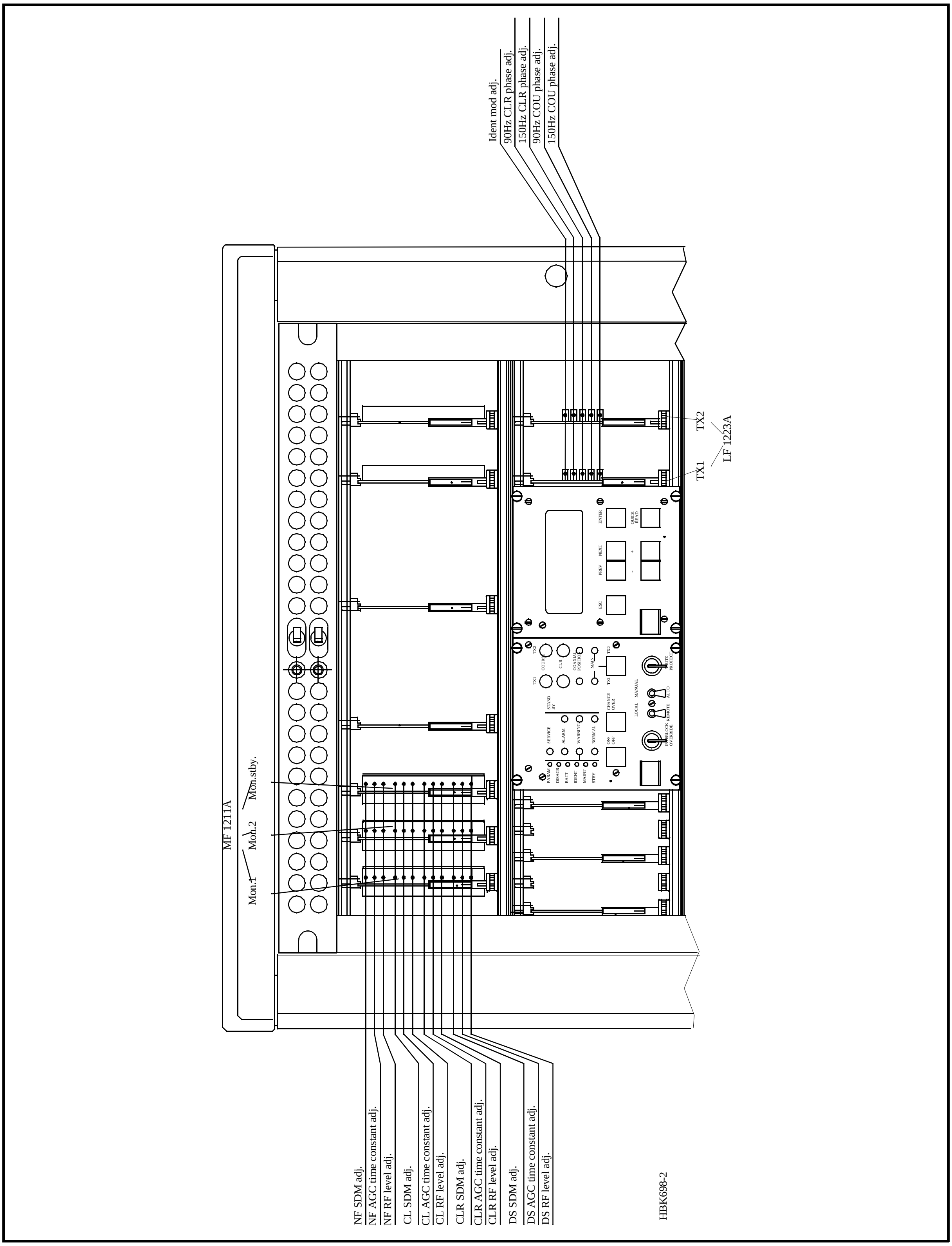

Figure 1-8 Front side adjustment points.

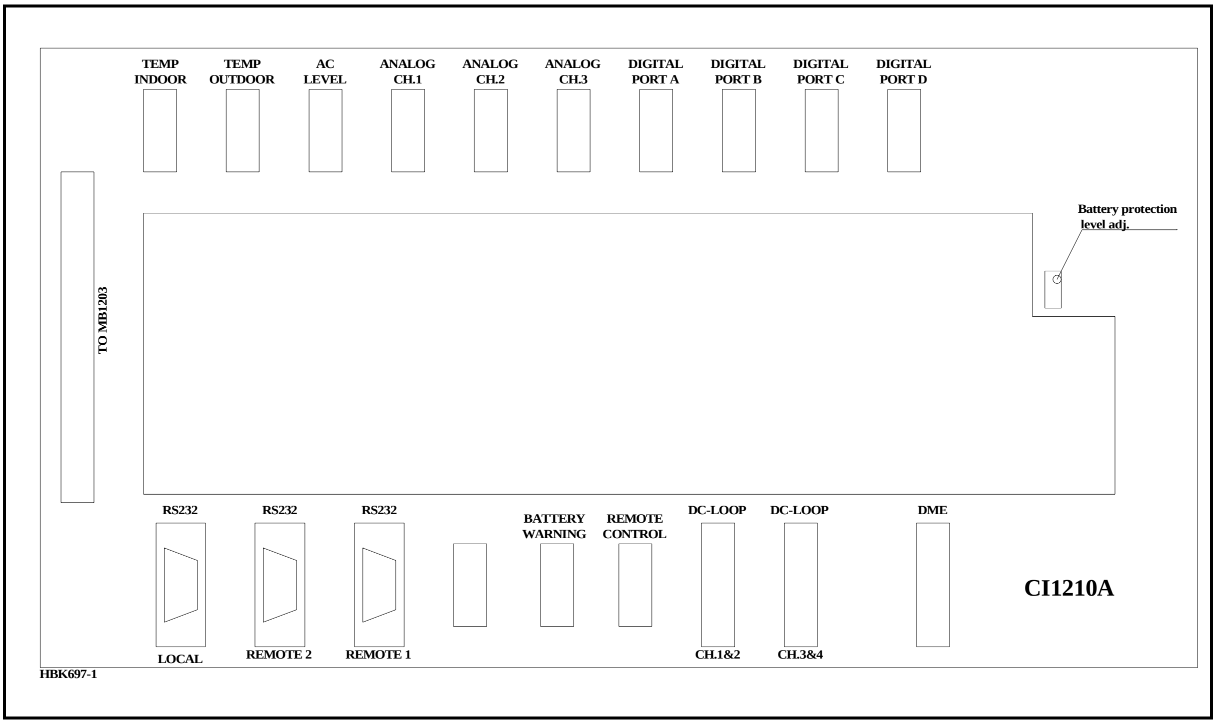

Figure 1-9 CI1210A Connection Interface adjustment point.

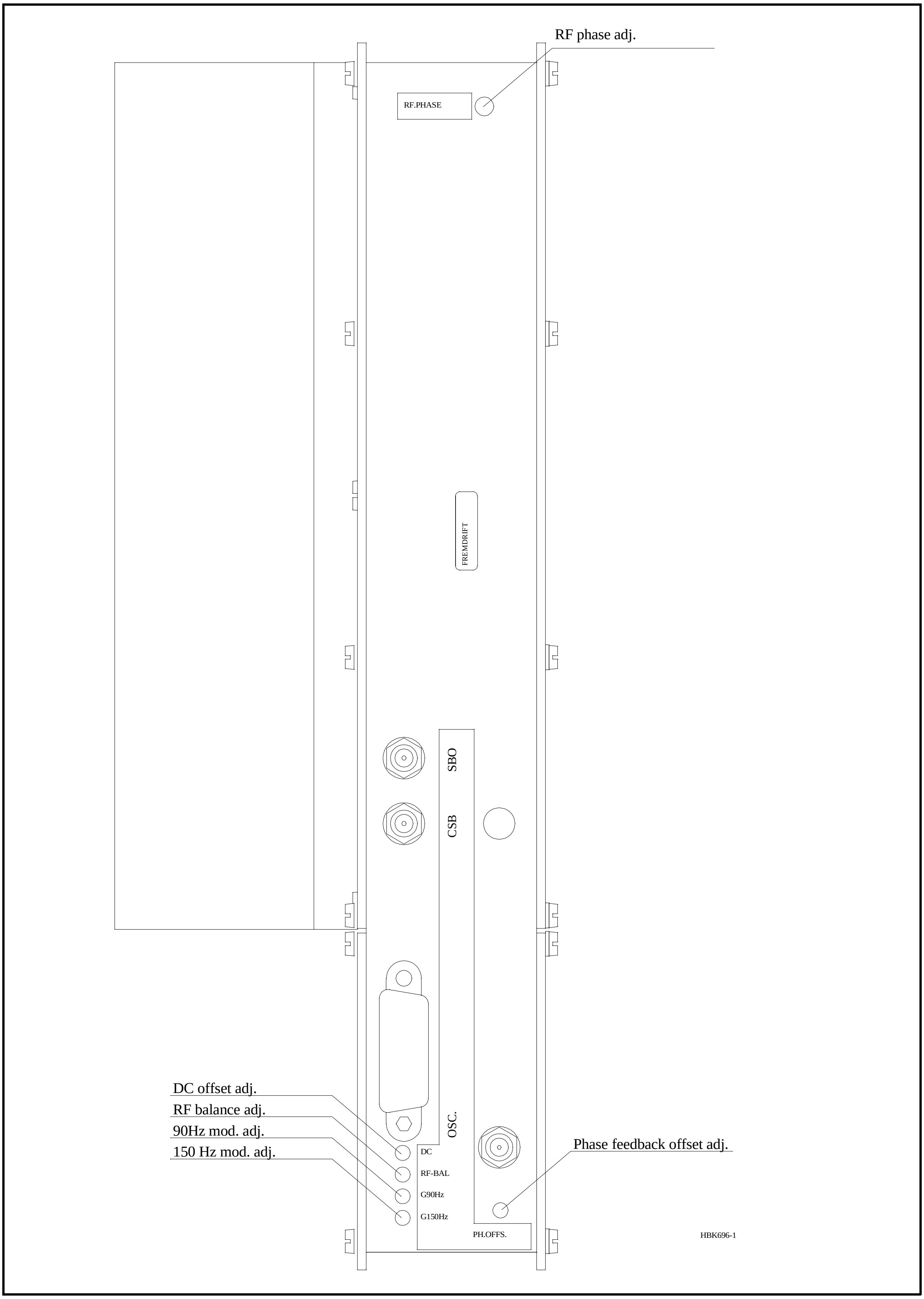

Figure 1-10 Power Amplifier Assembly adjustment points (rear view).

2 Tests and adjustments marker beacon

2.1

2.1.1 Preparations

Terminate the **RF OUT** terminal with a 50Ω load (antenna or dummy). The transmitters are factory adjusted to 2 watt output power. Let both transmitters run for ½ hour at this power to achieve a stable working temperature before any fine tuning is carried out.

2.1.2 Configuration settings

Follow this procedure to set the configurations in the Marker Beacon according to desired system configuration.

2.1.2.1 General Configuration

The static control strap on the Connection interface board sets hardware configuration, remote access configuration and shutdown configuration. Figure 2-1 shows where the static control strap is located on CI 1376

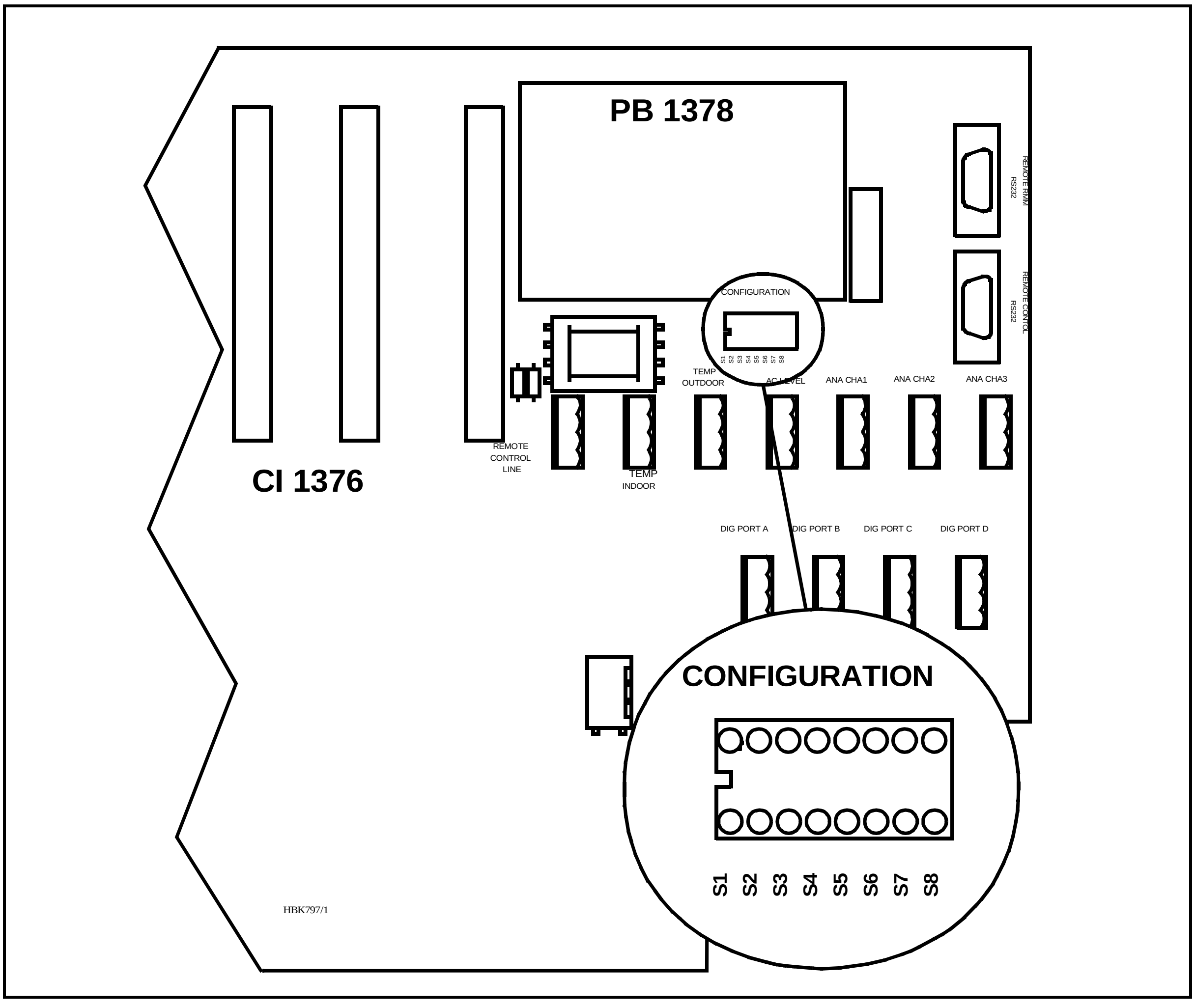

Figure 2-1 Location of Static Control Strap on CI 1376

Set the configuration for the MB according to Table 2-1
.

Strap no	**State**	**Function**
S1	Strap **IN**	2 power supplies *(NM 7050 B/D)*
	Strap **OUT**	1 power supply *(NM 7050 A/C)*
S2	Strap **IN**	Access Grant disabled
	Strap **OUT**	Access Grant enabled
S3	Strap **IN**	2 monitor units *(NM 7050 C/D)*
	Strap **OUT**	1 monitor unit *(NM 7050 A/B)*
S4	Strap **IN**	Lost contact with remote control will NOT cause shutdown
	Strap **OUT**	Lost contact with remote control will cause shutdown
S5	Strap **IN**	Standby transmitter failure will NOTcause shutdown
	Strap **OUT**	Standby transmitter failure will cause shutdown
S6	Strap **IN**	Access level 2 on RMM remote port enabled
	Strap **OUT**	Access level 2 on RMM remote port disabled
S7	Strap **IN**	Access level 3 on RMM remote port enabled
	Strap **OUT**	Access level 3 on RMM remote port disabled
S8		Should always be left open.

Table 2-1 MB Configuration settings

S1 and **S3** will decide the model (NM 7050 A, B, C or D) and show up in the **Link Status** window in the RMM program and the **Initial Window** in the LCD menu. A disagreement between the settings and the actual number of modules will cause a *Maintenance Warning* on the **Front Panel** and an *Error* in the **Maintenance** window.

With **S2** = *In* the **Access Grant** switch on the **Remote Control** will have no effect. You may still acquire *access level 2* and *3* on the **RMM remote port** if the settings of **S6** and **S7** permits.

S4 decides wheather lost communication with the **Remote Control** will cause shutdown (no TX to air) or not.

S5 instructs the transmitter control software weather a failed standby transmitter will be shut down or continue to transmit.

S6 and **S7** decides the highest **access level** permitted on the **RMM remote port**. All access levels are available on the RMM local port regardless of **S6** and **S7**.

2.1.2.2 Setting inner, outer or middle marker

To configure the beacon for outer, middle or inner marker set the straps (S1-S4) on the transmitter board(s) according to Table 2-2.

Strap	Function when strap is in
S1	Beacon is INNER marker
S2	Beacon is MIDDLE marker
S3	Beacon is OUTER marker
S4	Beacon is FAN marker

Table 2-2 Marker function configuration

Figure 2-2 shows where the straps are located on the transmitter board(s)
.

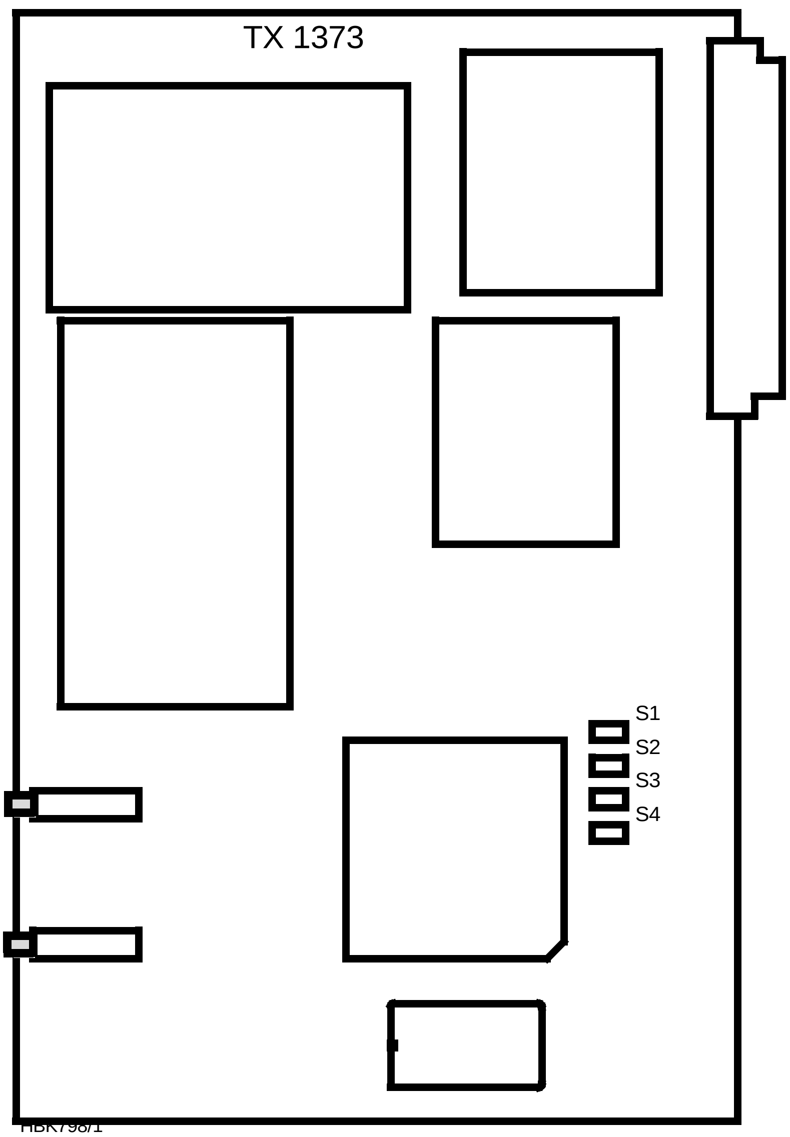

Figure 2-2 Location of Marker Beacon type straps on transmitter board

2.2 Adjustment points

The adjustment points are shown in Figure 2-3 Adjustment points and explained below. The figure shows a fully equipped system, NM 7050D, see Section 3 for configuration details:

1. Battery charging voltage (nom 27.4V@20°C)

2. Bias for power transistor (use factory settings)

3. Battery protection cut-off voltage (nom. 22V)

4. Tx Detected Rf level (nom. 2.5V@4W carrier)

5. Monitor RF level (nom. 3V@nominal output power)

6. Monitor frontend input filter centre frequency (use factory settings)

7. Real time clock fine tuning(use factory settings)

⇒The adjustment points marked *Use Factory Settings* should not be touched.
⇒The baseband level has to be adjusted at installation.
⇒The other are factory pre-set but may be adjusted.

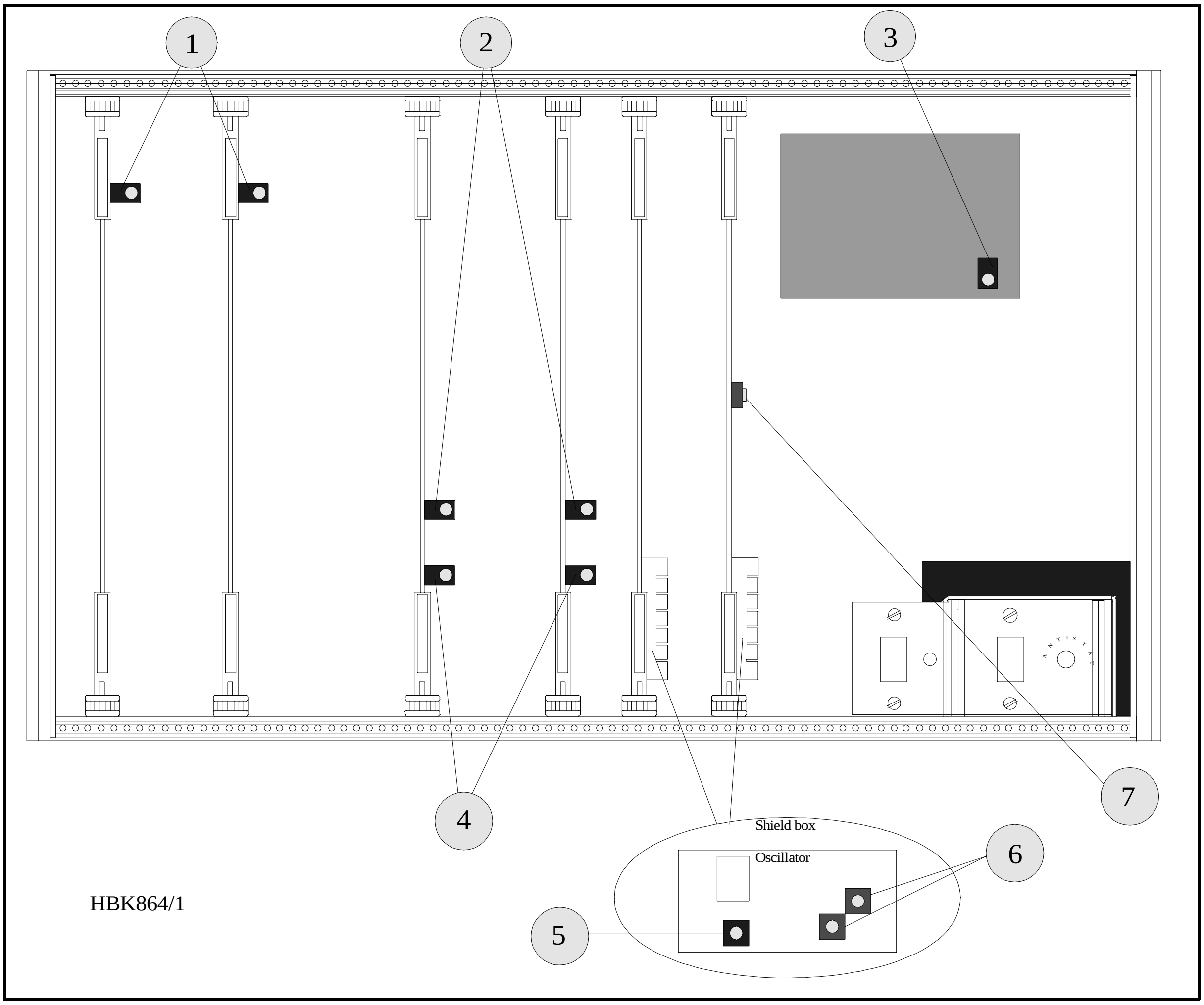

Figure 2-3 Adjustment points

2.3 Adjustments at installation

These procedures have to be carried out at installation in order to set up your equipment right.

2.3.1 Transmitter output power adjustment

This adjustment is most easily done with the RMM PC program but the local keyboard/display may be used.

- Make sure the output signal **RF OUT** is terminated with a 50Ω load (antenna or dummy load).
- If this is an Inner Marker make sure the external attenuator (10dB) is installed, inside the Cabinet at the Tx output.
- Start the RMM program on the PC (see chapter 10)
- Open the **TX settings** window, **RF level** for TX1 and TX2 are to be adjusted.
- Open the **Maintenance** window. **RF level** for TX1 and TX2 are to be watched.
- Set *Local* mode with the **Remote/Local** switch.
- Set *Manual* mode with the **Auto/Manual** switch.
- Set *TX1* to air with the **Changeover** button
- Adjust **RF level** in **TX settings** until you read the desired output power on **RF level** in **Maintenance**.

- Check that you read the desired modulation depth in **Maintenance**.
- Set *TX2* to air and repeat the two previous steps.

2.3.2 Monitor calibration

The software adjustments are most easily done with the RMM program, but may be carried out from the front panel.

- This procedure requires that the output power is already adjusted
- Set the input attenuation straps on MO1374 according to the marker type. Start out with 22dB attenuation for outer marker, 18dB for middle marker and 12dB for inner marker.
- Watch the Monitor parameter **RF level**.
- Adjust the potentiometer R850 until **RF level** is *3V* at the nominal output power.
- (Ref. fig. 2-4)
- If this is impossible to achieve, try another strap setting and readjust R850

.

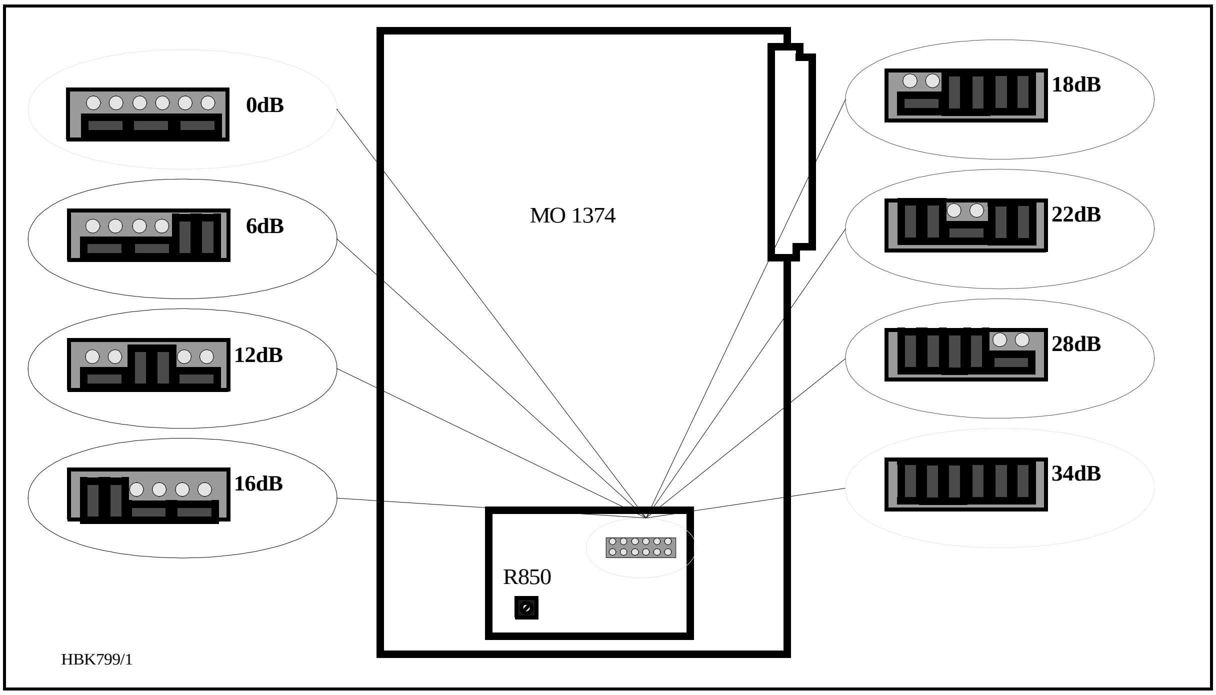

Figure 2-4 Input Signal attenuator

2.4 Other adjustments

These adjustments are normally not required, the factory settings should be sufficient.

2.4.1 Output power readout calibration

The **Carrier Power** parameter in the RMM **Maintenance** window is the internal wattmeter. It is factory calibrated, but may be recalibrated by following this procedure. The software adjustments are most easily done with the RMM program, but may be carried out from the front panel.

- Connect a reference wattmeter to the output signal **RF OUT**.
- Set TX1 to air.
- Watch the maintenance parameter **Carrier Power**
- Adjust the **TX settings** parameter **RF level** until the watt meter shows *2W*
- Check that the **Maintenance** parameter **Carrier Power** on TX1 is accurate to within 5%.

- If not, adjust the **Carrier Power** potentiometer on TX1 until the parameter shows 2.00W
- Repeat for 1W and 0.5W
- Repeat for TX2.

⇒Inner Marker uses an external 10 dB attenuator, use 0.2W, 0.1W and 50mW to calibrate. **Carrier Power** is measured prior to the attenuator, but the software will automatically compensate for the 10dB.

2.4.2 Battery protection cut-off voltage

The purpose of this circuit is to avoid deep discharge and thereby reduced life time of the backup battery. For normal lead acid accumulators 22V (1.83V/cell) is a reasonable cut-off voltage.

- Turn *Off* the **Mains** switch
- Connect a DC supply, preadjusted to the desired cut-off (**reference**) **voltage** and deactivated, to the external charger input on CI 1376. This is called the **reference supply**.
- Connect a multimeter in DC volt position to the battery input.
- Turn the **reference supply** On.
- If you measure 0V on the battery adjust the potentiometer on PB1378 until the relay toggles and you measure the **reference voltage**.
- If you measure the **reference voltage**, adjust the potentiometer until the relay disconnects and you measure 0V.

2.4.3 Battery charger voltage

The cells of a lead acid battery has an optimal voltage when they are fully charged. This voltage is greatly dependent on the temperature. The battery life time will decrease if this rule is not followed. To meet the demand, the internal battery charger(s) in NM 7050, the PS 1375, has a temperature compensated charging voltage.

Due to current limiting in PS 1375, a discharged battery will firstly be charged with a constant current, ≈2A with one PS1375 and ≈6A with two PS1375. When the battery draws less than the current limit, the battery will be charged with a constant voltage (U_{BATT}). The factory setting for the internal battery charger is:

UBATT20=27.6V@20°C with $k = \frac{\Delta U_{BATT}}{\Delta T} = -40\left[\frac{mV}{°C}\right]$

This is the normal final voltage for lead acid accumulators. If your batteries require a different final voltage, the adjustment procedure is as follows:

- Turn the **Battery** switch *Off* and have one TX on .
- Measure the environment temperature T_{ENV} (in °C)
- Compute the temperature deviation $\Delta T = T_{ENV} - 20°C$
- Compute the new expected final voltage at your environment temperature as

  $U_{BATT} = U_{BATT20} + k \cdot \Delta T$
- Adjust the potentiometer on PS1375 until you measure U_{BATT} on the 27V test point on CI 1376.

Example: **Your battery requires a final voltage of 26V at 20**°C, and you have measured an environmental temperature of 25°C. You should then adjust the charger to give **U_{BATT} = 26 + (-0.04)(25 - 20) = 25.8V**

SECTION 5

GROUND COMMISIONING REFERANCE DOCUMENTS

Table of Contents

NAVIA AVIATION

GROUND COMMISSIONING DOCUMENT

NM7000 LOCALIZER

Airport ____________________ Runway __________

Cabinet ____________________ Serial no. __________

Antenna system __________

Antenna Distribution Unit (ADU) __________ Serial no. __________

Monitor Distribution Unit (MCU) __________ Serial no. __________

Place: ____________________ Date: _______________

______________________________ ______________________________
Navia Aviation representative (Sign.) Customer representative (Sign.)

GENERAL

The purpose of this document is to

- Ensure that all operating functions are working before the equipment is put into service.
- Establish useful reference data and settings for comparisons to routine maintenance data and trouble shooting.

REQUIRED TEST EQUIPMENT

- Vector voltmeter or Network Analyser
- ILS Field Test Set NM3710 with 20 - 30 dB external input attenuator
- General purpose Oscilloscope
- Frequency Counter, 30 Hz to 350 MHz
- Digital Multimeter
- Directional Coupler, 75 - 350 MHz

DESCRIPTION OF TEST PROCEDURE

1.1 - 1.2 , 1.8 - 1.9
(COURSE AND CLEARANCE SECTIONS)
Connect NM3710 (use external 20-30 attenuator at BNC input) to COURSE RF BNC test point and CLEARANCE RF BNC test point of Cabinet Coaxial section respectively. Use keypad CHANGE OVER to alternate between Tx 1 and Tx 2. Read DDM and SDM.

1.3, 1.10
(COURSE AND CLEARANCE SECTIONS)
Connect the Frequency Counter (use 50Ω input port) to COURSE RF BNC test point and CLEARANCE RF BNC test point of Cabinet Coaxial section respectively. Use keypad CHANGE OVER to alternate between Tx 1 and Tx2.

1.4 - 1.5
Connect the Frequency Counter (use HI imp. input port) CSB BNC test point on Transmitter section LPA1230. Switch off IDENT modulation.
90 Hz count: Switch off 150 Hz tone.
150 Hz count: Switch on 150 Hz tone and switch off 90 Hz tone.

1.6, 1.11
Connect the Frequency Counter (use HI imp. input port) CSB BNC test point on Transmitter section LPA1230.
Switch off 90 and 150 Hz tones. Set the IDENT 1020 Hz to CONTINUOUS. Count the 1020 Hz.

1.7, 1.12
Connect NM3710 (use external 20-30 attenuator at BNC input) to COURSE RF BNC test point and CLEARANCE RF BNC test point of COA1207A respectively. Push keypad CHANGE OVER to activate the second transmitter. Read IDENT modulation depth.

1.13
Connect the Digital Multimeter (volts DC) to the BATTERY terminals. (Batteries shall be fully charged). Read the voltage.

2.1 - 2.2
Connect the NM3710 to the monitor input CL cable (from MCU). Use keypad CHANGE OVER to activate the second transmitter. Read DDM and SDM.

2.3 - 2.4
Connect the NM3710 to the monitor input DS cable (from MCU). Use keypad CHANGE OVER to activate the second transmitter. Read DDM and SDM.

2.5 - 2.6
Connect the NM3710 to the monitor input NF cable (from NF antenna). Use keypad CHANGE OVER to activate the second transmitter. Read DDM and SDM.

2.7 - 2.8
Connect the NM3710 to the monitor input CLR cable (from MCU). Use keypad CHANGE OVER to activate the second transmitter. Read DDM and SDM.

3.1 - 3.3
Connect the oscilloscope to BNC test points (LPA units) at each relevant Transmitter unit and check that normal waveforms exist.

4.1 - 4.7
Record all relevant SBO attenuator values obtained from Flight Commissioning Data.

4.8 - 4.11
Record relevant phaser settings (scale divisions). (4.9 is ADU SBO attenuator setting for NM3522 only.)

5.1 - 5.24
Fill in **phase** and **amplitude** of signals from the receiving end of the monitor cables referenced to the input phase/amplitude of the antenna cables. Normalise to A1/M1.
Fill in antenna return loss data in column *Return loss*.

6.1 - 6.9
Check that all remote control functions are OK.

7.1 - 7.6
Check that all Slave panel functions are OK.

8.1 - 8.2
Check that the 90° cable stub and 3 pcs different extension cards exist.

9.1 - 9.24
Transmitter shall be radiating. Select ILS\Measurements\Monitor II. Disconnect one antenna at a time. Read values (Mon 1,2) for DC LOOP Ø,1,2,3, and record in table. For each disconnected antenna check that one DC LOOP channel for Mon 1 and 2 is in Alarm.

10.1
Tx 1 operating normal. Make a Station Report to printer or file. Ref. Operator Manual para. 5.4.2.

10.2
Tx 2 operating normal. Make a Station Report to printer or file. Ref. Operator Manual para. 5.4.2.

11.0
Make a file copy to diskette of the NM70xx ILS Configuration file.

1.0 Recordings from test connectors on the Cabinet:

COURSE TRANSMITTERS

ITEM	PARAMETER	LIMITS	Tx 1	Tx 2
1.1	CSB DDM	-0.1...+0.1%	%	%
1.2	CSB SDM	39.5...40.5%	%	%
1.3	CARRIER FREQ.	F ± 2.2 kHz	MHz	MHz
1.4	MOD 90Hz	89.9...90.1 Hz	Hz	Hz
1.5	MOD 150 Hz	149.9...150.1 Hz	Hz	Hz
1.6	IDENT 1020 Hz	1010...1030 Hz	Hz	Hz
1.7	IDENT MOD	9...11%	%	%

CLEARANCE TRANSMITTERS

ITEM	PARAMETER	LIMITS	Tx1	Tx2
1.8	CSB DDM	-0.1...+0.1%	%	%
1.9	CSB SDM	39.5...40.5%	%	%
1.10	CARRIER FREQ.	F ± 2.2 kHz	MHz	MHz
1.11	IDENT 1020 Hz	1010...1030 Hz	Hz	Hz
1.12	IDENT MOD	9...11%	%	%

Recording across battery terminals of the Cabinet:

1.13	Battery charge voltage	26.4...27.0V	V

2.0 Recordings of monitor signal inputs to the Cabinet:

ITEM	PARAMETER	Tx 1 to Antenna	Tx 2 to Antenna
2.1	CL DDM	%	%
2.2	CL SDM	%	%
2.3	DS DDM	%	%
2.4	DS SDM	%	%
2.5	NF DDM	%	%
2.6	NF SDM	%	%
2.7	CLR DDM	%	%
2.8	CLR SDM	%	%

3.0 Transmitter waveforms test point **checks** (BNC test points):

ITEM	PARAMETER	COU Tx 1	COU Tx 2	CLR Tx 1	CLR Tx 2
3.1	CSB LF				
3.2	SBO LF				
3.3	PHASE CORR				

4.0 Attenuators and Phaser settings in the Cabinet, Antenna Distribution Unit (ADU) and Monitor combining unit (MCU). Cabinet:

ITEM	PARAMETER	Tx1	Tx2
4.1	COU SBO-attenuator Normal	dB	dB
4.2	COU SBO-attenuator Wide Alarm	dB	dB
4.3	COU SBO-attenuator Narrow Alarm	dB	dB
4.4	CLR SBO-attenuator Normal	dB	dB
4.5	CLR SBO-attenuator Wide Alarm	dB	dB
4.6	COU SBO-phaser	div.	div.
4.7	CLR SBO-phaser	div.	div.

ADU:

ITEM	PARAMETER	
4.8	CL phaser	div.
4.9	SBO-attenuator (NM3522 6el antenna system only)	dB

MCU:

ITEM	PARAMETER	
4.10	CL phaser	div.
4.11	CS phaser	div.

5.0 Phase and Amplitude transfer data, Antenna Return Loss.

ITEM	ANT. No.	Phase transfer	Ampli-tude transfer	Return loss
5.1	1	°	dB	dB
5.2	2	°	dB	dB
5.3	3	°	dB	dB
5.4	4	°	dB	dB
5.5	5	°	dB	dB
5.6	6	°	dB	dB
5.7	7	°	dB	dB
5.8	8	°	dB	dB
5.9	9	°	dB	dB
5.10	10	°	dB	dB
5.11	11	°	dB	dB
5.12	12	°	dB	dB
5.13	13	°	dB	dB
5.14	14	°	dB	dB
5.15	15	°	dB	dB
5.16	16	°	dB	dB
5.17	17	°	dB	dB
5.18	18	°	dB	dB
5.19	19	°	dB	dB
5.20	20	°	dB	dB
5.21	21	°	dB	dB
5.22	22	°	dB	dB
5.23	23	°	dB	dB
5.24	24	°	dB	dB

6.0 Remote Control functions:

ITEM	PARAMETER	RCU CHECK
6.1	TX ON/OFF	
6.2	CHANGE-OVER	
6.3	ALARM SILENCE	
6.4	PARAM WARNING	
6.5	DISAGR WARNING	
6.6	BATT WARNING	
6.7	IDENT WARNING	
6.8	MAINT WARNING	
6.9	STBY WARNING	

7.0 Slave panel functions:

ITEM	PARAMETER	SLAVE-CHECK
7.1	TX ON/OFF	
7.3	ALARM SILENCE	
7.4	ALARM	
7.5	NORMAL	
7.6	WARNING	

8.0 Accessories:

ITEM	DEVICE	CHECK
8.1	90° cable w/frequency label	
8.2	2 pcs different extension cards	

9.0 DC-loop Test:

ITEM	ANTENNA NO.	DLØ		DL1		DL2		DL3	
		Mon 1	Mon 2	Mon 1	Mon 2	Mon 1	Mon 2	Mon 1	Mon 2
9.1	A1								
9.2	A2								
9.3	A3								
9.4	A4								
9.5	A5								
9.6	A6								
9.7	A7								
9.8	A8								
9.9	A9								
9.10	A10								
9.11	A11								
9.12	A12								
9.13	A13								
9.14	A14								
9.15	A15								
9.16	A16								
9.17	A17								
9.18	A18								
9.19	A19								
9.20	A20								
9.21	A21								
9.22	A22								
9.23	A23								
9.24	A24								

NAVIA AVIATION

GROUND COMMISSIONING DOCUMENT

NM7000 GLIDE PATH

Airport ______________________ Runway __________

Cabinet ______________________ Serial no. __________

Antenna system __________

Antenna Distribution Unit (ADU) __________ Serial no. __________

Monitor Distribution Unit (MCU) __________ Serial no. __________

Place: ____________________ Date: ______________

______________________________ ______________________________

Navia Aviation representative (Sign.) Customer representative (Sign.)

GENERAL

The purpose of this document is to
- Ensure that all operating functions are working before the equipment is put into service.
- Establish useful reference data and settings for comparisons to routine maintenance data and trouble shooting.

REQUIRED TEST EQUIPMENT

- Vector voltmeter or Network Analyser
- ILS Field Test Set NM3710 with 20 - 30 dB external input attenuator
- General purpose Oscilloscope
- Frequency Counter, 30 Hz to 350 MHz
- Digital Multimeter
- Directional Coupler, 75 - 350 MHz

DESCRIPTION OF TEST PROCEDURE

1.1 - 1.2 , 1.8 - 1.9
(COURSE AND CLEARANCE SECTIONS)
Connect NM3710 (use external 20-30 attenuator at BNC input) to COURSE RF BNC test point and CLEARANCE RF BNC test point of Cabinet Coaxial section respectively. Use keypad CHANGE OVER to alternate between Tx 1 and Tx 2. Read DDM and SDM.

1.3, 1.10
(COURSE AND CLEARANCE SECTIONS)
Connect the Frequency Counter (use 50Ω input port) to COURSE RF BNC test point and CLEARANCE RF BNC test point of Cabinet Coaxial section respectively. Use keypad CHANGE OVER to alternate between Tx 1 and Tx2.

1.4 - 1.5
Connect the Frequency Counter (use HI imp. input port) CSB BNC test point on Transmitter section LPA1230.
90 Hz count: Switch off 150 Hz tone.
150 Hz count: Switch on 150 Hz tone and switch off 90 Hz tone.

1.6, 1.11
Not applicable

1.7, 1.12
Not applicable

1.13
Connect the Digital Multimeter (volts DC) to the BATTERY terminals. (Batteries shall be fully charged). Read the voltage.

2.1 - 2.2
Connect the NM3710 to the monitor input CL cable (from MCU). Use keypad CHANGE OVER to activate the second transmitter. Read DDM and SDM.

2.3 - 2.4
Connect the NM3710 to the monitor input DS cable (from MCU). Use keypad CHANGE OVER to activate the second transmitter. Read DDM and SDM.

2.5 - 2.6
Connect the NM3710 to the monitor input NF cable (from NF antenna). Use keypad CHANGE OVER to activate the second transmitter. Read DDM and SDM.

2.7 - 2.8
Connect the NM3710 to the monitor input CLR cable (from MCU). Use keypad CHANGE OVER to activate the second transmitter. Read DDM and SDM.

3.1 - 3.3
Connect the oscilloscope to BNC test points (LPA units) at each relevant Transmitter unit and check that normal waveforms exist.

4.1 - 4.7
Record all relevant SBO attenuator values obtained from Flight Commissioning Data.

4.8 - 4.11
Record relevant phaser settings (scale divisions).

4.12- 4.13
Record GP and SW attenuator settings.

4.14- 4.16
Record PH1, PH2, PH3 phaser settings.

5.1 - 5.24
Fill in **phase** and **amplitude** of signals from the receiving end of the monitor cables referenced to the input phase/amplitude of the antenna cables. Normalise to A1/M1.
Fill in antenna return loss data in column *Return loss*.

6.1 - 6.9
Check that all remote control functions are OK.

7.1 - 7.6
Check that all Slave panel functions are OK.

8.1 - 8.2
Check that the 90° cable stub and 3 pcs different extension cards exist.

9.1
Tx 1 operating normal. Make a Station Report to printer or file. Ref. Operator Manual para. 5.4.2.

9.2
Tx 2 operating normal. Make a Station Report to printer or file. Ref. Operator Manual para. 5.4.2.

10.0
Make a file copy to diskette of the NM70xx ILS Configuration file.

1.0 Recordings from test connectors on the Cabinet:

COURSE TRANSMITTERS

ITEM	PARAMETER	LIMITS	Tx 1	Tx 2
1.1	CSB DDM	-0.2...+0.2%	%	%
1.2	CSB SDM	79.0...81.0%	%	%
1.3	CARRIER FREQ.	F ± 5.0 kHz	MHz	MHz
1.4	MOD 90Hz	89.9...90.1 Hz	Hz	Hz
1.5	MOD 150 Hz	149.9...150.1 Hz	Hz	Hz
1.6	Not applicable			
1.7	Not applicable			

CLEARANCE TRANSMITTERS

ITEM	PARAMETER	LIMITS	Tx1	Tx2
1.8	CSB DDM	39.8...40.2%	%	%
1.9	CSB SDM	79.0...81.0%	%	%
1.10	CARRIER FREQ.	F ± 5.0 kHz	MHz	MHz
1.11	Not applicable			
1.12	Not applicable			

Recording across battery terminals of the Cabinet:

1.13	Battery charge voltage	26.4...27.0V	V

2.0 Recordings of monitor signal inputs to the Cabinet:

ITEM	PARAMETER	Tx 1 to Antenna	Tx 2 to Antenna
2.1	CL DDM	%	%
2.2	CL SDM	%	%
2.3	DS DDM	%	%
2.4	DS SDM	%	%
2.5	NF DDM	%	%
2.6	NF SDM	%	%
2.7	CLR DDM	%	%
2.8	CLR SDM	%	%

3.0 Transmitter waveforms test point **checks** (BNC test points):

ITE M	*PARAMETER*	*COU Tx 1*	*COU Tx 2*	*CLR Tx 1*	*CLR Tx 2*
3.1	CSB LF				
3.2	SBO LF				
3.3	PHASE CORR				

4.0 Attenuators and Phaser settings in the Cabinet, Antenna Distribution Unit (ADU) and Monitor combining unit (MCU).Cabinet:

ITE M	*PARAMETER*	*Tx1*	*Tx2*
4.1	COU SBO-attenuator Normal	dB	dB
4.2	COU SBO-attenuator Wide Alarm	dB	dB
4.3	COU SBO-attenuator Narrow Alarm	dB	dB
4.4	Not applicable	dB	dB
4.5	Not applicable	dB	dB
4.6	Not applicable	div.	div.
4.7	Not applicable	div.	div.

ADU NM3545 Antenna system:

ITE M	*PARAMETER*	div.
4.8	CSB Power Divider D1	div.
4.9	SBO Power Divider D2	div.
4.10	SBO Power Divider D3	div.
4.11	Upper Antenna Phaser PH3	div.
4.12	SBO Upper/Lower Antenna Phaser PH2	div.
4.11	Lower Antenna Phaser PH1	div.

MCU NM3545 Antenna system:

ITEM	*PARAMETER*	
4.12	GP Attenuator	dB
4.13	SW Attenuator	dB
4.14	Upper Antenna Phaser PH1	div.
4.15	Middle Antenna Phaser PH2	div.
4.16	Course Cancellation Phaser PH3	div.

5.0 Phase and Amplitude transfer data, Antenna Return Loss.

ITEM	*ANT. No.*	*Phase transfer*	*Ampli-tude transfer*	*Return loss*
5.1	1 (Lower)	°	dB	dB
5.2	2 (Middle)	°	dB	dB
5.3	3 (Upper)	°	dB	dB

6.0 Remote Control functions:

ITEM	*PARAMETER*	*RCU CHECK*
6.1	TX ON/OFF	
6.2	CHANGE-OVER	
6.3	ALARM SILENCE	
6.4	PARAM WARNING	
6.5	DISAGR WARNING	
6.6	BATT WARNING	
6.7	IDENT WARNING	
6.8	MAINT WARNING	
6.9	STBY WARNING	

7.0 Slave panel functions:

ITEM	*PARAMETER*	*SLAVE CHECK*
7.1	TX ON/OFF	
7.3	ALARM SILENCE	
7.4	ALARM	
7.5	NORMAL	
7.6	WARNING	

8.0 Accessories:

ITEM	*DEVICE*	*CHECK*
8.1	90° cable w/frequency label	
8.2	2 pcs different extension cards	

NAVIA AVIATION

GROUND COMMISSIONING DOCUMENT

NM7050 MARKER BEACON

Airport ______________________ Runway __________

Cabinet NM 7050 ______________________ Serial no. __________

Antenna system (NM3561/NM3562 __________

Place: ____________________ Date: ______________

______________________ ______________________
Navia Aviation representative (Sign.) Customer representative (Sign.)

GENERAL

The purpose of this document is to

- Ensure that all operating functions are working before the equipment is put into service.
- Establish useful reference data and settings for comparisons to routine maintenance data and trouble shooting.

REQUIRED TEST EQUIPMENT

- Vector voltmeter or Network Analyser
- General purpose Oscilloscope
- Frequency Counter, 30 Hz to 350 MHz
- Digital Multimeter
- Directional Coupler, 75 - 350 MHz

DESCRIPTION OF TEST PROCEDURE

1.1
Insert a 30 dB directional coupler in the antenna cable at the output connector. Turn OFF the modulation and connect a frequency counter to the detector output. Record the RF frequency. Switch to Tx 2 and repeat the procedure.

1.2
Set modulation to ‘keyed’. With Tx 1 switched on and the oscilloscope connected to the detector output, observe the keying code. Switch to Tx 2 and repeat the procedure.

1.3
With Tx 1 switched on, connect a frequency counter to TP 704 on TX1373A. Set Tx 1 modulation to ‘CONTINUOUS MODULATION’ and read Tx 1 modulation frequency. Change to transmitter 2 and set Tx 2 modulation to ‘CONTINUOUS MODULATION’. Record Tx 2 modulation frequency.

1.4
Set Tx 1 in normal operation, read the Modulation Depth value from Monitor 1 and 2. Change over to Tx 2 and repeat the procedure.

1.5
With Tx 1 in normal operation, read RF Power from the Maintenance Monitor. Change over to Tx 2 and repeat the reading.

2.1
Insert a 3 dB attenuator to the output. Set the transmitter to keyed operation with the output power 3 dB below normal level. Adjust the RF ALARM LOWER LIMIT until the alarm lamp is lit. Remove the 3 dB attenuator. The alarm lamp shall extinguish.

2.2
Set the transmitter to keyed operation. Set Tx in test mode and reduce modulation depth until the alarm lamp is lit.

2.3
With Tx 1 in normal keyed operation, set modulation to ‘CONTINUOUS MODULATION’ and observe that the alarm lamp is lit.

3.1
Connect a Directional Coupler, terminated to dummy load to the output. Turn off modulation and use the RF signal from the test output on the directional coupler for this measurement. Save Reference on the Vector Voltmeter, connect the Vector Voltmeter to the Antenna cable and measure the Return Loss.

4.1-4.10
Check that all remote control functions are OK.

5.1- 5.7
Check that all remote control functions are OK.

6.1
Check that 2 pcs different extension cards exist.

1.0 Recordings from external test instruments and Front Panel:

ITEM	PARAMETER	LIMITS	Tx 1	Tx 2
1.1	Carrier frequency	75 MHz ± 2.25 kHz	MHz	MHz
1.2	Keying code			
1.3	Modulation tone frequency	f ± 2.5%±4%	Hz	Hz
1.4	Modulation depth (Reading from Monitor 1 & 2)	95%	%	%
1.5	RF Power to antenna		W	W

2.0 Recordings of monitor signal inputs to the Cabinet

ITEM	PARAMETER	LIMITS	SETTING
2.1	Power alarm	-3 dB	W
2.2	Modulation depth alarm	Minimum 50%	%
2.3	Keying failure alarm		

3.0 Antenna Return Loss:

ITEM	ANTENNA NO.	RETURN LOSS
3.1	1	dB
3.2	2	dB

4.0 Remote Control functions:

ITEM	PARAMETER	RCU CHECK
4.1	TX ON/OFF	
4.2	CHANGE-OVER	
4.3	ALARM SILENCE	
4.4	PARAM WARNING	
4.5	DISAGR WARNING	
4.6	BATT WARNING	
4.7	IDENT WARNING	
4.8	MAINT WARNING	
4.9	STBY WARNING	
4.10	INTERLOCK SWITCH	

5.0 Slave panel functions:

ITEM	PARAMETER	SLAVE-CHECK
5.1	TX ON/OFF	
5.3	ALARM SILENCE	
5.4	ALARM	
5.5	NORMAL	
5.6	WARNING	
5.7	INTERLOCK SWITCH	

6.0 Accessories:

ITEM	DEVICE	CHECK
6.1	2 pcs different extension cards	

SECTION 6

APPENDIX

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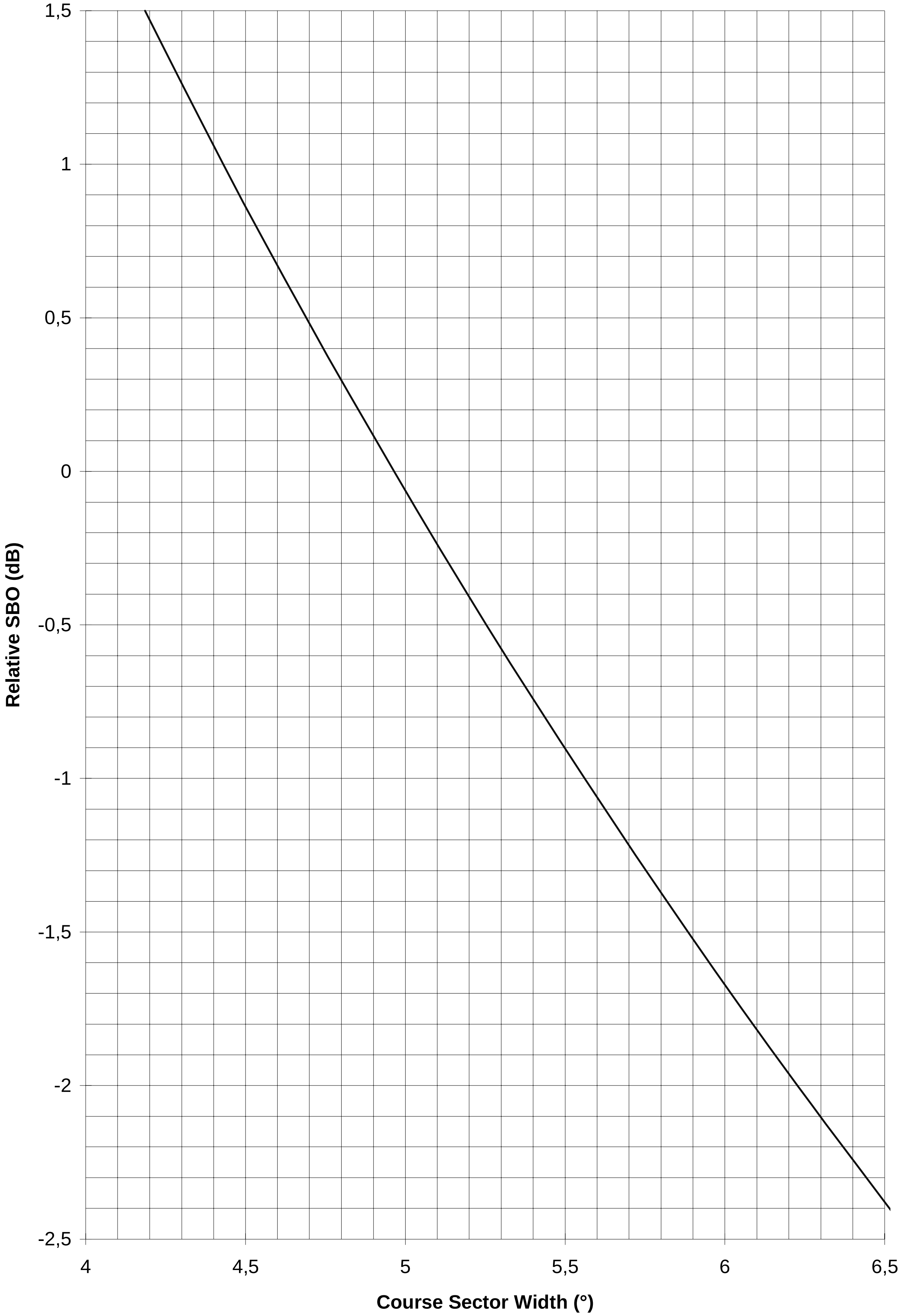


Diagram 1 Relative SBO vs CS Width, NM3522.

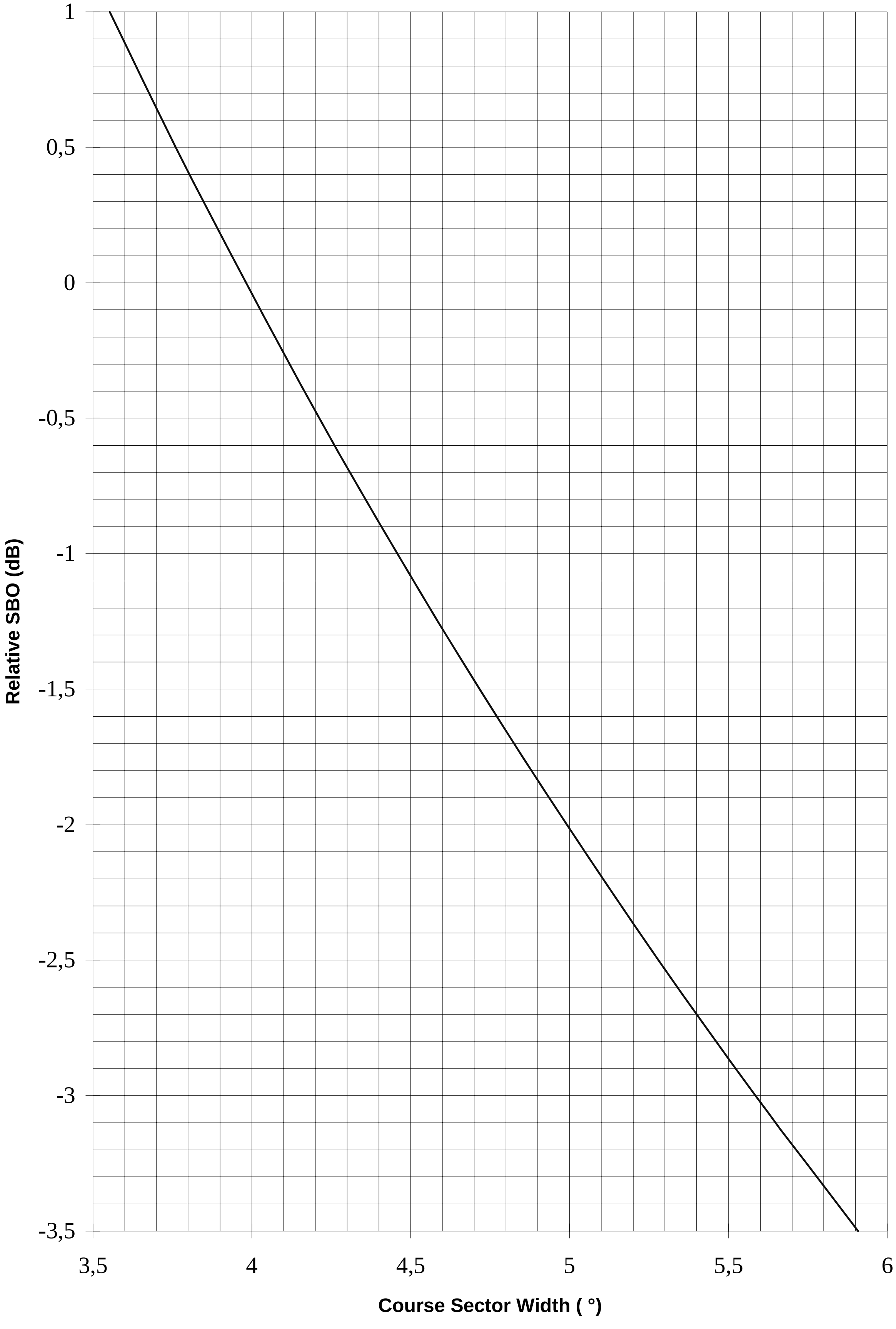


Diagram 2 Relative SBO vs CS Width, NM3523B.

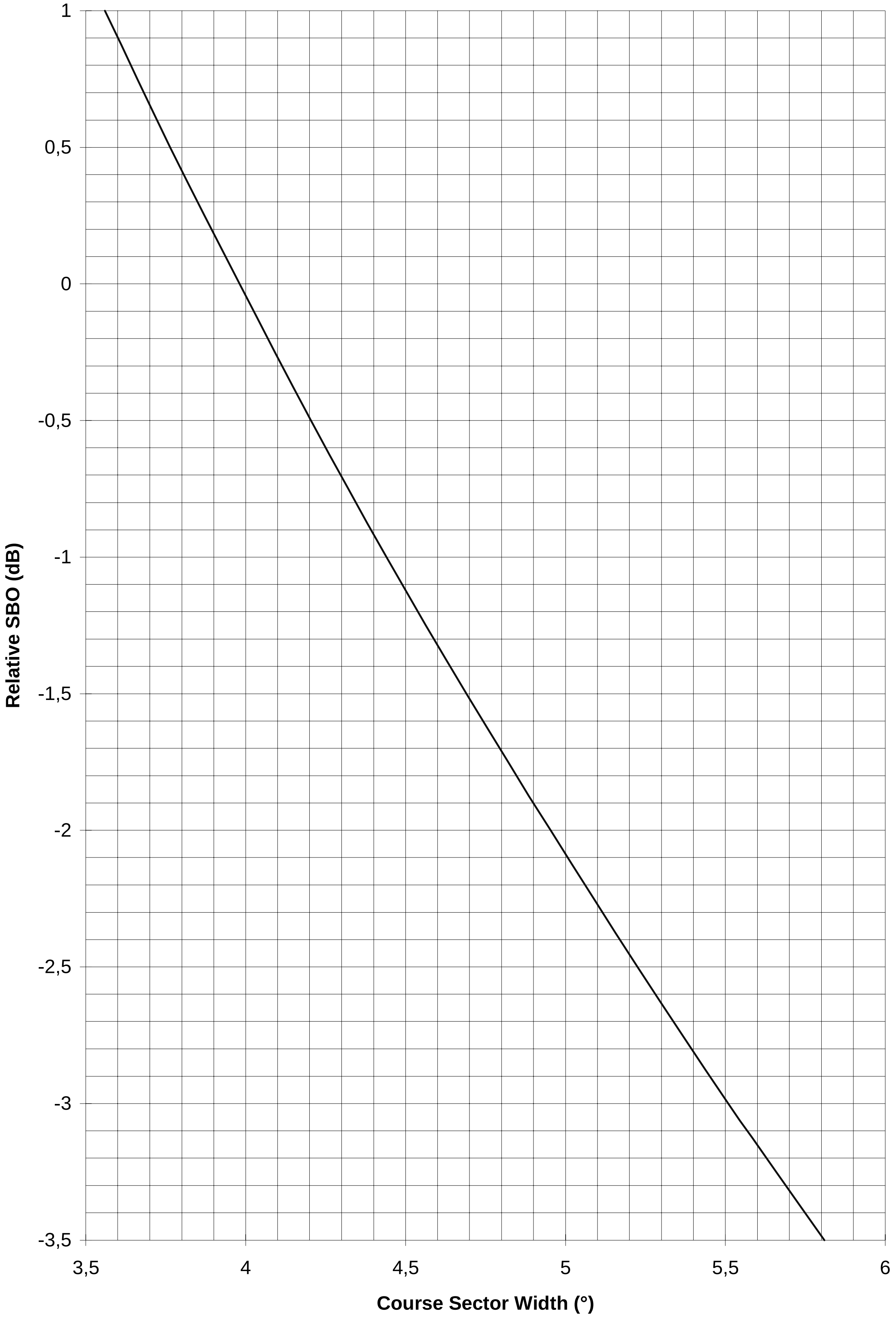


Diagram 3 Relative SBO vs CS Width, NM3524.

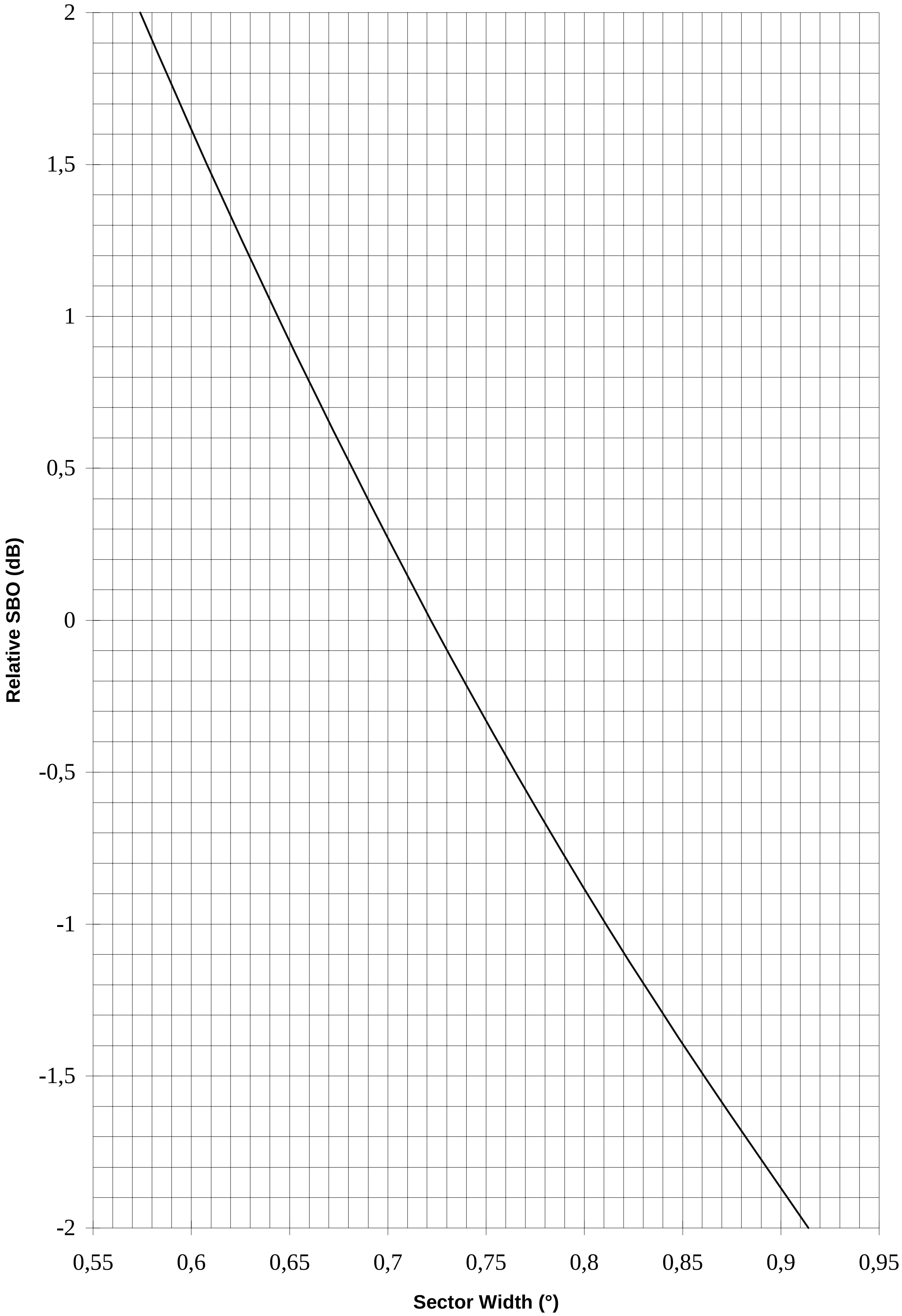


Diagram 4 Relative SBO vs CS Width, NM3525.

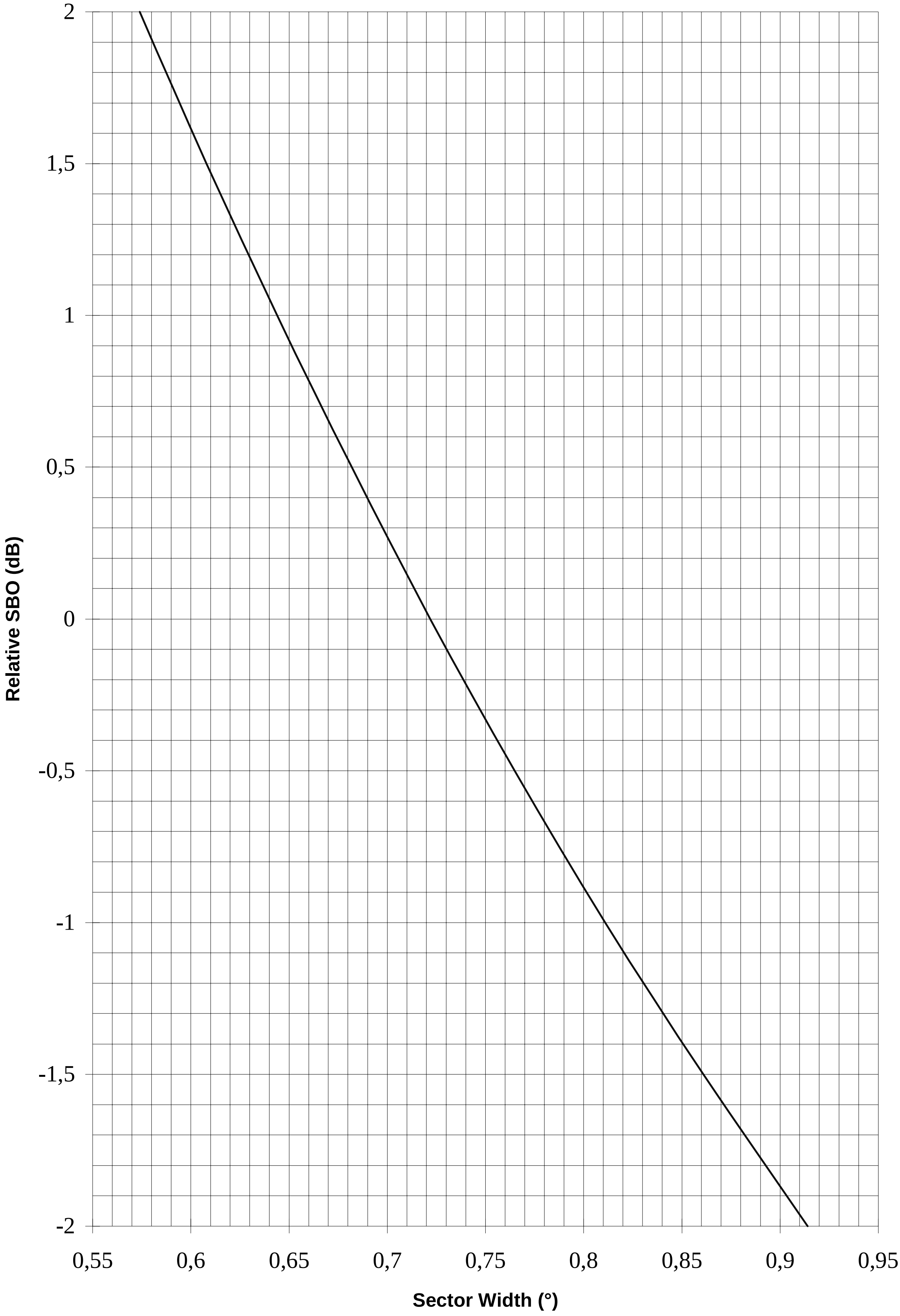
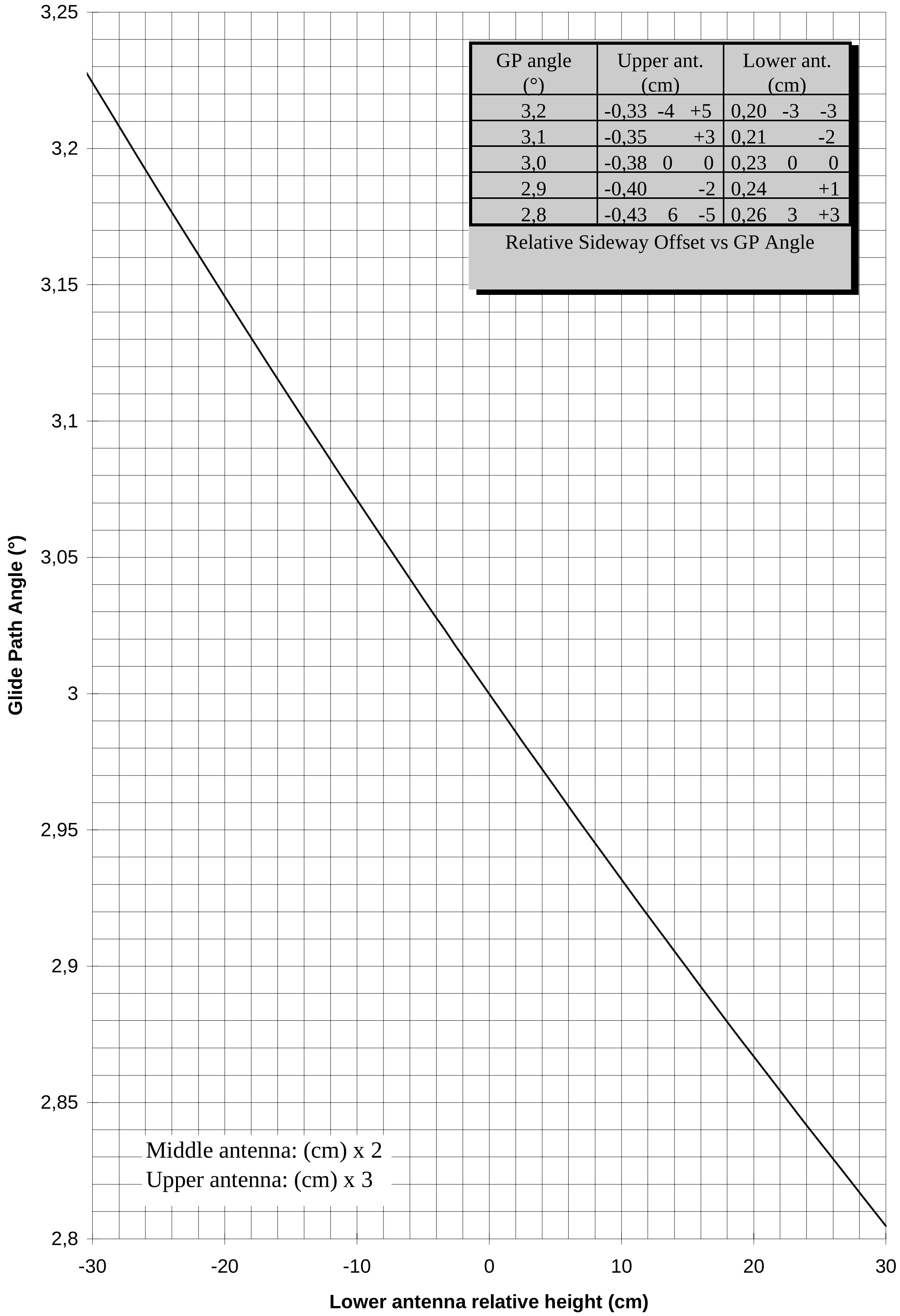


Diagram 5 Relative SBO vs CS Width, GP antenna systems.



GP angle (°)	Upper ant. (cm)			Lower ant. (cm)		
3,2	-0,33	-4	+5	0,20	-3	-3
3,1	-0,35		+3	0,21		-2
3,0	-0,38	0	0	0,23	0	0
2,9	-0,40		-2	0,24		+1
2,8	-0,43	6	-5	0,26	3	+3

Diagram 6 GP angle vs relative antenna height, NM3545.

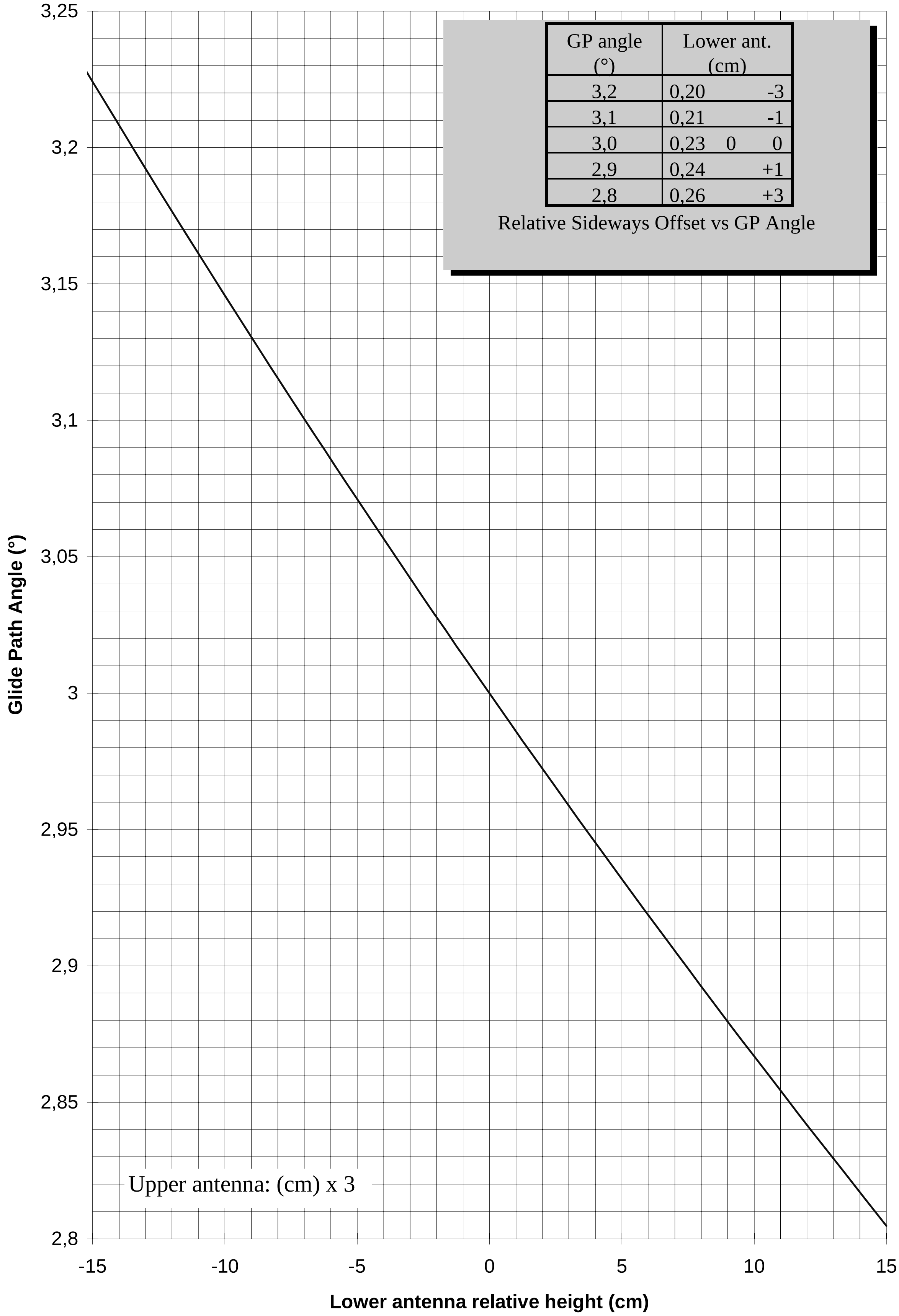
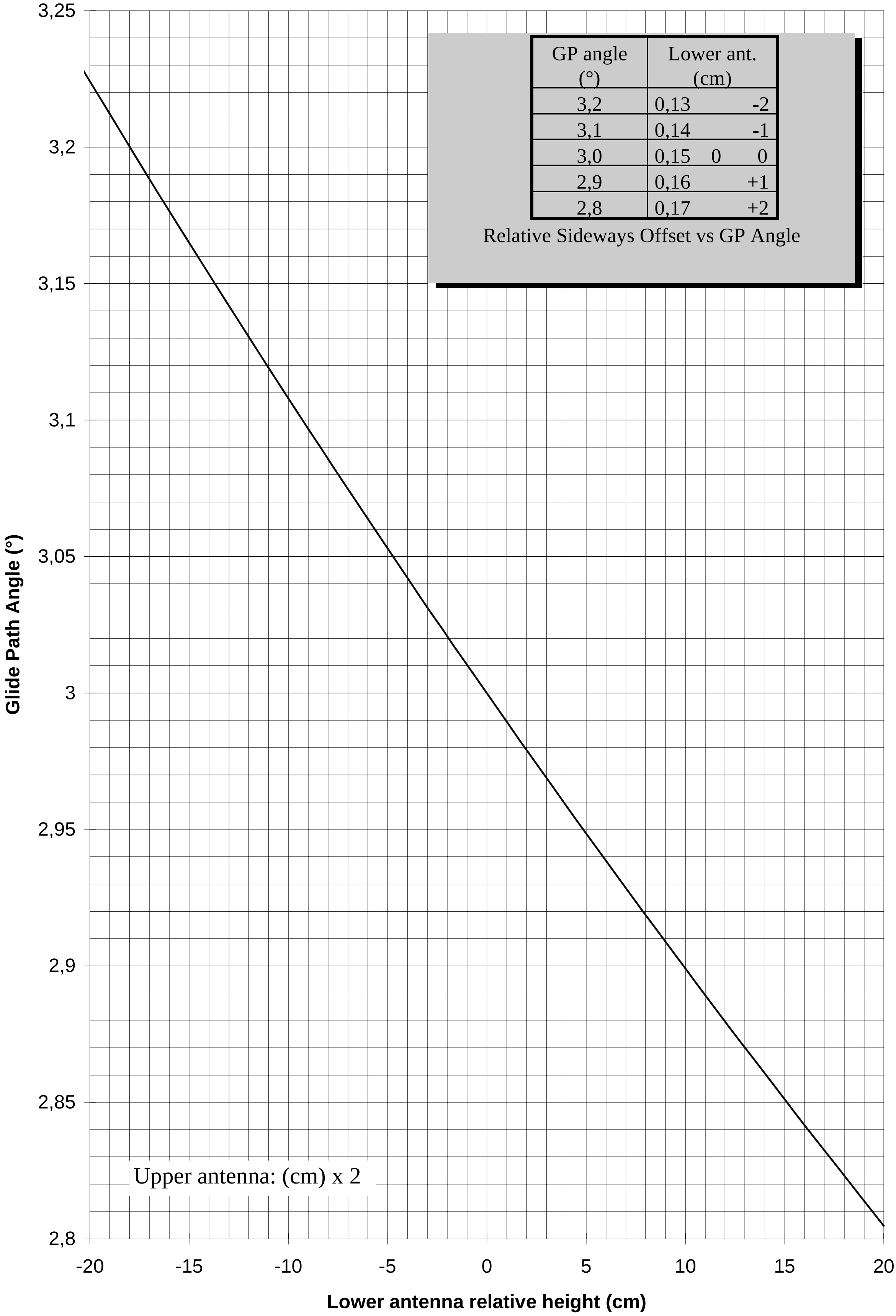


Diagram 7 GP angle vs relative antenna height, NM3544.



GP angle (°)	Lower ant. (cm)		
3,2	0,13		-2
3,1	0,14		-1
3,0	0,15	0	0
2,9	0,16		+1
2,8	0,17		+2

Diagram 8 GP angle vs relative antenna height, NM3543.