

Transnet Port Terminal
an Operating Division of TRANSNET SOC LTD
[hereinafter referred to as Transnet]
Registration Number 1990/000900/30

REQUEST FOR QUOTATION [RFQ] No 11484264

**FOR THE PROVISION OF: SUPPLY AND DELIVERY OF KIT TWO WAY HANDHELD RADIOS AT
TRANSNET SOC LTD (REG NO 1990/00090030) OPERATING AS TRANSNET PORT TERMINALS
DURBAN CONTAINER TERMINAL PIER 1**

ISSUE DATE:	07 November 2025
CLOSING DATE:	12 November 2025
CLOSING TIME:	12:00pm
SUBMISSION TO:	Transnet e-tender submission portal – see SBD 1 for details

SECTION 1: SBD1 FORM

PART A
INVITATION TO BID

YOU ARE HEREBY INVITED TO BID FOR REQUIREMENTS OF TRANSNET PORT TERMINAL, A DIVISION TRANSNET SOC LTD							
BID NUMBER:	11484264	ISSUE DATE:	07/11/2025	CLOSING DATE:	12/11/2025	CLOSING TIME:	12:00pm
DESCRIPTION	SUPPLY AND DELIVERY OF TWO WAY HANDHELD RADIOS FOR Transnet Port Terminal PIER 1						
BID RESPONSE DOCUMENTS SUBMISSION INSTRUCTIONS							
<p>Transnet has implemented a new electronic tender submission system, the e-Tender Submission Portal, in line with the overall Transnet digitalization strategy where suppliers can view advertised tenders, register their information, log their intent to respond to bids and upload their bid proposals/responses on to the system.</p> <p>The Transnet e-Tender Submission Portal can be accessed as follows:</p> <ol style="list-style-type: none"> Log on to the Transnet eTenders management platform website/Portal using Google Chrome: transnetetenders.azurewebsites.net; Click on "ADVERTISED TENDERS" to view advertised tenders; Click on "SIGN IN/REGISTER to register new bidder information and ensure that all mandatory information is completed OR to sign in if already registered; Toggle (click to switch) the "Log an Intent" button to submit a bid; Respondents are to submit bid documents by uploading them onto the Transnet system against each tender selected. A Bidder can upload 30mb per upload and multiple uploads are permitted. Bidders should ensure that electronic bid submissions are submitted at least a day before the closing date and bidders should not wait for the last hour before the deadline to submit. This is to enable them to timeously address issues which they may encounter due to internet speed, bandwidth or the size of the number of uploads being submitted. Transnet will not be held liable for any challenges experienced by bidders as a result of their own technical challenges. No late submissions will be accepted. Each company must register its own profile using its company details and use the corresponding registered profile to log an intent to bid as well as submitting any bid. Transnet will not accept a bid or will disqualify a bidder who submits a bid in the Transnet e-tender submission through another bidders'/Company's profile. In other words, each bidder must register the intent to bid and submit its bid through its own profile under the same company name that will eventually bid for the tender. No company shall submit a bid on behalf of another company regardless of the company being a subsidiary or holding company. In case of a Joint Venture, any of the parties/companies to the Joint Venture may use its registered profile to submit a bid on behalf of the Joint Venture. A detailed bidder guide can be found on the Transnet Portal transnetetenders.azurewebsites.net 							
BIDDING PROCEDURE / TECHNICAL ENQUIRIES MAY BE DIRECTED TO:							
CONTACT PERSON	Mncedi Ludonga						
TELEPHONE NUMBER	031 361 8996						
FACSIMILE NUMBER	N/A						
E-MAIL ADDRESS	Mncedi.Ludonga@transnet.net						
SUPPLIER INFORMATION							
NAME OF BIDDER							
POSTAL ADDRESS							
STREET ADDRESS							
TELEPHONE NUMBER	CODE			NUMBER			

CELLPHONE NUMBER			
FACSIMILE NUMBER	CODE		NUMBER
E-MAIL ADDRESS			
VAT REGISTRATION NUMBER			
IT IS A CONDITION OF THIS BID THAT THE TAX MATTERS OF THE SUCCESSFUL RESPONDENTS BE IN ORDER, OR THAT SATISFACTORY ARRANGEMENTS HAVE BEEN MADE WITH SOUTH AFRICAN REVENUE SERVICE (SARS) TO MEET THE RESPONDENTS TAX OBLIGATIONS.			
	TCS PIN		OR CSD NO:
SUPPLIER COMPLIANCE STATUS	<input type="checkbox"/> Yes <input type="checkbox"/> No	BBEE STATUS LEVEL SWORN AFFIDAVIT	
Yes, Who was the Certificate issued by			
AN ACCOUNTING OFFICER AS CONTEMPLATED IN THE CLOSE CORPORATION ACT (CCA) AND NAME THE APPLICABLE IN THE TICK BOX	<input type="checkbox"/>	AN ACCOUNTING OFFICER AS CONTEMPLATED IN THE CLOSE CORPORATION ACT (CCA)	
	<input type="checkbox"/>	A VERIFICATION AGENCY ACCREDITED BY THE SOUTH AFRICAN ACCREDITATION SYSTEM (SANAS)	
	<input type="checkbox"/>	A REGISTERED AUDITOR NAME:	
[A B-BBEE STATUS LEVEL VERIFICATION CERTIFICATE/ SWORN AFFIDAVIT MUST BE SUBMITTED FOR PURPOSES OF COMPLIANCE WITH THE B-BBEE ACT]			
1 ARE YOU THE ACCREDITED REPRESENTATIVE IN SOUTH AFRICA FOR THE GOODS /SERVICES /WORKS OFFERED?	<input type="checkbox"/> Yes <input type="checkbox"/> No [IF YES ENCLOSE PROOF]	2 ARE YOU A FOREIGN BASED SUPPLIER FOR THE GOODS /SERVICES /WORKS OFFERED?	<input type="checkbox"/> Yes <input type="checkbox"/> No [IF YES, ANSWER QUESTIONNAIRE BELOW]
Signature of the Bidder	Date:
QUESTIONNAIRE TO BIDDING FOREIGN SUPPLIERS			
IS THE BIDDER A RESIDENT OF THE REPUBLIC OF SOUTH AFRICA (RSA)?		<input type="checkbox"/> YES <input type="checkbox"/> NO	
DOES THE BIDDER HAVE A BRANCH IN THE RSA?		<input type="checkbox"/> YES <input type="checkbox"/> NO	
DOES THE BIDDER HAVE A PERMANENT ESTABLISHMENT IN THE RSA?		<input type="checkbox"/> YES <input type="checkbox"/> NO	
DOES THE BIDDER HAVE ANY SOURCE OF INCOME IN THE RSA?		<input type="checkbox"/> YES <input type="checkbox"/> NO	
IF THE ANSWER IS "NO" TO ALL OF THE ABOVE, THEN IT IS NOT A REQUIREMENT TO REGISTER FOR A TAX COMPLIANCE STATUS SYSTEM PIN CODE FROM THE SOUTH AFRICAN REVENUE SERVICE (SARS) AND IF NOT REGISTER AS PER 1.3 BELOW.			

PART B
TERMS AND CONDITIONS FOR BIDDING

1. TAX COMPLIANCE REQUIREMENTS
1.1 BIDDERS MUST ENSURE COMPLIANCE WITH THEIR TAX OBLIGATIONS.
1.2 BIDDERS ARE REQUIRED TO SUBMIT THEIR UNIQUE PERSONAL IDENTIFICATION NUMBER (PIN) ISSUED BY SARS TO ENABLE THE ORGAN OF STATE TO VERIFY THE TAXPAYER'S PROFILE AND TAX STATUS.
1.3 APPLICATION FOR TAX COMPLIANCE STATUS (TCS) PIN MAY BE MADE VIA E-FILING THROUGH THE SARS WEBSITE WWW.SARS.GOV.ZA.
1.4 BIDDERS MAY ALSO SUBMIT A PRINTED TCS CERTIFICATE TOGETHER WITH THE BID.
1.5 IN BIDS WHERE UNINCORPORATED CONSORTIA / JOINT VENTURES / SUB-CONTRACTORS ARE INVOLVED, EACH PARTY MUST SUBMIT A SEPARATE TCS CERTIFICATE / PIN / CSD NUMBER.
1.6 WHERE NO TCS IS AVAILABLE BUT THE BIDDER IS REGISTERED ON THE CENTRAL SUPPLIER DATABASE (CSD), A CSD NUMBER MUST BE PROVIDED.
1.7 RESPONDENTS ARE REQUIRED TO SELF- REGISTER ON NATIONAL TREASURY'S CENTRAL SUPPLIER DATABASE (CSD) WHICH HAS BEEN ESTABLISHED TO CENTRALLY ADMINISTER SUPPLIER INFORMATION FOR ALL ORGANS OF STATE AND FACILITATE THE VERIFICATION OF CERTAIN KEY SUPPLIER INFORMATION. ONLY FOREIGN SUPPLIERS WITH NO LOCAL REGISTERED ENTITY NEED NOT REGISTER ON THE CSD. THE CSD CAN BE ACCESSED AT HTTPS://SECURE.CSD.GOV.ZA/iu

NB: FAILURE TO PROVIDE / OR COMPLY WITH ANY OF THE ABOVE PARTICULARS MAY RENDER THE BID INVALID.

SIGNATURE OF BIDDER:

CAPACITY UNDER WHICH THIS BID IS SIGNED:

(Proof of authority must be submitted e.g. company resolution)

DATE: _____

SECTION 2: NOTICE TO BIDDERS

1 Responses to RFQ

Responses to this RFQ [Quotations] must not include documents or reference relating to any other quotation or proposal. Any additional conditions that the bidder wants to bring to the attention of Transnet must be embodied in an accompanying letter.

2 Communication (Clarifications and Complaints)

- 2.1 Specific clarification queries relating to this RFQ before the closing date of the RFQ should be submitted to Noxolo.Ngcobo@transnet.net before 12:00PM on **12/11/2025**. In the interest of fairness and **transparency Transnet's response to such a query will** then be made available to other bidders.
- 2.2 Specific complaints relating to this RFQ before or after the closing date should be formally submitted by emailing groupscmcomplaints@transnet.net. Once the complaint has been submitted, the Transnet SCM Complaints office will acknowledge your complaint and send you a complaint form for completion.
- 2.3 It is prohibited for Respondents to attempt, either directly or indirectly, to canvass any officer or employee of Transnet in respect of this RFQ between the closing date and the date of the award of the business.
- 2.4 Respondents found to be in collusion with one another will be automatically disqualified and restricted from doing business with organs of state for a specified period.
- 2.5 The outcome of the process will be communicated, via email, to all bidders as soon as the process is concluded. Should a bidder not receive any communication from Transnet 30 days after the expiry of the validity period of this bid, the bidder can consider its bid not being successful. All unsuccessful bidders have a right to request Transnet to furnish reasons for their bid not being successful. This requested must be directed to the contact person stated in the SBD 1 form

3 Legal Compliance

The successful Respondent shall be in full and complete compliance with any and all applicable national and local laws and regulations.

4 Employment Equity Act

Respondents must comply with the requirements of the Employment Equity Act 55 of 1998 applicable to it including (but not limited to) Section 53 of the Employment Equity Act.

5 Changes to Quotations

Changes by the Respondent to its submission will not be considered after the closing date and time.

6 Binding Offer

Any Quotation furnished pursuant to this Request shall be deemed to be an offer. Any exceptions to this statement must be clearly and specifically indicated.

7 Disclaimers

- 7.1 Respondents are hereby advised that Transnet is not committed to any course of action as a result of its issuance of this RFQ and/or its receipt of a Quotation in response to it. Please note that Transnet reserves the right to:
 - **modify the RFQ's goods / service(s);**
 - award only a portion of the proposed goods / services which are reflected in the scope of this RFQ;

- split the award of the order/s between more than one Supplier/Service Provider as may be explicitly articulated in the conditions or objective criteria to this RFQ;
- cancel the quotation process;
- validate any information submitted by Respondents in response to this bid. This would include, but is not limited to, requesting the Respondents to provide supporting evidence. By submitting a bid, Respondents hereby irrevocably grant the necessary consent to Transnet to do so;
- request audited financial statements or other documentation for the purposes of a due diligence exercise;
- not accept any changes or purported changes by the Respondent to the bid rates after the closing date and/or after the award of the business, unless the contract specifically provides for it;
- to cancel the contract and/request that National Treasury place the Respondent on its Database of Restricted Suppliers for a period not exceeding 10 years, on the basis that a contract was awarded on the strength of incorrect information furnished by the Respondent or on any other basis recognised in law;
- award the business to the next ranked bidder, provided that he/she is still prepared to provide the required Goods/Services at the quoted price, should the preferred bidder fail to sign or commence with the contract within a reasonable period after being requested to do so. Under such circumstances, the validity of the bids of the next ranked bidder(s) will be deemed to remain valid, irrespective of whether the next ranked bidder(s) were notified of their bid being unsuccessful. Bidders may therefore be requested to advise whether they would still be prepared to provide the required Goods/Services at their quoted price.
- Should a bidder fail to respond to a request for extension of the validity period before it expires, that bidder will be excluded from tender process.

8 Specification/Scope of Work

- **RADIO SET; TYPE: KENWOOD, SPECIAL FEATURES: COMPLETE REFER TO ANNEXURES ATTACHED ON DOCUMENT**

9 Legal review

A Proposal submitted by a Respondent will be subjected to review and acceptance or rejection of its proposed **contractual terms and conditions by Transnet's Legal Counsel, prior to consideration for an award of business.**

10 Security clearance

Acceptance of this bid could be subject to the condition that the Successful Respondent, its personnel providing the goods and its subcontractor(s) must obtain security clearance from the appropriate authorities to the level of CONFIDENTIAL/ SECRET/TOP SECRET. Obtaining the required clearance is the responsibility of the Successful Respondent. Acceptance of the bid is also subject to the condition that the Successful Respondent will implement all such security measures as the safe performance of the contract may require.

Transnet urges its clients, suppliers and the general public to report any fraud or corruption to

TIP-OFFS ANONYMOUS:



Ethics Helpdesk (Pty) LTD.
Ethics Management Systems™

You can choose to be Anonymous or Non-Anonymous on ANY of the platforms

PLEASE RETAIN YOUR REFERENCE NUMBER



AI Voice Bot "Jack"
Speak to our AI Voice Chat Bot "JACK", you converse with him like chatting to a human, with the option to record a message and speak to an agent at anytime.

What's App
Speak to an Agent via What's App.

Speak to an Agent
Speak to an Agent via the platform with no call or data charge

Telegram
Speak to an Agent via Telegram



0800 003 056



086 551 4153



reportit@ethicshelpdesk.com

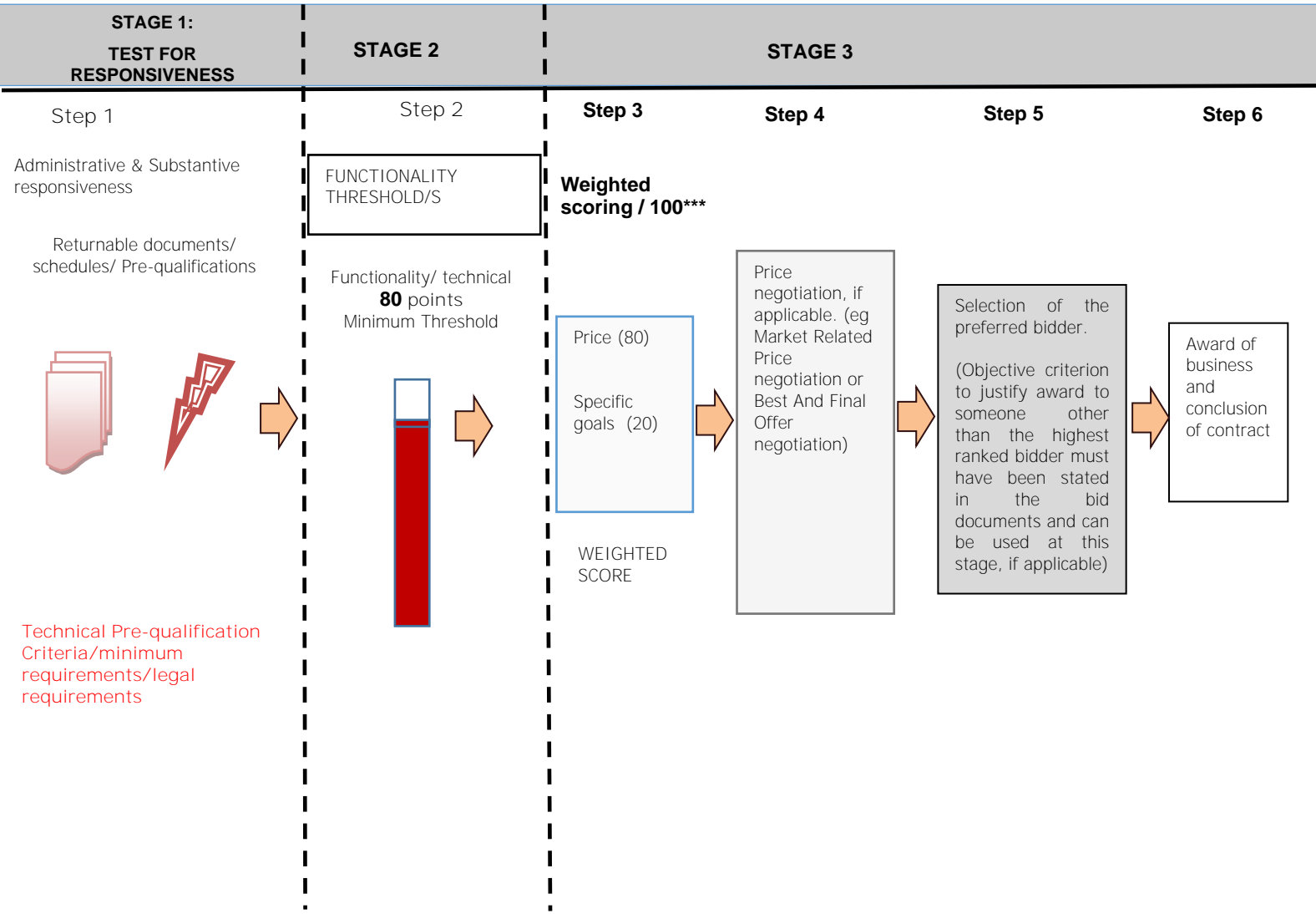


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SECTION 3
EVALUATION METHODOLOGY, CRITERIA AND RETURNABLE DOCUMENTS

1 Evaluation Criteria

Transnet will utilise the following methodology and criteria in selecting a preferred Supplier/Service provider:



1.1 STEP ONE: Test for Administrative and Substantive Responsiveness

The test for administrative and Substantive responsiveness will include the following:

Administrative & Substantive responsiveness check	RFQ Reference
• Whether the Bid has been lodged on time	
• Whether all Returnable Documents and/or schedules [where applicable] were completed and returned by the closing date and time	<i>Section 3</i>
• Verify the validity of all returnable documents	<i>Section 3</i>
• Verify if the Bid document has been duly signed by the authorised respondent	<i>All sections</i>
• Whether any general and legislation qualification criteria set by Transnet, have been met	<i>All sections</i>

<ul style="list-style-type: none"> Whether the Bid contains a priced offer 	<i>Section 4 - Quotation Form</i>
<ul style="list-style-type: none"> Whether the Bid materially complies with the scope and/or specification given 	<i>All Sections</i>
<ul style="list-style-type: none"> Whether any Technical Pre-qualification Criteria/minimum requirements/legal requirements have been met as follows: 	<i>Section 2 – paragraph 10 (Scope of Work)</i>
<ul style="list-style-type: none"> Entity’s financial stability 	<i>Not Applicable</i>

The test for responsiveness [Step One] must be passed for a Respondent’s Proposal to progress to Step Two for further pre-qualification

1.2 STEP TWO: Minimum Threshold 80 points for Technical Criteria (**ATTACHED AS ANNEXURE A**)

The test for the Technical and Functional threshold will include the following:

Respondents are to note that Transnet will round off final technical scores to the nearest 2 (two) decimal places for the purposes of determining whether the technical threshold has been met.

The minimum threshold for technical/functionality [Step TWO] must be met or exceeded for a Respondent’s Proposal to progress to Step Four for final evaluation

1.3 STEP THREE: Evaluation and Final Weighted Scoring

a) Price and TCO Criteria [Weighted score 80 points]:

Evaluation Criteria	RFP Reference
<ul style="list-style-type: none"> Commercial offer 	<i>Section 4</i>

Transnet will utilise the following formula in its evaluation of Price:

$$PS = 80 \left(1 - \frac{Pt - Pmin}{Pmin} \right)$$

Where:

Ps = Score for the Bid under consideration

Pt = Price of Bid under consideration

Pmin = Price of lowest acceptable Bid

b) Specific Goals [Weighted score 20 point]

- Specific goals preference points claim form
- Preference points will be awarded to a bidder for attaining the specific goals requirements in accordance with the table indicated in Section 4.1 of the specific goals Claim Form.

1.4 STEP FOUR: Price Negotiations (if applicable)

- Respondents are to note that Transnet may not award a contract if the price offered is not market-related. In this regard, Transnet reserves the right to engage in PTN with the view to achieving a market-related price or to cancel the tender. Negotiations will be done in a sequential manner i.e.:
 - first negotiate with the highest ranked bidder or cancel the bid, should such negotiations fail,
 - negotiate with the 2nd and 3rd ranked bidders (if required) in a sequential manner.
- In the event of any Respondent being notified of such short-listed/preferred bidder status, his/her bid, as well as any subsequent negotiated best and final offers (BAFO), will automatically be deemed to remain valid during the negotiation period and until the ultimate award of business.
- Should Transnet conduct post tender negotiations, Respondents will be requested to provide their best and final offers to Transnet based on such negotiations. Where a market related price has been achieved through negotiation, the contract will be awarded to the successful Respondent(s).

1.5 STEP FIVE: Objective Criteria (if applicable)

Transnet reserves the right to award the business to the highest scoring bidder/s unless objective criteria justify the award to another bidder. The objective criteria Transnet may apply in this bid process include:

- Skills Transfer and Capacity Building for Transnet;
- **Impact on Transnet's Return On Investment;**
- Rotation of Suppliers to promote opportunities for other suppliers, by overlooking a supplier that has been awarded business repeatedly overtime, in the same commodity, in order to benefit other suppliers in the market;
- the bidder is undergoing a process of being restricted by Transnet or other state institution that Transnet may be aware of,
- the bidder is insolvent, in receivership, under Business Rescue as provided for in chapter 6 of the Companies Act, 2008, bankrupt or being wound up, has his affairs administered by a court or a judicial officer, has suspended his business activities, or is subject to legal proceedings in respect of any of the foregoing,
- the bidder is unable, as objectively determined by Transnet, to perform the contract free of conflicts of interest.
- all risks identified during a risk assessment exercise/probity check (which may be conducted by an authorised third party) that would be done to assess all risks, including but not limited to:
 - the financial stability of the bidder based on key ratio analysis, which would include, but not be limited to Efficiency, Profitability, Financial Risk, Liquidity, Acid Test, and Solvency;
 - a commercial relationship with a Domestic Prominent Influential Person (DPIP) or Foreign Prominent Public Official (FPPO) or an entity of which such person or official is the beneficial owner; and
 - reputational and brand risks.

1.6 STEP SIX: Award of business and conclusion of contract

- Immediately after approval to award the contract has been received, the successful or preferred bidder(s) will be informed of the acceptance of his/their Quotation by way of a Letter of Award. Thereafter the final contract will be concluded with the successful Respondent(s), where applicable.
- Alternatively, the acceptance of a letter of award by the Successful Respondent will constitute the final contract read together with their RFQ response and the Standard Terms and Conditions. This will be stated in the letter of award.

2 Validity Period

Transnet requires a validity period of 90 [Ninety] Business Days from the closing date of this RFQ, excluding the first day and including the last day.

Bidders are to note that they may be requested to extend the validity period of their bid, on the same terms and conditions, if the internal evaluation process has not been finalised within the validity period. However, once the adjudication body has approved the process and award of the business to the successful bidder(s), **the validity of the successful bidder(s)' bid will be deemed to remain valid until a final contract has been concluded.**

3 Disclosure of contract information

Johannesburg Stock Exchange Debt Listing Requirements

Transnet may also be required to disclose information relating to the subsequent contract i.e. the name of the company, goods/services provided by the company, the value and duration of the contract, etc. in compliance with the Johannesburg Stock Exchange (JSE) Debt Listing Requirements.

Domestic Prominent Influential Persons (DPIP) OR Foreign Prominent Public Officials (FPPO)

Transnet is free to procure the services of any person within or outside the Republic of South Africa in accordance with applicable legislation. Transnet shall not conduct or conclude business transactions, with any Respondents without having:

- Considered relevant governance protocols;
- Determined the DPIP or FPPO status of that counterparty; and
- Conducted a risk assessment and due diligence to assess the potential risks that may be posed by the business relationship.

As per the Transnet Domestic Prominent Influential Persons (DPIP) and Foreign Prominent Public Officials (FPPO) and Related Individuals Policy available on Transnet website <https://www.transnet.net/search/pages/results.aspx?k=FPIDP#k=DPIP>, Respondents are required to disclose any commercial relationship with a DPIP or FPPO (as defined in the Policy) by completing the following section:

The below form contains personal information as defined in the Protection of Personal Information Act, 2013 (the "Act"). By completing the form, the signatory consents to the processing of her/his personal information in accordance with the requirements of the Act. Consent cannot unreasonably be withheld.					
Is the Respondent <i>(Complete with a "Yes" or "No")</i>					
A DPIP/FPPO		Closely Related to a DPIP/FPPO		Closely Associated to a DPIP/FPPO	
List all known business interests, in which a DPIP/FPPO may have a direct/indirect interest					

or significant participation or involvement.						
No	Name of Entity / Business	Role in the Entity / Business (Nature of interest/ Participation)	Shareholding %	Registration Number	Status (Mark the applicable option with an X)	
					Active	Non-Active
1						
2						

Respondents declaring a commercial relationship with a DPIIP or FPPO are to note that Transnet is required to annually publish on its website a list of all business contracts entered into with DPIIP or FPPO. This list will include successful Respondents, if applicable.

4 Returnable Documents

Returnable Documents means all the documents, Sections and Annexures, as listed in the tables below. There are three types of returnable documents as indicated below and Respondents are urged to ensure that these documents are returned with their bids based on the consequences of non-submission as indicated below:

Mandatory Returnable Documents	<i>Failure to provide all these Mandatory Returnable Documents at the Closing Date and time of this RFQ will result in a Respondent's disqualification.</i>
Returnable Documents Used for Scoring	<i>Failure to provide all Returnable Documents used for purposes of scoring a bid, by the closing date and time of this bid will not result in a Respondent's disqualification. However, Bidders will receive an automatic score of zero for the applicable evaluation criterion.</i>
Essential Returnable Documents	<i>Failure to provide essential Returnable Documents may result in Transnet affording Respondents a further opportunity to submit by a set deadline, where applicable. Should a Respondent thereafter fail to submit the requested documents, this may result in a Respondent's disqualification.</i>

All Returnable Sections, as indicated in the header and footer of the relevant pages, must be signed, stamped and dated by the Respondent.

a) Mandatory Returnable Documents

Respondents are required to submit with their bid submissions the following Mandatory Returnable Documents, and also to confirm submission of these documents by indicating [Yes or No] in the tables below:

Mandatory Returnable Documents	Submitted [Yes or No]
SECTION 4 : Quotation Form	

b) Returnable Documents Used for Scoring

In addition to the requirements of section (a) above, Respondents are further required to submit with their Proposals the following Returnable Documents Used for Scoring and also to confirm submission of these documents by indicating [Yes or No] in the table below:

RETURNABLE DOCUMENTS USED FOR SCORING	SUBMITTED [Yes or No]
Valid proof of Respondent's compliance to Specific Goal requirements stipulated in Section 6 of this RFQ	

c) Essential Returnable Documents:

Respondents are further required to submit the following Essential Returnable Documents with their RFQ and to confirm submission of these documents by indicating [Yes or No] in the table below:

ESSENTIAL RETURNABLE DOCUMENTS & SCHEDULES	SUBMITTED [Yes or No]
SECTION 5: Certificate of Acquaintance with RFQ Documents	
SECTION 6: RFQ Declaration and Breach of Law Form	
SECTION 7: Protection of Personal Information	
SECTION 1: SBD1 Form	

5 CONTINUED VALIDITY OF RETURNABLE DOCUMENTS

The successful Respondent will be required to ensure the validity of all returnable documents for the duration of any contract emanating from this RFQ. Should the Respondent be awarded the contract [the Agreement] and fail to present Transnet with such renewals as and when they become due, Transnet shall be entitled, in addition to any other rights and remedies that it may have in terms of the eventual Agreement, to terminate such Agreement immediately without any liability and without prejudice to any claims which Transnet may have for damages against the Respondent.

SECTION 4
QUOTATION FORM

I/We _____

hereby offer to supply the goods/services at the prices quoted in the Price Schedule below, in accordance with the conditions related thereto.

I/We agree to be bound by those terms and conditions in:

- the Standard RFQ Terms and Conditions for the Supply of Goods or Services to Transnet; and
- any other standard or special conditions embodied in this Request for Quotation.

I/We accept that unless Transnet should otherwise decide and so inform me/us, this Quotation [and, if any, its covering letter and any subsequent exchange of correspondence], **together with Transnet's acceptance** thereof shall constitute a binding contract between Transnet and me/us. I/We further agree that if, after I/we have been notified of the acceptance of my/our Quotation, I/we fail to deliver the said goods/service/s within the delivery lead-time quoted, Transnet may, without prejudice to any other legal remedy which it may have, cancel the order and recover from me/us any expenses incurred by Transnet in calling for Quotations afresh and/or having to accept any less favourable offer.

Price Schedule

I/We quote as follows for the goods/services **required, on a "delivered nominated destination" basis**, including VAT:

Respondents are to note that Transnet will round off final pricing scores to the nearest 2 (two) decimal places.

Notes to Pricing:

- a) Respondents are to note that if the price offered by the highest scoring bidder is not market-related, Transnet may not award the contract to that Respondent. Transnet may-
 - (i) negotiate a market-related price with the Respondent scoring the highest points or cancel the RFQ;
 - (ii) if that Respondent does not agree to a market-related price, negotiate a market-related price with the Respondent scoring the second highest points or cancel the RFQ;
 - (iii) if the Respondent scoring the second highest points does not agree to a market-related price, negotiate a market-related price with the Respondent scoring the third highest points or cancel the RFQ.

If a market-related price is not agreed with the Respondent scoring the third highest points, Transnet must cancel the RFQ.

- b) All Prices must be quoted in South African Rand, inclusive of VAT
- c) Any disbursement not specifically priced for will not be considered/accepted by Transnet.
- d) To facilitate like-for-like comparison bidders must submit pricing strictly in accordance with this price schedule and not utilise a different format. Deviation from this pricing schedule could result in a bid being disqualified.
- e) Please note that should you have offered a discounted price(s), Transnet will only consider such price discount(s) in the final evaluation stage if offered on an unconditional basis.

Respondent's Signature

Date & Company Stamp

RAIL NETWORK TELECOMS

SCHEDULE OF REQUIREMENTS FOR THE SUPPLY OF 30 TWO-WAY HANDHELD TRUNKED AND CONVENTIONAL RADIO EQUIPMENT FOR TRANSNET PORT TERMINALS DURBAN PIER 1

APPENDIX A: SCHEDULE OF COMPLIANCE FOR THE ABOVE:

- Tenders are invited in respect of the following Schedule of Requirements.
- Tenderers must indicate compliance with each item by providing a technical datasheet indicating make and model and functionalities being offered.
- Alternate offers must be **indicated on separate documents**.

ITEM	DESCRIPTION	MAKE & MODEL	COMMENT
1	HANDHELD REQUIREMENTS		
1.1	UHF, (400 – 470 MHz band) IP67 OR better, Handheld Trunked and Conventional radio, with a minimum of 16 conventional 12.5 kHz channels. (Can specify alternative number of channels). Excluding antenna and battery Must comply with attached Specifications BBD 8635 version 8 dated 21 May 2014 and BBF 2516 version 3.00, dated 6 June 2014.		
1.2	Quarter wave flexible whip antenna for item 1.1, to cover the 455 to 467 MHz band.		
1.3	High-capacity Battery to fit item 1.1, capable of sustaining a 20 - 20 - 60 duty cycle for an 8 hour shift. (Tx, Rx, Standby).		
1.4	Single bay rapid rate Charger for item 1.1 Provision must be made for a standard 3 pin 15-amp mains plug.		
1.5	Leather carry bag for item 1 with shoulder strap.		
1.6	Programming software, Leads, Adaptors and technical manuals on CD.		
1.7	Delivery as per delivery schedule Take note of evaluation and batch testing requirements.		

APPENDIX B & C: BILL OF QUANTITIES AND COST SCHEDULE

Indicate the cost per unit for the quantities indicated in the respective columns

ITEM	DESCRIPTION	QTY	UNIT PRICE	TOTAL
2	HANDHELD REQUIREMENTS			
2.1	UHF, (400 – 470 MHz band) IP54, Handheld Trunked and Conventional radio, with a minimum of 16 conventional 12.5 kHz channels. (Can specify alternative number of channels). Excluding antenna and battery Must comply with attached Specifications BBD 8635 version 8 dated 21 May 2014 and BBF 2516 version 3.00, dated 6 June 2014.	30		
2.2	Quarter wave flexible whip antenna for item 1.1, to cover the 455 to 467 MHz band.	30		
2.3	High-capacity Battery to fit item 1.1, capable of sustaining a 20 - 20 - 60 duty cycle for an 8-hour shift. (Tx, Rx, Standby).	60		
2.4	Single bay rapid rate Charger for item 1.1 Provision must be made for a standard 3 pin 15-amp mains plug.	30		
2.5	Leather carry bag for item 1 with shoulder strap.	30		
2.6	Programming software, Leads & Adaptors, technical manuals.	2		
2.7	Delivery as per delivery schedule Take note of evaluation and batch testing requirements.	1		

APPENDIX D: DELIVERY PERIOD

Indicate the delivery period, in weeks, for the quantities as indicated in the bill of quantities above:

ITEM	DESCRIPTION	QTY	DELIVERY DATE	COMMENT
3	HANDHELD REQUIREMENTS			
3.1	UHF, (400 – 470 MHz band) IP54, Handheld Trunked and Conventional radio, with a minimum of 16 conventional 12.5 kHz channels. (Can specify alternative number of channels). Excluding antenna and battery Must comply with attached Specifications BBD 8635 version 8 dated 21 May 2014 and BBF 2516 version 3.00, dated 6 June 2014.	30		
3.2	Quarter wave flexible whip antenna for item 1.1, to cover the 455 to 467 MHz band.	30		
3.3	High-capacity Battery to fit item 1.1, capable of sustaining a 20 - 20 - 60 duty cycle for an 8-hour shift. (Tx, Rx, Standby).	60		
3.4	Single bay rapid rate Charger for item 1.1 Provision must be made for a standard 3 pin 15-amp mains plug.	30		
3.5	Leather carry bag for item 1 with shoulder strap.	30		
3.6	Programming software, Leads & Adaptors, technical manuals.	2		
3.7	Delivery as per delivery schedule Take note of evaluation and batch testing requirements.	1		

APPENDIX E: DELIVERY SCHEDULE

Note that if equipment has not been evaluated before, if it is not in the document **BBD8208 Version 5.3.9**, it will need to be submitted for evaluation at the TFR test centre at 2 Foley St, Factoria, Krugersdorp before purchase.

It will be the responsibility of the supplier to arrange delivery (at their cost) to and from the Test Centre.

Note: Batch testing to be done prior to delivery.

10% of equipment required to be batch tested at the TFR test centre at 2 Foley St, Factoria, Krugersdorp.

It will be the responsibility of the supplier to arrange delivery (at their cost) to and from the Test Centre.

Should the technical evaluation & batch testing not be in line with the technical specification, TFR reserves the right to revoke or rescind the letter of award and P.O. and proceed with the next highest ranked bidder.

The supplied equipment quantities must be delivered to the following location after batch testing.

TRANSNET TFR RADIO

**Clark Drive.
Eel Road
Bayhead
Durban**

Box to be labelled: Durban TPT Pier 1 Handheld Two-Way Radios

CONTACT: Prior to Delivery Durban Tpt Pier 1 Handheld Two-Way Radios (contact MR. MNCEDI LUDONGA)

CONTACT (Mncedi Ludonga TEL 031 361 1797 CELL: 082 656 3853)

Workshop Representative

Luvuyo Jonkile

Office: 031 361 4944

Cell: 060 575 4957

Email: Luvuyo.Jonkile@transnet.net

TECHNICAL QUERIES

Anele Mlambo

Office: 035 906 7801

Cell: 071 736 5534

Email: Anele.Mlambo@transnet.net

SECTION 5

RFQ DECLARATION, CERTIFICATE OF ACQUAINTANCE & BREACH OF LAW FORM

By signing this certificate the Respondent is deemed to acknowledge that he/she has made himself/herself thoroughly familiar with, and agrees with all the conditions governing this RFQ. This includes those terms and conditions contained in any printed form stated to form part hereof, including but not limited to the documents stated below. As such, Transnet will recognise no claim for relief based on an allegation that the Respondent overlooked any such term or condition or failed properly to take it into account in calculating tendered prices or any other purpose:

1. Transnet's General Bid Conditions
2. Standard RFQ Terms and Conditions for the supply of Goods or Services to Transnet
3. Transnet's Supplier Integrity Pact
4. Non-disclosure Agreement

Note: Should a Respondent be successful and awarded the bid, they will be required to complete a Supplier Declaration Form for registration as a vendor onto the Transnet vendor master database.

Should the Bidder find any terms or conditions stipulated in any of the relevant documents quoted in the RFQ unacceptable, it should indicate which conditions are unacceptable and offer alternatives by written submission on its company letterhead, attached to its submitted Bid. **Any such submission shall be subject to review by Transnet's Legal Counsel** who shall determine whether the proposed alternative(s) are acceptable or otherwise, as the case may be. A material deviation from the Standard terms or conditions could result in disqualification.

Bidders accept that an obligation rests on them to clarify any uncertainties regarding any bid to which they intend to respond, before submitting the bid. The Bidder agrees that he/she will have no claim or cause of action based on an allegation that any aspect of this RFQ was unclear but in respect of which he/she failed to obtain clarity.

The bidder understands that his/her Bid will be disqualified if this Certificate of Acquaintance with RFQ documents included in the RFQ as a returnable document, is found not to be true and/ or complete in every respect.

We hereby certify that:

1. Transnet has supplied and we have received appropriate responses to any/all questions [as applicable] which were submitted by ourselves for RFQ Clarification purposes;
2. We have received all information we deemed necessary for the completion of this Request for Quotation [RFQ];
3. We have been provided with sufficient access to the existing Transnet facilities/sites and all relevant information relevant to the Supply of the Goods as well as Transnet information and Employees, and have had **sufficient time in which to conduct and perform a thorough due diligence of Transnet's operations and business** requirements and assets used by Transnet. Transnet will therefore not consider or permit any pre- or post-contract verification or any related adjustment to pricing, service levels or any other provisions/conditions based on any incorrect assumptions made by the Respondent in arriving at his Bid Price.

4. At no stage have we received additional information relating to the subject matter of this RFQ from Transnet sources, other than information formally received from the designated Transnet contact(s) as nominated in the RFQ documents;
5. We have complied with all obligations of the Bidder/Supplier as indicated in the Transnet Supplier Integrity Pact which includes but are not limited to ensuring that we take all measures necessary to prevent corrupt practices, unfairness and illegal activities in order to secure or in furtherance to secure a contract with Transnet;
6. We are satisfied, insofar as our entity is concerned, that the processes and procedures adopted by Transnet in issuing this RFQ and the requirements requested from Bidders in responding to this RFQ have been conducted in a fair and transparent manner;
7. we declare that an owner / member / director / partner / shareholder/employee of our entity has / has not been [delete as applicable] a former employee or board member of Transnet in the past 10 years. I further declare that if they were a former employee or board member of Transnet in the past 10 years that they were/were not involved in the bid preparation or had access to the information related to this RFQ; and
8. If such a relationship as indicated in paragraph 7 exists, the Respondent is to complete the following section:

FULL NAME OF OWNER/MEMBER/DIRECTOR/
PARTNER/SHAREHOLDER/EMPLOYEE:

ADDRESS:

Indicate nature of relationship with Transnet:

[Failure to furnish complete and accurate information in this regard will lead to the disqualification of a response and may preclude a Respondent from doing future business with Transnet]. Information provided in the declaration may be used by Transnet and/or its affiliates to verify the correctness of the information provided.

9. We declare, to the extent that we are aware or become aware of any relationship between ourselves and Transnet [other than any existing and appropriate business relationship with Transnet] which could unfairly advantage our entity in the forthcoming adjudication process, we shall notify Transnet immediately in writing of such circumstances.

BIDDER'S DISCLOSURE (SBD4)

12 PURPOSE OF THE FORM

12.1 Any person (natural or juristic) may make an offer or offers in terms of this invitation to bid. In line with the principles of transparency, accountability, impartiality, and ethics as enshrined in the Constitution of the Republic of South Africa and further expressed in various pieces of legislation, it is required for the bidder to make this declaration in respect of the details required hereunder.

12.2 Where a person/s are listed in the Register for Tender Defaulters and / or the List of Restricted Suppliers, that person will automatically be disqualified from the bid process.

13 **Bidder's declaration**

13.1 Is the bidder, or any of its directors / trustees / shareholders / members / partners or any person having a controlling interest¹ in the enterprise, employed by the state? YES/NO

13.1.1. If so, furnish particulars of the names, individual identity numbers, and, if applicable, state employee numbers of sole proprietor/ directors / trustees / shareholders / members/ partners or any person having a controlling interest in the enterprise, in table below.

Full Name	Identity Number	Name of State institution

13.2 Do you, or any person connected with the bidder, have a relationship with any person who is employed by the procuring institution? YES/NO

13.2.1. If so, furnish particulars:

13.3 Does the bidder or any of its directors / trustees / shareholders / members / partners or any person having a controlling interest in the enterprise have any interest in any other related enterprise whether or not they are bidding for this contract? YES/NO

13.3.1. If so, furnish particulars:

14 **DECLARATION**

I, the undersigned, (name)..... in submitting the accompanying bid, do hereby make the following statements that I certify to be true and complete in every respect:

¹ the power, by one person or a group of persons holding the majority of the equity of an enterprise, alternatively, the person/s having the deciding vote or power to influence or to direct the course and decisions of the enterprise.

- 14.1 I have read and I understand the contents of this disclosure;
- 14.2 I understand that the accompanying bid will be disqualified if this disclosure is found not to be true and complete in every respect;
- 14.3 The bidder has arrived at the accompanying bid independently from, and without consultation, communication, agreement or arrangement with any competitor. However, communication between partners in a joint venture or consortium² will not be construed as collusive bidding.
- 14.4 In addition, there have been no consultations, communications, agreements or arrangements with any competitor regarding the quality, quantity, specifications, prices, including methods, factors or formulas used to calculate prices, market allocation, the intention or decision to submit or not to submit the bid, bidding with the intention not to win the bid and conditions or delivery particulars of the products or services to which this bid invitation relates.
- 14.5 The terms of the accompanying bid have not been, and will not be, disclosed by the bidder, directly or indirectly, to any competitor, prior to the date and time of the official bid opening or of the awarding of the contract.
- 14.6 There have been no consultations, communications, agreements or arrangements made by the bidder with any official of the procuring institution in relation to this procurement process prior to and during the bidding process except to provide clarification on the bid submitted where so required by the institution; and the bidder was not involved in the drafting of the specifications or terms of reference for this bid.
- 14.7 I am aware that, in addition and without prejudice to any other remedy provided to combat any restrictive practices related to bids and contracts, bids that are suspicious will be reported to the Competition Commission for investigation and possible imposition of administrative penalties in terms of section 59 of the Competition Act No 89 of 1998 and or may be reported to the National Prosecuting Authority (NPA) for criminal investigation and or may be restricted from conducting business with the public sector for a period not exceeding ten (10) years in terms of the Prevention and Combating of Corrupt Activities Act No 12 of 2004 or any other applicable legislation.

I CERTIFY THAT THE INFORMATION FURNISHED IN PARAGRAPHS 12, 13 and 14 ABOVE IS CORRECT.

I ACCEPT THAT THE STATE MAY REJECT THE BID OR ACT AGAINST ME IN TERMS OF PARAGRAPH 6 OF PFMA SCM INSTRUCTION 03 OF 2021/22 ON PREVENTING AND COMBATING ABUSE IN THE SUPPLY CHAIN MANAGEMENT SYSTEM SHOULD THIS DECLARATION PROVE TO BE FALSE.

15 BREACH OF LAW

We further hereby certify that *I/we have/have not been* [delete as applicable] found guilty during the preceding 5 [five] years of a serious breach of law, including but not limited to a breach of the Competition Act, 89 of 1998, by a court of law, tribunal or other administrative body. The type of breach that the Respondent is required to disclose excludes relatively minor offences or misdemeanours, e.g. traffic offences. This includes the imposition of an administrative fine or penalty.

² Joint venture or Consortium means an association of persons for the purpose of combining their expertise, property, capital, efforts, skill and knowledge in an activity for the execution of a contract.

Where found guilty of such a serious breach, please disclose:

NATURE OF BREACH:

DATE OF BREACH: _____

Furthermore, I/we acknowledge that Transnet SOC Ltd reserves the right to exclude any Respondent from the bidding process, should that person or entity have been found guilty of a serious breach of law, tribunal or regulatory obligation.

SIGNED at _____ on this _____ day of _____ 20__

For and on behalf of _____ duly authorised hereto	AS WITNESS:
Name:	Name:
Position:	Position:
Signature:	Signature:
Date:	Registration No of Company/CC _____
Place:	Registration Name of Company/CC _____

SECTION 6: SPECIFIC GOALS POINTS CLAIM FORM

This preference form must form part of all bids invited. It contains general information and serves as a claim for preference points for specific goals Contribution. Transnet will award preference points to companies who provide valid proof of evidence of as per the table below.

NB: BEFORE COMPLETING THIS FORM, BIDDERS MUST STUDY THE GENERAL CONDITIONS, DEFINITIONS AND DIRECTIVES APPLICABLE IN RESPECT OF SPECIFIC GOALS, AS PRESCRIBED IN THE PREFERENTIAL PROCUREMENT POLICY FRAMEWORK ACT, 2000.

1. GENERAL CONDITIONS

1.1 The following preference point systems are applicable to all bids:

- the 80/20 system for requirements with a Rand value of up to R50 000 000 (all applicable taxes included); and

1.2 The value of this bid is estimated to not exceed R50 000 000 (all applicable taxes included) and therefore the 80/20 preference point system shall be applicable. Despite the stipulated preference point system, Transnet shall use the lowest acceptable bid to determine the applicable preference point system in a situation where all received acceptable bids are received outside the stated preference point system.

1.3 Either the 80/20 preference point system will be applicable to this tender.

1.4 Preference points for this bid shall be awarded for:

- (a) Price;
- (b) B-BBEE Status Level of Contribution.
- (c) Any other specific goal determined in Transnet preferential procurement policy.

1.5 The maximum points for this bid are allocated as follows:

	POINTS
PRICE	80
B-BBEE STATUS LEVEL OF CONTRIBUTOR -BBEE Level of contributor – Level 1 (15) B-BBEE Level of contributor – Level 2 (10) 50% Black Youth Owned Entities (05)	20
Total points for Price and Specific Goals must not exceed	100

1.6 Failure on the part of a bidder to submit proof of specific goals together with the bid will be interpreted to mean that preference points for B-BBEE status level of contribution are not claimed.

1.7 The purchaser reserves the right to require of a bidder, either before a bid is adjudicated or at any time subsequently, to substantiate any claim in regard to preferences, in any manner required by the purchaser.

2. DEFINITIONS

- (a) **“all applicable taxes”** includes value-added tax, pay as you earn, income tax, unemployment

insurance fund contributions and skills development levies;

- (b) **"B-BBEE"** means broad-based black economic empowerment as defined in section 1 of the Broad-Based Black Economic Empowerment Act;
- (c) **"B-BBEE status level of contributor"** means the B-BBEE status received by a measured entity based on its overall performance using the relevant scorecard contained in the Codes of Good Practice on Black Economic Empowerment, issued in terms of section 9(1) of the Broad-Based Black Economic Empowerment Act;
- (d) **"bid"** means a written offer in a prescribed or stipulated form in response to an invitation by an organ of state for the supply/provision of services, works or goods, through price quotations, advertised competitive bidding processes or proposals;
- (e) **"Broad-Based Black Economic Empowerment Act"** means the Broad-Based Black Economic Empowerment Act, 2003 (Act No. 53 of 2003);
- (f) **"EME"** means an Exempted Micro Enterprise as defines by Codes of Good Practice under section 9 (1) of the Broad-Based Black Economic Empowerment Act, 2003 (Act No. 53 of 2003);
- (g) **"functionality"** means the ability of a bidder to provide goods or services in accordance with specification as set out in the bid documents;
- (h) **"Price"** includes all applicable taxes less all unconditional discounts.
- (i) **"Proof of B-BBEE Status Level of Contributor"** means:
- 1) B-BBEE status level certificate issued by an unauthorised body or person;
 - 2) A sworn affidavit as prescribed by the B-BBEE Codes of Good Practice;
 - 3) Any other requirement prescribed in terms of the B-BBEE Act.
- (j) **"QSE"** means a Qualifying Small Enterprise in terms of a Codes of Good Practice under section 9 (1) of the Broad-Based Black Economic Empowerment Act, 2003 (Act No. 53 of 2003);
- (k) **"rand value"** means the total estimated value of a contract in South African currency, calculated at the time of bid invitations, and includes all applicable taxes and excise duties.
- (l) **"Specific goals"** means targeted advancement areas or categories of persons or groups either previously disadvantaged or falling within the scope of the Reconstruction and Development Programme identified by Transnet to be given preference in allocation of procurement contracts in line with section 2(1) of the PPPFA.

3. POINTS AWARDED FOR PRICE

3.1 THE 80/20 PREFERENCE POINT SYSTEMS

A maximum of 80 points is allocated for price on the following basis:

80/20

$$Ps = 80 \left(1 - \frac{Pt - P \min}{P \min} \right)$$

Where

- Ps = Points scored for comparative price of bid under consideration
- Pt = Comparative price of bid under consideration
- Pmin = Comparative price of lowest acceptable bid

In terms of Transnet Preferential Procurement Policy (TPPP) and Procurement Manuals, the following preference points must be awarded to a bidder who provides the relevant required evidence for claiming points

Selected Specific Goal	Number of points allocated (80/20)
B-BBEE Level of contributor – Level 1	15
B-BBEE Level of contributor - Level 2	10
+50% Black Youth Owned Entities	05
Non-Compliant and/or B-BBEE Level 3-8 contributors	0

4. EVIDENCE REQUIRED FOR CLAIMING SPECIFIC GOALS

4.1 In terms of Transnet Preferential Procurement Policy (TPPP) and Procurement Manuals, preference points must be awarded to a bidder for providing evidence in accordance with the table below:

Specific Goals	Acceptable Evidence
B-BBEE	B-BBEE Certificate / Sworn- Affidavit / B-BBEE CIPC Certificate (in case of JV, a consolidated scorecard will be accepted) as per DTIC guideline
30% Black Women Owned Entities	B-BBEE Certificate / Sworn- Affidavit / B-BBEE CIPC Certificate (in case of JV, a consolidated scorecard will be accepted) as per DTIC guideline
+50% Black Youth Owned Entities	Certified copy of ID Documents of the Owners and B-BBEE Certificate / Sworn- Affidavit / B-BBEE CIPC Certificate (in case of JV, a consolidated scorecard will be accepted) as per DTIC guideline
Entities Owned by People with Disability (PWD)	Certified copy of ID Documents of the Owners / Doctor's note and /or EEA1 form confirming the disability
Entities/Black People living in rural areas	Entity 's Municipal/ESKOM bill or letter from Induna/chief confirming residential address not older than 3 months.
South African Enterprises	CIPC Certificate
EME or QSE 51% Black Owned	B-BBEE Certificate / Sworn-Affidavit / CIPC Certificate
Entities that are 51 % Black Owned	CI B-BBEE Certificate / Sworn- Affidavit / B-BBEE CIPC Certificate (in case of JV, a consolidated scorecard will be accepted) as per DTIC guideline
Promoting exports Orientated for Job creation	Section.....Job Creation Schedule Returnable documents
Local Content and Local Production	Returnable Local Content and production Annexures
NIPP	NIPP Returnable documents
Creation of new jobs and labour intensification	Section.....Job Creation Schedule Returnable documents
The promotion of supplier development through sub-contracting or JV for a minimum of 30% of the value of a contract to South African Companies which are: <ul style="list-style-type: none"> I. 30% Black Women owned, 51% Black Youth and 51% Black people with disabilities II. Entities with a specified minimum B-BBEE level (1 and 2) III. EMEs and/or QSEs who are 51% black-owned 	Sub-contracting agreements and Declaration / Joint Venture Agreement and CIPC – B-BBEE Certificate / Sworn- Affidavit / B-BBEE CIPC Certificate as per DTIC guideline
The promotion of enterprises located in a specific province/region/municipal area for work to be done or services to be rendered in that province/region/municipal area	CIPC – B-BBEE Certificate / Sworn- Affidavit / B-BBEE CIPC Certificate (in case of JV, a consolidated scorecard will be accepted) as per DTIC guidelines and Proof Registered address of entity

4.2 The table below indicates the required proof of B-BBEE status depending on the category of enterprises:

Enterprise	B-BBEE Certificate & Sworn Affidavit
Large	Certificate issued by SANAS accredited verification agency
QSE	Certificate issued by SANAS accredited verification agency Sworn-Affidavit signed by the authorised QSE representative and attested by a Commissioner of Oaths confirming annual turnover and black ownership (only black-owned QSEs - 51% to 100% Black owned) [Sworn- affidavits must substantially comply with the format that can be obtained on the DTI’s website at www.dti.gov.za/economic_empowerment/bee_codes.jsp .]
EME ³	Sworn-Affidavit signed by the authorised EME representative and attested by a Commissioner of Oaths confirming annual turnover and black ownership Certificate issued by CIPC (formerly CIPRO) confirming annual turnover and black ownership Certificate issued by SANAS accredited verification agency only if the EME is being measured on the QSE scorecard

4.3 A trust, consortium or joint venture (including unincorporated consortia and joint ventures) must submit a consolidated B-BBEE Status Level verification certificate for every separate bid.

4.4 Tertiary Institutions and Public Entities will be required to submit their B-BBEE status level certificates in terms of the specialized scorecard contained in the B-BBEE Codes of Good Practice.

4.5 Bidders are to note that the rules pertaining to B-BBEE verification and other B-BBEE requirements may **be changed from time to time by regulatory bodies such as National Treasury or the DTI. It is the Bidder’s responsibility to ensure that his/her bid complies fully with all B-BBEE requirements at the time of the submission of the bid.**

5. BID DECLARATION

5.1 Bidders who claim points in respect of B-BBEE Status Level of Contribution must complete the following:

6. B-BBEE STATUS LEVEL OF CONTRIBUTION CLAIMED

6.1 B-BBEE Status Level of Contribution: . =(maximum of 20 points)

(Points claimed in respect of paragraph 6.1 must be in accordance with the table reflected in paragraph 4.1 and must be substantiated by relevant proof of B-BBEE status level of contributor.

7. SUB-CONTRACTING

7.1 Will any portion of the contract be sub-contracted?

(Tick applicable box)

YES	<input type="checkbox"/>	NO	<input type="checkbox"/>
-----	--------------------------	----	--------------------------

7.1.1 If yes, indicate:

- i) What percentage of the contract will be subcontracted.....%
- ii) The name of the sub-contractor.....
- iii) The B-BBEE status level of the sub-contractor.....
- iv) Whether the sub-contractor is an EME or QSE

(Tick applicable box)

YES	<input type="checkbox"/>	NO	<input type="checkbox"/>
-----	--------------------------	----	--------------------------

v) Specify, by ticking the appropriate box, if subcontracting with any of the enterprises below:

An EME or QSE which is at least 51% owned by:	EME ✓	QSE ✓
Black people	<input type="checkbox"/>	<input type="checkbox"/>

Black people who are youth		
Black people who are women		
Black people with disabilities		
Black people living in rural or underdeveloped areas or townships		
Cooperative owned by black people		
Black people who are military veterans		
OR		
Any EME		
Any QSE		

8. DECLARATION WITH REGARD TO COMPANY/FIRM

8.1 **Name of company/firm:**.....

8.2 **VAT registration number:**.....

8.3 **Company registration number:**.....

8.4 TYPE OF COMPANY/ FIRM

- Partnership/Joint Venture / Consortium
- One person business/sole propriety
- Close corporation
- Company
- (Pty) Limited

[TICK APPLICABLE BOX]

8.5 DESCRIBE PRINCIPAL BUSINESS ACTIVITIES

.....
.....

8.6 COMPANY CLASSIFICATION

- Manufacturer
- Supplier
- Professional service provider
- Other service providers, e.g. transporter, etc.

[TICK APPLICABLE BOX]

8.7 **Total number of years the company/firm has been in business:**.....

8.8 I/we, the undersigned, who is / are duly authorised to do so on behalf of the company/firm, certify that the points claimed, based on the B-BBEE status level of contribution of the foregoing certificate, qualifies the company/ firm for the preference(s) shown and I / we acknowledge that:

- i) The information furnished is true and correct;
- ii) The preference points claimed are in accordance with the General Conditions as indicated in paragraph 1 of this form;
- iii) In the event of a contract being awarded as a result of points claimed as shown in paragraph 4.1 and 6.1, the contractor may be required to furnish documentary proof to the satisfaction of the purchaser that the claims are correct;
- iv) If the B-BBEE status level of contributor has been claimed or obtained on a fraudulent basis or any of the conditions of contract have not been fulfilled, the purchaser may, in addition to any other remedy it may have-
 - (a) disqualify the person from the bidding process;
 - (b) recover costs, losses or damages it has incurred or suffered as a result of that **person's conduct**;
 - (c) cancel the contract and claim any damages which it has suffered as a result of

- having to make less favourable arrangements due to such cancellation;
- (d) if the successful bidder subcontracted a portion of the bid to another person without disclosing it, Transnet reserves the right to penalise the bidder up to 10 percent of the value of the contract;
 - (e) recommend that the bidder or contractor, its shareholders and directors, or only the shareholders and directors who acted on a fraudulent basis, be restricted by the National Treasury from obtaining business from any organ of state for a period not exceeding 10 years, after the *audi alteram partem* (hear the other side) rule has been applied; and
 - (f) forward the matter for criminal prosecution.

WITNESSES
1.
2.

..... SIGNATURE(S) OF BIDDERS(S)
DATE:
ADDRESS
.....

SECTION 7

PROTECTION OF PERSONAL INFORMATION

1. The following terms shall bear the same meaning as contemplated in Section 1 of the Protection of Person **information act, No.4 of 2013.("POPIA"):**

consent; data subject; electronic communication; information officer; operator; person; personal information; processing; record; Regulator; responsible party; special information; as well as any terms derived from these terms.

2. Transnet will process all information by the Respondent in terms of the requirements contemplated in Section 4(1) of the POPIA:

Accountability; Processing limitation; Purpose specification; Further processing limitation; Information quality; Openness; Security safeguards and Data subject participation.

3. The Parties acknowledge and agree that, in relation to personal information that will be processed pursuant to this RFQ, **the Responsible party is "Transnet" and the Data subject is the "Respondent". Transnet will process** personal information only with the knowledge and authorisation of the Respondent and will treat personal information which comes to its knowledge as confidential and will not disclose it, unless so required by law or subject to the exceptions contained in the POPIA.
4. Transnet reserves all the rights afforded to it by the POPIA in the processing of any of its information as contained in this RFQ and the Respondent is required to comply with all prescripts as detailed in the POPIA relating to all information concerning Transnet.
5. In responding to this bid, Transnet acknowledges that it will obtain and have access to personal information of the Respondent. Transnet agrees that it shall only process the information disclosed by Respondent in their response to this bid for the purpose of evaluating and subsequent award of business and in accordance with any applicable law.
6. Transnet further agrees that in submitting any information or documentation requested in this RFQ, the Respondent is consenting to the further processing of their personal information for the purpose of, but not limited to, risk assessment, assurances, contract award, contract management, auditing, legal opinions/litigations, investigations (if applicable), document storage for the legislatively required period, destruction, de-identification and publishing of personal information by Transnet and/or its authorised appointed third parties.
7. Furthermore, Transnet will not otherwise modify, amend or alter any personal data submitted by the Respondent or disclose or permit the disclosure of any personal data to any third party without the prior written consent from the Respondent. Similarly, Transnet requires the Respondent to process any personal information disclosed by Transnet in the bidding process in the same manner.
8. Transnet shall, at all times, ensure compliance with any applicable laws put in place and maintain sufficient measures, policies and systems to manage and secure against all forms of risks to any information that may be shared or accessed pursuant to this RFQ (physically, through a computer or any other form of electronic communication).

- 9. Transnet shall notify the Respondent in writing of any unauthorised access to information, cybercrimes or suspected cybercrimes, in its knowledge and report such crimes or suspected crimes to the relevant authorities in accordance with applicable laws, after becoming aware of such crimes or suspected crime. The Respondent must take all necessary remedial steps to mitigate the extent of the loss or compromise of personal information and to restore the integrity of the affected personal information as quickly as is possible.
- 10. The Respondent may, in writing, request Transnet to confirm and/or make available any personal information in its possession in relation to the Respondent and if such personal information has been accessed by third parties and the identity thereof in terms of the POPIA. The Respondent may further request that Transnet correct (excluding critical/mandatory or evaluation information), delete, destroy, withdraw consent or object to the **processing of any personal information relating to the Respondent in Transnet’s possession in terms of the provision of the POPIA and utilizing Form 2 of the POPIA Regulations.**
- 11. In submitting any information or documentation requested in this RFQ, the Respondent is hereby consenting to the processing of their personal information for the purpose of this RFQ and further confirming that they are aware of their rights in terms of Section 5 of POPIA

Respondents are required to provide consent below:

YES	NO
-----	----

- 12. **Further, the Respondent declares that they have obtained all consents pertaining to other data subject’s** personal information included in its submission and thereby indemnifying Transnet against any civil or criminal action, administrative fines or other penalty or loss that may arise as a result of the processing of any personal information that the Respondent submitted.
- 13. The Respondent declares that the personal information submitted for the purpose of this RFQ is complete, accurate, not misleading, is up to date and may be updated where applicable.

Signature of Respondent’s authorised representative: _____

Should a Respondent have any complaints or objections to processing of its personal information, by Transnet, the Respondent can submit a complaint to the Information Regulator on <https://www.justice.gov.za/inforeg/>, click on contact us, click on complaints.IR@justice.gov.za

Respondent's Signature

Date & Company Stamp



RAIL NETWORK TELECOMMUNICATION

SPECIFICATION BBF 2516 VERSION 4.00

SPECIFICATION FOR UHF HANDHELD TRUNKED AND CONVENTIONAL RADIO

Author:	Manager Radio Rail Network Telecommunication Radio	G. A Daly	<i>PP</i> <i>MAH</i>
Reviewed:	Senior Engineer Rail Network Telecommunication Radio	M. Mmbengwa	<i>Mmbengwa</i>
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		Date	25 May 2015
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Contents

I. Document Authorisation I

II. Distribution I

III. Document Change History I

IV. Changes since Last Revision I

V. List of Abbreviations and Acronyms II

VI. Relevant Documentation Applicable..... III

1. INTRODUCTION 1

2. SCOPE 1

3. COMPLIANCE..... 1

4. TENDER REQUIREMENTS 2

5. TECHNICAL REQUIREMENT..... 3

6. TRAINING 5

I. Document Authorisation

FUNCTION	NAME	TITLE & DIVISION		DATE
Reviewed By:	Freddie Visser	Frequency Spectrum Management Rail Network		
Reviewed By:	Chris Muller	Quality Assurance Rail Network		

II. Distribution

Once updated, a copy of the latest revision will be published on the document management system, "Project Wise".

III. Document Change History

ISSUE NO.	DATE ISSUED	ISSUED BY	HISTORY DESCRIPTION
1.00	October 2011	Robert Yates	New Document
2.00	November 2012	Graeme Daly	New Document
2.01	December 2012	Graeme Daly	Revised 5.17 & 5.18
2.02	May 2013	Graeme Daly	Signatory & Revision 4.1
3.00	June 2014	Graeme Daly	Revised Document
4.00	May 2015	Graeme Daly	Clause 3.4 & 3.5 - Changed wording Clause 5.12 – Removed

IV. Changes since Last Revision

CLAUSES	DESCRIPTION
3.4	Changed clause
3.5	Changed and added clause
5.17 & 5.18	Channel Availability
5.2, & 5.3	Revised clauses
5.12	Removed

V. List of Abbreviations and Acronyms

ABBREVIATIONS AND ACRONYMS	DESCRIPTION
AC	Alternating Current
Ah	Ampere hour
EC Amendment Act	Electronic Communications Amendment Act No.1 2014
BS	British Department of Trade and Industry Specification
dBm	Decibel relative to 1 milli watt
LED	Light Emitting Diode
M	Metre
Mm	Millimetre
MPT	Minister of Post and Telecommunication
PTT	Press – To - Talk
RBU	Radio Base Unit
RCU	Remote Control Unit
RF	Radio Frequency
RTO	Radio Train Order
Rx	Receive
TFR	Transnet Freight Rail
THD	Total Harmonic Distortion
Tx	Transmit
UHF	Ultra High Frequency
V	Volt
W	Watt
Char	Character
CTC	Central Train Control
CTCSS	Continuous Tone Code Squelch System
dB(A)	Sound pressure A-weighted
DC	Direct Current
GPS	Global Positioning System
ICASA	Independent Communication Authority of South Africa
ID	Identification
IP	International Protection
mW	Milli watt
RF	Radio Frequency
TCO	Train Controlling Officer
UHF	Ultra High Frequency
VCO	Voltage Control Oscillator
VSWR	Voltage Standing Wave Ratio
NTC	National Test Centre
RFQ	Request for quotation

VI. Relevant Documentation Applicable

Where there is a conflict between the SPECIFICATION and SCHEDULE OF REQUIREMENT DOCUMENT, the SCHEDULE OF REQUIREMENT DOCUMENT takes precedence.

The equipment must comply with the latest issue of the following applicable specifications:

DOCUMENT NO.	DESCRIPTION	LOCATION
ISO 9000	Quality Management Systems.	External
ETSI EN 300 086	European Telecommunication Standards for Radios.	External
GG 3736	Electronic Communications Amendment Act No.1 2014	External
BS 3939	British Department of Trade and Industry Specification:	External
MPT 1317	Code of Practice for Transmission of Digital Information over Land Mobile Radio Systems.	External
MPT 1327	A signalling Standard for Trunked Private Mobile Radio Systems	External
MPT 1343	System Interface Specification for Radio Units to be used with Commercial Trunked Networks.	External
BBD 8635 Version 8 27 June 2014	Technical specifications and methods of measurement for angle modulated equipment.	Internal
IP 54	Dust protected. Protected against splashing of water.	External
IP 55	Dust protected. Protected against water jets.	External
IP 57	Dust protected. Protected against the effect of immersion between 15 cm and 1 m.	External
IP 67	Totally protected against dust. Protected against the effect of immersion between 15 cm and 1 m.	External

1. INTRODUCTION

Transnet utilise UHF Handheld - Trunked and Conventional radio equipment, to control train shunting movements, communicate with train control officers, flagmen, shipping and harbours operations, etc.

2. SCOPE

- 2.1. This specification is for the supply of the above radio equipment and accessories as per attached Schedule of Requirements. **(Appendix A)**.
- 2.2. This specification will provide Bill of Quantities and Cost Schedule, as per attached. **(Appendix B & C)**
- 2.3. It is envisaged that equipment for this enquiry will be ordered and supplied to Transnet Freight Rail's nominated address. **(Appendix D & E)**.
- 2.4. This specification BBF2516 must be read in conjunction with technical specification and method of measurement for angle modulated radio equipment BBD8635 version 8, dated 27 June 2014.

3. COMPLIANCE

Item	Description	Comply Y/N	Remarks
3.1.	Tenderers must comply with the clause-by-clause statement of the tender requirements provided below. *Failure to comply will exclude Tenderers from consideration.		
3.2.	Alternative offers, will be considered at Transnet Freight Rail's discretion, provided that such offers provide equivalent functionality to what has been specified in this document. Separate compliance documents must be completed for each alternative offer. (Appendix A- B & C – D & E) *Failure to comply will exclude Tenderers from consideration.		
3.3.	The successful bidder is obligated as per the Act to ensure Transnet is in possession of a valid frequency spectrum licence, for the Radio's to be supplied. A reference must be obtained from Transnet Frequency Spectrum Manager Mr Freddie Visser, at Freddie.Visser@Transnet.net or at 011 583 0125 prior to the delivery. *Failing to adhere to the above will result in the cancelation of this transaction and the matter will be reported to ICASA.		
3.4.	Only radio on the current approved list BBD 8208 version 5.3.2 dated the January 2015 will be considered for purchase. (Transnet internal Document) The Software / Firmware submitted when the radio was first evaluated and approved will be the only acceptable version for use in Transnet for a period of one year. Any Software/Firmware changes should be submitted to SCS during tender submissions. *Failure to comply will exclude Tenderers from consideration.		

Item	Description	Comply Y/N	Remarks
3.5.	The equipment offered must be ICASA equipment type approved and a certificate per model offered must be submitted. *Failure to comply will exclude Tenderers from consideration.		
3.6.	Tenderers must provide a copy of their current ICASA Radio Dealer's certificate. *Failure to comply will exclude Tenderers from consideration.		
3.7.	Radios will be required to be batch tested by Transnet NTC prior to delivery or shipment. *Failure to comply will result in the termination of the order when radio equipment is delivered.		

4. TENDER REQUIREMENTS

Item	Description	Comply Y/N	Remarks
4.1.	Tenderers shall submit a clause-by-clause statement of compliance for equipment / items offered on the attached Schedule of Requirements (Appendix A) in the columns provided. *Failure to comply will exclude Tenderers from consideration.		
4.2.	Tenderers shall complete the attached Cost Schedule (Appendix B & C) for equipment. *Tenderers will be excluded from supplying any items not priced.		
4.3.	Tenderers shall complete the attached Delivery Schedule (Appendix D & E) for equipment. *Tenderers will be excluded from supplying if delivery dates are not included, as this will be a deciding factor.		

5. TECHNICAL REQUIREMENT

Item	Description	Comply Y/N	Remarks
5.1.	Technical specifications for items offered must be submitted. *Failure to comply will exclude Tenderers from consideration.		
5.2.	The Receiver loudspeaker must comply with a sound pressure level ≥ 84 dB (A) at 300 mm. Refer to document BBD 8635 version, 8 dated 27 June 2014 for test method.		

Item	Description	Comply Y/N	Remarks
5.3.	The Transmitter deviation must be between 300 and 500 Hz from sound pressure level of 80 dB (A) at the microphone. Refer to document BBD 8635 version 8, dated 27 June 2014 for test method.		
5.4.	Radios must be capable of handling a frequency switching bandwidth of 15 MHz on both transmit and receive between channels with no degradation.		
5.5.	Radios must be programmable in the 400 – 470 MHz band without signal degradation or component or board changes - to be specified.		
5.6.	Radios must operate with 12, 5 kHz channel spacing.		
5.7.	The handheld radio RF output power must be software selectable between 1 and 4 watts, or to be specified.		
5.8.	In conventional mode, the handheld radio must have a minimum of 16 channels. (Can specify alternative number of channels)		
5.9.	The display on the radio must have a minimum of twelve alpha numeric characters.		
5.10.	It must be possible to assign an alpha – numeric label to each conventional channel.		
5.11.	Radios must be IP54 compliant or better.		
5.12.	Battery capacity to be declared in mAh.		
5.13.	Battery chemical composition to be provided.		
5.14.	Battery Model number must be provided.		
5.15.	Radio key pad must have a lock - out facility after a channel has been selected.		
5.16.	Rotary channel selector switch must be able to be disabled with software.		

Item	Description	Comply Y/N	Remarks
5.17.	Birth date of radio. (when was it released into the market)		
5.18.	Date expected to be withdrawn, superseded or replaced from the market. (Manufacture official letter to be provided)		
5.19.	Warranty period, exceptions, terms and conditions to be indicated.		
5.20.	Warranty period of radio to be indicated.		
5.21.	Warranty turn – around time for repairs to be specified in working days.		
5.22.	Supplier must prove that warranty repairs and technical support can be carried out on its own premises.		
5.23.	Spares and technical support must be readily available locally for a period of at least seven years from date of purchase.		
5.24.	All equipment returned from repairs must be fully aligned to meet the specification of compliance. Certification must be issued and random batch testing will be performed.		
5.25.	Service manuals must be in English and available on CD-ROM.		
5.26.	Programming software must be on CD-ROM.		
5.27.	Programming software must be Microsoft Windows 7 compatible.		
5.28.	The selection between Trunked and Conventional modes must be easily selectable.		
5.29.	Trunked handheld radio must operate in accordance with MPT 1327 and MPT 1343 standards.		
5.30.	Trunked radio handheld must have a User Selectable inclusive and exclusive Group call facility catering for 100 Groups.		

6. TRAINING

Item	Description	Comply Y/N	Remarks
6.1.	Tenderers must be in a position to provide training on all products offered, country wide.		
6.2.	Training required on products will be indicated in the schedule of requirements.		

END OF DOCUMENT



A Division of Transnet Limited

INFRASTRUCTURE TELECOMS

STANDARD

TECHNICAL SPECIFICATION AND METHODS OF MEASUREMENT FOR ANGLE MODULATED RADIO EQUIPMENT

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CONTENTS

I.	Distribution.....	3
II.	Document Change History	3
III.	Changes Since Last Revision	3
IV.	List of Abbreviations and Definitions	3
1.	Technical Specification.....	8
1.1	Radio Receiver	8
1.2	Radio Transmitter	9
1.3	Radio Base Station	11
1.4	Filters	12
1.5	Coaxial Cable	12
1.6	Antenna	12
1.7	Transmitting Power.....	13
1.8	Receiver Desensing	13
1.9	Audio Line Branching Unit.....	13
1.10	Power Supply Unit & Battery Charger	14
1.11	Trunking.....	14
1.12	Acoustical Measurements	15
1.13	Co-Channel Interference	15
2.	Methods of Measurement.....	17
2.1.	Applied Standard	17
2.2.	Radio Receiver	18
2.3.	Radio Transmitter	29
2.4.	High Site Equipment.....	38
2.4.1	Radio Base Station Response Time	38
2.4.2	Talk Through Signal	39
2.4.3	Filters.....	43
2.4.4	Coaxial Cable	46
2.4.5	Antenna	47
2.4.6	Receiver Desensing	48
2.4.7	Audio Line Branching Unit.....	48
2.4.8	Power Supply Unit & Battery Charger.....	53
2.5.	Trunking Functional Tests	56
2.6.	Acoustical Measurements	57
3.	Relevant Documentation	58

I Distribution

Once updated, a copy of the latest revision will be published in the document management system in use. An e-mail to this effect will be sent to the relevant personnel or heads of department.

II Document Change History

ISSUE NO.	DATE ISSUED	ISSUED BY	HISTORY DESCRIPTION
2.00	January 2004	Quality Assurance, Infrastructure	Revision
3.0	June 2006	QA	Convert to ISO Standard
3.1	June 2007	QA	Revision
4.0	July 2008	QA	Revision
5.0	February 2010	QA	New format & revision
6.0	August 2010	QA	New format & revision
6.1	November 2010	QA	Add measurement
6.2	August 2011	QA	Add information, definitions, supply standards & DC-DC Converter
7.0	January 2012	QA	Revision & add Trunking functional tests
8.0	May 2014	QA	Omit the difference between General and Shunt portables, revise the Loudspeaker sound pressure level & Transmitter microphone sensitivity.
8.1	June 2014	QA	Update clauses Numbers

III Changes Since Last Revision

CLAUSES	DESCRIPTION
IV	Add abbreviations
1.3.3.5	Change specification
1.11	Add trunking
2.4.2.3	Change graph
2.5	Add trunking functional tests
1.12	Omit the difference between General and Shunt portables, revise the Loudspeaker sound pressure level & Transmitter microphone sensitivity.

IV List of Abbreviations and Definitions

ABBREVIATIONS	DESCRIPTION
AC	Alternating Current
AF	Audio Frequency
BS	Base Station
CCITT	Consultative Committee for International Telephone and Telegraph (ITU-T)
CTCSS	Continuous Tone Coded Squelch System
dB	Decibel
dB(A)	Sound pressure A-weighted
dBc	Decibel relative to the carrier power
dBd	Decibel relative to a Dipole antenna
dBm	Decibel relative to 1 mW, impedance 50 Ω (power)
dBm	Decibel relative to 0.775 V_{pd} , impedance 600 Ω (audio frequency)
dB_{MUOP}	Decibel relative to the Maximum Useful Output Power
dB_{SOP}	Decibel relative to the Standard Output Power
DC	Direct Current
EMF	Electromotive Force
ERP	Effective Radiated Power
FFSK	Fast Frequency Shift Keying

FM	Frequency Modulation
GSM	Global System for Mobile communication
Hz	Hertz
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector
kHz	Kilohertz
LBU	Line Branching Unit
LS	Loudspeaker
m	Metre
mA	Milliampere
MHz	Megahertz
mm	Millimetre
ms	Millisecond
mVp-p	Millivolt peak-to-peak
mW	Milliwatt
MUOP	Maximum Useful Output Power
pd	Potential Difference
PM	Phase Modulation
PSTN	Private Switching Telephone Network
RF	Radio Frequency
Rx	Radio receiver
SANS	South African National Standards
SINAD	Signal, Noise & Distortion to Noise & Distortion ratio
SOP	Standard Output Power
SPL	Sound Pressure Level
THD	Total Harmonic Distortion
TSC	Trunk Site Controller
Tx	Radio transmitter
V	Voltage
Vp-p	Voltage peak-to-peak
VSWR	Voltage Standing Wave Ratio
W	Wattage
WiFi	Wireless Fidelity
μV	Microvolt
%	Percentage

<u>DEFINITIONS</u>	<u>DESCRIPTION</u>
<u>GENERAL</u>	
Angle Modulation	A term used to encompass both frequency modulation and phase modulation.
Decibel	The decibel is 1/10 of a Bel. Decibel is the logarithm of the ratio between a measured quantity and an agreed reference level.
dBc	The absolute power in decibel with reference to the carrier power.
dBm	The absolute power in decibel with reference to 1 mW.
Land Mobile Radio Services	Radio communication from fixed radio stations to mobile radio stations carried in surface vehicles or portable radio stations, and between mobile and portable radio stations.

<u>DEFINITIONS</u>	<u>DESCRIPTION</u>
Portable Radio Station	A radio station designed to be carried by or on a person.
Mobile Radio Station	A radio station designed for installation in a surface vehicle and capable of operating while the vehicle is in motion and while it is stationary.
Fixed Radio Station	It is a fixed radio station installed in an office or control room, fitted with an external antenna.
Base Station	A radio station designed to be installed in a fixed location and performing the function of a repeater/enhancer.

RADIO RECEIVER

Adjacent Channel Selectivity and Desensitization Ratio	A measure of the ability of a radio receiver to receive the modulated standard input signal in the presence of modulated signals that differ in frequency from the standard input signal frequency by the spacing of one channel.
Amplitude Characteristics	The relationship between the radio frequency input level of a specified modulated signal and the audio frequency level at a radio receiver output.
Attack Time	The time required to produce an audio output level of $-0.5 \text{ dB}_{\text{SOP}}$ after application of a RF signal level, 12 dB above usable sensitivity, modulated with standard test modulation.
Audio Frequency Response	The relationship between the modulation factor of a received signal and the audio output level of the demodulated signal at various audio frequencies.
Audio Frequency Total Harmonic Distortion	The change in harmonic content of an audio signal as a result of its passing through the audio frequency and radio frequency circuits of a radio.
Blocking or Desensitisation	A reduction in the wanted audio output power of a radio receiver, or a reduction in the SINAD ratio, owing to an unwanted signal on another frequency.
Co-channel Rejection Ratio	A measure of the capability of a radio receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at the nominal frequency of the receiver.
Conducted Spurious Radiation	It is radiation components at any frequency generated by a radio receiver and radiated by the radio's antenna.
Desensitisation	Is a condition where off-channel transmitting energy passes through the front-end of the radio receiver, causing a reduction in receiver gain.
High RF Signal Level Interference	A measure of the ability of a radio receiver to oppose high RF signal levels at frequencies other than the normal frequency of the receiver.
Intermodulation Spurious Response Attenuation/Rejection	The ability of a radio receiver to receive a modulated standard input signal, in the presence of two interfering signals of which the carrier frequencies are so separated from the standard input signal frequency and from each other that n'th order mixing of the two undesired signals can occur in the non-linear elements of the receiver, producing a third signal whose frequency is equal to that of the standard input signal frequency, or intermediate frequency.
Maximum Useful Output Power	The greatest average audio output power supplied to the rated load, which power does not exceed 10 % of the total harmonic distortion.
Modulation Acceptance Bandwidth	The selectivity characteristic of an angle modulated radio receiver that limits the maximum permissible modulation deviation of the radio frequency input signal that a receiver can accept, without degradation of the 12 dB SINAD ratio, when the radio frequency input signal is 6 dB greater than the usable sensitivity level.
Modulation Factor	The ratio of the maximum positive or negative peak variation of the modulating variable, to the maximum rated system-modulating variable, expressed as a

<u>DEFINITIONS</u>	<u>DESCRIPTION</u>
	percentage.
Signal, Noise & Distortion to Noise & Distortion Ratio	The ratio, expressed in decibels of the signal power, plus noise power, plus distortion power, to noise power plus distortion power produced at the output of a radio receiver resulting from a modulated signal input.
Signal to Hum and Noise Ratio	The ratio of residual receiver audio output power to standard output power.
Spurious Response Attenuation/ Rejection	A measure of the ability of a radio receiver to discriminate between the standard input signal frequency and an undesired signal at any other frequency to which it is also responsive, excluding the two adjacent channels.
Squelch Closing Time	The period of time between the removal of the RF signal and the squelch closure.
Squelch Operating Threshold	The RF signal input level, modulated with standard test modulation, at which the squelch opens and closes.
Standard Output Power	An audio output level 3 dB below maximum useful output power used to define a reference level for test purposes.
Usable Sensitivity	The minimum radio frequency input signal level modulated with standard test modulation that will produce, at a radio receiver, a SINAD ratio of at least 12 dB and an audio output signal power of at least $-3 \text{ dB}_{\text{SOP}}$.
<u>RADIO TRANSMITTER</u>	
Adjacent Channel Power	The part of the total power output of a radio transmitter that, under defined conditions of modulation, falls within a specified bandwidth centred on the normal frequency of either of the adjacent channels.
Amplitude Modulation Hum & Noise Level	A measure of the unwanted amplitude modulation of a carrier resulting from hum and noise.
Angle Modulation Hum & Noise Ratio	The ratio of residual angle modulation to standard test modulation.
Audio Frequency Response	The relationship between the modulation factor of a transmitted signal and the input level of the modulating signal at various audio frequencies.
Audio Frequency Total Harmonic Distortion	The change in harmonic content of an audio signal as a result of its passing through the audio frequency and radio frequency circuits of a radio.
Carrier Attack Time	The time required, changing the state of a radio transmitter from standby to a state where the unmodulated carrier voltage level reaches a value 6 dB below the steady state.
Carrier Frequency Error	Is the difference between the measured unmodulated carrier frequency from the assigned frequency.
Carrier Power	The mean power available at the output terminal of a radio transmitter in the absence of modulation.
Conducted Spurious Emissions	Emissions at the antenna terminal of a radio transmitter on a frequency or frequencies that are outside the channel on which the transmitter is operating.
Extreme Transmitter Loads	Conditions under which the radio transmitter operates into an open circuit or short circuit.
Intermodulation Attenuation	The ability of a radio transmitter to attenuate signals generated in its non-linear elements by the presence of the carrier and a parasitic signal arriving at the transmitter through its antenna.
Microphone sensitivity	It is the amount of modulation that the radio transmitter produces when a specified audio signal level is present at the microphone.

<u>DEFINITIONS</u>	<u>DESCRIPTION</u>
Mismatch between Transmitter and Antenna System	A condition in which the impedance as presented to the radio transmitter by the transmission line and antenna is not the same as the designed system impedance.
Modulation Limiting (Tx deviation)	A measure of the ability of radio transmitter circuits to prevent a transmitter from producing modulation such that the modulation factor exceeds the maximum rated system modulation factor.

TALK THROUGH SIGNAL

Modulation Factor Linearity	The relationship between the modulation factor of a received signal and the transmitted modulation factor.
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FILTERS

Duplexer/Combiner	Is a filter system providing RF isolation to allow the sharing of a single antenna for both transmission and reception.
Insertion Loss	It is the amount of loss to a signal passing through a filter at a designated frequency.
Receiver Isolation at Transmitter Frequencies	It is the ability of the duplexer/combiner to suppress the transmitter carrier power at the receiver port. It is also called the selectivity of the duplexer/combiner.

ANTENNAS

Effective Radiated Power	It is the mean power radiated by the antenna in the direction of maximum radiation.
dBd	The power gain of an antenna in decibel with reference to a Dipole antenna.

TRUNK CONTROL SIGNAL

Fast Frequency Shift Keying	Bit 0 = 1.8 kHz Bit 1 = 1.2 kHz
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AUDIO LINE BRANCHING UNIT

Common-mode Rejection Ratio	Is the ratio of the differential gain over the common-mode gain.
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POWER SUPPLY UNIT, DC-DC CONVERTER AND BATTERY CHARGER

Noise Voltage	Is irregular amplitude voltages superimposed on the output DC voltage line.
Output Voltage Regulation	It is the ability of a power supply device to keep the output voltage constant over a range of applied loads.
Ripple Voltage	Is AC voltage superimposed on the output DC voltage line.
Variac	A device that supply a variable AC voltage from 0 V to 260 V.

ACOUSTIC

A-weighted	It is a network that weights an audio signal in a manner, which approximates to an inverted equal loudness contour (it approximates the human ear's response to sound).
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<u>DEFINITIONS</u>	<u>DESCRIPTION</u>
Sound Pressure	It is the force (N) of sound on a surface area (m^2) perpendicular to the direction of the sound. SPL is express as N/m^2 or Pascal (Pa).

1. TECHNICAL SPECIFICATION

Where not specifically indicated, this specification only applies for open channel and Trunked radio systems.

1.1 Radio Receiver: 12.5 kHz channel spacing; operating frequency band 450 MHz to 470 MHz.

1.1.1 Normal condition (see clause 2.1.1)

Characteristics	Portable	Mobile & Fixed Radio Station	Base Station (Repeater)
1.1.1.1 Maximum Useful Audio Output Power	Maximum power not exceeding 10 % THD.		
1.1.1.2 Audio Frequency THD at Low Output Power Level 500 Hz & 1.0 kHz	≤ 5 %	≤ 2 %	≤ 2 %
1.1.1.3 Usable Sensitivity	≤ -115 dBm		
1.1.1.4 Squelch Operating Threshold Open Close	- 115 dBm minimum ≤ 3 dB lower than the opening threshold		See clause 1.3.1.1 ≤ 3 dB lower than the opening threshold
1.1.1.5 Attack Time	≤ 150 ms		
1.1.1.6 Squelch Closing Time	≤ 250 ms		
1.1.1.7 Modulation Acceptance Bandwidth	≥ 3.75 kHz		
1.1.1.8 Adjacent Channel Selectivity and Desensitization Ratio	≥ 60 dB	≥ 65 dB	≥ 70 dB
1.1.1.9 Spurious Response Attenuation/Rejection	≥ 70 dB	≥ 75 dB	≥ 75 dB
1.1.1.10 Intermodulation Spurious Response Attenuation/Rejection	≥ 65 dB	≥ 65 dB	≥ 70 dB
1.1.1.11 Co-channel Rejection Ratio	≤ 12 dB		
1.1.1.12 Blocking	≥ 84 dB		
1.1.1.13 Conducted Spurious Radiation	≤ - 57 dBm		
1.1.1.14 Audio Frequency Response (6 dB/octave) 300 to 900 Hz 1.1 to 2.5 kHz 3.0 kHz	+ 1 dB to - 3 dB + 1 dB to - 3 dB + 1 dB to - 4.5 dB		
1.1.1.15 Signal to Hum and Noise Ratio Squelched Unsquelled	≥ 60 dB ≥ 39 dB		
1.1.1.16 Amplitude Characteristics	≤ 3 dB		

1.1.2 Extreme conditions (see clause 2.1.2)

Characteristics	Portable	Mobile & Fixed Radio Station	Base Station (Repeater)
Power Supply			
1.1.2.1 Usable Sensitivity variation	$\leq \pm 3$ dB		
1.1.2.1.2 Adjacent Channel Selectivity and Desensitisation Ratio	≥ 60 dB	≥ 65 dB	≥ 70 dB
Temperature			
1.1.2.2.1 Usable Sensitivity variation	$\leq \pm 3$ dB		
1.1.2.2.2 Adjacent Channel Selectivity and Desensitisation Ratio	≥ 60 dB	≥ 65 dB	≥ 70 dB
Selectivity at High RF Signal Level			
1.1.2.3.1 Input signal level	– 47 dBm to – 7 dBm		

1.2 **Radio Transmitter:** 12.5 kHz channel spacing; operating frequency band 450 MHz to 470 MHz.

1.2.1 Normal condition (see clause 2.1.1)

Characteristics	Portable	Mobile & Fixed Radio Station	Base Station (Repeater)
1.2.1.1 Carrier Power (conducted)	$\leq \pm 1$ dB from manufacturer's claim		
1.2.1.2 Conducted Spurious Emissions Operating Standby	≤ -36 dBm ≤ -57 dBm		
1.2.1.3 Carrier Frequency Error	≤ 1.5 kHz	≤ 1.5 kHz	≤ 1.0 kHz
1.2.1.4 Carrier Attack Time	≤ 100 ms		
1.2.1.5 Adjacent Channel Power	≤ -60 dBc	≤ -70 dBc	≤ -70 dBc
	Or – 37 dBm maximum.		
1.2.1.6 Intermodulation Attenuation	n.a.	n.a.	≥ 40 dB
1.2.1.7 Modulation Limiting (Tx Deviation) Modulating freq. 0.3 to 2.55 kHz 3 to 6 kHz 6 to 12.5 kHz	2.5 kHz maximum 0.75 kHz maximum at 6 kHz – 14 dB/octave		
1.2.1.8 CTCSS Deviation	250 Hz		
1.2.1.9 Audio Frequency THD 500 Hz 1.0 kHz	≤ 5 %	≤ 2 %	≤ 2 %

	Characteristics	Portable	Mobile & Fixed Radio Station	Base Station (Repeater)
1.2.1.10	Audio Frequency Response (6 dB/octave) 300 to 900 Hz 1.1 to 2.5 kHz 3.0 kHz	+ 3 dB to – 1 dB + 3 dB to – 1 dB + 4.5 dB to – 1 dB		
1.2.1.11	Angle Modulation Hum & Noise Ratio	≥ 34 dB		
1.2.1.12	Amplitude Modulation Hum & Noise Level	≤ – 34 dB		

1.2.2 Extreme conditions (see clause 2.1.2)

	Characteristics	Portable	Mobile & Fixed Radio Station	Base Station (Repeater)
1.2.2.1	Power Supply			
1.2.2.1.1	Carrier Power Variation	≤ ± 2 dB		
1.2.2.1.2	Conducted Spurious Emissions Operating Standby	≤ – 36 dBm ≤ – 57 dBm		
1.2.2.1.3	Carrier Frequency Error	≤ 1.5 kHz	≤ 1.5 kHz	≤ 1.0 kHz
1.2.2.2	Temperature			
1.2.2.2.1	Carrier Power Variation	≤ ± 2 dB		
1.2.2.2.2	Conducted Spurious Emissions Operating Standby	≤ – 36 dBm ≤ – 57 dBm		
1.2.2.2.3	Carrier Frequency Error	≤ 1.5 kHz	≤ 1.5 kHz	≤ 1.0 kHz
1.2.2.3	Antenna Terminal Loads			
1.2.2.3.1	Short Circuit and Open Circuit Carrier Power Variation	≤ ± 1 dB		

1.3 **Radio Base Station (Repeater):** 12.5 kHz channel spacing; operating frequency band 450 MHz to 470 MHz.

The receiver and transmitter specifications are referred to in clauses 1.1 and 1.2 respectively.

1.3.1 Receiver

	Characteristics	Base Station (Repeater)
1.3.1.1	Squelch operating threshold calculation Open Close	– 115 dBm minus coaxial cable loss minus duplexer loss plus antenna gain. ≤ 3 dB lower than the opening threshold

1.3.2 Receiver and transmitter

	Characteristics	Base Station (Repeater)
1.3.2.1	Response time	≤ 300 ms

1.3.3 Talk Through Signal

	Characteristics	Base Station (Repeater)
1.3.3.1 1.3.3.1.1 1.3.3.1.2	Audio input and output terminals Impedance Return Loss	600 Ω balanced ≤ – 25 dB
1.3.3.2 1.3.3.2.1 1.3.3.2.2	Audio Levels RTO & Trunking (local & intersite) Old Trunking Teletra system	– 10 dBm ± 0.5 dBm – 4 dBm ± 0.7 dBm
1.3.3.3	Audio Frequency Response (With de-emphasis and pre-emphasis) <u>Modulating frequency</u> 300 to 900 Hz 1.1 to 3.0 kHz	± 3.0 dB ± 3.0 dB
1.3.3.4	Audio Frequency Response (Without de-emphasis and pre-emphasis) <u>Modulating frequency</u> 300 to 900 Hz 1.1 to 3.0 kHz	± 2.0 dB ± 2.0 dB
1.3.3.5	Modulation Factor Linearity <u>Modulation</u> 0.5 kHz 1.0 kHz 1.5 kHz 2.0 kHz 2.5 kHz	0.5 kHz ± 100 Hz 1.0 kHz ± 100 Hz 1.5 kHz ± 100 Hz 2.0 kHz ± 100 Hz 2.5 kHz – 250 Hz (not to exceed 2.5 kHz)
1.3.3.6	Audio Frequency THD	≤ 5 %

1.4 Filters

1.4.1 Duplexer (Radio Train Order)

Characteristics	Base Station (Repeater)
1.4.1.1 Insertion Loss (Tx & Rx)	≤ 1.2 dB
1.4.1.2 Rx Isolation at Tx Frequencies	≥ 65 dB (operating band) ≥ 80 dB (single channel)
1.4.1.3 Impedance Matching, 50 Ω (all ports)	VSWR ≤ 1.5:1 Return Loss ≤ - 14 dB
1.4.1.4 * Operating Frequency Band Receiver Transmitter	465.0500 MHz to 465.9875 MHz 455.0500 MHz to 455.9875 MHz

* Duplexer for link operation is channelized.

1.4.2 Combiner (Trunked)

Characteristics	Base Station (Repeater)
1.4.2.1 Insertion Loss - Receiver path	0 dB ± 0.5 dB
1.4.2.2 Insertion Loss - Transmit path	≤ 10 dB
1.4.2.3 Rx Isolation at Tx Frequencies	≥ 85 dB
1.4.2.4 Isolation between Rx ports	≥ 20 dB
1.4.2.5 Isolation between Tx ports	≥ 60 dB
1.4.2.6 Impedance Matching, 50 Ω (all ports)	VSWR ≤ 1.5:1 Return Loss ≤ - 14 dB
1.4.2.7 Operating Frequency Band Receiver Transmitter	465.0000 MHz to 466.6375 MHz 455.0000 MHz to 456.6375 MHz

1.5 Coaxial Cable

Characteristics	Mobile & Fixed Radio Station	Base Station (Repeater)
1.5.1 Impedance	50 Ω	
1.5.2 Impedance matching	VSWR ≤ 1.5:1 Return Loss ≤ - 14 dB	
1.5.3 Insertion loss	≤ 1 dB	≤ 5 dB

1.6 Antenna

Characteristics	Various
1.6.1 Impedance	50 Ω
1.6.2 Impedance matching VHF & UHF GSM & WiFi	VSWR ≤ 1.5:1 Return Loss ≤ - 14 dB VSWR ≤ 2.0:1 Return Loss ≤ - 9.54 dB

Characteristics	Various
-----------------	---------

1.6.3	* Antenna gain Mobile Fixed station Radio link: Point to point Point to multipoint Base station	0 dBd ≤ 12 dBd 9 dBd minimum Not specified ≤ 12 dBd
1.6.4	# Antenna vertical separation	≥ 4 λ
1.6.5	* Antenna height above ground level Mobile & Fixed station Radio link: Point to point Point to multipoint Base station	10 m maximum 20 m maximum 20 m maximum 20 m maximum

Based on 20 W ERP and antennae having a Dipole as a live element. Distance measured from centre to centre of dipoles.

* Licence conditions

1.7 Transmitting Power

	Characteristics	Various
1.7.1	* Conducted power at transmitter terminal Radio link: Point to point Point to multipoint	1 W maximum 1 W maximum
1.7.2	* Effective Radiated Power (ERP) Mobile & Fixed station Radio link: Point to point Point to multipoint Base station	20 W maximum 8.2 W maximum 8.2 W maximum 20 W maximum

* Licence conditions

1.8 Receiver Desensing

	Characteristics	Various
1.8.1	Desensing	≤ 1 dB
1.8.2	Desensing at high receiving signal level (radio links only) ≥ - 100 dBm	≤ 20 dB

1.9 Audio Line Branching Unit

	Characteristics	Base Station (Repeater)
1.9.1	Audio input and output terminals Impedance Return Loss	600 Ω balanced ≤ - 25 dB
1.9.2	Input and output audio signal level	- 10 dBm ± 0.5 dB
1.9.3	Audio frequency response 300 Hz to 3 kHz	± 0.5 dB
1.9.4	Audio total harmonic distortion (THD)	≤ 0.5 %
1.9.5	Audio signal to hum and noise ratio	≥ 70 dB
1.9.6	Channel cross talk	≥ 60 dB
1.9.7	Common-mode rejection ratio	≥ 60 dB at 1 kHz
1.9.8	E-signal	Up to 50 V DC, 10 mA Opto coupler

	Characteristics	Base Station (Repeater)
1.9.9	M-signal	Bi-directional polarity Up to 50 V DC, 10 mA Voltage free contact

1.10 Power Supply Unit, DC-DC Converter and Battery Charger

	Characteristics	Various
1.10.1	Operating conditions Temperature range Relative humidity	- 10 °C to 60 °C Up to 85 %
1.10.2	Input power AC Voltage Frequency DC Voltage	220 V AC \pm 10 % 50 Hz \pm 2 % Nominal \pm 10 %
1.10.3	Output voltage regulation (Intermittent & continuous)	13.8 V \pm 5 % (12 V system) 27.6 V \pm 5 % (24 V system) 55.2 V \pm 5 % (48 V system)
1.10.4	Efficiency	\geq 70 %
1.10.5	Output voltage ripple & noise	\leq 200 mVp-p (12 V system) \leq 400 mVp-p (24 V system) \leq 800 mVp-p (48 V system)
1.10.6	Radiation of spurious frequencies	\leq - 119 dBm in radio operating band
1.10.7	Desensing of receiver	\leq 1 dB
1.10.8	Load shedding (when required) Shed Restore	11.0 V (12 V system) 22.0 V (24 V system) 44.0 V (48 V system) 13.0 V (12 V system) 26.0 V (24 V system) 52.0 V (48 V system)

1.11 Trunking

1.11.1 Functional Tests

	Characteristics	Various
1.11.1.1	Registration	Register on instrument Register on trunk system
1.11.1.2	Local call to radio with the same prefix number	Establish call to instrument Establish call through the trunk system
1.11.1.3	Local call to radio with an interprefix number	Establish call to instrument Establish call through the trunk system
1.11.1.4	Local call to radio with the same prefix number using short form dialling	Establish call to instrument Establish call through the trunk system
1.11.1.5	Intersite call to radio with the same prefix number	Establish call through the trunk system
1.11.1.6	Intersite call to radio with an interprefix number	Establish call through the trunk system
1.11.1.7	Intersite call to radio with the same prefix number using short form dialling	Establish call through the trunk system

1.11.1.8	PSTN call	Establish call to instrument Establish call through the trunk system
1.11.1.9	Call the radio under test	Establish call from instrument Establish call through the trunk system
1.11.1.10	Handoff	Reregister on new control channel with Instrument Reregister on new control channel on the trunk system

1.11.2 Control Signal - Trunk Site Controller

	Characteristics	Base Station (Repeater)
1.11.2.1	FFSK level from TSC	1 Vp-p \pm 0.2 Vp-p
1.11.2.2	FFSK frequency from TSC	1.2 kHz \pm 100 Hz 1.8 kHz \pm 100 Hz
1.11.2.3	Tx deviation at FFSK level For channel dragging problem	1.5 kHz \pm 100 Hz 800 Hz \pm 100 Hz
1.11.2.4	FFSK level from Rx measured at TSC (Modulation 1.5 kHz) (Modulating frequency 1.2 kHz)	1 Vp-p \pm 0.2 Vp-p

1.12 Acoustical measurements

	Characteristics	Portable
1.12.1	Receiver	
	Loudspeaker sound pressure level	\geq 84 dB(A) at 300 mm
1.12.2	Transmitter	
	Transmitter deviation	Between 300 and 500 Hz from a SPL of 80 dB(A) at the microphone

1.13 Co-channel Interference

	Characteristics	Various
1.13.1	Speech	
	Level difference between signals	\geq 15 dB
1.13.2	Data (FFSK)	
	Level difference between signals	\geq 20 dB

2. METHODS OF MEASUREMENT

Applied Standard

2.1 Normal condition

Temperature	:	23 °C ± 3 °C
Relative Humidity	:	45 to 85 %
Lead acid battery	:	2.3 V per cell
Lithium-ion battery	:	3.6 V per cell
Nickel cadmium	:	1.2 V per cell
Nickel Metal Hydrate battery	:	1.2 V per cell
Mains	:	220 V AC 50 Hz

2.2 Extreme conditions

Temperature	:	- 10 °C and 60 °C
Relative humidity	:	45 to 95 %
Lead acid battery	:	1.8 V minimum & 2.6 V maximum per cell
Lithium-ion battery	:	3.0 V minimum & 4.2 V maximum per cell
Nickel Cadmium battery	:	1.0 V minimum & 1.5 V maximum per cell
Nickel Metal Hydrate battery	:	1.0 V minimum & 1.5 V maximum per cell
Mains	:	220 V AC ± 10 % 50 Hz ± 2 %

Power Supply Systems

12 V system	:	Minimum 11.0 V	Nominal 13.8 V	Maximum 15.6 V
24 V system	:	Minimum 22.0 V	Nominal 27.6 V	Maximum 31.2 V
48 V system	:	Minimum 44.0 V	Nominal 55.2 V	Maximum 62.4 V

2.3 Warm up time

As specified by the manufacturer.

2.4 Temperature stabilising period

One hour minimum.

2.5 Power source tolerance

≤ ± 3 %.

2.6 Standard RF Test Signal

2.6.1 Standard test modulation

Modulating frequency	:	1.0 kHz.
Modulation	:	1.5 kHz (60 % of maximum rated system deviation).

2.6.2 Standard RF Signal Input Level

- 60 dBm (223.6 μ V_{pd} or 447.2 μ V_{EMF}).

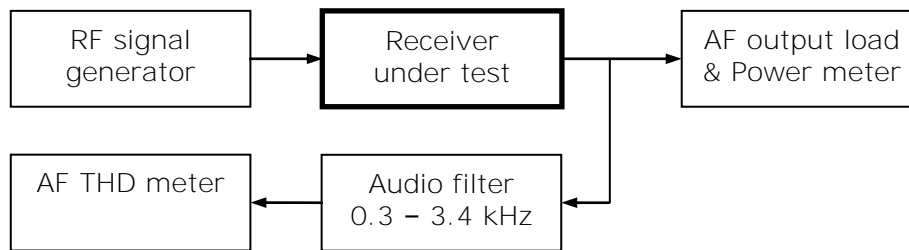
2.7 Audio Output Level

SOP = - 3 dB_{MUOP}.

2.2 Radio Receiver

2.2.1 Maximum Useful Output Power

Connect the equipment as shown below.



2.2.1.1 Inject a standard RF test signal from the RF signal generator.

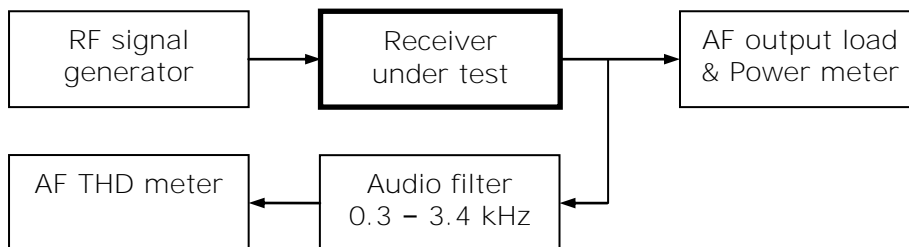
2.2.1.2 Adjust the volume control of the radio until the THD is 10 % or the volume control reaches its maximum travel, whichever occurs first.

2.2.1.3 Measure the audio output power (MUOP).

Note: The impedance of the AF output load must be the same value as the load (loudspeaker) with which the receiver normally operates.

2.2.2 Audio frequency total harmonic distortion

Connect the equipment as shown below.



2.2.2.1 Standard measurement

2.2.2.1.1 Test 1.

2.2.2.1.1.1 Inject a standard RF test signal from the RF signal generator into the receiver.

2.2.2.1.1.2 Adjust the volume control of the radio to obtain SOP.

2.2.2.1.1.3 Measure the THD.

2.2.2.1.2 Test 2.

2.2.2.1.2.1 Change the modulating frequency to 500 Hz using the same modulation factor as in test 1, except that in the case of PM receivers, the modulation factor should be reduced by 50 %.

2.2.2.1.2.2 Repeat the procedure given in test 1.

2.2.2.1.2.3 Measure the THD.

2.2.2.2 600 Ω balanced line

Where a 600 Ω balanced line is provided, the THD must be measured on this line.

2.2.2.2.1 Inject a standard RF test signal from the RF signal generator into the receiver.

2.2.2.2.2 Load the line with a 600 Ω resistive load or equivalent impedance, provided by the measuring instrument.

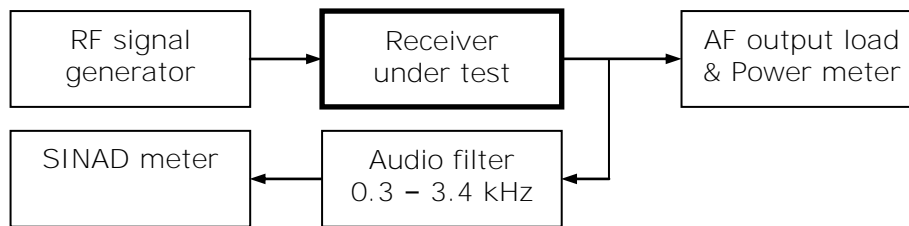
2.2.2.2.3 Adjust the audio signal level to measure -10 dBm on the line.

2.2.2.2.4 Measure the THD.

2.2.2.2.5 Repeat the THD measurement when applying test 2.

2.2.3 Usable sensitivity

Connect the equipment as shown below.



- 2.2.3.1 Adjust the RF signal generator to produce a standard RF input signal level.
- 2.2.3.2 Adjust the volume control of the radio to obtain SOP.
- 2.2.3.3 Reduce the RF signal level until the SINAD ratio is 12 dB.
- 2.2.3.4 Without readjustment of the volume control check whether the audio output level is less than $-3 \text{ dB}_{\text{SOP}}$.
- 2.2.3.5 If the audio output is less than $-3 \text{ dB}_{\text{SOP}}$, increase the RF signal level until $-3 \text{ dB}_{\text{SOP}}$ is obtained.
- 2.2.3.6 Take the RF signal output level from the signal generator at this setting as the usable sensitivity.
- 2.2.3.7 The measurement shall be made under the extreme test conditions as well.
Under the extreme test conditions, the receiver audio output power shall be within $\pm 3 \text{ dB}$ of the value obtained under normal test condition.

Note: The impedance of the AF output load must be the same value as the load (loudspeaker) with which the receiver normally operates.

2.2.4 Squelch operating threshold

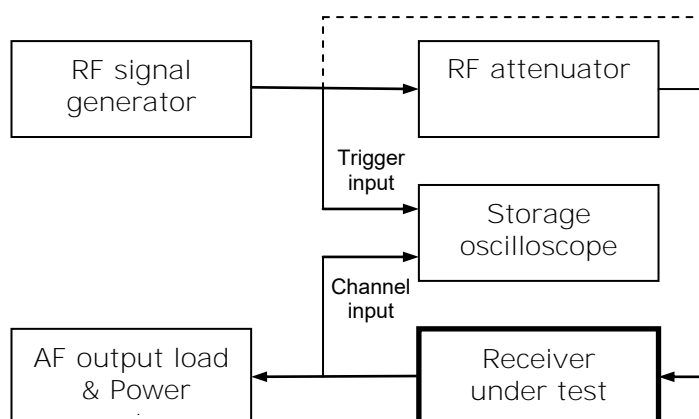
Connect the equipment as shown below.



- 2.2.4.1 Apply a standard RF test signal to the receiver under test and adjust the volume control of the radio to obtain SOP.
- 2.2.4.2 Reduce the RF signal level **slowly** until the squelch closes and record this RF signal level as the squelch closing level in dBm.
- 2.2.4.3 Increase the RF signal level **slowly** until the squelch opens and record this RF signal level as the squelch opening level in dBm.

2.2.5 Attack time

Connect the equipment as shown below.

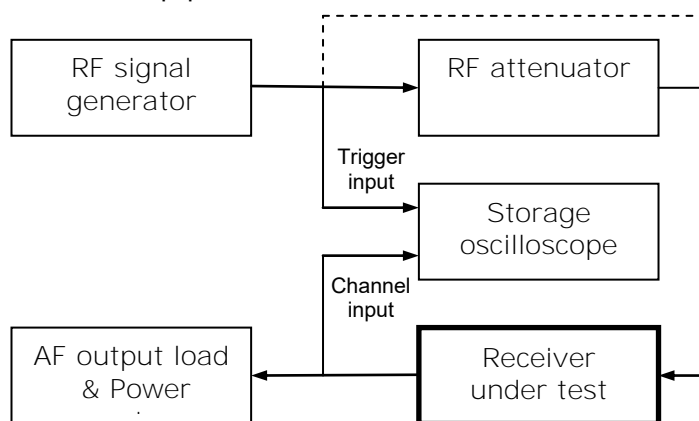


- 2.2.5.1 Apply a standard RF test signal to the receiver under test.

- 2.2.5.2 Adjust the volume control of the radio to obtain SOP.
- 2.2.5.3 Determine the usable sensitivity as described in clause 2.2.3.
- 2.2.5.4 Adjust the squelch to open at a RF signal level of -115 dBm, measured at the antenna terminal.
- 2.2.5.5 Set the RF signal level from the signal generator to 0 dBm.
- 2.2.5.6 Set the value of the RF attenuator to decrease the signal level to 12 dB above the usable sensitivity level, measured at the antenna terminal and switch the output of the signal generator off.
- 2.2.5.7 Set the storage oscilloscope to single sweep operation.
- 2.2.5.8 Switch the RF output on and measure the time required for the audio output to reach -0.5 dB_{SOP}.
- 2.2.5.9 Repeat the measurement three times and take the average of the three measurements as the receiver attack time.

2.2.6 **Squelch Closing Time**

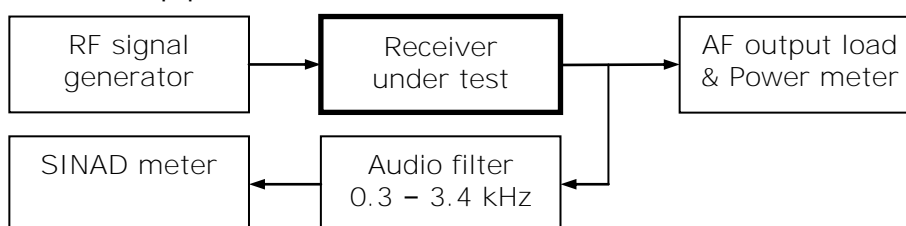
Connect the equipment as shown below.



- 2.2.6.1 Apply a standard RF test signal to the receiver under test.
- 2.2.6.2 Adjust the volume control of the radio to obtain SOP.
- 2.2.6.3 Determine the usable sensitivity as described in clause 2.2.3.
- 2.2.6.4 Adjust the squelch to open at a RF signal level of -115 dBm, measured at the antenna terminal.
- 2.2.6.5 Set the RF signal level from the signal generator to 0 dBm.
- 2.2.6.6 Set the value of the RF attenuator to decrease the signal level to 12 dB above the usable sensitivity level, measured at the antenna terminal.
- 2.2.6.7 Set the storage oscilloscope to single sweep operation.
- 2.2.6.8 Switch the output of the signal generator off and measure the time required for the audio output to be reduced by 10 dB from the SOP value.
- 2.2.6.9 Repeat the measurement three times and take the average of the three measurements as the squelch closing time.

2.2.7 **Modulation acceptance bandwidth**

Connect the equipment as shown below.

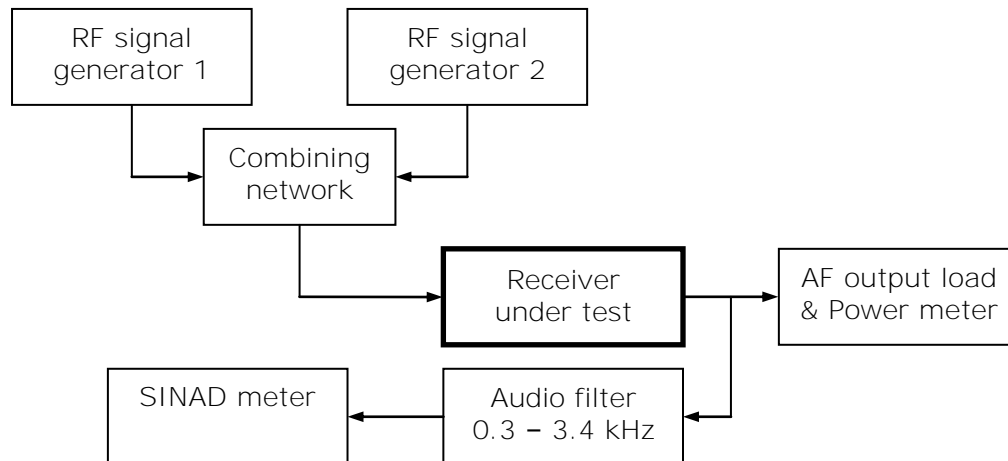


- 2.2.7.1 Apply a standard RF test signal to the receiver under test.
- 2.2.7.2 Adjust the receiver volume control to obtain SOP.

- 2.2.7.3 Reduce the RF signal level until the SINAD ratio is 12 dB.
- 2.2.7.4 Increase the RF signal level by 6 dB.
- 2.2.7.5 Increase the modulation factor until the SINAD ratio is again 12 dB.
- 2.2.7.6 Record this value of the modulation factor as the modulation acceptance bandwidth.

2.2.8 **Adjacent channel selectivity and desensitization ratio**

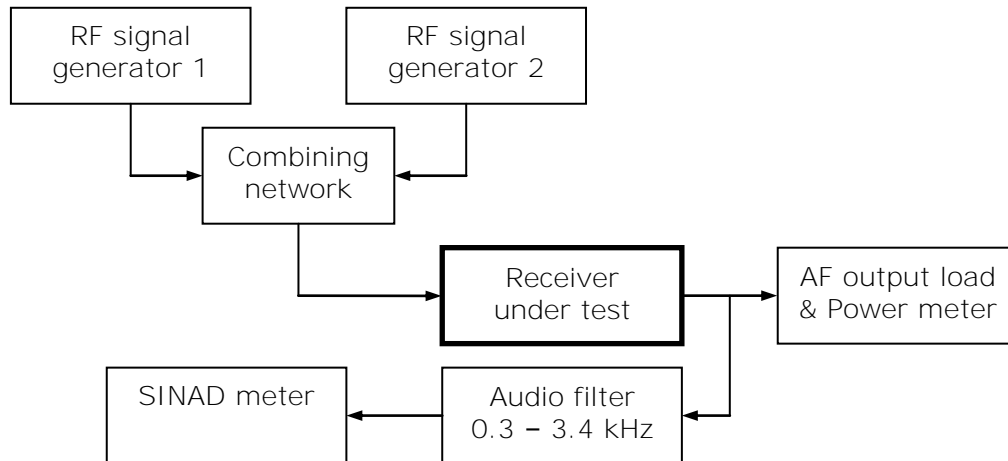
Connect the equipment as shown below.



- 2.2.8.1 Switch the RF signal output of signal generator 2 off.
- 2.2.8.2 RF signal generator 1:
 - 2.2.8.2.1 Apply a standard RF test signal to the receiver under test.
 - 2.2.8.2.2 Adjust the volume control of the radio to obtain SOP.
 - 2.2.8.2.3 Reduce the RF signal until the SINAD ratio is 12 dB (wanted signal).
 - 2.2.8.2.4 Note this RF signal level.
- 2.2.8.3 RF signal generator 2:
 - 2.2.8.3.1 Switch the RF signal output on (unwanted signal).
 - 2.2.8.3.2 Modulate the RF signal with 400 Hz at the standard modulation factor.
 - 2.2.8.3.3 Set the frequency (unwanted signal) to a frequency one-channel width above the assigned frequency (wanted signal).
 - 2.2.8.3.4 Adjust the RF signal level such that the SINAD ratio is degraded to 6 dB.
 - 2.2.8.3.5 Note this RF signal level.
 - 2.2.8.3.6 Repeat for the unwanted signal set to a frequency one-channel width below the assigned frequency.
- 2.2.8.4 Calculate the difference between the unwanted and wanted signal levels in dB, as the adjacent channel selectivity and desensitization ratio.
- 2.2.8.5 Take the worst case of the two measurements as the result.
- 2.2.8.6 The measurements shall be made under the extreme test conditions as well.

2.2.9 Spurious response attenuation/rejection

Connect the equipment as shown below.



2.2.9.1 Switch the RF signal output of signal generator 2 off.

2.2.9.2 RF signal generator 1:

2.2.9.2.1 Adjust the RF signal generator to produce a standard RF test signal.

2.2.9.2.2 Adjust the volume control of the radio to obtain SOP.

2.2.9.2.3 Reduce the RF signal to the receiver until the SINAD ratio is 12 dB.

2.2.9.3 RF signal generator 2:

2.2.9.3.1 Switch the RF signal output on and adjust the signal level to 80 dB (portable) or 85 dB (mobile and base) higher than that of signal generator 1.

2.2.9.3.2 Modulate the RF signal with 400 Hz at standard modulation factor.

2.2.9.3.3 Slowly sweep the carrier frequency over the range 100 kHz to 1 GHz in 12.5 kHz steps (channels) excluding the assigned channel and the two adjacent channels.

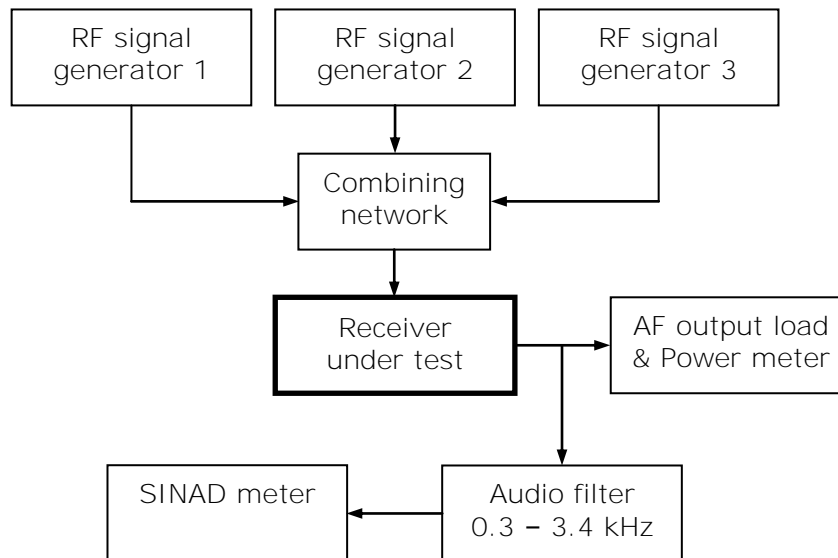
2.2.9.3.4 When the receiver is responsive to a spurious signal, adjust the RF signal level until the SINAD ratio is 6 dB.

2.2.9.4 Note the frequency and the RF signal levels of the two signal generators and take the difference between the two levels expressed in dB as the measure of the spurious response attenuation at that frequency.

Note: Ensure that the measured response is not caused by spurious signals from the RF signal generators or Intermodulation products between the two signals.

2.2.10 Intermodulation spurious response attenuation/rejection

Connect the equipment as shown below.



2.2.10.1 Switch the RF signal output of signal generators 2 & 3 off.

2.2.10.2 RF signal generator 1:

2.2.10.2.1 Adjust the RF signal generator to produce a standard RF test signal.

2.2.10.2.2 Adjust the volume control of the radio to obtain SOP.

2.2.10.2.3 Reduce the RF signal to the receiver until the SINAD ratio is 12 dB.

A. 2.2.10.3 RF signal generator 2:

2.2.10.3.1 Adjust the unmodulated frequency of the RF signal generator to the second adjacent channel above the nominal carrier frequency.

2.2.10.4 RF signal generator 3:

2.2.10.4.1 Modulate the RF signal with 400 Hz at standard modulation factor.

2.2.10.4.2 Adjust the frequency of the RF signal generator to the fourth adjacent channel above the nominal carrier frequency.

2.2.10.5 Switch the RF signal output of signal generators 2 & 3 on.

2.2.10.6 Maintain the outputs of RF signal generators 2 & 3 at equal levels.

2.2.10.7 Adjust the RF signal levels to reduce the SINAD ratio to 6 dB.

2.2.10.8 Adjust the frequency of RF signal generator 3 slightly to produce the maximum interfering signal.

2.2.10.9 Note the difference in dB between the RF signal output level from RF signal generator 1 and the RF signal output level from RF signal generators 2 & 3.

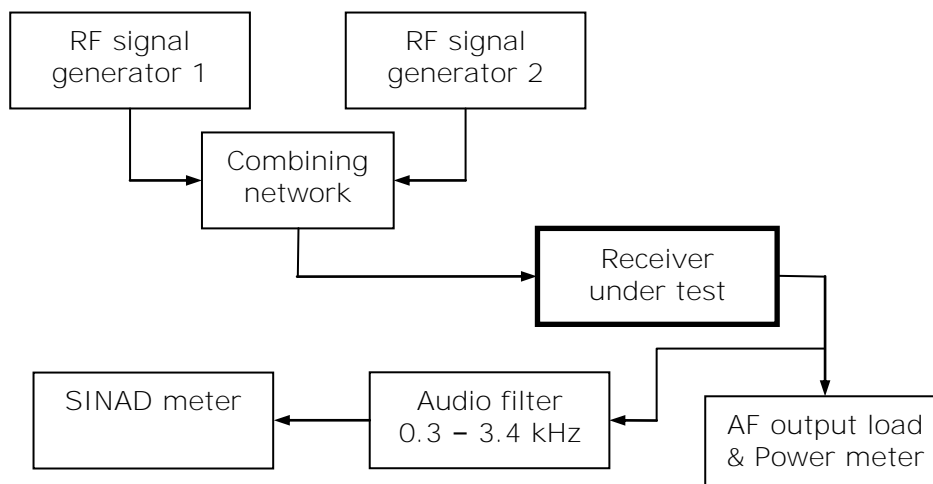
B. 2.2.10.10 Repeat these measurements with RF signal generators 2 & 3 adjusted to the fourth adjacent and eighth adjacent channels above the nominal carrier frequency.

C. 2.2.10.11 The measurements described in A & B shall be repeated with RF signal generators 2 & 3 set to the appropriate channels below the nominal frequency of the receiver.

2.2.10.12 Record the worst ratio in dB as the measure of the intermodulation spurious response attenuation.

2.2.11 Co-channel rejection ratio

Connect the equipment as shown below.



2.2.11.1 Switch the RF signal output of signal generator 2 off.

2.2.11.2 RF signal generator 1:

2.2.11.2.1 Adjust the RF signal generator to produce a standard RF test signal.

2.2.11.2.2 Adjust the volume control of the radio to obtain SOP.

2.2.11.2.3 Reduce the RF signal until the SINAD ratio is 12 dB (wanted signal).

2.2.11.3 RF signal generator 2:

2.2.11.3.1 Switch the RF signal output on (unwanted signal).

2.2.11.3.2 Set the frequency to the assigned receiver frequency.

2.2.11.3.3 Modulate the RF signal with 400 Hz at standard modulation factor.

2.2.11.3.4 Adjust the RF signal level such that the SINAD ratio is reduced to 6 dB.

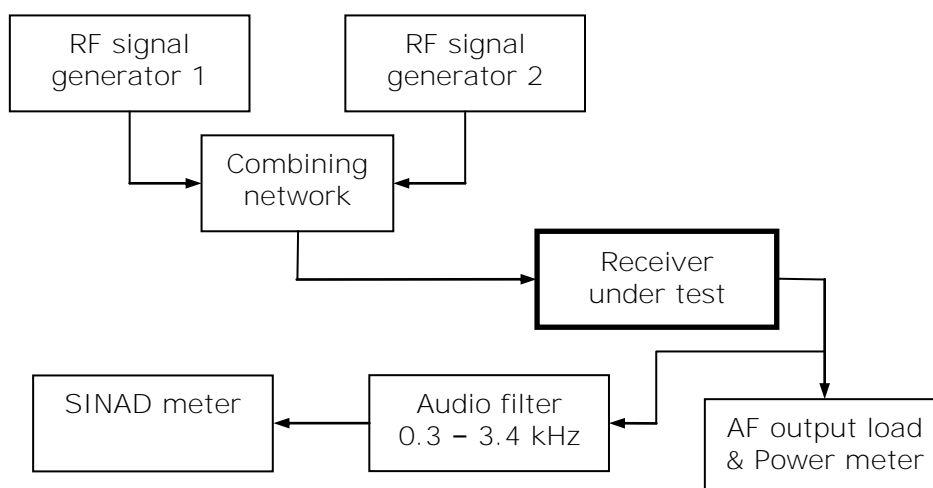
2.2.11.4 Record the co-channel rejection ratio as the difference in dB, between the wanted and unwanted signal levels.

2.2.11.5 Repeat the measurement with signal generator 2 set to frequencies 1.5 kHz and 3.0 kHz above and below the assigned frequency.

2.2.11.6 The highest value of the five measurements shall be recorded as the co-channel rejection ratio.

2.2.12 Blocking or Desensitisation

Connect the equipment as shown below.



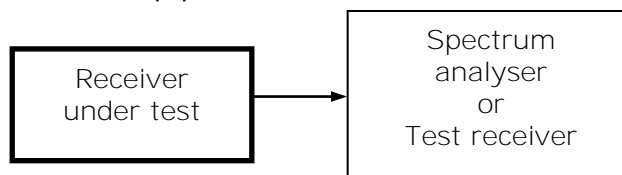
2.2.12.1 Switch the RF signal output of signal generator 2 off.

2.2.12.2 RF signal generator 1:

- 2.2.12.2.1 Adjust the RF signal generator to produce a standard RF test signal.
- 2.2.12.2.2 Adjust the volume control of the radio to obtain SOP.
- 2.2.12.2.3 Reduce the RF signal until the SINAD ratio is 12 dB (wanted signal).
- 2.2.12.3 RF signal generator 2:
- 2.2.12.3.1 Switch the unmodulated RF signal output on (unwanted signal).
- 2.2.12.3.2 Set the RF signal to a level 84 dB higher than signal generator 1.
- 2.2.12.3.3 Vary the frequency from 1 MHz to 10 MHz on either side of the assigned carrier frequency.
- 2.2.12.4 Monitor the variation in the audio output level and the SINAD ratio.
- 2.2.12.5 Record the difference in dB between the signal output levels from the two RF signal generators at which the audio output power decreased with 3 dB or the SINAD ratio decreases to 6 dB, whichever occurs first.
- Note: Ensure that the measured response is not caused by spurious signals from the RF signal generators.

2.2.13 **Conducted Spurious radiation**

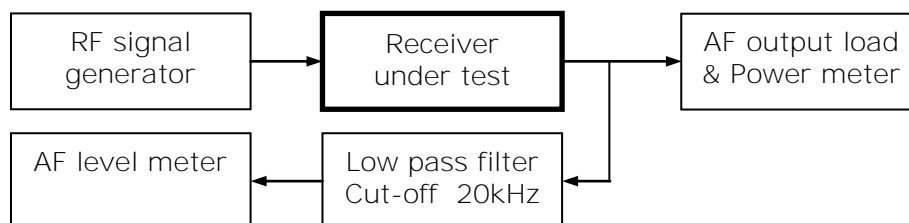
Connect the equipment as shown below.



- 2.2.13.1 Switch the receiver on.
- 2.2.13.2 The receiver must be in standby mode.
- 2.2.13.3 Slowly sweep the measuring instrument over the range 9 kHz to 4 GHz.
- 2.2.13.4 Record the frequencies and measure the absolute levels of the conducted spurious radiation.

2.2.14 **Audio frequency response**

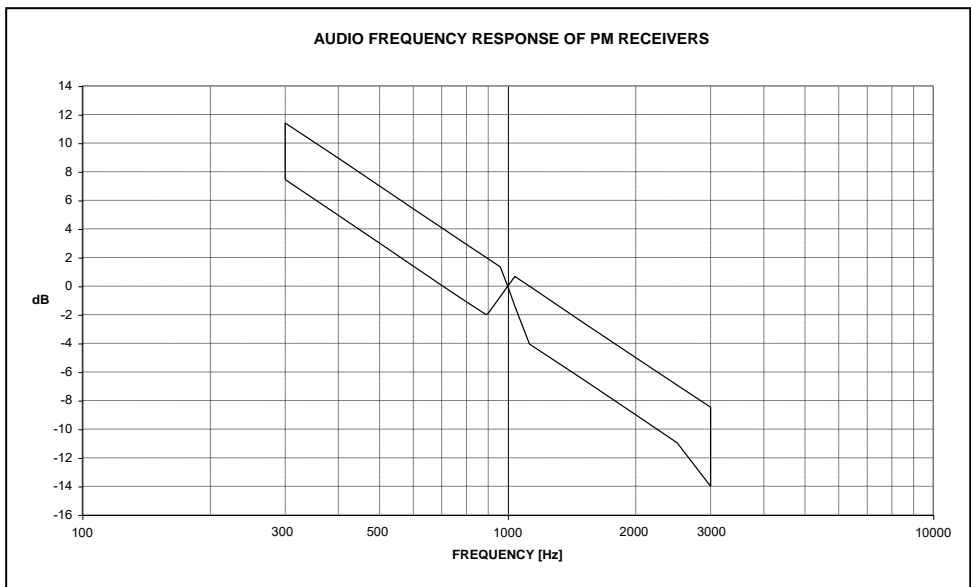
Connect the equipment as shown below.



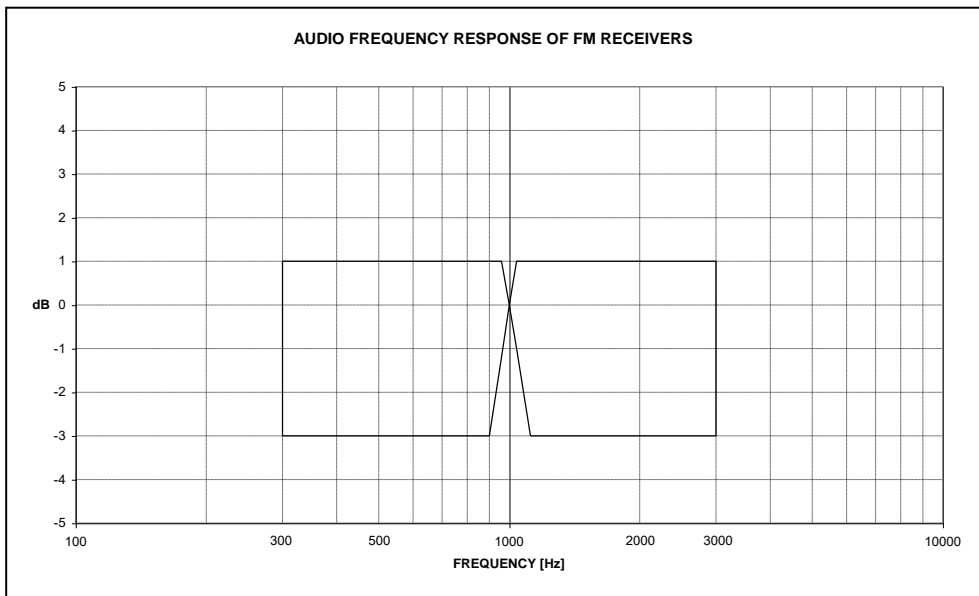
- 2.2.14.1 Standard measurement
- 2.2.14.1.1 Adjust the RF signal generator to produce a standard RF test signal and inject it into the receiver.
- 2.2.14.1.2 Adjust the volume control of the radio to obtain SOP.
- 2.2.14.1.3 Adjust the modulation of the RF signal generator to 20 % of the maximum system deviation.
- 2.2.14.1.4 While keeping the modulation factor constant vary the modulating frequency over the range 300 Hz to 3 kHz.
- 2.2.14.1.5 Record the variation of the audio output power over this range in dB with reference to the corresponding level at 1 kHz.
- 2.2.14.1 600 Ω balanced line
- Where a 600 Ω balanced line is provided, the audio frequency response must be measured on this line.
- 2.2.14.2.1 Inject a standard RF test signal from the RF signal generator into the receiver.
- 2.2.14.2.2 Load the line with a 600 Ω resistive load or equivalent impedance, provided by the measuring instrument.

2.2.14.2.3 Adjust the audio signal level to measure – 10 dBm on the line.

2.2.14.2.4 Proceed with clauses 2.2.14.1.3 and 2.2.14.1.5.

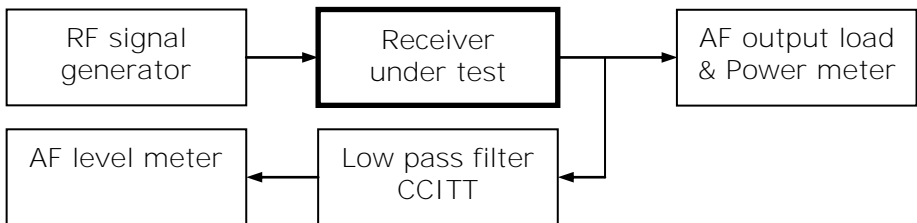


6dB/octave slope



2.2.15 **Signal to hum and noise ratio**

Connect the equipment as shown below.



2.2.15.1 Select the CCITT filter (low pass filter).

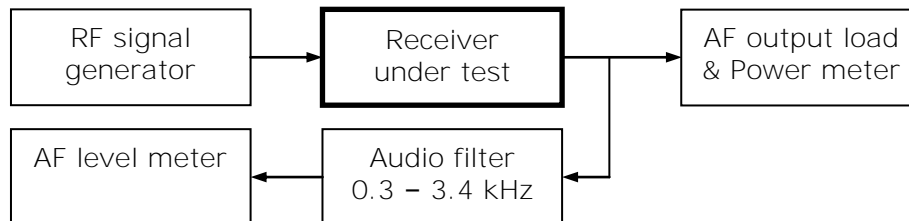
2.2.15.2 Adjust the RF signal generator to produce a standard RF test signal.

2.2.15.3 Adjust the volume control of the radio to obtain SOP.

- 2.2.15.4 Adjust the squelch to its minimum (unsquelched).
- 2.2.15.5 Remove the modulation and measure the audio output power.
- 2.2.15.6 Adjust the squelch to its maximum (squelched).
- 2.2.15.7 If the receiver remains unsquelched remove the RF signal.
- 2.2.15.8 Measure the audio output power.
- 2.2.15.9 Record the ratio in dB between the audio output powers without modulation, and the SOP level as the signal to hum and noise ratio.

2.2.16 **Amplitude characteristics**

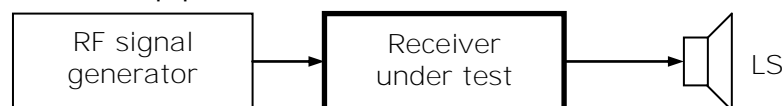
Connect the equipment as shown below.



- 2.2.16.1 Adjust the RF signal generator to produce a standard RF test signal.
- 2.2.16.2 Increase the RF output signal level to -13 dBm.
- 2.2.16.3 Adjust the volume control of the radio to obtain SOP.
- 2.2.16.4 Decrease the RF signal output level from -13 dBm to -107 dBm and measure the change in the audio output level in dB.

2.2.17 **High RF signal level interference**

Connect the equipment as shown below.



- 2.2.17.1 Set the radio to operate on the lowest channel.
- 2.2.17.2 Adjust the RF signal generator to produce a standard RF test signal.
- 2.2.17.3 Adjust the squelch to open at a RF signal level of -115 dBm.
- 2.2.17.4 Increase the RF signal level to -7 dBm.
- 2.2.17.5 Scan the frequencies of 132 channels above the receiving channel, excluding the assigned channel and the adjacent channels.
- 2.2.17.6 Record the channel and the RF signal level, at which the squelch opens in the window of -47 dBm to -7 dBm.
- 2.2.17.7 Set the radio to operate on the highest channel.
- 2.2.17.8 Scan the frequencies of 132 channels below the receiving channel, excluding the assigned channel and the adjacent channels.
- 2.2.17.9 Record the channel and the RF signal level, at which the squelch opens in the window of -47 dBm to -7 dBm.

Note: Where the interfering channels correspond with the intermodulation free channel groups, interference could occur.

Intermodulation free channel groups**High site channels**Duplex, 5th order, 132 channels

Group A	1	2	6	8	22	37	54	61	79	80	88	91	101	124	129
---------	---	---	---	---	----	----	----	----	----	----	----	----	-----	-----	-----

Duplex, 5th order, 132 channels

Group B	3	4	7	23	45	73	75	85	96	102	120	128
---------	---	---	---	----	----	----	----	----	----	-----	-----	-----

Duplex, 5th order, 132 channels

Group C	16	41	57	59	74	78	83	110	122	123	130
---------	----	----	----	----	----	----	----	-----	-----	-----	-----

Duplex, 5th order, first 52 channels

Group D	17	18	21	31	40	46	48
---------	----	----	----	----	----	----	----

Duplex, 5th order, first 52 channels

Group E	19	28	32	43	44	49	51
---------	----	----	----	----	----	----	----

Duplex, 5th order, first 52 channels

Group F	29	30	35	42	50	52
---------	----	----	----	----	----	----

Duplex, 5th order, first 52 channels

Group G	11	14	24	26
---------	----	----	----	----

Duplex, 5th order, first 52 channels

Group H	34	36	47
---------	----	----	----

Shunting channelsSimplex, 5th order, last 80 channels

Group A	53	56	60	71	97	99	109	118	126	131	132
Group B	55	58	62	63	72	84	112	125			
Group C	64	67	69	76	95	103	116	127			
Group D	68	77	82	90	107	113	114	117			
Group E	65	66	70	94	100	121					
Group F	81	87	89	92	104	108					

2.3 Radio Transmitter

2.3.1 Carrier power (conducted)

Connect the equipment as shown below.

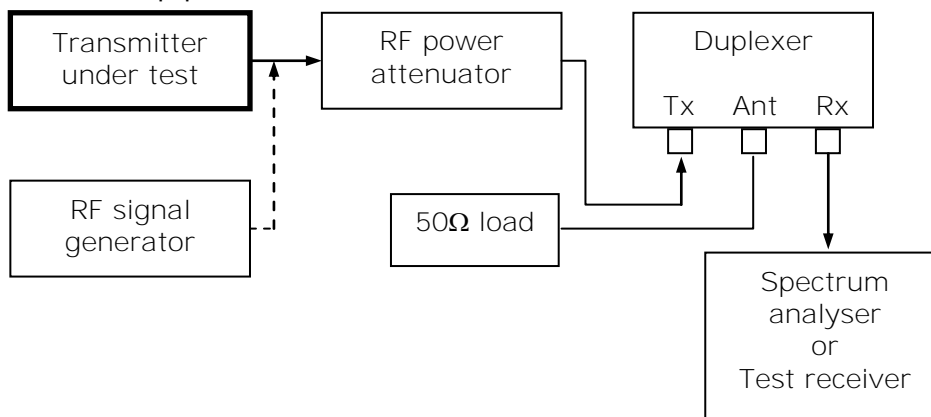


2.3.1.1 Measure the carrier power in the absence of modulation.

2.3.1.2 The measurement shall be made under the extreme test conditions as well.

2.3.2 Conducted spurious emissions

Connect the equipment as shown below.



2.3.2.1 The duplexer must be tuned to the operating band. See specifications in clause 1.4.1.

2.3.2.2 The value of the RF attenuator (including the duplexer) must be such to limit the carrier level at the spectrum analyser/test receiver to approximately – 60 dBm.

2.3.2.3 With the transmitter transmitting an unmodulated carrier, measure and record the frequencies and absolute levels of the conducted spurious up to the 5th harmonic.

2.3.2.4 Replace the transmitter with the RF signal generator.

2.3.2.5 Tune the RF signal generator to the recorded frequency and adjust the output level to obtain the recorded level on the spectrum analyser/test receiver.

2.3.2.6 Record the output level of the RF signal generator as the conducted spurious emission at that specific frequency.

2.3.2.7 Repeat 2.3.2.5 & 2.3.2.6 for all the other spurious emissions detected.

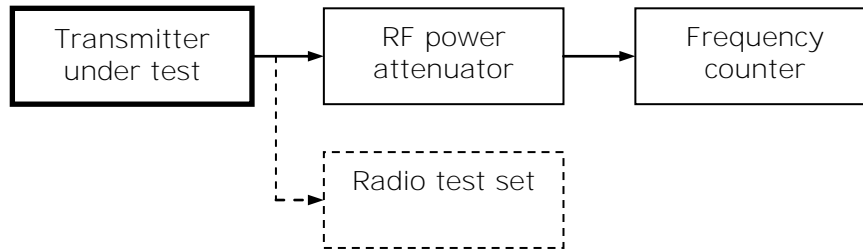
2.3.2.8 Remove the RF attenuator and duplexer and repeat the measurements when the transmitter is in the standby mode.

2.3.2.9 The measurements shall be made under the extreme test conditions as well.

2.3.1.10 With the above circuit the reverse channels can also be tested.

2.3.3 **Carrier frequency error**

Connect the equipment as shown below.



2.3.3.1 Measure the carrier frequency in the absence of modulation.

2.3.3.2 Repeat the measurement on each channel on which the transmitter is equipped to operate.

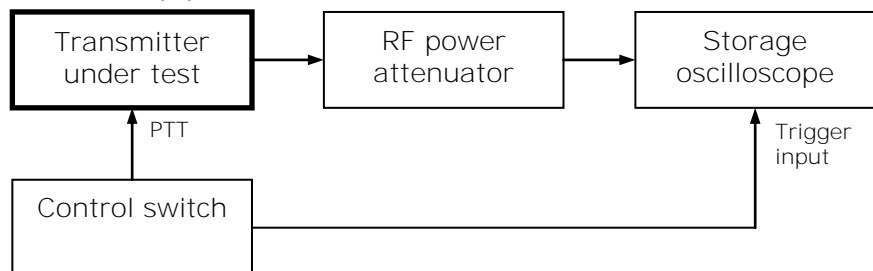
2.3.3.3 Calculate the carrier frequency error as the difference between the assigned frequency and the measured frequency. (Some test instruments can be set to measure the frequency error directly).

2.3.3.4 Record the worst case as the result.

2.3.3.5 The measurement shall be made under the extreme test conditions as well.

2.3.4 **Carrier attack time**

Connect the equipment as shown below.

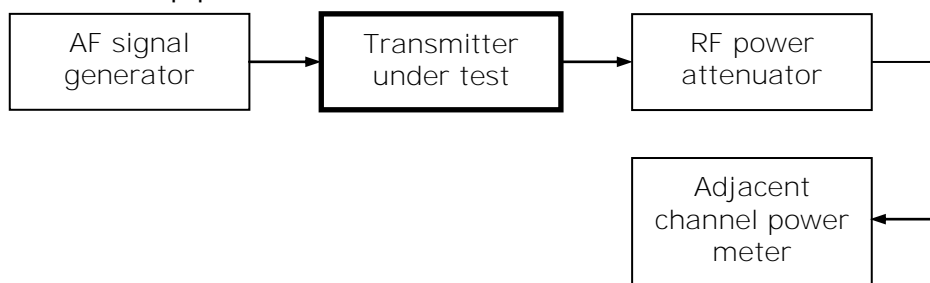


2.3.4.1 Set the storage oscilloscope to single sweep operation.

2.3.4.2 Operate the control switch and measure the time interval for the unmodulated carrier voltage level to reach a value 6 dB (50 %) below the steady state level.

2.3.5 **Adjacent channel power**

Connect the equipment as shown below.



2.3.5.1 Ensure that the modulation limiting (Tx deviation) is set correctly (see clause 2.3.7).

2.3.5.2 Measure the unmodulated carrier power level.

2.3.5.3 Modulate the transmitter with a 1 250 Hz signal at a level 20 dB greater than that required to produce the standard test modulation factor.

2.3.5.4 Measure the mean power produced by the modulation, hum and noise of the transmitter in the adjacent channels.

2.3.5.5 Express the adjacent channel power in dB with reference to the measured carrier power.

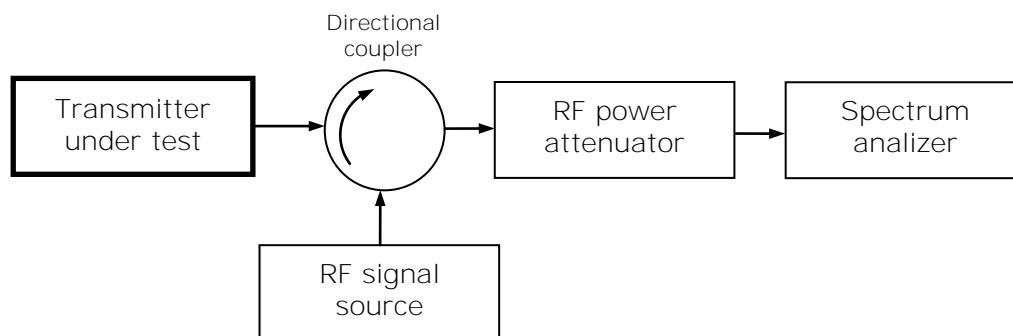
2.3.5.6 Record the worst ratio as the measure of the adjacent channel power.

Or: When the measured level does not comply with the specification:

The adjacent channel power not to exceed a level of -37 dBm irrespective of the carrier power level.

2.3.6 **Intermodulation attenuation** (fixed radio stations only)

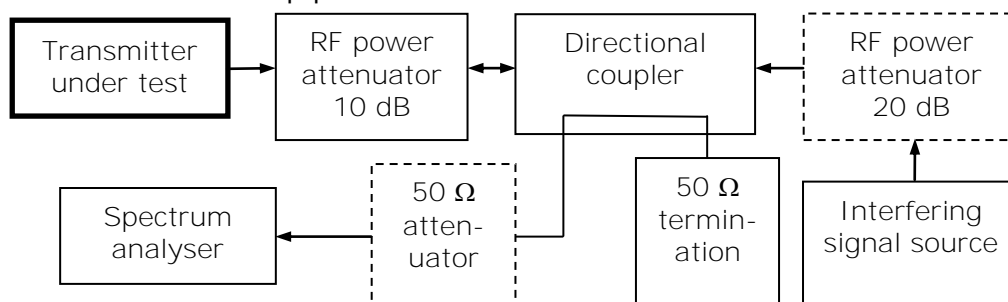
Method A: Connect the equipment as shown below.



- 2.3.6.1 Set the unmodulated signal level from the RF signal source to give a level, measured at the transmitter output terminal, 30 dB below the output carrier level.
- 2.3.6.2 With the transmitter transmitting an unmodulated carrier, vary the frequency of the RF signal source between 50 kHz and 100 kHz, above and below the carrier frequency.
- 2.3.6.3 Measure the levels of the Intermodulation components.
- 2.3.6.4 The Intermodulation attenuation is expressed as the ratio of the carrier level to the level of the largest Intermodulation product (third order) observed.
- 2.3.6.5 Record the worst case as the result.

Note: Ensure that the measured response is not caused by spurious signals from the RF signal source.

Method B: Connect the equipment as shown below.



- 2.3.6.6 The coupling between the transmitter under test and the 10 dB RF power attenuator must be as short as possible to minimize mismatching.
- 2.3.6.7 The directional coupler must have an insertion loss of ≤ 1 dB, directivity of ≥ 20 dB and sufficient bandwidth.
- 2.3.6.8 The transmitter under test and the interfering signal source must have sufficient physical separation to prevent the measurement being influenced by direct radiation.
- 2.3.6.9 The RF signal level from the interfering signal source must have the same level as that of the transmitter. Alternatively, the RF signal level from the interfering signal source must be 20 dB lower than that of the transmitter – omit the 20 dB RF power attenuator.
- 2.3.6.10 The transmitter under test shall be unmodulated.
- 2.3.6.11 The spectrum analyser must be adjusted to give a maximum indication (amplitude) with a frequency scan of 500 kHz.
- 2.3.6.12 The interfering signal source must be unmodulated and the frequency must be varied between 50 kHz to 100 kHz above and below the frequency of the transmitter under test.

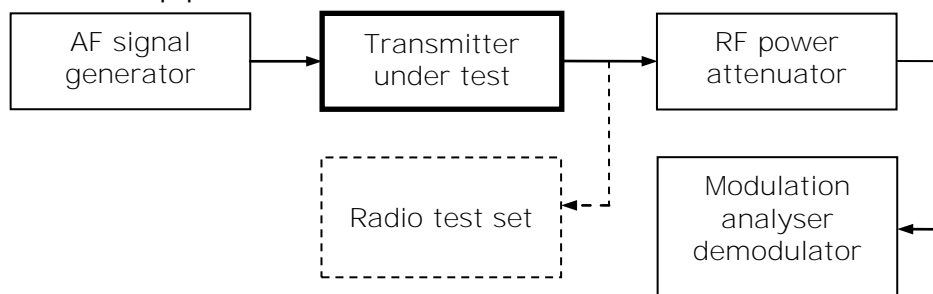
2.3.6.13 Measure the levels of the Intermodulation components on the spectrum analyser and determine the ratio of the carrier level to the level of the largest Intermodulation product (third order) observed, in dB.

2.3.6.14 Record the worst case as the result.

Note: Ensure that the measured response is not caused by spurious signals from the RF signal source.

2.3.7 **Modulation limiting** (Tx deviation)

Connect the equipment as shown below.



2.3.7.1 Ensure that the maximum deviation is set correctly and according to the manufacturer's procedure.

2.3.7.2 Apply electrically a 1 kHz audio test signal to the microphone input of the transmitter at a level sufficient to produce the standard test modulation factor.

(When an electrical input signal cannot be applied this may be replaced by an acoustical signal.)

2.3.7.3 Set the audio filter of the modulation analyser to Low Pass cut-off 15 kHz or 20 kHz.

2.3.7.4 Note the level of the audio test signal (reference).

2.3.7.5 Modulating frequency 0.3 kHz to 2.55 kHz:

2.3.7.5.1 Increase the audio test signal with 20 dB. Ensure that the measured deviation equals the maximum system deviation.

2.3.7.5.2 Without changing the audio input signal level vary the modulating frequency between 300 Hz and 2.55 kHz.

2.3.7.5.3 Record the largest positive or negative peak deviation obtained, as the modulation limit.

2.3.7.6 Modulating frequency 2.55 kHz to 6.0 kHz:

2.3.7.6.1 Decrease the audio test signal to obtain the standard test modulation factor (reference).

2.3.7.6.2 Without changing the audio input signal level vary the modulating frequency between 2.55 kHz and 6.0 kHz.

2.3.7.6.3 Record the largest positive or negative peak deviation obtained, as the modulation limit for the specific modulating frequency band.

Note: The deviation produced by the modulating frequencies between 2.55 kHz and 6.0 kHz must not exceed that of the deviation produced by the modulating frequency 2.55 kHz.

2.3.7.7 Modulating frequency 6.0 kHz to 12.5 kHz:

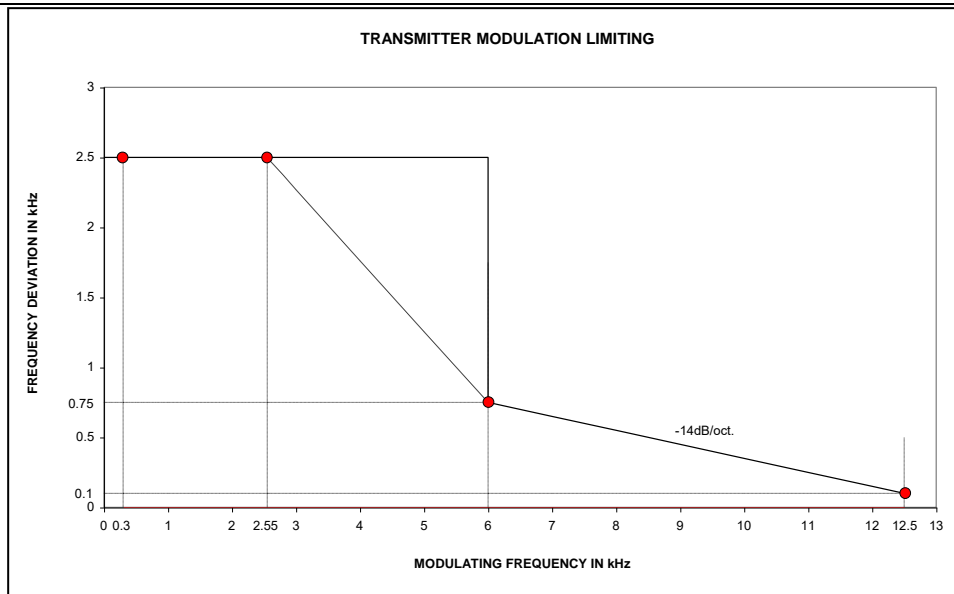
2.3.7.7.1 Obtain the standard test modulation factor (reference).

2.3.7.7.2 Without changing the audio input signal level vary the modulating frequency between 6.0 kHz and 12.5 kHz.

2.3.7.7.3 Record the decrease in the positive or negative peak deviation, as the modulation limit for the specific modulating frequency band.

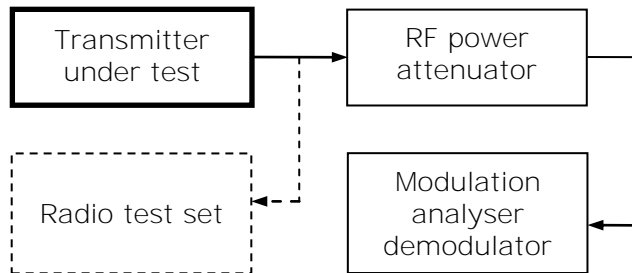
Note: Care must be taken not to generate hum when the audio signal is connected electrically.

It must be ensured that the acoustical audio source has a flat response throughout the bandwidth.



2.3.8 CTCSS deviation

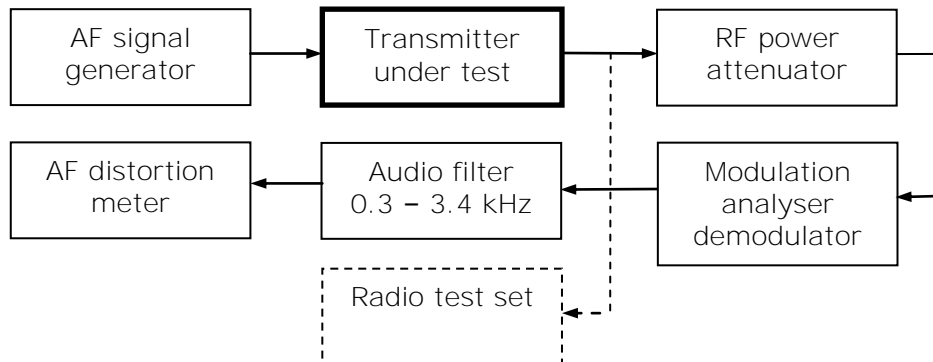
Connect the equipment as shown below.



- 2.3.8.1 Select the CTCSS frequency and activate the function.
- 2.3.8.2 Set the audio filter of the modulation analyser to Low Pass cut-off 15 kHz or 20 kHz.
- 2.3.8.3 In the absence of an audio input signal (modulating signal) transmit a carrier.
- 2.3.8.4 Measure and record the deviation of the sub-audible tone.

2.3.9 Audio frequency total harmonic distortion (THD)

Connect the equipment as shown below.



- 2.3.9.1 Standard measurement
 - 2.3.9.1.1 Apply electrically a 1 kHz audio test signal to the microphone input of the transmitter at a level sufficient to produce the standard test modulation factor.
 - 2.3.9.1.2 Record the distortion obtained.
 - 2.3.9.1.3 Adjust the audio signal generator frequency to 500 Hz.

2.3.9.1.4 Set the audio output signal at a level sufficient to produce the standard test modulation factor.

2.3.9.1.5 Record the distortion obtained.

Note: Care must be taken not to generate hum when the audio signal is connected electrically.

2.3.9.2 600 Ω balanced line input

Where a 600 Ω balanced line is provided, the THD must be measured on this line.

2.3.9.2.1 Load the line with a 600 Ω resistive load or equivalent impedance, provided by the test instrument.

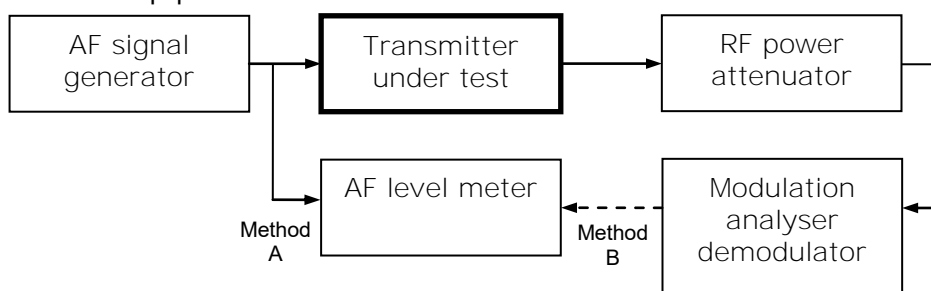
2.3.9.2.2 Inject a 1 kHz audio test signal into the line at a level of -10 dBm.

2.3.9.2.3 Ensure that the transmitting signal deviation comply with the standard test modulation factor.

2.3.9.2.4 Measure and record the THD.

2.3.10 Audio frequency response

Connect the equipment as shown below.



2.3.10.1 Standard measurement

Method A.

2.3.10.1.1 Apply electrically a 1 kHz audio test signal to the microphone input of the transmitter at a level sufficient to obtain 20 % of the maximum system deviation.

2.3.10.1.2 Select the low pass filter (cut-off 20 kHz) at the modulation analyser.

2.3.10.1.3 Vary the modulating frequency (audio signal) from 300 Hz to 3 kHz.

2.3.10.1.4 Adjust the modulating frequency level (audio signal) to maintain the modulation factor constant.

2.3.10.1.5 Record the variation in the audio output level of the AF signal generator in dB with reference to the corresponding level at 1 kHz.

Method B.

2.3.10.1.6 Apply electrically a 1 kHz audio test signal to the microphone input of the transmitter at a level sufficient to obtain 20 % of the maximum system deviation.

2.3.10.1.7 Select the low pass filter (cut-off 20 kHz) at the modulation analyser.

2.3.10.1.8 Keeping the audio signal level constant, vary the frequency from 300 Hz to 3 kHz.

2.3.10.1.9 Record the variation in the audio output level from the demodulator in dB with reference to the corresponding level at 1 kHz.

Note: The + and – signs must be inverted to be able to apply the graph.

2.3.10.2 600 Ω balanced line input

Where a 600 Ω balanced line is provided, the audio frequency response must be measured on this line.

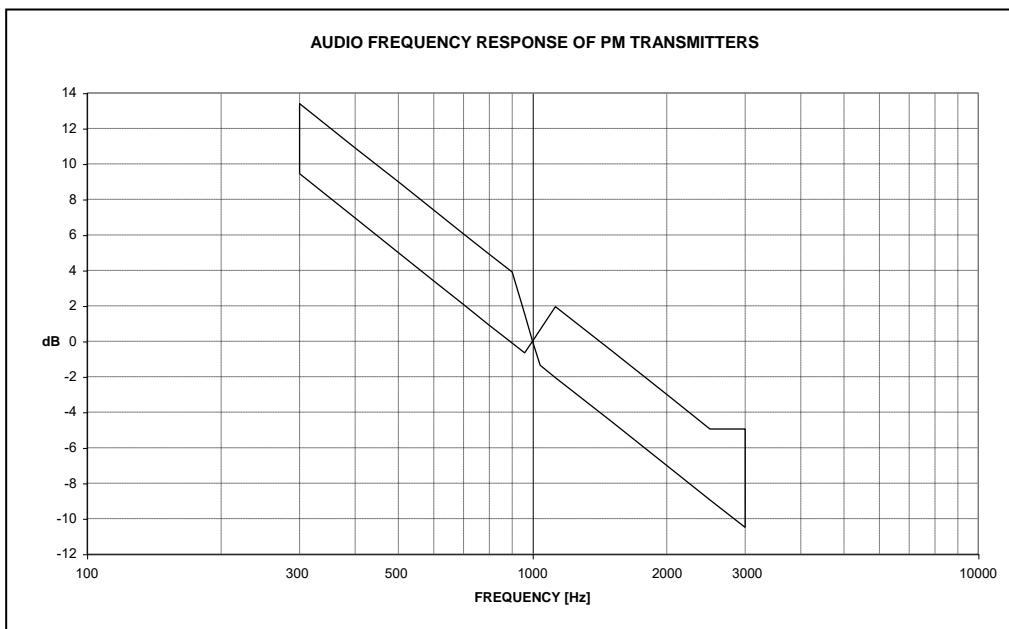
2.3.10.2.1 Load the line with a 600 Ω resistive load or equivalent impedance, provided by the test instrument.

2.3.10.2.2 Inject a 1 kHz audio test signal into the line at a level of -10 dBm.

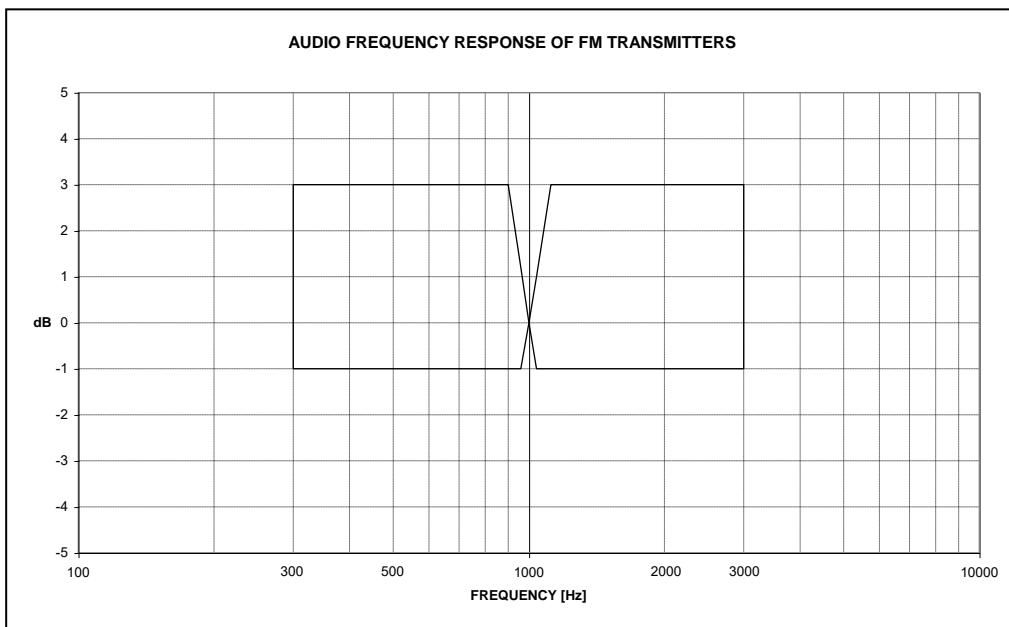
2.3.10.2.3 Ensure that the transmitting signal deviation comply with the standard test modulation factor.

2.3.10.2.4 Reduce the audio signal level to obtain 20 % of the maximum system deviation.

2.3.10.2.5 Proceed with test method A (2.3.10.1.2 to 2.3.10.1.5) or test method B (2.3.10.1.7 to 2.3.10.1.9)

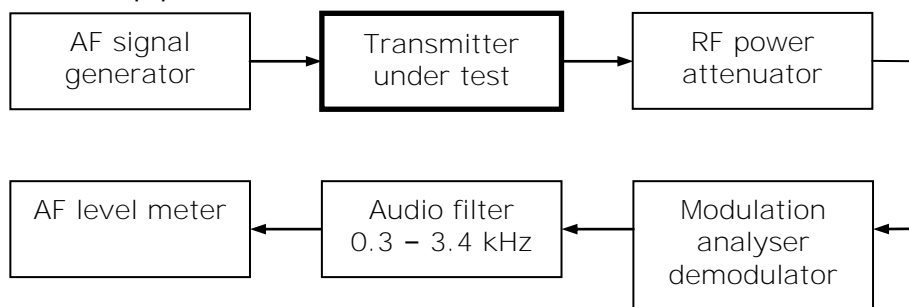


6dB/octave slope



2.3.11 Angle modulation hum and noise ratio

Connect the equipment as shown below.



- 2.3.11.1 Apply electrically a 1 kHz audio test signal to the microphone input of the transmitter at a level sufficient to produce the standard test modulation factor.
- 2.3.11.2 Record the audio output level from the modulation analyser demodulator.
- 2.3.11.3 Remove the modulation from the transmitter.
- 2.3.11.4 Again record the audio output level from the modulation analyser demodulator.
- 2.3.11.5 Calculate the angle modulation hum and noise ratio by determining the difference between the two measurements in dB.

Note: Care must be taken not to generate hum when the audio signal is connected electrically.

Short circuit the audio input connections of the radio transmitter when the audio signal is removed.

2.3.12 Amplitude modulation hum and noise level

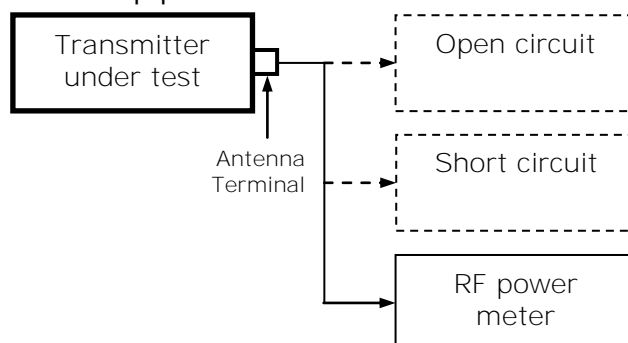
Connect the equipment as shown below.



- 2.3.12.1 Set the modulation analyser to measure the RMS AM modulation factor (m %).
- 2.3.12.2 In the absence of an audio input signal (modulating signal) measure the modulation factor.
- 2.3.12.3 Calculate the AM hum and noise level as follow:
AM hum and noise level (dB) = $20\text{Log}(2 m/100)$

2.3.13 Extreme transmitter loads

Connect the equipment as shown below.



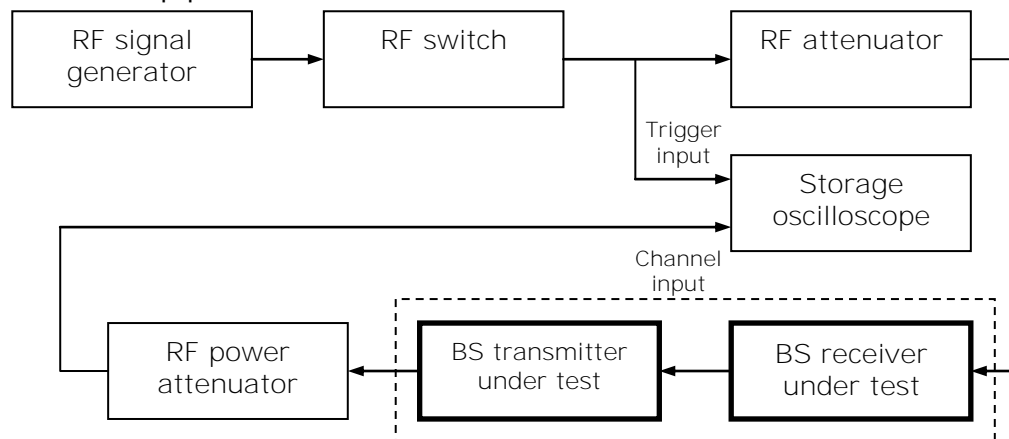
- 2.3.13.1 Measure the carrier power in the absence of modulation.
- 2.3.13.2 Operate the transmitter under open and short circuit load conditions for a period of:
 - 2.3.13.2.1 One minute each in the case of a transmitter rated for intermittent duty cycle.
 - 2.3.13.2.2 Five minutes each in the case of a transmitter rated for continuous operation.

- 2.3.13.3 After each exposure to the extreme load measure the carrier power in the absence of modulation.
- 2.3.13.4 Calculate the variation of the carrier power in dB with reference to clause 2.3.13.1.

2.4 High Site Equipment

2.4.1 Radio Base Station Response Time

Connect the equipment as shown below.

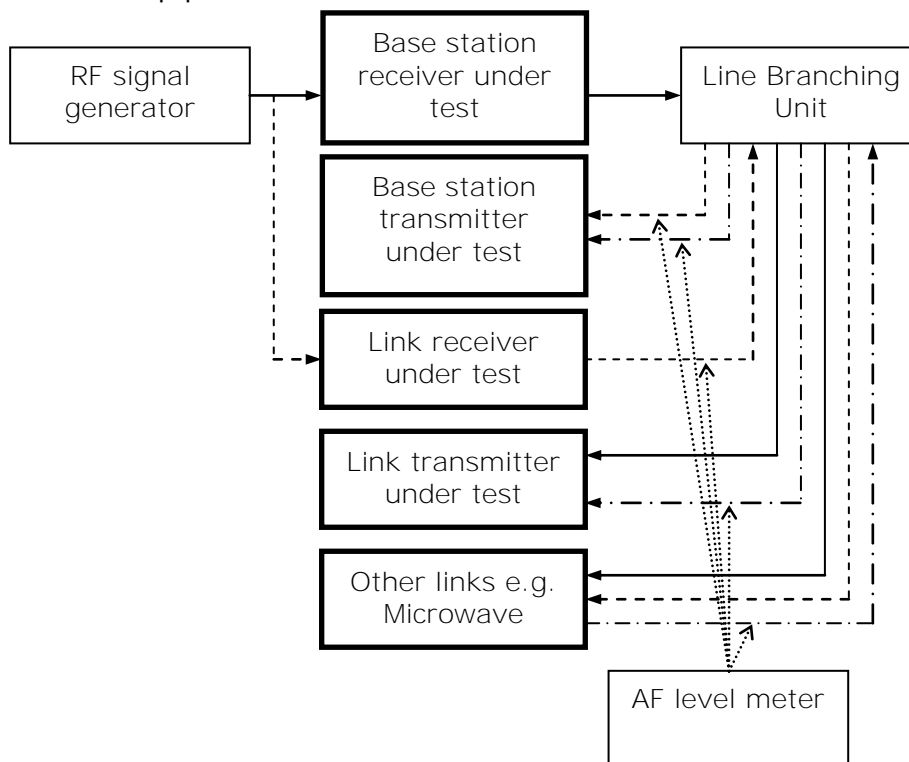


- 2.4.1.1 Apply a standard RF test signal to the receiver under test.
- 2.4.1.2 Determine the usable sensitivity as described in clause 2.2.3.
- 2.4.1.3 Adjust the squelch to open at a RF signal level of -115 dBm, measured at the antenna terminal.
- 2.4.1.4 Set the RF signal level 12 dB above the usable sensitivity level.
- 2.4.1.5 Set the storage oscilloscope to single sweep operation.
- 2.4.1.6 Enable the RF switch and measure the time required for the unmodulated transmit carrier voltage level to reach a value 6 dB (50 %) below the steady state level.
- 2.4.1.7 Repeat the measurement three times and take the average of the three measurements as the repeater attack time.

2.4.2 **Talk Through Signal**

2.4.2.1 **Audio levels**

Connect the equipment as shown below.

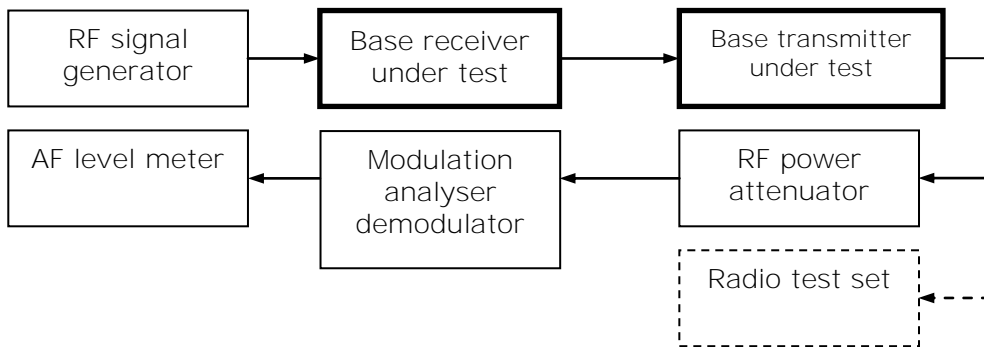


- 2.4.2.1.1 Adjust the RF signal generator to produce the standard RF test signal.
- 2.4.2.1.2 Connect the audio lines to the units as it would be connected when in operation. This is to ensure that the lines are correctly loaded.
- 2.4.2.1.3 Set the audio frequency level meter to high impedance/bridge mode. This is to ensure that the level meter does not load the lines.
- 2.4.2.1.4 Measure the audio level from the source (Rx) first. Adjust the level if necessary.
- 2.4.2.1.5 Measure all the outgoing lines from the LBU and adjust the levels if necessary.
- 2.4.2.1.6 Use the method described in clauses 2.4.2.1.1 to 2.4.2.1.4 to measure and adjust the audio level from the link receiver.
- 2.4.2.1.7 Measure the audio level from the microwave and adjust if necessary.

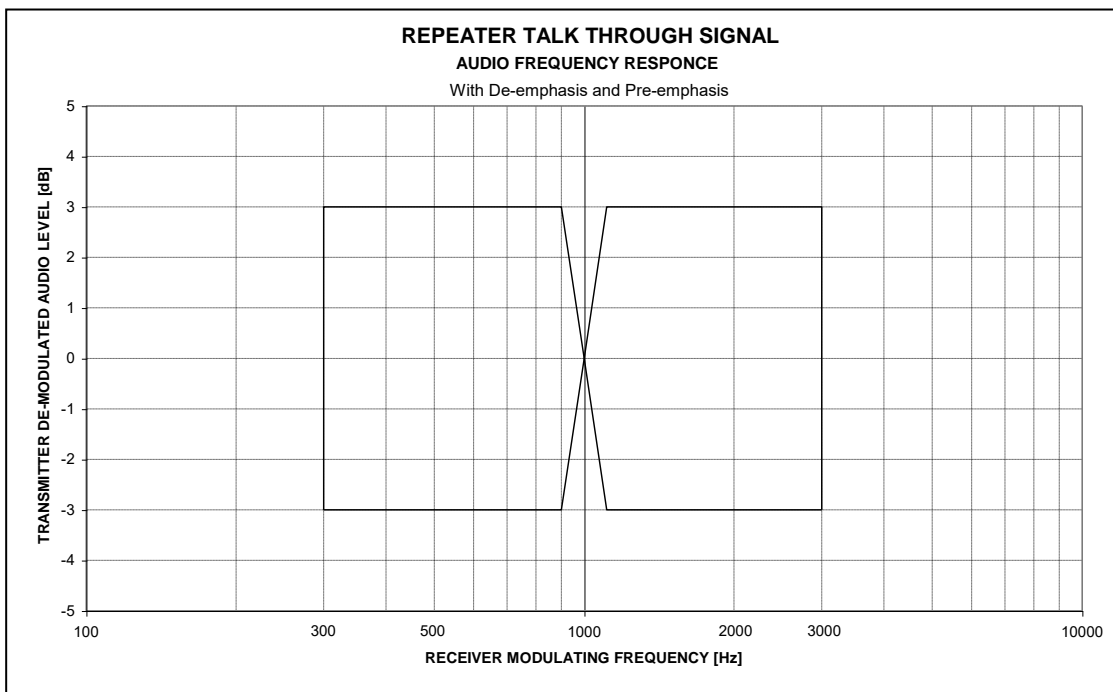
Note: The same measuring method is used on the Trunked radio equipment.

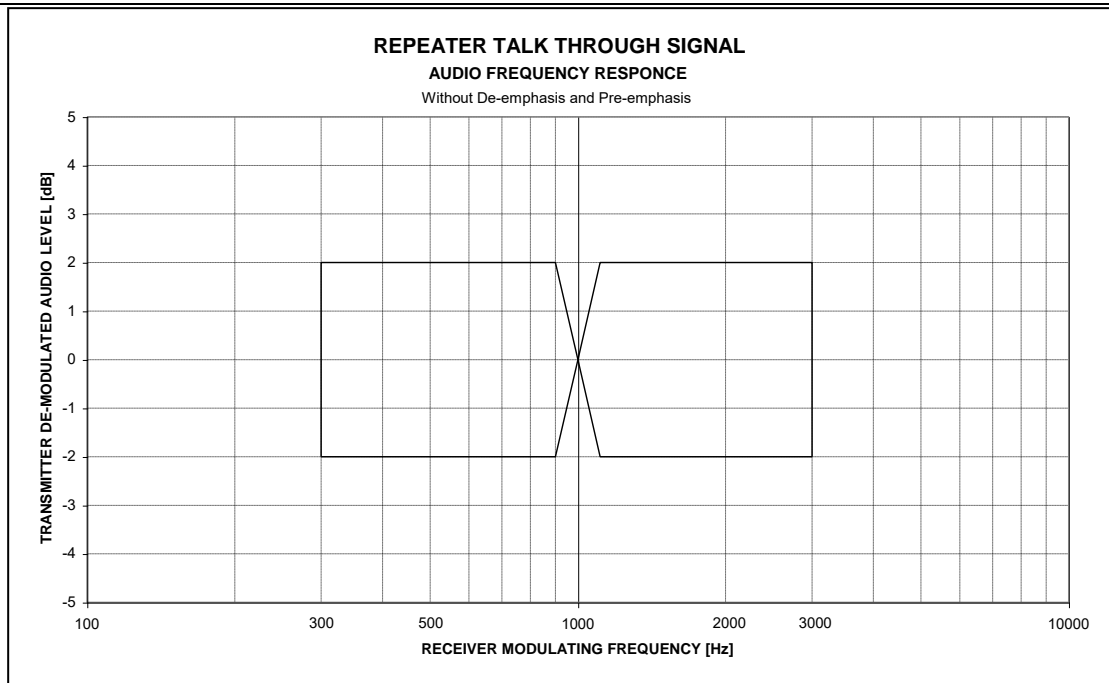
2.4.2.2 **Audio Frequency Response**

Connect the equipment as shown below.



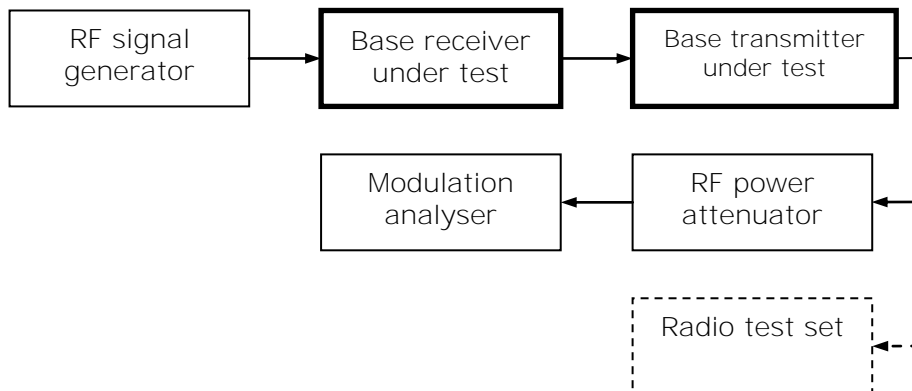
- 2.4.2.2.1 Ensure that all the audio level settings have been set correctly.
- 2.4.2.2.2 Adjust the RF signal generator to produce the standard RF test signal.
- 2.4.2.2.3 Select the low pass filter (cut-off 20 kHz) at the modulation analyser.
- 2.4.2.2.4 While keeping the modulation factor constant vary the modulating frequency over the range 300 Hz to 3 kHz.
- 2.4.2.2.5 Record the variation in the audio output power from the demodulator over this range in dB with reference to the corresponding level at 1 kHz.
- 2.4.2.2.6 Branches to the link radio and other links must also be measured.



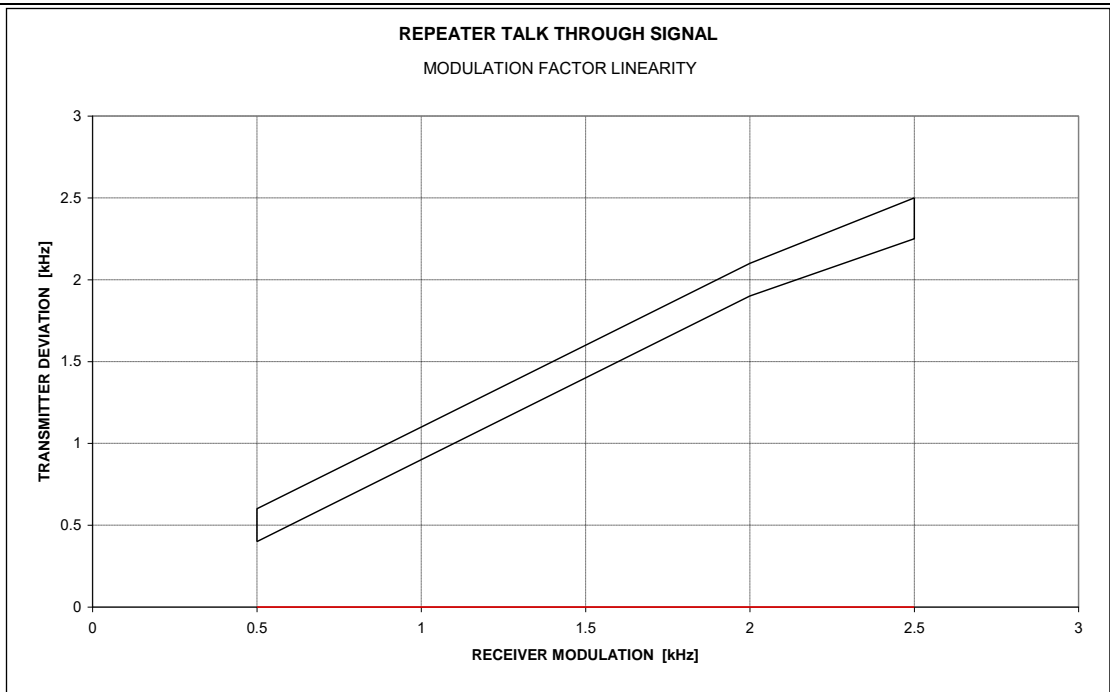


2.4.2.3 **Modulation factor linearity**

Connect the equipment as shown below.

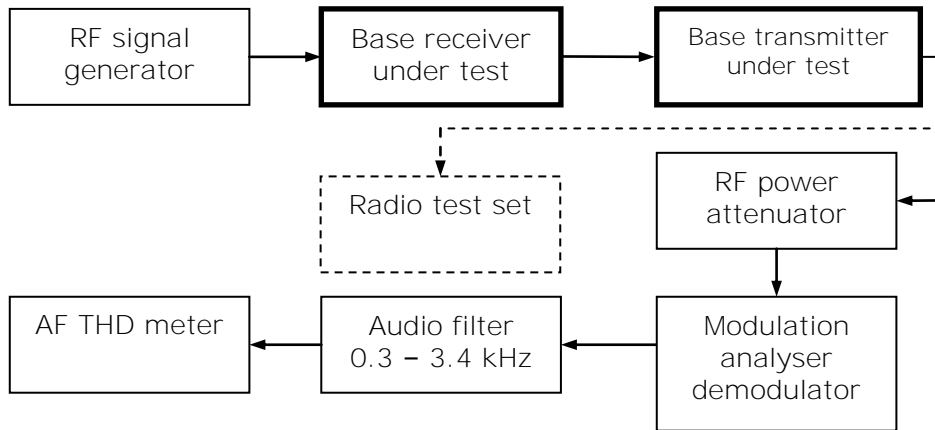


- 2.4.2.3.1 Ensure that the transmitter modulation limiting (deviation) has been set correctly (see clause 2.3.7).
- 2.4.2.3.2 Ensure that all the audio levels have been set correctly (see clause 2.4.2.1).
- 2.4.2.3.3 Apply a standard RF test signal from the RF signal generator to the receiver.
- 2.4.2.3.4 Vary the modulation of the RF input signal between 0.5 kHz and 2.5 kHz and measure the transmitter deviation.
- 2.4.2.3.5 Branches to the link radio and other links must also be measured.



2.4.2.4 **Audio frequency THD**

Connect the equipment as shown below.



- 2.4.2.4.1 Ensure that all the audio levels are set correctly.
- 2.4.2.4.2 Apply a standard RF test signal to the receiver under test.
- 2.4.2.4.3 Record the audio total harmonic distortion from the transmitter.
- 2.4.2.4.4 Branches to the link radio and other links must also be measured.

2.4.3 **Filters**

2.4.3.1 **Duplexer**

The best method to check or tune a duplexer is to use a Transmission Line Analyser. This measuring method will not be covered in this document.

If any problem is detected the duplexer/combiner must be sent to a facility with the proper equipment and competency. Do not attempt to tune the unit.

A RF signal generator and a test receiver/spectrum analyser could be used to make measurements.

2.4.3.1.1 **Calibration**

2.4.3.1.1.1 Connect the RF signal generator with the two connecting cables to the test receiver or spectrum analyser.

2.4.3.1.1.2 Tune the RF signal generator and the test receiver/spectrum analyser to the in-band receiving/transmitting frequency to be measured.

2.4.3.1.1.3 Set the output level of the RF signal generator as required:

e.g. Low-level : ≤ -60 dBm

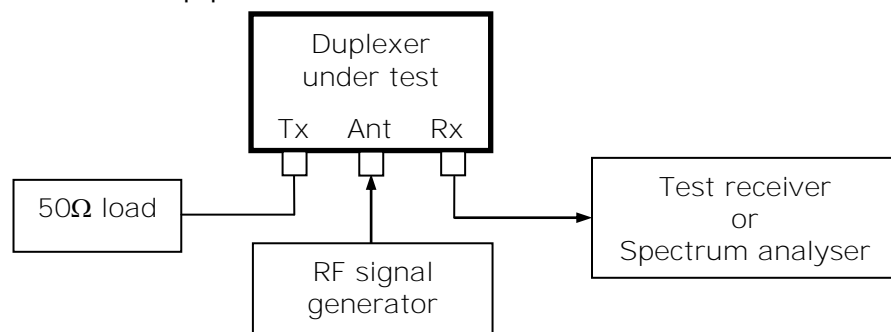
High-level : 0 dBm.

2.4.3.1.1.4 Record the difference between the applied and measured signal level. The difference must be included in the calculations.

Note: This method compensates for differences and the connecting cable losses.

2.4.3.1.2 **Insertion loss - Rx**

Connect the equipment as shown below.



2.4.3.1.2.1 Tune the RF signal generator and the test receiver/spectrum analyser to the in-band receiving frequency to be measured.

2.4.3.1.2.2 Inject the signal at the antenna port (low level) and measure the level at the receiving port.

2.4.3.1.2.3 Calculate the insertion loss by determining the difference between the injected signal level and the measured level in dB.

2.4.3.1.2.4 The insertion loss must comply throughout the operating band.

At the high site this measurement can be made in the following way:

2.4.3.1.2.5 Connect the RF signal generator directly to the receiver.

2.4.3.1.2.6 Adjust the RF signal generator to produce a standard RF test signal.

2.4.3.1.2.7 Decrease the RF signal level till the squelch closes.

2.4.3.1.2.8 Increase the RF signal level **slowly** and note the level when the squelch open.

2.4.3.1.2.9 Connect the RF signal generator to the receiver via the duplexer (Ant port).

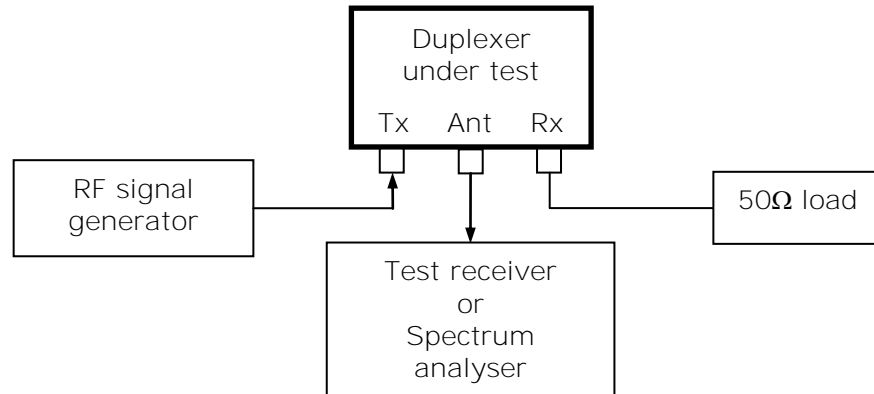
2.4.3.1.2.10 Repeat the procedure from clause 2.4.3.1.2.6 to 2.4.3.1.2.8.

2.4.3.1.2.11 Calculate the insertion loss by determining the difference between the two recorded signal levels in dB.

Note: When the result is within specification, the insertion loss through the coaxial cable between the receiver and duplexer can be ignored.

2.4.3.1.3 **Insertion loss - Tx**

Connect the equipment as shown below.

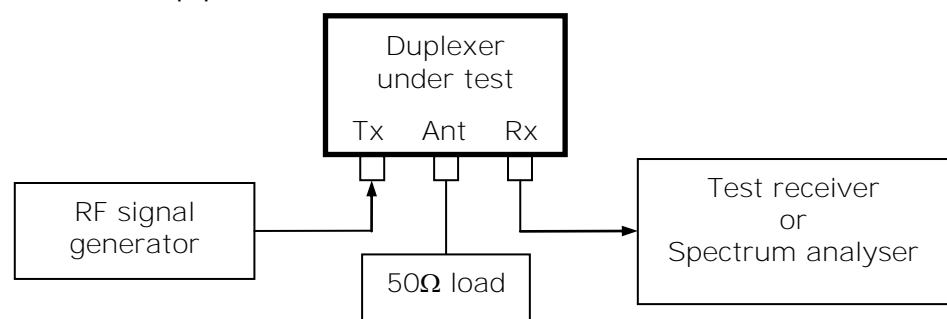


- 2.4.3.1.3.1 Tune the RF signal generator and the test receiver/spectrum analyser to the in-band transmitting frequency to be measured.
 - 2.4.3.1.3.2 Inject the signal at the transmitting port (high level) and measure the level at the antenna port.
 - 2.4.3.1.3.3 Calculate the insertion loss by determining the difference between the injected signal level and the measured level in dB.
 - 2.4.3.1.3.4 The insertion loss must comply throughout the operating band.
- At the high site this measurement can be made in the following way:
- 2.4.3.1.3.5 Connect a terminated wattmeter directly to the transmitter.
 - 2.4.3.1.3.6 Measure the un-modulated carrier power from the transmitter.
 - 2.4.3.1.3.7 Connect the same terminated wattmeter to the transmitter via the duplexer (Antenna port).
 - 2.4.3.1.3.8 Measure the un-modulated carrier power from the transmitter.
 - 2.4.3.1.3.9 Calculate the insertion loss by determining the difference between the two measured power levels in dB.

Note: When the result is within specification, the insertion loss through the coaxial cable between the transmitter and duplexer can be ignored.

2.4.3.1.4 **Isolation between the transmitting and receiving paths**

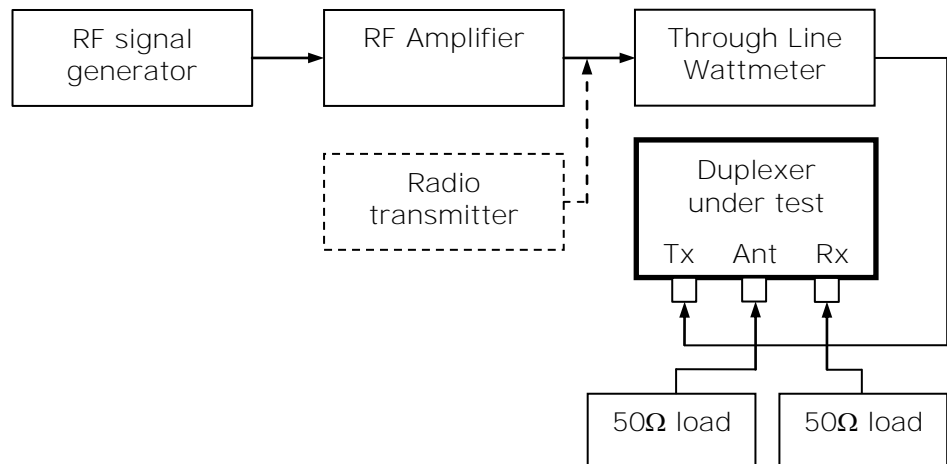
Connect the equipment as shown below.



- 2.4.3.1.4.1 Tune the RF signal generator and the test receiver/spectrum analyser to the in-band transmitting frequency to be measured.
- 2.4.3.1.4.2 Inject the signal at the transmitting port (high level) and measure the level at the receiving port.
- 2.4.3.1.4.3 Calculate the isolation by determining the difference between the injected signal level and the measured level in dB.
- 2.4.3.1.4.4 The isolation must comply throughout the operating band.

2.4.3.1.5 **Impedance matching**

Connect the equipment as shown below.



2.4.3.1.5.1 Tune the RF signal generator to the in-band transmitting frequency to be measured.

2.4.3.1.5.2 Measure the Voltage Standing Wave Ratio (VSWR) with a through line wattmeter.

2.4.3.1.5.3 If the wattmeter does not indicate the VSWR, note the forward and reflected power and calculate the VSWR.

$$(1 + \sqrt{\text{Power reflected} / \text{Power forward}}) / (1 - \sqrt{\text{Power reflected} / \text{Power forward}})$$

2.4.3.1.5.4 The impedance matching must comply throughout the operating band.

2.4.3.1.5.5 Use the same method to measure the impedance at the receiver and antenna terminals.

2.4.3.2 **Combiner**

2.4.3.2.1 **Insertion loss - Rx**

2.4.3.2.1.1 The insertion loss can be measured as explained in clause 2.4.3.1.2.

2.4.3.2.1.2 Fifty-ohm loads must be connected to all open transmitting and receiving ports.

2.4.3.2.1.3 The injected signal level at the antenna port must be low (≤ -80 dBm) to prevent the RF amplifier in the receiving path being saturated.

2.4.3.2.1.4 All the receiving ports must be measured.

2.4.3.2.1.5 The insertion loss must comply throughout the operating band.

2.4.3.2.2 **Insertion loss - Tx**

2.4.3.2.2.1 The insertion loss can be measured as explained in clause 2.4.3.1.3.

2.4.3.2.2.2 Fifty-ohm loads must be connected to all open transmitting and receiving ports.

2.4.3.2.2.3 All the transmitting ports must be measured.

2.4.3.2.2.4 The insertion loss must comply throughout the operating band.

2.4.3.2.3 **Isolation between the transmitting and receiving paths**

2.4.3.2.3.1 The isolation between the transmitting and receiving paths can be measured as explained in clause 2.4.3.1.4.

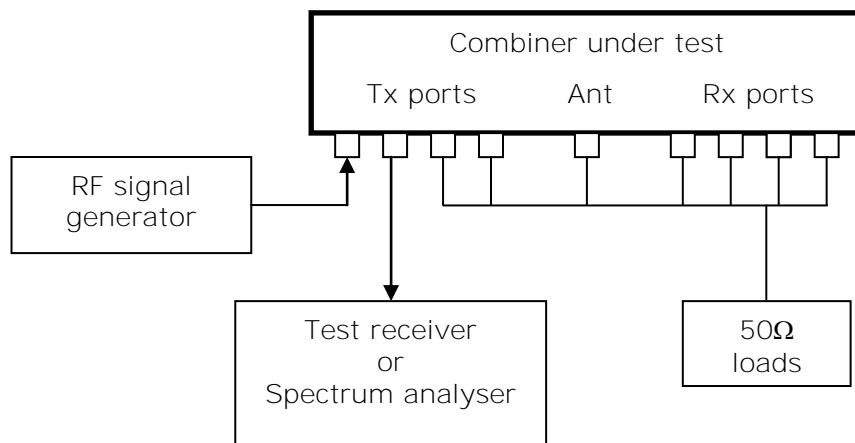
2.4.3.2.3.2 Fifty-ohm loads must be connected to all open transmitting and receiving ports.

2.4.3.2.3.3 All the ports must be measured.

2.4.3.2.3.4 The isolation must comply throughout the operating band.

2.4.3.2.4 **Isolation between the transmitting ports**

Connect the equipment as shown below



- 2.4.3.2.4.1 Tune the RF signal generator and the test receiver/spectrum analyser to the in-band transmitting frequency to be measured.
- 2.4.3.2.4.2 Fifty-ohm loads must be connected to the antenna- and all open transmitting and receiving ports.
- 2.4.3.2.4.3 Inject the signal at the first transmitting port (high level) and measure the level at the other transmitting ports.
- 2.4.3.2.4.4 Repeat step 2.4.3.2.4.3 when injecting the signal at ports 2 to 4.
- 2.4.3.2.4.5 Calculate the isolation by determining the difference between the injected signal level and the measured level in dB.
- 2.4.3.2.4.6 The isolation must comply throughout the operating band.

2.4.3.2.5 **Impedance matching**

- 2.4.3.2.5.1 The impedance matching can be determined as explained in clause 2.4.3.1.5.
- 2.4.3.2.5.2 Fifty-ohm loads must be connected to all open transmitting and receiving ports.
- 2.4.3.2.5.3 All the transmitting ports must be measured.

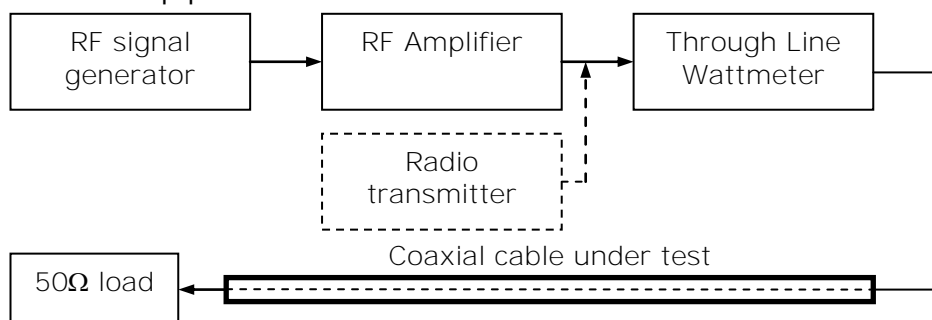
Note: **Do not** use this method to determine the impedance matching at the receiver and antenna terminals. If a problem is suspected, the combiner must be sent to a facility with the proper equipment and competency.

2.4.4 **Coaxial Cable**

2.4.4.1 **Impedance matching**

The best method to measure the impedance and insertion loss of the coaxial cable is to use a Transmission Line Analyser. This measuring method will not be covered in this document.

Connect the equipment as shown below.

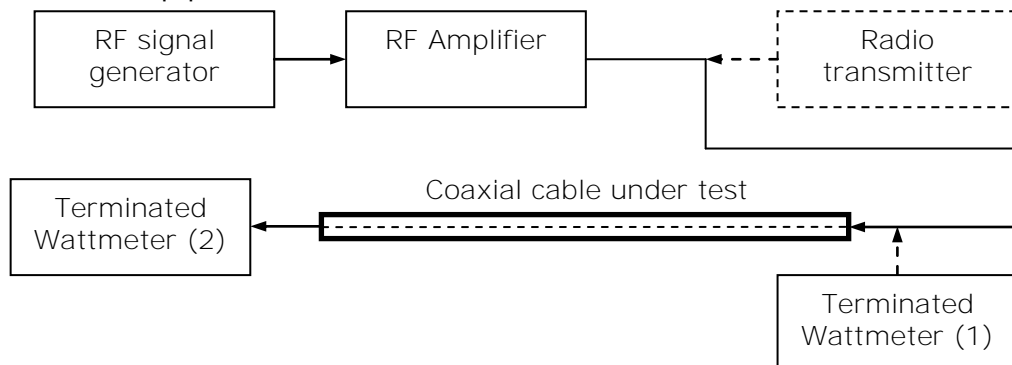


- 2.4.4.1.1 Tune the RF signal generator to the in-band transmitting frequency.
- 2.4.4.1.2 Measure the Voltage Standing Wave Ratio (VSWR) with a through line wattmeter.
- 2.4.4.1.3 If the wattmeter does not indicate the VSWR, note the forward and reflected power and calculate the VSWR (see clause 2.4.3.1.5.3).

- 2.4.4.1.4 Tune the RF signal generator to the in-band receiving frequency.
- 2.4.4.1.5 Measure the Voltage Standing Wave Ratio as above.
- 2.4.4.1.6 The impedance matching must comply throughout the operating band.
- 2.4.4.1.7 Record the worst case as the impedance matching.

2.4.4.2 **Insertion loss**

Connect the equipment as shown below.



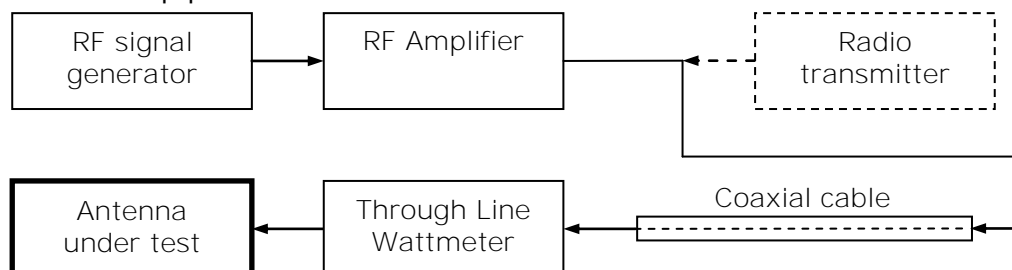
- 2.4.4.2.1 Tune the RF signal generator to the in-band transmitting frequency.
- 2.4.4.2.2 Measure the power at the near end of the coaxial cable using the terminated wattmeter (1).
- 2.4.4.2.3 Measure the power at the far end of the coaxial cable using the same terminated wattmeter (2).
- 2.4.4.2.4 Calculate the insertion loss by determining the difference between the power levels measured in dB.
- 2.4.4.2.5 Tune the RF signal generator to the in-band receiving frequency.
- 2.4.4.2.6 Repeat the measurements as above.
- 2.4.4.2.7 The insertion loss must comply throughout the operating band.
- 2.4.4.2.8 Record the highest loss measured, as the insertion loss.

2.4.5 **Antenna**

2.4.5.1 **Impedance matching**

The best method to measure the impedance of the antenna is to use a Transmission Line Analyser. This measuring method will not be covered in this document.

Connect the equipment as shown below.



- 2.4.5.1.1 The impedance matching of the coaxial cable (clause 2.4.4.1) must be measured first.
- 2.4.5.1.2 Tune the RF signal generator to the in-band transmitting frequency.
- 2.4.5.1.3 Measure the Voltage Standing Wave Ratio (VSWR) with a through line wattmeter.
- 2.4.5.1.4 If the wattmeter does not indicate the VSWR, note the forward and reflected power and calculate the VSWR (see clause 2.4.3.1.5.3).
- 2.4.5.1.5 Tune the RF signal generator to the in-band receiving frequency.
- 2.4.5.1.6 Measure the Voltage Standing Wave Ratio as above.

2.4.5.1.7 The impedance matching must comply throughout the operating band.

2.4.5.1.8 Record the worst case as the impedance matching.

2.4.5.2 **Effective Radiated Power (ERP)**

2.4.5.2.1 The effective radiated power is calculated as follows:

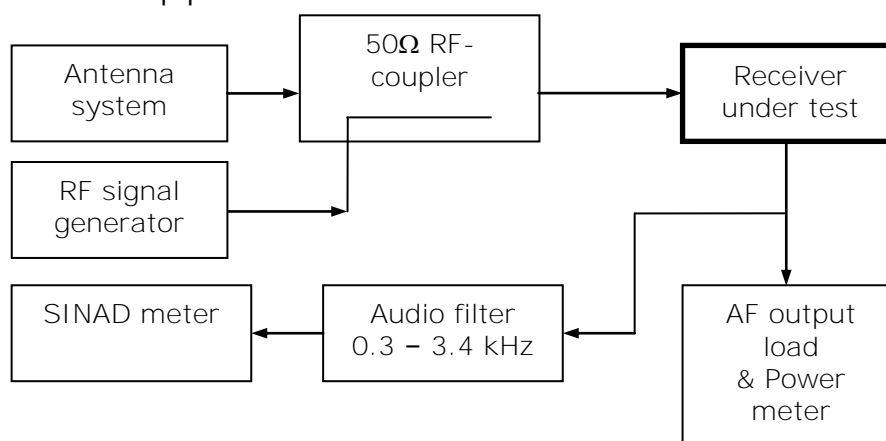
The RF power measured into a 50 Ω load that replaces the antenna, times the gain of the antenna with reference to a Dipole antenna (dBd).

2.4.5.2.2 The following calculation could also be used:

Antenna gain (dBd) - Duplexer/combiner insertion loss (dB) - Coaxial cable insertion loss (dB) + Transmitting power at transmitter (dBm). Convert the result to Watts ($0.001 \times \text{Antilog}(\text{dB}/10)$).

2.4.6 **Receiver Desensitisation (Desensing)**

Connect the equipment as shown below.



2.4.6.1 The transmitting power of all the transmitters must be set correctly.

2.4.6.2 The insertion loss of the RF-coupler must be ≤ 1 dB.

2.4.6.3 Adjust the RF signal generator to produce the standard test signal and apply it to the receiver via the RF-coupler.

2.4.6.4 Reduce the RF signal output level until the SINAD ratio is 12 dB.

2.4.6.5 Note the RF signal level at which the 12 dB SINAD is obtained.

2.4.6.6 Transmit from the other transmitters situated on the site.

2.4.6.7 Note if the SINAD ratio is degrading.

2.4.6.8 If so, while transmitting increase the RF signal output from the generator to obtain a SINAD ratio of 12 dB.

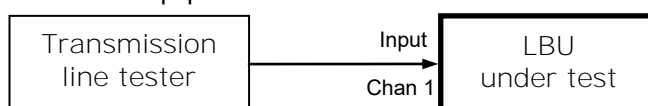
2.4.6.9 Note the RF signal level.

2.4.6.10 Calculate the desensing level by determining the difference between the two measurements in dB.

2.4.7 **Audio Line Branching Unit (LBU)**

2.4.7.1 **Impedance matching**

Connect the equipment as shown below.



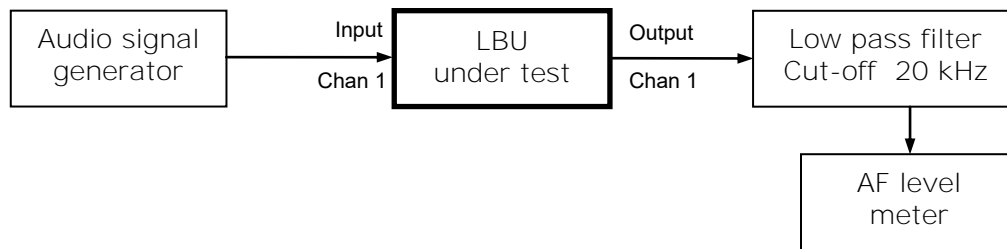
2.4.7.1.1 Switch the power of the LBU on.

2.4.7.1.2 Measure the return loss of the input transformer to determine the impedance matching.

- 2.4.7.1.3 Repeat the measurement to determine the impedance matching of the other input and output terminals.

2.4.7.2 **Audio levels**

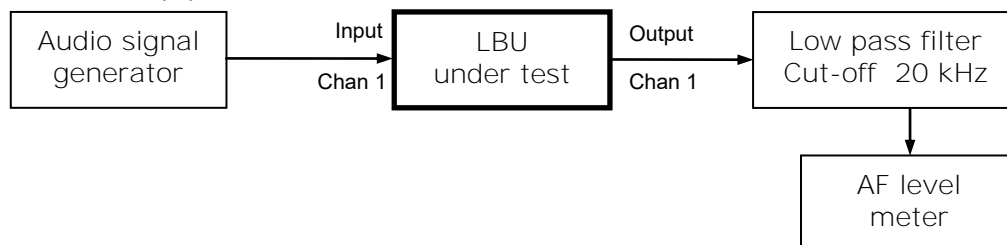
Connect the equipment as shown below.



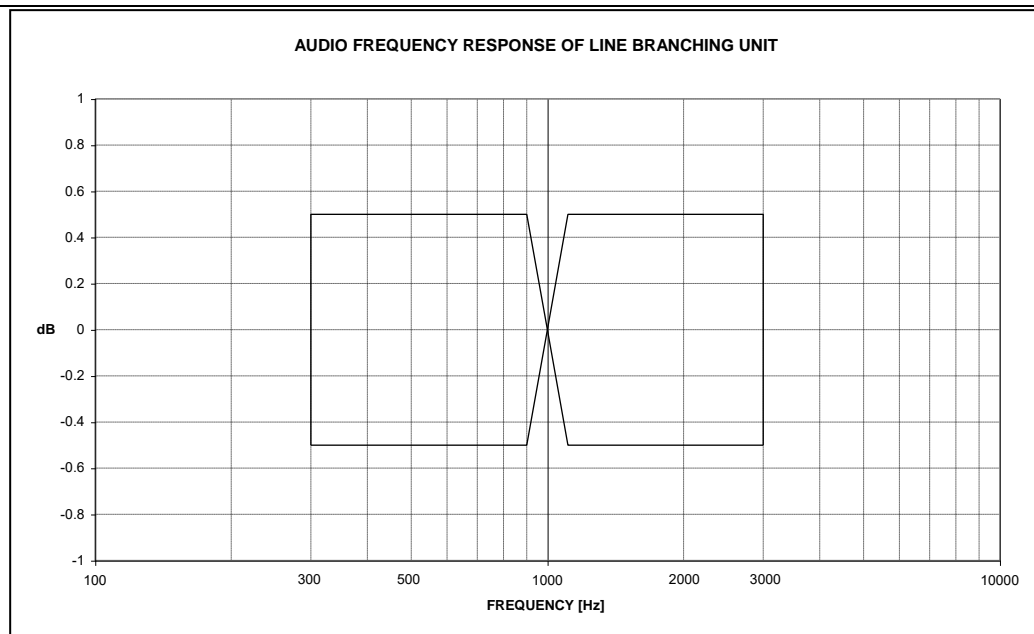
- 2.4.7.2.1 Ensure that the audio signal generator and audio level meter are set to the correct impedance.
- 2.4.7.2.2 Route all the input terminals to all the output terminals. This is required for the tests that follow.
- 2.4.7.2.3 Apply a 1 kHz signal at a level of – 10 dBm into channel 1 of the LBU.
- 2.4.7.2.4 Measure the signal level at the output terminals of the LBU.
- 2.4.7.2.5 Adjust the output levels to obtain – 10 dBm if necessary.
- 2.4.7.2.6 Repeat the measurements with the audio signal applied to the other input terminals.
- 2.4.7.2.7 All output levels should be – 10 dBm without readjustment.

2.4.7.3 **Audio frequency response**

Connect the equipment as shown below.

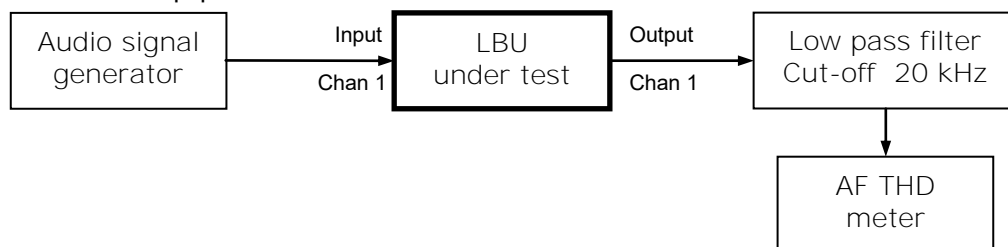


- 2.4.7.3.1 Ensure that all the audio levels are set correctly.
- 2.4.7.3.2 Apply a 1 kHz signal at a level of – 10 dBm into channel 1 of the LBU.
- 2.4.7.3.3 Measure the signal level at the output terminal of channel 1.
- 2.4.7.3.4 While keeping the audio signal level constant vary the frequency from 300 Hz to 3 kHz.
- 2.4.7.3.5 Record the variation of the audio output level in dB with reference to the corresponding level at 1 kHz.
- 2.4.7.3.6 Repeat the measurements with the audio signal applied to the other input terminals.



2.4.7.4 **Audio total harmonic distortion (THD)**

Connect the equipment as shown below.



2.4.7.4.1 Ensure that all the audio levels are set correctly.

2.4.7.4.2 Route all the input terminals to all the output terminals.

2.4.7.4.3 Ensure that the audio signal generator and THD meter are set to the correct impedance.

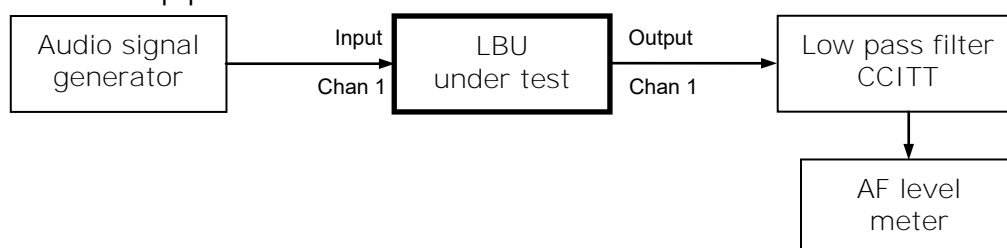
2.4.7.4.4 Apply a 1 kHz signal at a level of – 10 dBm into channel 1 of the LBU.

2.4.7.4.5 Record the audio total harmonic distortion obtained at the output terminals.

2.4.7.4.6 Repeat the measurements with the audio signal applied to the other input terminals.

2.4.7.5 **Audio signal to hum and noise ratio**

Connect the equipment as shown below.



2.4.7.5.1 Ensure that all the audio levels are set correctly.

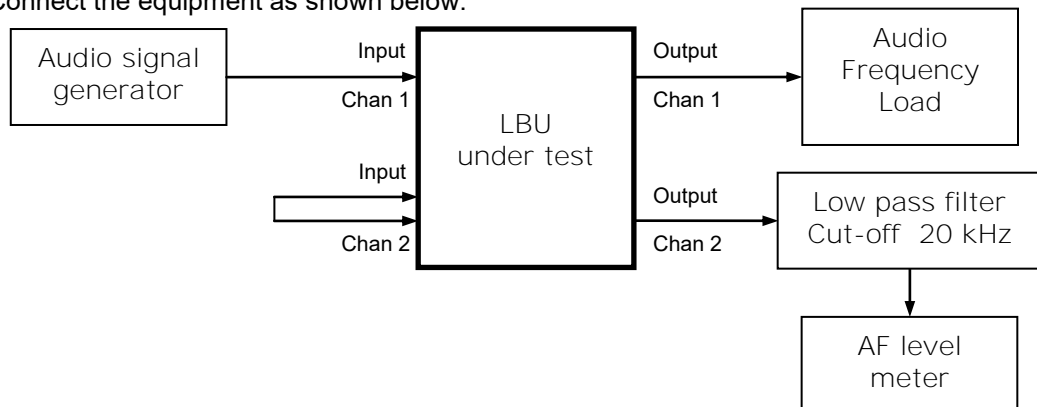
2.4.7.5.2 Route all the input terminals to all the output terminals.

2.4.7.5.3 Apply a 1 kHz signal at a level of – 10 dBm into channel 1 of the LBU.

- 2.4.7.5.4 Short-circuit all the other input terminals.
- 2.4.7.5.5 Measure the signal level at the output terminals of the LBU.
- 2.4.7.5.6 Remove the audio signal generator and short circuit the input terminal (1) of the LBU.
- 2.4.7.5.7 Measure the signal level at the output terminals of the LBU.
- 2.4.7.5.8 Calculate the ratio in dB between the audio output levels obtained with and without the applied audio signal, as the signal to hum and noise ratio.
- 2.4.7.5.9 Repeat the measurements with the audio signal applied to the other input terminals.
- 2.4.7.5.10 Record the lowest ratio as the result.

2.4.7.6 **Channel cross talk**

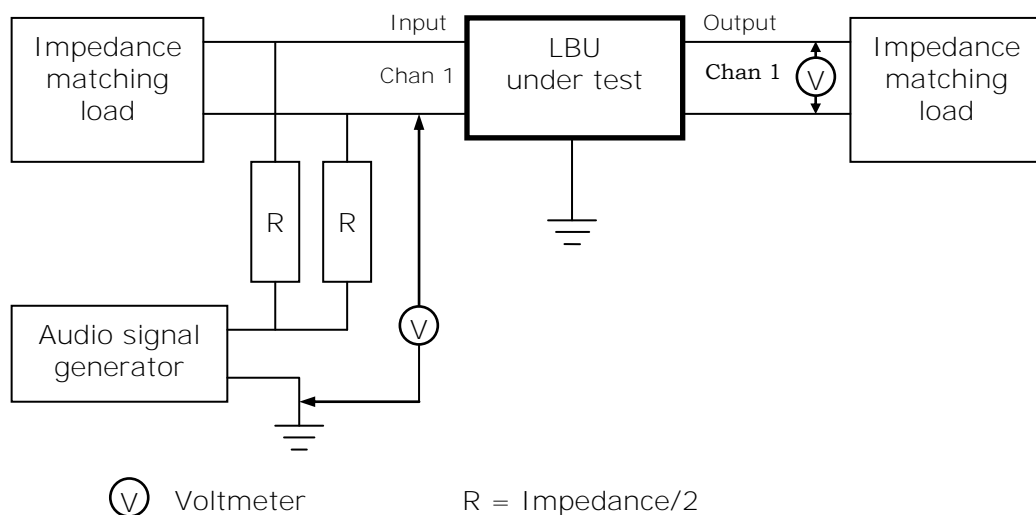
Connect the equipment as shown below.



- 2.4.7.6.1 Route all the channels to operate separately e.g. Channel 1 input terminal to channel 1 output terminal; channel 2 input terminal to channel 2 output terminal; etc.
- 2.4.7.6.2 Ensure that all the level settings are correct for each channel.
- 2.4.7.6.3 Inject a 1 kHz signal at a level of – 10 dBm into channel 1 of the LBU.
- 2.4.7.6.4 Short-circuit all the other input terminals.
- 2.4.7.6.5 Calculate the ratio in dB between the audio input signal level and that measured at the other output terminals, except that of channel 1.
- 2.4.7.6.6 Repeat the measurements with the audio signal injected into the other input terminals.
- 2.4.7.6.7 Record the worst case as the result.

2.4.7.7 Common-mode rejection ratio

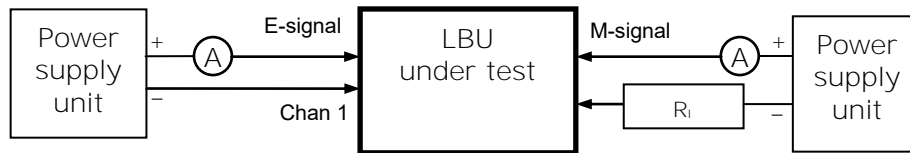
Connect the equipment as shown below.



- 2.4.7.7.1 Adjust the amplification of the LBU to unity gain.
If the gain cannot be adjusted, measure the input and output voltage levels and calculate the gain.
- 2.4.7.7.2 Set the audio signal generator frequency to 1 kHz and set the output impedance to HIGH.
- 2.4.7.7.3 Increase the signal output level of the audio generator till the level measured on the output line of the LBU, also increases.
- 2.4.7.7.4 Record the input and output signal voltage levels.
- 2.4.7.7.5 If the LBU is set for unity gain, calculate the ratio in dB between the audio input signal level and that measured on the output line of the LBU.
OR
- 2.4.7.7.6 If the LBU has a gain, calculate the ratio by dividing the input voltage level by the output voltage level.
Multiply the calculated ratio with the gain of the LBU under tests and express the ratio in dB.
e.g. Input voltage/Output voltage = R:1
R x Gain = T:1
 $\text{dB} = 20\text{Log}_{10}(T/1)$
- 2.4.7.7.7 Repeat the measurement on the other channels.
- 2.4.7.7.8 Record the worst case as the result.

2.4.7.8 **E & M-signalling**

Connect the equipment as shown below.



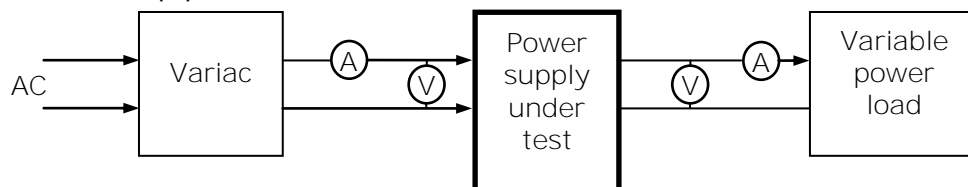
(A) Ammeter

- 2.4.7.8.1 Route the E-signal of channel 1 to activate the M-signal of all the channels.
- 2.4.7.8.2 The value of the load resistor R_L must be such to permit a current flow of 8 mA to 10 mA.
- 2.4.7.8.3 Apply a DC voltage at the appropriate level to the M signal terminal.
- 2.4.7.8.4 Apply a DC voltage at the appropriate level to the E signal terminal and measure the current.
- 2.4.7.8.5 Measure the current flow at all the M-signal terminals.
- 2.4.7.8.6 Reverse the voltage polarity at the E & M-signal terminals and repeat the test.
- 2.4.7.8.7 Repeat the above tests with other routing combinations.
- 2.4.7.8.8 Measure the resistance between the E & M-signal terminals and the LBU earth. The resistance must be infinity.

2.4.8 **Power Supply & Battery Charger Unit**

2.4.8.1 **Output voltage regulation**

Connect the equipment as shown below.



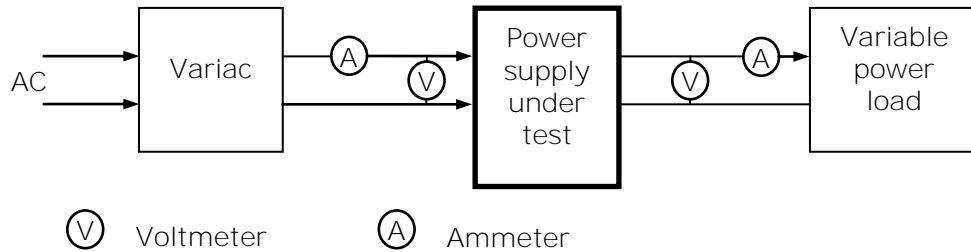
(V) Voltmeter

(A) Ammeter

- 2.4.8.1.1 Intermittent:
 - 2.4.8.1.1.1 Adjust the Variac to obtain the nominal input voltage to the power supply/battery charger.
 - 2.4.8.1.1.2 Vary the power load to obtain a current drain from 0 ampere to maximum current while recording the output voltage.
 - 2.4.8.1.1.3 The measurement shall be made under the extreme test conditions as well.
- 2.4.8.1.2 Continuous:
 - 2.4.8.1.2.1 Adjust the Variac to obtain the nominal input voltage to the power supply/battery charger.
 - 2.4.8.1.2.2 Set the power load to obtain the maximum current drain and record the output voltage level for a period of four hours.

2.4.8.2 **Efficiency**

Connect the equipment as shown below.

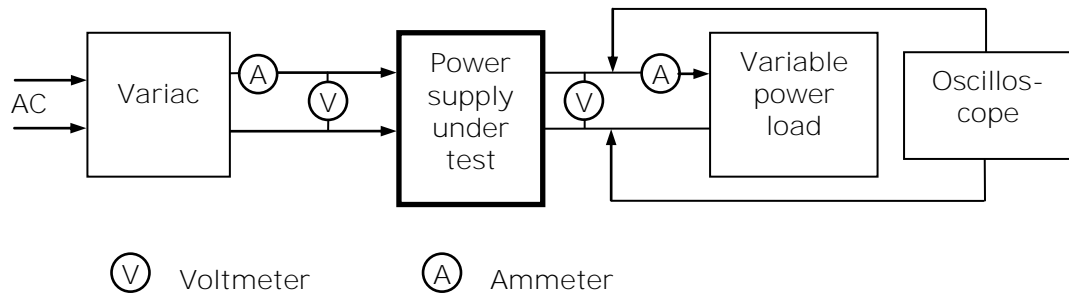


- 2.4.8.2.1 Adjust the Variac to obtain the nominal input voltage to the power supply/battery charger.
- 2.4.8.2.2 Vary the power load to obtain a current drain from 0 ampere to maximum current while recording the input and output voltages and currents.
- 2.4.8.2.3 Calculate the efficiency in percentage.

$$\text{Efficiency} = (\text{Power out} / \text{Power in}) \times 100 \%$$
- 2.4.8.2.4 Repeat the test with the specified minimum and then the maximum input voltage to the power supply/battery charger.
- 2.4.8.2.5 Record the worst case as the result.

2.4.8.3 **Output voltage ripple**

Connect the equipment as shown below.

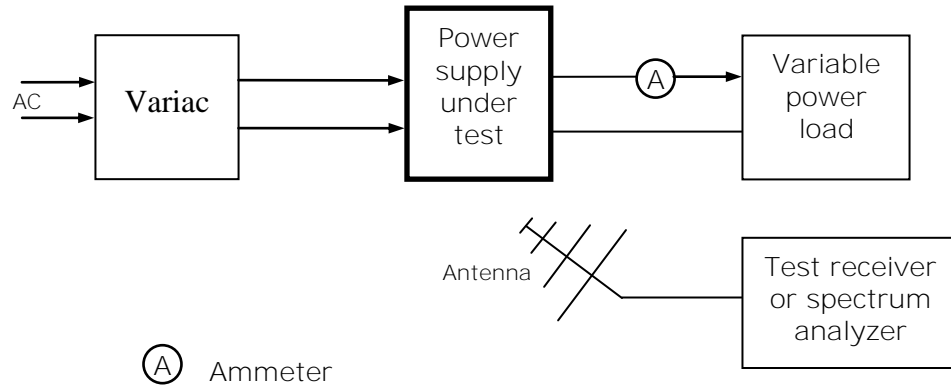


- 2.4.8.3.1 Adjust the Variac to obtain the nominal input voltage to the power supply/battery charger.
- 2.4.8.3.2 Vary the power load to obtain a current drain from 0 ampere to maximum current while recording the output voltage ripple with the oscilloscope.
- 2.4.8.3.3 The measurement shall be made under the extreme test conditions as well.
- 2.4.8.3.4 Record the worst case as the result.

Note: Some battery chargers apply high instantaneous pulses of short duration. In a Lead-acid battery, this breaks down lead-sulphate crystals, thus extending the battery service life. This function must be noted.

2.4.8.4 Radiation of spurious frequencies

Connect the equipment as shown below.



2.4.8.4.1 This test has to be performed inside a Faraday cage (RF shielding).

2.4.8.4.2 All the instruments and electrical equipment inside the cage not used for the test have to be switched off to prevent interference with the frequencies to be scanned. Ideally, all the equipment except the power supply under test and the antenna should be on the outside of the cage.

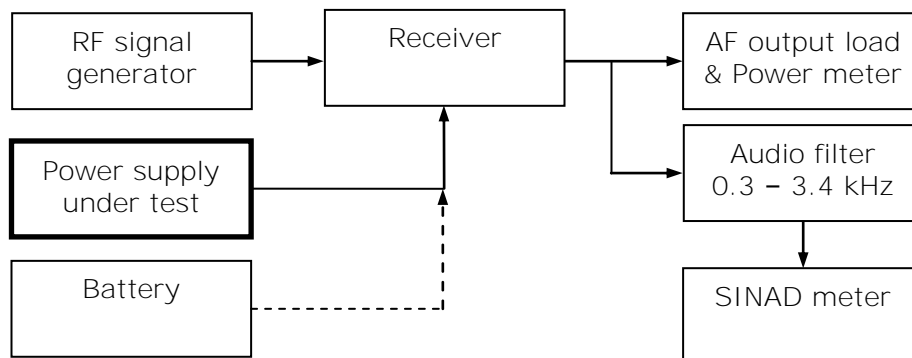
2.4.8.4.3 The measuring antenna to be placed 1 m from the power supply/battery charger.

2.4.8.4.4 Vary the power load to obtain a current drain from 0 ampere to maximum current while scanning the radio-operating band (455.0000 MHz to 467.0000 MHz).

2.4.8.4.5 Record the frequencies and levels of all the detected signals.

2.4.8.5 Desensing of receiver (conductive)

Connect the equipment as shown below.



2.4.8.5.1 Use a battery to power the receiver.

2.4.8.5.2 Adjust the RF signal generator to produce a standard RF test signal.

2.4.8.5.3 Adjust the volume control of the radio to give SOP.

2.4.8.5.4 Reduce and record the RF signal input level at which 12 dB SINAD ratio is obtained.

2.4.8.5.5 Replace the battery with the power supply under test.

2.4.8.5.6 The length of the power leads to the radio must be 1.0 m.

2.4.8.5.7 Place the power supply as far as possible from the radio.

2.4.8.5.8 Readjust and record the RF signal output level at which 12 dB SINAD ratio is obtained.

2.4.8.5.9 Record the difference in dB between the recorded RF signal levels as the receiver desensing.

2.5 Trunking functional tests

Programme the radio under test with the correct trunking parameters and with a validated number on the trunk network.

1.5.1 **On instrument**

Connect the radio under test to the trunk enabled instrument.

1.5.1.1 Registration

Switch the radio on and ensure that it register on the instrument. The radio will display a registered indication and the instrument will display the radio's trunking number.

1.5.1.2 Make a call with the same prefix number (e.g. 2052001203 to 2052001204).

The instrument will display the called radio's prefix and the *derived* identification number.

1.5.1.3 Make a call with the interprefix number (e.g. interfleet call: 2052001203 to 2142001301).

The instrument will display the called radio's prefix and the *derived* identification number.

1.5.1.4 Short form dialling (e.g. 204)

Repeat 1.5.1.2 using the short form dialling.

1.5.1.5 PSTN call (e.g. 0117748227)

The dialled number must be presided with 0 (e.g. 00117748227). The instrument will display the called number.

1.5.1.6 Call the radio under test

Make a call to the radio from the instrument.

1.5.1.7 Handoff

Change the control channel on the instrument and ensure that the radio re-register on the new channel.

1.5.2 **On trunk system**

Two trunk radios and a PSTN telephone must be available and dedicated to the tests.

One trunk radio must be programmed with the same prefix number as the radio under test and the second radio with an interprefix number.

1.5.2.1 Registration

Switch the radio under test on and ensure that it register on the trunk system.

The radio will display a registered indication.

1.5.2.2 **Local call**

Ensure that all the trunk radios are registered on the same local site.

1.5.2.2.1 Call a radio with the same prefix number

Call the radio having the same prefix number. Have a conversation with the second party.

1.5.2.2.2 Call a radio with an interprefix number

Call the radio having the interprefix number. Have a conversation with the second party.

1.5.2.2.3 Short form dialling

Repeat 1.5.2.2.1 using the short form dialling. Have a conversation with the second party.

1.5.2.2.4 Call the radio under test

Make a call to the radio under test from the other radios.

1.5.2.3 **Intersite call**

Move the radio under test to a distant site.

Ensure that the radio is registered on that site.

1.5.2.3.1 Call a radio with the same prefix number

Call the radio having the same prefix number. Have a conversation with the second party.

1.5.2.3.2 Call a radio with an interprefix number

Call the radio having the interprefix number. Have a conversation with the second party.

1.5.2.3.3 Short form dialling

Repeat 1.5.2.3.1 using the short form dialling. Have a conversation with the second party.

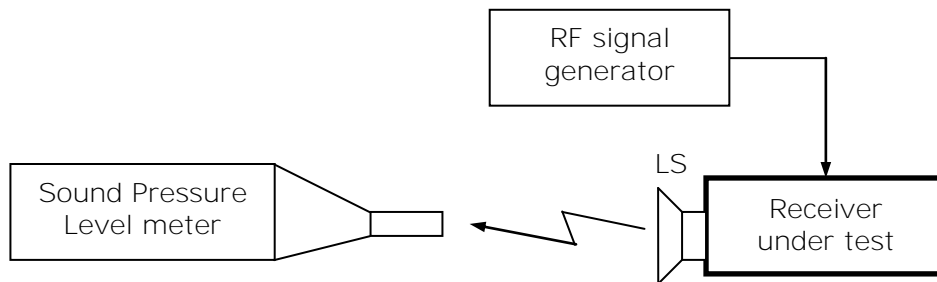
- 1.5.2.3.4 PSTN call
Call the PSTN telephone. Have a conversation with the second party.
- 1.5.2.3.5 Call the radio under test
Call the radio under test from the other radios. Have a conversation with the second party.
- 1.5.2.3.6 Handoff
Travel between sites and ensure that the radio under test re-register on the different sites.

Note: Call failures must be confirmed through different trunk sites.

2.6 Acoustical Measurements

2.6.1 Receiver loudspeaker sound pressure level

Connect the equipment as shown below.

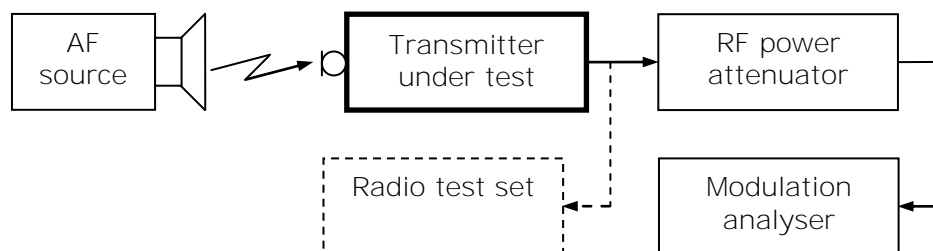


- 2.6.1.1 Adjust the RF signal generator to produce a standard RF test signal.
- 2.6.1.2 Increase the modulation to 2.5 kHz (maximum system modulation).
- 2.6.1.3 Adjust the volume control of the radio to obtain MUOP.
- 2.6.1.4 Place the Sound Pressure Level (SPL) meter at a distance of 300 mm in front of the radio loudspeaker.
- 2.6.1.5 Record the SPL in dB(A).

Note: Sound wave reflections should be kept to a minimum by measuring in an open area.

2.6.2 Transmitter modulation (deviation)

Connect the equipment as shown below.



- 2.6.2.1 Ensure that the transmitter modulation limiting has been set correctly (see clauses 2.3.7).
- 2.6.2.2 Generate a 1 kHz tone with the AF source at a level of 80 dB(A), measured at the radio microphone.
- 2.6.2.3 Transmit and record the measured deviation.

Note: Sound wave reflections should be kept to a minimum by measuring in an open area.

3. RELEVANT DOCUMENTATION**APPLICABLE**

DOCUMENT NO.	DESCRIPTION	LOCATION
SANS 300086-1:2005	Electromagnetic compatibility and Radio Spectrum Matters (ERM); Land Mobile Service; Radio equipment with an internal or external RF connector intended primarily for analogue speech Part 1: Technical characteristics and methods of measurement.	External

RELEVANT

DOCUMENT NO.	DESCRIPTION	LOCATION

END OF DOCUMENT



RAIL NETWORK
TELECOMS

REGISTER

EVALUATED RADIO EQUIPMENT
(LIST OF APPROVED RADIO EQUIPMENT)
Quality Assurance National Test Centre

Author: Chief Engineering Technician K S Mniniyo
Rail Network Telecoms - Quality Assurance
National Test Centre

A handwritten signature in black ink, appearing to read "K S Mniniyo", written over a horizontal line.

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Date: 31 October 2023

Circulation Restricted To: Transnet Freight Rail
Transnet and Relevant Third Parties

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CONTENTS

- I. Distribution 3
- II. Document Version Control 3
- III. List of Abbreviations and Definitions 4
- 1. SCOPE 6
- 2. COMMENT 6
- 3. LIST OF APPROVED EVALUATED RADIO EQUIPMENT 7
- 4. APPLICABLE DOCUMENTATION 20

I. Distribution

Once updated, a copy of the latest revision will be published in the document management system in use. An e-mail to this effect will be sent to the relevant personnel or heads of department.

II. Document Version Control

VERSION NO.	DATE ISSUED	ISSUED BY	HISTORY DESCRIPTION
1.0	5 August 2010	Infrastructure Telecoms	First document
2.0	6 October 2010	Infrastructure Telecoms	Update list of evaluated radio equipment
3.0	3 May 2011	Infrastructure Telecoms	Update list of evaluated radio equipment
4.0	18 January 2012	Infrastructure Telecoms	Update list of evaluated radio equipment. Apply new standard. Remove discontinued items.
4.1	17 April 2012	Infrastructure Telecoms	Update list of evaluated radio equipment.
4.2	1 August 2012	Rail Network Telecoms	Change document heading & company registration number. Update list of evaluated radio equipment.
4.3	17 September 2012	Rail Network Telecoms	Add abbreviations and definitions. Change Handheld Radio heading and comment.
4.4	13 June 2013	Rail Network Telecoms	Update list of evaluated radio equipment. Add IP Rating explanation.
5.0	22 May 2014	Rail Network Telecoms	Change Handheld Radio heading and comment. Update list of evaluated radio equipment.
5.1	24 June 2014	Rail Network Telecoms	Update list of evaluated radio equipment.
5.2	15 August 2014	Rail Network Telecoms	Update list of evaluated radio equipment.
5.3	15 Sep 2014	Rail Network Telecoms	Update list of evaluated radio equipment.
5.3.1	18 Sep 2014	Rail Network Telecoms	Update list of evaluated radio equipment.
5.3.2	16 Jan 2015	Rail Network Telecoms	Update list of evaluated radio equipment. Add Battery service life
5.3.3	10 January 2017	Rail Network Telecoms	Update list of evaluated radio equipment.
5.3.4	24 July 2018	Rail Network Telecoms	Update list of evaluated radio equipment.

5.3.5	08 July 2019	Rail Network Telecoms	Update list of evaluated radio equipment.
5.3.5	03 September 2019	Rail Network Telecoms	Update list of evaluated radio equipment.
5.3.6	29 April 2020	Rail Network Telecoms	Update list of evaluated radio equipment.
5.3.6	14 May 2021	Rail Network Telecoms	Added Kopano remote base station evaluated and passed in 2012
5.3.7	20 June 2022	Rail Network Telecoms	Update list of evaluated radio equipment.
5.3.8	08 February 2023	Rail Network Telecoms	Update list of evaluated radio equipment.
5.3.8	08 February 2023	Rail Network Telecoms	Update list of evaluated radio equipment.
5.3.9	23 October 2023	Rail Network Telecoms	Update list of evaluated radio equipment.

III. List of Abbreviations and Definitions

ABBREVIATIONS	DESCRIPTION
A	Ampere
dB(A)	Sound Pressure A-weighted in decibel.
DC	Direct current
Fn	Function
GHz	Gigahertz
ICASA	Independent Communications Authority of South Africa
IP	Ingress Protection'
IR	Iridium
kPa	Kilo Pascal
m	Metre
MHz	Megahertz
Mic	Microphone
MIMO	Multi-in & Multi-out
mm	Millimetre
PMU	Power Management Unit
PSU	Power supply unit
RF	Radio frequency
Rx	Radio receiver
SPL	Sound Pressure Level
TFR	Transnet Freight Rail
Tx	Radio transmitter
V	Voltage

DEFINITIONS	DESCRIPTION
VERSION	A particular form of something, which varies slightly from other forms of the same thing.
Base Radio Stations	A Radio station designed to be installed in a fixed location and performing the function of a repeater/enhancer.
Fixed Radio Station	It is a fixed radio station installed in an office or control room, fitted with an external antenna.
Handheld/Portable Radio	A Radio designed to be carried by or on a person.
Mobile Radio	A radio designed for installation in a surface vehicle and capable of operating while the vehicle is in motion and while it is stationary.
A-weighted	It is a network that weights an audio signal in a manner, which approximates to an inverted equal loudness contour (it approximates the human ear's response to sound) .
Safe Working	It refers to any working where the safety of people and equipment rely on radio communication.
IP Rating IP5X	Dust protected: Ingress of dust is not entirely prevented, but it must not enter in sufficient quantity to interfere with the satisfactory operation of the equipment; complete protection against contact
IP Rating IP6X	Dust tight: No ingress of dust; complete protection against contact
IP Rating IPX4	Splashing of water: Water splashing against the enclosure from any direction shall have no harmful effect. Test duration: 5 minutes. Water volume: 10 litres per minute Pressure: 80–100 kPa
IP Rating IPX6	Powerful water jets: Water projected in powerful jets (12.5 mm nozzle) against the enclosure from any direction shall have no harmful effects. Test duration: at least 3 minutes. Water volume: 100 litres per minute Pressure: 100 kPa at distance of 3 m
IP Rating IPX7	Immersion up to 1 m: Ingress of water in harmful quantity shall not be possible when the enclosure is immersed in water under defined conditions of pressure and time (up to 1 m of submersion). Test duration: 30 minutes. Immersion at depth of at least 1 m measured at bottom of device, and at least 15 cm measured at top of device

1. SCOPE

- 1.1 This document lists the radio equipment that complies with the Act No. 36 of 2005 Electronic Communications Act as well as the Transnet Freight Rail technical standard BBD8635 Transnet Freight Rail technical standard BBD8635 ver. 8.2 extracted from ETSI EN 300 086 as well as the BBG 1946 Ver. 4 & BBF 2516 Ver. 5 specifications.
- 1.2 This document is a reference guide for acquiring ICASA and TFR type approved radio equipment. Where the ICASA type approval certificate number does not appear in the list, that equipment does not require a type approval certificate.
- 1.3 Radio equipment that does not comply with the TFR standard is listed in a separate document, can be released upon request to facilitate decision making and tender processes.

2. COMMENT

- 2.1 **A supplier's radio not appearing** on the list, but having ICASA type approval, can be submitted during Request for Proposal to supply and deliver radio equipment issued by TFR Telecoms yearly.

3. LIST OF APPROVED EVALUATED RADIO EQUIPMENT

3.1 HANDHELD/PORTABLE RADIOS

MAKE	MODEL	Open channel APPROVED	Trunk APPROVED	TFR APPROVAL NUMBER	IP RATING	ICASA TYPE CERTIFICATE	Battery service life	COMMENTS
HYTERA	PD685	Yes	Yes	QA-NTC020/19	IP 67	TA-2016/3527	n.a.	Software version number V8.05.06.008 EMS should be used when programming this portable radio. 1024 Conventional channels 64 zones consisting of 256 channels per zone Full Keypad with auto lock function Display
HYTERA	PD-705	Yes	No	QA-NTC015/14	IP 67	TA-2013/106	03:55	Firmware version number 6.05.07.105SA should be used when programming this portable radio. 1024 Conventional channels No Keypad No Display
HYTERA	PD785G	Yes	Yes	QA-NTC013/19	IP 67	TA-2011/1385	n.a.	Software version number V8.05.06.008 EMS should be used when programming this portable radio. 1024 Conventional channels 64 zones consisting of 16 channels per zone Full Keypad with auto lock function Display
HYTERA	X1p	Yes	Yes	QA-NTC015/19	IP 67	TA-2016/094	n.a.	Firmware version number V8.01.02.002 EM5 should be used when programming this portable radio. 1024 Conventional channels 64 zones consisting of 16 channels per zone Full Keypad with auto lock function Display
Icom	IC-F4032T	Yes	No	QA-NTC009/14	IP 67	TA-2012/251	05:08	128 Conventional channels Full Keypad Programmable lock Display Radio discontinued – replaced with IC-F2000T

Icom	IC-F4262DT	Yes	No	QA-NTC013/14	IP 67	TA-2012/753	04:57	512 Conventional channels Full Keypad Programmable lock Display. Radio discontinued – replaced with IC-F4400D
Kenwood	NX 300E	Yes	Yes	QA-NTC011/11	IP 67	TA-2013/2240	03:57	512 Conventional channels Full Keypad Programmable lock Display
Kenwood	NX 300E4	Yes	Yes	QA-NTC011/11	IP 54/ 55/67	TA-2009/120	03:57	512 Conventional channels Limited Keypad Programmable lock Display
Kenwood	NX 300GE	Yes	Yes	QA-NTC002/19	IP 54/ 55/67 MIL-STD- 810-C/D/E/F	TA-2013/2240	n.a.	Software version number KPG 111d, firmware ver. 5.21 512 Conventional channels Full Keypad with key lock function Display
Kenwood	NX3220EX	Yes	No	TFR-ICTM-T-OA- NTC004/23	IP 67	TA-2017/1415	n.a.	Software KPG-3D V3.30 with test/tuning Fn 1000 optional channels 128 zones consisting of 250 channels per zone. Radio operates in Digital or Analogue mode. Full Keypad with auto lock function Display NB: The program needs to be authenticated online with a license key and is limited to 1 PC installation. Intrinsically safe VHF digital radio
	NX 3320E1	Yes	No Firmware not compatible with MPT 1327 trunk mode	QA-NTC003/19 ver. 1	IP 67	TA-2017/1416	n.a.	Software version number KPG-3D V1.40 with test/tuning Fn should be used when programming this portable radio. 250 Conventional channels 128 zones consisting of 250 channels per zone 1000 optional channels Full Keypad with auto lock function Display. Approved radio for Point switching

Kenwood	NX 3320E2	Yes	No Firmware not compatible with MPT 1327 trunk mode	QA-NTC004/19	IP 67 & MIL-STD-810-C/D/E/F/G	TA-2017/1416	n.a.	Software version number KPG-3D V1.40 with test/tuning Fn should be used when programming this portable radio. 250 Conventional channels 128 zones consisting of 250 channels per zone 1000 optional channels 4-way Directional-pad (D-pad) with auto lock function Display <i>Approved radio for Point switching</i>
Simoco	SRP9180	Yes	Yes	QA-NTC005/19	IP67	TA-2010/444	n.a.	1000 Conventional channels Full Keypad with key lock function Display <i>Quality and durability problems rectified by re-designing the outer radio casing.</i>
Tait	TP3350	Yes	No	QA-NTC007/19	IP67	TA-2018/3953	n.a.	TP3000 Software version number V1.12.009 should be used when programming this portable radio. 2000 Conventional channels 250 Zones with digital & analogue channels Full Keypad with key lock function Display
Tait	TP8110	Yes	No	QA-NTC005/13	IP67	TA-2007/1060	04:20	16 Conventional channels No Keypad No Display <i>Radio in the process of being discontinued</i>
Tait	TP8115	Yes	No	QA-NTC005/13	IP67	TA-2007/1060	04:20	128 Conventional channels Limited Keypad Display. <i>Radio in the process of being discontinued</i>
Tait	TP8120	Yes	No	QA-NTC005/13	IP67	TA-2007/1060	04:20	350 Conventional channels Full Keypad Programmable lock Display <i>Radio in the process of being discontinued</i>

Tait	TP8135	Yes	Yes	QA-NTC005/13	IP67	TA-2007/1060	04:20	100 Conventional channels Limited Keypad Programmable lock Display Only 100 Alphanumeric Presets Trunk numbers. Radio in the process of being discontinued
Tait	TP8140	Yes	Yes	QA-NTC005/13	IP67	TA-2007/1060	04:20	100 Conventional channels Full Keypad Programmable lock Display Radio in the process of being discontinued
Tait	TP9360-H5	Yes	Yes	QA-NTC006/19	IP67	TA-2013/2157	n.a.	TP9300 programming application should be used when programming this portable radio. UHF Digital Transceiver 1500 Conventional channels 100 Zones consisting of 253 channels per zone Full Keypad with key lock function Display Radio intrinsically safe (Atex radio)
Tait	TP9361-HB Atex	Yes	Yes	QA-NTC006/19 Ver.1	IP67	TA-2013/2157	n.a.	TP9300 programming application should be used when programming this portable radio. UHF Digital Transceiver 1500 Conventional channels 100 Zones consisting of 253 channels per zone Full Keypad with key lock function Display Radio intrinsically safe (Atex radio)

3.2 MOBILE RADIOS

MAKE	MODEL	Open channel APPROVED	TRUNKED APPROVED	TFR APPROVAL NUMBER	ICASA TYPE APPROVAL CERTIFICATE	COMMENTS
Hytera	MD785G	Yes	Yes	QA-NTC003/20	TA-2013/105	
Icom	IC-F6022	Yes – Condition apply	No	QA-NTC003/16	TA-2009/800	Frequency allocation to be considered when distributing the radios – refer to radio report QA-NTC003/16 comments.
Kenwood	Nexedge NX700	Yes	Not applicable	QA-NTC003/12	TA-2009/117	VHF mobile radio
Kenwood	Nexedge NX800	Yes	Yes	QA-NTC005/17 v1	TA-2009/118	
Kenwood	TK 8102	Yes – Condition apply	Not applicable	Rep-00089/07	TA-2003/311	Not for safe working operations. General use only.
Kenwood	TK 8180	Yes	Yes	QA-NTC022/05	TA-2004/765	
Kenwood	TK-8302	Yes	No	QA-NTC001/18 v1	TA-2009/1422	Frequency allocation to be considered when distributing the radios – refer to radio report QA-NTC001/18 comments.
Motorola	GM 340	Yes	Not applicable	QA-NTC021/05	SPLS/RX-87/2002	
Simoco	SRM9020	Yes	Yes	QA-NTC005/12	TA-2011/820	
Tait	TM9315	Yes	Yes	TFR-RNT-QA-NTC001/22 v1	TA-2013/2158	
Tait	TM 9300	Yes	No (Not tested, out of tender scope)	TFR-RNT-QA-NTC001/23 TFR-RNT-QA-NTC002/23	TA-2013/2158	
Tait	TM8254	Yes	Yes	Rep-00044/06	TA-2004/285	Radio only, no faceplate, to work with inelegant handset. (Train driver handset) Squelch Detect Type to be set to Noise Level.
Tait	TM8255	Yes	Yes	Rep-00044/06	TA-2004/285	Radio with faceplate, to work with Fist microphone with a numeric keypad. Squelch Detect Type to be set to Noise Level.

Tait	TM9315	Yes	Yes	QA-NTC005/20 QA-NTC002/22 QA-NTC003/22 TFR-RNT-QA-NTC001/22 TFR-RNT-QA-NTC002/22	TA-2013/2158	TM9300 TFR Programming Application (35.27.31.1) The radio is IP 54 compliant. The radio needs to be deployed in an area where adjacent channel frequency allocation is closely monitored (refer to recommendations of report QA-NTC005/20) as that can pose interference.
Vertex Standard	EVX5300	Yes	No	QA-NTC009/15	TA-2014/2228	
Vertex Standard	VX4500	Yes – Condition apply	No	QA-NTC002/16	TA-2012/320	Frequency allocation to be considered when distributing the radios – refer to radio report number QA-NTC002/16 comments.

3.3 PORTA PACK RADIO

MAKE	MODEL	APPROVED	TRUNKED APPROVED	TFR APPROVAL NUMBER	ICASA TYPE APPROVAL CERTIFICATE	COMMENTS
Emcom	Tait TM8254	Yes	Yes	QA-NTC006/17 ver. 2	TA-2004/285	The radio porta pack contains a Tait TM8255 mobile radio.

3.4 BASE RADIO STATIONS (Repeaters)

MAKE	MODEL	APPROVED	TRUNKED APPROVED	TFR APPROVAL NUMBER	ICASA TYPE APPROVAL CERTIFICATE	COMMENTS
Simoco	TSF21000	Yes – Condition apply	Yes	QA-NTC020/11	TA-2009/1602	The radio dual power requirement must be converted to a single supply.
Simoco	Xfin Blade TSF 2000 series	Yes	Yes	QA-NTC028/11	TA2009/1602	Power 50 W.
Spectra	MX 800 1 Watt	Yes – Condition apply	Not applicable	Rep 00048/06	TA-2006/090	Acceptable as a link radio. When used as a repeater the talk-through audio circuit to be modified to improve frequency response.
Spectra	MX 800 50 Watt	Yes	Yes	Rep-00068/07	TA-2006/090	Engineering panel must be ordered separately.

Tait	TB-7100	Yes	Not applicable	QA-NTC008/13	TA-2005/572	
Tait	TB-8100 1 W	Yes	Not applicable	Rep-00088/07	TA-2003/198	Squelch Detect Type to be set to Noise Level.
Tait	TB-8100 50 W	Yes	Yes	Rep-00046/07	TA-2003/198	Squelch Detect Type to be set to Noise Level.
Tait	TB-9300 50 W	Yes	Not tested (out of tender scope test request)	QA-NTC010/21	TA-2013/2156	Squelch Detect Type to be set to Noise Level.
Tait	TB-9300 5 W	Yes	Not tested (out of scope test request)	QA-NTC010/21	TA-2013/2156	Practical speech quality field test after repeater installation will be recommended to ensure that there's no impact to the audio quality over a long distance
Tait	TB-9400 50 W	Yes	Not tested (out of scope test request)	QA-NTC007/23	TA-2021/3206	DMR/MPT version dmr-3.40.00.0006 The frequency allocation on shared sites should not include the 8th channel above and below the receiving channel as that could cause interference. Squelch Detect Type to be set to Noise Level.
Tait	TB-9400 5 W	Yes	Not tested (out of scope test request)	QA-NTC007/23	TA-2021/3206	DMR/MPT version dmr-3.40.00.0006 The frequency allocation on shared sites should not include the 8th channel above and below the receiving channel as that could cause interference.

3.5 FIXED STATIONS AND CONSOLES

MAKE	MODEL	APPROVED	TRUNKED APPROVED	TFR APPROVAL NUMBER	ICASA TYPE APPROVAL CERTIFICATE	COMMENTS
SOS	S034	Yes	No	Tel. Rad 035/04	Not applicable.	Based on Tait headset.
Emcom	Kopano	Yes	No	QA-NTC006/21	Not applicable.	Based on Tait headset.

3.6 REMOTE BASE STATIONS

MAKE	MODEL	APPROVED	TRUNKED APPROVED	TFR APPROVAL NUMBER	ICASA TYPE APPROVAL CERTIFICATE	COMMENTS
EMCOM	KOPANO	Yes	N/A	QA-NTC006/12 Ver. 1	Not applicable.	The base unit houses a TM8225 mobile radio (approved radio - report no. REP- 00044)

3.7 RADIOS FOR TELEMETERS

MAKE	MODEL	APPROVED	TFR APPROVAL NUMBER	ICASA TYPE APPROVAL CERTIFICATE	COMMENTS
DAKA	DT155	Yes Condition apply	QA-NTC014/14	0044272	Pre-emphasis is applied at the transmitter, but no de-emphasis at the receiver. Does not comply with the audio frequency response (Tx & Rx) and adjacent channel power. Therefore the radio is acceptable to be used with telemeters (data applications) at Transnet with reference to standard ETSI EN300 113-1.
Friendcom	FC-301/D	Yes RF only	QA-NTC006/11	TA-2009/756	RX audio frequency response not acceptable. Tx audio distortion too high. The RF performance of the radio is acceptable.

3.8 POWER UNITS

MAKE	MODEL	TYPE	APPROVED	TFR APPROVAL NUMBER	COMMENTS
Mean Well	SD 200C-12 48 V to 12 V 16.7 A	DC – DC converter	No	-----	High output voltage noise. No alarms available & no fuse provided in the output line on the converter. QA-NTC004/08.
Mean Well	SD-100D-24 110 V to 24 V 4.2 A	DC – DC converter	No	-----	High output voltage noise. No alarms available & no fuse provided in the output line on the converter. QA-NTC007/08.
Mean Well	SD-100B-12 24 V to 12 V 8.5 A	DC – DC converter	Yes	QA-NTC006/08	
Mean Well	SE-600-24 AC to 24 V DC 25 A	PSU	No	-----	High output voltage noise. QA-NTC010/11.
Mean Well	ESC-240-27	Battery charger	No	-----	Additional filtering to limit maximum ripple voltage. No alarm indicators or monitoring facilities provided with the battery charger. REP 040/06.

Orion	SMC 12R2 24V to 12 V 12 A	DC – DC converter	Yes – Condition apply	QA-NTC026/11	In line fuses to be provided. Not dust and splash proof.
SOS	004C 60V to 48 V 5 A	DC – DC converter	Yes – Condition apply	Tel.Rad 042/03	Fuse to be provided in the output line. No alarms indicators provided on the converter.
SOS	S004CR 110 V to 48 V 5 A	DC – DC converter	Yes – Condition apply	Tel.Rad 042/04	Fuse to be provided in the output line. No alarms available on the converter.
SOS	S004A 48V 48 V to 12 V 12 A	DC – DC converter	Yes – Condition apply	QA-NTC008/08	Input and output terminals to be labelled. Maximum current drain to be indicated. Fuses to be provided in the input and the output lines. No alarms available on the converter.
SOS	S104C 60VLS 48 V 10 A	PSU	Yes	QA-NTC017/11	
SOS	S106B 24 V 20 A	PSU	Yes – Condition apply	QA-NTC015/11	Dust filters to be provided. Have no alarms & load shedding.
SOS	S119A 13.8 V 30 A	PSU	Yes – Condition apply	REP 00092/07	19" enclosure. Output ratings to be indicated on the PSU.
SOS	S130A 13.8 V 30 A	PSU	Yes – Condition apply	REP 00094/08	In line fuse to be included in the battery line if not equipped. Output ratings to be indicated on the PSU.
Tait	PMU 13.8 V 15 A	PSU & Battery Charger	Yes – Condition apply	QA-NTC002/05	The load shed hysteresis to be increased to 2 V.

3.9 BATTERIES

MAKE	MODEL	TYPE	APPROVED	TFR APPROVAL NUMBER	COMMENTS
CSB	TPL121500AFR	Sealed Lead Acid	Yes	QA-NTC003/18	12 V 150 Ah battery 547 mm x 124.8 mm x 320.3 mm

Deltec Power Distributors Pty LTD.	CNFJ-120	Lead Crystal	Yes	-----	12 V 120 Ah battery 405 cm x 170 cm x 240 cm Deployment of batteries to evaluate them in the actual environmental conditions will be required, especially where equipment has to stay powered after load shedding has occurred.
Emcom	EB48-100LifeP04	Sealed Lithium Ion Acid	Yes	QA-NTC008/21	48 V 100 Ah battery 400 mm x 442 mm x 176 mm

3.10 DUPLEXERS & COMBINERS

MAKE	MODEL	APPROVED	TFR APPROVAL NUMBER	COMMENTS
Webb	DU 400/6 Duplexer	Yes	Tel. Rad 001/01	
Webb	4-Port Tx-Rx Combiner	Yes	QA-NTC001/12	All combiners procured must be inspected by QA NTC department (due to combiner critical adjustments) prior delivery to Transnet/TFR regions.

3.11 LINE BRANCHING UNITS

MAKE	MODEL	APPROVED	TFR APPROVAL NUMBER	COMMENTS
Owl II	RP-013	Yes – Condition apply	REP 058/06	

3.12 ANTENNAE

MAKE	MODEL	APPROVED	TFR APPROVAL NUMBER	COMMENTS
Amphenol Jaybeam	7018450 12 dBd Yagi	Yes	QA-NTC010/12	
Amphenol Jaybeam	7536000 6 dBd Collinear	Yes	QA-NTC010/12	
Amphenol Jaybeam	7148455 4 stack dipole	Yes	QA-NTC014/09	15° down tilt

Powerlane	Eagle 450Y3 3 Element Yagi	Yes	QA-NTC012/08	
Sinclair Technologies	SY307- SF3SNM 9 dBd Yagi	Yes	QA-NTC010/12	
Sinclair Technologies	SC329- HF2SNM 6 dBd Collinear	Yes	QA-NTC010/12	6° down tilt
Sirio	SPO440-8 5 dBd Collinear	Yes	QA-NTC024/11	
Webb	HD460/4 4-stack Dipole	Yes	QA NTC 014/09	
Webb	SM 450/5 5 dBd Collinear	Yes	REP 00066/06	
Webb	SM 450/6 6 dBd Collinear	Yes	QA-NTC010/12	
Webb	TRD 150GLS Low profile train antenna	Yes - Condition apply	QA-NTC023/11	TRD 150GLS VHF train antenna: VHF and GSM systems to be connected to minimise Rx desensing.
Webb	TRD 450GLS Low profile train antenna	Yes - Condition apply	QA-NTC023/11	TRD 450GLS UHF train antenna: UHF, WiFi and GPS systems to be connected to minimise Rx desensing.
Webb	TRD450 MIMO	Yes (Condition apply)	TFR-RNT-QA-NTC011/22	
Webb	TRD1000	Yes (Condition apply)	TFR-RNT-QA-NTC005/22	IR (Iridium) Low Profile train antenna. Frequency band: (Iridium 1616.0 MHz to 1626.0 MHz), GSM / WiFi 900 MHz; 1.8 GHz & 2.4 GHz bands, GPS receiving antenna 1.2276 GHz & 1.57542 GHz
Webb	TRD 4067	Yes	QA-NTC006/15	

Webb	Y460/7 7 Element Yagi	Yes	QA-NTC024/11 ver 2	
Webb	Y460/12 12 Element Yagi	Yes	QA-NTC010/12	
Powerlane	Eagle 450 Folded dipole	No	-----	Radiating power loss is unacceptably high. Report no. QA-NTC 012/08.
Powerlane	Eagle 450Y8 8 Element Yagi	No	-----	Low gain of antenna is unacceptable. Report no. QA-NTC 012/08.

3.13 COAXIAL CABLES

MAKE	MODEL	APPROVED	TFR APPROVAL NUMBER	COMMENTS
Times Microwave Systems	LMR100A	Yes	QA-NTC 018/11	
Times Microwave Systems	LMR195DB & UF	Yes	QA-NTC 018/11	
Times Microwave Systems	LMR240DB & UF	Yes	QA-NTC 018/11	
Times Microwave Systems	LMR400DB & UF	Yes	QA-NTC 018/11	
Amphenol	TEB4001UF	No	-----	Insertion loss too high – does not comply with the manufacturer's claimed specification.

3.14 RF SURGE SUPPRESSOR

MAKE	MODEL	APPROVED	TFR APPROVAL NUMBER	COMMENTS
Telegärtner	Series N 40 Watt.	Yes	QA-NTC 002/10	

4. APPLICABLE DOCUMENTATION

APPLICABLE

DOCUMENT NO.	DESCRIPTION	LOCATION
Act No. 36 of 2005 as amended Act No. 1 of 2014 (Date:07 April 2014)	Electronic Communications Amendment Act, 2013.	Internal -Manager, Spectrum Management
BBD2051 version 2 (Date:04 January 2016)	Compliance Manual to the Independent Communications Authority of South Africa (ICASA) Frequency Spectrum Regulations, Directive relating to the procurement of electronic communications equipment facilities in Transnet	Manager, Spectrum Management
BBD8635 version 8.1 (Date:27 June 2014)	Technical Specification and Methods of Measurement for Angle Modulated Radio Equipment.	Internal -Manager, Quality Assurance National Test Centre

END OF DOCUMENT

RAIL NETWORK TELECOMS

SCHEDULE OF REQUIREMENTS FOR THE SUPPLY OF 30 TWO-WAY HANDHELD TRUNKED AND CONVENTIONAL RADIO EQUIPMENT FOR TRANSNET PORT TERMINALS DURBAN PIER 1

APPENDIX A: SCHEDULE OF COMPLIANCE FOR THE ABOVE:

- Tenders are invited in respect of the following Schedule of Requirements.
- Tenderers must indicate compliance with each item by providing a technical datasheet indicating make and model and functionalities being offered.
- Alternate offers must be **indicated on separate documents**.

ITEM	DESCRIPTION	MAKE & MODEL	COMMENT
1	HANDHELD REQUIREMENTS		
1.1	UHF, (400 – 470 MHz band) IP67 OR better, Handheld Trunked and Conventional radio, with a minimum of 16 conventional 12.5 kHz channels. (Can specify alternative number of channels). Excluding antenna and battery Must comply with attached Specifications BBD 8635 version 8 dated 21 May 2014 and BBF 2516 version 3.00, dated 6 June 2014.		
1.2	Quarter wave flexible whip antenna for item 1.1, to cover the 455 to 467 MHz band.		
1.3	High-capacity Battery to fit item 1.1, capable of sustaining a 20 - 20 - 60 duty cycle for an 8 hour shift. (Tx, Rx, Standby).		
1.4	Single bay rapid rate Charger for item 1.1 Provision must be made for a standard 3 pin 15- amp mains plug.		
1.5	Leather carry bag for item 1 with shoulder strap.		
1.6	Programming software, Leads, Adaptors and technical manuals on CD.		
1.7	Delivery as per delivery schedule Take note of evaluation and batch testing requirements.		

APPENDIX B & C: BILL OF QUANTITIES AND COST SCHEDULE

Indicate the cost per unit for the quantities indicated in the respective columns

ITEM	DESCRIPTION	QTY	UNIT PRICE	TOTAL
2	HANDHELD REQUIREMENTS			
2.1	UHF, (400 – 470 MHz band) IP54, Handheld Trunked and Conventional radio, with a minimum of 16 conventional 12.5 kHz channels. (Can specify alternative number of channels). Excluding antenna and battery Must comply with attached Specifications BBD 8635 version 8 dated 21 May 2014 and BBF 2516 version 3.00, dated 6 June 2014.	30		
2.2	Quarter wave flexible whip antenna for item 1.1, to cover the 455 to 467 MHz band.	30		
2.3	High-capacity Battery to fit item 1.1, capable of sustaining a 20 - 20 - 60 duty cycle for an 8-hour shift. (Tx, Rx, Standby).	60		
2.4	Single bay rapid rate Charger for item 1.1 Provision must be made for a standard 3 pin 15-amp mains plug.	30		
2.5	Leather carry bag for item 1 with shoulder strap.	30		
2.6	Programming software, Leads & Adaptors, technical manuals.	2		
2.7	Delivery as per delivery schedule Take note of evaluation and batch testing requirements.	1		

APPENDIX D: DELIVERY PERIOD

Indicate the delivery period, in weeks, for the quantities as indicated in the bill of quantities above:

ITEM	DESCRIPTION	QTY	DELIVERY DATE	COMMENT
3	HANDHELD REQUIREMENTS			
3.1	UHF, (400 – 470 MHz band) IP54, Handheld Trunked and Conventional radio, with a minimum of 16 conventional 12.5 kHz channels. (Can specify alternative number of channels). Excluding antenna and battery Must comply with attached Specifications BBD 8635 version 8 dated 21 May 2014 and BBF 2516 version 3.00, dated 6 June 2014.	30		
3.2	Quarter wave flexible whip antenna for item 1.1, to cover the 455 to 467 MHz band.	30		
3.3	High-capacity Battery to fit item 1.1, capable of sustaining a 20 - 20 - 60 duty cycle for an 8-hour shift. (Tx, Rx, Standby).	60		
3.4	Single bay rapid rate Charger for item 1.1 Provision must be made for a standard 3 pin 15-amp mains plug.	30		
3.5	Leather carry bag for item 1 with shoulder strap.	30		
3.6	Programming software, Leads & Adaptors, technical manuals.	2		
3.7	Delivery as per delivery schedule Take note of evaluation and batch testing requirements.	1		

APPENDIX E: DELIVERY SCHEDULE

Note that if equipment has not been evaluated before, if it is not in the document **BBD8208 Version 5.3.9**, it will need to be submitted for evaluation at the TFR test centre at 2 Foley St, Factoria, Krugersdorp before purchase.

It will be the responsibility of the supplier to arrange delivery (at their cost) to and from the Test Centre.

Note: Batch testing to be done prior to delivery.

10% of equipment required to be batch tested at the TFR test centre at 2 Foley St, Factoria, Krugersdorp.

It will be the responsibility of the supplier to arrange delivery (at their cost) to and from the Test Centre.

Should the technical evaluation & batch testing not be in line with the technical specification, TFR reserves the right to revoke or rescind the letter of award and P.O. and proceed with the next highest ranked bidder.

The supplied equipment quantities must be delivered to the following location after batch testing.

TRANSNET TFR RADIO

**Clark Drive.
Eel Road
Bayhead
Durban**

Box to be labelled: Durban TPT Pier 1 Handheld Two-Way Radios

CONTACT: Prior to Delivery Durban Tpt Pier 1 Handheld Two-Way Radios (contact MR. MNCEDI LUDONGA)

CONTACT (Mncedi Ludonga TEL 031 361 1797 CELL: 082 656 3853)

Workshop Representative

Luvuyo Jonkile

Office: 031 361 4944

Cell: 060 575 4957

Email: Luvuyo.Jonkile@transnet.net

TECHNICAL QUERIES

Anele Mlambo

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