



**SPECIFICATION FOR A VOICE  
FREQUENCY LINE-BRANCHING UNIT  
FOR USE WITH RADIO EQUIPMENT**

**SPC-00647**

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**Revision 4.00**

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**TABLE OF CONTENTS**

I	DISTRIBUTION .....	4
II	DOCUMENT CHANGE HISTORY .....	4
III	CHANGES SINCE LAST REVISION .....	4
IV	ABBREVIATIONS, ACRONYMS AND DEFINITIONS .....	5
V	RELEVANT DOCUMENTATION .....	5
1.	SCOPE.....	6
2.	COMPLIANCE.....	6
3.	SERVICE CONDITIONS.....	6
4.	SCHEDULE OF REQUIREMENTS.....	7
5.	QUALITY OF MATERIALS.....	10
6.	TECHNICAL HANDBOOKS .....	11
7.	ACCEPTANCE TESTS .....	11
8.	GUARANTEE.....	12
9.	MAINTENANCE AND SERVICE.....	12
	ANNEXURE A: TECHNICAL SPECIFICATION.....	13

**I DISTRIBUTION**

Once updated, a copy of the latest revision will be published in the document management system in use. 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
1.00	September 2004	Transmission Engineering	New document
2.00	October 2006	Transmission Engineering	Converted to ISO 900 Standard
3.00	June 2011	Transmission Engineering	Converted to TFR format and referred to TFR QA standards
4.00	June 2022	Radio Access Network	Revised clauses

**III CHANGES SINCE LAST REVISION**

CLAUSES	DESCRIPTION
V. Relevant documentation	BS 3939 replaced with IEC 60617
Clause 6.1, 6.4 Annexure A: 1, 2 and 10	Revised

**IV ABBREVIATIONS, ACRONYMS AND DEFINITIONS**

<b>ABBREVIATIONS AND ACRONYMS</b>	<b>DESCRIPTION</b>
<b>A</b>	Ampere
<b>AC</b>	Alternating current
<b>BS</b>	British Standards
<b>D</b>	Diameter
<b>dB</b>	Decibel
<b>dBm</b>	Decibel-milliwatts
<b>DC</b>	Direct Current
<b>E&amp;M</b>	Input and Output Signalling
<b>H</b>	Height
<b>Hz</b>	Hertz
<b>ISO</b>	International Standards Organization
<b>kHz</b>	Kilo Hertz
<b>LED</b>	Light Emitting Diode
<b>mA</b>	Milliampere
<b>mm</b>	Millimetre
<b>PTT</b>	Push To Talk
<b>RX</b>	Receive
<b>TX</b>	Transmit
<b>USB</b>	Universal Serial Bus
<b>V</b>	Voltage
<b>Vcc</b>	Common Collector Voltage
<b>VF</b>	Voice Frequency
<b>W</b>	Width

**V RELEVANT DOCUMENTATION**

<b>DOCUMENT NO.</b>	<b>DESCRIPTION</b>	<b>LOCATION</b>
ISO 9000	Quality Management Systems	External
IEC 60617	Graphical symbols for use in electrotechnical diagrams.	External
SPC-00846	Two-Way Mobile Radio communication Equipment (Old number SCEH-54)	Internal
BBD 8635	Technical Specification and methods of Measurement for Angle Modulation Radio Equipment.	Internal

## 1. SCOPE

This specification covers the requirements of Transnet Freight Rail for the supply of Line-branching units. The line unit is required to connect line-controlled radio repeater and base stations to long distance carrier channel circuits on a 6-wire basis with E and M signaling.

## 2. COMPLIANCE

- 2.1 Tenderers shall submit their main offers in terms of this specification. Deviations which are of a minor nature, and do not depart materially from this specification will be considered at the discretion of Transnet Freight Rail
- 2.2 Offers, which include deviations of a minor nature, not departing greatly from the specification, will be considered at the discretion of Transnet Freight Rail
- 2.3 Tenderers may offer alternatives for consideration. Alternative offers are to be reflected on a separate schedule and the following particulars are to be provided:
  - a) A fully detailed technical description in English explaining the functioning of the individual components, the operation of the items of equipment as well as the procedure to be followed in clearing faults and maintenance.
  - b) Drawings and brochures supporting the offer.
  - c) Details of deviations from the specifications of Transnet Freight Rail.
- 2.4 The value of imported and local components of complete items are to be stated separately.

## 3. SERVICE CONDITIONS

- 3.1 The equipment offered must be suitable for continuous operation under the following conditions:

Ambient temperature	:	-10° to 60° Celsius.
Relative humidity	:	As high as 95 %.
Altitude	:	0 to 2 000 metres.
Air pollution	:	Heavily saline laden industrial and locomotive fumes containing metallic dust.
Relative humidity	:	As high as 95%.
- 3.2 Component parts, including wiring, must be manufactured, and processed to ensure reliable operation under these conditions.
- 3.3 The equipment must be suitable for operation under the stated conditions without the use of blower fans, heaters, or air-conditioners etc.

## 4. SCHEDULE OF REQUIREMENTS

### 4.1 General Requirements

- 4.1.1 The unit must be 1U in height and 19" rack mount.
- 4.1.2 The unit dimensions and external connections are to comply as per annexure A.
- 4.1.3 The unit must consist of a minimum of four audio and signalling ports.
- 4.1.4 The unit must be capable of being cascaded with another unit without losing a port.
- 4.1.5 An engineering handset facility must be made available for the testing of ports and port peripheral equipment individually. The port selection switch must be available on the front panel of the unit.
- 4.1.6 E and M activity per port must be clearly visible on the front panel of the unit
- 4.1.7 The unit must make provision for a range of input and output audio levels per port.
- 4.1.8 The line branching unit is to provide a means to combine or split 4-wire 600 $\Omega$  E&M audio circuits. The combining or splitting of ports may be done by means of physical strapping or via software control.
- 4.1.9 The unit must provide a busy-channel lockout feature to allow the active port priority over the other ports. If enabled, the first active port must prevent signalling on the other ports from affecting the conference configuration, until it becomes inactive.
- 4.1.10 Provision must be made for the external connection of a supervisory system to connect/disconnect ports.
- 4.1.11 The line-branching units shall be housed in a rugged, dustproof cabinet which shall be constructed of impact resistant plastic or metal.
- 4.1.12 Tenderers shall supply a list detailing the number and types of semi-conductors used in the equipment.
- 4.1.13 All card settings may be performed either by software control or by means of physical jumpers.

### 4.2 Supply Voltage

- 4.2.1 The unit must be capable of operation within specification with an input supply voltage of between 10 and 60 Volts DC.
- 4.2.2 The input supply must be isolated from the branching card circuitry strapping must be available to strap the unit earth to station earth

- 4.2.3 The tenderer shall state the maximum DC current consumption of the complete line-branching unit. The line-branching unit shall provide for internal regulation, over-voltage, and reverse polarity protection, etc. of the DC supply. Current consumption of the unit is to be limited to an absolute minimum due to the use of the units at solar-powered station.

### **4.3 Audio Circuits**

- 4.3.1 The audio input and output impedance per port must be 600 Ohm balanced
- 4.3.2 The audio inputs and outputs must be via 600 Ohm isolation transformers.
- 4.3.3 Level adjustment must be provided by means of a multi-turn potentiometer for each individual input and output. Adjustments must be made possible from the rear of the unit.
- 4.3.4 Input and output level setting test points must be made available at the rear of the unit.
- 4.3.5 An option is to be made available per port to only allow audio into that port when E signalling is present on the same port i.e., a gated audio input.
- 4.3.6 The audio circuitry must be capable of operating over an input and output level range of -25 to +5 dBm. Distortion and audio levels to remain within specifications over the entire audio bandwidth of 300 to 3400 Hz.
- 4.3.7 Adjustments must be stable, and the performance must be maintained for long periods without recourse to adjustment
- 4.3.8 The line-branching unit circuitry shall provide for adequate filtering of (300 Hz to 3 400 Hz) on all ports.
- 4.3.9 Input and output audio must be made available at the rear of the unit via a 9-pin male "D" type connector. Pin designation must be as per Annexure A.

#### **4.4 Signal Inputs (E wire)**

- 4.4.1 All signal inputs are to be opto-coupled and capable of being operated by an input signal range of between 10 and 60 Volts. The polarity must be bi-directional.
- 4.4.2 Jumpers may be made available in order to ensure that the input signalling current is kept within the required specification.
- 4.4.3 E (+) and E (-) pins must be available on the external port connectors.
- 4.4.4 An option must be made available to totally isolate the "E" signalling from the unit and operate over an input voltage range of 10 to 60 Volts
- Or
- 4.4.5 Allow an "E" signalling in the range of 10 to 60 Volts positive or negative with respect to the units ground.
- Or
- 4.4.6 Allow the units (+) Ve supply leg to be used in the signalling path.

#### **4.5 Signal Outputs (M wire)**

- 4.5.1 M (+) and M (-) output signalling must be made possible via normally open relay contacts thus enabling isolation between the unit and peripheral equipment
- 4.5.2 On option must be made available via a jumper to allow one of the M legs to be strapped to the units ground.

#### **4.6 Maintenance Ports**

- 4.6.1 An audio maintenance port must be provided on the front panel to enable service personnel access audio and signalling ports circuits using a standard telephone handset.
- 4.6.2 Audio levels must be as per port settings.
- 4.6.3 A port selection switch must be made available on the front panel to allow the selection of the ports.
- 4.6.4 Signalling on the selected port must be provided by means of a PTT switch on the handset.

- 4.6.5 A loudspeaker must be fitted on the front panel to monitor inbound outbound speech on the selected port.

#### **4.7 Auxiliary Ports**

- 4.7.1 An auxiliary port must be provided at the rear of the unit to facilitate connection of a "High Site Management System" which will be used for the remote switching of the audio and signalling ports of the unit as well as the relaying of alarm outputs from the unit.
- 4.7.2 The alarm outputs must be made possible via normally open relay contacts thus enabling isolation between the unit and the peripheral equipment.
- 4.7.3 Port switching inputs are to be opto-coupled and capable of being operated by an input range of between 10 and 60 Volts. The polarity must be bi-directional.
- 4.7.4 Allow the units (+) Ve or ground to be used in the input switching circuitry.
- 4.7.5 A 15-pin high-density socket to be used. Connector pin outs as per Annexure A.

### **5. QUALITY OF MATERIALS**

- 5.1 Materials which may, under the influence of heat, light or pressure, decompose or liberate elements or compounds likely to corrode or affect other materials or cause electrolytic corrosion will not be acceptable.
- 5.2 Mounting screws, where used, must not be self-tapping. Bushes and threaded inserts must be used.
- 5.3 All covers, jacks, sockets etc. must be provided with adequate seals.
- 5.4 Pilot indicator lamps must be light emitting diode (LED) types.
- 5.5 The functions of all controls, switches, etc. must be clearly engraved or otherwise permanently marked by means of approved symbols in English.
- 5.6 All components must be suitably rated for the function they have to perform without interference to neighbouring material.
- 5.7 Resistors and restive components must not rise in temperature so that mounting boards or markings thereon are burnt or discoloured.
- 5.8 Fuses must be rated to give adequate protection to the circuit served while not rupturing prematurely.
- 5.9 The equipment lay-out must be planned to facilitate fault clearance and maintenance.
- 5.10 All components must be clearly marked and must be capable of easy reference to circuit diagrams and handbooks to be supplied with the equipment.

## 6. TECHNICAL HANDBOOKS

- 6.1 Technical handbooks shall be clearly printed in English. Copies contained in a USB drive must be provided.
- 6.2 The technical handbooks shall be packed with the equipment.
- 6.3 Each set of handbooks shall include the following:
  - 6.3.1 Operating instructions.
  - 6.3.2 Complete maintenance instructions.
  - 6.3.3 Complete and detailed alignment procedures.
  - 6.3.4 A detailed technical description of the equipment.
  - 6.3.5 Complete circuit diagrams, drawings and photographs of the equipment. The photographs and drawings shall clearly indicate component/module location on printed circuit boards etc. All component numbers shall be clearly shown.
  - 6.3.6 Voltage levels, current values, test points etc., shall be clearly indicated on circuit diagrams and printed circuit board layouts.
  - 6.3.7 Complete circuit diagrams of individual modules shall be included.
- 6.4 All symbols and notations used on drawing and circuit diagrams shall preferably comply with the requirements laid down in IEC 61617. Where symbols and notations do not comply with these requirements, each drawing shall be accompanied by a legend clearly detailing BS 3939 equivalent.
- 6.5 Transnet Freight Rail reserves the right to reproduce in whole or in part, by any means whatsoever, any technical handbook or instruction manual supplied by the successful Contractor. Any such reproductions will be for the sole use of Transnet.

## 7. ACCEPTANCE TESTS

- 7.1 Transnet Freight Rail will conduct acceptance tests on the equipment. The equipment will not be accepted until these tests have been completed and it has been confirmed that the equipment supplied is fully in accordance with the requirements of the specification and/or the stated claims of the tenderer as accepted by Transnet.
- 7.2 The tenderer shall agree to rectify any defects at no cost to Transnet, where the equipment does not meet the tender requirements and/or the stated claims of the supplier as accepted by Transnet.

**8. GUARANTEE**

- 8.1 Notwithstanding anything contained in the specifications and documents included in this specification, the tenderer shall guarantee the satisfactory operation of the complete system and accept liability for maker's defects which may appear in the equipment for a period of twelve (12) months after acceptance by Transnet. The tenderer shall clearly state the guaranteed terms.
- 8.2 If any urgent repairs must be carried out during the guarantee period by Transnet, the Contractor shall inspect such repairs to ensure that the guarantee is unaffected.
- 8.3 The tenderer shall note that repairs required to be done in terms of the will need to be done at various sites. Tenderers shall state how they propose to meet this requirement.

**9. MAINTENANCE AND SERVICE**

- 9.1 The tenderer shall give full particulars of the maintenance, spare parts and service facilities, which will be available in the Republic of South Africa. The names and addresses of the persons concerned shall be furnished.
- 9.2 Transnet Freight Rail will not consider tenders from tenderers who cannot provide an efficient spares and maintenance service.

**ANNEXURE A: TECHNICAL SPECIFICATION**

<b>1. General</b>		
A	Measurements (mm)	83(W) x 55(D) x 44(H)
B	Mounting method	19" rack mount

<b>2. Power</b>		
A	Requirements for 12 Volt input	Operating range 10,8 to 15,6 V
B	Linkable) For 24 Volt input	Operating range 21,6 V to 30,5 V
C	For 48 Volt input	Operating range 43,2 to 56,8 V
D	Current Consumption	Max 3 Watts
E	Unit Ground Negative	Input connector type 2 Pin Molex
F	Grounding terminal	5mm threaded rod with nut and washer

<b>3. Line Inputs</b>		
A	Number of Ports	4
B	Impedance	600 Ohm Balanced
C	Level	-25 dBm to +5 dBm
D	Bandwidth	300 – 3400 Hz
E	Return Loss Better than	- 25 dB

<b>4. Line Outputs</b>		
A	Number of Ports	4
B	Impedance	600 Ohm Balanced
C	Level	- 25 dBm to + 5 dBm
D	Bandwidth	300-3400 Hz
E	Response	Within 0,5 dB of quoted range
F	Distortion	< 0.1 % over entire level range @ 1 kHz
G	Crosstalk	> 60 dB relative to 0 dBm input
H	Common-mode rejection	Ratio = 60 dB at 1 kHz

<b>5. Signalling Input "E" lead</b>		
A	Input leads (Options)	Isolated 10 to 60 volts, 10 to 60 volts positive or negative w.r.t unit ground
B	Voltage range (Linkable)	As per specification 2(a) above
C	Current range	Not to exceed per port 10 mA for reliable switching.

<b>6. Signalling Output "M" lead</b>		
A	Type	Voltage free contacts normally open
B	Current handling	0,5 A

<b>7. Fusing</b>		
A	Input power supply fuse	20 mm Glass fuse 1 A
B	Output power supply fuse	20 mm Glass fuse 500 mA

<b>8. Auxiliary Port</b>		
A	Input Port Switching	Isolated 10 to 60 Volts bi-directional
B	Output power fail alarm	Contacts must be voltage free and normally open

<b>9. External Connector Types</b>		
A	Remote Port Switching Socket	15 pin D-Range Hi-Density
B	Four Wire E + M	Socket 9 pin D-Range
C	DC Input power	2 Pin Molex Socket

<b>10. Programming Port / Engineering Handset</b>		
A	Type	RJ45 socket. Note: Engineering handset socket could be used.
B	Location	Front panel

<b>11. DB9 Connector Pin outs</b>	
Pin No.	Description
1	RX Line VF (Audio input A Leg)
2	TX Line VF (Audio output A Leg)
3	Ground
4	"E" Lead (Return leg)
5	"M" Lead out (Common)
6	RX Line VF (Audio input B Leg)
7	TX Line VF (Audio output B Leg)
8	"E" Lead + (Active Leg)
9	"M" Lead Out (Normally Open)

<b>12. Auxiliary Port</b>	
1	Port 1 Switching (Active Leg)
2	Port 1 Switching (Return Leg)
3	Port 2 Switching (Active Leg)
4	Port 2 Switching (Return Leg)
5	Port 3 Switching (Active Leg)
6	Port 3 Switching (Return Leg)
7	Port 4 Switching (Active Leg)
8	Port 4 Switching (Return Leg)
9	Power Fail Alarm (Normally Open)
10	Power Fail Alarm (Common)
11	Unit Ground
12	Unit + Vcc

**END OF DOCUMENT**