



ICTM RAIL NETWORK TELECOMMUNICATIONS

LTE & DMR RADIO TEST INSTRUMENTS REPORT

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LTE and DMR Radio Test Instruments Report

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Summary of Version Control

Version NO.	Nature of amendment	Issued By	Changes	Date Issued
1.0	First Document	Lebohang L Mphirime	N/A	25/04/2023

DOCUMENTATION SIGN OFF

I, the undersigned hereby approve this document


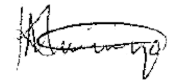


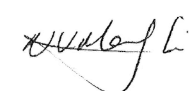

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I. DISTRIBUTION

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 Transnet departments.

II. ABBREVIATIONS, ACRONYMS AND DEFINITIONS

ABBREVIATIONS AND ACRONYMS	DESCRIPTION
AC	Alternating Current
AM	Amplitude Modulation
ALC	Automatic Level Control
dB	Decibel
DC	Direct Current
DMR	Digital Mobile Radio
°C	Degree Celsius
FM	Frequency Modulation
4FSK	Four Frequency Shift Keying
GHz	Gigahertz
GUI	Graphic User Interface
Hz	Hertz
kHz	Kilohertz
LAN	Local Area Network
LTE	Long-term Evolution
MHz	Megahertz
mW	Milliwatts
OEM	Original Equipment Manufacturer
W	Watts
QA	Quality Assurance
QPSK	Quadrature phase shift keying
RF	Radio Frequency
SCPI	Standard Commands for Programmable Instruments
16QAM, 64QAM	Sixteen or Sixty-Four Quadrature Modulation
VSWR	Voltage Standing Wave Ratio
W	Watt
DEFINITIONS	DESCRIPTION
Version	A particular form of something, which varies slightly from other forms of the same thing.
dB	The decibel is 1/10 of a Bel. dB is the logarithmic of the ratio between a measured quantity and an agreed reference level.
dBm	The absolute power in decibel with reference to 1 mW, impedance 50 Ω (power)

III. RELEVANT STANDARD AND DOCUMENTATION APPLICABLE

DOCUMENT NO.	DESCRIPTION	LOCATION
BBG4667	Specification for Radio Communication Service Monitor	Internal - ProjectWise
BBH3838	Specification for RF Signal Generator	Internal - ProjectWise
BBG64666	Specification for a Portable Handheld and Antenna Site Analyzer	Internal – Radio Ops & Maintenance

1 INTRODUCTION

1.1 BACKGROUND

- 1.1.1 A request from ICTM Telecoms received from Principal Engineer to form a task team, to research and compile a list of radio test instruments for the upcoming Digital Migration project. Digital migration project focuses on upgrading Transnet Radio Communication infrastructure, from the current RTO and Trunked radio systems to DMR and LTE technology.
- 1.1.2 The research findings are based to the current network and therefore changes when the DMR and LTE network has been fully designed and operational might be added.
- 1.1.3 The contents of this document are purely based on research of instruments that are currently in the market. It is an internet based research, as there was no formal demonstration or training acquired. Therefore, it would be advisable to acquire training and demonstration of the technologies and the testing instruments, before proceeding to the procurement of these instruments, to gain a more detailed insight on the operation, features of the instruments and those technologies.
- 1.1.4 The task team consisted of the following members:

Table 1: Task team members

<i>No</i>	<i>Employee Name</i>	<i>Position</i>	<i>Department</i>
1	Khunjulwa Mniniyo	Chief Engineering Technician	Quality Assurance
2	Nomaxabiso Mayoli	Senior Engineer	Operations & Maintenance
3	Nkosinathi Nyawose	Chief Engineering Technician	Operations & Maintenance
4	Bulelani Kovane	Engineering Technician	Operations & Maintenance
5	Lebohang Mphirime	Engineering Technician	Quality Assurance

2 SCOPE

- 2.1 This document covers the minimum requirements of radio test instruments required for DMR and LTE technologies that will be deployed for maintenance of Transnet radio infrastructure. Detailed requirements and information of these test instruments will be outlined in their respective specification documents.
- 2.2 The test and measurement instrument must be simple to operate and be ideally suited for South African climatic conditions.
- 2.3 The test instruments that will be listed in this document are as follows:
 - 2.3.1 Radio Communication Test Set
 - 2.3.2 Vector Signal Generator
 - 2.3.3 Vector Network Analyzer
 - 2.3.4 Portable Antenna Site Analyzer

3 TEST INSTRUMENTS

3.1 RADIO COMMUNICATION TEST SET

Table 2: RADIO COMMUNICATION TEST SET

Number	Feature	Analog	DMR	LTE
1.	Frequency Range 100 kHz – 3 GHz	✓	✓	✓
2.	Modulation	FM and AM	4FSK,	QPSK, 16QAM, 64 QAM
3.	Max input power 150 W	✓	✓	✓
4.	Distortion $\leq 5\%$	✓	✓	✓
5.	Selectable channel spacing between 25, 12.5, 6.25 kHz	✓	✓	✓
6.	Signal level for receiver measurements -140 dBm	✓	✓	✓
7.	RF Ports connector N Female	✓	✓	✓
8.	Dual Power Supply (DC & AC)	✓	✓	✓
9	Operating Temperature Range 0 °C to +45 °C	✓	✓	✓
10.	Convenient Operation – touchscreen, rotary knob and Keypad entry	✓	✓	✓

Detailed information of an existing Radio Communication Test Set instrument is available in ProjectWise: Specification for Radio Communication Service Monitor BBG4667 version 1.

<http://jhbtfrwppws02/default.aspx?default=pwgui%7c!%7cDMSSearch%7c%3dBBG4667>

3.2 VECTOR SIGNAL GENERATOR

Table 3: VECTOR SIGNAL GENERATOR

Number	Feature	Analog	DMR	LTE
1.	Frequency Range 10 kHz – 3 GHz	✓	✓	✓
2.	Modulation	FM and AM	4FSK	QPSK, 16QAM, 64 QAM
3.	Signal Level range -145 dBm to + 16 dBm	✓	✓	✓
4.	Distortion $\leq 5\%$	✓	✓	✓
5.	Selectable channel spacing between 25 kHz, 12.5 kHz, 6.25 kHz	✓	✓	✓
6.	RF port connector N Female	✓	✓	✓
7.	RF Port Impedance 50 Ω	✓	✓	✓
8.	Dual Power Supply (AC & DC)	✓	✓	✓
9.	Operating Temperature Range 0 °C to +55 °C	✓	✓	✓
10	Convenient Operation – touchscreen, rotary knob and keypad entry	✓	✓	✓

Detailed information of an existing Signal Generator instrument suitable for analog tests is available in ProjectWise: Specification for RF Signal Generator BBH3838 revision 1.

<http://jhbtfwppws02/default.aspx?default=pwgui%7c!%7cDMSSearch%7c%3dBBH3838>

3.3 VECTOR NETWORK ANALYZER

Table 4: VECTOR NETWORK ANALYZER

Number	Feature	Analog	DMR	LTE
1.	Frequency range 9 kHz -3GHz	✓	✓	✓
2.	RF ports x 2	✓	✓	✓
3.	RF input power \leq 27dBm	✓	✓	✓
4.	RF output power -10dbm to 0 dBm	✓	✓	✓
5.	RF Port Impedance 50 Ω	✓	✓	✓
6.	RF port connector N Female	✓	✓	✓
7.	2 x USB ports	✓	✓	✓
8.	Dual Power Supply (AC & DC)	✓	✓	✓
9.	Operating Temperature Range +5 °C to +40 °C	✓	✓	✓
10.	Convenient Operation – touchscreen, rotary knob and Keypad entry	✓	✓	✓

Detailed information of the Vector Network Analyzer instrument will be compiled and stored in ProjectWise.

3.4 PORTABLE ANTENNA SITE ANALYZER

Table 5: PORTABLE ANTENNA SITE ANALYZER

Number	Feature	Analog	DMR	LTE
1.	Frequency Range 2 MHz to 3 GHz	✓	✓	✓
2.	RF ports x 2	✓	✓	✓
3.	RF Input power 30 dBm	✓	✓	✓
4.	RF Output power -10 dBm	✓	✓	✓
5.	RF ports connector N female	✓	✓	✓
6.	RF port impedance 50 Ω	✓	✓	✓
7.	2 x USB port	✓	✓	✓
8.	Dual Power Supply (AC & DC)	✓	✓	✓
9.	Operating Temperature –20 °C to +50 °C	✓	✓	✓
10.	Convenient Operation – touchscreen, rotary knob and Keypad entry	✓	✓	✓

Detailed information of an existing Portable Antenna Site Analyzer instrument specification is available upon request from Radio Operations & Maintenance staff, and it will be loaded onto ProjectWise as Specification for Portable Handheld and Antenna Site Analyser BBG 64666 once amendment has been completed.

4 CONCLUSION

Currently there's a number of OEMs for the test instruments listed in clause 2.3 of this document therefore the specifications of a particular instrument may slightly differ with each manufacturer. Thus, some instruments may not have the exact information in the tables 1 to 4 mentioned above specification but should however be compliant with Transnet's proposed digital radio systems.

END OF DOCUMENT