1. Module details

Module name

Receiver and Transmitter Circuits

Suggested structured learning time

A learner possessing the prerequisite skills and knowledge should achieve the module purpose in 36 to 40 hours.

Module code

NUE180

Discipline code

031309

2. Module purpose

This module will provide learners with knowledge required to maintain, test and repair transmitters and receiver equipment and circuits used in RF communications

3. Learning pathway

Intended use in the structured learning program

This module is intended to support learners in a structured program of learning for relevant competency standards unit(s) associated with the electronics, radio and television servicing and repair. In particular it may also contribute specifically to the knowledge required to maintain, test and repair transmitters and receiver equipment used in communications.

Therefore before undertaking this module a learner should have acquired demonstrated skills in relevant workshop practices, safe us of tools and equipment, test equipment and basic repair practices used in electronic equipment and circuits.

Recommended prerequisites

For the most effective learning this module should be undertaken after knowledge and skills in workshop practices, safe us of tools and equipment, test equipment and basic electronic principles and circuits has been achieved.

4. Relationship to competency standards

This module provides part of the underpinning knowledge and skills in the 'Evidence Guide' of specific units of competency in the National Electrotechnology Training Package and provides similar support, where mapped, to equivalent units in other National Competency Standards. Those mapped are: National Electrotechnology Industry Standards, Units NES207, NES302, NES403, NES502, NES703, and the relevant specialisation; Metals & Engineering Industry Standards, Units 5.1A, 18.56A, 18.57A, 18.65A.

For details refer to the module to unit maps available from EE-Oz Training Standards (formerly EEQSBA).

5. Content

1. Transmitters:
   - Block diagram of both high level and low level AM transmitters.
   - Class A, Class B and Class C amplifiers in AM

transmitters.
- Applications using AM transmitters.
- Block diagram of the filter method SSB transmitter.
- Block diagram of the phase method SSB transmitter.
- SSB transmitter stage frequencies.
- Two tone testing of SSB transmitter.
- Block diagram of the direct method FM transmitter.
- Frequency multipliers and converters in FM transmitters.
- Block diagram of the indirect method FM transmitter.
- Classes of stage amplifiers in an FM transmitter.
- Pre-emphasis and de-emphasis in FM systems.
- Stereo FM principles.
- Transmitter frequency stability requirements.
- Transmitter spurious signal suppression.
- Transmitter power level requirements.
- Transmission modes.
- Radiation exposure levels.
- Measure output power of a transmitter.
- Measure output carrier frequency.
- Measure spurious output levels.

2. Receivers:
Block diagram of a single conversion superheterodyne receiver.

RF Amplifier
- Filtering
- Gain
- Low Noise
- Antenna Match
- AGC
-Stability
- Typical Circuit

Local Oscillator
- Frequency Stability
- Signal Purity
- Synthesiser Local Oscillator
- Typical Circuit

Mixers
- Function
- Problems
- Typical Circuits

IF Strip
- Function
- Choice of Frequency
- IF Selectivity

- AGC
- Typical Circuits

Demodulation
- AM, FM, SSB
- BFO
- DC for AGC
- S Meters

Image Frequency
- Dual Conversion Superheterodyne
- AM, SSB and FM receivers.
- Applications of AM, SSB and FM receivers

3. Digital Signal Processing in RF communications Receivers and Transmitters

6. Assessment strategy

Assessment methods

Assessment should be progressive reflecting a holistic and integrated approach to ensure the module purpose is met. To assist in ensuring validity, reliability and fairness assessment instruments is to include monitoring learner progress; practical exercises, assignments and written tests consisting of a number of item types, such as multiple choice, short answer and problem solving. "Checklist" or atomistic assessment approaches are to be avoided.

Conditions of assessment

Learning and assessment is to take place in a formal learning environment that is conducive to learning.

7. Learning outcome details

Learning outcome 1

Describe the basic principles involved in both high and low level AM transmitters.

Assessment criteria

1.1 Identify the modulation technique (high or low level) and describe the function of each block given a block diagram

1.2 State the classes of amplification used in the various stages on the above block diagrams.

1.3 List services that use AM modulation for radio transmissions.

Learning outcome 2

Describe the operating principles of SSB transmitters.

Assessment criteria

2.1 Sketch a block diagram of a filter method SSB transmitter and describe the function of each block.

	2.2	Sketch a block diagram of a phase method SSB transmitter and describe the function of each block.
	2.3	State the classes used in both of the above block diagrams
	2.4	Determine the oscillator frequencies required to cause radiation of the required sideband on a specified frequency for both of the above methods of SSB generation.
	2.5	State the reasons for using two tone testing of SSB transmitters.
Learning outcome 3	Describe the operating principles of FM transmitters	
Assessment criteria	3.1	Sketch a block diagram of the direct method FM transmitter and describe the function of each block.
	3.2	Describe how frequency multipliers and frequency converters differ in the way they effect frequency of the carrier and frequency deviation.
	3.3	Sketch a block diagram of the indirect method FM transmitter and describe the function of each block.
	3.4	State the classes of amplification used in both of the above block diagrams.
	3.5	Describe how pre-emphasis and de-emphasis are used with FM system to improve signal-to-noise ratio.
	3.6	Describe the basic principles involved in broadcast stereo FM.
Learning outcome 4	Describe basic transmitter output signal specifications.	
Assessment criteria	4.1	Describe typical frequency range and stability requirements of a transmitter.
	4.2	Describe the need for suppression of spurious signals from a transmitter.
	4.3	Describe power level requirements of a transmitter.
	4.4	List type of emission modes.
	4.5	Explain radiation exposure level.
Learning outcome 5	Measure transmitter output signals.	
Assessment criteria	5.1	Measure the output power of a transmitter.

	5.2 Measure the output carrier frequency.
	5.3 Measure the level of spurious output from a transmitter.
Learning outcome 6	Demonstrate knowledge of the concepts and characteristics of superheterodyne receiver systems.
Assessment criteria	6.1 Sketch a block diagram of a superheterodyne receiver and describe the function of each block.
	6.2 State the problems with the basic superheterodyne design and how these are overcome by the inclusion of selectivity and RF amplification prior to the mixer.
	6.3 State typical Intermediate Frequencies (IF's) and reasons why `designers use these frequencies.
	6.4 Calculate the image frequency for a superheterodyne given the IF, the wanted frequency and the local oscillator frequency.
	6.5 State the reason for its use and describe its operation given a block diagram of a dual conversion superheterodyne receiver.
	6.6 State the reasons why Automatic Gain Control (AGC) is necessary in receivers.
	6.7 Describe the differences that exist between AM, SSB and FM receivers.
	6.8 Calculate the oscillator frequencies required for reception of a specified frequency and mode of transmission, given the IF frequency (ies) to be used.
	6.9 Identify the functional blocks, given a receiver circuit.
	6.10 Describe the need for AFC in some receivers and how it is achieved.
Learning outcome 7	Describe the basic differences between AM, SSB and FM receivers.
Assessment criteria	7.1 Sketch a block diagram for a typical AM, SSB and FM receiver.
	7.2 Describe the differences that exist between the three receivers.
	7.3 State the advantages and applications of AM, SSB and FM receivers.

Learning outcome 8	Describe basic receiver specifications.
Assessment criteria	8.1 Define receiver sensitivity and list the sections of a receiver that have a major influence on its value. 8.2 Describe the use of sensitivity at a stated signal-to-noise ratio as a measure of receiver performance. 8.3 Describe receiver selectivity. 8.4 Describe the use of noise figure as a measure of receiver performance. 8.5 Define receiver dynamic range.
Learning outcome 9	Demonstrate an understanding digital signal processing (DSP) applications used in RF communications equipment.
Assessment criteria	9.1 Describe typical examples of how DSP techniques can improve communications equipment specifications. 9.2 Identify the advantages of using DSP techniques in communications receivers and transmitters. 9.3 Draw a block diagram of a typical narrow band digital receiver and outline the function of each block 9.4 Describe the meaning of "base band I and Q signals" used in digital signal processing.

8. Delivery of the module

Delivery strategy	Delivery strategies must be suitable for learning both theoretical and practical aspects described in the module purpose. It is considered that the most effective method to achieve this is by integration of theory and practice where learners learn by experimentation, research and reports. It is recommended that learning and assessment be facilitated in a holistic manner that may require a learning outcome sequence other than that indicated in the module.

Resource requirements	Resources should be sufficient for learners to carry out learning activities on an individual basis and should include: - A fully equipped basic electronics laboratory and advanced electronics laboratory with an appropriate ratio of consumables and equipment per learner. Trainers/teachers/facilitators must have qualifications in the relevant subject area for the AQF level program being delivered and, they are engaged to deliver recognised trainer and assessment training and at least three to five years relevant work experience. *Suggested Learning Resource:* Kennedy, George. Davis, Bernard. Electronic Communication Systems, 4th Edition 1992, McGraw Hill, Sydney. Carr, Joseph, Practical Radio Frequency Test and Measurement: A Technician's Handbook 2002 Elsevier Science, Burlington Sayre, Cotter W, Complete RF Technician's Handbook 2nd Edition 1999 Prompt Publications Indianapolis. Useful references include: • Class notes, workbook, calculator • *Standards Australia*, Relevant standards Where this module is used in an approved Traineeship or Apprenticeship program learners should be advised to obtain, where available, respective EE-Oz Training Standards[1] ***User Guides*** (*these outline in detail what training and work performance the Learner is required to undertake for the program*).
Occupational health and safety requirements	A safe and healthy environment will be provided for learners/participants and teacher/trainers/assessors, as well safety procedures with regard to learning and assessment activities shall be formally advised.

[1] EE-Oz Training Standards – ElectroComms and EnergyUtilities Industry Skills Council Ltd formerly ElectroComms and EnergyUtilities Qualifications Standards Body of Australia Ltd (EEQSBA)