

**1. Module details****Module name****Basic Transmitters****Module duration**

It is expected that students with the appropriate entry knowledge and skills will successfully complete this module in 36 - 40 hours.

**Module code**

NUE152

**Discipline code**

0703501 Communications Engineering – General.

**2. Module purpose**

This module will provide students with the knowledge and skills to tune, adjust and test Double Side Band Full Carrier (DSBFC) and Single Side Band Suppressed Carrier (SSBSC) radio transmitters.

**3. Prerequisites**

NUE704 Modulation Principles.

**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 the National Metals and Engineering Competency Standards. For details refer to the module to unit maps, available from NUEITAB.

**5. Content****DSBFC transmitter operation**

low and high level modulation functional blocks  
oscillator requirements  
buffer stages and tuned amplifiers  
frequency multipliers  
radio frequency power amplifiers  
low level modulation operation  
high level modulation operation

**DSBFC transmitter tuning and adjustment**

oscillator tuning and frequency adjustments  
tuning buffer stages and RF amplifiers  
tuning frequency multipliers  
tuning radio frequency power amplifiers  
adjusting modulation level

**DSBFC transmitter testing**

radio frequency power output  
carrier frequency  
spurious radiation  
modulation depth  
modulation frequency response  
modulation linearity (carrier shift)

**SSBSC transmitter operation**

functional block diagram  
carrier oscillators  
balanced modulators  
sideband filters  
heterodyne mixers  
linear power amplifiers  
automatic level control  
audio processors

**SSBSC transmitter tuning and adjustment**

adjusting radio frequency power output  
adjusting carrier frequency  
adjusting carrier balance  
reducing spurious emissions by tuning/adjustment  
adjusting audio compression/processing

**SSBSC transmitter tests**

radio frequency power output  
carrier frequency  
spurious emissions – carrier leak – opposite sideband third  
order intermodulation  
products  
modulation frequency response  
audio compression

**6. Assessment strategy**

**Assessment methods**

Assessment should be progressive reflecting a holistic approach to ensure the module purpose is met. To assist in ensuring validity, reliability and fairness assessment instruments should include practical exercises, assignments and written tests consisting of a number of item types, such as multiple choice, short answer and problem solving.

**Conditions of assessment**

Learning and assessment will take place in an environment that is conducive to a learner's development.

**7. Learning outcome details****Learning outcome 1****Assessment criteria****Explain the operation of a DSBFC transmitter.**

- 1.1 Draw block diagrams of DSBFC transmitters using low level and high level modulation and explain the requirements for each.
- 1.2 Identify the operational blocks of a simple DSBFC transmitter given the circuit diagram.
- 1.3 Describe the purpose and characteristics of buffer stages and tuned amplifiers.
- 1.4 Describe the operation and characteristics of frequency multipliers. Relate these characteristics to the use of multiplier in high and low level modulation circuits.
- 1.5 Describe the operation of simple linear and class radio frequency power amplifier stages.
- 1.6 Perform calculations (eg. gain, power levels, frequency deviation) related to the circuit diagram/block diagram.
- 1.7 Describe the operation of high-level series modulators using transformers and series transistors.
- 1.8 Describe the operation of low level modulators.

**Learning outcome 2****Assessment criteria****Tune and adjust a DSBFC transmitter to achieve correct operation.**

- 2.1 State the safety precautions to be taken when working with transmitters.
- 2.2 Describe how to tune transmitter oscillators and adjust their frequency
- 2.3 Describe how to tune buffer stages and RF amplifiers.
- 2.4 Describe how to tune frequency multipliers.

**Learning outcome 3**

**Assessment criteria**

- 2.5 Describe how to tune radio frequency power amplifiers.
- 2.6 Describe how to adjust modulation level.
- 2.7 Correctly tune the above stages and adjust the transmitter oscillators frequency and modulation level, given appropriate test equipment, manuals and a DSBFC transmitter.
- 2.8 Diagnose and repair faults in particular DSBFC transmitters.

**Use the appropriate tests to determine correct operation of a DSBFC transmitter.**

- 3.1 Draw diagrams of set ups to test the following characteristics:
  - radio frequency power output
  - carrier frequency
  - spurious radiation
  - modulation depth
  - modulation frequency response
  - modulation linearity (carrier shift).
- 3.2 Describe the performance of the above tests and the precautions necessary to ensure accuracy, reliability and protection from damage for both the test equipment and the transmitter under test.
- 3.3 Connect set ups to test the following characteristics, given appropriate test equipment and manuals:
  - radio frequency power output
  - carrier frequency
  - spurious radiation
  - modulation depth
  - modulation frequency response
  - modulation linearity (carrier shift).
- 3.4 Correctly carry out the above tests, record the results and identify stages in the transmitter which require alignment, adjustment or repair.

**Learning outcome 4**

**Explain the operation of an SSBSC transmitter.**

**Assessment criteria**

- 4.1 Draw the block diagram of a simple SSBSC transmitter and outline the operation and characteristics of the major functional blocks.
- 4.2 Describe the operation of the balanced modulator and carrier oscillator.
- 4.3 Describe the operation and characteristics of the side band filters.
- 4.4 Describe the operation of the heterodyne mixer and channel oscillator or synthesizer.
- 4.5 Describe the operation of tuned and broadband linear power amplifiers and associated aerial filters.
- 4.6 Describe the operation of the automatic level control (ALC) circuits.
- 4.7 Calculate the transmitter output suppressed carrier frequency, given the carrier oscillator and heterodyne oscillator or synthesizer frequencies.
- 4.8 Describe the operation of audio processing circuits.

**Learning outcome 5**

**Tune and adjust an SSBSC transmitter to achieve correct operation.**

**Assessment criteria**

- 5.1 Describe how to tune transmitter carrier oscillators and adjust their frequency.
- 5.2 Describe how to tune buffer stages.
- 5.3 Describe how to tune balanced modulators.
- 5.4 Describe how to tune sideband filters.
- 5.5 Describe how to tune heterodyne mixers.
- 5.6 Describe how to tune linear radio frequency power amplifiers.
- 5.7 Describe how to adjust ALC circuits and audio processing circuits.

**Learning outcome 6**

**Assessment criteria**

5.8 Correctly tune the above stages and adjust the transmitter oscillator frequency and modulation level, given appropriate test equipment, manuals and a SSBSC transmitter.

5.9 Diagnose and repair faults in particular SSBSC transmitters.

**Use the appropriate tests to determine correct operation of an SSBSC transmitter.**

6.1 Draw diagrams of set ups to test the following characteristics:

- radio frequency power output
- suppressed carrier frequency
- ALC operation
- transmitter audio frequency response
- carrier leak
- unwanted sideband
- third order intermodulation
- heterodyne oscillator leak
- other spurious emissions.

6.2 Describe the performance of the above tests and the precautions necessary to ensure accuracy, reliability and protection from damage for both the test equipment and the transmitter under test.

6.3 Connect set ups to test the following characteristics, given appropriate test equipment and manuals:

- radio frequency power output
- suppressed carrier frequency
- ALC operation
- transmitter audio frequency response
- carrier leak
- unwanted sideband
- third order inter-modulation
- heterodyne oscillator leak
- other spurious emissions.

6.4 Correctly carry out the above tests, record the results and identify stages in the transmitter, which require alignment, adjustment or repair.

## 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 students learn by experimentation, research and reports. It is recommended that learning and assessment be facilitated in a holistic manner that may require learning outcome sequence other than that indicated in the module.

### Resource requirements

*Resources should be sufficient for students to carry out learning activities on an individual basis. This will require the following:*

- Spectrum analyser (suitable for SSB & FM measurements)
- Analog VOM
- Frequency counter, 1MHz-250MHz
- Cathode Ray Oscilloscope, 60MHz, dual beam
- Audio frequency signal generator or function generator
- AM-FM Modulation meter
- AM-SSB transmitter or transceiver
- VHF or UHF FM transmitter or transceiver
- Audio frequency noise and distortion meter
- Radio frequency dummy load for transmitters
- Radio frequency power meter
- Workshop manuals, set
- Power supply, dual, 0 to +/- 30 V DC, 5A
- Multimeter, analog
- Multimeter, digital

#### *Suggested Learning Resources:*

Miller, Gary M. Modern Electronic Communication, 5th Edition, Prentice Hall, 1996.  
ISBN 0-13-217879-6

Tomasi, Wayne Electronic Communications Systems: Fundamentals Through Advanced, 3rd Edition, Prentice Hall, 1998.  
ISBN 0-13-751439-5

Schweber, William Electronic Communication Systems: A Complete Course, 2nd Edition, Prentice Hall, 1996.  
ISBN 0-13-301482-7

**Occupational health  
and safety requirements**

Young, Paul H. Electronic Communication Techniques, 4th Edition, Prentice Hall, 1994.

ISBN 0-13-779984-5

A safe and healthy environment will be provided for students and teachers as well as the particular safety procedures followed as part of the learning / teaching activity and content.