Passive Intermodulation – PIM
Competencies Requirements

The following competencies will show the technician the various knowledge and abilities necessary to be trained in Passive Intermodulation testing, equipment and safety procedures.

1.0 PASSIVE INTERMODULATION - PIM
- 1.1 Define PIM in radio circuits
- 1.2 Discuss associated terminology and be able to define related network elements
- 1.3 Identify the Key Performance Indicators of PIM – KPI
- 1.4 Know wireless carrier and manufacturer PIM methods and procedures
- 1.5 Explain the difference between a “System Test” and a “Component Test.”

2.0 PIM – TECHNOLOGY OVERVIEW
- 2.1 Identify and define dB and dBm
- 2.2 Discuss radio power levels and the difference between radiated and non-radiated power
- 2.3 Define dBc and the difference with dBm
- 2.4 Define and understand Intermodulation in radio systems
- 2.5 Identify and describe noise and spurious emissions in radio systems
- 2.6 Describe receiver Desense (loss of sensitivity)
- 2.7 Describe the difference between an antenna and a load
- 2.8 Discuss the role of antenna line sweep and the role of PIM testing

3.0 PIM SOURCES
- 3.1 Identify Internal PIM Sources
- 3.2 Identify External PIM sources
- 3.3 Describe how to identify multiple PIM sources
- 3.4 Demonstrate how to reduce external PIM sources at radio sites
- 3.5 Describe and be able to define the role of connectors, antennas, filters, combiners, and other network elements as possible sources of PIM

4.0 PIM TESTING
- 4.1 Define and understand Static PIM Testing
- 4.2 Define and understand Dynamic PIM Testing
- 4.3 Demonstrate how to determine the correct frequencies for PIM Testing
- 4.4 Discuss the difference between swept frequency and fixed frequency PIM testing
- 4.5 Show by example how to determine the level of a 3rd order Intermodulation product
- 4.6 Demonstrate how to use a Spectrum Analyzer to find spurious emissions and intermodulation
- 4.7 Demonstrate the proper procedure for conducting a PIM test
- 4.8 Conduct a System test with an antenna attached
- 4.9 Conduct a System test with a “LOW PIM” Load attached
- 4.10 Identify and discuss the purpose of a HIGH PIM Load
- 4.11 Identify and explain the purpose of a LOW PIM Load
- 4.12 Conduct an Antenna “ONLY” test

5.0 RF SAFETY OVERVIEW
- 5.1 Conduct a tailboard conference and discuss the safety risks of conducting PIM tests
- 5.2 Demonstrate competence in the understanding of RF exposure to workers
- 5.3 Show by practical example the proper procedure for working with PIM equipment
- 5.4 Describe the importance of physical clearance from the PIM test head
- 5.5 Define how the time period of a PIM test is related RF safety awareness
- 5.6 Know and describe the process for taking a radio outage
- 5.7 Define the proper procedures for Lock-out and Tag-out of radio equipment

6.0 PIM RESULTS INTERPRETATION

6.1 Demonstrate the proper steps for verifying the PIM test equipment during test set-up
6.2 Place markers or labels within the test equipment to identify components
6.3 Demonstrate the power levels of two fixed carriers being generated by the PIM test equipment
6.4 Mathematically calculate the 3rd Order Intermodulation product and determine the level of this carrier
6.5 Determine the level of the thermal noise floor on the spectrum analyzer in an idle (normal state)
6.6 Determine the level of the noise floor with the RF-ON from the PIM tester, note the difference
6.7 Be able to explain the impact of full power downlink carriers on the associated up-link receivers

7.0 DOCUMENTING PIM TESTS

7.1 Save PIM test equipment set-up procedures (state files)
7.2 Name the location and sector if applicable
7.3 Create and save test markers or labels for the system under test
7.4 Explain the typical carrier requirements for a PIM test report
7.5 Generate or create a report using the test equipment
7.6 Save the report to an external memory source (thumb drive or equivalent)
7.7 Open or print the report on another computer and display the results
7.8 Remove the equipment from the system under test and return all clearances to operators
7.9 Remove any Lock-out, Tag-out Orders
7.10 Ensure proper operation of all equipment to pre-test status

WARNING: YOU CAN SUFFER SEVERE RF BURNS FROM THE IMPROPER USE OF THE PIM TEST SETS. DO NOT OPERATE THE INSTRUMENT WITHOUT UNDERSTANDING THIS!

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Terms and Acronyms

Acronym	Description
4G	4th Generation
AWS	Advanced Wireless Services
BTS	Base Transceiver Station
CDMA	Code Division Multiple Access
DAS	Distributed Antenna System
dB	Decibel
dBc	decibel referenced to a carrier level
dBm	decibel referenced to 1 milliwatt
dBW	decibel referenced to 1 Watt
DUT	Device Under Test
F1	Frequency 1
F2	Frequency 2
FCC	Federal Communications Commission
GSM	Groupe Spéciale Mobile, Global System for Mobile Communications
IEC	International Electrotechnical Commission
iHA	A Kaelus (Summitek) PIM tester
IM	Intermodulation
IM3	3rd order intermod product
IM5	5th order intermod product
IM7	7th order intermod product
IM9	9th order intermod product
iMT	A Kaelus (Summitek) PIM tester
iQA	A Kaelus (Summitek) PIM tester
KPI	Key Performance Indicator
LED	Light Emitting Diode
LO	Local Oscillator
LTE	Long Term Evolution
NOC	Network Operations Center
OSHA	Occupational Safety & Health Administration
PCS	Personal Communication(s) System/Service(s)
PIM	Passive Intermodulation
PPE	Personal Protection Equipment
RF	Radio Frequency
RFDS	Radio Frequency Distribution System
RSSI	Receive Signal Strength Indication
TCH	Traffic Channel
TMA	Tower Mounted Amplifier
Tx	Transmit
UMTS	Universal Mobile Telecommunications System
VSWR	Voltage Standing Wave Ratio

