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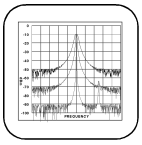
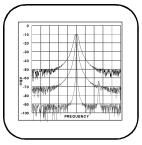


FUNDAMENTAL
RF & MICROWAVE SPECTRUM ANALYSIS

01 February 2006 REV Draft B

PROGRAM	TP3304A RF & Microwave Spectrum Analyzer Operator Training Course.
SCOPE	Covers RF and Microwave fundamentals as related to spectrum analysis and network analysis (requires tracking generator). Installs confidence in the use of spectrum analyzers by overcoming the complexities involved in the use of key features and measurement techniques. Provides a basis for advanced applications.
AUDIENCE	Engineers, scientists and technicians involved in research, development production and/or maintenance who will operate or have operated a spectrum analyzer.
STUDENT PREREQUISITES	It is desirable, but not essential, that students have some familiarity with transmission line theory, logarithms, vectors and modulation theory.
EXPECTED OUTCOMES	At completion of the program, the students will be more productive users of spectrum analyzers by readily selecting appropriate sweep times, resolution bandwidths and detectors to produce meaningful signal measurements. The *Training Strategy* lists the course modules against which specific outcomes are usually tested by exercises. Student workbooks are used to record the skills and knowledge acquired, and additional information provided by the instructor.
RESOURCES REQUIRED	Student workbook handout, test devices, training environment, RF/Microwave spectrum analyzer system, for example: HP/Agilent 856X, 859X, 70XXX Anritsu MS260X, MS265X, MS266X and many more.
STUDENT LIMIT	Usually a maximum of 2 students per network analyzer system but numbers may be increased at the expense of "hands-on" time.
ELIGIBILITY	This training program conforms to the guidelines of *The Training Guarantee* which is enforced by the *Australian Taxation Office* (as explained in "The Training Guarantee - Your Questions Answered", Australian Taxation Office, 1 July 1992).



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OBJECT

The training program aims to expand the capability of RF/Microwave spectrum analyzer operators to include complex devices that require detailed knowledge of network analyzer operation. This will be achieved through a modularised training course containing theory that is supported by practical exercises.

The modules aim for the student to:

- ☑ Measure signal levels and frequencies accurately.
- ☑ Determine signal modulation types.
- ☑ Improve the displayed test signal dynamic range to find low level signals such as spurs and low power transmitters.
- ☑ Analyze signals further with key features such as zero span and FFT modes.

And where a tracking generator is available:

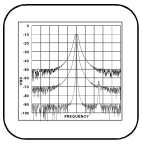
- ☑ Use a spectrum analyzer as a network analyzer and characterise components accurately.
- ☑ Review network analysis principles.
- ☑ Understand the basic scalar calibration techniques for return loss and insertion loss measurements.

TRAINING STRATEGY

The following modules contain lectures, interactive tutorials, demonstrations, exercises and/or discussions[1] which form the strategy to this one day (approximately 8 hours) training course.

[1]. The following topics may be discussed if time permits:

Internally generated spurious signals.
Preselectors.



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SECTION 1: SPECTRUM MEASUREMENTS

SIGNAL ANALYSIS
Module 1: 4-4½ hours.

This module provides a coverage of analyzer configurations which assist in identifying and characterising signals:

- ♦ Resolve signals.
- ♦ Extract signals from noise by understanding detector modes, attenuation setting and video averaging.
- ♦ Locate where in the analyzer hardware that operator settings cause changes.
- ♦ Determine simple amplitude modulation depth, frequency modulation deviation and modulation rates using traditional, zero span and FFT techniques (where available).

SPECTRUM ANALYZER FEATURES
Module 2: ½-1 hours.

This module presents the basic spectrum analyzer features and how to use them in a general measurement sequence:

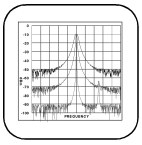
- ➢ Determine feature accessibility through front panel keys and associated menus.
- ➢ Describe the basic measurement process.

SECTION 2: COMPONENT MEASUREMENTS (Tracking Generator Required in Spec An)

NETWORK ANALYSIS BASICS
Module 3: ½ hours.

This module provides a review of transmission line theory, network measurement principles and hardware requirements:

- * Define network measurement terms and use S-parameters to describe device characteristics.
- * Define the measurements of linear networks.
- * Determine device operating frequency range by relating reflection and transmission measurements.
- * Describe the basic network analyzer block diagram and data processing flow.



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MEASUREMENT ACCURACY & SCALAR ANALYSIS ISSUES
Module 4A: 2-2½ hours.

This module presents specific scalar analysis features and concerns, and provides an overview of measurement errors, calibration concepts and measurement limitations:

- ⌘ Describe the systematic errors and error models applicable to reflection and transmission measurements then optimize hardware for particular measurement applications.
- ⌘ Perform calibrations for reflection and transmission measurements and recognize the importance of performing calibrations with true standards.
- ⌘ Recognize tradeoffs between analyzer hardware performance and measurement uncertainty, and identify calibration limitations.
- ⌘ Describe measurement trade-offs between narrow- and broad-band detection schemes where spurious levels, sweep speed and dynamic range issues exist. Understand when either AC or DC detection mode is preferred (where available).

DESIGNER/INSTRUCTOR
This training program has been designed and developed by Mr. Glenn Williams (B.Eng) of Impulse Engineering. Glenn has designed, developed and instructed RF & microwave test equipment usage programs since 1985, including many as an RF/Microwave Engineer for Hewlett-Packard over an 8 year period. Glenn has completed numerous train the trainer and presentation type courses. Some of the organisations to benefit from Glenn's expertise during training programs are:

Aerospace Technologies of Australia (ASTA-formely GAF Govt. Aircraft Factory)
ADI Electronics (St Marys, NSW)
ADI Marine (Garden Island, NSW)
Box Hill TAFE (Melbourne)
Communications & Energy Corp (Syracuse, NY)
Civil Aviation Authority (Canberra)
CSIRO Department of Radiophysics (NSW)
CSIRO Department of Applied Physics (NSW)
Defence Science and Technology Organisation
- Microwave Radar Division (Adelaide)
- Electronic Warfare Division (Adelaide)
- Materials Research Laboratories (Melbourne)

Department of Defence (Army, Navy, Air Force)
- Mobile Operational Technical Unit (MOTU, Garden Island, NSW)
- Directorate of Naval Communications Eng
- RANTEWSS
- RAEME Signals
- Defence Signals Directorate
- All major RAAF Base Calibration Centres

Department of Transport and Communications (Canberra)
Fairey Australia Ltd (Adelaide)
Hong Kong National Standards Laboratory
Jenkins Engineering (Sydney)
J.N.S. Electronics (Australia) Pty Ltd (Melbourne)
Mitec Australia Ltd (Brisbane)
Mt Newman Mining (for AWA in Port Hedland, WA)
NEC Australia Pty Ltd (Melbourne)
NSW Police Joint Tactical Services Group (Sydney)
NSW Police Digital Voice Privacy Section (Sydney)
OTC Australia (Sydney)
Quiktrak Technologies Pty Ltd (Adelaide)
Radio Frequency Systems Pty Ltd (Adelaide)
Radio Frequency Systems Cablewave Div (Nth Haven, CT)
Spinaway Cables (National Cables - Sydney)
Telstra Electronic Products & Services (Melb, Brisbane)
Telstra Research Laboratories (Melbourne)
Tidbinbilla Space Tracking Station (Canberra)
Transfield AMECON Ltd (Melbourne)
Universities of Melbourne, Sydney, Adelaide, Queensland and Auckland