

**VOLUME III  
SYSTEMS PHASE**

**CHAPTER 6B  
ECM AND ECCM WORKBOOK**

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USAF TEST PILOT SCHOOL  
EDWARDS AFB, CA

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ECM-ECCM

ELECTRONIC COUNTERMEASURES AND  
ELECTRONIC COUNTER-COUNTERMEASURES

COURSE HANDOUT

PHASE: Systems

HOURS: 2

ABSTRACT: Electronic Countermeasures (ECM) and Electronic Counter-Counter Measures (ECCM) is a basic introductory course into the techniques used to counter radar and electro-optical equipment. This course begins with an introduction to electronic warfare and jamming techniques, and ends with discussions on countering those jamming techniques. This course builds on the material presented in the Radar and the Electro-Optics Courses.

ASSIGNMENTS: Reading only. Listed on following pages.

REFERENCES: Radar, ECM, ECCM Principles, USAF Test Pilot School,  
Edwards AFB, CA, 1986

Stimson, George W., Introduction to Airborne Radar, Hughes  
Aircraft Company, El Segundo, CA, 1983

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ECM-ECCM

HOUR 1

Reading Assignment: Radar, ECM, ECCM Principles pg III-1 to  
pg III-19

Recommended Reading: Radar, ECM, ECCM Principles pg II-15 to  
pg II-40  
Section VI

Stimson, George W., Introduction to Airborne Radar,  
Hughes Aircraft Company, El Segundo, CA, 1983

Homework Assignment: None

OBJECTIVES: Introduction to Electronic Warfare, Noise Jamming

1. Know the purpose of ECM and ECCM.
2. Understand the concept of jamming, frequency matching, continuous interference and external factors affecting ECM.
3. Know the basic principle of noise jamming.
4. Understand the differences in barrage, spot, sweep, sweep lock-on, and coverpulse jammers; and side lobe and modulated jamming.
5. Understand the concept of low observables.

HOUR 1  
STUDENT OUTLINE

I. Purpose of ECM and ECCM

A. ECM

B. ECCM

II. Concepts

A. Enemy Defenses

B. Jamming

1. Confusion

2. Denial

C. Frequency Matching

D. Continuous Interference

E. External Factors

1. Burnthrough Range

Jammer - power:

Echo - power:

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2. Victim Radar

3. Jammer Characteristics

III. Principles of Noise Jamming

A. S/N...

B. Result

IV. Differences in Noise Jamming

A. Barrage

1. Use

2. Advantages

3. Disadvantages

4. Trend

B. Spot Jammers

1. Use
2. Advantages
3. Disadvantages
4. Trend

C. Sweep Jammers

1. Use
2. Advantages
3. Disadvantages
4. Trend

D. Sweep Lock-On Jammers

1. Use
  
2. Advantages
  
3. Disadvantages
  
4. Trend

E. Coverpulse Jammers

1. Use
  
2. Advantages
  
3. Disadvantages
  
4. Trend

F. Side Lobe Jammers

1. Use



2. Advantages

3. Disadvantages

4. Trend

G. Modulated Jamming

1. Use

2. Advantages

3. Disadvantages

4. Trends

ECM-ECCM

HOUR 2

Reading Assignment: Radar, ECM, ECCM Principles pg III-20 to  
pg III-40  
Section IV

Recommended Reading: Radar, ECM, ECCM Principles Section VII  
Section V

Homework Assignment: None

OBJECTIVES: Deception/Confusing Jamming, Expendables, and ECCM

1. Know the basic principle of deception/confusion jammers.
2. Understand the differences in the following jamming techniques: range deception, angle deception, false target generations, scan-rate modulation, inverse gain jammer, RGPO, VGPO, and combined range angle deception.
3. Know the utility of expendable jamming techniques, including chaff, flares and decoys.
4. Understand the techniques involved in monopulse and doppler radar jamming, and ECM vs radar tracking.
5. Know four primary areas targeted for ECCM.
6. Be familiar with the transmitter and receiver "fixes" for ECCM.

HOUR 2

STUDENT OUTLINE

I. Principle of Deception/Confusion Jammers

A. Principle

B. Process

C. Results

II. Differences in Following Techniques

A. Range Deception

1. Use

2. Advantages

3. Disadvantages

B. Angle Deception

1. Use

2. Advantages

3. Disadvantages

C. False Target Generation

1. Use

2. Advantages

3. Disadvantages

D. Scan Rate Modulation

1. Use

2. Advantages

3. Disadvantages

4. Trends

E. Inverse Gain Jammers

1. Use

2. Advantages

3. Disadvantages

F. RGPO

1. Use

2. Advantages

3. Disadvantages

G. Combined Range-Angle Deception

1. Use

2. Advantages

H. Velocity Gate Pull Off (VGPO)

1. Use

2. Advantages

3. Disadvantages

III. Expendables

A. Chaff

1. Background

2. Function

3. Use

4. Effectiveness

5. Operational Use

a. Pen Aid

b. Defense

6. Applications (5)

B. Flares

1. Use

2. Advantages

3. Disadvantages

C. Decoys

1. Use

2. Advantages

3. Disadvantages

IV. Special Radar Jamming Techniques

A. Monopulse

1. Why

2. Techniques

a. Denial

b. RGPO

c. Formation

d. Blinking

e. Skirt

f. Image

g. Cross Polarization

h. Cross-eye

B. Doppler

1. VGPO

V. ECCM Targets

A. Transmitter

B. Antenna



C. Receiver-Signal Processor

D. Total System (Including Operator)

VI. ECCM Fixes

A. Transmitter-Antenna

1. Adaptive Antenna
2. Angular RES Improvement
3. Antenna Gain Increase
4. Bistatic Antenna
5. Frequency Diversity
6. Low Scan Rate
7. Main Lobe Blanking
8. Monopulse Detection
9. Polarization Diversity
10. Power Increase
11. PRF Diversity
12. PRF Increase
13. Scan Diversity
14. SORO
15. Scan Rate Diversity
16. Side Lobe Cancellation
17. Side Lobe Reduction
18. Spread Spectrum Modulation

B. Receiver/Signal Processor

1. Coherent Signal Processing
2. Correlation Detection
3. Double Threshold Detection
4. Dynamic Range Increase
5. Gain Control
6. Leading Edge Tracking
7. Linear Improvement
8. Logrithm Amplification
9. Moving Target Detection
10. Noise and Jamming Cancellation
11. Predetection Discrimination
12. Predictive Tracking
13. Pulse Discrimination
14. Pulse Integration
15. Range Gating
16. Range Resolution Improvement
17. Shielding
18. Target Return Width Discrimination
19. Threshold Detection
20. Velocity Gating
21. Wideband Limiting (Dicke-Fix)
22. Zero Crossing Detection

C. Data Processing/Operational

1. Anti-ARM ECM
2. Aural Detection
3. Decoy Radiators
4. Doppler Velocity/Range Comparisons
5. Electronic Reconnaissance
6. Human Operator Monitoring and Control
7. Home-On-Jam Missiles
8. Manually-Aided Tracking
9. Missile Fuse ECCM
10. Multiple Sensor Tracking
11. Operating Time Minimization
12. Remote Location (Antenna)
13. Sensor Mobility
14. Threat Identification
15. Tracking Acceleration Limiting
16. Track-On-Jamming Signal
17. Trilateration