LIST OF ILLUSTRATIONS

FIGURE PAGE

3-1 Block Diagram of Non-Diversity Radar Receivers 3-3

3-2 Block Diagram of Frequency Diversity Radar Receivers 3-4

3-3 ASR-8 RF System Simplified Block Diagram 3-6

3-4 ASR-8 Diplexer Filter Characteristics. 3-8

3-5 ASR-8 Receiver Unit Block Diagram. 3-10

3-6 STC Waveform Generation. 3-12

3-7 Typical IF Output Time Wavefore Responses for On-Tune and Off-Tune Pulses 3-17

3-8 Signal-to-Noise Ratio Transfer Properties of a Linear Detector . .3-19

3-9 Signal-to-Noise Ratio Transfer Properties of a Square-Law Detector 3-20

3-10 Probability-Density Function for Noise Only and for Signal-Plus-Noise at the Normal Channel Envelope Detector Output 3-21

3-11 Logarithmic Amplifier-Detector Block Diagram 3-23

3-12 Log Amplifier Transfer Characteristics 3-25

3-13 Receiver Unit MTI I and MTI Q Channel. 3-28

3-14 Probability Density Function for Noise Only and for Signal-Plus-Noise at the MTI Phase Detector Output. 3-31

3-15 Processor Unit Normal Channel Block Diagram. 3-34

3-16 Log-FTC Block Diagram. 3-36

3-17 Feedback Integrator Block Diagram. 3-39

3-18 Simulated Normal Channel Unintegrated Target Return Pulse Train for a SNR = 15 dB. 3-41

3-19 Simulated Normal Channel Integrated Target Return Pulse Train for the Input Limiter Set at 1.0 Volts and a SNR = 15 dB 3-41

3-20 Simulated Normal Channel Integrated Target Return Pulse Train for the Input Limiter Set at 0.5 Volts and a SNR = 15 dB 3-42

3-21 Simulated Normal Channel Integrated Target Return Pulse Train for the Input Limiter Set at 0.34 Volts and a SNR = 15 dB. 3-42

3-22 Simulated Normal Channel Unintegrated Radar Output with Interference 3-44

3-23 Simulated Normal Channel Integrated Radar Output with Interference 3-44

3-24 ASR-7 (AN/GPN-12) Binary Integrator Block Diagram. 3-45

3-25 Hit/Miss Characteristic Curve for FAA Modified ASR-7 Enhancer. . .3-47

3-26 Simulated Binary Integrator Output for Target Return Pulse Train (ASR-7, AN/GPN-12) 3-50

3-27 Simulated FAA Modified Binary Integrator Output for Target Return Pulse Train (ASR-7). 3-50

3-28 Simulated Normal Channel Unintegrated Target Return Pulse Train for a SNR = 15 dB. 3-51

3-29 Simulated Normal Channel Integrated Target Return Pulse Train for a SNR = 15 dB. 3-51

3-30 Simulated Normal Channel Unintegrated Radar Output with Interference 3-53

3-31 Simulated Normal Channel Integrated Radar Output with Interference 3-53

3-32 Weather Background Modes 3-55

3-33 Processor Unit MTI Channel Block Diagram 3-56

3-34 Canonical Form of Simulated ASR-7 MTI Canceller. 3-58

3-35 Probability Density Function for Noise Only and for Signal-Plus-Noise at the MTI Canceller Output for a single Channel Double Stage Canceller. 3-62

3-36 Probability Density Function for Noise Only and for Signal-Plus-Noise at the MTI Canceller Output for a Dual Channel Double Stage Canceller (Simulated). 3-64

3-37 Simulated MTI Channel (Mode 1 and 2 CASC) Unintegrated Radar Output with Interference 3-67

3-38 Simulated MTI Channel (Mode 1 and 2 CASC) Radar Feedback Integrator Output with Interference for the Input Limiter Set at 2.0 Volts. 3-67

3-39 Simulated MTI Channel (Mode 1 and 2 CASC) Radar Feedback Integrator Output with Interference for the Input Limiter Set at 0.34 Volts 3-68

3-40 Simulated MTI Channel (Mode 1 and 2 CASC) Radar Binary Integrator Output with Interference 3-68

3-41 Processor Unit Alignment/Diversity Combiner Block Diagram. 3-70

4-1 Block Diagram of Radar Data Acquisition Subsystem. 4-2

4-2 Block Diagram of Radar Extractor 4-4

4-3 Block Diagram of Rank Quantizer Logic. 4-6

4-4 Block Diagram of Hit Processing Logic. 4-7

4-5 Block Diagram of Target Detection. 4-9

4-6 Block Diagram of Clutter Monitor Logic 4-10

4-7 ARTS-IIIA/RDAS MTI Channel Hit Count Threshold Control for Maintaining a Constant False Alarm Rate. 4-12

4-8 ARTS-IIIA/RDAS Probability of False Target Hit Versus Rate of Received Interference (ASR-7 Victim Radar, Normal Channel, Rank Quantizer Threshold 23). 4-18

4-9 ARTS-IIIA/RDAS Probability of False Target Hit Versus Rate of Received Interference (ASR-7 Victim Radar, Normal Channel, Rank Quantizer Threshold 24) 4-19

4-10 ARTS-IIIA/RDAS Probability of False Target Hit Versus Rate of Received Interference (ASR-7 Victim Radar, MTI Channel, Rank Quantizer Threshold 23). 4-20

4-11 ARTS-IIIA/RDAS Probability of False Target Hit Versus Rate of Received Interference (ASR-7 Victim Radar, MTI Channel, Rank Quantizer Threshold 24). 4-21

4-12 ARTS-IIIA/RDAS Probability of False Target Hit Versus Rate of Received Interference (ASR-8 Victim Radar, Normal Channel, Rank Quantizer Threshold 23). 4-22

4-13 ARTS-III/RDAS Probability of False Target Hit Versus Rate of Received Interference (ASR-8 Victim Radar, Normal Channel, Rank Quantizer Threshold 24). 4-23

4-14 ARTS-IIIA/RDAS Probability of False Target Hit Versus Rate of Received Interference (ASR-8 Victim Radar, MTI Channel, Rank Quantizer Threshold 23) 4-24

4-15 ARTS-IIIA/RDAS Probability of False Target Hit Versus Rate of Received Interference (ASR-8 Victim Radar, MTI Channel, Rank Quantizer Threshold 24). 4-25

4-16 ARTS-IIIA/RDAS Probability of False Alarm Versus Probability of False Target Hit for Various Hit/Miss Count Threshold Parameter Combinations 4-31

4-17 Probability of Target Hit Versus Signal-to-Noise Ratio for the ARTS-IIIA/RDAS connected to the ASR-7 or ASR-8 Radar Normal Channel (Rank Quantizer Thresholds 23 and 24) 4-39

4-18 Probability of Target Hit Versus Signal-to-Noise Ratio for the ARTS-IIIA/RDAS Connected to the ASR-7 Radar MTI channel (Rank Quantizer Thresholds 23 and 24). 4-41

4-19 Probability of Target Hit Versus Signal-to-Noise Ratio for the ARTS-IIIA/RDAS Connected to the ASR-8 Radar MTI Channel (Rank Quantizer Threshold 23 and 24) 4-42

4-20 ARTS-IIIA/RDAS Probability of Target Hit Versus Rate of Received Interference (ASR-7 Victim Radar, Normal Channel, Rank Quantizer Threshold 23). 4-43

4-21 ARTS-IIIA/RDAS Probability of Target Hit Versus Rate of Received Interference (ASR-7 Victim Radar, Normal Channel, Rank Quantizer Threshold 24). 4-44

4-22 ARTS-IIIA/RDAS Probability of Target Hit Versus Rate of Received Interference (ASR-7 Victim Radar, MTI CHannel, Rank Quantizer Threshold 23). 4-45

4-23 ARTS-III/RDAS Probability of Target Hit Versus Rate of Received Interference (ASR-7 Victim Radar, MTI CHannel, Rank Quantizer Threshold 24). 4-46

4-24 ARTS-IIIA/RDAS Probability of Target Hit Versus Rate of Received Interference (ASR-8 Victim Radar, Normal Channel, Rank Quantizer Threshold 23). 4-47

4-25 ARTS-IIIA/RDAS Probability of Target Hit Versus Rate of Received Interference (ARS-8 Victim Radar, Normal Channel, Rank Quantizer Threshold 24). 4-48

4-26 ARTS-IIIA/RDAS Probability of Target Hit Versus Rate of Received Interference (ARS-8 Victim Radar, MTI Channel, Rank Quantizer Threshold 23). 4-49

4-27 ARTS-IIIA/RDAS Probability of Target Hit Versus Rate of Received Interference (ASR-8 Victim Radar, MTI Channel, Rank Quantizer Threshold 24). 4-50

4-28 ARTS-IIIA/RDAS Probability of Target Detection Versus Probability of Target Hit for Rank Quantizer Threshold 23 and Various Hit/ Miss Count Threshold Parameters Combinations (Probability Scale) .4-57

4-29 ARTS-IIIA/RDAS Probability of Target Detection Versus Probability of Target Hit for Rank Quantizer Threshold 24 and Various Hit/ Miss Count Threshold Parameter Combinations (Probability Scale). .4-58

4-30 ARTS-IIIA/RDAS Probability of Target Detection Versus Probability of Target Hit for Rank Quantizer Threshold 23 and Various Hit/ Miss Count Threshold Parameter Combinations (Linear Scale) 4-61

A-1 Radar Mixer Block Diagram. A-2

B-1 ASR-8 Normal IF Bandpass Filter Schematic. B-3

B-2 "Y" Parameter Equivalent Circuit for One IF Amplifier Stage Shown in Figure B-1. . . . . .B-4

B-3 Simulated IF Output Time Waveform Envelope B-12

B-4 Simulated IF Output Time Waveform Envelope B-13

B-5 Simulated IF Output Time Waveform Envelope B-14

B-6 Simulated IF Output Time Waveform Envelope B-15

B-7 Simulated IF Output Time Waveform Envelope B-16

B-8 Simulated IF Output Time Waveform Envelope B-17

B-9 Simulated IF Output Time Waveform Envelope B-19

B-10 Simulated IF Output Time Waveform Envelope B-20

B-11 Simulated IF Output Time Waveform Envelope B-21

B-12 Measured IF Output Time Waveform B-22

B-13 Measured IF Output Time Waveform B-22

B-14 Measured IF Output Time Waveform B-22

B-15 Simulated IF Output Phase Modulation for an Off-Tuned Pulse Signal B-23

C-1 Digital MTI Channel Block Diagram. C-2

C-2 Inphase and Quadrature Digital MTI Channel Block Diagram C-3

C-3 Radar Coherent MTI Phase Detector. C-4

C-4 Probability Density Function for Noise Only and for Signal-Plus-Noise at the MTI Phase Detector Output C-10

C-5 Measured MTI Low Pass Filter Output Time Waveform. C-12

C-6 Measured MTI Low Pass Filter Output Time Waveform. C-12

C-7 Measured MTI Low Pass Filter Output Time Waveform. C-12

C-8 First-Order Nonrecursive Filter. C-14

C-9 Canonical Form of First-Order Nonrecursive Filter. C-14

C-10 Frequency Response for a Single Stage MTI Canceller. C-16

C-11 Measured Single Stage MTI Canceller Output Time Waveform. C-16

C-12 Second-Order MTI Filter with Feedback for Velocity Shaping C-19

C-13 Canonical Form of Second-Order Recursive Filter. C-19

C-14 Frequency Response for a Double Stage Canceller with Feedback. . .C-22

C-15 Measured Double Stage MTI Canceller Response to an Interfering Pulse (1 and 2 CASC Mode). C-25

C-16 Simulated Double Stage MTI Canceller Response to an Interfering Pulse (1 and 2 CASC Mode). C-25

C-17 Simulated Double Stage MTI Canceller Response to an Interfering Pulse (SCV-25 Mode). C-26

C-18 Simulated Double Stage MTI Canceller Response to an Interfering Pulse (SCV-30 Mode). C-26

C-19 Simulated Double Stage MTI Canceller Response to an Interfering Pulse (SCV-35 Mode). C-27

C-20 Simulated Double Stage MTI Canceller Response to an Interfering Pulse (SCV-40 Mode). C-27

C-21 Probability Density Function for Noise Only and for Signal-Plus Noise at the MTI Canceller Output for a Single Channel Double Stage Canceller. C-29

C-22 Probability Density Function of One-Sided Gaussian Distribution (Equation C-41). C-30

C-23 Probability Density Function for Noise Only and for Signal-Plus-Noise at the MTI Canceller Output for a Dual Channel Double Stage Canceller (Simulated). C-32

C-24 Probability Density Function of Rayleigh Distribution (Equation C-44). C-34

D-1 Feedback Integrator Block Diagram. D-3

D-2 Canonical Form of Second-Order MTI Canceller Filter Showing Noise Correlation at MTI Channel Output. D-7

D-3a Simulated Normal Channel Unintegrated Target Return Pulse Train for a SNR = 3 dB D-11

D-3b Simulated Normal Channel Integrated Target Return Pulse Train For a SNR = 3 dB (V = 2.0). D-11

D-4a Simulated Normal Channel Unintegrated Target Return Pulse Train for a SNR = 5 dB D-12

D-4b Simulated Normal Channel Integrated Target Return Pulse Train for a SNR = 5 dB (V = 2.0). D-12

D-5a Simulated Normal Channel Unintegrated Target Return Pulse Train for a SNR = 10 dB. D-13

D-5b Simulated Normal Channel Integrated Target Return Pulse Train for a SNR = 10 dB (V = 2.0) D-13

D-6a Simulated Normal Channel Unintegrated Target Return Pulse Train for a SNR = 15 dB. D-14

D-6b Simulated Normal Channel Integrated Target Return Pulse Train for a SNR = 15 dB (V = 2.0) D-14

D-7 Simulated Normal Channel Integrated Target Return Pulse Train for a SNR = 15 (V = 1.0). D-15

D-8 Simulated Normal Channel Integrated Target Return Pulse Train for a SNR = 15 (V = 0.7). D-15

D-9 Simulated Normal Channel Integrated Target Return Pulse Train for a SNR = 15 (V = 0.5). D-16

D-10 Simulated Normal Channel Integrated Target Return Pulse Train for a SNR = 15 (V = 0.34) D-16

D-11 Measured ASR-8 Normal Channel Integrated Output. D-17

D-12 Measured ASR-8 Normal Channel Integrated Output. D-17

D-13 Measured ASR-8 Normal Channel Integrated Output. D-17

D-14 ASR-7 Six Stagger Sequence D-22

D-15 ASR-8 Four Stagger Sequence. D-22

D-16 Simulated Feedback Integrator Output for Asynchronous Normal Channel Interference (V = 2.0, INR = 30 dB) D-23

D-17 Simulated Feedback Integrator Output for Asynchronous Normal Channel Interference (V = 1.0, INR = 30 dB) D-23

D-18 Simulated Feedback Integrator Output for Asynchronous Normal Channel Interference (V = 0.34, INR = 30 dB). D-24

D-19 Measured ASR-8 Integrator Output for Asynchronous Normal Channel Interference D-25

D-20 Measured ASR-8 Integrator Output for Asynchronous Normal Channel Interference D-25

D-21 Measured ASR-8 Integrator Output for Asynchronous Normal Channel Interference D-25

D-22 Simulated Normal Channel Unintegrated Radar Output with Interference D-26

D-23 Simulated Normal Channel Integrated Radar Output with Interference D-26

D-24 Simulated Feedback Integrator Output for Asynchronous MTI Channel Interference (V = 2.0, INR = 30 dB) D-28

D-25 Simulated Feedback Integrator Output for Asynchronous MTI Channel Interference (V = 1.0, INR = 30 dB) D-28

D-26 Simulated Feedback Integrator Output for Asynchronous MTI Channel Interference (V = 1.0, INR 30.0 dB) D-29

D-27 Measured ASR-8 Integrator Output for Asynchronous MTI Channel Interference D-30

D-28 Measured ASR-8 Integrator Output for Asynchronous MTI Channel Interference D-30

D-29 Measured ASR-8 Integrator Output for Asynchronous MTI Channel Interference D-30

D-30 Simulated MTI Channel (Mode 1 and 2 CASC) Unintegrated Radar Output with Interference D-31

D-31 Simulated MTI Channel (Mode 1 and 2 CASC) Integrated Radar Output with Interference D-31

D-32 ASR-7 (AN/GPN-12) Binary Integrator Block Diagram. D-33

D-33 FAA Modified ASR-7 Enhancer Block Diagram. D-35

D-34 Hit/Miss Characteristic Curve for FAA Modified ASR-7 Enhancer. . .D-36

D-35 Probability of Noise Causing a Binary 1 at the Threshold Comparator Output. D-38

D-36 Probability of 1 at the Threshold Comparator Output as a Function of the Signal-to-Noise Ratio at the Threshold Comparator Input for the Normal Channel D-44

D-37 Probability of 1 at the Threshold Comparator Output as a Function of the Signal-to-Noise Ratio at the Threshold Comparator Input for a Single Channel MTI Canceller D-46

D-38 Simulated Binary Integrator Output for Target Return Pulse Train (ASR-7, AN/GPN-12) D-50

D-39 Simulated FAA Modified Binary Integrator Output for Target Return Pulse Train (ASR-7). D-50

D-40a Simulated Normal Channel Unintegrated Target Return Pulse Train for a SNR = 3 dB. D-51

D-40b Simulated Normal Channel Integrated Target Return Pulse Train for a SNR = 3 dB. D-51

D-41a Simulated Normal Channel Unintegrated Target Return Pulse Train for a SNR = 5 dB. D-52

D-41b Simulated Normal Channel Integrated Target Return Pulse Train for a SNR = 5 dB. D-52

D-42a Simulated Normal Channel Unintegrated Target Return Pulse Train for a SNR = 10 dB D-53

D-42b Simulated Normal Channel Integrated Target Return Pulse Train for a SNR = 10 dB D-53

D-43a Simulated Normal Channel Unintegrated Target Return Pulse Train for a SNR = 15 dB D-54

D-43b Simulated Normal Channel Integrated Target Return Pulse Train for a SNR = 15 dB D-54

D-44a Simulated MTI Channel (Mode 1 and 2 CASC) Unintegrated Target Return Pulse Train for a SNR = 3 dB D-55

D-44b Simulated MTI Channel (Mode 1 and 2 CASC) Integrated Target Return Pulse Train for a SNR = 3 dB D-55

D-45a Simulated MTI Channel (Mode 1 and 2 CASC) Unintegrated Target Return Pulse for a SNR = 10 dB D-56

D-45b Simulated MTI Channel (Mode 1 and 2 CASC) Integrated Target Return Pulse Train for a SNR = 10 dB. D-56

D-46a Simulated MTI Channel (Mode 1 and 2 CASC) Unintegrated Target Return Pulse Train for a SNR = 20 dB. D-57

D-46b Simulated MTI Channel (Mode 1 and 2 CASC) Integrated Target Return Pulse Train for a SNR = 20 dB. D-57

D-47a Simulated Normal Channel Unintegrated Radar Output with Interference. D-59

D-47b Simulated Normal Channel Integrated Radar Output with Interference. D-59

D-48a Simulated MTI Channel (mode 1 & 2 CASC) Unintegrated Radar Output with Interference. D-61

D-48b Simulated MTI Channel (mode 1 & 2 CASC) Integrated Radar Output with Interference D-61

E-1 Block Diagram of Simulated ASR-7 Processor Unit. E-2

E-2 Clock Timing and Desired Signal Characteristics for ASR-7 Radar. .E-3

E-3 ASR-5 Interfering Signal Characteristics E-7

E-4 ASR-8 Interfering Signal Characteristics E-7

E-5 AN/FPS-90 Interfering Signal Characteristics E-7

E-6 Probability Density Function for Noise Only and for Signal-Plus-Noise at the Normal Channel Envelope Detector Output E-9

E-7 ASR-7 (AN/GPN-12) Binary Integrator Block Diagram. E-10

E-8 Probability Density function for Noise Only and for Signal-Plus-Noise at the MTI Phase Detector Output E-13

E-9 Canonical Form of Simulated ASR-7 MTI Canceller. E-14

E-10 Feedback Integrator Block Diagram. E-16

E-11 Simulated PPI Display of Interference. E-17

F-1 Modified Cumulative Distribution of Signal-Plus-Noise at ASR-7 Radar MTI Channel Output for Various Signal-to-Noise Voltage Ratios F-6