

CONFIDENTIAL

CIRCUITRY OF SHIPBOARD ELECTRONICS EQUIPMENT

**Prepared by
BUREAU OF NAVAL PERSONNEL**

**DOWNGRADING AT 12-YEAR INTERVALS
NOT AUTOMATICALLY DECLASSIFIED
DOD DIR 5200.10**

NAVPERS 10787

CONFIDENTIAL

PREFACE

Circuitry of shipboard electronics equipment is written primarily for electronics officers (LDO's). It is one of the officer texts replacing Naval Electronics Part I, II, and III and should provide invaluable aid to anyone who desires more knowledge of the system described.

This text contains block diagram and circuit analysis of the principal representative shipboard electronic equipments presently in use. Circuitry of Shipboard Electronic Equipment was prepared by the Navy Training Publication Center, Washington, D. C., which is a field activity of the Bureau of Naval Personnel.

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1962

CONTENTS

CHAPTER	PAGE
1. Countermeasures, AN/WLR-1	1
2. Operating principles of a representative uhf radio transmitter TED series.	31
3. Operating principles of a representative vhf radio communications receiver, AN/URR-27.	57
4. Operating principles of a representative uhf radio communications receiver, AN/URR-35A.	75
5. Electronic aids to navigation: Tacan, AN/SRN-6 (Part I)	94
6. Electronic aids to navigation: Tacan, AN/SRN-6 (Part II)	120
7. Operating principles of a representative uhf transceiver, AN/GRC-27A.	146
8. Operating principles of a representative ssb radio transceiver, AN/URC-32 (Part I)	181
9. Operating principles of a representative ssb radio transceiver, AN/URC-32 (Part II).	203
10. Operating principles of a representative surface search radar, AN/SPS-10D (Part I).	222
11. Operating principles of a representative surface search radar, AN/SPS-10D (Part II)	241
12. Operating principles of a representative air search radar, AN/SPS-29 (Part I).	259
13. Operating principles of a representative air search radar, AN/SPS-29 (Part II)	291
14. Operating principles of a hemispherical scan radar, AN/SPS-42 (Part I).	311
15. Operating principles of a hemispherical scan radar, AN/SPS-42 (Part II)	343
16. Operating principles of a representative h-f radio transmitter, AN/WRT-2	361
INDEX	381

INDEX

- Acquisition scope, countermeasures receiving set, AN/WLR-1, 18
- A-f-c, surface search radar, 245
- AGC-silencer amplifier, UHF radio receiver, AN/URR-35A, 89
- Air search radar, AN/SPS-29, 259-290
 block diagram, 264-267
 functional description, 259-290
 component parts, diagrams of, 260-263
 low voltage section, 308
 modulating section, 269-273
 monitoring section, 304-308
 horizon section, 306
 power supplies, 307
 vertical section, 306
 ranging functional section, 299
 range indicator, 299-303
 receiving functional section, 291-299
 control monitor group, 296-299
 radar receiver, 291-296
 transmitting section, 273-290
 antenna, 288-290
 buffer amplifier, 275-279
 duplexer, 283
 exciter, 275
 power amplifier, 280
 power and vswr monitor, 284-286
 radio frequency amplifier, 279
 rotating joint of antenna pedestal, 287
 transmission line tuner, 286
 water cooling system, 281
 trigger generating circuit, 267-269
 trigger generator section, 267
- Amplifier
 bearing magnetic, AN/SRN-6, 140-142
 circuits, radio set, AN/GRC-27A, 163
 modulator, AN/SRN-6, 133
 radio frequency, radar set, AN/SPS-29, 262
 surface search radar, 246
 SSB, transceiver, AN/URC-32, 220, 221
 stages, UHF radio receiver AN/URR-35A, 89
 UHF radio transmitter TED series, 37
- Amplifiers
 h-f radio transmitter AN/WRT-2, 372
 feedback, 368
 power, 372
 radiofrequency, 373
 i-f, Tacan, AN/SRN-6, 115, 123
 i-f, countermeasures receiving set, AN/WLR-1, 8
 receiver, surface search radar, 251
 r-f radio receiver, AN/URR-35A, 79
 scan radar, 345
- Antenna
 and microwave section, scan radar, 344
 assembly and antenna control circuits, surface search radar, 239
- Antenna--continued
 construction and antenna patterns, AN/SRN-6, diagram of, 97
 input, UHF radio receiver AN/URR-35A, 78
 input, VHF radio receiver, AN/URR-27, 61
 positioning section, scan radar, 355-357
 speed control, Tacan, AN/SRN-6, 135
 synchronization oscillator, AN/SRN-6, 127
 system, AN/SRN-6, 108
 tuner, h-f radio transmitter, AN/WRT, 372
- Antistickoff voltage, AN/SRN-6, 142
- AN/URR-27, VHF radio communications receiver set, 57-74
 block diagram, 60
 circuit analysis, 61
 comparison with the AN/URR-21, 71
 I-F amplifiers, 64-71
 if/af section, 64
 preselector section, 61-64
 general description of, 57-60
 operational uses of, 73
- Audio
 amplifier circuits, AN/GRC-27A, 163
 amplifier stages, AN/URR-35A, 91-93
 amplifiers, UHF radio transmitter, TED series, 42
 and AVC circuits, UHF radio transmitter, ted series, 39
 and control unit SSB radio receiver AN/URC-32, 183-188
 block diagram, 183
 circuit operation, 186
 speaker amplifier, 187
 detector, VHF radio receiver AN/URR-27, 65
 frequency circuits, VHF radio receiver AN/URR-27, 69
 monitoring circuit, UHF radio transmitter, TED series, 48
- Automatic gain control, scan radar, 348
- Autopositioner, radio receiver, R-278B/GR, 153
- Autopositioner UHF transceiver, AN/GRC-27A, 153
- AVC circuit, UHF radio transmitter, TED series, 40
- AVC rectifier circuit, VHF radio receiver AN/URR-27, 68
- Azimuth indicator-pulse analyzer, countermeasures receiving set AN/WLR-1, 17
- Azimuth-range indicating section (PPI), 357-359
- Band suppression filter, VHF radio receiver AN/URR-27, 71
- Beacon a-f-c circuit, 248-251
- Beam pattern, scan radar, 353
- Bearing, Tacan AN/SRN-6
 components, scan radar, 330
 servo system, 109,140

- Bias rectifier
 - surface search radar, 247
 - UHF radio transmitter series, TED, 50
- Binary number system, scan radar, 321
- Blanking gate circuits, Tacan
 - AN/SRN-6, 117
- Blower, thermostat and primary circuits,
 - VHF radio receiver AN/URR-27, 71
- Broadside beam, scan radar, 340
- Butler oscillator, UHF radio transmitter
 - TED series, 36

- Cabinet, radio receiver set, AN/URR-35A, 76
- Cable filter section, VHF radio receiver
 - AN/URR-27, illustration of, 59
- Capacitor, UHF radio transmitter TED series, 41
- Carrier-control circuit, UHF radio transmitter, TED series, 44
- Carrier generating chain, Tacan, AN/SRN-6, 112
- Carrier-operated relay and squelch circuit, radio transmitter, TED series, 161
- Chassis, radio receiver set, AN/URR-35A, 76
- Circuit analysis
 - radio transmitter TED series, 36
 - UHF radio receiver AN/URR-35A, 78
 - VHF radio receiver AN/URR-27, 61
- Clipper circuit, UHF radio transmitter, TED series, 40
- Clutter gate, scan radar, 349
- Coder indicator, Tacan AN/SRN-6, 104
 - functions of, 120
- Coherent oscillator, scan radar, 346
- Control circuits, SSB radio receiver, AN/URC-32, 200-202
- Control-duplexer, AN/SRN-6, 107, 134
- Control indicator of radar set, AN/SPS-29, 263
- Control-storer, AN/WLR-1, 26
- Countermeasures receiving set, AN/WLR-1, 1-30
 - analysis indicator presentations, diagram of, 3, 4
 - block diagram, 5
 - circuit analysis, 6
 - acquisition scope, 18
 - analysis scope, 20-22
 - azimuth indicator-pulse analyzer, 17
 - control-storer, 26
 - frequency converter, 2, 13
 - frequency discriminator, 15
 - r-f transmission line switch, 10
 - panoramic display, 25
 - surface-to-air missile reports, 242-244
 - video input circuits, 18
- Crystal oscillator
 - 1-mc, H-F radio transmitter, AN/WRT-2, 364
- C-w and fsk unit, SSB radio receiver
 - AN/URC-32, 197-200

- Data-stabilization section, scan radar, 357
- Dead time stages, scan radar, 348
- Delay line, scan radar, 351
- Detector and noise limiter, UHF radio receiver, AN/URR-35A, 89
- Direction finding, electronic countermeasures receiving set, AN/WLR-1
 - displays, 22
 - horizontal waveforms, 24
- Doubler, UHF radio transmitter, TED series, 37
- Driver stages, radio set, AN/GRC-27A, 173
- Dynamic handset, SSB radio receiver, AN/URC-32, 183

- Electrical frequency control circuit, H-F radio transmitter, AN/WRT-2, 364
- Electronic aids to navigation, TACAN (Tactical Aids to navigation), AN/SRN-6, 94-119
 - block diagram, 102-111
 - antenna system, 108-111
 - code-indicator, 104
 - control-duplexer, 107
 - receiver, 102
 - transmitter, 105
 - circuit analysis of radio receiver, 111
 - blanking gate circuits, 117
 - carrier generating chain, 112
 - ferris discriminator, 115
 - intermediate frequency amplifiers, 115
 - metering circuit, 118
 - mixer, 112
 - power supplies, 118
 - preamplifier stages, 114
 - squitter control circuit, 118
 - video amplifier stages, 116
 - general description, 94-102
 - antenna construction and patterns, 97
 - major components of, diagram, 95
 - reference burst pulser assembly, illustration, 98
 - roll and pitch servo system, 143-145
- Electronic radio set, Tacan (Tactical aid to navigation), AN/SRN-6, 94-119
 - antenna speed control, 135
 - power amplifier, 139
 - voltage magnetic preamplifier, 137-139
 - bearing servo system, 140
 - antistickoff voltage, 142
 - bearing magnetic amplifier, 140-142
 - block diagram, 102-111
 - antenna system, 108-111
 - code-indicator, 104
 - control-duplexer, 107
 - receiver, 102
 - transmitter, 105
 - circuit analysis of radio receiver, 111
 - blanking gate circuits, 117
 - carrier generating chain, 112
 - ferris discriminator, 115
 - intermediate frequency amplifiers, 115
 - metering circuit, 118
 - mixer, 112

- Electronic radio set, Tacan (tactical aid to navigation), AN/SRN-6--continued
 power supplies, 118
 preamplifier stages, 114
 squitter control circuit, 118
 video amplifier stages, 116
 coder-indicator, 120-127
 antenna synchronization oscillator, 127
 encoding delay line and output amplifiers, 123
 identification code circuits, 124-127
 reference burst generator stages, 120-123
 control-duplexer, 134
 frequency multiplier-oscillator, 127-134
 amplifier-modulator, 133
 video chassis, 128-133
 Elevation beam, scan radar, 341
 Elscan computer program, scan radar, 322
 Elscan terminology and timing signals, 322-327
 CV-MTI mode, 327
 elevation scan positions, diagram, 324
 normal MTI mode, 324
 video mode, 326
 Exciter stages, radio set AN/GRC-27A, 171
 Fast automatic gain control, scan radar, 348
 Filament-heater and plate screen supply, VHF radio receiver AN/URR-27, 71
 Flip-flop circuits, hemispherical scan radar, 318
 Frequency
 converters, countermeasures AN/WLR-1, 10-15
 converter tuner, countermeasures AN/WLR-1, 7
 counter, 321
 discriminator, 15
 generator, SSB transceiver, AN/URC-32, 203
 indicator, AN/WLR-1, 30
 multiplier-oscillator, AN/SRN-6, 127
 selector system, UHF transceiver AN/GRC-27A, 152
 Gain control, scan radar, 348
 Generator, modulator pulse, surface search radar, 230
 Geometry, stabilization, scan radar, 328
 Handset adapter, SSB radio receiver AN/URC-32, 183
 Hemispherical scan radar, AN/SPS-42, 311-341
 antenna positioning section, 355-357
 general description, 311-314
 transmitting function, 331
 antenna, 337-341
 modulator channel, 332
 r-f channel, 333
 traveling wave tube, 334-337
 H-F radio transmitter, AN/WRT-2, 361
 general description, 361
 master oscillator-frequency multiplier circuit analysis, 369
 H-F radio transmitter, AN/WRT-2--continued
 frequency multiplier circuits, 376
 master oscillator, 369
 modulating section, 370
 block diagram, 370-372
 overall block diagram, 361
 power amplifier and antenna section, 372
 block diagram, 373
 circuit analysis, 374-378
 power supply section, 378
 r-f generating section, 363
 detailed block diagram, 364
 interpolation oscillator, 368
 master oscillator-phase detector, 366-368
 100-kc phase detectors, 368
 Identification code circuits, AN/SRN-6, 124-127
 I-f amplifiers
 bandwidth circuit, surface search radar, 253
 countermeasures, AN/WLR-1, 8, 10
 scan radar, 345
 UHF radio communications receiver, AN/URR-35A, 86
 VHF radio receiver, AN/URR-27, 64
 I-f oscillator, radio set, AN/GRC-27A, 168
 Indicating function, scan radar, 357
 Indicator adapter, search radar, 256
 Injection system, radio set AN/GRC-27A, 154
 Intermediate frequency amplifiers, AN/SRN-6, 115
 Interpolation oscillator, H-F radio transmitter, AN/WRT-2, 368
 Isolation amplifier, SSB radio transceiver AN/URC-32, 221
 Local oscillator, countermeasures, AN/WLR-1, 9
 Logical algebra, 315
 Logic circuits, hemispherical scan radar, 316-320
 Low voltage rectifier, UHF radio transmitter series, TED, 50
 Master circuit, air search radar, 292
 Master oscillator, H-F radio transmitter, AN/WRT-2, 369
 Master oscillator-phase detector, H-F radio transmitter, AN/WRT-2, 366
 Metering circuits
 surface search radar, 257
 Tacan, AN/SRN-6, 118
 UHF radio transmitter series, TED series, 51
 VHF radio receiver, AN/URR-27, 64
 Meter readings for aircraft positions, AN/SRN-6, 100
 Mixer and i-f amplifier stages, UHF transceiver, AN/GRC-27A, 156-160
 Mixer-preamplifier, scan radar, 344
 Mixer, Tacan, AN/SRN-6, 112
 Modulating section
 air search radar, AN/SPS-29, 269
 H-F radio transmitter, AN/WRT-2, 370-372

- Modulator-power supply, UHF transceiver, 176
 audio input circuit, 177
 audio stages, 178
 mcw oscillator circuit, 178-180
- Modulator, surface search radar, AN/SPS-10D, 226
- Moving target indicator, scan radar, 352
- Multipliers, UHF radio communications receiver, AN/URR-35A, 78
- Narrow band operator, countermeasures, AN/WLR-1, 12
- Navigation aids, electronic, radio set AN/SRN-6, 94-119
 block diagram, 102-111
 antenna system, 108-111
 code-indicator, 104
 control-duplexer, 107
 receiver, 102
 transmitter, 105
 circuit analysis of radio receiver, 111
 blanking gate circuits, 117
 carrier generating chain, 112
 ferris discriminator, 115
 intermediate frequency amplifiers, 115
 metering circuit, 118
 mixer, 112
 power supplies, 118
 preamplifier stages, 114
 squitter control circuit, 118
 video amplifier stages, 116
 general description of, 94-102
 antenna construction and patterns, 97
 major components of, diagram, 95
 reference burst pulser assembly, illustration, 98
- Noise cancellation detector, radio set AN/GRC-27A, 160
- Noise circuits and noise figure check, air search radar, AN/SPS-29
- Noise limiter, VHF radio receiver AN/URR-27, 65-68
- Nuclear warheads, 18
- Oscillator-multiplier section, UHF radio receiver, AN/URR-35A, 82
- Oscillator-multiplier, VHF radio receiver, AN/URR-27, 63
- Oscillators
 amplifier, scan radar, 333
 Butler radio transmitter, TED series, 36
 countermeasures, AN/WLR-1, 7
 H-F radio transmitter, AN/WRT-2
 interpolation, 368
 master, 363
 master oscillator-frequency multiplier circuit analysis, 369
 master oscillator-phase detector, 366
 1-mc crystal, 364
 radio frequency, 363-365
 radio receiver, UHF, AN/URR-35A, 77
 local, 82
 radio set, i-f, AN/GRC-27A, 168
 radio transmitter, MCW, UHF, TED series, 44
- Oscillators--continued
 radio transmitter
 repetition rate, surface search radar, 229-232
 scan radar, 346
 Tacan, AN/SRN-6, 127
 transceiver, SSB, AN/URC-32
 master, 214
 reference, 219
 sidestep, block diagram, 215-217
 stabilized master, 212-214
- Panoramic display, AN/WLR-1, 25
- Peak detector, search radar, 246
- Phantastron circuit, surface search radar, 247
- Phase sensitive detector, AN/SRN-6, 135
- Pitch and roll compensation, scan radar, 330
- Power amplifier
 and antenna section, H-F radio transmitter, AN/WRT-2, 372-378
 block diagram, 373
 circuit analysis, 374-378
 AN/SRN-6, 139
 radio set, AN/GRC-27A, 173
 SSB transceiver, AN/URC-32, 207-209
- Power supply
 AN/SRN-6, 118
 section, H-F radio transmitter, AN/WRT-2, 378
 SSB transceiver, AN/URC-32, 209-212
 UHF radio transmitter, TED series, 49
 VHF radio receiver AN/URR-27, 71
- PPI video amplifiers, 297
- Preamplifier
 scan radar, 344
 stages, AN/SRN-6, 114
 voltage magnetic, AN/SRN-6, 137
- Preselector section, VHF radio receiver, AN/URR-27, 61
- Pulse amplifier, surface search radar, 246
- Pulse stretcher circuit, diagram, 21
- Radar
 antenna, sinous feed assembly, scan radar, diagram, 338
 beam pattern, scan radar, 353
 beam stabilization geometry, scan radar, 328
 indicator, hemispherical scan radar, 358
 receiver, air search radar, AN/SPS-29, 259-290
 receiver, surface search radar, 241
- Radio
 receiver R-278B/GR, 149
 receiver set, AN/URR-21A, 71
 comparison with AN/URR-27, 71
 diagram of, 73
 receiver set, UHF, AN/URR-35A, 75-93
 block diagram, 75-78
 receiver set, Tacan, AN/SRN-6, 94-145
 block diagram, 102-111
 circuit analysis of radio receiver, 111-118
 general description, 94-102
 roll and pitch servo system, 143-145

- Radio--continued
- receiver set, UHF, AN/URR-35A, 75-93
 - block diagram, 75-78
 - circuit analysis, 78-93
 - general description of, 75
 - receiver set, VHF, AN/URR-27, 57-74
 - block diagram, 60
 - circuit analysis, 61
 - general description of, 57-60
 - operational uses of, 73
 - transceiver set, SSB, AN/URC-32, 181-221
 - audio and control unit, 183-188
 - block diagram, 181
 - control circuits, 200
 - c-w and fsk unit, 197-200
 - dynamic handset, 182
 - frequency divider, 217-219
 - frequency generator, 203
 - handset adapter, 183
 - isolation amplifier, 221
 - power amplifier, 207-209
 - power supply, 209-212
 - reference oscillator, 219-221
 - r-f tuner block diagram, 203-207
 - sideband generator, 188
 - sidestep oscillator, block diagram, 215-217
 - stabilized master oscillator, 212-215
 - transceiver set, UHF, AN/GRC-27A, 146-180
 - description of, 146
 - frequency selector system, 152
 - modulator-power supply, 176
 - radio transmitter, T-217A/GR, 165-167
 - receiver block diagram, 147-152
 - receiver circuit operation, 167
 - transmitter set, H-F, AN/WRT-2, 361-379
 - general description, 361
 - master oscillator-frequency multiplier circuit analysis, 369
 - modulating section, 370
 - overall block diagram, 361
 - power amplifier and antenna section, 372-378
 - power supply section, 378
 - r-f generating section, 363-368
 - transmitter set, T-217A/GR, 165
 - transmitter set, UHF, TED series, 31-56
 - audio monitoring circuit, 48
 - basic similarities in model TED series equipments, 55
 - block diagram, 32-36
 - carrier-control circuit, 44
 - general description of, 31
 - metering circuit, 51-55
 - power supplies, 49-51
 - volume expander, 46
- Receivers, radio
- AN/URR-21A, 71
 - R-278B/GR, 149
 - Tacan, AN/SRN-6, 94-119
 - UHF, AN/URR-35A, 75-93
 - VHF, AN/URR-27, 57-74
- Receiving functional section, air search radar, AN/SPS-29, 291-299
- Receiving functional section, air search radar, AN/SPS-29--continued
 - control monitor group, 296-299
 - noise circuits and noise figure check, 298
 - PPI video amplifiers, 297
 - range video amplifier, 297
 - video detector circuits, 296
 - video preamplifier, 297
 - radar receiver, 291-296
 - bias pulser, 292
 - i-f amplifiers, 295
 - meter circuit, 292-295
 - mixer-local oscillator, 292
 - r-f amplifiers, 291
- Receiving function, hemispherical scan radar, 343
- antenna and microwave section, 344
 - clutter gate, 349-352
 - i-f amplifiers, 345-349
 - mixer-preamplifier, 344
 - moving target indicator, 352
 - receiving section inputs, 343
- Receiving set, countermeasures, AN/WLR, 1-30
- Reference
- burst generator stages, AN/SRN-6, 120-123
 - burst pulses assembly, AN/SRN-6, 97
 - oscillator, SSB transceiver, AN/URC-32, 219-221
- Repetition rate oscillator, surface search radar AN/SPS-10D, 229
- R-f amplifiers
- air search radar, 291
 - radio set, AN/GRC-278, 154
 - scan radar, 332-334
 - UHF radio receiver, AN/URR-35A, 79
 - VHF radio receiver, AN/URR-27, 61
- R-f and injection frequencies for various dial readings, chart of, 151
- R-f monitoring circuits, H-F radio transmitter, AN/WRT-2, 375
- R-f transmission line switch, countermeasures, AN/WLR-1, 10
- R-f tuner, block diagram, SSB transceiver, AN/URC-32, 203-207
- transmit function, 206
- Roll and pitch servo systems, 143
- Tacan, AN/SRN-6, 143
- Scan-channel amplifier, UHF radio receiver, AN/URR-35A, 88
- Scan operation, countermeasures, AN/WLR-1, 27
- Scan radar, hemispherical, AN/SPS-42, 311-341
- antenna positioning section, 355-357
 - general description, 311-314
 - indicating function, 357
 - azimuth-range indicating section (PPI), 357
 - data-stabilization section, 357
 - slant-range and height indicating section, 358
 - receiving function, 343
 - side lobe suppression section, 353
 - synchronizing function, 314-331

- Scan radar, hemispherical--continued
 binary-number system, 320
 elscan computer programmer, 322
 elscan terminology and timing signals, 322-327
 frequency counter, 321
 logical algebra, 315
 logic circuits, 316-320
 space-stabilization geometry, 327-331
 transmitting function, 331
 antenna, 337-341
 modulator channel 332
 r-f channel, 333
 traveling wave tube, 334-337
- Sensitivity-time channel, scan radar, 347
- Sensitivity time control circuit, surface search radar, 254
- Servo systems, AN/SRN-6, 108-111, 143
- Shunt noise limiter, radio set, AN/GRC-27A, 160
- Sideband generator, SSB, AN/URC-32, 188-197
 receive circuit, 193-197
 receive function, 189
 transmit circuit, 189-193
 transmit function, 188
- Side lobe suppression section, scan radar, 353-355
- Sidestep oscillator, SSB radio transceiver, AN/URC-32, 215-219
 functional description, 217
 twenty-kilocycle divider circuit, 217-219
- Silencer amplifier, UHF radio receiver, AN/URR-35A, 89
- Silencer, UHF radio receiver, AN/URR-35A, 91
- Slant-range and height-indicating section, 358
- Space-stabilization geometry, scan radar, 327-331
- Squelch circuits
 radio receiver, AN/URR-35A, 91
 radio set, AN/GRC-27A, 161
- Squitter control circuit, AN/SRN-6, 118
- Stabilized master oscillator, SSB transceiver, AN/URC-32, 212-215
- Storage channel pushbutton mechanism, AN/WLR-1, 28
- Surface search radar, AN/SPS-10D, 222-258
 antenna assembly and antenna control circuits, 239, 240
 block diagram, detailed, 222-226
 general description, 222
 indicator adapter, 256
 meter circuits, 257
 modulator, 226-232
 block diagram, 227-229
 blocking oscillator, 230
 limiter-shaper, 230
 modulator pulse generator, 230-232
 repetition rate oscillator, 229
 radar receiver, 241
 beacon a-f-c circuit, 248-251
 block diagram, detailed, 243
 circuit operation, 243
 i-f amplifier bandwidth selection circuit, 252
- Surface search radar, AN/SPS-10D--continued
 mixer assembly, 244
 radar a-f-c circuit, 245-248
 receiver i-f amplifiers, 251
 sensitivity-time control circuit, 254-256
 video circuit, 252
 transmitter, 232-239
 block diagram, 232
 circuit analysis, 233-235
 directional coupler and echo box, 237-239
 microwave switching, 235-237
- Switch tubes, scan radar, 351
- Synchronizing function, hemispherical scan radar, 314
 binary-number system, 320
 elscan terminology and timing signals, 322-327
 frequency counter, 321
 logic circuits, 316-320
- Target indicator, scan radar, 352
- Target position information, scan radar, 329
- Thyratron trigger amplifier, air search radar, AN/SPS-29, 271
- Time
 base circuits, air search radar, 299
 control channel, scan radar, 347
 control circuit, surface search radar, 254-256
- Transceiver, SSB, AN/URC-32
 audio and control unit, 183-188
 block diagram, 183-186
 circuit operation, 186-188
 block diagram, 181
 control circuits, 200
 c-w and fsk unit, 197-200
 dynamic handset, 182
 frequency divider, 217-219
 frequency generator, 203
 handset adapter, 183
 isolation amplifier, 221
 power amplifier, 207-209
 power supply, 209-212
 reference oscillator, 219-221
 r-f tuner block diagram, 203-207
 sideband generator, 188
 receive circuit, 193-197
 receive function, 189
 transmit circuit, 189-193
 sidestep oscillator, block diagram, 215-217
 stabilized master oscillator, 212-215
- Transceiver, UHF, AN/GRC-27A, 146-180
 description of, 146
 frequency selector system, 152
 autopositioner, 153
 preset panel, 152
 modulator-power supply, 176-180
 audio input circuit, 177
 output network, 174
 power amplifier, 173
 radio transmitter, T-217A/GR, 165-167
 receiver block diagram, 147-152
 radio receiver, R-278B/GR, front panel controls, 148
 r-f and injection frequencies for various dial readings, 151

- Transceiver, UHF, AN/GRC-27A--continued
 receiver circuit operation, 154-165
 audio amplifier circuits, 163
 audio detector, series noise limiter,
 and AVC stages, 157
 carrier-operated relay and squelch
 circuit, 162
 delayed automatic volume control,
 160-162
 first injection system, 154
 first mixer and first i-f amplifier
 stages, 156
 noise cancellation detector, 160
 r-f amplifiers, 154
 second injection system, and second
 mixer, 157
 shunt noise limiter, 160
 third mixer-oscillator, 157
 transmitter circuit operation, 167-176
 audio input circuit, 177
 driver, 173
 exciter, 171-173
 i-f oscillator, 168
 main oscillator and frequency multiplier-
 amplifier, 167
 output network, 174
 power amplifier, 173
 transmitter power and control circuits,
 175
- Transmitter
 circuit operation, radio set, AN/
 GRC-27A
 driver, 173
 exciter, 171-173
 i-f oscillator, 168-171
 main oscillator and frequency
 multiplier-amplifier, 167
 output network, 174
 power amplifier, 173
 transmitter power and control circuits,
 175
- Transmitter--continued
 group of radar set, AN/SPS-29, 261
 power and control circuits, radio set,
 AN/GRC-27A, 175
 pulse sequence, Tacan, AN/SRN-6, 130
 surface search radar, 232-239
 block diagram, 232
 circuit analysis, 233
 directional coupler and echo box,
 237-239
 microwave switching, 235-237
 Tacan, AN/SRN-6, 105
- Transmitting function, scan radar, 331
 antenna, 337-339
 modulator channel, 332
 r-f channel, 333
 traveling wave tube, 334-337
- Traveling wave tube, scan radar, 334-337
 microwave circuits and antenna, 336
 structural drawing, 334
- Trigger generator section, air search
 radar, AN/SPS-29, 267
- Tripler power amplifier, UHF radio trans-
 mitter, TED series, 38
- Tuning mechanism, countermeasures,
 AN/WLR-1, 8
- Video amplifier stages, Tacan, AN/SRN-6,
 116
- Video chassis, AN/SRN-6, 128
- Video circuits
 countermeasures, AN/WLR-1, 18
 detector, Air search radar, 296
 surface search radar, 252-254
- Voltage, antistickoff, Tacan, AN/SRN-6,
 142
- Voltage, magnetic preamplifier, Tacan,
 AN/SRN-6, 137
- Volume control, radio set, AN/GRC-27A, 160
- Volume expander circuit, UHF radio trans-
 mitter, TED series, 46