EXHIBIT NO. 1

Contract: DAAD07-84-C-0094

Issued by: U.S. Army White Sands Missile Range
White Sands Missile Range, New Mexico 88005

This contract "sets forth the requirements for design, fabrication, testing and performance of a Multiple Object Tracking Radar (MOTR) system. This system will provide position data on multiple tracked targets".

"Each MOTR will track as many as 10 objects. A major advantage of the MOTR is that mission tracks can be controlled and observed from a single location, enabling the radar operator to make rapid priority decisions during operations."

RCA

Industry Leader in

PRECISION

INSTRUMENTATION

RADAR

SYSTEMS

Introduces

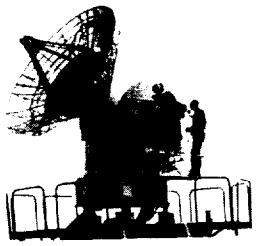
MOTR

1950

AN/FPQ-4

USN Bumblebee/land-based TALOS used monopulse tracking, conical lobing for capture, and skew lobing for guidance; four built.

AN/FPS-16

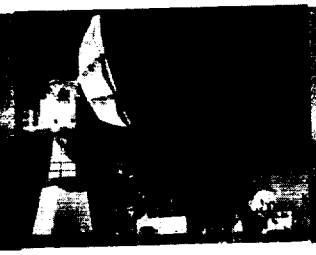


First specifically designed instrumentation radar with monopulse feed; 50 built.

AN/MPS-25

Mobile version of the AN/FPS-16, first hydraulic drive antenna pedestals; seven built.

AN/FPQ-6

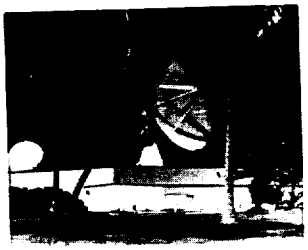


Missile Precision Instrumentation Radar (MIPIR); first with embedded, programmable computer, 20-bit angle encoders, cassegrain antenna.

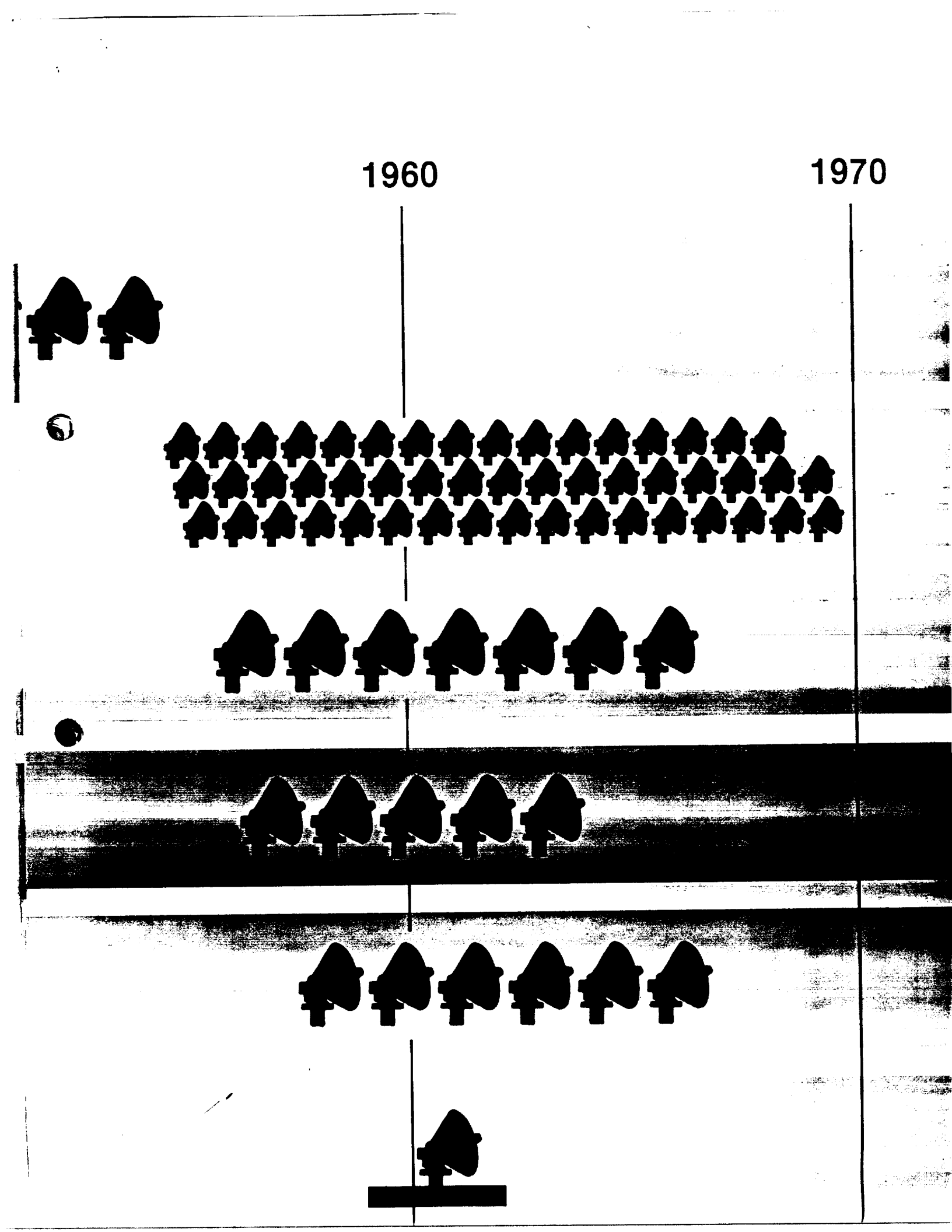
AN/TPQ-18

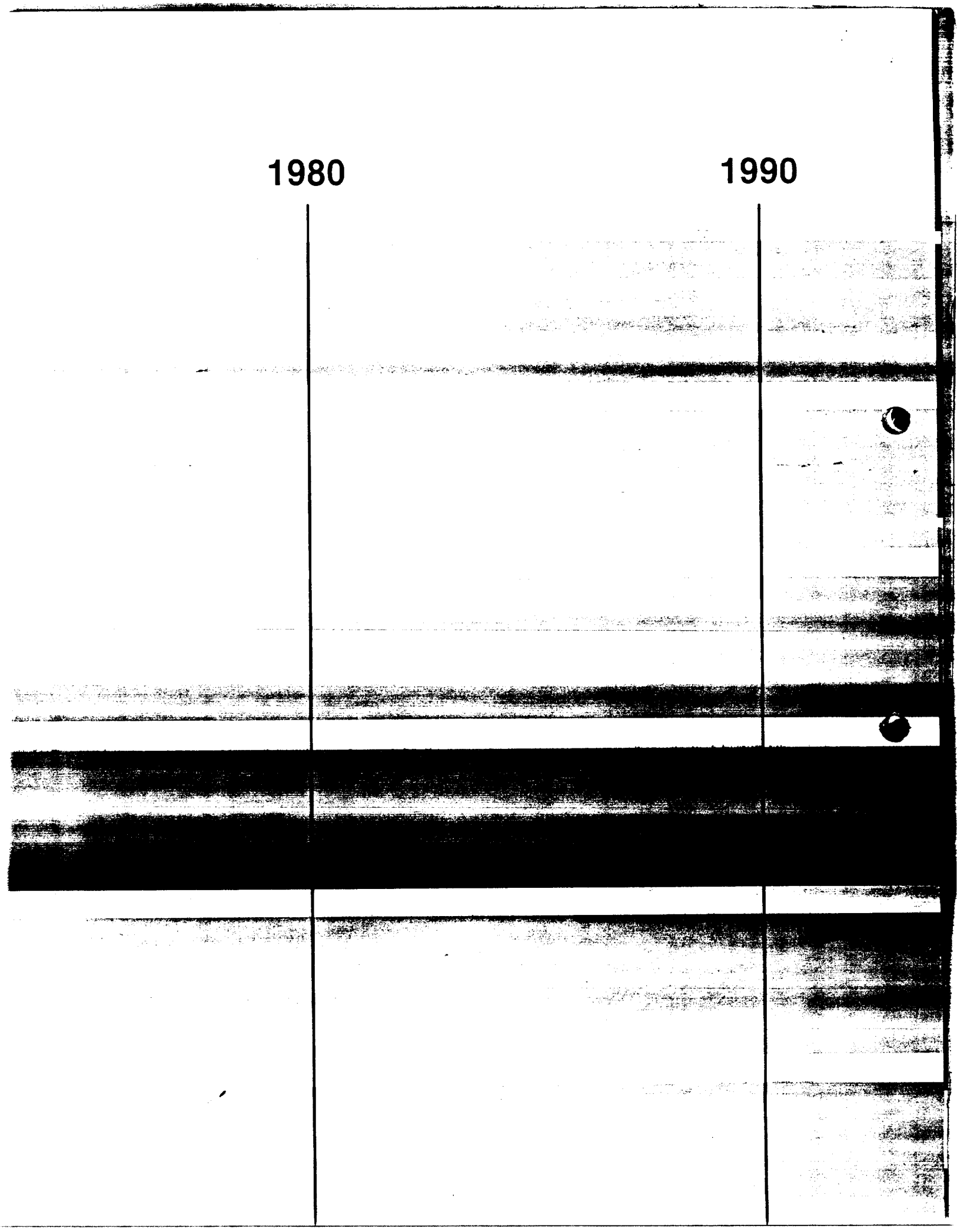
Relocatable version of AN/FPQ-6; six built.

TRADEX



Computer-controlled special purpose satellite tracking radar; one built.


1960
1970


1980
1990

ADVANCED TECHNIQUES INTRODUCED

1955 — Monopulse feed on AN/FPS-16 Instrumentation Radar.

1958 — Nth time-around digital range machine (DIRAM).

1959 — Cassegrain antenna feed; semi-monocoque antenna reflector; single-speed 20-bit digital encoder; embedded programmable digital computers; built-in static and dynamic digital error correction; console-selectable linear, circular antenna polarization; sidelobe tracking indicator; beam broadener — Features of AN/FPQ-6 and AN/TPQ-18 MIPIR Radars.

1960 — First shipboard-installed AN/FPS-16 (TAGM-1) with ship motion compensation. Eight additional radars were shipmounted: 3 FPS-16s; 1 MPS-25; 2 FPQ-4s and 2 FPS-105s.

1960 — Computer controlled closed servo-loop angle tracking — Feature of TRADEX (Target Resolution and Discrimination Experiment) Radar.

1960 — Common aperture, multi-frequency feed antenna.

1962 — Pulse doppler.

1962 — First integrated circuit instrumentation radar, AN/FPS-105 (CAPRI).

1963 — "On-axis" tracking and star calibration. "Feed-forward" tracking techniques to improve real-time tracking accuracy.

1964 — Monopulse, sngle-horn, high-gain antenna feed — AN/FPS-16 (ASIR).

1968 — First instrumentation radar with built-in pulse doppler — AN/MPS-36.

1971 — Digital computer supervised instrumentation radar — AN/TPQ-39(V) DIR.

1975 — Combined microwave radar and laser tracker instrumentation system.

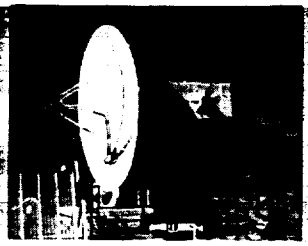
1975 — Combined digital radar with Nike-Hercules antenna subsystem.

1978 — Solid state subsystem modernization retrofits to existing radar (universal range trackers, data subsystems, receivers, servo systems, etc.)

1980 — Off-line star-calibration for precision measurement radars and optical equipment.

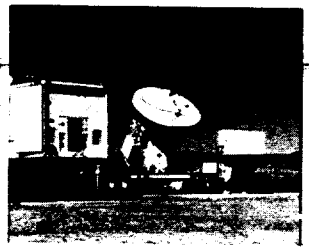
1983 — Solid-state, computer generated "smart" displays.

AN/FPS-105



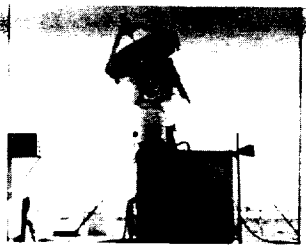
Compact All-Purpose Range Instrument (CAPRI), first integrated circuit instrumentation radar; five built.

AN/MPS-36



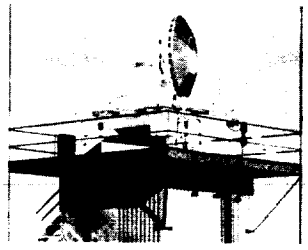
First instrumentation radar with built-in pulse doppler, featured rapid change from mobile to operational status; 14 built.

AN/TPQ-39(V) DIR



Digital Instrumentation Radar (DIR), first instrumentation radar to use digital computer to provide radar subsystem functions (range target detection); five built.

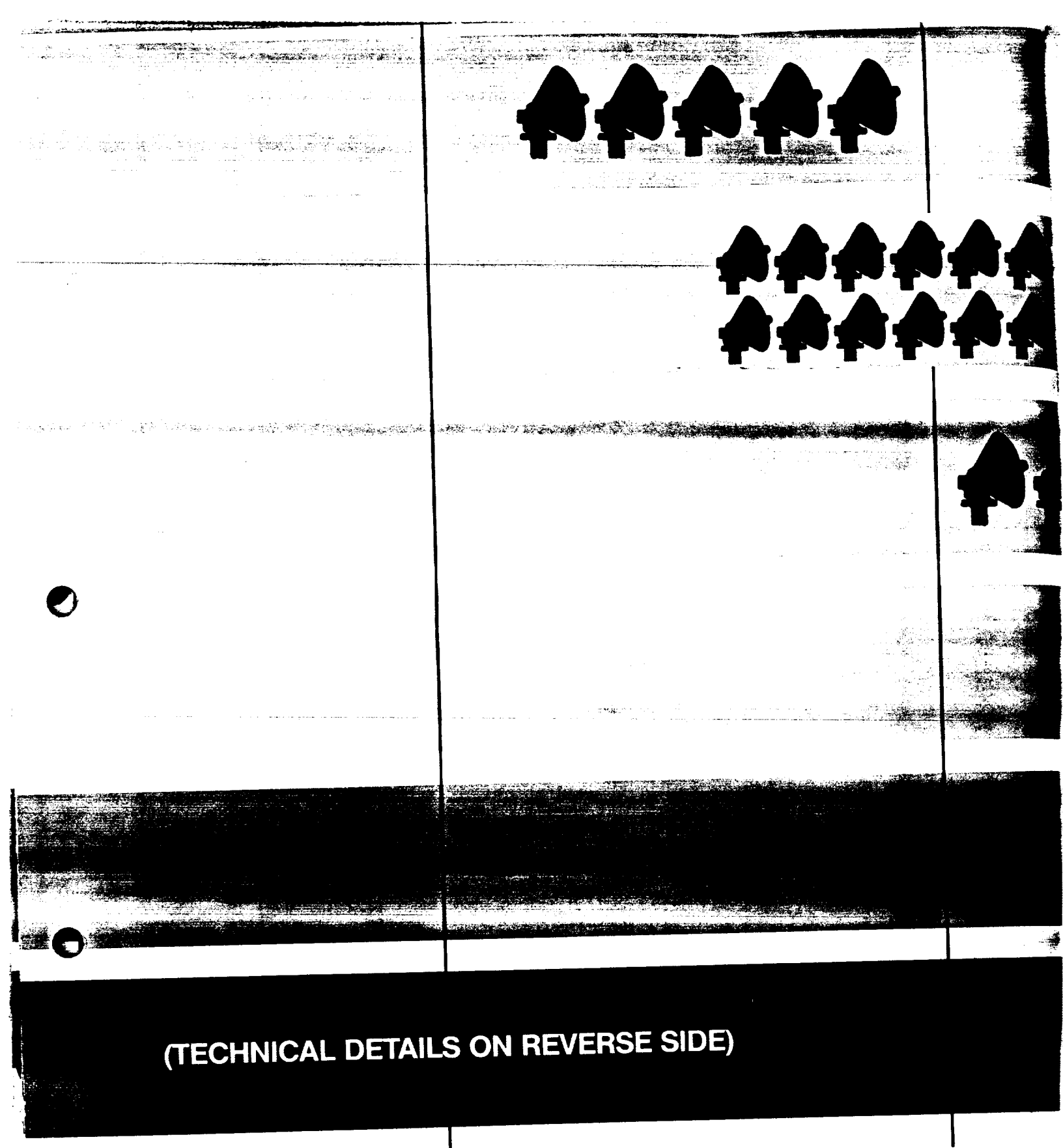
AN/TPQ-39(V) NIDIR



Variant of AN/TPQ-39 Radar uses antenna pedestal of Nike Hercules and DIR techniques; (NIDIR); 11 built.

AN/FPQ-19

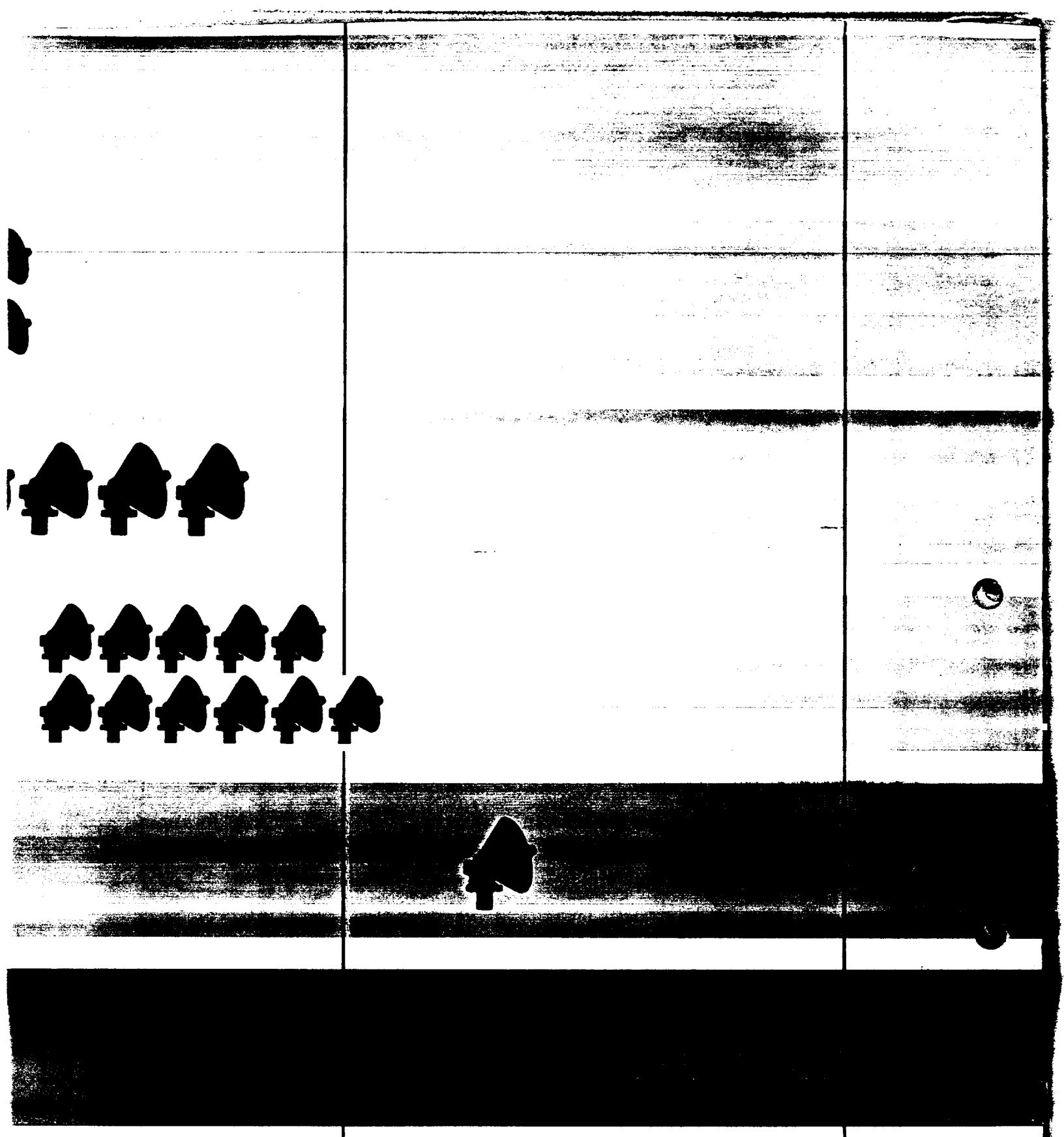
Upgraded and modernized AN/TPQ-18 (Serial No. 1); featured dual trackers, dual display console, advanced integrated circuit, and solid-state subsystems; one modernized.



(TECHNICAL DETAILS ON REVERSE SIDE)

INSTRUMENTATION RADAR S

**Since 1960, the USAF has contracted annually with R
modifications, and other related tasks on RCA-built r
free of logistic and support concerns for all instrume
over 106 instrumentation radars - - 95% have been o**



ᵖORT PROGRAM

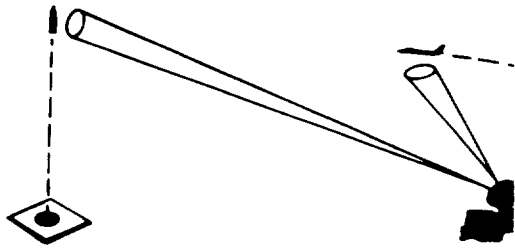
› perform depot-level maintenance,
. This assures peak performance,
n radar users. RCA has fielded
onal since their initial delivery.

MOTR

Multiple Object Tracking Radar

TRACKING OBJECTS WITH EXTREME ACCELERATION

A major benefit of the MOTR System's inertialess beam is the ability to track objects with extreme angular accelerations. Large angular accelerations occur during proximity fly-by or lift-off of small missles. MOTR will track objects having angular accelerations of 25,000 mils/sec^2.



TARGET ACQUISITION

Acquisition time of less than one second and real time data delays under 25 μsec.

1 WAVEFORM GENERATOR

- Three Coherent Frequency Synthesizers
  - — Transmitter Exciter
  - — Two Identical L.O. Channels
    - — Amplitude and Phase Control for Front End Signal Insertion
- 480 MHz and 60 MHz Reference Outputs for Down Conversion
- Pulse Expansion Channels
  - — Linear Chirp
  - — 2.5, 5.0, 10.0 and 50.0 μsec

2 IF RECEIVER

- Dual Three Channel Monopulse
- Identical Separate Echo (Skin) and Beacon Receivers
- IF Frequency — 60 MHz
- IF Gain (PRF-Computer Control)
- Computer/Signal Processor Controlled STC During Search
- Matched Filter Selection (PRF-Computer Control)
- Pulse Compression Filters (PRF-Computer Control)
  - — 2.5, 5.0, 10.0 and 50.0 μsec
  - — Compressed to .25 μsec
  - — Switched Between Skin and Beacon Receivers
- 1 to 4 MHz Bandwidth
- AGC, AFC Digital Control

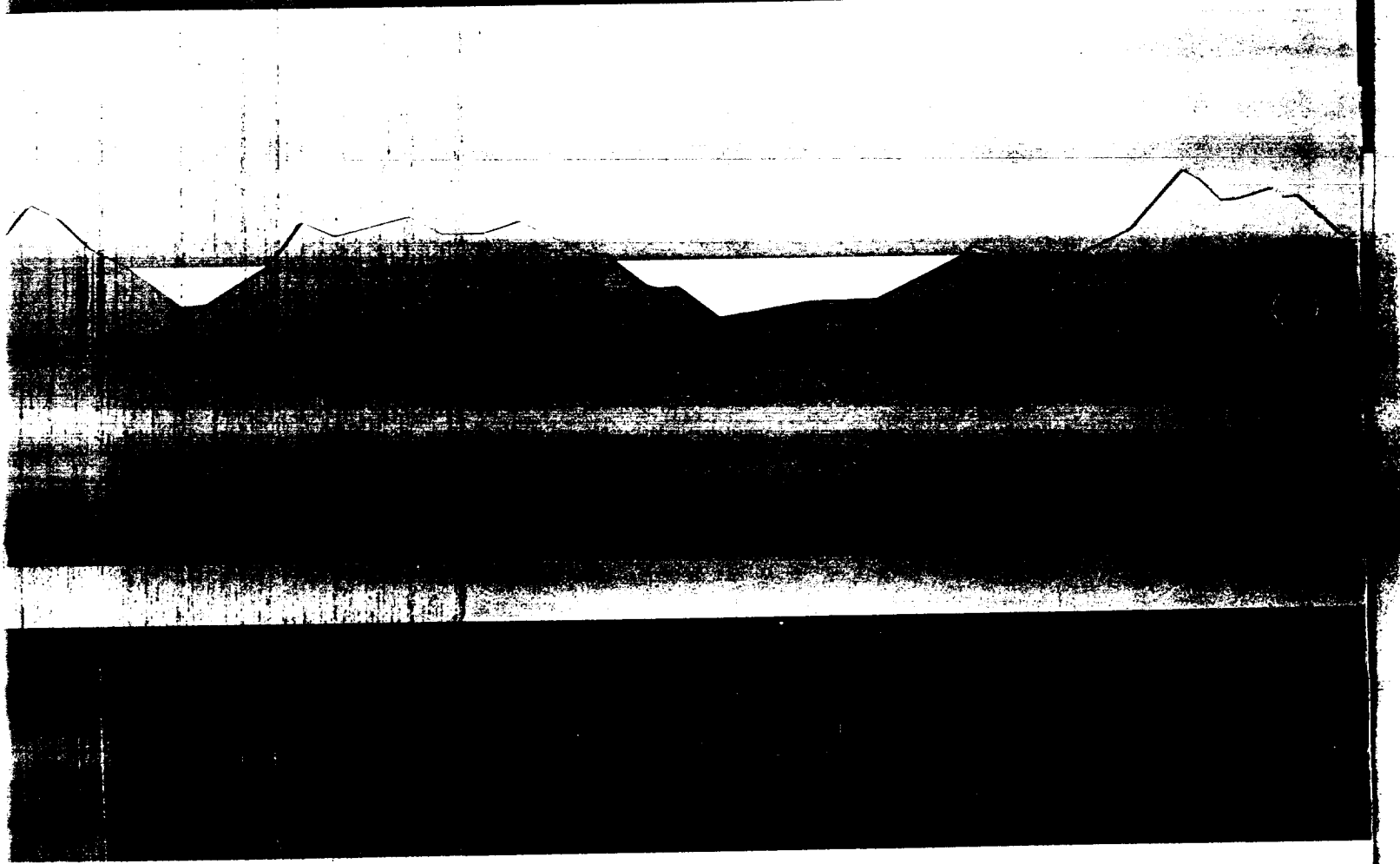
3 SIGNAL PROCESSOR

The Solution to Test and Ti

Track Accuracies	<0.2 mil (Absolute) 0.15 mil (Relative) 0.9 yards
Sensitivity	9.3 dB S/N 6-inch sphere 100-kyd range 1-μs pulse 1-megawatt power
Range (1 m^2 Target)	310 nm (10 μsec P.W.) 460 nm (50 μsec P.W.)

TRACKING OBJECTS AT LOW ELEVATION ANGLES

MOTR will offer significant improvements in performance, comp
data obtained with either the AN/FPS-16 or the AN/MPS-36 radar
tracking objects at low elevation angles. Although the baseline
has no special clutter suppression electronics such as MTI or FF
in angle sidelobes are inherently 10 dB lower than those of para
reflector antenna trackers, yielding a two-way 20 dB [redacted]rove
signal-to-clutter ratios. The important by-product of the lo[redacted]r ang
lobes is a 3 to 1 reduction in tracking error due to multipath.



raining Support Requiremer

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MOTR
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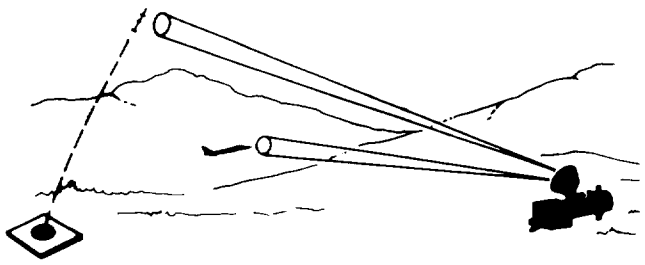
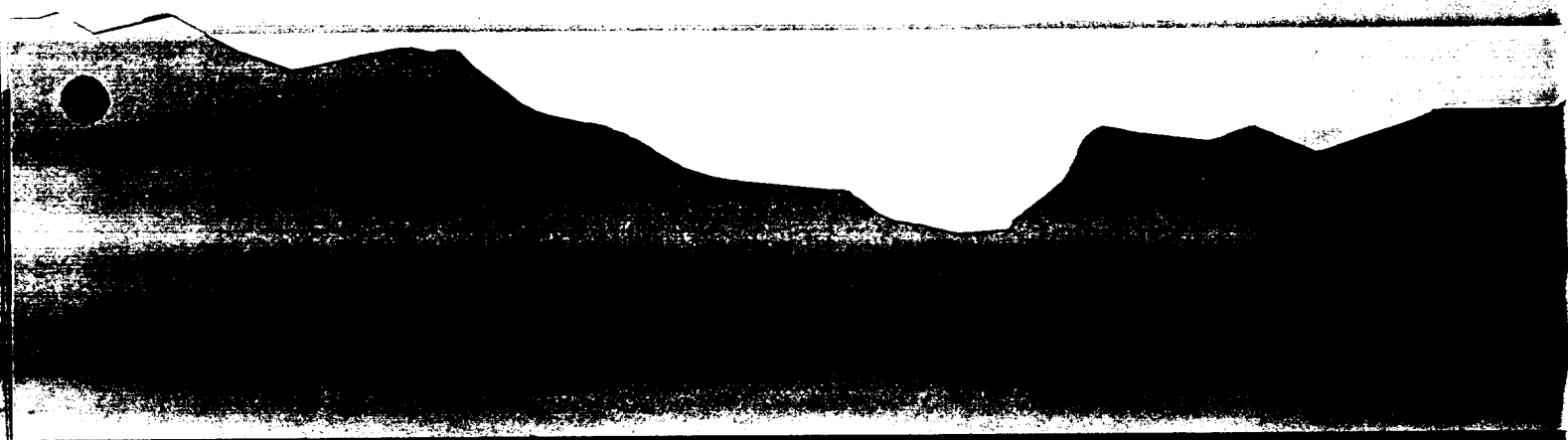
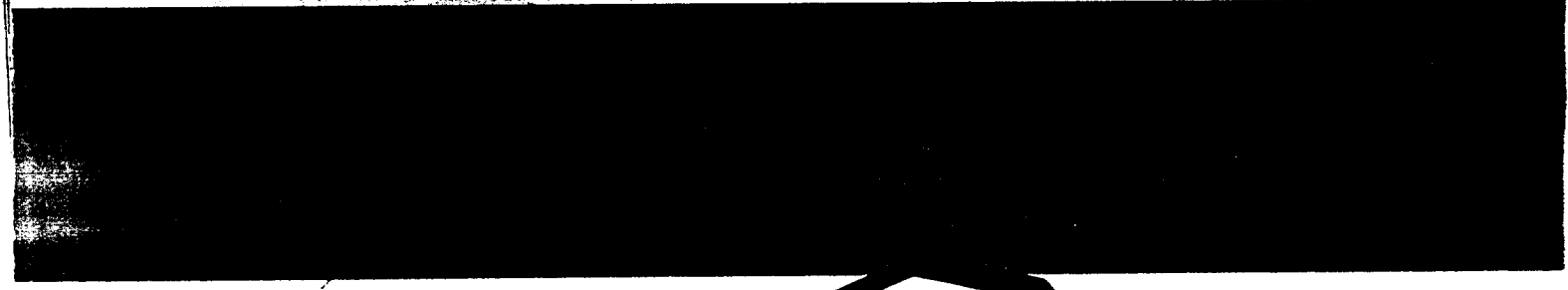


Tracking	Up to 10 objects Simultaneous skin/beacon
Target Motion Resolution	Provides data for TMR analysis
Reliability Maintainability	MTBF System 159 hours Transmitter 917 hours Array 47,619 hours Element 253,800 hours MTTR 1.26 hours MTTR MAX 2.69 hours





- Envelope Detection
- A/D Conversion and Buffering
- Two Console A and R Scope Video Logic and Control (Live Video)
- System Timing Logic
  - — External PRF Sync
  - — Transmission Timing and Control
  - — Reception Timing and Control
  - — Customer Strobe Timing
  - — IRIG Standard
- Single Return Logic
  - — Detection (M out of N)
  - — Acquisition
  - — Track

4 DATA PROCESSOR

- Hardware
  - — 32 Bit Super Minicomputer
    - — 7.0 MIPS Computing Capacity (Dual CPU)
    - — 4.0 M Byte Memory
  - — Commercially Available
    - — SEL 32/8750
    - — Support Software
    - — Peripherals
    - — Ease of Software Development/Maintenance
- Software
  - — Structured Program
  - — High Order Language (Fortran 77)

MULTIPLE OBJECT TRACKING RADAR

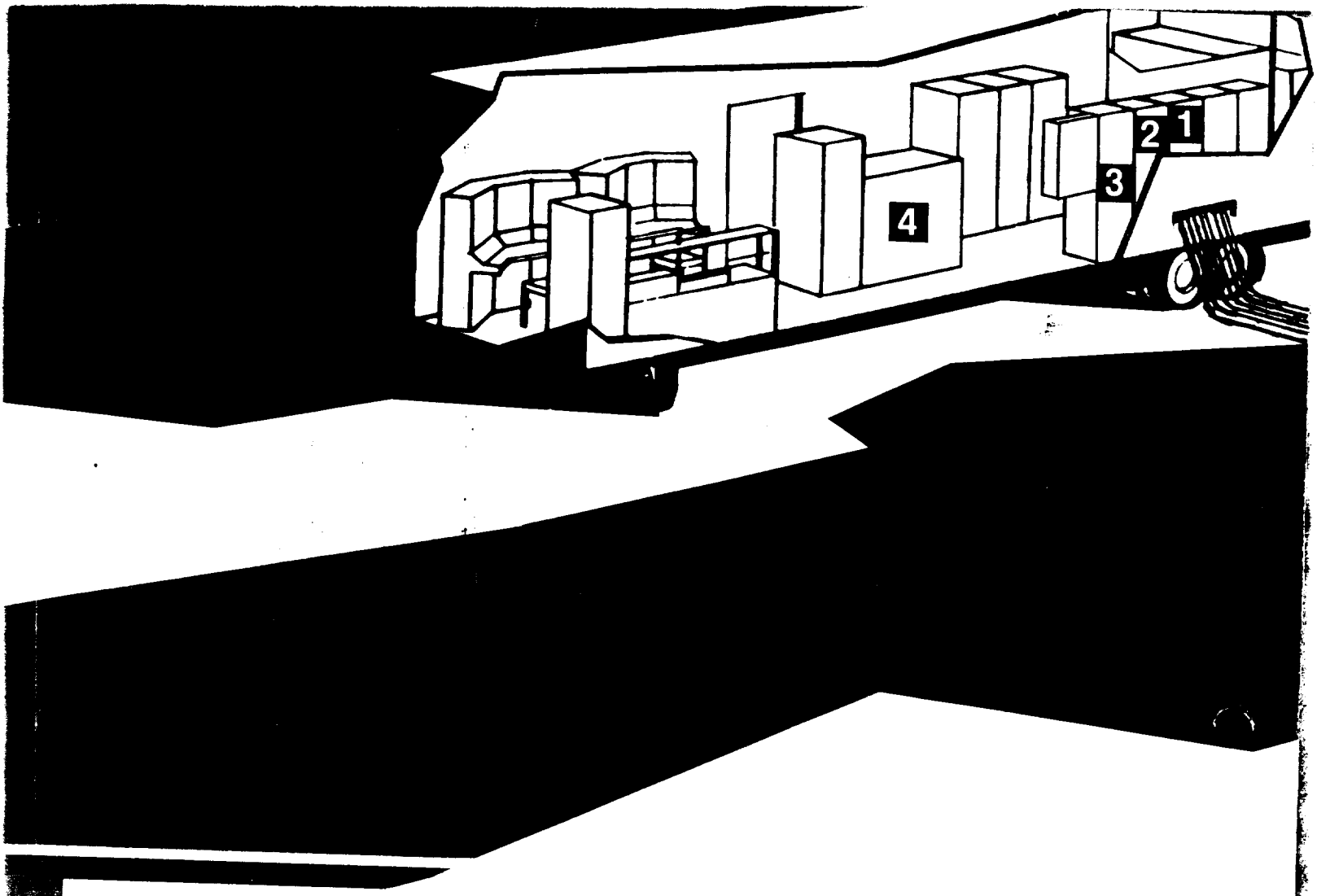
The MOTR is a primary, general purpose, metric track radar — designed to be compatable with existing range instrumentation systems.

Major new test and evaluation needs require a MOTR class radar system for effective support. The inertialess beam, high power and low sidelobes characteristics of the MOTR provide the performance features needed.

Each MOTR will track as many as ten objects. A major advantage of the MOTR is that mission tracks can be controlled and observed from a single location, enabling the radar operator to make rapid priority decisions during operations. MOTR will provide absolute accuracy performance, plus a 2 to 1 improvement in relative accuracy over that obtainable with single target trackers. This performance is achievable because instrument to instrument pedestal biases and timing differences are not a factor.

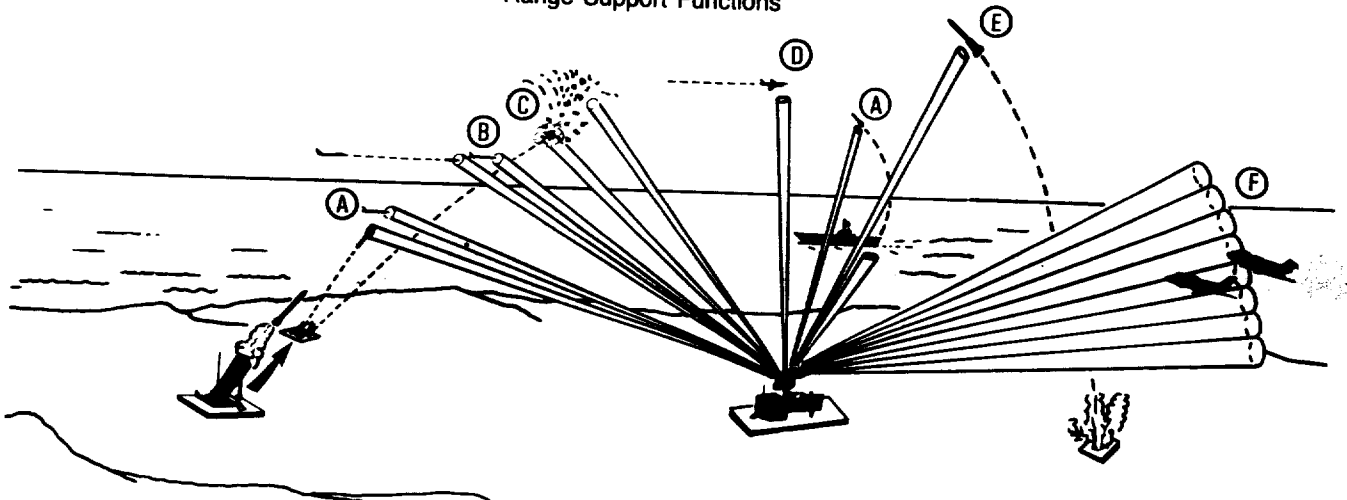
MOTR is capable of using one tracked object as a designation source, then acquiring and tracking multiple objects ejected from that source. Since MOTR can cross-gate between tracks, only one track on each piece of debris will occur. The multiple track feature could reduce range O&M costs because fewer single target trackers will be required; surveillance scan capability also provides further operational enhancement and O&M reduction.

The first three MOTR units are being built by RCA Missile and Surface Radar, Moorestown, New Jersey for the U.S. Army White Sands Missile Range, New Mexico. The first unit is scheduled for delivery to the range in early 1987.

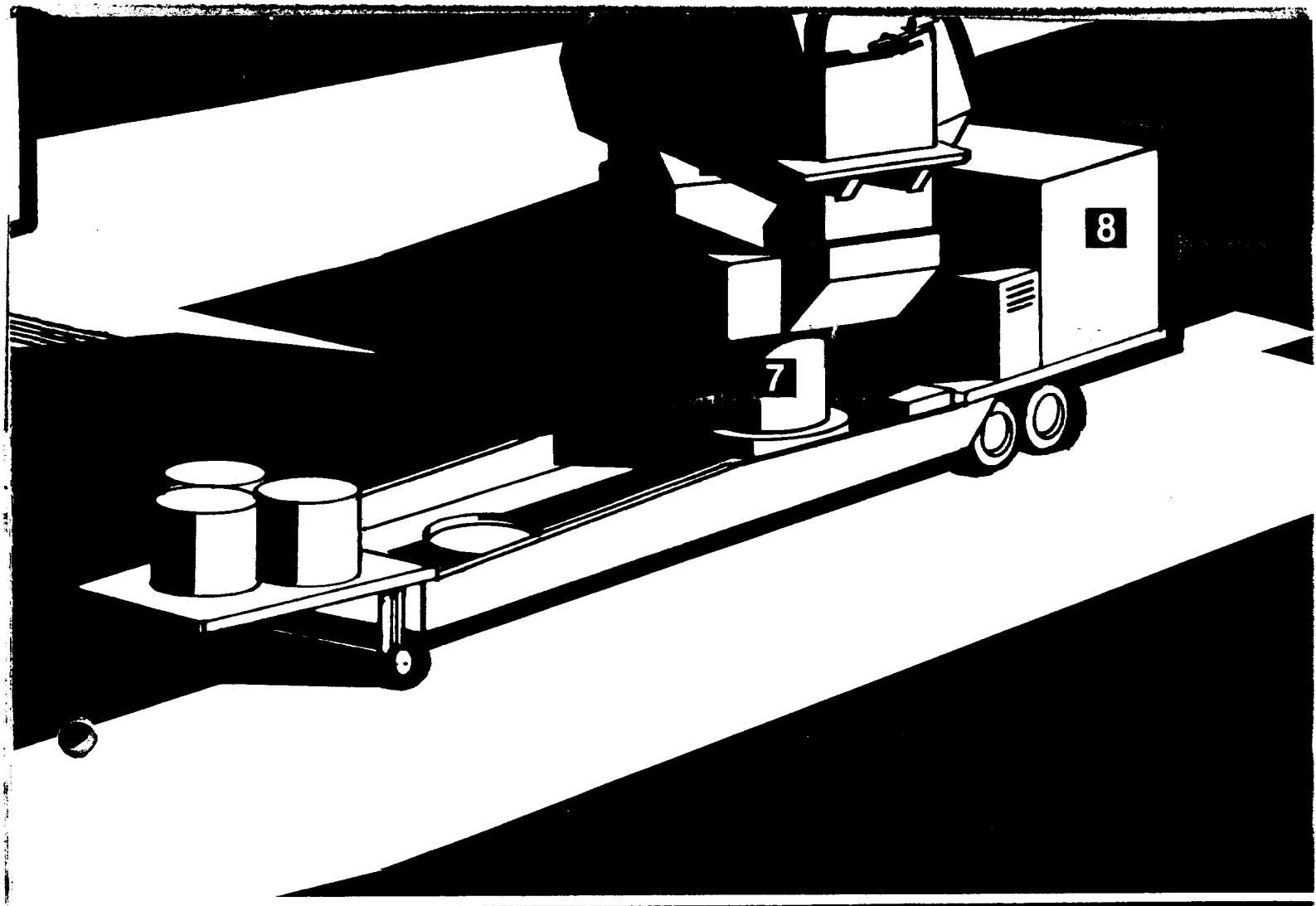


TYPICAL FUNCTIONS

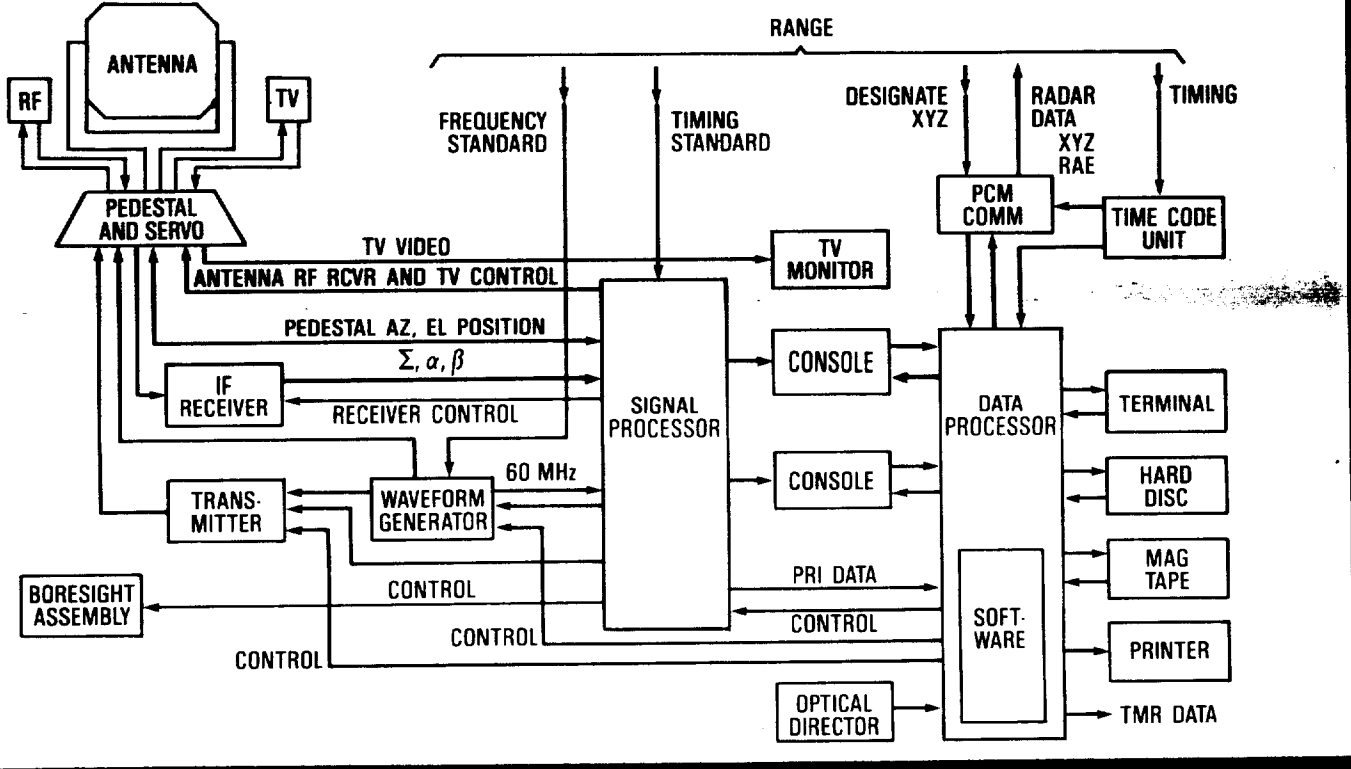
Adaptive to perform a variety of
Range Support Functions



Ⓐ SURFACE-TO-AIR
Ⓑ AIR-TO-AIR
Ⓒ RANGE SAFETY
Ⓓ DRONE CONTROL
Ⓔ SURFACE-TO-SURFACE
Ⓕ SURVEILLANCE



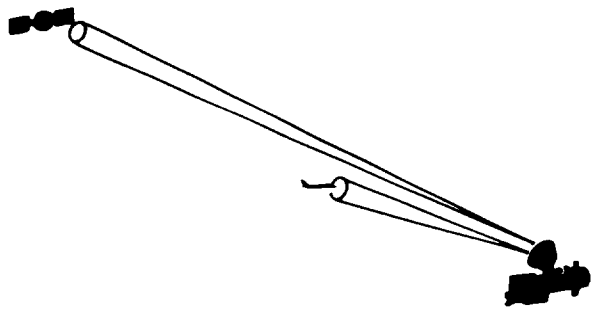
SYSTEM BLOCK DIAGRAM AND TYPICAL RANGE INTERFACES



RCA

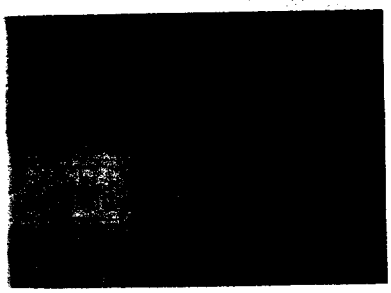
TRACKING LONG RANGE/SMALL RADAR CROSS SECTION

MOTR's 10 microsecond pulsewidth sensitivity will permit the system to track at longer ranges and/or to track objects with smaller radar cross-section. System architecture will enable the operator to concentrate radar resources on a single object to achieve maximum tracking ranges, or to maximize tracking performance against multiple objects. A 7 dB additional improvement in performance can be obtained by the addition of a 50 μsec chirp-pulse waveform to the WFG and IF Receiver. The Transmitter and Antenna are supplied initially with this capability.



5 ANTENNA

- Space-Fed Transmission Lens Transfer Array
- Scan Angle—60° Cone, 60° x 36° Box
- Aperture—12 Feet, 1° Broadside Beamwidth
- 45.6 dB Gain
- Sidelobes
  - — First, -26.5 dB
  - — Second & Third, -31 dB
  - — All Others -38 dB
- 3-Bit Diode Phase Shifters
- 8359 Elements
- Integral Beam Steering Controller
  - — Independent Transmit/Receive Beam Steering
  - — Transmit Decollimation Provides Per Pulse Power Programming
  - — Collimation Data for 22 Frequencies Stored on Board Array
- 3 Channel Monopulse Feed (Four Horn-Triple Mode)



6 RF RECEIVER

- Dual Three Channel Monopulse
- GaAs FET LNA
  - — 2 dB Noise Figure
  - — LNA Bypass (PRF Control)
- Identical Separate Skin (Echo) and Beacon Receivers
- RF Attenuator
  - — Single 20 dB Step (PRF Control)
- Double Down Conversion
  - — Reduces Interference
  - — 540 MHz 1st IF, 60 MHz 2nd IF
- Signal Insertion for Calibration

7 PEDESTAL/SERVO DRIVE

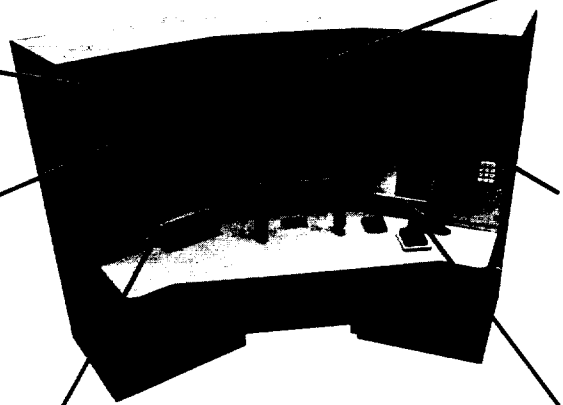
- — Angle Encoders ..... 19 Bits
- — Plunge Capability
- — Optics Compatibility
- Azimuth
  - — Coverage ..... Continuous
  - — Rate ..... 800 mils/sec
  - — Acceleration ..... 200 mils/sec^2
- Elevation
  - — Coverage ..... -10 to +190 Degrees
  - — Rate ..... 300 mils/sec
  - — Acceleration ..... 200 mils/sec^2
- AN/MPS-36 Pac Compatible
- Rate-Aided Type II Servo
  - — Fixed Wideband Operation
  - — Minimizes Pedestal Pointing Error for Optics
- Existing Product Line (Scientific-Atlanta 3315 + Wide Yoke)

8 TRANSMITTER

- Frequency ..... 5.4-5.9 GHz (instantaneous Bandwidth)
- Power ..... 1 Mw Peak; 5.0 Kw Average (0.005 Duty)
- Waveforms
  - — Pulsewidths ..... 0.25 to 50 μsec
  - — PRF ..... Up to 1280 pps
  - — Pulse Coding ..... Up to a 5 Pulse Code (IRIG Std.)
    0.25, 0.5, or 1.0 μsec
    Pulsewidths with Minimum Spacing of 1.0 μsec
- Low Risk Design ..... Existing Varian 1060A CFA and VTC5760 TWT
- Manual Power Programmer & Feed Through Mode

CONTROL/DISPLAY CONSOLES

Two identical consoles provide for concurrent or independent Mission and Maintenance Functions.



Track monitor display presents true video signal "R" trace for up to ten targets

G, H display shows ground range to targets and targets' altitude

Alpha, beta display shows targets' angular position by reference to antenna array boresight axis

X, Y display shows targets' East/West and North/South position

Summary display presents track data for ten targets, equipment status, power use, alerts/faults

Selected channel display presents data for selected track; keypad label display indicates available key functions