Your G-E RADAR RANGE COMPUTER

Compliments of
HMEE Department of
GENERAL ELECTRIC

HEAVY MILITARY ELECTRONIC EQUIPMENT DEPARTMENT
SYRACUSE, NEW YORK

FIND YOUR RANGE:

GIVEN: A HEIGHT FINDING RADAR WITH THE FOLLOWING CHARACTERISTICS:

F = 1000 PPS (pulse repetition rate).
P_T = 2000 KW (transmitted peak power).
λ = 10 cm (RF operating wavelength).
G = (gain of antenna — find from antenna 20'h × 8'w).
NF = 9 db (receiver noise factor).
τ = 1 μsec (pulse duration).
A_R = 1 meter^2 (effective back scattering area of target).
M = modifying term in percent. (To be computed below.)
β = 1 mc (receiver bandwidth).

TO CALCULATE THE RANGE OF THE HEIGHT FINDING RADAR:

(1)

(1) G is obtained from the back of the computer as follows: Set λ (10 cm) under diameter (20'h); at the arrow read 43 db.

(1)

Repeat this procedure for the 8' side; read 35 db.

Then the antenna gain is $\frac{43+35}{2} \cong 40$ db.

(2)

(3)

(2) Set P_T (2 MW) beneath F (1 KC).

(3) Set G (40 db) beneath λ (10 cm).

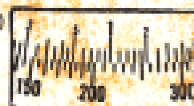
(4) Set τ (1 μsec) under NF (9 db).

(4)

(5) Under 1 square meter read searchlight range 214 miles.

(6) M — modifying term.

(5)

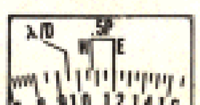


(A) ONE WAY LOSSES.

(1) L_S — scanning losses.
(a) Horizontal scanning losses.
GIVEN: ω = 3 rpm. θ_H (horizontal beamwidth) is obtained from the computer as follows: Set λ (10 cm) under diameter 8'w. Then on degree scale under .5P (E), read 3.0°.
Use ω = 3 rpm and θ_H = 3° in Chart 1 and read 17%.

(b) Vertical scanning losses.

GIVEN: V = 10° (vertical angle scanned in degrees). θ_V (vertical beamwidth) is obtained from the computer as follows: Set λ (10 cm) under diameter (20'h). Then on the degree scale under .5P (H), read 1.08°.
Use V = 10° and θ_V 1.08° in Chart 2 and read 10%.



Multiply H scan loss × V scan loss = 17% × 10% = 1.7%. Then from Chart 3 at 1.7% read L_S = 13 db.

(2) $L_{\tau\beta}$ — assume loss is zero for optimum radar design. (For $\tau \times \beta = 4$ or ¼, loss is 2 db; for $\tau \times \beta = 2$ or ½, loss is 1 db.)
(3) L_{TR} — duplexing TR box loss, assume 2 db loss.
(4) L_{PPI} — assume 3 db loss for long persistence PPI. (0 db loss for A scan.)
(5) L_C — indicator collapsing loss (height finding radars only), assume 5 db loss.
(6) L_I — incoming target, assume 5 db loss.

ALL ONE-WAY LOSSES TOTAL:

L_S = 13 db
$L_{\tau\beta}$ = 0 db
L_{TR} = 2 db
L_{PPI} = 3 db
L_C = 5 db
L_I = 5 db
Total 28 db.

From Chart 4, 28 db of one-way losses reduces range 80%.

(B) TWO-WAY LOSSES.

(1) L_W — wave guide loss. GIVEN: 100 feet of guide. .034 (Chart 5) × $\frac{100}{3} \cong 1$ db.
(2) L_L — lobing loss = 0. (= 2 db for conical scan radars.)
(3) From Chart 6 for a wavelength of 10 cm L_A — atmospheric loss = 0 (.01)

ALL TWO-WAY LOSSES TOTAL:

L_W = 1 db
L_L = 0
L_A = 0
Total 1 db reduces range 0% — Chart 4.

M total = one-way losses (%) + two-way losses (%) = 80% + 0 = 80%.
Height finder range (for 50% blip scan ratio) = searchlight range X (100%-M%) = 214 X (100%-80%) = 42.8 miles

RULES FOR FINDING "M" FOR OTHER TYPES OF RADAR										
TYPES	L_S		$L_{\tau\beta}$	L_{TR}	L_{PPI}	L_C	L_I	L_W	L_L	L_A
	H	V								
FIRE CONTROL Monopulse			X	X				X		X
Conical Scan			X	X				X	X	X
SEARCH Horizontal Search	X		X	X	X		X	X		X
HEIGHT FINDER Vertical Scan	X	X	X	X	X	X	X	X		X
Stacked Beam	X		X	X	X	X	X	X		X
Frequency Scan	X		X	X	X	X	X	X		X

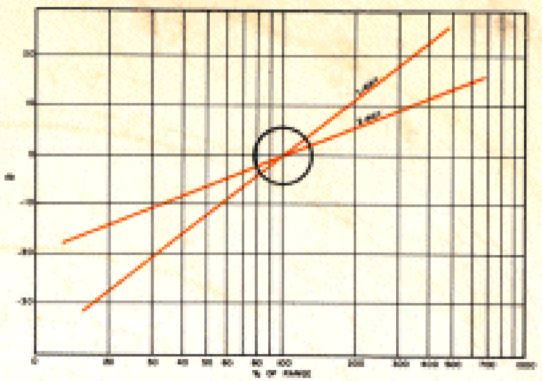
Loss terms affecting range of a given type of radar are indicated by an "X".

CHART 1

HORIZONTAL BEAMWIDTH IN DEGREES

RPM	¼	½	¾	1	1½	2	3	4	5	7	10	15	20	30	40
¼	.17	.33	.50	.67	1.0	1.3	2.0	2.7	3.3	4.7	6.7	10.	13.	20.	27.
½	.08	.17	.25	.33	.50	.67	1.0	1.3	1.7	2.3	3.3	5.0	6.7	10.	13.
1	.04	.08	.13	.17	.25	.33	.50	.67	.83	1.2	1.7	2.5	3.3	5.0	6.7
2	.02	.04	.06	.08	.13	.17	.25	.33	.41	.58	.83	1.3	1.7	2.5	3.3
3	.01	.03	.04	.05	.08	.11	.17	.22	.28	.39	.56	.83	1.1	1.7	2.2
4		.02	.03	.04	.06	.08	.13	.17	.21	.29	.42	.63	.83	1.3	1.7
5		.02	.03	.03	.05	.07	.10	.13	.17	.23	.33	.50	.67	1.0	1.3
7				.02	.04	.05	.07	.10	.12	.14	.24	.36	.48	.71	.95
10				.02	.03	.03	.05	.07	.08	.12	.17	.25	.33	.50	.67
15				.01	.02	.02	.03	.04	.06	.08	.11	.17	.22	.33	.44
20				.01	.01	.02	.03	.03	.04	.06	.08	.13	.17	.25	.33
30				.01	.01	.01	.02	.02	.03	.04	.06	.08	.11	.17	.22
40					.01	.01	.01	.02	.02	.03	.04	.06	.08	.13	.17

CHART 4



EFFECT ON THE MAXIMUM RANGE OF LOSSES OR GAINS IN ONE-WAY AND TWO-WAY FACTORS

CHART 2

VERTICAL BEAMWIDTH IN DEGREES

Vertical Angle Scanned in Degrees	¼	½	¾	1	1½	2	3	4	5	7
5	.05	.10	.15	.25	.30	.40	.60	.80	1.0	1.4
7	.04	.07	.11	.14	.21	.29	.43	.57	.71	1.0
10	.03	.05	.08	.10	.15	.20	.30	.40	.50	.70
15	.02	.03	.05	.07	.10	.13	.20	.27	.33	.47
20	.01	.03	.04	.05	.08	.10	.15	.20	.25	.35
30	.01	.02	.03	.03	.05	.07	.10	.13	.17	.23

CHART 5

λ in CM.	GUIDE SIZE	db/METER
20	3¼" x 6½"	0.
10	1½" x 3"	.034
10	⅜" x 2¾"	.11
3	½" x 1"	.11
1	¼" x ½"	.50

WAVE GUIDE LOSS

CHART 3

SCANNING LOSS IN DB

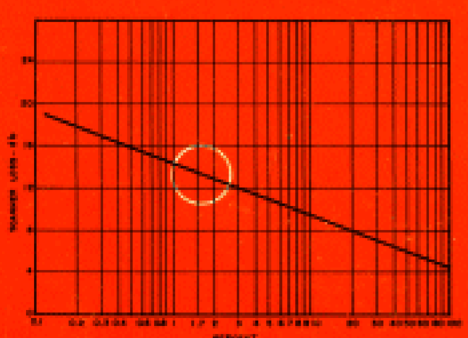
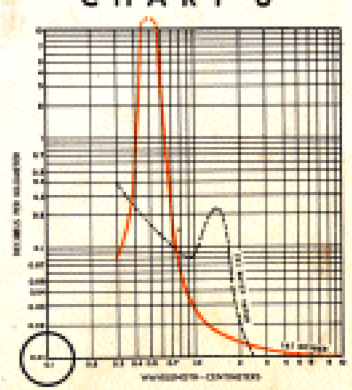
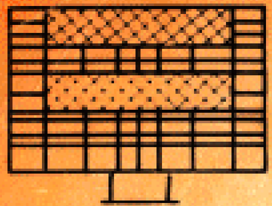


CHART 6



POWER ATTENTUATION IN DB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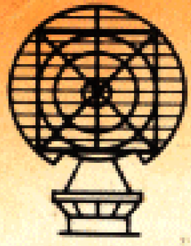
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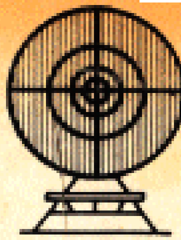
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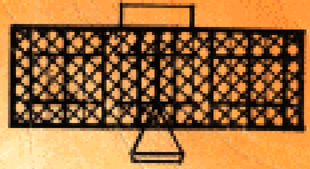
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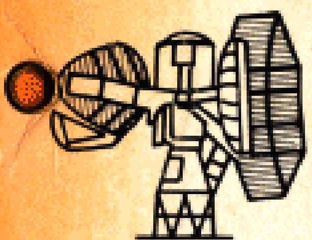
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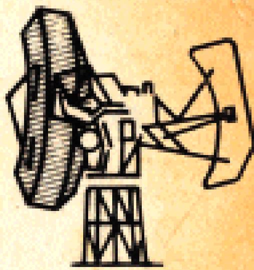
SPS-8

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OUR KNOW-HOW HAS PRODUCED THE WORLD'S MOST POWERFUL RADARS FOR THE DEFENSE OF OUR NATION

Progress Is Our Most Important Product

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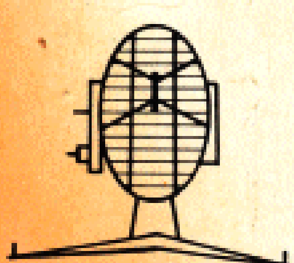
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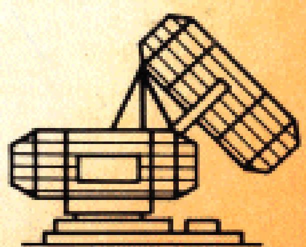
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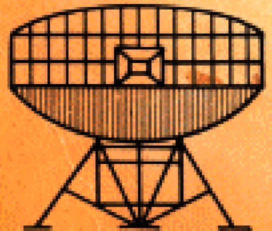
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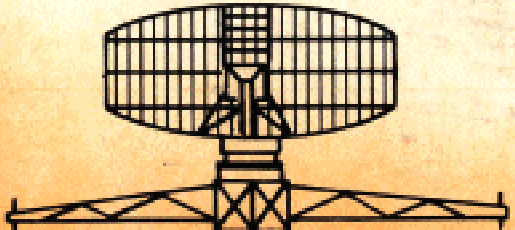
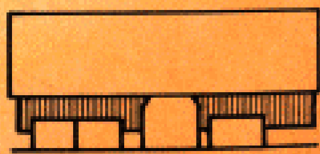

FPS-8 MPS-11


FPS-6 MPS-14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