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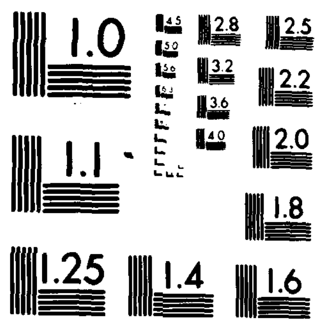

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AIR FORCE SYSTEMS COMMAND

RESULTS OF AN EXPERIMENTAL STUDY OF A TWIN-REFLECTOR ANTENNA WITH A MODIFIED COUNTERREFLECTOR

by

D. A. Dmitrenko, L. N. Zakhar'yev, et al.

FOREIGN TECHNOLOGY DIVISION

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U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

RESULTS OF AN EXPERIMENTAL STUDY OF A TWIN-REFLECTOR ANTENNA WITH A MODIFIED COUNTERREFLECTOR

Report

D. A. Dmitrenko, L. N. Zakhar'yev, A. A. Lemanskiy,
A. Ye. Tumanskaya

This report gives the results of an experimental study of a twin-reflector antenna obtained using an ordinary counterreflector and a counterreflector whose surface is corrected according to the recommendations of report [1].

A twin-reflector antenna whose main parabolic dish had a diameter of $A = 70\lambda$ and a focal length of $f = 0.4$ A was tested. The ordinary hyperbolic counterreflector had a diameter of $d = 11\lambda$, eccentricity of $e = 1.4$, and provided an angle of irradiation of $2\theta_0 = 128°$, which corresponds to $f/A = 0.4$. A hyperboloid of revolution with $d = 11.7\lambda$ and $e = 1.28$ was used as the modified counterreflector. This counterreflector provided an angle of irradiation of $2\theta_0 = 170°$ instead of 128°. The calculation according to the formulae in report [1] shows that the use of a modified counterreflector with the indicated parameters makes it possible to obtain the maximum KIP [area use coefficient ?] and the minimum scattering coefficient of the antenna, in which

$A = 70\lambda$, $f = 0.4\ A$, if the edge of the counterreflector is irradiated by a power level on the order of 0.01. The primary horn-and-lens feed of the antenna, focused on the tip of the counterreflector, created virtually an axisymmetric field distribution on its surface with a power level on the edge close to that indicated above. Obviously, a twin-reflector antenna with this feed and an ordinary counterreflector should have a low noise temperature, a low scattering coefficient, and a low KIP.

The characteristics of the antenna in question with the two types of counterreflectors were determined by radioastronomic methods. The directivity pattern, in particular, its width $\Delta\theta_{0.5}$, E - and H - planes on the level of half the power - were measured according to the radio emission of the sun (broadening of the pattern because of the angular dimensions of the source was considered by calculation). The directivity factor D and the scattering coefficient $\beta_{гл}$ outside the spatial angle corresponding to the main lobe of the directivity pattern were measured by two methods: according to the emission of Cassiopeia-A ($D = D_к$) and the moon ($\beta_{гл} = \beta_{гл}^{(л)}$) [2], and according to the emission of a "black" disk located in the Fresnel zone of the antenna ($D = D_д$, $\beta_{гл} = \beta_{гл}^{(д)}$) [3]. The components T_1, T_2 of the antenna noise temperature T_Σ caused by the reception of noise from the surrounding space (T_1) and the losses in the antenna channel and reflectors (T_2) were determined according to the emission of the Earth and the atmosphere [2]. The efficiency η was measured according to the noise of the antenna directed at the zenith. The depth of modulation of the "focal spot" [2] and the value of the reduction of the antenna's directivity factor ΔD were determined along with the indicated values. The KIP of the antenna κ and the value of the KIP $\kappa' = (1 + \Delta D)\kappa$, which an antenna would have in the absence of modulation of the "focal spot", were calculated from the mean measured value of the directivity factor $D = (D_к + D_д)/2$. When tuning the antenna feed, its directivity factor, directivity pattern, and, in particular, the power level δ^2 in the direction toward the edge of the counterreflector were measured.

The table gives the measured values of the antenna characteristics. The first line of the table corresponds to an antenna with an ordinary counterreflector, and the second - with a modified counterreflector.

Table 1.

δ_E^2	δ_H^2	$\Delta\theta_{0,5}^E$	$\Delta\theta_{0,5}^H$	$\frac{D_К}{10^3}$	$\frac{D_Д}{10^3}$	$\beta_{гл}^E$	$\beta_{гл}^H$	$\varkappa$	ΔD	$\varkappa'$	η	$T_Σ$	T_1
0,008	0,004	64′	76,5′	14,8	15,4	0,44	0,44	0,31	0,15	0,36	0,75	97°K	18°K
0,01	0,006	58′	60′	24,6	23,2	0,38	0,39	0,5	0,04	0,52	0,71	102°K	23°K

Based on the data of reports [2]-[4], we can confirm that the values of the directivity factor and KIP given in the table were determined with a relative error not greater than ±3%, while the scattering coefficient, noise temperature and efficiency of the antenna were measured with a maximum error of ±5%.

The results of the measurements show that the use of the modified counterreflector in the antenna in question made it possible to obtain KIP of $\kappa = 0.5$ and a scattering coefficient of $\beta_{гл} = 0.39$. The replacement of the ordinary counterreflector by the modified one caused the main lobe of the pattern to be constricted by 20%, while the scattering coefficient decreased by 10%. At the same time, the noise temperature of the antenna increased by a value on the order of 5°K. Since the conventional system was tested at a very small level of irradiation of the edge of the counterreflector, the replacement of the ordinary counterreflector by the special one increased the KIP by 60%. The actual gain in the KIP is 25%, since the maximum KIP of the conventional system (when $\delta^2 = 0.1$) has a value of $\kappa = 0.4$, as

ɔws. However, in this case, $T_{\Sigma} = 120°K$ and
Thus, the use of the modified counterreflector in-
ordinary one made it possible to considerably improve
nna characteristics.

usion, we will point out that according to the ade from the formulae in report [1], the antenna in the modified counterreflector should have $\kappa = 0.6$, $\theta_{0.5} = 55'$. A certain divergence in the calculated tal values is mainly caused by the fact that the eport [1] were obtained without consideration of the "focal spot" and shading of the reflector he counterreflector rods. If we consider the e ΔD and the results of report [5], it turns out, for the calculated KIP of an antenna with a modified tor $\kappa = 0.54$. The small difference in this value from value is obviously due to the divergence between d calculated irradiation pattern, as well as the error.

April 1971

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