NRL Report No. R-1515
Test of Filter Unit for
Elimination of Key Clicks at Shore Stations
(Constructed from Norfolk Navy Yard Drawing No. RN 53F 103B)

FR-1515

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DATE 9 February 1939

SUBJECT

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for
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(Constructed from Norfolk Navy Yard Drawing No. RN 53F 103B)

BY

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NAVY DEPARTMENT

BUREAU OF ENGINEERING

Report on

Test of Filter Unit

for

Elimination of Key Clicks at Shore Stations

(Constructed from Norfolk Navy Yard Drawing No. RN 53F 103B)

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WASHINGTON, D.C.

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AUTHORIZATION

1. This problem was authorized by reference (a).

Reference: (a) BuEng. letter S67/53 (9-23-R8) of 28 September 1938.

OBJECT OF TEST

2. The object of this problem was to construct a filter unit described in enclosure (A) of reference (a) and ascertain its effectiveness in reducing receiver noise caused by key clicks.

ABSTRACT

3. The filter unit for the elimination of key clicks at shore stations was constructed in accordance with Norfolk Navy Yard Drawing RN 53F 103B by the Naval Research Laboratory. Tests were made to determine the relative attenuation to the radiated impact voltages as produced by a keyed circuit, when the filter was employed.

Conclusions

(a) The filter unit should be of considerable value in reducing receiver interference resulting from key clicks. It should provide an average attenuation of the impact voltage applied to a Model RAA or RAB receiver input, through antenna pick-up, of more than 40 decibels between 100 and 30,000 kilocycles except for the band from 1300 to 2600 kilocycles. Within this latter range, the attenuation will average better than 20 decibels.

Recommendations

(a) It is recommended that this form of filter be considered superior to any simple form of condenser and resistor filter.

DESCRIPTION OF MATERIAL

4. Referring to Norfolk Navy Yard Drawing RN 53F 103B, the filter unit is composed of 4 coils of #28 D.S. magnet wire of 164 turns each wound on 2 pieces of 3/4" bakelite tubing, two 0.1 mfd condensers and one .05 mfd condenser. Said coils and condensers are mounted in an aluminum box as described in the Norfolk Navy Yard Drawing, having dimensions 2 x 4-1/2 x 7-1/2 inches and connected as shown in Figure 1, Plate 1.

METHOD OF TEST

5. The voltage picked up in the receiver antenna, resulting from a field created by keying a Bunnell relay with a 6 volt supply was used for a test signal. The peak value of this signal, in terms of a receiver resonant cw input voltage, was determined by the substitution method. The peak output of the receiver for the key click voltage input was indicated by the deflection of the spot in a cathode ray oscillograph. This same deflection was obtained by the application of a receiver resonant cw input from a voltage calibrated source. The attenuation of the click voltage with the filter unit in the circuit was taken as a measure of the effectiveness of the filter unit.

DATA RECORDED DURING TEST

6. The data recorded during the test are shown in Table 1. Plate 1 shows a complete diagram of the test circuit. Plate 2 shows the peak voltage resulting from key clicks at the receiver input, as found by comparison with a cw voltage developed in a signal generator, both with and without the filter unit in the keyed circuit. Plate 3 shows the attenuation, in decibels, due to the presence of the filter unit over the range covered by the Model RAA and RAB receivers.

PROBABLE ERRORS

7. The filter can be assumed to be more effective than curves show at 20 and 40 kilocycles due to limitation of signal generator output voltage to 100,000 microvolts, at 800 and 975 kilocycles and from 3,000 to 30,000 kilocycles due to receiver and equipment limitations. The personal error due to difficulty in observing rapid deflections on oscillograph and averaging of same may amount to 50% in terms of voltage.

RESULTS OF TEST

8. A circuit was constructed containing a standard telegraph key, a 150 ohm Bunnell relay, a four pole double throw switch, a 6 volt storage battery and the filter unit, connected in such a manner that the filter unit could be thrown in or out of the circuit at will. The electrical impact developed by opening and closing the key in this circuit was coupled to the antenna binding post of the Model RAA or RAB

receiver through a 240 micromicrofarad condenser and a 250 ohm resistor. The condenser was used to establish a known coupling, and the resistor to prevent loading when the signal generator was substituted for the test circuit. The receiver output was limited to about 3 volts at all times to prevent receiver overloading and was fed into a cathode ray oscillograph through its audio amplifier to produce a standard output deflection.

9. Step (a). The receiver was tuned to a given frequency. The filter unit was cut in. The key was operated manually and, starting from minimum, the receiver gain was increased to the point where the signal due to key click gave a standard indication on the oscillograph. At this point and without disturbing any receiver adjustment, the test circuit was disconnected and a signal generator was connected to the receiver input and tuned to receiver resonance. The signal generator output voltage was then adjusted to give the standard indication on the oscillograph. The following data were recorded: frequency in kilocycles, signal generator output in microvolts, position of filter transfer switch, and receiver gain setting as indicated by sensitivity control.

10. Step (b). The signal generator was removed and the keyed circuit coupled to the receiver input. The filter unit was cut out of the keyed circuit, the hand key operated and the receiver gain reduced, due to a much stronger signal, until the standard indication was again obtained on the oscillograph. Again the signal generator was substituted for the keyed circuit, adjusted for standard indication on the oscillograph and the same data recorded as in Step (a). Both of these measurements were repeated for two or more frequencies on each band of both the Model RAA and RAB receivers. The value of the signal generator output voltage as recorded in Step (b) divided by the voltage obtained in Step (a) gave a ratio from which the decibel attenuation was calculated for each frequency.

CONCLUSIONS

11. The filter unit should be of considerable value in reducing receiver interference resulting from key clicks. It should provide an average attenuation of the impact voltage applied to a Model RAA or RAB receiver input, through antenna pick-up, of more than 40 decibels between 100 and 30,000 kilocycles except for the band from 1300 to 2600 kilocycles. Within this latter range, the attenuation will average better than 20 decibels.

Table 1

RAA Receiver

Frequency kc	Sig.Gen.Output in microvolts	Filter	Rec Gain	DB
10	20,000	In	70)	13
10	90,000	Out	68)	
15	10,000	In	67)	19
15	90,000	Out	64)	
20	20,000	In	66)	14+
20	>100,000	Out	63)	
30	20,000	In	68)	12
30	80,000	Out	66)	
40	60,000	In	70)	24.5+
40	>100,000	Out	65)	
50	4,000	In	70)	23.5
50	60,000	Out	66)	
60	3,000	In	70)	30.5
60	100,000	Out	65)	
70	2,000	In	80)	20
70	20,000	Out	70)	
80	400	In	80)	28
80	10,000	Out	69)	
90	300	In	80)	30.5
90	10,000	Out	69)	
100	150	In	82)	40
100	15,000	Out	68)	
110	100	In	83)	43.5
110	15,000	Out	68)	
120	75	In	88)	52
120	30,000	Out	68)	
150	25	In	92)	60
150	25,000	Out	69)	
180	130	In	85)	45.5
180	25,000	Out	68)	
300	70	In	88)	54
300	35,000	Out	68)	

Frequency kc	Sig.Gen.Output in microvolts	Filter	Rec Gain	DB
			RAA Receiver	
380	60	In	88)	54
380	30,000	Out	68)	
450	35	In	93)	40
450	35,000	Out	70)	
600	50	In	88)	57
600	35,000	Out	68)	
800	<70	In	90)	54
800	28,000	Out	70)	
975	<100	In	88)	48
975	25,000	Out	69)	
			RAB Receiver	
1100	500	In	50)	57
1100	35,000	Out	30)	
1500	750	In	40)	26
1500	15,000	Out	30)	
1700	2,000	In	40)	25
1700	35,000	Out	30)	
2300	1,800	In	36)	11
2300	6,500	Out	31)	
2600	500	In	50)	41.5
2600	60,000	Out	30)	
3700	<400	In	46)	33
3700	18,000	Out	30)	
4200	<650	In	60)	40
4200	65,000	Out	36)	
6000	<50	In	70)	60
6000	50,000	Out	36)	
7000	<75	In	70)	56.5
7000	50,000	Out	35)	
9000	<100	In	66)	50.5
9000	33,000	Out	35)	

RAB Receiver

Frequency kc	Sig.Gen.Output in microvolts	Filter	Rec Gain	DB
12,000	<350	In	60)	40
12,000	35,000	Out	35)	
15,000	< 50	In	70)	63.5
15,000	60,000	Out	35)	
18,000	< 70	In	80)	63.5
18,000	100,000	Out	50)	
23,000	< 65	In	80)	53
23,000	30,000	Out	60)	
26,000	<200	In	86)	52
26,000	80,000	Out	70)	
29,000	<60	In	86)	54
29,000	30,000	Out	78)	

KEY CLICK FILTER

FIG. 1

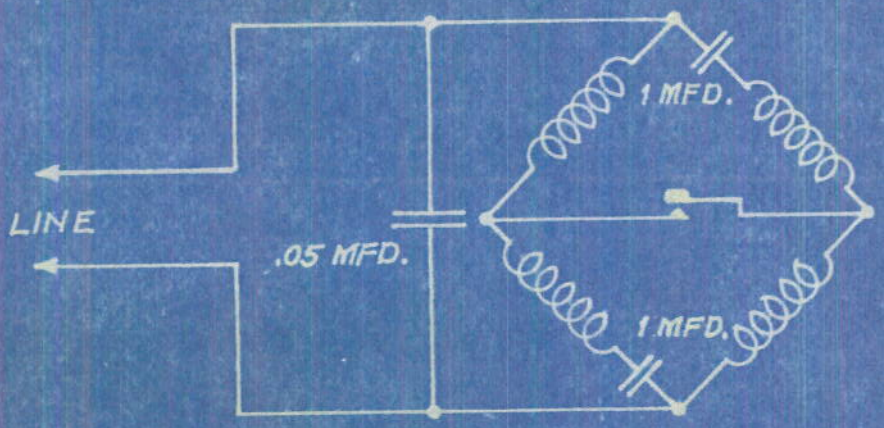


FIG. 2

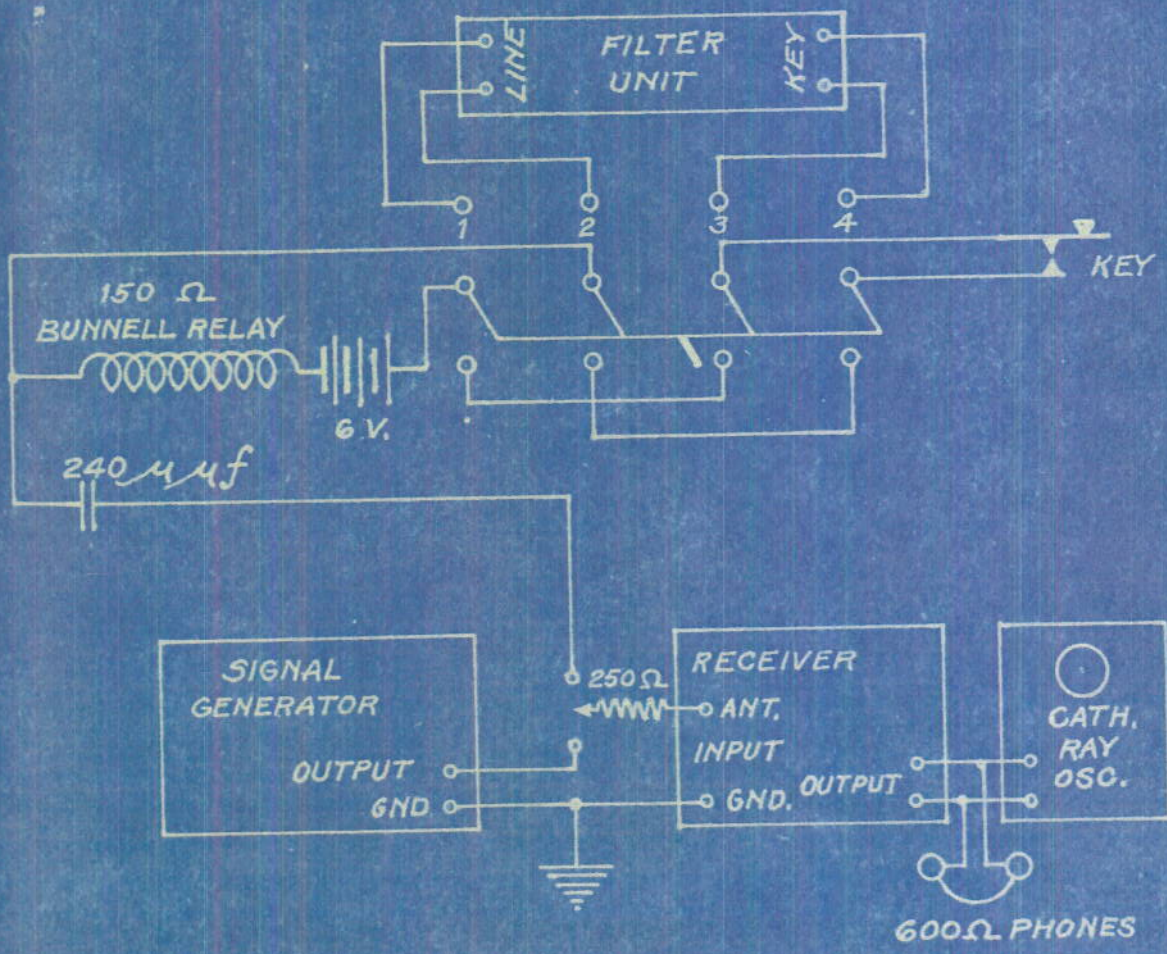


PLATE 1

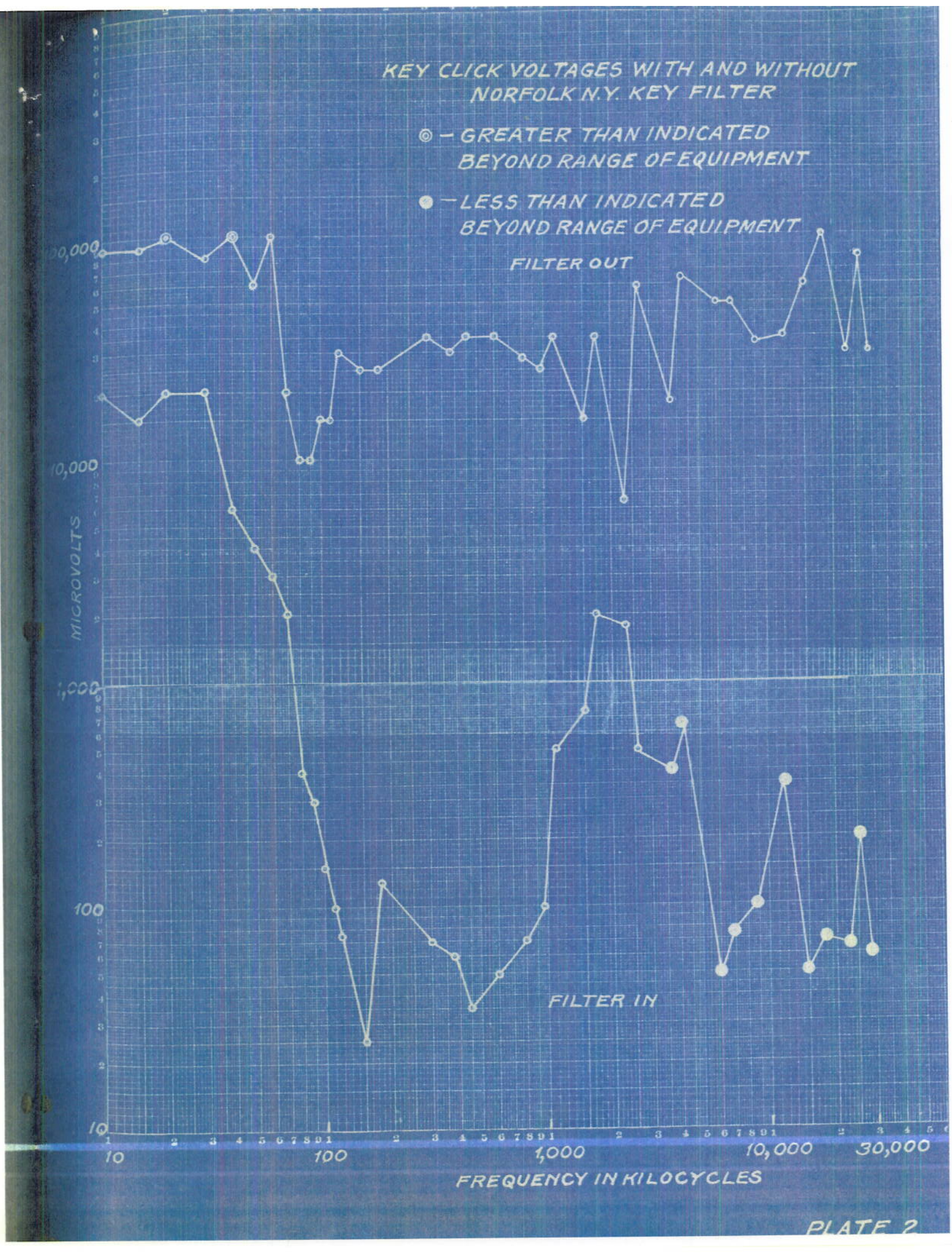
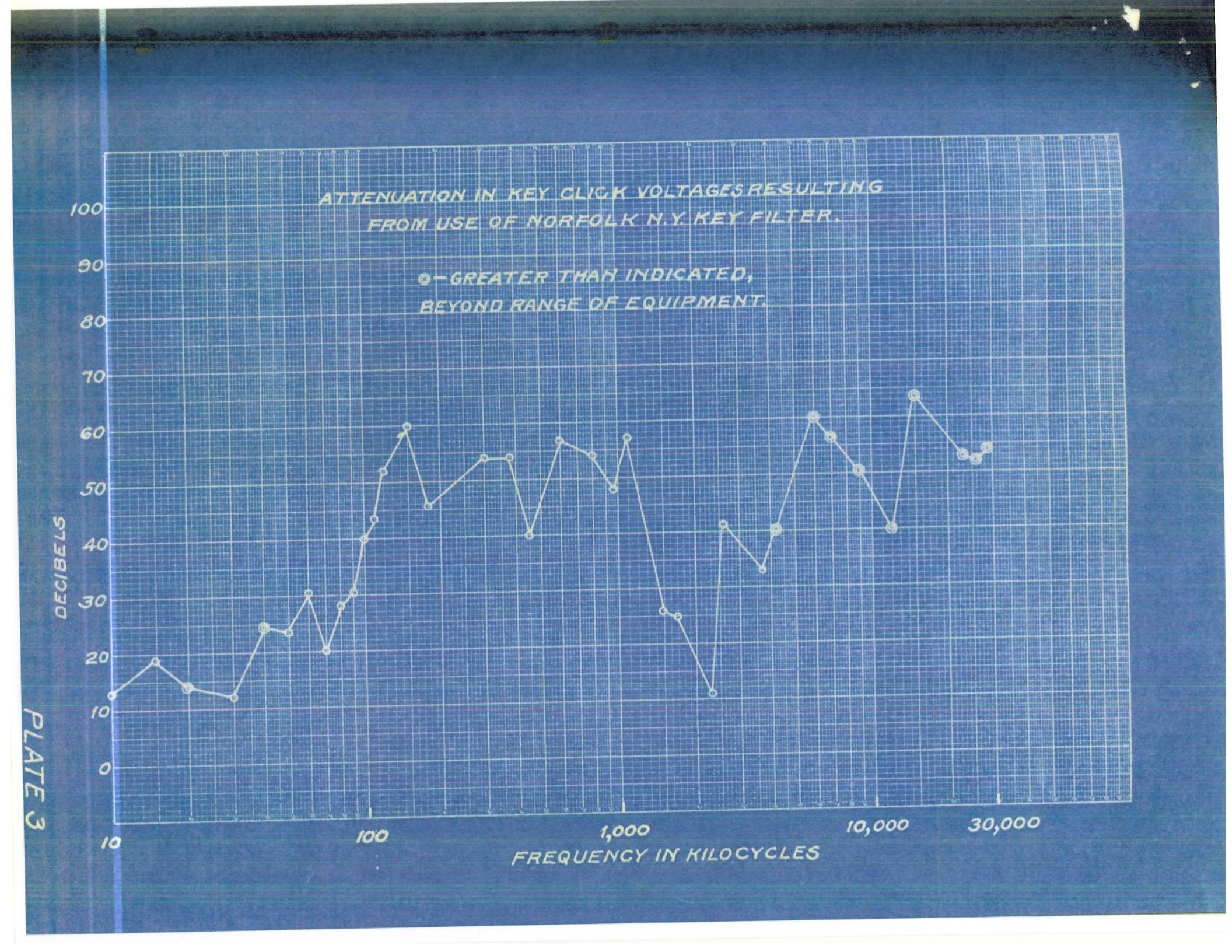

KEY CLICK VOLTAGES WITH AND WITHOUT
NORFOLK N.Y. KEY FILTER
◎ – GREATER THAN INDICATED
BEYOND RANGE OF EQUIPMENT
● – LESS THAN INDICATED
BEYOND RANGE OF EQUIPMENT
FILTER OUT
FILTER IN
MICROVOLTS
100,000
10,000
1,000
100
10
10
100
1,000
10,000
30,000
FREQUENCY IN KILOCYCLES

PLATE 2


ATTENUATION IN KEY CLICK VOLTAGES RESULTING
FROM USE OF NORFOLK N.Y. KEY FILTER.
⊙-GREATER THAN INDICATED,
BEYOND RANGE OF EQUIPMENT.
DECIBELS
100
90
80
70
60
50
40
30
20
10
0
10
100
1,000
10,000
30,000
FREQUENCY IN KILOCYCLES
PLATE 3